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# **ACTUAL PROBLEMS OF THE MEAT-PROCESSING INDUSTRY**

**Manual**

Under the general editing  
of doctor of technical sciences,  
professor **L.V. Bal'-Prylypko**

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The manual describes the problems that exist at the modern situation in meat-processing industry of Ukraine and considered the principal properties of substances, which form the raw materials and finished products, as well as reviewed the mechanisms of processes of their use at all stages of their reprocessing and production. there are given the comparative characteristics of the traditional and modern technologies of manufacturing of meat products and specified advantages and drawbacks of use of ingredients of foods, as well as the biologically active additives used as the integral components of ration of men in XXI century. There is detailed the information on modern state of use of nanomaterials in processes of producing and packing of meat products, interpreted the problem of modern state of assuring of its proper quality and safety of consumption. There are given the information on recommended methods of organization of mass production in conditions of protection of good conditions of the territory adjoining to the enterprise and environment in whole.

The manual is assigned for masters of sciences of specialty of 181 "Alimentary technologies", post-graduate students, specialists who operate in sphere of reprocessing of products of agriculture and all persons interested rising of quality and safety of foods.

## CONTENTS

	<u>Page</u>
<b>Foreword .....</b>	<b>5</b>
<b>Chapter 1 Actual problems and characteristic of state of the meat industry of Ukraine .....</b>	<b>7</b>
1.1 Food additives, history of their emergence, role and functions .....	23
1.2 Norms of harmless consumption of food additives .....	28
Checking questions .....	31
Literature .....	32
<b>Chapter 2 Food additives used in producing of meat products.....</b>	<b>42</b>
2.1 Albuminous substances .....	46
2.2 Dietary fibers.....	66
2.3 Hydrocolloids .....	72
2.4 Colorants .....	87
2.5 Aromatizing and flavoring additives.....	93
2.6 Preservatives.....	97
2.7 Emulsifiers and stabilizers .....	109
2.8 Enzymes .....	114
Checking questions .....	117
Literature .....	118
<b>Chapter 3 Introduction and use of biologically active substances in technologies of producing of meat products.....</b>	<b>123</b>
3.1 Essence of concept of optimal alimentation .....	123
3.2 Characteristics and classification of biologically active additives .....	139
3.2.1 Nutricevtics .....	144
3.2.2 Probiotics .....	151
3.2.3 Prebiotics.....	153
3.3 Components, formulations and norms of producing of biologically active additives .....	156
3.4 Organizational and technological principles of enrichment of foodstuffs by biologically active additives .....	164
Checking questions.....	166
Literature .....	167
<b>Chapter 4 Development of innovative technologies in branch-industry.....</b>	<b>170</b>
4.1 Use of activated aqueous systems in purposes of ensuring of microbiological stability of meat products.....	170
4.2 Actuality of nanotechnologies, preconditions and basic tendencies of their introduction.....	176
4.2.1 Perspectives of introduction of nanotechnologies in agriculture and animal husbandry.....	179
4.2.2 Practice of realization of principles of nanotechnology in meat industry.....	184

4.2.3	Safety of nanomaterials.....	194
4.3	Progress of biotechnology in the sphere of reprocessing of meat .....	196
4.3.1	Screening of data on use of biotechnological processes in meat-processing industry .....	196
4.3.2	Basic directions and experience of use of starting cultures in processes of producing of meat products.....	200
4.3.3	Analysis of conceptual principles of theory of "barrier" technologies .....	210
4.4	Use of genetically modified organisms in food industry.....	214
4.5	Problems of purification of wastewaters of meat-processing enterprises .....	232
4.5.1	Quality of superficial waters of Ukraine. Problems of supply of drinking water for inhabitants.....	232
4.5.2	Principal methods of purification of wastewaters .....	238
4.5.3	Fundamentals of theory of purifying of wastewaters in use of physicochemical methods .....	249
4.5.4	Basic principles of work in purifying of wastewaters of meat-processing enterprises .....	252
4.5.5	Typical technological schemes of purifying of wastewaters of meat-processing enterprises .....	259
	Checking questions.....	262
	Literature .....	263
	<b>Chapter 5 Quality and safety of meat and meat products .....</b>	<b>274</b>
5.1	Concept of quality.....	274
5.2	International standards of quality .....	278
5.3	Concept of total quality management.....	289
5.4	Basic notions, factors of influence and principles of evaluation of quality of meat products.....	293
5.5	Methods of evaluation of quality of meat products.....	306
5.6	Principles of State control of quality and safety of foodstuffs .....	323
5.7	Procedures of import of agricultural production in Ukraine .....	330
5.8	Systems of environmental management.....	336
	Checking questions.....	352
	Literature .....	353
<b>Annex 1</b>	List of additives permitted for use in foodstuffs (for the state of up to 01.11.2015).....	357
<b>Annex 2</b>	Technological functions of food colorants, fixers of color and preservative agents .....	365
<b>Annex 3</b>	Technological functions of antioxidants, regulators of acidity and alimentary phosphates.....	366
<b>Annex 4</b>	Technological functions of alimentary emulsifiers and substances, which form gels, amplifiers of aroma and some additives of similar destination.....	367

## FOREWORD

The modern market of production of agriculture is in the qualitatively new stage of development character by intensification of tendencies of globalization of economical relations, unification of technologies of manufacturing and crucial alteration of state of markets of distribution and consumption of foods. There are clearly seen also the appreciable strengthening of regulatory influences in spheres of manufacturing and distribution of produced foodstuffs.

The role food industry as the systemic branch of agricultural industry exhibits prime in those that it is the capacious market of use of products of agriculture, which extension influences sufficiently on specialization of operators of market and structure of agricultural manufacturing, what stimulates progress of the industry in whole and rise effectiveness of management. Development of economical relations in sphere of production and reprocessing of prime products intensifies also activities of businesspersons, which specialize in storage and transporting and uninterrupted supply of finished products, as well as work on preservation of their proper quality up to stage of sale.

The one of criteria that determines the level of alimentary culture of the State is quality and safety of foodstuffs. The expert estimations show that the men's health depends of effectiveness of the system of protection of health by factor of  $8 \div 12 \%$ , by  $20 \div 25\%$  of conditions of environment and by  $18 \div 20 \%$  of genetic factors. At the same time, its determinative part of  $52 \div 55 \%$  is formed by socio-economic factors and conditions of living, where the one of their conclusive constituents is structure of alimentation.

The modern state of development of society is character by the continuous spread of assortment of consumed foods. As a result there arise continuously new technologies of storage and realization of foods. These processes are supplemented by extensive introduction in their formulations of various chemical additives. Therefore the intense progress of alimentary technologies, especially methods of production of meat products, induces the need in assuring of proper level of protection of health of consumers and creation of rational structure of use of alimentary resources of the State. Hence, the problems of supply of qualitative raw materials of animal origin to enterprises of meat industry of Ukraine acquire in contemporary conditions the especial significance. This is conditioned prime by considerable decrease of population of livestock and hogs, instability of their weight characteristics, as well as notable variation of quality of meat raw in different proposed by different producers, what complicates the task of its reprocessing because requires the continuous variation of used technologies.

The obligatory condition to be observed in carrying out of such activities is guaranteeing of safety of foods, what requires in turn of strengthening of role and betterment of procedures of control of quality of finished production and raw materials used in its fabrication, what is especially important in producing of new types of products. The tendencies of progress in food and reprocessing branches of agriculture, both in Ukraine and worldwide, are stated by demands of State policy in the field of ensuring of healthy feeding, changes on demography and social status of

citizens and existing conditions of their living and work. The technical progress in the alimentary segment of agriculture is based on latest achievements of science specified in result of origination of novel technological opportunities. The complex of listed factors leads to crucial refinement of alimentary technologies and fabrication of foodstuffs of improved nutritional category.

The manual describes the problems of modern state of meat industry of Ukraine, preconditions and principal causes of origination of its current situation, lists global and domestic prognosis of development of this branch of economy, formulated prospective tasks of agricultural industry and tasks of future specialists who will work in this sphere. It is given the data on expediency, tendencies and prospects of use of achievements of biotechnology in solving of existing problems, as well as analyzed the prospective directions of realization of principles of biotechnology in native meat-processing industry in taking into consideration of problems of guaranteeing of safety for health of men of use of modern ingredients of food.

The need of guaranteeing of quality and safety of raw materials and finished products is much important and must be considered in work in stable functioning and steady development of meat-processing industry. Assuring of the stable and high-quality of foodstuffs is the priority task of all branches of food industry. It is especially necessary now, when the factor of competitiveness of production became the crucial one in "surviving" of manufacturers in conditions of modern market. Quality of meat products depends prime of properties and conditions of raw materials, which cost constitute  $70 \div 80\%$  of prime cost of finished products, but not of level of development of technique and technologies. So, the manual contains the chapter devoted to this actual problem, where authors gave the brief characteristic of notions of quality, factors that influence on its level and modern systems of quality management. Therefore the significant value has the information on functional and technical properties of various types of meat raw and influence of auxiliary ingredients and external factors on character of their variation. The one of crucial factors of such influences is the problem of use of food additives, which now are the integral part of formulations of meat products as the effective instrument in solving of the concrete technological and economical problems of manufacture used in betterment of medical, biological and social conditions of functioning of the society.

The materials of the manual have to help students to understand all constitutive problems to be studied in learning of the discipline of "Actual Problems of Meat-Processing Industry". To simplify mastering and control knowledge of materials of the manual, each of its five chapters is finished by checking questions.

The manual is assigned for masters of sciences of specialty 181 "Alimentary technologies", post-graduate students, specialists who operate in sphere of reprocessing of products of agriculture and all persons interested rising of quality and safety of foods.

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# ACTUAL PROBLEMS AND CHARACTERISTIC OF STATE OF THE MEAT INDUSTRY OF UKRAINE

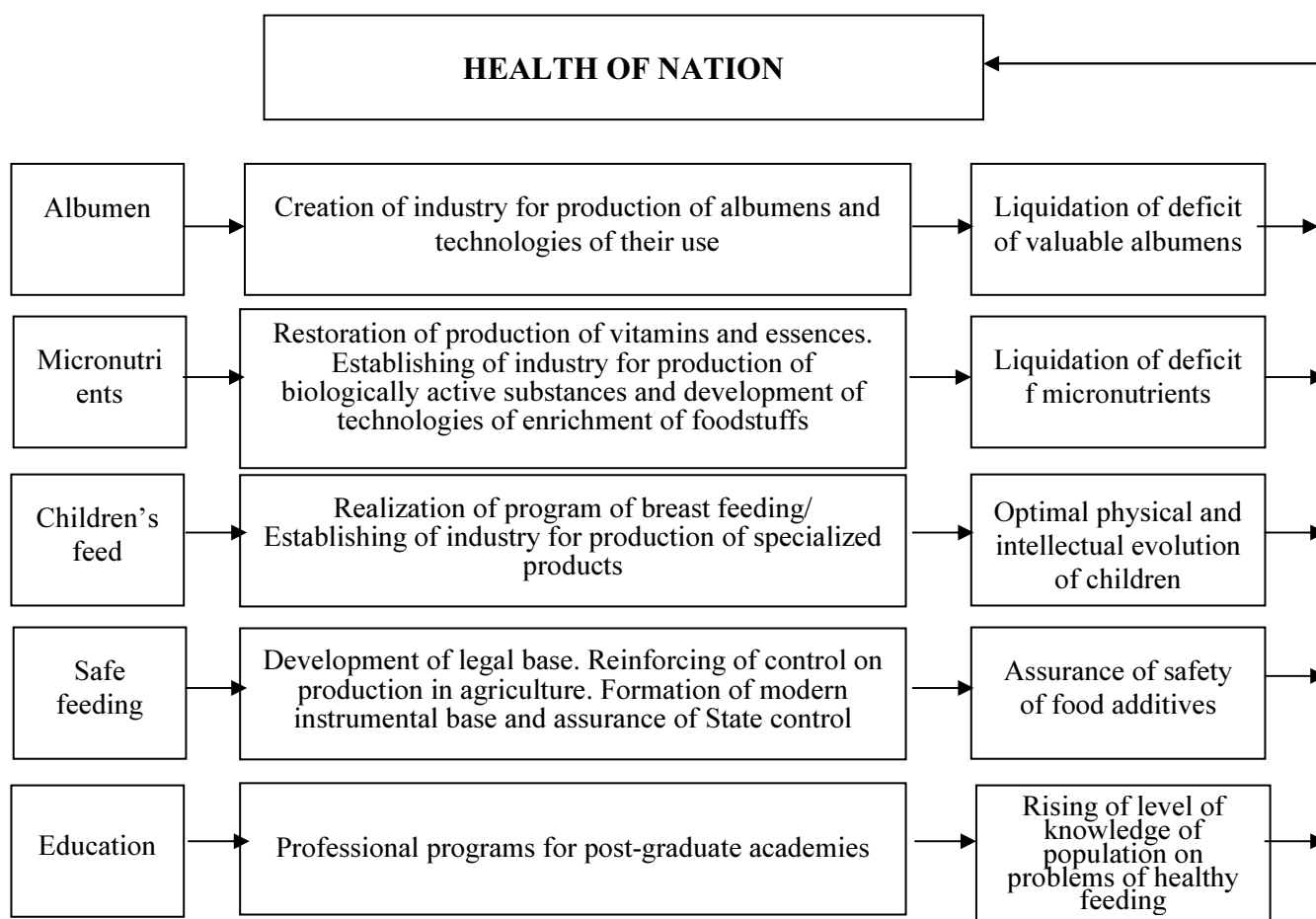
The priority factor of development of agricultural sector of Ukrainian economy as the guarantor of safety of alimentation and important factor of assuring of socioeconomic stability of the society is assisting in rising of volumes of manufacturing of agricultural products up to reaching of the norms of alimentation grounded from the scientific viewpoint. Reaching of stability of food status of the State depends of her capability to organize the effective control of domestic manufacture, influence on process of importing in observance global norms of required and qualitative food. The purposes set in this work are assurance of sufficiency of foods on the domestic market and guaranteeing of minimum potential vulnerability of inhabitants in case of origination of complications in their importing (lack of money, rise of prices, embargo etc.).

Except of alimentary safety, the one more significant factor is assuring of technological safety. The essence of the latter consists in intense use of results of scientific and technical advances, introduction of novel technologies and preservation of level of scientific, technical and production potential, which would be capable to ensure survival of national economy in case of deterioration of the internal and external circumstances. To reach this state, the country has to assure the effective functioning of own intellectual and technological resources, introduce the rational forms of management and assist in rising of productivity of labor and modernize the existing technologies up to global standards.

The estimations of FAO/WHO experts evidence that the factor of alimentation (goodness of ration depends of qualitative and quantitative composition of nutrients consumed by men) brings 50-70 % in good state of mode of living. At the same time, the ration character by unbalance of vitally necessary substances is the source of various disfunctions of metabolism and deterioration of capacity to work.

One of the basic directions of progress of food industry is development of meat-processing technologies, which are directed on supply population by irreplaceable amino-acids and mineral salts. The meat industry represents itself the complex of enterprises, which reprocess livestock and the structure of their activities depends of type of production to produce. The market of production and distribution of meat products is one of biggest markets of foods, which have the considerable influence on other food markets and character by structure of manufacturing based on steady traditions formed during the long time.

The modern priorities in realization of policy of healthy nutrition of population are (Fig. 1.1)

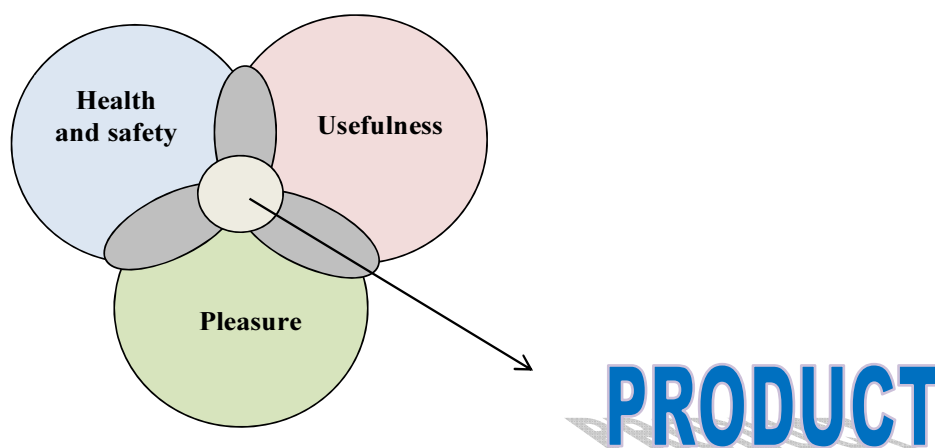


**Figure 1.1** *Principal constituents of healthy alimentation*

The scientific philosophy of notion of "health" must have qualitative character, e.g. health means the sum of reserved capacities of principal functional systems of man. There exists even the formula of nutrition in XXI century ( $FN_{21}$ ): natural products (NP) + natural products modified chemically ( $NP_{mc}$ ) + biologically active substances (BAS):

$$FN_{21} = NP + NP_{mc} + BAS$$

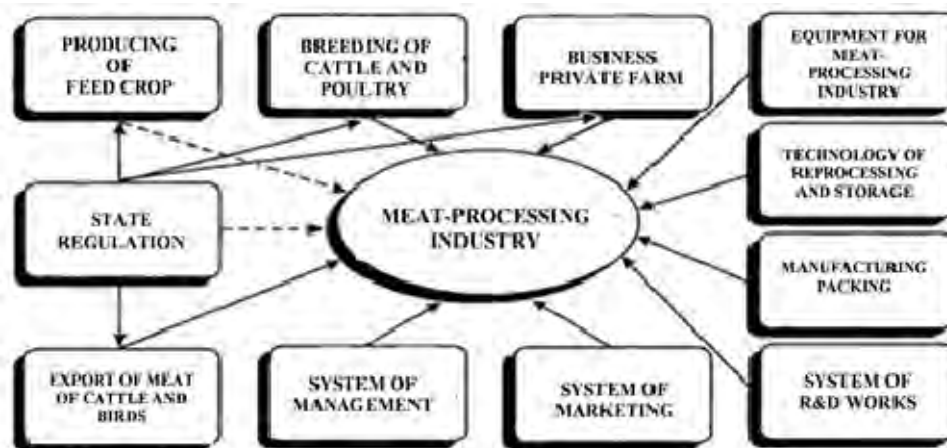
The user pays his attention the more often to quality of foodstuffs, what forms the specific requirements to conditions of their safe consumption (Fig. 1.2):



**Figure 1.2** *Modern requirements to quality of foodstuffs*



Production of meat and meat products is one of the most capital spheres of food industry, and indices of its progress are the object of steadfast care of the State and community. This kind activity is the interconnecting link of various spheres of agricultural industry with enterprises of wholesale and retail trade that realize meat products, which scheme shows the basic constituents of meat industry and chart of interference of its structural branches and systems of production of foods (Fig. 1.3).



**Figure 1.3** *Scheme of interference of basic branches of meat industry and systems of operation in its production on processes of its development*

The Ukrainian market of meat is the multifunctional complex, which combines in its structure enterprises that produce various kinds of meat and meat products and structures, which fabricate other type products (mixed fodders, agricultural machines etc.), enterprises that reprocess produced meat products and enterprises of light industry.

The perspectives of progress of meat-processing industry of Ukraine depends prime of state of its raw materials base. Hence, the motive powers of this branch of economy are producers of raw materials for producers of finished products. These category producers include enterprises of agricultural profile and privately owned farms. The market of meat and meat products cannot be isolated of farming of livestock that is the source of raw indivisible of reprocessing enterprises of meat industry and the principal structural branches, which work in producing of meat products, are those that reprocess cattle and poultry.

To understand modern processes, which take place on meat markets, it's necessary to view the state of development of breeding of cattle as the principal producer of raw materials used in meat industry during the whole period of development of Ukraine as the independent State, because it is the event of finding of independence gave the impulse for modernization of practice of operation in this sphere.

Being in the USSR, the Ukrainian meat industry cannot be competitive in conditions of market economy and State borders open to importing of commodities including the meat ones. It was seen first in disproportions in structure of rearing of cattle because it was centered of farming of heavy beasts and hogs and less in breeding of poultry. At the same time, the parts of beef and other types of meat was determined in developed countries under the influence of demand of market but not of decrees of the communist party in planning the next five-year period of development of economy. As a result, there existed the absolutely different structure of production of meat, and the

leading branch of farming was keeping of poultry. This phenomenon may be explained by those the prime cost of 1 kilo of bird it much less of the analogous index of beef and hog. However, this trend became gradually alter in the end of 1970-s. Its cause was that Soviet directory understood at once the need of introduction of market mechanisms in practice of management. However, despite the governmental structures understood the crucial need of development of aquiculture, they could not cut the population of livestock because of political reasons. Moreover, it was planned its quantitative rise. Hence, the correction of said disproportions was too slow. Absence of market drive resulted in absence of rational program of selection of cattle lead to rising of production of fat but not meat. The ineffective use of domestic reserves of forage forced the governmental structures to buy grain abroad and spent for this purpose the means gained in sale of oil and gas. This resulted in rise of expenses spent on breeding of animals, especially in production of beef, where this index was about of 45 % of its prime cost. However the meat products were sold in Soviet period without taking of their real cost into consideration and were distributed by the imagined prices, which were fixed and all structure of manufacturing was unprofitable up to its finishing stages. The difference in prime and retail costs was compensated from means of the State budget. Because of relative cheapness, the meat products were bought soon and there existed the sharp deficit in the market of meat. The effect of such practice was absence of assortment policy because the needs of the market had no influence of intentions of manufacturers.

Because of inherited unprofitableness, the part of production of meat of cattle and birds in independent Ukraine steady decreased in the gross output of products of agriculture. For example, in 1990 it was of 32.0 % of gross output of agricultural production produced in Ukraine, and in 2006 it fall to 21 % (22.8 % in 2009).

Contraction of profitability of breeding of cattle and birds forced Ukrainian manufacturers to cut appreciable the population of livestock (Table 1.1):

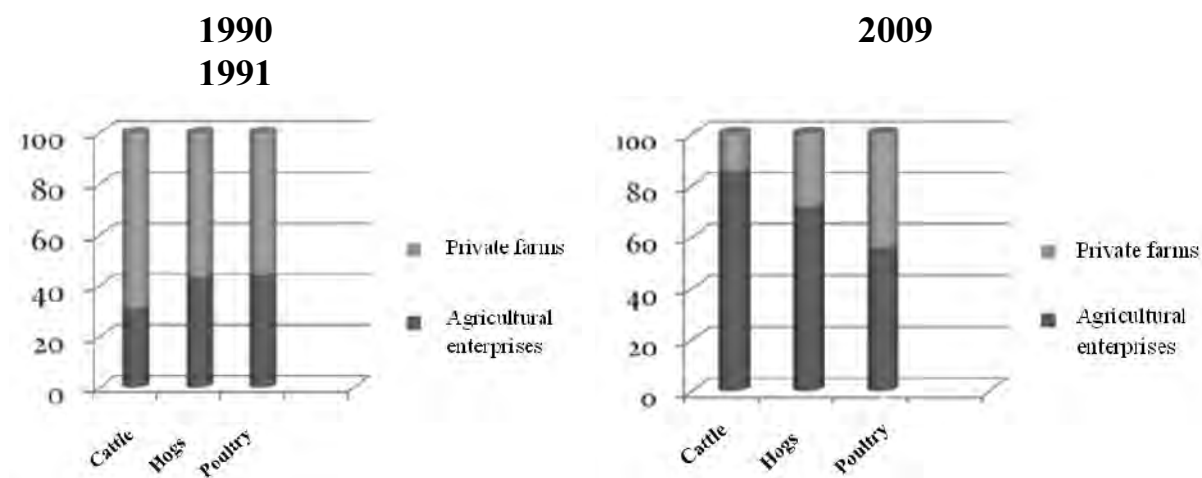
**Table 1.1**

***Population of livestock of basic types of cattle and birds(thousands of beings)***

Type of animals	Agricultural enterprises									
	1990	1995	2000	2005	2006	2007	2008	2009	2010	2015
<b>Heavy beasts</b>	21566.7	10794.1	4994.4	2643.9	2332	2099.4	1644.9	1730.2	1524.5	1178.8
<b>Hogs</b>	11309.7	8228.2	4440.8	2386.1	2680.1	3141	2773.5	3031.5	3068.3	3089.7
<b>Poultry</b>	137700	79300	59300	65200	71200	75400	76000	86600	83900	87880
Private farms										
	1990	1995	2000	2005	2006	2007	2008	2009	2010	2015
<b>Heavy beasts</b>	3628.1	8830.2	5632.1	4259	4182.1	4076	3846	3528.3	3393.1	3355.2
<b>Hogs</b>	8636.9	5717.3	5632.1	4080	4372.7	4914	4246.4	4416.1	4067.1	4832.5
<b>Poultry</b>	117400	85600	66800	87600	90800	91100	93300	114700	106600	131820
Total quantity										
	1990	1995	2000	2005	2006	2007	2008	2009	2010	2015
<b>Heavy beasts</b>	25194.8	19624.3	10626.5	6902.9	6514.1	6175.4	5490.9	5258.5	4826.7	4534.0
<b>Hogs</b>	19946.7	13945.5	10072.9	6466.1	7052.8	8055.0	7019.9	7447.6	7576.6	7922.2
<b>Poultry</b>	255100	164900	126100	152800	162000	166500	169300	201300	191400	219700

The subsequent tendency was the gradual decrease of quota of agricultural enterprises and presently the ratios are cardinally different: heavy beasts 31 % to 69 %, hogs 57 % to 43 % and poultry 56 % to 44 % (Fig. 1.4).

At the same time the rural population raised the number of cattle and poultry in their farms. Thus the processes occurred in Ukraine in 1990-s resulted in formation of structure appreciably different of those that existed in developed countries. The principal cause of such phenomenon was those that the bigger mass of farmed animals was in privately owned farms, what radically changed the situation that existed in the country during many years. The official data show that in 1990 the ratio of cattle breed by big agricultural producers and private farms was: heavy beasts 86 % to 14%, hogs 72% to 28 %, poultry 56 % to 44 %.



**Figure 1.4** *Ratio of number of domestic animals breed by agricultural manufacturers and private farms*

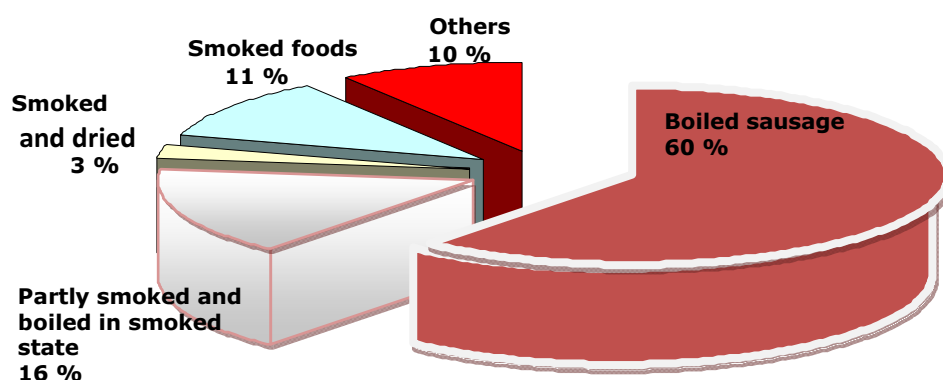
In period of development of market relations, there was formed the tendency of origination of integrated structures in all spheres of food raw: formation by agricultural enterprises of workshops of small capacity, buying by meat-packing factories of agricultural enterprises, formation by agricultural and meat-processing plants of own nets of wholesale and retail realization of their production. Respectively, the part of private farms on total volume of purchase by reprocessing enterprises of cattle and birds decreased, e.g. in 2014 it was 5.7 % as compared with 8.4 % in 2013. The modern market of meat in Ukraine is the multifunctional complex, which includes production of not only various kinds of meat and meat products but includes the enterprises that produce other type products (mixed fodders, agricultural technique etc.), reprocessing enterprises (businesspersons that reprocess meat products), as well as enterprises of light industry (production of fell and footwear). The quantity of enterprises that constitute the meat industry includes now meat-packing plants, battery industrial complexes, 9 meat-processing plants and factories that produce sausages, 3 factories by production of feather and down hair, and 1 plant by production of glue and gelatin. At the same time, there was organized about of 2.5 thousands of small profile workshops, which quantity raise each year. 115 of such capacities and some associations of provincial scale are in structure of

the National association of "Ukrmiaso". At the same time more of 60 % of productive capacities of meat products are located in 5 provinces of Ukraine: in Donetsk province – 22 %, Dnipropetrovsk province – 15 %, Kyiv province – 13 %, Poltava province – 6.5%, Luhansk province – 6.3%.

The principal problems in their operation are grounded by specific factors as follows:

- decreasing of number of cattle and territorial dispersal of agricultural enterprises and private farms resulted in local deficit of raw,
- big material consumption in production of meat products,
- complexity of technological processes,
- need of rising of grade of reprocessing of raw materials, what requires augmentation of investments of capital in technical modernization of enterprises,
- short term of realization of certain types of finished products and extensive assortment of products to produce.

There is spread also the tactics of realization of meat products passing the blanking shops and reprocessing enterprises. The crisis in farming of livestock in Ukraine influences also on processes of operation of enterprises of meat-processing industry. The productive capacities of enterprises are not used last years: their charging now is of 15 ÷ 40 % only. Such structural changes in distribution of agricultural products resulted mainly because of untimely payment of procurers and reprocessing plants with owners of supplied raw materials, and structure of production of sausages in Ukraine is as follows (Fig. 1.5):



**Figure 1.5** *Structure of market of cooked meats by types of production in period of 2005-2009*

Presently, the principles of the system of economic relations were changed, what is seen prime in liberalization of prices, privatization of means of manufacturing including the fertile soil, rising of part of imported raw materials and importing in Ukraine of finished products. at the same time, there was decreased the role of factors of effectiveness of use of national manufacturing potential, modernization of style of economic relations, development of cooperation and integration of manufacturing facilities in big productive associations.

However, the situation of the market of raw materials is still unsatisfactory. Moreover, the meat of Ukrainian manufacture is not called extensively by reprocessing enterprises because of its high price as compared with the raw of foreign origin. decreasing of population of livestock is also the consequence of reduction of quantity of meat consumed by population, e.g. in 1990 each man ate 84 kilos of meat per year but now this index is of 53 kilos only. The principal factors lead to such phenomenon are poor standards of life and insolvency of population.

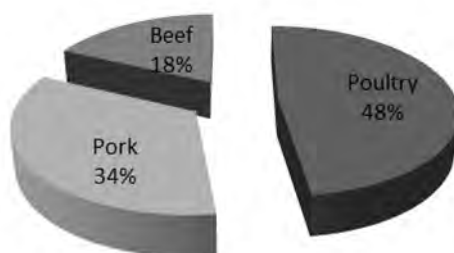
Analysis of structure of the market of meat shows that till 2009 it was seen the rise of production of meat of birds and steady decreasing of production of meat of beef and veal. This tendency is stored till 2001 but since 2010 it began to rise the quantities of produced pork (Table 1.2):

**Table 1.2**

***Dynamics of production of meat of various kinds and sausages in Ukraine in period of 1990-2011 (thousands ton)***

<b>Name of the product</b>	<b>1990</b>	<b>1995</b>	<b>2000</b>	<b>2005</b>	<b>2009</b>	<b>2011</b>
Production of basic types of meat	4358	2294	1663	1597	1917	2059
<i>including:</i>						
beef and veal	1986	1186	754	562	454	428
pork	1576	807	676	494	526	631
birds	708	235	193	497	894	954
mutton and goat's meat	46	40	17	16	18	21
meat of rabbits	30	19	14	13	13	13
horseflesh	12	7	9	15	12	12

Because of some socioeconomic causes, the quantity of meat consumed in Ukraine is less of norms established by the Ministry of protection of health of Ukraine. Moreover, the structure of consumption of meat differs of rational norms, which set that 40 % of meat ration of men is beef and veal, 34.5 ÷ 35 % – pork and the rest – meat of birds. The factual structure of consumption of meat in Ukraine today is as follows (Fig. 1.6):



**Figure 1.6 Structure of consumption of meat in Ukraine**

The shown data witness that the rational element of meat menu is pork only. The quota of beef is disastrously less and the quantity of meat of birds is greatly more of the recommended norm.

Summarizing, one may make the conclusion that the existing state of the meat-processing industry is such under the influence of causes as follows:

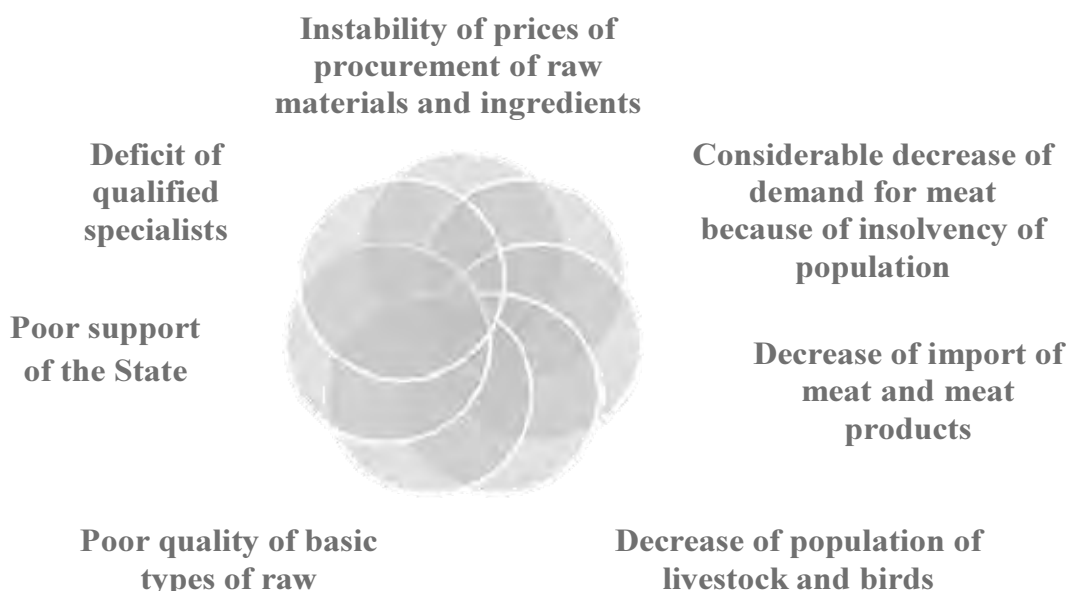
- decreasing of profitability of work in breeding of animals,
- decrease of effective demand of population,

- increase of demand for forages spent of unit of mass of produced meat,
- contraction of quantity of big farms and rise of quota of small-scale production of meat,
- formation of irrational structure of population of livestock,
- catastrophic deficit of State support and regulation of meat industry,
- raising of volumes of imported meat raw materials.

Taking the listed factors into consideration, the State service of statistics of Ukraine identified the following priority tendencies of development of meat industry in last years:

- it occurred the insignificant decreasing of population of livestock of domestic animals and birds (1 – 3.4 %) in all categories of farms,
- there arose the volumes of inflow on meat-processing enterprises of meat of cattle and poultry (by 4.2 %),
- there arose the volume of produced meat of all types (by 4.7 %),
- volumes of export of and meat products rose by 19.5 % (218.1 thousand ton),
- volumes of imported met and meat products decreased by 38.5% (200.8 thousand ton),
- indices of procurement prices for cattle and poultry in period of January-December 2015 rose by 122.3 % (December to November – 101.0 %), indices of prices for meat and meat products by 131.4 % (102.4 %), prices for consumers by group of "Meat and meat products" by 127.5 % (101.7 %).

The principal factors that influence negatively on development of the sphere of production of meat and meat products are (Fig. 1.7):



**Figure 1.7 Actual problems of meat-processing industry**

The one of ways of liquidation of crisis in the state of the branch industry and assuring of successful functioning of industry of agriculture is the effective State

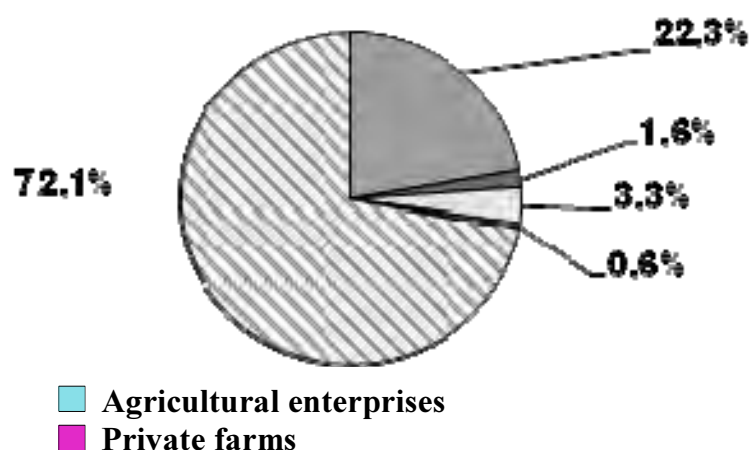
regulation of processes of production of meat, development of adequate legislation, purposeful subsidization and overall support of manufacturers, and the experience collected by European countries witness that the problems of regulation of market of meat in Ukraine may be solved on condition of State regulation only.

The State service of statistics of Ukraine registers in 2015 the following tendencies of development of market of meat raw materials and state of production of finished products as follows:

1. *Index of producing of products of breeding of cattle was 102 % (in agricultural enterprises 104.6 %, in private farms 100 %).*

2. *The agricultural enterprises (except the small ones) raised population of breed cattle and birds by factor of 5.3 % (including hogs by 4.2 %, birds by 7.3 % and decrease of population of cattle by 5.3 %).*

3. *The ratio of total population of breed cattle and birds to quantity of their sale for butchering was of 104 % (105.5 % in). The average daily increase of mass of cattle in its growth, fattening and putting on flesh rose by factor of 4.3%, hogs – by 2.1 % and was of 528 grams and 485 grams, respectively.*

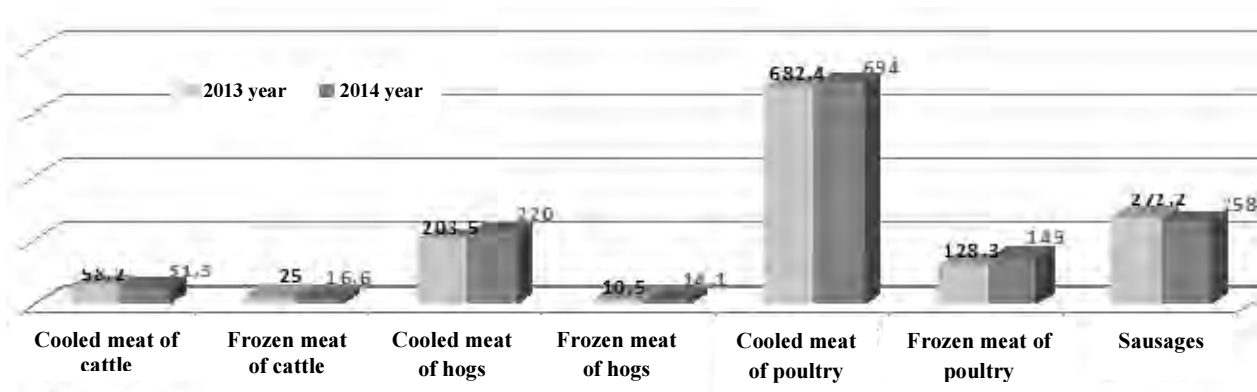


**Figure 1.8 Structure of receipt of meat by reprocessing enterprises in 2014**

The statistics of 2014 showed also the rise in use of meat by enterprises rose by factor of 6.6 % as compared with 2013 – 1228.1 thousands ton of cattle and birds breed by own strength (Fig. 1.8):

It is necessary to note that reprocessing enterprises obtain in 2015 totally *1702.9 thousand ton of cattle and birds counting of their live weight*, what if more by factor of 4.2 % as compared with 2014 (including 463.9 thousand ton – 27.2 % of

total mass – bought for reprocessing on the side). The ratio of quantities of meat and meat products produced of this raw show the Figure 1.9:



**Figure 1.9 Volumes of produced meat products**

The analysis of balance of supply and demand for meat and meat products (Table 1.2) permits to make the following predictions for their production and consumption in Ukraine in 2016:

- The expected level of consumption of meat products (counting on meat) would be of 2292 thousands ton.
- The volume of own manufacture would be of 2440 thousands ton (410 thousands ton of beef, 775 thousands ton of pork and 1215 thousands ton of meat of birds).
- The presumable volume of export would be of 260 thousands ton of meat (45 thousands ton of beef, 25 thousands ton of pork and 235 thousands ton of meat of birds).
- The presumable volume of import would be of 169 thousands ton (10 thousands ton of beef, 95 thousands ton of pork and 50 thousands ton of meat of birds).
- The anticipated level of consumption of meat by one person in 2016 is 53.5 kilos (8.7 kilos of beef, 19.6 kilos of pork and 24 kilos of meat of birds).
- The forecasted level of consumption of meat by one person would be of about of 66.9 % of its rational norm (80 kilos), especially by beef by 27.8% only, by pork by 65.3 % and by meat of birds by 143.7 %.

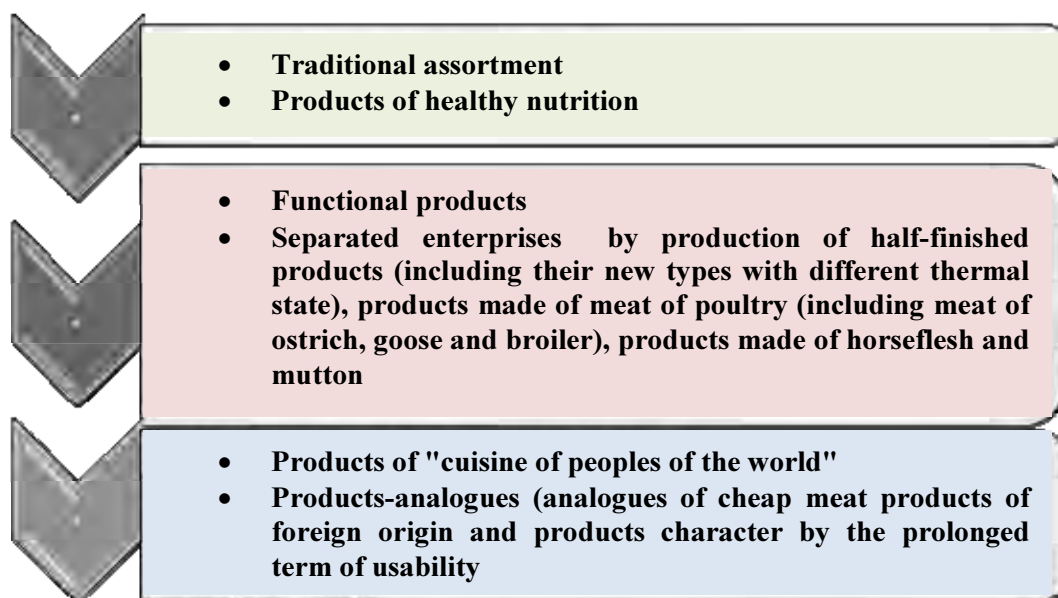


**Table 1.2**

**Balance of demand and supply of meat and meat products counting on  
meat, thousands ton**

	2015 (preliminary data)	Including			2016 (anticipated)
		beef	pork	meat of birds	
<b>Demand for production</b>	<b>2599</b>	<b>425</b>	<b>878</b>	<b>1250</b>	<b>2609</b>
In the inner market	2367	394	862	1069	2349
<b>including:</b>					
fund of consumption	2360	391	860	1067	2292
other uses	7	3	2	2	7
Foreign markets (export)*	218	28	11	175	260
<b>Supply of production</b>	<b>2599</b>	<b>425</b>	<b>878</b>	<b>1250</b>	<b>2609</b>
In the inner market	2398	409	763	1186	2440
Foreign markets (import*)	201	16	115	64	169
<i>Consumption by one person, kg</i>	<i>54.9</i>	<i>9.1</i>	<i>20.0</i>	<i>24.8</i>	<i>53.5</i>
<i>Rational norm, kg</i>	<i>80</i>	<i>31.3</i>	<i>30.0</i>	<i>16.7</i>	<i>80</i>
<i>% of rational norm</i>	<i>69</i>	<i>29.1</i>	<i>67</i>	<i>149</i>	<i>67</i>
<i>Deficit «-»/excess «+» of production necessary for reaching of rational norm</i>	<i>-1133.2</i>	<i>-1002.3</i>	<i>-451.5</i>	<i>+365.7</i>	<i>-1135.5</i>

The available results of analysis of history of development of meat-processing industry permit to forecast the prospective assortment of market of meat products actual in future (Fig. 1.10):



**Figure 1.10 Forecasted assortment of the market of meat products**

As to the assortment of meat produced globally, the analytical report of "Review of state of agriculture in 2009-2018" prepared by the Organization for Economic Collaboration and Development (OECD), UN Food and Agricultural Organization (FAO), US Ministry of Agriculture CIHA (USDA) and American

Federal Institute of Research of Agricultural and Productive Policy (FAPRI) forecasted that production of meat would gradually rise during 10 years and will be of 328 million ton in 2018. At that, the annual rise of production of meat of birds will be sufficiently bigger (2.3 %) of the analogous indices of production of pork and mutton (1.8 %) and beef (1.3 %). At the same time, the part of consumption of meat of birds (37 %) will exceed for the first time the respective part of pork 36%. The long-term perspective of state of the global market of meat shows the annual rise of volume of trade by meat (up to 2.4 %). The biggest operator on the market will be Brazil, which would augment its part in global export of meat to 64 %. It is expected, that the global prices of meat will be appreciably bigger and experts forecast that in 2018 they will be bigger of prices of 1999-2007 by 30 %.

The only one possible way of socioeconomic reforms in Ukraine as the country, which economy is in state of transition from planned to market system of economy, is introduction of innovative processes based on advances of national science and technology. Hence, there became the critically actual the problem of development of the system of innovative development of economy similar with those that exist in advanced countries. Its base should be the intense carrying out of R&D works and use of new knowledge in introduction of novel laws, rules and procedures. It's necessary to note that introduction of innovations would result in growth of effective processes of manufacturing and unconditional assuring of safety and proper quality of marketed production. The positive effect of use of innovative technologies on level of competitiveness of national economy appears in raising of productivity of labor, structural renovation of economy, rising of position of advanced technologies of manufacturing in producing of products of export orientation, betterment of quality of production, which factors lead to emergence of new markets of realization of production of domestic fabrication.

Development of innovative sector of economy became the key factor in realization of strategy of development of each enterprise of food industry. The problem became the crucially actual after Ukraine joined to WTO structures, what result in increase of quota of products exported on global markets and rise of quota of imported raw materials. Progress of said processes results in origination of problem of unification of domestic and foreign indices of safety and quality of production of food industry. The factors that assist in such unification are the intense informative exchange and carrying out of actions of popularization of the advanced knowledge (Fig. 1.11).

The one more problem of marketing of products of domestic manufacture in international markets is discordance of indices of their quality and safety with norms of fundamental treaties on technical barriers in trade and on sanitary and phytosanitary measures signed in founding of the World Trade Organization. Some of principal problems of their origination are:

- differences of national norms of certification and standards of evaluation and attestation of conformity,
- specific procedures used by some countries in carrying out of certification, the excessively severe conditions of recognition of validity of certificates of conformity issued abroad.



4. *Mutual recognition of results of testing.* Manufacturers may have problems in confirmation of proper quality of their production abroad because of differences of methods of its analysis in different countries, what may be eliminated, if the attestation of its quality will be done once by the third-party person authorized by the international norms of accreditation.

5. *Transparency.* Each WTO member-country has to found the national information center responsible for answering on all substantiated inquiries of interested parties and disseminating of documents, which inform on the content of national procedures used in assessment and attestation of conformity.

The preamble of the Treaty on Sanitary and Phytosanitary Measures recommends WTO members to recognize procedures of such activities accepted out in foreign countries as the equivalent to those that they use in domestic market. The only condition is that they would permit to reach in their use of results that would be analogous to those that will be reached in use of domestic measures of sanitary and phytosanitary protection.

*Sanitary or phytosanitary measure means any action, which is carried out in purposes of:*

- *protection of life or health of animals or plants against risks, which emerge in result of penetration, rooting or spreading of harmful organisms, sicknesses and organisms, which are the carriers of sicknesses and pathogenic organisms,*
- *protection of life and/or health of men and/or animals against risks, which emerge in consumption of additives, pollutants, toxins or pathogenic organisms, which are in foodstuffs or forages,*
- *protection of life and health of men and/or animals against risks, which emerge as the result of sicknesses that are transferred by animals, plants or products produced with their use, as well as those that result of penetration, rooting or spreading of harmful organisms, sicknesses, organisms, which are the carriers of sicknesses and pathogenic organisms,*
- *avoiding or limiting of grade of other kind harm, which results in penetration, rooting or spreading of harmful organisms, sicknesses and organisms, which are the carriers of sicknesses and pathogenic organisms.*

*The category of sanitary and phytosanitary measures include all legal and normative deeds by problems of assuring of safety of foodstuffs and health of animals; manufacturing processes and methods of manufacturing; procedures of testing, inspection and approval; quarantine procedures including those ones that regulate norms of transporting of animals or plants or materials necessary for their persistence in processes of transporting; procedures of sampling and methods of analysis of risks; norms of packing and marking, which identify the state of safety of foodstuffs*

This Treaty fixes also the condition that each WTO member-country has to observe the norm of obligatory attestation of proper quality of foodstuffs (if there are absent the norms of safety established by regulatory documents of higher level of oblige, e.g. by European directives) as the activity, which has the purpose of reaching of the sufficient level of safety of life and goodness of state of health.

The sphere of validity of norms of this Treaty is: 1) actions specified by relative legal and normative deeds, rules and procedures, 2) methods of producing of

foodstuffs, 3) procedures of testing, inspecting and attestation of objects of sanitary and veterinary control, 4) conditions of organization of quarantines, 5) methods of selective inspection and evaluation of grade of influence of risks, 6) procedures of packing and marking of foods.

So, the domestic manufacturers of foodstuffs are forced to operate in conditions of existence of strict norms of sale of their production and limited possibilities of protection of import of poor-quality foods. In such conditions, Ukrainian governmental structures have to harmonize the national legal and normative base with the respective international norms and define priorities in development of food industry.

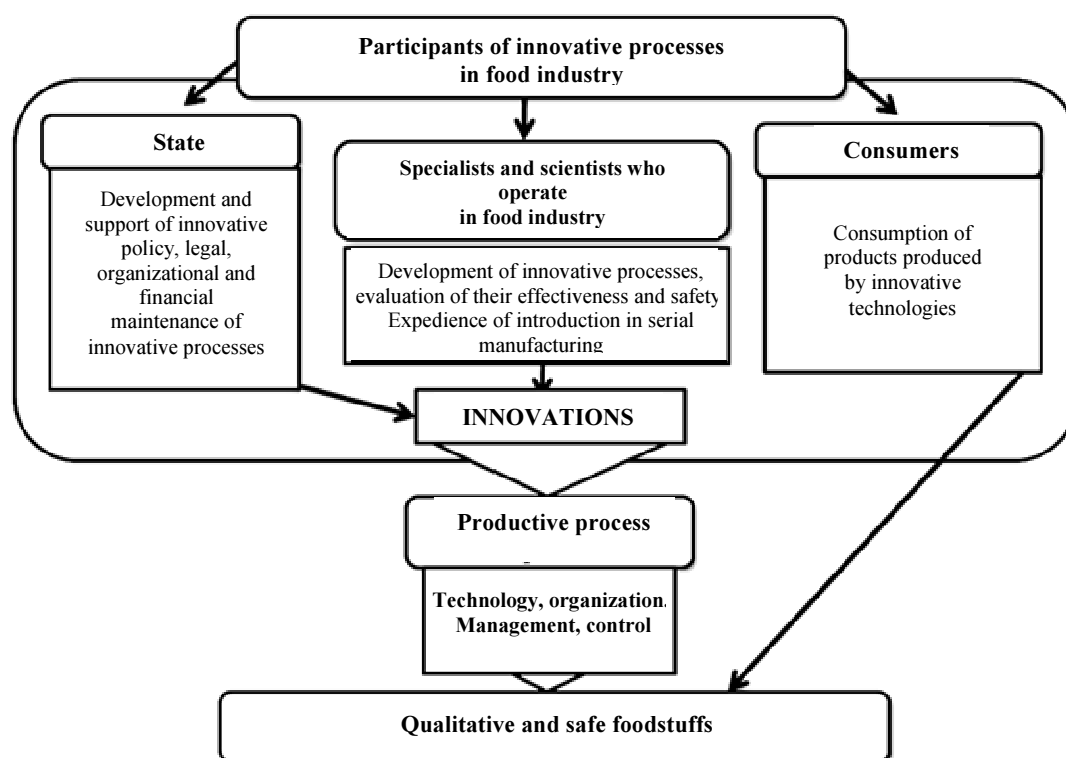
The modern Ukrainian agricultural industrial complexes function in more of 30 directions of operation and produce thousands types of foodstuffs. The principal tendencies of their development are combining of rough resources, development of products analogous or imitating those that were produced in earlier time, what result in considerable spreading of their assortment and diapason of prices of new types of foods.

The wide variation of tasks arising in these conditions sets the problem of intense work in carrying out worldwide of investigations of fundamental and applied character. The respective indices of innovative activities in EU countries are the lowest in Portugal 26 % and Greece 29 %. Nevertheless these ones are twice bigger of the respective index of innovations in Ukraine and 3 ÷ 4 times bigger in such countries as Austria (67 %), Germany (69 %), Denmark (71 %) and Ireland (74 %).

The basic points in introduction of innovative concept of production of qualitative and safe foodstuffs are creation of conditions of commonality of norms of quality of raw and finished products, interconnection of technologies used in agriculture and observance of environmental considerations in their development. The priorities in organization of such activities are:

- use of live organisms in processes of reprocessing of agricultural raw materials,
- development of biotechnologies and practice of use of nanosystems in producing of biomaterials and foodstuffs,
- development of information systems, assurance of traceability, modeling and control of parameters of technological processes,
- introduction of rational processes of saving of energy in processes of production of foods,
- introduction of systems of quality management,
- assurance of norms of protection of environment,
- development of alternative safe food additives to be used in purposes of betterment of quality of foodstuffs,
- development of programs of training, informative centers and introduction of informative centers to be used by population,
- development and introduction of innovative technologies, which use would permit to improve and stabilize quality of raw materials, ingredients and finished foods.

To improve the structure of introduction of innovations in food industry, there may be used the proposed scheme of realization of these processes as follows (Fig. 1.12):



**Figure 1.12** *Scheme of realization of innovations in food industry*

The fundamental condition that has to be observed in this work is guaranteeing of safety of foods and raw materials used in their production. Solving of this problem is one of decisive factors in ensuring of economical safety of the State and her capability to organize the effective control of processes of production and import of qualitative foodstuffs. The problem of assurance of safety of foods, especially of products of animal origin, became one of the most urgent on the market of products of agriculture. The most reasonable way to solve the problem of supply of "healthy" foods by acceptable prices is use in their production of food additives and ingredients, which have considerable nutritional and biological value, improve their organoleptic properties (outward appearance, delicacy, juiciness, taste and flavor) of finished products, as well as introduction of good practices of their manufacture, control of quality, storage and distribution.

This problem appears the most evidently in process of storage of meat products in view of need of prolongation of term of their guaranteed storage and preservation of proper level of their quality and safety. Because of short terms of storage, marketing of most meat products is limited by regions of their production and adjacent territories. Therefore, development of new technologies of prolongation of such terms is the problem of considerable scientific and practical interest. The one of possible concepts capable to help in solving of this problem is use of preservatives and antimicrobial preparations, which assist in retardation of processes of deterioration of meat products. At the same time, such substances must not cause damage to health of consumers and do not pollute the organoleptic properties of foodstuffs. The one more basic problem is the substantial rise of demand for meat products in conditions of the steady decrease of level of production of primary

product. The modern science sees the way to solve it in use in meat compositions of various additives and bulking agents capable to replace meat ion finished products.

### **1.1 Food additives, history of their emergence, role and functions**

Men used methods of betterment of taste, smell and color of foods. The substances, which were used traditionally for these purposes in the world, were of natural origin. However, transition of practice of manufacturing to use of intense technologies in the end of XIX century lead to change of priorities in meat industry and use of bigger quantity of food additives, preferably of artificial nature. The main cause of such transition was the crucial rise of quantity of urban population, hence need of considerable rising of volumes of produced food supplemented by improvement of technologies of manufacturing.

The problems of issuing of permissions on use of said substances and approval of their allowable quantities in concrete foodstuffs are in sphere of responsibility of the Commission "Codex Alimentarius" – the specialized organization that develops standards on foods. To systemize and simplify choose of concrete additives, it was proposed some technological classifications based on use of different principles and approaches to solving of problems of optimization of composition of foods. The basic character of said systems is the source of origin of used additives classified as the natural taken from vegetative or zoic raw materials and those that were produced artificially. The additives may be divided conditionally by four groups by characteristic of technological effect reached in their use (Fig. 1.13).

- **I group** – substances, which control the flavor and taste of foodstuffs (flavoring agents, intensifiers of smell and taste, sweeteners, substitutes of salt and sugar, alimantal acids and their salts) or improve their color.
- **II group** – substances, which regulate consistence and form texture of products (substances that form gels, stiffeners, emulsifiers, bulking agents etc.).
- **III group** – substances, which raise stability of products and extend terms of their storage (antioxidants and their synergists, preservatives, agents that assist in holding of moisture, stabilizers, substances that form films).
- **IV group** – substances, which make quicken and easier passing of technological processes (enzymes, substances used for extraction and loosening etc.).

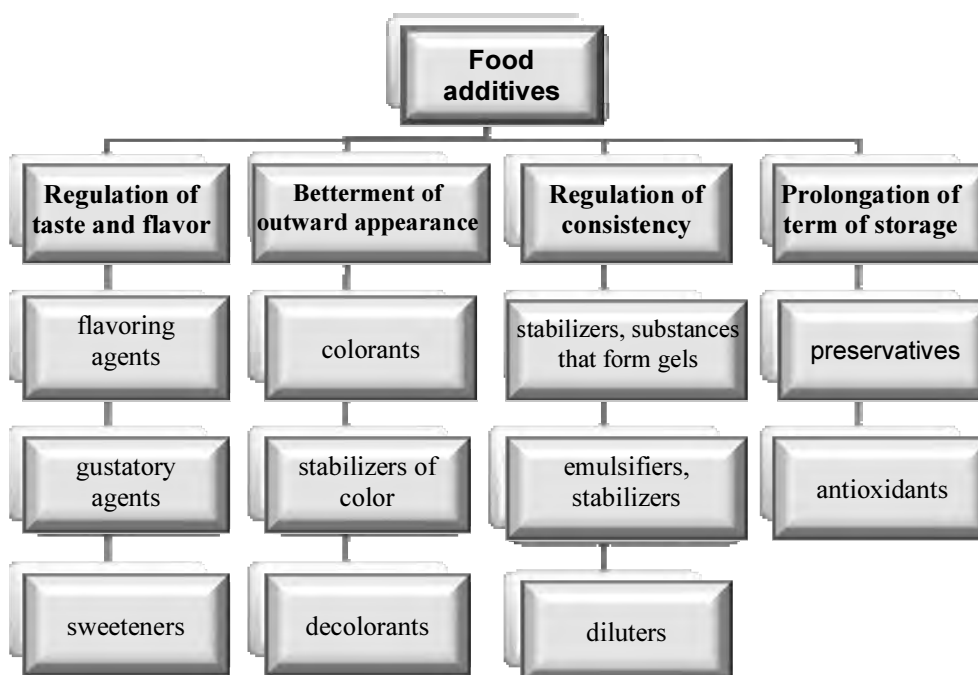
It's necessary to note that the clear subdivision of food additives by the listed classes is too ritualistic because of those that:

- many additives are character by the multifunctional effect,
- the food additives do not improve parameters of technological processes by simplify their execution.

So, the specialists differentiate food additives in their practical work on the basis of their prospective destination by two big classes (Table 1.3):

**I class** Additives that influence on parameters of technological processes and following storage of their products.

**II class** Additives that make better the indices of quality of finished products.



**Figure 1.13**      *Classification of food additives by their functions*

**Table 1.3**

*Classification of food additives by their functional destination*

Destination	Service of additives
<b>Additives used for improvement of parameters of technologies of reprocessing of raw materials and producing of foodstuffs</b>	Regulation of structural and rheological properties (consistency)
	Intensification of technological process
	Optimization of technological conditions
<b>Additives used for betterment of quality and nutritional value of products</b>	Prolongation of terms of storage of products
	Betterment of outward appearance
	Improvement of taste and flavor
	Enrichment by valuable nutritional substances
	Betterment of dietetic ground
	Decreasing of risks of progress of sicknesses
	Maintaining of normal functional activity of digestive organs and other systems of the organism

The turning point in process of development of food additives came in 1953, when the European countries introduced the system of identification of additives legalized in the USSR in 1978. At the same time there were identified 45 classes of food additives, which 23 classes were recognized as the basic ones. To simplify their recognition, the EU Council developed the rational system of their numeral indication. Each additive has its own three or four-digit number preceded by letter "E". The food industry uses now approximately 2 thousands of food additives.



However, it is necessary to note that the list of used additives is the same in the world despite of existence of differing approaches to their classification and systematization. The permission of their use issues the specialized international organization – *the Amalgamated FAO/WHO Committee of Experts by Food Additives and Contaminants*.

The basic principle of classification of food additives is their ranking by destination of use and is as follows:

- E100 ÷ E182 – colorants,
- E200 and farther – preservatives,
- E300 and farther – antioxidants,
- E400 and farther – stabilizers of consistency,
- E500 and farther – emulsifiers,
- E600 and farther – amplifiers of taste and flavor,
- Numbers of series of E700 ÷ E800 are reserved and may be used for giving of additional information,
- E900 and farther – preparation that prevent formation of foams,
- E1000 and farther – agents used for forming of icing, sweeteners, additives that prevent caking of sugar, additives used for treating of flour, starch etc.,
- E 1100 ÷ E 1105 – enzymes.

The fact of assignment of index **"E"** and identification number for the concrete food additive means that:

- this substance was controlled on safety of use by destination,
- this substance may be used (recommended for use) in production of concrete foodstuff in set quantities and/or in quantities required by technologies of its fabrication and the respective information has to be given in information for consumers,
- there was established the norm of its purity necessary for reaching of the set level of quality of the foodstuff where it may be used by formulation.

Some of "E-codes" are supplemented by small letters, e.g. E160a – carotenes, E160b – extracts of annatto etc. These are the examples of the complementary classification subgroup of food additives, which combine into one some of their concrete kinds. Such small letters are the indivisible parts of code of **"E"** and have to be used if exist to give the concrete expression to the type of food additive in question. There exist also some cases when the code of the additive is supplemented by the Roman numeral put in parentheses, for example the codes of various types of sodium carbonates of E-500 series may be recognized by Roman numerals of (I) and (II), which specify differences in their formulas. It's necessary to note also that some of **E**-additives used in the European Union are not permitted for use in Ukraine by national agencies by protection of health. Besides there exist the additives that have the differing symbols, e.g. the codes of **"G"** (Germany) or **"R"** (Russia), which use is possible only in the country of codification. The food additive may be designated as the individual substance, e.g. sodium nitrite, sorbic acid, lecithin etc., or by its grouped denomination, e.g. preservative, emulsifier, synthetic colorant etc.

The practical specialists operate often not only with codified individual ("*direct*") food additives but with their mixtures (spices, biologically active additives, preparation that contain albumens etc.), commercial kits (such as those that contain spices, food additives, functional components) and technological ingredients.

The additives of technological category mean substances added into the product in reprocessing of raw materials and deleted from the product after the respective operation would have been ended. There exist the probability that minor quantities of this kind materials may be present in the finished product.

The class of auxiliary materials includes any substances or materials, which are not the nutritional components but used in reprocessing of raw materials and in process of manufacturing of foods in purposes of improvement of details of used technologies of their fabrication. The finished products do not contain the auxiliary materials, as a rule, but may contain them in some cases in residual quantities, which may be removed in use of expensive procedures only. At the same time most of them are the ballast substances and do not influence on quality of the product.

The class of complex food additives includes the commercial mixes of two and/or more food additives and macroingredients (flour, sugar, salt, starch, spices, and albuminous substances) produced industrially. This class additives includes also the biologically active substances and ingredients that modify taste and aroma of foods, fix their colors etc.

Naturally, each additive may have the non-adequate action on state of consumer even it contains the same ingredients but present in different ratios. Therefore, the technologist has to take into consideration in his practical work this phenomenon and potential influence of mixes he proposes on state of health of consumers of the product of modified composition. The principal factors to be observed in it are:

- most of complex food additives are of multifunctional effect of influence on properties of the foodstuff and their adding permits in many cases to improve its color, taste, odor, consistency, raise the output of the product and prolong the guaranteed term of its storage (the examples are sodium nitrite, which displays properties of preservative, antioxidant; sodium phosphates that are regulators of acidity, emulsifiers and agents that assist in retention of water in the product),
- some additives, if present simultaneously, may strengthen or inhibit action of one other,
- meat systems consist of many components, which are appreciably different by physical and chemical properties (pH, temperature, ionic strength), ratios of their basic nutrients and types of substances that form structure of the product. Meantime, to reach the necessary effectiveness of action, technologists have to hold the necessary physicochemical parameters, which the most effective is the level of acidity of the system,
- food additives are present in foodstuffs in small quantities, as a rule. Therefore the main care in their production has to be given to assuring of uniformity of their distribution in the meat system. To reach such condition, the technologist has to evaluate the structural state of raw

materials and/or semi-finished products and choose the optimal stage of bringing of additives in the product to be carried out in observance of the aggregate state of the commercial preparation (solution, emulsion, powder, granules), its concentration (concentrated product, preparation applied onto the carrier, composition), peculiarities of physicochemical properties of raw materials (solubility in water and fatty environments, resistivity to action of salts, capability to swell, grade of dispersion) and so on.

At the same time the additives are the most extended xenobiotics of substances deliberately produced by men for consumption, what may lead to origination of hazards to health. This phenomenon is the especially meaningful in conditions of abundance on the market of various food additives, complex preparations and mixes, technological ingredients and functional additives. Therefore one must try to minimize quantities of added substances.

Most of additives have no nutritional value. However, most of them may take part in digestive processes and effect as regulators of metabolic processes in the organism. To avoid negative influences of health, all food additives are controlled thoroughly for their toxicological safety by indices of *sharp toxicity*, *genotoxic/mutagenic effects (capability to cause the hereditary alterations in the organism)*; *reproductive toxicity and teratogenic effects (capability to cause occurrence of abnormalities in evolution of fetus)* and *influence on capability to reproduction of breed*; *subchronic toxicity*; *chronic toxicity*; *carcinogenicity (capability to produce cancerous growths)*. One has take into consideration also the probability of cumulative and synergic effect of food additives, as well as causing of allergic reactions. Therefore the condition of issuing of permission ion marketing of certain food additive, its producer (supplier, distributor) must give the exhausting materials on safety of its use (toxicological dossier, method of analysis, scientific publications on results of their investigation etc.), destination, information on technological doses, list of foodstuffs where it may be used, contingent of population that may consume the foodstuffs modified by this additive. In absence of sufficient data, the person interested in its marketing has to organize the necessary R&D works.

It was recommended to observe the following rules of operation that should permit to minimize the harmful influence of potentially dangerous additives:

- each day consume products reach by dietary fibers, e.g. vegetables and fruits. Such fibers permit to purify the organism of toxic substances,
- avoid of excessive use of foodstuffs that have the unnaturally bright coloring – the clear feature of presence of artificial colorants, as well as minimize consumption of imported vegetables and fruits unnaturally fresh for the season,
- minimize heating (e.g. their roasting) and other type treating, which may result in formation of toxic substances, of foodstuffs that contain chemical additives. The example is heating of products that contain substitute of sugar aspartam (E-951) and sodium nitrite (E-250) resulting in formation of substances, which are the appreciably more harmful that said additives.

The revision of decisions on safety of food additives taken in earlier time may be done also in introduction of new technological process of their production, change of character or level of its consumption, as well as in cases of emergence of novel data on nature and biological properties of the additive proper and admixtures present in it. The example is discussion in USA of problem of permissibility of use of the same aspartame, which consumption leads to formation of brain-growths of experimental animals. There is studied also the problem of permissibility of use and identification of permissible dosing of other type additives. Thus, there was found that mono- and diglycerides capable to cause the allergic reactions and intense consumption of sodium glutamate may cause headaches, atonia of muscles, speeded heartbeat and other symptoms named in USA as the *"syndrome of Chinese restaurant"*.

## **1.2 Norms of harmless consumption of food additives**

Consumption of any food additive must not lead to emergence of direct toxic effects. At the same time all chemical compounds are potentially toxic. Thus, the American pediatric academy published in 2008 the report, which contains the following information:

*"Despite big complexity in excluding of mistakes and ambiguity of taken data, the fulfilled investigations showed the statistically significant differences in behavior of children who consumed food additives as compared with those that did not ate them. Such differences were exhibited in their overactivity especially clear if they consumed drinks that contained food additives"*.

Therefore use of any food additive in foods for children is appreciably limited till the time of development of respective normative documents. The important factor of such limitation is probability of interaction of certain substances and the additives proper with other substances, which come into the organism from environment. Toward this end, the Chief State sanitary doctor of Ukraine controls the list of products permitted for consumption by adults, which may contain food additives. The decisive role in it plays their doses (quantities of substances coming into the organism during the day and night time), duration, regimen of consumption and ways of coming of products into the organism.

It is known that big doses of some additives became the aggressive ingredients of foods and cause the toxic effects, what needs of detailed investigation of mechanisms of influence on the organism of each one and the corresponding investigations are conducted under the FAO/WHO aegis. The taken results permit to identify the permissible doses of consumption of the substance that may be safely eaten by consumers during the specified time. The quantitative diapasons of consumption of food additives establish on the base of toxicological investigations such international organizations as FAO – UN Food and Agricultural Organization, WHO – UN World Health Organization, YECFA – technical committee of specialists who work under the WHO aegis, and the specialized bodies for protection of health of certain States. The indices taken into consideration in such works are:

- **ADI** (acceptable daily intake) means the daily quantity of substance expressed in dimensionality of milligrams per kilogram of mass of carcass,

which consumption would not cause harm for life in intake during the whole life,

- **MAC** (maximally allowable concentration) means the quantity of the food additive expressed in dimensionality of milligrams per kilogram of the finished product, which consumption would not cause harm for health of men and emergence of diseases and deflections in conditions of health of consumers and future generations of men.

The most harmful additives are preservatives and antioxidants. Preservatives disturb the normal passing of biochemical reactions. The result is impossibility of life in sphere of their action and death of bacteria what permit to store the product for the longer time. However man consists of scores of various cells and has the bigger mass as compared with the bacterium. So, he does not die in intake of additives consumed in permissible quantities. However coming or accumulation in the organism of big doses of preservatives would deteriorate its normal metabolism. The expressive example is consumption of boric acid in period since 1870-s till 1920-s, which use as the preservative was prohibited finally because of toxic influence on health of men and animals. However in the WW II period it was permitted for use because of deficit of other preservatives but was finally prohibited in this use in 1950-s. Many of colorants display the toxic effects too because most of them are the substances obtained synthetically. This resulted in total absence of confidence of men to rationality of use of additives and introduction of practice of avoiding of their use in practical manufacture till the State would establish the permissible doses and prove safety of their systematical consumption in such quantities. Consumers who live in most of foreign countries consumption of food additives regard the practice of consumption of products that contain more of 2 to 3 types of additives negatively. So, the manufacturers and technologists try to replace the ingredients that have indices of "**E**" in formulations of foodstuffs for additives of natural origin.

This does not mean that the buyer has to avoid fanatically of consumption of products that contain additives. Some of these substances, such as natural additives of E 164 – "saffron", E 166 – "sandal wood", E 160 – natural extracts of carotenes, E260 – acetic acid, E 290 – carbon dioxide, E 322 – lecithin and many other do not pose hazard to health even in big quantities. Therefore there is not needed to set the parameters of their **ADI**. Some of natural additives used in housekeeping for preparation of food, such as gelatin, starch, table salt and many other are not coded and not included in any sanitary rules and norms.

The influence of food additives on state of health is too different: some of these substances may cause aggravation and emergency of diseases of food origin. at the same time, consumption of some additives promotes to preservation of nutritional value of foodstuffs because of their enrichment by vitamins, minerals and such nutrients as flour, cereals, margarine, milk present in the product in its normal state in insufficient quantities. Use of preservatives leads to decrease of level of bacterial, fungus and yeasty pollution of foods.

The meat products contain small quantities of additives, as a rule. Hence, the technologist has to take the especial care to their uniform distribution in the meat

mass. Doing this work, he has to assess the structure of raw material of semi-finished product, properly choose the stage of technological process to apply the additive in the product, consider the aggregate state of used commercial preparation (solution, emulsion, dry powder, granules), form of its application (concentrate, immobilized preparation on carrier, composite preparation), physicochemical properties (solubility in water and fatty environments, stability in salted medium, capability to swelling, rate of dispersity) etc.

The Ukrainian legal norms demand of manufacturer (supplier) of the product to inform consumers on presence of food additives in it and indicate on their labels names (codes) of additives by the FAO/WHO classification.

*Use of food additives is prohibited in cases as follows:*

- in absence of guarantees of safety of consumers,
- if use of additives disturbs norms of technology of treating of raw materials used in producing of foods,
- if presence of the additive results in considerable loss of nutritional and biological value of the product,
- is use of the additive result in falsification of quality of the foodstuff,
- if the desired result may be reached in use of other methods.

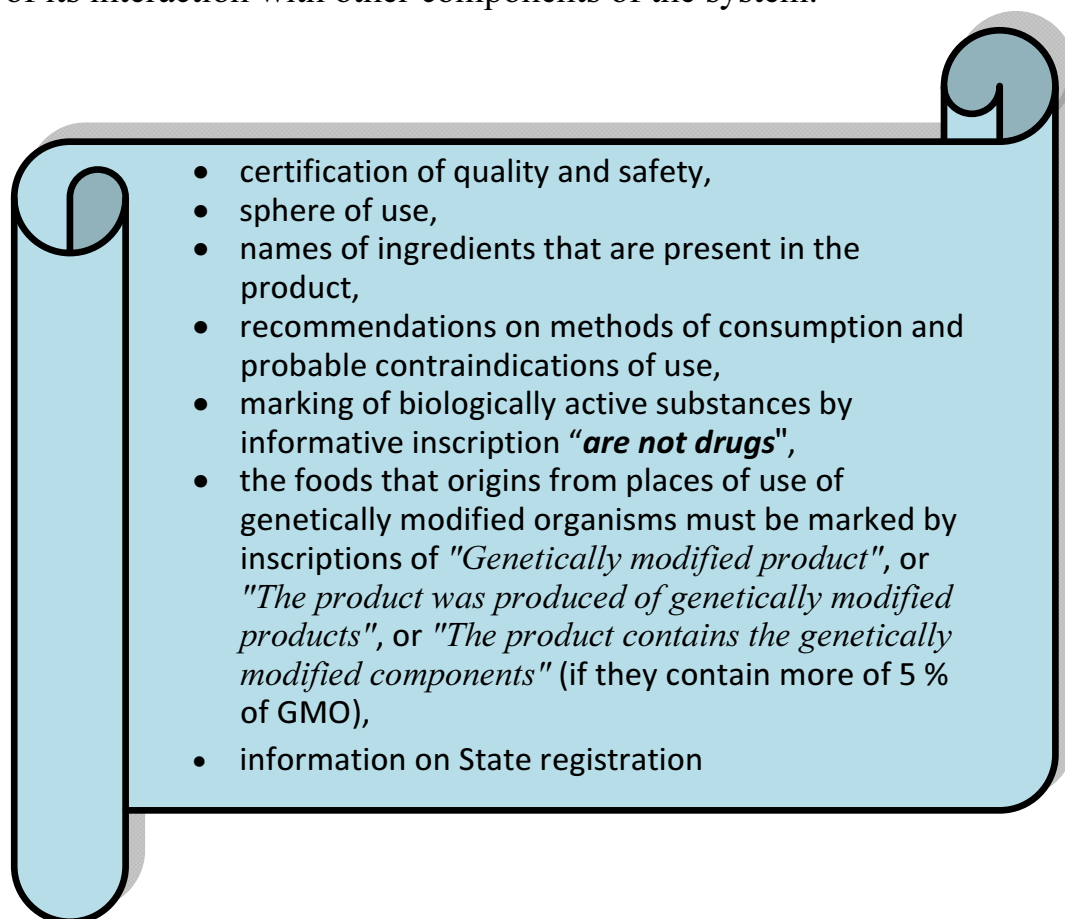
Use of food additives is prohibited also in purposes of aftermath of results of use of poor-quality raw materials, infringement of the normalized parameters of technological processes and sanitary and hygienic norms. The requirements that have be observed in application of food additive in the product are:

- the additive has be used in minimal quantities, which are sufficient for reaching of the set purpose and does not exceed the established levels of **ADI** and **MAC**,
- the additive may be used only in cases of impossibility of reaching of set purposes by other methods,
- the food additives must be of the maximal grade of purity.

Taking these factors into consideration, one may state that consumption of food additives causes the minimal risk of origination of diseases of food origin. The Sanitary and hygienic norms of 2.3.2.1078-01 "*Hygienic Norms of Safety and Nutritional Value of Foodstuffs*" to be observed in consumption of some types of foods (products for children, dietetic and specialized nutrition), food additives and biologically active substances must be marked by their manufacturer on their labels (Fig. 1.14):

The problem of guaranteeing of safety of food additives is the fundamentally significant. Therefore there are established the practice of steady control of their use and continuous reconsideration of used norms in development of novel methodology of chemical and toxicological investigations directed on identification of their negative action unknown in earlier time. The responsible State bodies reconsider regularly the list of additives permitted for use and there exist the numerous cases of limiting or absolute prohibition of use of some of such substances.

The technologist operates, as a rule, with the codified and certified food additives which are biologically safe in their application in regulated norms of use. However, the level of their technological effectiveness depends considerably of qualification of the specialist and taking by him into consideration of features of chemical properties and structure of used additives, their specificity, functional properties and mechanisms of input. Depending of composition of the mass, existing environmental factors (temperature, variation of *pH* and ionic strength of the mass, presence of enzymes etc.) and stability of the applied additive, there are possible events of its interaction with other components of the system.



**Figure 1.14** *Information that must be put on the label of foods and food additives by norms of Ukrainian legislation*

### **Checking questions**

1. What is your interpretation of notion of "healthy nutrition" ?
2. What is the meat industry ?
3. Name the dominant constituents of the meat-producing complex of food industry.
4. Name the principal characteristics of meat raw materials. Give the examples.
7. What is the modern structure of market of meat in Ukraine ?
8. Describe the global and native prognoses of dynamics of production and consumption of meat.
9. Name the basic ingredients used in traditional technologies of meat-processing industry.

10. Name the meat products that would be the most claimed in future.
12. What is the "food additive" ?
13. What are the principal goals of application of additives in foodstuffs ?
15. Give the examples of processes and properties of meat products, which may be regulated in application of food additives.
17. What are the cases of prohibition of use of food additives ?
18. What is your concept of understanding of notion of "technological mix" ?
21. What are the auxiliary substances ?

### Література

1. Азрилевич М.Р. Заменители сахара // Пищ. ингредиенты. 2002. —№1. —С. 42-45
2. Амброзович Е. Г. Особенности европейского и восточного подходов к ингредиентам для продуктов здорового питания // Пищевые ингредиенты. Сырье и добавки. – 2005. – №1. – с. 30–31
3. Архангельская Н.М. Курсовое и дипломное проектирование предприятий мясной промышленности./Архангельская Н.М - М.: Агропромиздат, 1986. – 272 с.
4. Бабенко А. Г. Управление повышением производительности труда на предприятиях мясной отрасли в Украине. / Бабенко А. Г.-Донецк: ИЭП НАН Украины, 1996. – 270 с.
5. Байдалинова Л. С. Характеристика компонентного состава растительных экстрактов и оценка их антиокислительного действия на мясные системы / Л. С. Байдалинова, Я. И. Шарыгина // Известия КГТУ. – Калининград, 2011. – № 21. – с. 96–104
6. Баль-Прилипко Л.В «Современные принципы разработки рецептур мясных изделий или "старые песни о главном" / Баль-Прилипко Л.В.- Мясное дело. -№1, 2010, стр. 36-40
7. Баль-Прилипко Л.В. Усвідомлений вибір – запорука здоров'я нації / Баль-Прилипко Л.В,Слива Ю.В.- Киев: Молочное дело.- №1, 2010, с.22-25.
8. Баль-Прилипко Л.В., Лозова О.М "Магічні" речовини в харчовій промисловості:використання функціональних добавок при виробництві м'ясних виробів, Киев: Мясное дело.- №3, 2010, с. 34-36
9. Баль-Прилипко Л.В. Актуальні проблеми та основні тенденції м'ясопереробної галузі АПК / Л. В. Баль-Прилипко, Е. Р. Старкова // Мясное дело. – 2013. – № 10. – С. 4 – 8
10. Баль-Прилипко Л.В. Сучасний стан питання якості та безпечності м'яса та м'ясних продуктів в Україні / Баль-Прилипко Л.В, Слива Ю.В., Хомічак Л.М. – Киев: Мясное дело. - №5, 2010,с.
11. Баль-Прилипко Л.В. Актуальні проблеми та характеристики стану м'ясної промисловості України / Баль-Прилипко Л.В., Леонова Б.І. – Киев: Мясное дело. - № 9, 2010, с. 14-17
12. Баль-Прилипко Л.В, Лозова О.М Удосконалення технології м'ясних продуктів за допомогою комплексних функціональних сумішей, Київ: НУБІП України. Матеріали міжнародної науково-практичної конференції молодих вчених, аспірантів і студентів. 20-22.04.10, с. 92



13. Баль–Прилипка Л. В. Актуальні проблеми галузі / Л. В. Баль–Прилипка. – К. : 2010. – 374 с.
14. Баль–Прилипка Л.В. Актуальні проблеми м'ясопереробної галузі / Л.В. Баль–Прилипка: Підручник. – Київ, 2011. – 288 с.
15. Баль–Прилипка Л. В. Моніторинг ринку ковбасних виробів України та безпечності продукції / Л. В Баль–Прилипка // Продовольча індустрія АПК. – 2011. – № 3. – с. 4–7
16. Баль–Прилипка Л.В. Інноваційні технології якісних та безпечних м'ясних виробів / Л.В. Баль–Прилипка: Монографія. – Київ, 2012 – 207 с.
17. Баль–Прилипка Л.В. Інноваційне сприяння розвитку підприємств / Л.В. Баль–Прилипка // Продовольча індустрія АПК.- 2011.- №1.- С. 8-10
18. Баль–Прилипка Л. В. Лабораторний практикум з дисципліни "Актуальні проблеми м'ясопереробної галузі" для магістрів напряму підготовки 0917 «Харчова технологія та інженерія» для спеціальності 8.091707 "Технологія зберігання, консервування та переробки м'яса" / Л.В. Баль–Прилипка, - К.: ]-К: Видавничий центр НУБіП України, 2014. – 43 с.
19. Березов Т.Т., Коровкин Б.Ф. Биологическая химия: Учебник / Под ред. С.С. Дебова — М.: Медицина, 1983. — 752 с.
20. Бессалая И. И. Лечебно–профилактические колбасные изделия– продукты будущего / И. И. Бессалая, А. И. Решетняк, Л. В. Донченко // Научный журнал. – 2013. – № 94 (10). – 11 с.
21. Биологически активные добавки в питании человека / Упельян В.А., Суханов Б.Н., Андриевских А.Н., Поздняковских В.М. — Томск: Научно-техническая литература, 1999. – 229 с.
22. Битуева Э. Б. Способ обогащения мясных продуктов железом / Э. Б. Битуева, А. В. Рябушева // Мясная индустрия. – 2000. – № 10. – с. 45–46
23. Будник Н. В. Використання харчової кісткової пасти в технології виробництва м'ясних напівфабрикатів / Н. В. Будник, Н. В. Олійник // Мясной бизнес. – 2010. – №8. – с. 69–71
24. Бурштейн А.И. Методы исследования пищевых продуктов.- К. "Медицина", 1963. – 515 с.
25. Васильева Л.Д. Транспортировка и хранение пакетного бескостного полуфабриката из говядины/Васильева Л.Д., Куликовская Л.В., Дибирсулаева М.А. – М.: ЦНИИТЭИ Мясомолпром СССР, №7, с. 22-23 - (Экспресс-информация, серия «Мясная промышленность»).
26. Вивчення жирокислотного складу м'яса та ковбасних виробів при зберіганні з комбінованими консервантами / Л.В.Баль–Прилипка та ін. - "Харчова промисловість". Міжвідомчий тематичний науковий збірник, № 42. К.: "Урожай", 1996, с. 120-124
27. Виробництво якісних та безпечних м'ясних виробів - пріоритет розвитку галузі. Лондон-Київ: 8 Международная научная конференция, 2011 г. - К., 2011. - С. 43-45
28. Витаминизация мясных продуктов фолиевой кислотой / С. А. Гордынец [и др. ] // Мясные технологии. – 2006. – № 6. – с. 27–29

29. Вишневская Т. И. Разработка технологии получения йодсодержащих продуктов из ламинарии японской / Т. И. Вишневская, Н. М. Аминина, О. Н. Гурулева. – Владивосток: Известия ТИНРО, 2001. – 163. – 169 с.
30. ВООЗ. Серия технических докладов №738. Оценка некоторых пищевых добавок и контаминантов. 41 доклад Объединённого комитета экспертов ФАО/ВООЗ по пищевым добавкам. – Женева, 1993. – 314 с.
31. Гігієна харчування з основами нутриціології : [ ред. В.І. Ціпріян.]. – Київ 1999. – 400 с.
32. Гигиенические требования по применению пищевых добавок: Санитарно-эпидемиологические правила и нормативы. – М.: Федеральный центр Госсанэпиднадзора Минздрава России. СанПиН 2.3.2.1293-03
33. Гиро Т. М. Мясные продукты с растительными ингредиентами для функционального питания / Т. М. Гиро, О. И. Чиркова // Мясные технологии. – Москва, 2007. – № 1. – с. 43–46
34. Головні засади формування смаку, аромату й післясмаку готових м'ясопродуктів, БальПрилипко Л.В, Тернопіль: World Meat Technologies. - № 4 2010
35. Голубев В.Н. Основы пищевой химии. – М.: Биоинформсервис, 1997. – 223с.
36. Гуманітарні та ресурсні проблеми національної безпеки України: монографія / [Баль-Прилипко Л.В., Дубина М.І., Баранівський В.Ф. та ін.]. К.: «ВПК Експрес-Поліграф», 2012 – 368 с.
37. Гуринович Г. В. Биотехнологические способы производства продуктов повышенной пищевой ценности: учебник / Г. В. Гуринович. –К. : ЛМТ КемТИПП, 2002. – с. 130
38. Даниленко И.П. Справочник по качеству продуктов животноводства. – К.: Урожай, 1988
39. Дерев'янюк Л. П. Використання біологічно активної добавки еламіну для корекції гіпоталамо–гіпофізарно надниркової системи на фоні внутрішнього опромінення <sup>137</sup>Cs / Л. П. Дерев'янюк // Проблеми харчування. – 2004. – № 2 (3). – с. 39–47
40. Дефіцит білка можна поповнити / Л.В. Баль-Прилипко. К.: Харчова і переробна промисловість, № 5, 2000, с. 20-22
41. Долгая М.М. Пищевые добавки и их использование в производстве продуктов питания. – М.: ВНИИЦентр, 1987
42. Доронин А. Ф. Функциональное питание / А. Ф. Доронин, Б. А. Шендеров. – М.: ГРАНТЬ, 2002. – 296 с.
43. Дурнев А. Д. Функциональные продукты питания / А. Д. Дурнев, Л. А. Оганесянц, А. Б. Лисицын // Хранение и переработка сельхозсырья. – 2007. –№ 9. – с. 15–21
44. Егорченкова Л. А. Гигиенические аспекты обогащения колбасных изделий витаминами В<sub>1</sub> В<sub>2</sub>, РР и С: дис. канд. биол. наук: 14. 00. 07 / Егорченкова Лариса Алексеевна. – М. , 1990. – 187 с.

45. Жаринов А.И., Соколова Н.А. Мясопродукты, потребитель и некоторые аспекты современного маркетинга // Вестник "Аромарос-М". – 2005. - № 3, – с. 53-62
46. Жаринов А.И., Ивашкин Ю.А. Проектирование комбинированных продуктов питания // Все о мясе. – 2004. - № 2– с. 16-21, № 3 – с. 6-15
47. Журнал "Пищевые ингредиенты. Сырье и добавки" 2001-2004
48. Закон України "Про безпечність та якість харчових продуктів" № 771/97 – ВР: підписано 23 груд. 1997 р. / Верховна Рада України. – Офіц. вид. – К. : Офіційний вісник України, 2008. – № 3. с. 13 – (Бібліотека офіційних видань).
49. Запорожский А. А. Перспективы создания комбинированных мясопродуктов геродиетического назначения / А. А. Запорожский, М. Г. Михайлова //Известия вузов. Пищевая технология, 2005. – № 1. – с. 44–46
50. Заремба П.О. Розвиток м'ясопереробної промисловості України: проблемні питання та шляхи їх вирішення / П. О. Заремба // Вісн. екон. науки України. – 2005. – № 2 (8). – С. 124–126.
51. Зонин В.Г. Современное производство колбасных и солёно-копченый изделий. – СПб.: Профессия, 2006. – 224 с.
52. Заяс Ю.Ф. Качество мяса и мясопродуктов.- М.: Легкая и пищевая промышленность, 1981. – 480 с.
53. Інновації, як вектор розвитку харчової промисловості України: матеріали Міжнародної науково-практичної конференції [«Современные направления теоретических и прикладных исследований 2012»] (Одесса, 20-31 марта 2012г.) /Научно-исследовательский институт проектно-конструкторский институт морского флота Украины, Одес. Нац.морс. ун-т.-Одесса.: Одес.нац.морс.ун.-т, 2012.- С.22-23.
54. Інновації, як вектор розвитку харчової промисловості України: матеріали Міжнародної науково-практичної конференції [«Современные направления теоретических и прикладных исследований 2012»] (Одесса, 20-31 марта 2012г.) /Научно-исследовательский институт проектно-конструкторский институт морского флота Украины, Одес. Нац.морс. ун-т.-Одесса.: Одес.нац.морс.ун.-т, 2012.- С.22-23
55. Інноваційні технології бездимного копчення при виробництві ковбасних виробів, Баль-Прилипко Л.В, Шокун В.В., Київ: НУБІП України. Матеріали міжнародної науково-практичної конференції молодих вчених, аспірантів і студентів .20-22.04.2010, с.93.
56. Использование альгината натрия при производстве мясных полуфабрикатов [«Биотехнология. Вода и пищевые продукты»], (Москва, 11–13 мар., 2008 г. ) / М. С. Алиев. – М. : ЗАО «Экспо–биохим–технологии», РХТУ им. Д. И. Менделеева, 2008. –с. 472–474
57. Исупов В.П. Пищевые добавки и пряности. – СПб.: ГИОРД, 2000
58. "Йод–альгинат" структурированный наполнитель для мясных рубленых изделий / А. Б. Лисицын [и др. ] // Мясная индустрия. – 2007. – № 5. – с. 18–20

59. Капрельянц Л. В. Функциональные продукты питания: современное состояние и перспективы развития / Л. В. Капрельянц // Продукты и ингредиенты. – 2004. – № 1. – С. 22–24.
60. Кацерикова Н. В. Технология продуктов функционального питания / Н. В. Кацерикова. – К. : Кемеровский технологический институт пищевой промышленности, 2004. – 146 с.
61. Киприянов Н. А. Экологически чистое растительное сырье и готовая пищевая продукция // Н. А. Киприянов. – М. : Пищевая промышленность, 1997. – 176 с.
62. Классен Н. В. О возможности использования ламинарии японской в качестве структурообразователя формованных продуктов / Н. В. Классен. – В. : Известия ТИНРО, 1997. – 193 с.
63. Коденцова В. М. Использование пищевых продуктов, обогащенных железом и витаминами, для коррекции железодефицитных состояний / В. М. Коденцова, О. А. Вржесинская // Вопросы питания. – 2002. – № 4. – с. 39 – 43
64. Колобаев Р.В. Справочник по закупкам продуктов животноводства. – М.: Колос, 1981
65. Колодязная В. С. Пищевая химия: Учеб. пособие / В. С. Колодязная. – СПб. : СПбГАХПТ, 1999. – 140 с.
66. Кравченко В. І. Йододефіцит – актуальна проблема для України / В. І. Кравченко // Еженедельник 2000. – 2011. – № 36. – с. 13–14
67. Крижова Ю. П. Удосконалення технології пельменів з метою збагачення йодом / Ю. П. Крижова, М. І. Філоненко, Р. Б. Ребець // Продукты и ингредиенты. – 2011. – №9. – с. 72–73
68. Кудряшов Л. С. Использование пищевых волокон и лактулозы для выработки колбасных изделий / Л. С. Кудряшов, А. Б. Лисицын, А. А. Семенова, В. А. Куприянов // Мясная индустрия. – 2003. – № 3. – с. 30–32
69. Лескова С. Ю. Разработка технологии йодированных белково–жировых эмульсий для производства вареных колбас: автореф. дис. канд. техн. наук: 05.18. 04 / Светлана Юрьевна Лескова. – Улан–Удэ, 2005. – 19 с.
70. Лечебно–профилактические продукты для детей и взрослых, в том числе проживающих в экологически неблагоприятных зонах и в крупных городах / А. Б. Лисицын [и др. ] // Хранение и переработка сельхозсырья. – 2002. – № 9. – с. 11–15
71. Липатов Н. Н. Принципы проектирования состава и совершенствования технологии многокомпонентных мясных и молочных продуктов: автореф. дис. д–ра техн. наук: 05. 18. 04 / Никита Николаевич Липатов. – Москва, 1988. – 56с.
72. Лисицын А. Б. Функциональные продукты на мясной основе / А. Б. Лисицын, А. В. Устинова, Н. Е. Белякина // Хранение и переработка сельхозсырья. – 2007. – № 8. – с. 59–64
73. Лисицын А. Б. Tehnologija mesa/ А. Б. Лисицын // Institut zahigi jenui tehnologiju mesa. – 2007. – № 48. – с. 45–52

74. Лузан В. Н. Влияние морской капусты на функционально–технологические свойства мясного фарша // Мясная индустрия. – 1999. – № 7. – с. 18–19
75. Люк Э. Консерванты в пищевой промышленности. Свойства и применение./Пер. с нем. Сарафановой Л.А.. – СПб.: ГИОРД, 1998
76. Мазо В. К. Функциональные пищевые продукты: современные подходы / В. К. Мазо // Хлебопекарное производство. – 2011. – № 3. – с. 56–58
77. Матеріали (доповідь) науково-практичної конференції "Аерокосмічні спостереження в інтересах сталого розвитку та безпеки" (м. Київ, 14-17 червня 2010 року) / Хомічак Л.М. – 2010
78. Машенцева Н. Г. Функциональные стартовые культуры в мясной промышленности / Н. Г. Машенцева, В. В. Хорольский. – М. : ДеЛи принт, 2008. – 336 с.
79. Моргунова А. В. Применение активации водных систем в технологии производства колбасных изделий нового поколения / А. В. Моргунова, Л. А. Борисенко, А. А. Борисенко [и др. ] // Вестник СевКавГТУ. – Ставрополь: СевКавГТУ, 2012. – №1 (30). – с. 69 –73
80. Морская водоросль фукус в мясных продуктах / Л. Ф. Митасева [и др. ] // Пищевая промышленность. – 2004. – № 12. – С. 91
81. Наказ Міністерства охорони здоров'я України від 16 грудня 1996 р. № 222 "Про затвердження "Санітарних правил і норм по застосуванню харчових добавок"
82. Наказ Міністерства охорони здоров'я України "Про затвердження Норм фізіологічних потреб населення України в основних харчових речовинах та енергії" № 272: підписано 18 лист. 1999 р. / Верховна Рада України. – Офіц. вид. – К.: Офіційний вісник України, 1999. – № 49. – 340 с. – (Бібліотека офіційних видань)
83. Нечаев А.П., Траубенберг С.Е., Попов М.П. Пищевая химия: Курс лекций в 2 ч. – М.: МГУПП, 1998. – 258 с.
84. О способах обработки колбасных изделий жидкими консервантами /Л.В. Баль, В.С.Гуц, В.Н.Вендичанский. К.: Пищевая промышленность № 3, с. 34-36, 1987
85. Особенности развития рыночной экономики в переходный период: СПб. науч. статей. Ч.1./ Донецк. гос. техн. ун-т - Донецк: Дон ТУ, 1996
86. Особенности использования стартовых бактериальных культур в производстве мясопродуктов: материалы IX Международной научно–технической конференции, [«Техника и технология пищевых производств»], (Могилев, 25–26 апр. 2013) / науч. ред. А. А. Соловьева, О. В. Зинина, М. Б. Ребезов. – Могилев: МГУП, 2013. – 105 с.
87. Патракова И. С. Технология функциональных мясопродуктов: учеб. – метод. комплекс / И. С. Патракова, Г. В. Гуринович. – К. : Кемеровский технологический институт пищевой промышленности, 2007. – с. 128
88. Перспективные технологии XXI века: монография / [Баль-Прилипко Л. В., Абдуллин И.Ш., Абуталипова Л.Н. и др.]. – Одесса: КУПРИЕНКО СВ, 2013. – 162 с.

89. Пилат Т. Л. Биологически активные добавки к пище (теория, производство, практика) / Т. Л. Пилат, А. А. Иванов. – М.: Авваллон, 2002. – 710 с.
90. Пищевая биотехнология: научно-практические решения в АПК: монография / А.И. Жаринов, И.Ф. Горлов, Ю.Н. Нелепов, Н.А. Соколова. – М.: Вестник РАСХН, 2007. – 476 с.
91. Подобедов А.В. Уникальные свойства сои / А.В. Подобедов // Достижения науки и техники АПК. 2002. - № 6. - с. 42-45
92. Полезные свойства льняного масла [Электронный ресурс]: научная статья / Ю. А. Лебедева. – К.: 2012. – с. 2. – Режим доступа к ст.: <http://nmedik.org/lechenie-maslami/lnyanoe-maslo/ispolzovanie-lnyanoe-maslo.html>
93. Постановка Кабінету Міністрів України від 04.01.1999 р. № 12 "Про затвердження переліку харчових добавок, дозволених для використання у харчових продуктах"
94. Постанова Кабінету Міністрів України "Про затвердження Державної програми профілактики йодної недостатності у населення на 2002–2005 роки" № 1418: підписано 26 вересня 2002 р. / Кабінет Міністрів України. – Офіц. вид. – К. : Офіційний вісник України, 2002. — № 39. – С. 61–64. – (Бібліотека офіційних видань)
95. Продовольственная и сельскохозяйственная организация объединенных наций Союз научно-исследовательских центров органики (ORCA) [Электронный ресурс]. – Режим доступа к ст.: [http://www.fao.org/organicag/oa-portal/ru/?no\\_cache=1](http://www.fao.org/organicag/oa-portal/ru/?no_cache=1)
96. Продукти збагачені соєю – вживання їх запобігає виникненню злякисних новоутворень /Л.В.Баль-Прилипко та ін. К.: Харчова і переробна промисловість, 2000, № 5, с. 20-22
97. Продукти харчові. Маркування для споживачів. Загальні правила: ДСТУ 4518: 2008. – [Чинний від 01–11–2008]– К.: Держспоживстандарт України, 2008. – 16 с. – (Національні стандарти України)
98. Производство функциональных мясных продуктов [Электронный ресурс] / В. Загорская // ИД «Сфера» – 2013. – С. 1. – Режим доступа к ст. : <http://sfera.fm/articles/proizvodstvo-funktsionalnykh-myasnykh-produktov>
99. Разработка технологии производства мясопродуктов с биологически активными пищевыми волокнами: труды научно-практической конференции [«Наукоемкие конкурентоспособные технологии продуктов питания со специальными свойствами»], (Москва, 2004) / В. А. Самылина, В. В. Садовой. – Углич Россельхозакадемия, 2004. – с. 408–410
100. Разработка пищевых продуктов для профилактики железодефицитной анемии / А. И. Жаринов [и др. ] // Новое мясное дело. – 2006. – № 3. – с. 21–25
101. Ребезов М. Б. Экология и питание. Проблемы и пути решения. / М. Б. Ребезов [и др. ]. – Фундаментальные исследования, 2011. – № 8. – с. 393–396

102. Рогов И.А. Технология и оборудования колбасного производства. / Рогов И.А., Забашта Г.А., Алексахин В.А. и др. - М.: Агропромиздат, 1989, -272 с.
103. Розпорядження Кабінету Міністрів України "Про затвердження плану заходів щодо розроблення, впровадження і функціонування систем управління якістю, екологічного управління та інших систем управління" № 492 / 2013 – р: підписано 19 чер. 2013 р. / Верховна Рада України. – Офіц. вид. – К. : Урядовий кур'єр, 2013. – № 131. – (Бібліотека офіційних видань)
104. Рослинні композиції для м'ясних консервів / Л.В.Баль-Прилипко та ін. К.: Харчова промисловість, № 6, 2000, с. 21-22
105. Санитарные правила и нормы. Гигиенические требования по применению пищевых добавок, Омега-Л, 2007 г.
106. Санитарные правила и нормы 13-10 РБ 2002 "Гигиенические требования к качеству и безопасности пищевых добавок и их применению"
107. Санитарные правила и нормы 2.3.2.1293-03 "Гигиенические требования по применению пищевых добавок"
108. Сарафанова Л.А., Кострова И.Е. Применение пищевых добавок. Технические рекомендации. – СПб.: ГИОРД 1997
109. Соеві компоненти в м'ясних виробках / Л.В.Баль-Прилипко. К.: Харчова і переробна промисловість, 1999, с. 24-25
110. Соловьева А. А. Актуальные биотехнологические решения в мясной промышленности / А. А. Соловьева [и др. ] // Молодой ученый. – 2013. – № 5. – с. 105–107.
111. Состояние и перспективы развития концепции "Функциональное питание в России" [Электронный ресурс] / Б. А. Шендеров // ФГНУ Московский НИИ эпидемиологии и микробиологии им. Г. Н. Габричевского. ФГНУ Московский государственный университет пищевых производств – 2006. –Режим доступа к ст. :<http://obad.ru/badinfo/pro-bady/sostoyanie-i-perspektivy-razvitiya-kontseptsii-funktsionalnoe-pitanie-v-rossii>
112. Спиричев В. Б. Обогащение пищевых продуктов микронутриентами: научные подходы и практические решения / В. Б. Спиричев, Л. Н. Шатнюк, В. М. Позняковский // Пищевая промышленность. – Москва, 2003. – № 3. – с. 10 –16
113. Срок годности пищевых продуктов: Расчет и испытание / Под ред. Р. Стеле, пер. с англ. В. Широкова, под общ. ред. Ю.Г.Базарной. – СПб.: Профессия, 2006. – 480 с.
114. Сучасний стан питання якості та безпечності зерна та зернопродуктів в Україні, Баль-Прилипко, Л.В, Хомічак Л.М., Слива Ю.В Киев: Хлебопекарское и кондитерское дело.- № 5, 2010
115. Терминологический словарь-справочник по пищевым добавкам и специям - Д.А. Васильев, Л.П. Пульчаровская, Г.Н. Зеленов; Кафедра микробиологии, вирусологии, эпизоотологии, ветеринарно-санитарной экспертизы, кафедра биотехнологии и переработки сельскохозяйственной

продукции Ульяновской государственной сельскохозяйственной академии

116. Технологія виробництва котлет, збагачених йодом та селеном / Ю. П. Крижова [та ін.] // Продукты и ингредиенты. – 2008. – № 2. – с. 103–105
117. Указ Президента України "Про заходи щодо підвищення якості вітчизняної продукції" № 113 / 2001: підписано 23 лют. 2001 р. / Верховна Рада України. – Офіц. вид. – К. : Офіційний вісник України, 2001. – № 9. – 27 с. – (Бібліотека офіційних видань)
118. Функциональное питание / А. А. Кочеткова [и др.] // Вопросы питания. – 2000. – №4. – с. 78–86
119. Функциональные пищевые продукты: общее и частное [Электронный ресурс]: научная статья / А. Кочеткова. – М.: 2012. – с. 1. – Режим доступа к ст. : <http://www.produkt.by/Technic/print/314>.
120. Хантургаев А. Г. Разработка технологии бифидосодержащих молочных продуктов с использованием кедрового шрота. Автореф. дисс. на соиск. уч. степ. к. т. н. : 05. 18. 04. / Андрей Геннадиевич Хантургаев – Улан–Удэ, 2002. – 32 с.
121. Харыбина К. Е. Разработка состава и технологии производства вареных колбас с использованием белковойодированного комплекса: дис. канд. техн. наук: 05. 18. 04 / Ксения Евгеньевна Харыбина. – Москва, 2001. – 170 с.
122. Чиркина Т. Ф. Йодированные мясопродукты / Т. Ф. Чиркина, Э. Б. Битуева, В. Н. Лузан // Известия Вузов. Пищевая технология – 1998. – № 5–6. – с. 45–46
123. Чулкова Н. А. Специализированные консервированные продукты для здорового питания / Н. А. Чулкова, Л. М. Семенова // Мясная индустрия. – 2000. – № 3. – с. 30–31
124. Шатнюк Л. Н. Пищевые ингредиенты в создании продуктов здорового питания / Л. Н. Шатнюк // Пищевые ингредиенты. Сырье и добавки. – Москва, 2005. – № 2. – с. 18–22
125. Шипулин В. И. Технология вареной колбасы категории "Халяль" / В. И. Шипулин, Е. П. Мирзаянова // Мясные технологии. – 2009. – № 9 (81). – с. 26–29
126. Шулбаева М. Т. Сохранение традиционных качеств пищевых продуктов при использовании пищевых волокон / М. Т. Шулбаева // Пищевая промышленность. – 2004. – № 5. – с. 16–17
127. Downs M, MPH (17 December 2008). "The Truth About 7 Common Food Additives". WebMD
128. Dunn J. T. A practical Guide to the correction of iodine deficiency / J. T. Dunn, F. Vander Haar. – N.: International Council for Control of Iodine Deficiency Disorders, 1990. – 62 p.
129. Dybing E. (Dec 2002). "Development and implementation of the IPCS conceptual framework for evaluating mode of action of chemical carcinogens". Toxicology. 181-182: 121–125



130. Edward D. Strontium Metabolism / D. Edward , T. Paul, J. Lenihan [et al.] – London, 1967. – №198. – p. 329–341
131. Fennema O. R. (1996). Food chemistry. New York, N.Y: Marcel Dekker. p. 827
132. Food Standards Australia New Zealand (2007). "Choosing the Right Stuff - the official shoppers' guide to food additives and labels, kilojoules and fat content". Retrieved 3 May 2009
133. IFIC. Food Additives Nutrition – Nutrition, Function, Side Effects - NY Times Health Information. Режим электронного доступа: <http://health.nytimes.com/health/guides/nutrition/food-additives/overview.html>
134. Lin Kuo–Wei T. Textural and physicochemical properties of low–fat, precooked ground beef patties containing carrageenan and sodium alginate / T. Lin Kuo–Wei, J. Keeton // Journal Food Science. – Texas, 1998. – №4. – p. 571–574
135. McCann D; Barrett A; Cooper A; Crumpler D; Dalen L; Grimshaw K; Kitchin E; Lok K; et al. (2007). "Food additives and hyperactive behavior in 3-year-old and 8/9-year-old children in the community: a randomized, double-blinded, placebo-controlled trial". Lancet 370 (9598): 1560–7
136. Messemer M. Чем является Clean Label? [Электронный ресурс]. – Режим доступа к ст. : <http://clean-label.de/index.php?page=start—russisch>
137. Orlandi P. A., Chu D. M. T., Bier J. W. Jackson G.J. Parasites and the food supply // Food Technology. – 2002. - 56(4). – P. 72-81
138. Robinson R. K, Batt C. A., Patel P. D. Encyclopedia of Food Microbiology. – Academic Press: NY, 2000.
139. Roudaut G., Dacremont C, Lemeste M. Influence of water on the crispness of cereal-based foods – acoustic, mechanical, and sensory studies // J. of Texture Studies. – 1998. – 29(2). – p. 199-213
140. Scientific Concepts of Functional Foods in Europe/ A. T. Diplock [et al.]// British Journal of Nutrition. – 1999. – № 81. – p. 1–27
141. Smith J. Functional Food Product Development / J. Smith, E. Charter. – Charlottetown: Blackwell Publishing Ltd, 2010. – 528 p.
142. Whysner J.; Williams GM. (1996). "Saccharin mechanistic data and risk assessment: urine composition, enhanced cell proliferation, and tumor promotion", Pharmacol Ther. 71 (1–2): 225–52

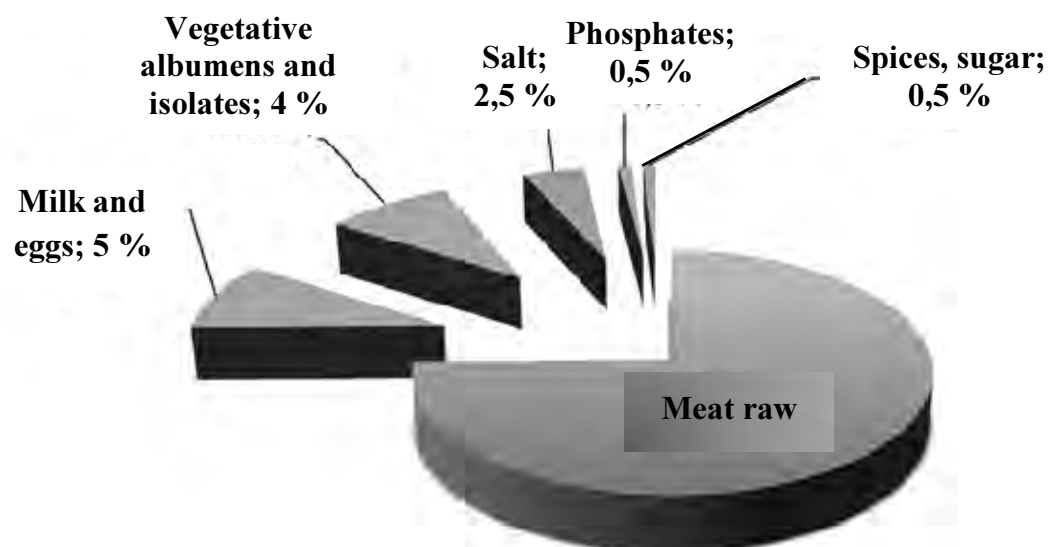
## FOOD ADDITIVES USED IN PRODUCING OF MEAT PRODUCTS

The longstanding chase for intensification of manufacture and rising of volume of products of the meat-processing industry leads to ungrounded modification of its assortment, subjective simplification of numeral technological processes, break of interests of manufacturer of demands of consumers, and the main – to devaluation of notion of *"quality of meat and meat products"*. Regardless of formal existence of standards, which normalize properties of raw and auxiliary materials, quality of finished products deviates in many cases of global norms and the existing system of technological control is not sufficiently effective.

Meat is the specific type of raw material and its peculiar characteristic is that despite it is the source of valuable albumen, meat is the multicomponent mix, has the heterogeneous structure, non-adequate by its functional and technological properties, and is biologically active and capable to vary its characteristics depending of climatic and environmental conditions of surrounding space. The same meat products produced by different enterprises are character by appreciably differing organoleptic, structural, mechanical and technological characteristics. Because meat easily varies its initial properties, composition and structure, the operator is capable to operate by the process of their production properly only on base of knowledge of peculiarities of biochemical, microbiological and fermentative processes occurred in process of their manufacturing. As a result, rational use of raw materials, production of meat products of high quality and reaching of efficiency in their fabrication are possible only on condition of thorough understanding of basic principles of technologies to be used by persons who operate these problems. The ingredients used in production of meat products traditionally, were (Fig. 2.1).

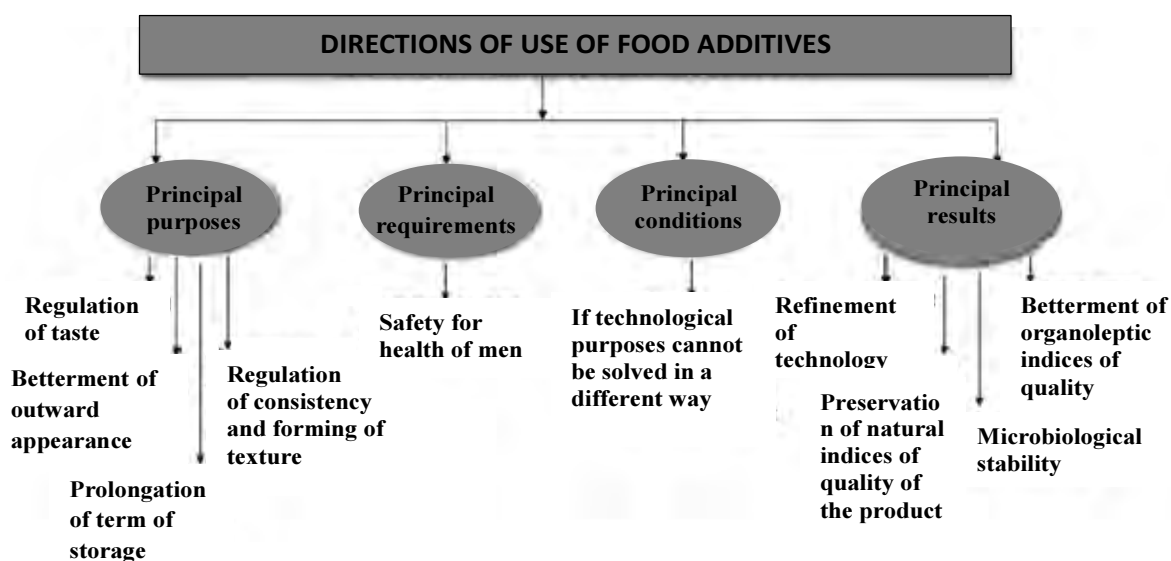
The primary tasks of work in modification of traditional compositions are betterment of functional and flavoring properties of products. Uncontrolled rising of volumes of produced products not supported by proper knowledge of their specificity, introduction of innovative processes character in many cases by simplifying of technological techniques, spreading of assortment of products oriented on demand of consumers who has various levels of income, lead to devaluation of notion of *"quality of meat and meat products"*. There occurred simplifying of the whole set of technological operations and processes resulted in deepening of gap between interests of manufacturers and consumers.

However, progress of technologies and progressive deficit of raw caused the problem of improvement and stabilization of quality of produced products despite the unstable composition and properties of raw materials used in their manufactures. The one of methods used to solve this problem is use of various food additives in novel compositions of meat products. The principal driving motives of their introduction in new formulations are: a) changes of methods of trade; b) changes of requirements of consumers to quality of meat products and c) widening of assortment of traditional meat products and development of their new types.



**Figure 2.1** *Structure of basic additives and ingredients used by classical technologies of production of meat products of I – III classes of quality*

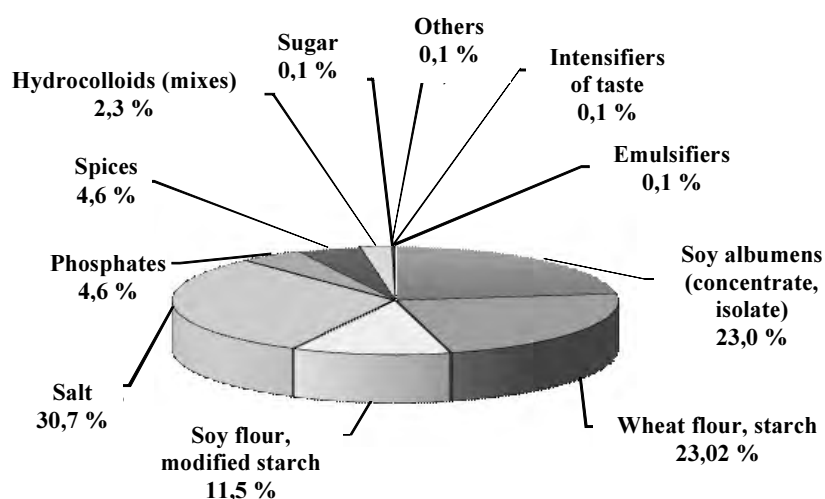
The most accepted method of solving of this problem is use of food additives that influence appreciably on functional and technological characteristics of foodstuffs. The preferable direction of such work is use of those additives of natural origin that influence on functional and technological properties of raw materials and possess at the same time by sufficient biological activities and sometimes by medicinal effect too. The example is use of dietary fibers for decreasing of risks of origination of diverticulum and cancer of large bowel, fatness, diabetes, thrombosis and occlusion of tubules and support of normal conditions of microflora of bowels.



**Figure 2.2** *The principal purposes, results, requirements and conditions of use of food additives in process of production of meat products*

The wishes of consumers to obtain more new kinds of cheap products safe for their life, and packed in suitable packing initiate developers to find new methods of intensification of taste and flavor of foods. The one of character peculiarities of novel types of foods that fit to modern requirements of science on foods (small caloricity, dietetic properties) is use of food additives, which influence on texture of meat products. The purposes, requirements to quality and conditions of their use in process of production of meat products show the Figure 2.2.

The modern plants produce sausage in big quantities, operate by intensive technologies and use in it not only traditional food additives of vegetative and animal origin but the relatively cheap synthetic ones too, which are character by functional properties similar with those of muscular albumens. The senses of their use are improvement or stabilizing of quality of finished products, raise their stability in storage and simplifying of processes of compositing of masses of sausage meat (Fig. 2.3).

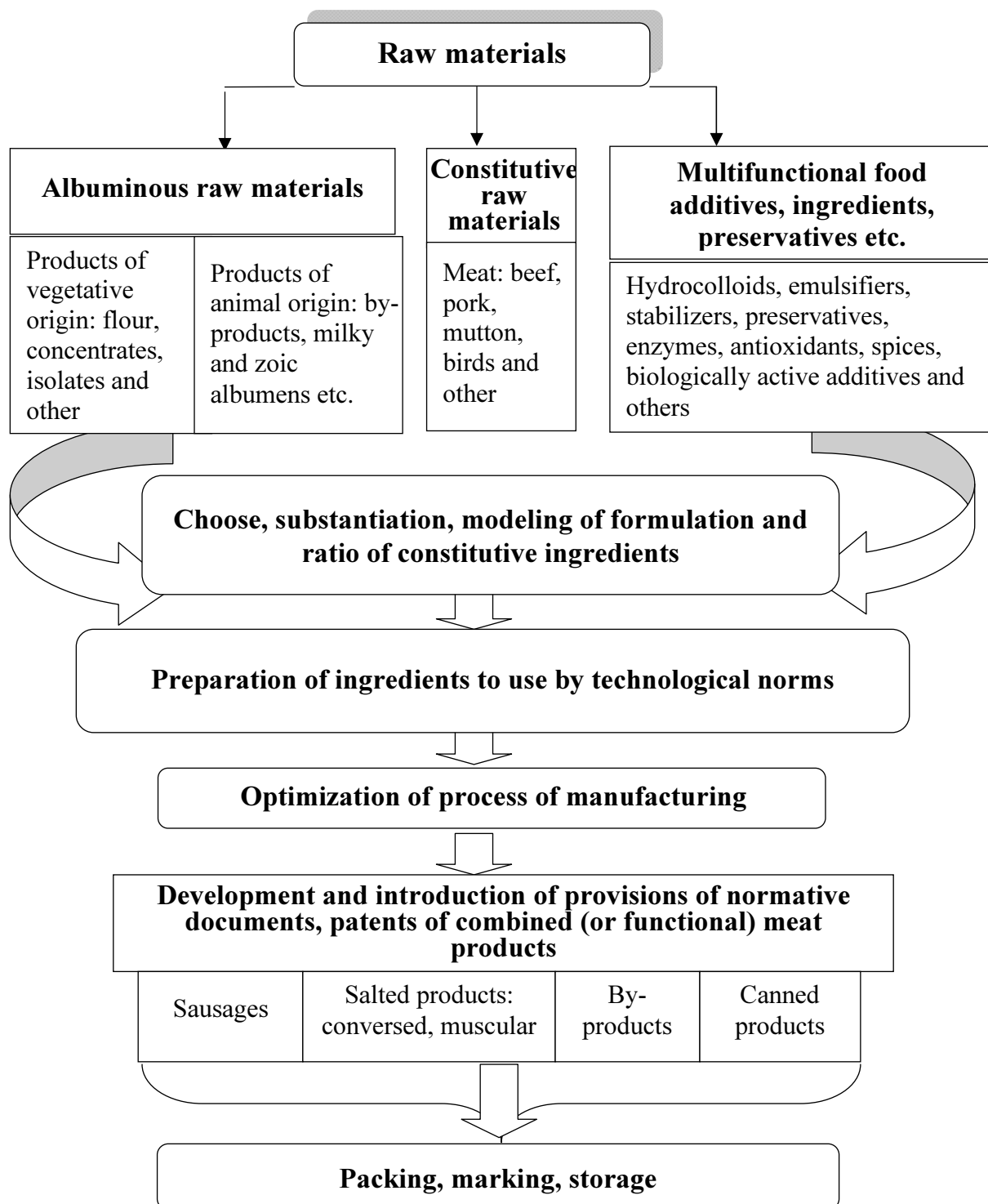


**Figure 2.3 Basic ingredients used by modern technologies of reprocessing of meat**

Use of such additives permitted to produce sausages that would have the set properties in advance, i.e. to fabricate the exactly such products that requires the concrete consumer who live in certain region and has the certain level of income and needs. The basic stages of carrying out of work in improvement of existing technologies are (Fig. 2.4).

Taking the diversity of food additives present on the market and insufficiency of base of normalized requirements to their quality, there exist the problem of rational choose of components to use. Therefore, the only way of solving of said problem in relation to the whole assortment of produced products is the complex evaluation of technological quality of each additive and its compliance to specificity of existing technological problems.

To formalize the notion of "*technological property of food additive*", there were proposed the set of terms and relative attributions.



**Figure 2.4 Basic stages of optimization of technology of fabrication of meat products**

Analogously to the term of "quality of foodstuff", the term of "technological property" of the food additive is understood as the complex of properties (technological functions), which characterize its capability to vary in prerequisite direction of property of the foodstuff (alimentary system) in its stabilization and/or improvement of its quality. Choosing the sequence of actions in evaluation of quality of the additive, one has to identify its constituents and hierarchical structure. The notions used in this work are as follows.

Technological function of food additive means its capability to give the alimentary system new properties directed on rising of level of its safety and/or betterment of quality of products that contain this ingredient.

Basic technological property of food additive means its character property that gives the technologist to reach the set level of safety and quality of the product (alimentary system) he produces.

The basic determinative technological property of the food additive in most cases is its functional destination of use. However, in most cases additives have some definitions and the principal of these one may be named only in concrete conditions of its use.

Additional technological function of food additive means its attendant property, which exhibits in the meat system together with the basic technological function and influences positively on safety and/or quality of the product.

Subsidiary technological function of food additive means the positive or negative property of the additive, which may appear in the food system in certain conditions (composition of the system, temperature, concentration, activity of water, presence of catalysts and synergists etc.).

Functional technological index means the organoleptic, physicochemical, microbiological, structural, mechanical, histological or other individual (integral) index, which value characterizes the grade of appearance of technological function (group of technological functions) of used additive.

Technological effect means the magnitude of the functional technological index (value of its variation) after application of certain portion of a food additive into the system.

The technologically adequate use of food additive means such procedure of use of the additive that permits to reach the set level of technological effect in its minimal introduction, and the additives used in the meat-processing industry may be divided conditionally by classes as follows.

## **2.1 Albuminous substances**

The increasing of level of well-being of life and rising of demand on alimental albumens calls for intense progress of technologies of producing of meat products and evolution of principles of reprocessing of albumens that are centered on guaranteeing of healthy style of life, liquidation of deficit of foody albumens in rations and satisfaction of demand of men for fine and valuable foodstuffs. The basic principle of such policy of functioning of the meat-processing industry became introduction of optimized norms of combining of albuminous nutritional components, which hold ingredients that contain meat albumen, with products free of compounds of albuminous nature done in purpose of fabrication of cheap foods of high-quality.

Quality of food depends of presence in it of complex of biologically active substances: albumens, fats, carbohydrates, vitamins, microelements etc. The problems of protection of health, liquidation of deficit of alimental albumens, satisfying of demand of consumers for various fine and valuable foods were urgent in all times. Because raw materials of vegetative origin contain albumens differing by their properties and composition of zoic ones, they may be used in modern

technologies of producing of meat products on principles of scientific substantiation of qualitative norms of their application in technological intermixtures with the meat raw materials. The principal condition of providing of suppliers by valuable albumens is organization of producing of meat products that contain the mix of meat and albuminous preparations of different origin, what permit to enrich the meat raw materials by valuable ingredients (of chemical and aminoacid character), rise their biological value, improve organoleptic indices of quality of finished products and decrease it cost.

The modern ideology of consumption of albumen consists in fabrication of meat products produced of mix of mutually enriched (in general, by chemical substances and vitally necessary amino acids) meat of hot-blooded animals, products of vegetative origin and albuminous preparations. The purposes set in their production are rising of biological validity and betterment of organoleptic indices of quality of finished products obtained in decreasing of their prime cost. The norm of consumption of meat substantiated by medical science is at least 20 kilograms per year. However, Ukrainian consumers suffer of deficit of basic nutritional substances in their ration and the inadequacy of albumens of animal origin ( $30 \div 40$  % of physiological norms) they compensate by consumption of excessive quantities of carbohydrates. The existing disbalance in structure of their nutrition causes the need of search by scientists of untraditional sources of albumens of zoic origin to be used in producing of sausage products. The one of points of interest in this work is studying of possibility of use of soluble in water blood albumens, which contain globulin, albumin rich by the sufficient quantities of irreplaceable amino acids. Said substances contain also albumens of connective tissues similar by their structure to muscular albumens, which may be used as stabilizers of structure of finished products capable to retain sufficient quantities of water. Both groups of albumens are easily combined with milky albumens and products of vegetative origin and use of these materials in production of sausages permits:

- compensate deficit of albumens of zoic origin and preserve in it the proper conditions of sausage meats and emulsions,
- raise output of finished production in lesser charges of meat raw materials,
- ensure the necessary level of nutritional and biological value of meat products,
- decrease the prime cost of finished products.

The quantity of blood albumens (mostly albumens) applied into sausages may reach 20 %. Their use permits to improve their consistency and raise sufficiently output of finished products due to decreasing of losses in process of their heat treatment. Eggs and egg products are used in producing of sausages and canned products mainly in purposes of enhancement of functional and technological properties of meat systems. The one more its purpose is raising of nutritional and biological values. The quantity of egg products used in formulations of meat products is limited by 4 % because their use results in rise of prime cost and variation of organoleptic indices of quality (color, consistency) of finished products. Except of named preparations, technologists use dried milk, sodium caseinate, lactic serum,

non-fat milk in production of meat products. the main goal of their use is optimization of functional properties of modified products and raising of their nutritional value.

At the same time the porcine skin, the albuminous additive used the most often, must be carefully purified, smashed to pieces and subjected to fermentation. Moreover, its albumens are represented mostly by collagen that has the small nutritional value, what decreases the biological value of finished products, which contain such additive.

Accordingly to medical and biological norms, the men's organisms needs not the alimentary albumens proper, but in valuable albumens that are contained mainly in products of animal nature (meat, fish, eggs). However, crucial rise of demand for alimentary albumens brings to intense introduction of new principles of production of high-grade and cheap meat products character by optimum combining of ingredients of zoic origin with nutritional components that contain albumens of vegetative nature and do not contain meat.

The most effective way of progress of meat-producing industry is introduction in practice of manufacturing of new types of meat products, which contain emulsifying and jellifying compounds formed by modification of soy albumen. The products that contain such additives are classified as "healthy" foods character by optimized composition of nutritional substances as compared with traditional foodstuffs. The modern tendency of progress of market of meat products is the considerable growth of assortment of foodstuffs enriched by ingredients of cereal cultures (wheaten flour, starch, various groats). Their use permits to minimize technological losses in process of manufacturing of sausages. At the same time, use of compositions that contain fabaceous cultures permits to raise their biological value by  $19 \div 20 \%$  and the energetic one – by  $3 \div 5 \%$ . The positive results are reached also in introduction in formulations of sausages of dry powders of cucurbit, carrot and other vegetables. The classification of products used for enrichment of meat compositions by albumens is presented in Figure 2.5.



**Figure 2.5** *Forms of products rich by albumens used in meat-processing industry*

The raw materials of vegetative and zoic origin both contain nutritional albumens, which main types show the Table 2.1:

Table 2.2 gives the data on functional properties, mechanism of action and sphere of use of albuminous products in the meat-processing industry.

However, the structure of vegetative albumens differs of this of zoic ones by their nature, properties and composition. Therefore, technologists have to choose their right combination, what task complicates by the simultaneous requirement of decreasing of prime cost and rising of nutritional value and output of produced finished product. The term of "*combining of meat products*" is not criminal because the most known combined meat product id sausage. Each specialist knows that this



product contains traditionally both meat raw materials and considerable quantities of additives critically necessary in preparation of products of high quality. The substances used in this work are water, corning agents, spices and functional additives (dried whole and fat-free milks, starch, flour, egg products, blood and its plasma etc.).

**Table 2.1**

***Perspective sources of nutritional albumens***

<b>Vegetative</b>	<b>Zoic</b>
Soybean	By-products of II category
Sunflower	Blood and its fractions
Corn	Milk serum
Wheat	Buttermilk
Groundnut	Nutritional bones
Pea	Products of reprocessing of fish
Seed of cotton	Krill
Seed of tomato	
Nucleus of grape	
Lucerne	
Rape	
Tobacco leaves	

**Table 2.2**

***Functional properties, mechanism of action and spheres of use of substances applied for enrichment of meat products by albumens***

<b>Types of substances</b>	<b>Functional properties</b>	<b>Mechanism of action</b>
Flour, concentrate	Absorption of water, binding of water and regulation of activity of water	Effect exhibits due to formation of hydrogen binding
Concentrate, isolate	Assistance in formation of gels, good rheological properties of products (extent of penetration, limiting tenseness of cutoff, flexibility etc.)	Formation of albuminous matrix, i.e. structure of the product
Flour, concentrate, isolate	Cohesion, adhesion	Protein acts as the adhesive material
Isolate	Elasticity	Effect exhibits due to formation of disulfide binds in deformed gels
Flour, concentrate, isolate	Emulsifying	Formation and stabilization of emulsions of fats
Flour, concentrate, isolate	Absorption of fat	Binding of free forms of fats

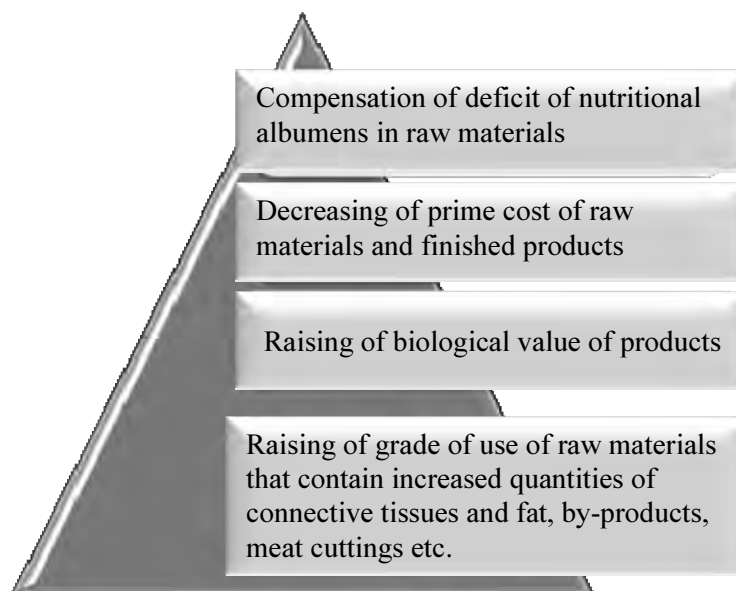
There exist three main groups of additives, which do not contain meat but used as ingredients in producing of meat products:

- filling materials represented mainly by insoluble albuminous products, cereals etc.,
- adhesive materials represented by additives soluble in water, which main function is holding of water in process of thermal treatment of products,
- emulsifiers – substances, which contain soluble albumens and applied into the mass in purposes of forming of stable emulsions.

The obligatory condition of forming of stable structure of minced meat is presence in it of enough quantity of substances that stabilize the system of meat albumens. It's especially necessary in absence of sufficient quantity of qualitative meat raw materials or in use of meat of poor quality (frozen, stored for the ;long time, this that contain big quantity of connective tissue and fat etc.).

The albuminous additives must not retard and amend passing of processes of interaction of muscular albumens with water, therefore have the property to decrease the surface tension in interfacial films and rise viscosity and stability of minced meats. That's why some additives highly soluble in water may influence negatively on their stability. Moreover, additives must be stable at elevated temperatures, assist in formation of jellylike structures and rise its capability to hold water and fat, what is necessary in choose of preparations used for replacing in formulations of part of meat albumens.

Use of albuminous preparations in formulations of meat products is conditioned mainly by factors as follows (Fig 2.6):






***Figure 2.6 Reasons of use of albuminous substances in meat compositions***

The albuminous preparations of vegetative nature are added to minced meat in purpose of replacing of part of albumens of zoic origin and have to assist in rising of viscosity of the composition, decrease the superficial tension on boundary of phases, be thermally stable at temperatures of processing of mixes and capable to form the

gel structures, as well as raise the capability of mixes to hold water and fats. However, the technologist has to use food additives only on condition of improvement of properties and betterment of quality of finished products modified by these substances.

The generalized requirements producible to albuminous preparations used in producing of sausages are shown on Figure 2.7 below:

	<ul style="list-style-type: none"> <li>— <b>high content of fat and hydrocarbons;</b></li> <li>— <b>good functional properties;</b></li> <li>— <b>considerable nutritional and biological value;</b></li> </ul>
	<ul style="list-style-type: none"> <li>— <b>non-toxicity;</b></li> <li>— <b>good organoleptic properties (absence of specific taste and color character for used raw materials);</b></li> <li>— <b>stability in storage and transportation;</b></li> </ul>
	<ul style="list-style-type: none"> <li>— <b>pH in limits of 6.0 ... 6.5;</b></li> <li>— <b>absence of negative influence on quality, nutritional and biological values of the product in preservation of grade of output of the finished product;</b></li> <li>— <b>economical expediency of use.</b></li> </ul>

**Figure 2.7 Requirements producible to albuminous preparations**

Therefore, it's better to use in these purposes soluble and active albuminous preparations (isolates, proteinates, concentrates).

The textured albuminous preparations do not conform to all listed requirements because they contain mostly the denaturated proteins, which do not dissolve in water but swell in it only. So, they are used in boiled (emulsified) sausages mostly as bulking agents and in limited quantities because of their negative, as compared with the isolated albumens, influence first on consistency of products. However, they are successfully used in producing of milled semi-manufactured products, finished products and foods proposed in public catering installations, which has to preserve the structure of raw materials used in their fabrication.

#### **Albumens of vegetative nature**

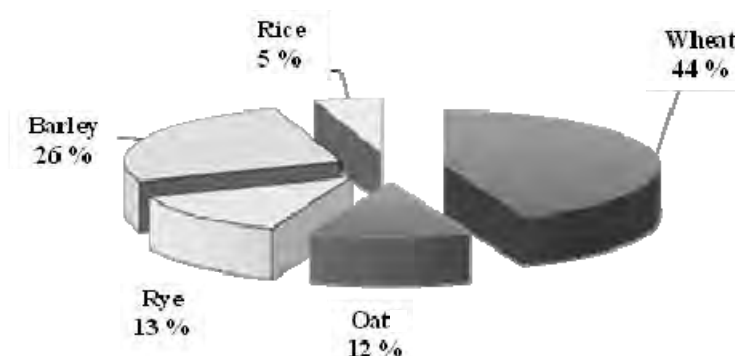
There exist two determinative factors that influence on quality of the meat product in use in its production of albumens of vegetative origin. *The first* one is clear orientation of population on use of "healthy" products, what is the result of active popularizing of information on concept of adequate nutrition, and the *second* phenomenon is that use of vegetative ingredients assists in betterment of of qualitative characteristics of raw materials, their rational use and rising of nutritional and biological value of finished products.

The most often additives applied to meat raw are treated cereals modified by different methods, which permit to improve parameters of their functional and technological properties. There exists the extensive experience of use of cereals as

ingredients of combined products worldwide. Many nations have the long history of consumption of meat in combination with floury products (pelmeny, pies, oriental dumplings, cheburecks etc.). Using their experience, scientists proved expedience of development of meat products, which contain ingredients of vegetative nature. Such practice permits to raise variety of formulations of products, improve homogeneity of dispensing of ingredients in the mass, minimize expenses and create conditions of fabrication of products of stably high quality. At the same time the composite products have good consuming properties and high nutritional and biological values. The existing technologies of producing on minced meats presume application in the mass of products that contain starches, what assists in certain rise of its capability to retain water and fats (typically  $2 \div 3\%$ ) without loss of their organoleptic properties and nutritional value of finished products.

Use of compositions that contain fabaceous products permits to increase the nutritional value of sausages by  $19 \div 20\%$  and the energetic one by  $3 \div 5\%$ . It was shown also the possibility of use in this purpose of dry powders of curcubit, carrot, beet, aubergine, apple, tomato and other vegetative cultures in producing of processed cheese and dietetic boiled sausage. The ingredients traditionally used in production of sausages are wheat flour, starch and cereals (millet, rice, pearl barley, fine-ground barley etc.). The cereal crops used in it contain set of irreplaceable albumens, which use in pure form does not permit to assimilate them in full. The one more perspective way of progress of manufactures of combined processed cheeses and sausages is use of vegetative additive of chick-pea.

For instance, the wheaten albumens are assimilated by men by 69% only, but albumens of meat contain the overall set of indispensable amino acids, therefore increase considerably the aminoacidic scor of cereals, hence their digestibility. This phenomenon is character for other corny products used in producing of composite meat products as well (Fig. 2.8).



**Figure 2.8** *Quantities of production of basic corny cultures in Ukraine in 2005-2009*

The list of such cultures and the principal positive properties of their application in composite products are given below.

**Wheat** is the most important nutritional culture in many countries. There exist many its species, but the most popular worldwide are soft and hard wheat. Grains of wheat character by high content of albumens, gluten and germs. In increasing of grade of their milling there improves the more their functional and technological characteristics of flour because of increasing of number of hydrophilic and

hydrophobic centers on the surface of particles of derived flour. The multiple investigations show that their optimum dimensions are for gluten – 20 microns, for germs – 21.9 microns. Use of flour of wheat that consists of particles of such dimensions permits to reach the best quality of resulted composite meat products. The example is meat balls, which mass contains 60% of meat м'яса and is enriched by small quantity of "wheat fibers".

The basic indices of quality of wheat flour is its humidity, which varies in limits of  $8 \div 20$  %, as well as content of gluten in it. The wheat grain raised in Europe contains  $20 \div 28$  % of gluten, and the American one – up to 45 % because of more active synthesis of albumen during the longed daytime. The residual constituents of the grain are polysaccharides capable to swell and hold small quantity of water in the mass of minced meat too.

Meantime, application of flour and similar additives in minced meat may cause both positive and considerable negative consequences. The *positive effects* of use of products obtained in their use are serving of added substances as bulking agents, decreasing of prime cost of finished products, reaching of their capability to hold the increased quantities of water and increasing of "density" of the modified system. The *negative effects* of their use are absence of rising of capability of products to form emulsions and regular structures, as well as the considerable level of pollution of products by microorganisms. The one more serious problem that arises in application of big doses of flour is forming of adherent gummy consistence and partial loss by the modified products of character meat taste.

**Barley** is one of cultures known from the earliest time of man's civilization. The barley' grain is used in production of foods, forages and auxiliary products. The most known products of their reprocessing are flour and cereals (pearl barley and fine-grounded barley). The numerous investigations of nutritional properties of barley show that albuminous complexes of its grain are character by high content of biologically active substances, especially the complex of irreplaceable amino acids and carotinoides, which quantities are analogous to those that are present in grains of other gramineous cultures. The value of aminoacidic scores of grain of barley inferiors to grains of rye and buckwheat but exceeds values of grains of oat, wheat, millet and corn.

**Rye** is the valuable nutritional and feed culture second by its value after wheat in production of bread. It is character by good winter resistance and lesser exactingness to conditions of planting as compared with wheat. The output of rye and areas under this crop are ranked as forth worldwide.

**Oat** is one of basic cereal cultures in global agriculture and takes one of basal places in structure of consumption of these cultures in Ukraine. Its grains are used in producing of groats that reserves one of leading positions by its nutritional properties among other kinds of cereals.

**Rice** is one of the most significant agricultural products in global farming. Its sowing areas and gross output of grain follows the harvest of wheat and is the second in the world among the cereal cultures. The rice' grain is used for production of groats rich by starch more of groats of other cultures and so they are assimilated by organisms much better of other cereals. There were carried out the numerous investigations of chemical and functional properties of thermally treated rice flour

subjected to thermoplastic extrusion, which permitted to develop the standardized formulations and technologies of fabrication of boiled sausages with use of such product, which optimum compositions contain about of 3% of treated rice flour and 6% of milled rice. Applying of rice flour into the sausage meat stabilizes pH, rises capability to hold water and increases viscosity of meat systems.

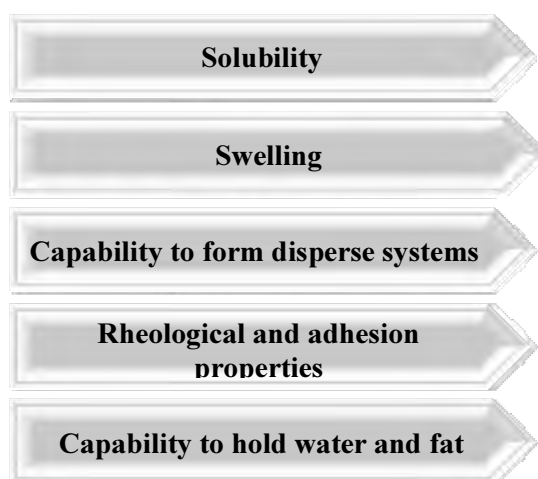
**Pea** is reach by albumens, which are the important constituent of men's ration and valuable component of forage of domestic animals. The pea' albumens contain many significant amino acids, which assist in its full assimilation. The pea grain and green mass contain significant quantities of hydrocarbons, mineral salts and vitamins and may be used also in animal husbandry as green and concentrated forage, hay, haylage and grassy powder. The albuminous product produced of grain of pea has good functional properties and contain the full set of irreplaceable amino acids. It was studied the possibility of its use producing of modified albuminous products and results of comparative analysis of functional properties of albumens in modified and initial flours of pea showed that the process of endogenic modification of albumens present in the product results in rising of their capability to assist in emulsifying of minced meat and decreases the critical concentration of forming of gels in it. The made conclusion was that use of modified pea albumens is expedient in fabrication of products produced of minced meats.

**Lentil** is the agricultural culture known from the ancient time. It was planted since the 7<sup>th</sup> millennium B.C., what witness the mentioning in the Sanscrit language. Lentil was used as the foodstuff by ancient Egyptians, Hindu and Arabs. Lentil was well known in cultures of Ancient Greece and Rome. Its grains contain up to 36% of albumens assimilated by organisms and character by good softening in boiling and taste, which surpass together with haricot by such properties all other leguminous plants. Studies of physicochemical properties of lentil flour and its compatibility with other minced meat systems showed that its capability to hold water surpasses the respective index for soy flour. The emulsifying properties and adhesiveness and effective viscosity of hydrated lentil flour are considerably more in sausage mint of other flours and so applying of such flour in model mince meat in quantities of 3÷8% results in betterment of their functional and technological properties (Fig. 2.9).

The physicochemical and organoleptic properties of boiled sausages that contain the mentioned quantities of lentil flour are analogous to respective indices of traditional meat products. The quantity of albumens in beans of lentil vary considerably dependently of kind of the plant and conditions of its planting but inferior to the respective index of soy. Despite this factor preparations made of lentil contain the full set of irreplaceable amino acids.

Grains of various cultures contain different quantities of albumens and the richest of mentioned cultures are barley and wheat (Table 2.3).

The albumens of cereal cultures may form gluten, which quality depend prime of type of grain and the best one forms the culture of wheat. The biological values of nutritional albumens define mostly two factors: balancing of amino acids contained in the grain and their digestibility. The basic hydrocarbons present in cereals are starch, gluten, sugars, hemicelluloses and pentosanes. The content of mono- and disaccharides in cereals is of 0.5 ÷ 1.5 %, and the biggest one contains grain of rye (Table 2.4).



**Figure 2.9** Functional characteristics of product of reprocessing of grain

**Table 2.3**  
*Content of irreplaceable amino acids in albumens of some cereal cultures and demand of men for these compounds*

Aminoacid	Content of irreplaceable amino acids (mg/kg of albumen)				Need of men by data of FAO, %
	Wheat	Rye	Barley	Oat	
Isoleucine	40	36	37	41	40
Leucine	75	63	72	72	70
Lysine	26	37	36	38	55
Methionine + Cystine	36	40	38	42	35
Phenylaniline+Tyrosine	80	74	89	92	60
Tryptophan	11	13	12	15	10
Treonine	28	30	34	33	40
Valine	45	46	52	61	50
Minimal score	6.473	0.673	0.655	0.691	
Coefficient of balancing of albumen	0.556	0.779	0.708	0.685	

**Table 2.4**  
*Content of basic nutritional substances and energetic values of cereal products*

Product	Content in 100 grams of product, g						Quantity of vitamins (mg/100 g)		Energetic value, kilocalories
	water	album en	fat	monosac carides	starch	gluten	B <sub>1</sub>	PP	
Hard wheat	14	13	2.5	0.8	54.5	2.3	0.37	4.94	301
Rye	14	9.9	2.2	1.5	54	2.6	0.44	1.3	287
Oat	13.5	10	6.2	1.1	36.5	10.7	0.48	1.5	250
Barley	14	10.3	2.4	1.3	48.1	4.3	0.33	4.48	264
Rice	14	7.5	2.6	0.9	55.2	9	0.34	3.82	283
Manna- croup	14	10.3	1	0.3	67.4	0.2	0.14	1.2	326
Wheat flour	14	10.6	1.3	0.5	67.1	0.2	0.25	2.2	331

The fats contained in grain hold big quantity of various compound of different chemical composition, which biggest fraction (63 ÷ 65 %) are the unsophisticated lipids. The fraction of fats is represented by 70 ÷ 85 % by triacylglycerol of unsaturated fatty acids: oleic, linoleic, and linoic, which the biggest fraction of all cereals contain grains of rye.

Farther, we'll consider characteristics of composite meat products that contain albumens of vegetative origin, which the most known and used in formulations of meat products for the long time are the soy albumens.

### Soy albumens

Soy (*Glycine max*) is the legume plant, which seed (beans) contain the unique big quantity of albumens (35-40%) and have the high biological value. The values of aminoacidic score calculated by modern methods and their biological value considered in taking into consideration of grade of assimilating of albumens show that some isolated soy albumens surpass by this parameter albumens of corn, wheat and potato by factor of 1.5 ÷ 2 and are identical by this index with albumens of beef and milk. This phenomenon permits so to replace effectively the albumens of animal nature by albumens of soy without loss of biological value of resulted composite products. Besides, soy albumens contain numerous useful nutritional and biologically active substances, what rises interest to use of this culture. The soy beans contain 3.7 ÷ 5.9 % of ash and relatively big quantities of phosphorus, iron and magnesium, as well as vitamins of "B" group, especially thiamine, choline and other vitamins of this group excluding riboflavin.

The technologies of producing of soy albumens are actively developed in direction of creation of functional soy albumens, i.e. the albuminous ingredients that are character by functional properties specific for certain spheres of their use. The experience of producing of foodstuffs accumulated during millenniums and the modern experience of introduction of modern industrial technologies of their use during last 40 years proved the possibility of fabrication of numerous albuminous products to be consumed by men directly or introduced into the meat products. The industrial production of products of prescribed chemical composition and functional properties permitted to develop the basic principles of production of large assortment of mass products, which have the refined nutritional value, medicinal and prophylactic action, as well as products used in children' dietetic and special nutrition.

The meat-processing enterprises use the types of albumens as follows.

Concentrated soy albumens (concentrates) contain up to 70 % of albumen and about of 20% of nutritional vegetative fibers (gluten). These products may be divided conditionally by two groups: *1) concentrates produced by standard technologies* character by relatively small coefficient of hydration (1 : 3) and weak capability to hold fat and form emulsions. Soy albumen concentrates are used mainly as ingredients used instead of meat and in purposes of condensing of structure of sausages, as well as *2) functional concentrates* – new generation soy albuminous products character by for basic properties: high capability to form emulsions, high



grade of hydration (1:4), intense absorption of fat and good turn for forming and stabilization of specified structures of sausage products at the stage of preparation of minced meat. The positive effect of their use as multifunctional albuminous ingredient of finished meat products is reached in influence of factors as follows:

- betterment of consistency, succulence, delicacy and outward appearance of meat products,
- decreasing of level of risk of forming of bouillon and fatty swellings in the mass,
- decreasing of content of cholesterol in finished products,
- stabilization and rising of steadiness of minced emulsions in their heating.

Use of soy concentrated albumens improves economical indices of manufacturing because of decreasing of prime cost of its production (1 part of albumen holds 5 parts of water and replaces 6 parts of meat), promotes rising of output of finished production owing to decreasing of losses in its thermal treatment and use of the most efficient technologies of use of meat raw materials of poor quality (meats character by defects of PSE and DFD, meats that contain much fat and/or connective tissue).

Soy flour is the simplest form of being of soy albumens produced in milling of soy flakes. The flour contains up to 50 % of albumens and much oligosaccharides – soluble hydrocarbons that add flour the fabaceous after-taste. The soy bean is the albuminous product the less acceptable for applying into the mince meat compositions because of very small degree of hydration (not more of 1 : 2). At the same time, it is the cheapest substance because of absence of expenses spent on extraction of pure albumens in its producing. The soy flour fabricate in one- or two-screw extruders dependently of desired structure of the product (fibers or pieces) to be used as the ingredient of the food. The technology of their producing is arranged by such mode, that the finished product has the structure and appearance of beef, pork, seafood or poultry.

Texturate is the soy powder textured as dry granules or pieces of various configuration. It contains 48 ÷ 53 % of albumens and has the dense fibrillar consistence compatible with meat. The soybean textured albumens are character by the raised capability to absorb water and hold it (up to 390 %) and fat (up to 138 %). It was certified the positive effect of this product on process of general stabilization of fat. The texturate is used mostly in producing of sausages of boiling mode of fabrication, semi-smoked and summer-smoked sausages, as well as in production of semi-finished products or boiled sausages that have the heterogeneous structure, where they promote with improvement of their structure and decreasing of content of fat. Producing the composite meat products and semi-finished meat products (cutlets, meat-balls, steaks made of milled meat) that contain soy, technologies prefer to use its textured albumens, which promote forming of such their properties as stability of structure, shape of section and optimum volume of finished product. Texturates are used the more often not only in producing of composite meat products, but in purpose of vegetarian nutrition as imitations of cutlets, mince meat etc.

Texturates are applied into the mince meats in hydrated form prepared in poring of water into the dry product and storing of the mix during 20-30 minutes

necessary for soaking into the mass of all water. One kilogram of dry product permits to obtain up to 4.5 kilos of mix used instead of meat. Experiments and investigations showed that use of textured soy albumens in producing of meat products permits to cut their price considerably and increase their nutritional value as well. Such effects are reached thanks to rising of content in the composition of proteins, vitamins, mineral substances and decreasing in mixes of content of fats in parallel. Therefore, good functional properties of soy texturates permit to cut expenses spent in manufacturing of meat products and make better their organoleptic characteristics. The flavoring feelings remain even in process of preserving, freezing and defrosting of foods that contain these ingredients. Thus, testing of beef cutlets, which contained up to 20 % of hydrated textured albumen, showed that consumers are satisfied by these products because of their pleasant taste. It's possible to add to the mix bigger quantities of texturates but this leads to certain loss of taste of meat, what phenomenon may be camouflaged by adding into the composition of various flavoring substances.

Soy isolate contains mainly the globular albumens, which combines good with the meat raw materials owing to closeness of their physical characteristics (ability to hydrate, high solubility, viscosity, stability in systems that contain the kitchen salt, stability in heating). The product is made by traditional technologies of chemical extraction of albumen out of flakes by method of its dissolution and following precipitation at isoelectric potential (potential of uncharged surface). The dried substance contains up to 90 % of albumens and does not contain dietary fibers. This substance is used as the ingredient of boiled sausages, frankfurters, small sausages and meat breads – all of the extra- first and second classes of quality, as well as in producing of semi-smoked, smoked and smoke-dried sausages, milled semi-finished products (cutlets, burgers, meat balls, mince meat, pelmenies etc.), crab sticks, canned meat products.

The positive effects of soy isolates are:

- stabilization of matrix of "water / fat / albumen",
- betterment of consistency of composite products, increasing of their succulence, delicacy and appearance,
- decreasing of level of risk of formation of bullion and fatty swellings,
- stabilizing and rising of stability of emulsions of mince meats in heating,
- increases output of finished products owing to decreasing of level of losses in their thermal treatment,
- enriches the products of modified composition by albumens,
- decreases prime cost of products (1 part of albumen holds 6 parts of water in the composition and replaces so 7 parts of meat),
- does not change taste of finished products.

Preparing milled meat, technologists add the dry soy isolate into the mixer directly onto the meat and add water at the same time to hydrate it. The soy isolate may be applied also in form of gel, which was prepared in the cutter in mixing of dry product with 6 parts of cool water during 3-5 minutes (till the product would acquire the glossy shine). To prepare emulsions that contain albumen and fat, one uses the soy isolate and any material, which contains fat (cheeks, fatty pork, its cuttings, fatty

beef, suet etc.) and cool water in ratio of "albumen : fat : water" = 1 : 6 : 6. To imitate meat raw materials in producing of semi-smoked, smoked and smoke-dried sausages, which contain soy isolate, one may prepare its granules that contain albumen and water in ratio of = 1 : 3.5.

The soy isolates are character by good functional and technological properties (Fig. 2.10):



**Figure 2.10** *Physicochemical properties of isolates of soy albumen*

At the same time the product has the pronouncedly controlled quality and is stable by its composition and properties.

*The principal purposes of use of soy isolate are:*

- retaining of content of fat in finished products,
- preparation of compositions with the poor quality meat raw materials (e.g. those that contain increased quantities of fat and connecting tissue),
- stabilization of functional and technological properties and parameters of quality of meat raw of various composition and properties, especially of meat that have the characters of PSE,
- producing of meat products of lowered energetic value that contain big quantities of albumens and decreased quantities of fat and cholesterol,
- betterment of such organoleptic properties of meat products as their consistency, appearance, succulence and delicacy,
- cutting of expenses spent in producing of meat products owing to surpassing of their capability to stabilize meat emulsions as compared with the muscular meat albumens.

The stabilizing effect of soy isolates exhibits even in application of small quantities of this preparation. The one more their advantage is remaining unchanged of their initial functional and technological properties even in case of unforeseen rising of temperature of minced meat in its cutering up to critical level ( $20 \div 25^{\circ}\text{C}$ ). The greater mass part of used soy albumens (46.2 %) spent for production of various groups of meat products falls to the share of semi-finished products and boiled sausages (including frankfurters and small sausages).

The averaged characteristics of named soy preparations taken experimentally are given in Table 2.5:

Table 2.5

**Basic characteristics of various groups of soy albuminous preparations**

Characteristic	Defatted soy flour	Traditional concentrate	Functional concentrate	Isolate
Content of albumens, %	50	70	70	90
Ability to hold fat	1:2	1:3	1:5	1:5
Ability to hold water	1:2	1:3	1:5	1:5
Influence on structure	+	+++	++++	++++

*+ - quantity of positive properties exhibited in use on structure*

Analysis of data given in the Table shows that the best abilities in holding of water and fat exhibit the functional concentrates and isolates of soy. Their use permits to produce stable emulsions character by ratios of albumens, fat and water of 1 : 5 : 5. However, to preserve the traditional quality of meat products, technologists must select the type of soy albumen that would fit the best by its functional properties to the kind of produced product and observe unconditionally all norms of recommended technologies of their preparation and application. At that, the functional concentrates are more competitive because they have the same ability to hold water and fat as the isolated albumens, but are considerably cheaper of these preparations.

Thus, the technological properties of soy albuminous preparations permit to use them in producing of almost all meat products. Realization of such possibility in coupling with the lowered price of modified foods makes the products that contain soy albumens indispensable in modern processes of manufacturing of composite meat products.

Next we show the illustrated comparative formulations used in producing of boiled sausages – the product the most popular among population. Here are given formulations of sausages produced by classical technology and sausages that contain albuminous and some other additives (Fig. 2.11).

As seen, use of soy ingredients as ingredients of meat compositions permits to increase the output of finished products and add them the numerous positive properties. At the same time their use in complex with the additives showed in Figure 2.11 (*Forsmix*, i.e. the mix of phosphates, *EM* – emulsifiers, *Mixpro* – mix of vegetative albumens) permits to expand sufficiently and vary properties of meat compositions necessary for each concrete type of production.

However, applying of soy ingredients in meat compositions may lead to undesirable changes of their color. To avoid this phenomenon, it's necessary to observe the following conditions:

- use the meat raw materials, which contain the increased quantity of mioglobine,
- add into the emulsion 0.3 ÷ 0.5 % of special preparations or preparations that contain hemoglobin (0.5 ÷ 1,0 % of mass of meat material) after its mixing with water in ratio of 1:1,
- use the sodium ascorbate (0.05 %) to increase the speed of formation of nitrogen oxides.

**A) Classical technology of producing of meat products (group of boiled sausages):**



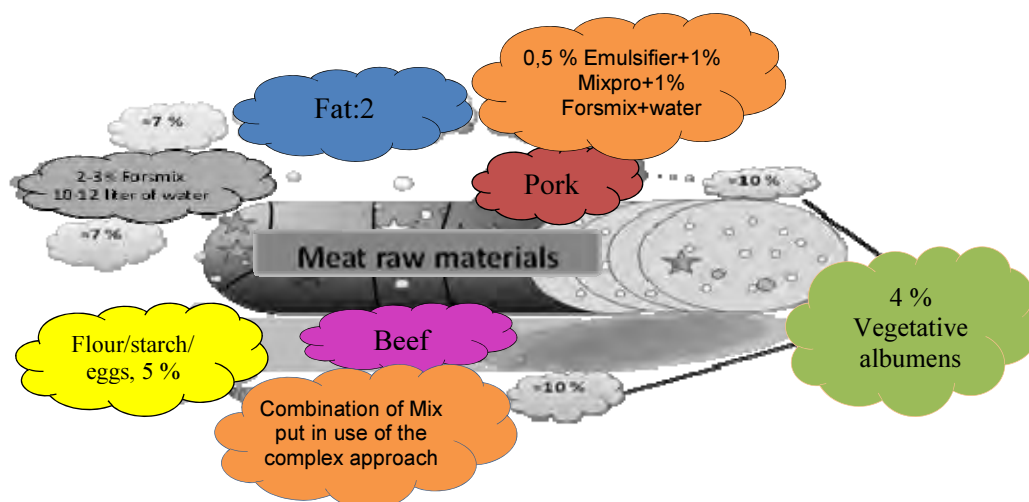
OUTPUT (average) 106-108%

**B) Producing of sausages that contain vegetative albumens (isolate, concentrate):**



OUTPUT (minimal)-120 % + decreased prime cost

**C) Producing with use of mixes that contain phosphates, vegetative albumens, emulsifiers and spices**



OUTPUT (minimal -130-140 %+ decreased prime cost

**Figure 2.11 (A,B,C) Technological solutions used in producing of boiled sausages**

### **Animal proteins**

Technologists that operate in producing of meat products are interested in latest years the more by use of animal proteins, for they combine with the meat raw materials the best. The albumens used in these purposes the most often are:

- water-soluble albumens (albumins, globulins etc.) produced on base of plasma of blood,
- albumens soluble in alkaline environments (collagen, elastins) produced of porcine skin, trimmer etc.

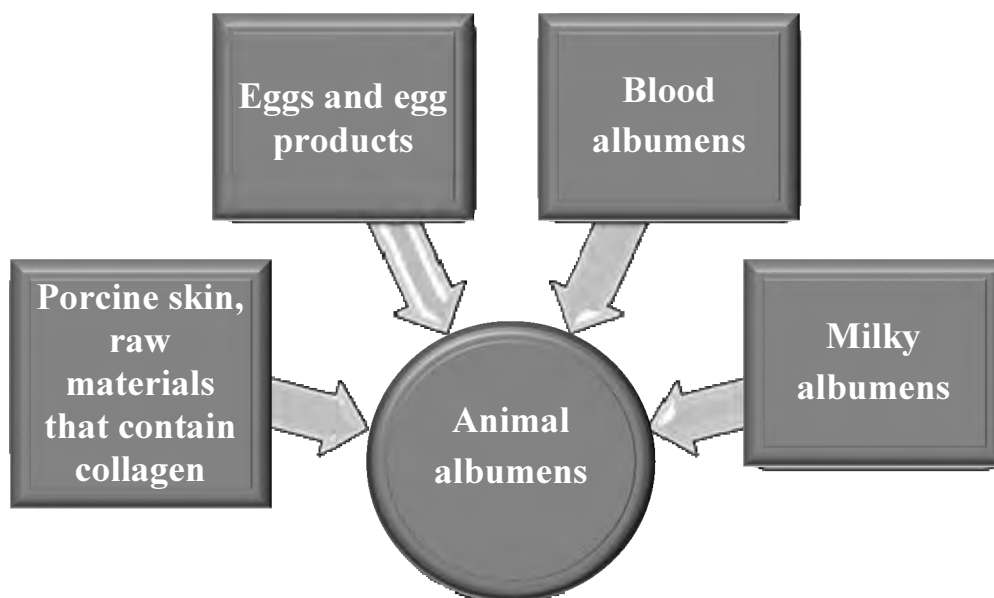
The animal albumens are closely similar by their properties to muscular albumens and are good emulsifiers and stabilizers of structure capable to hold big quantities of water and fat. Both groups albumens are capable to combine good with albumens of vegetative and milky nature.

*Use of animal albumens in producing of sausages permits:*

- compensate small content of albumens in meat raw materials and guarantee reaching of necessary properties of mince meat and emulsions,
- increase output of finished products in conditions of decreasing of quantity of used meat raw,
- produce production of stably high quality,
- raise nutritional value of meat products,
- decrease prime cost of finished products.

Choosing and using animal albumens, same as in use of any other additives, one has to study carefully recommendations of their producer. Generally, the sphere of use of animal albumens is broader as compared with vegetative albumens. They are more universal and their structure combines better in production of sausages with structure of meat raw materials.

The main sources of animal albumens are raw materials, which contain collagen (Fig. 2.12):



**Figure 2.12** *Additives of group of zoic albumens*

Dairy albuminous preparations are used in producing of meat products for optimization of functional characteristics of compositions in process of manufacturing and rising of their nutritional and biological value. Most of such products contain the water-soluble albumens (lactic albumins and lactic globulins) and have the high capability to hold water and form emulsions and foams. The dairy albuminous preparations apply in compositions both in fresh (whole milk, skimmed milk, cream, dairy serum, casein preparations), and concentrated form (dried whole and skimmed milks, concentrates of albumens of serum, dairy albumin, nutritional casein, sodium caseinate).



Producing sausages, technologists use natural (liquid) dairy albuminous preparations in process of preparation of emulsions of meat, which are added then to cuter instead of water (in 5 % excess over its quantity by regulations) and dry components are applied into the meat emulsions together with water after their swelling in form of suspensions, prepared emulsions and gels.

The nutritional value of dry milk is in close coincidence with meat. Moreover, this ingredient effects in meat compositions as the effective emulsifier (Table 2.6):

*Table 2.6*

*Compositions of dry milk and casein*

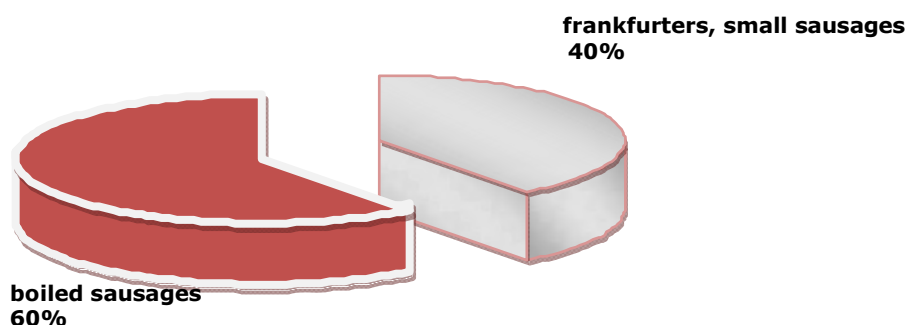
Components	Content in albuminous additive, %		
	skimmed milk	whole milk	casein
Lactose	50.0	40.0	88-91
Albumens	38.5	25.7	0.4
Fats	1.0	26.0	0.5
Ash	8.0	6.5	4.5
Water	2.5	1.8	4-6

The emulsifying properties of skimmed dry milk and casein (one of types of diary albumens) and its derivatives – caseinates – are extensively used by manufacturers of sausages. Especially, dried milk is used in producing of boiled sausages and in segment of expensive meat products of extra- and first classes. The one more type of ingredients used as substitutes of meat are **diary albuminous** mixes. Unlike dried milk, they contain much more albumens of serum, what gives finished products the pronounced taste and assist in forming of dense albuminous matrix, what improves texture of the product. However, use of emulsifiers of dairy nature leads to maceration of finished products. So, the they are used mainly in producing of pastes and other products used for spreading on other foodstuffs. Because of good solubility in water, dairy albumens may be used as components of brines, particularly those that are used in corning of meat of birds. Because this ingredient is used extensively in producing of boiled products, we use this group of foods for illustration of structure of distribution of dry milk in the market (Table 2.7, Figure 2.13):

**Table 2.7**

***Amounts of dosing and capacity of the market of dried milk used in producing of some types of meat products***

<b>Type of finished product</b>	<b>Output for the state for 01.01.2010, tons</b>	<b>Dosing, %</b>	<b>Capacity of the market, tons</b>
Frankfurters, small sausages	61435	до 5	3761
Boiled sausages	102134	до 5	5698
<b>Total capacity of the market, tons</b>			<b>4729.5</b>



***Figure 2.13 Ratio of use of dried milk in producing of various types of meat products***

The one of albumens present in this system is collagen capable to form after its thorough crushing the watery-albuminous suspensions. However, use of porcine skin may be done only after of careful and long-continued cleaning because its quality has to conform to strict sanitary and hygienic norms of cleanness. This requirement restricts considerably the sphere of use of this material. Besides, albumens of porcine skin are of small biological and nutritional value what lead to decreasing, as a rule, of nutritional value of finished products that contain this ingredient as compared with the porcine-free products of the same composition. If the skin was grained of bristle by method of scalding but not by mechanical trimming, the resulting emulsion contains grains even in fine crushing. The explanation of obtaining of this result is that the albumen contained in skin coagulates in process of thermal treatment, so its particles do not swell and remain hard in the following processing of the mix.

The collagenous albumen is character by high solubility, hence used wide in producing of foods as the component that improves quality of finished meat products because of betterment of their consistency and fashion. Its use permits also to rise the economical indices of manufacture owing to decreasing of prime cost of products (1 part of albumens holds in compositions 6 ÷ 8 parte of cooled water, hence replaces 7 ÷ 9 parts of meat raw), decreasing of losses of mass of minced meat in its thermal treatment and permits to use in manufacturing the meat of poor rating (meat that has defects of PSE and DFD, meats that contain big quantities of fat and connecting tissue).

Albumens of blood plasma is the one more component in producing of meat products. They possess by such significant functional and technological properties as



solubility, capability to hold water and form emulsions, capability to form foams and permit to hydrate and dehydrate the technological mixes.

Blood of heavy beasts contains up to 17 % of easily assimilated albumens. The albuminous fraction of blood of heavy beasts consists of blood albumens and molding elements, and its plasma contains up to 7 % of albumens. The dominant part of blood albumens relates to class of albumens and globulins rich by indispensable amino acids digested easily by enzymes of gastrointestinal tract. Albumens are the determinative substances, which possess by the important functional and nutritional values because they are good emulsifiers. Thanks to this property, they are used in producing of pastes, frankfurters, boiled sausages and meat breads. Applying of plasma albumens mainly albumens) in formulations of listed products in quantities of  $1 \div 3$  %, and in other products in quantities of  $4 \div 20$  % permits to rise considerably the output of finished products owing to betterment of their consistency and decreasing of losses in thermal treatment.

Eggs and egg products (vitellus and protein of eggs, egg powder) are used in production of sausages and canned products mainly in purposes of betterment of functional and technological properties of meat systems and, in some cases, rising of nutritional and biological values of foods, which the most important are:

- high solubility,
- capability to form foams and gels,
- high capability to form emulsions.

Proteins of egg albumens are capable to hold cations and interact with detergents, what assist in rising of thermal stability of meat systems. Such capability intensifies in presence of small quantities of table salt.

Despite the positive effect of presence of egg products in meat systems on their functional and technological properties, quantities of added eggs (mélange) used in practice do not exceed  $1 \div 4$  % because of their high cost and negative influence of egg protein on organoleptic characteristics (color, consistency) of finished products.

Technologies used in producing of meat products do not demand to use the albumens of high quality. Therefore the egg powder produced by Ukrainian poultry farms is used in production of sausages and other meat products in big quantities (Table 2.8, Fig. 2.14).

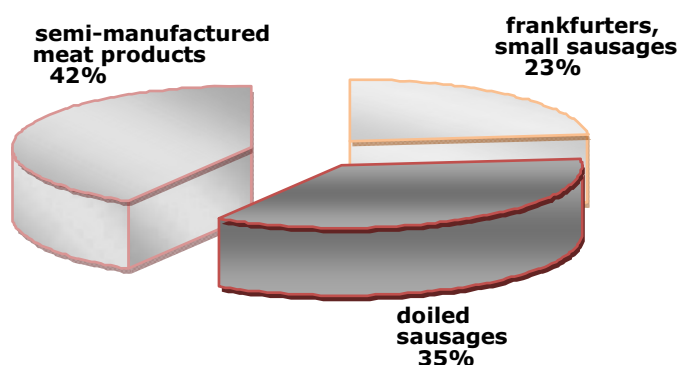
Dietary fibers are the complex hydrocarbons not assimilated in the gastrointestinal tract of men. They are contained in vegetables, fruits, coating of grains of wheat, rye, rice and other plants. The grade of significance of consumption of dietary fibers, which by their nature are the structural substances that consist of cellular walls of grain, hemicelluloses, pectic substances, lignin, all capable to form complexes, is the topic of intensive discussions among scientists because of numerous causes.



**Table 2.8**

***Dosing and capacity of Ukrainian market of egg products used in producing of certain types of meat products***

Type of finished product	Production capacity for the state of 01.01.2010, tons	Dosing, %	Potential, tons
Frankfurters, small sausages	61435	up to 1	0 ÷ 752.2
Boiled sausages	102134	up to 1	0 ÷ 1139.7
Semi-manufactured meat products	73302	up to 1.6	0 ÷ 1331
<b>Capacity of the market, tons</b>			<b>1 611.5</b>



***Figure 2.14 Ratio of quantities of egg products spent in producing of various types of meat products***

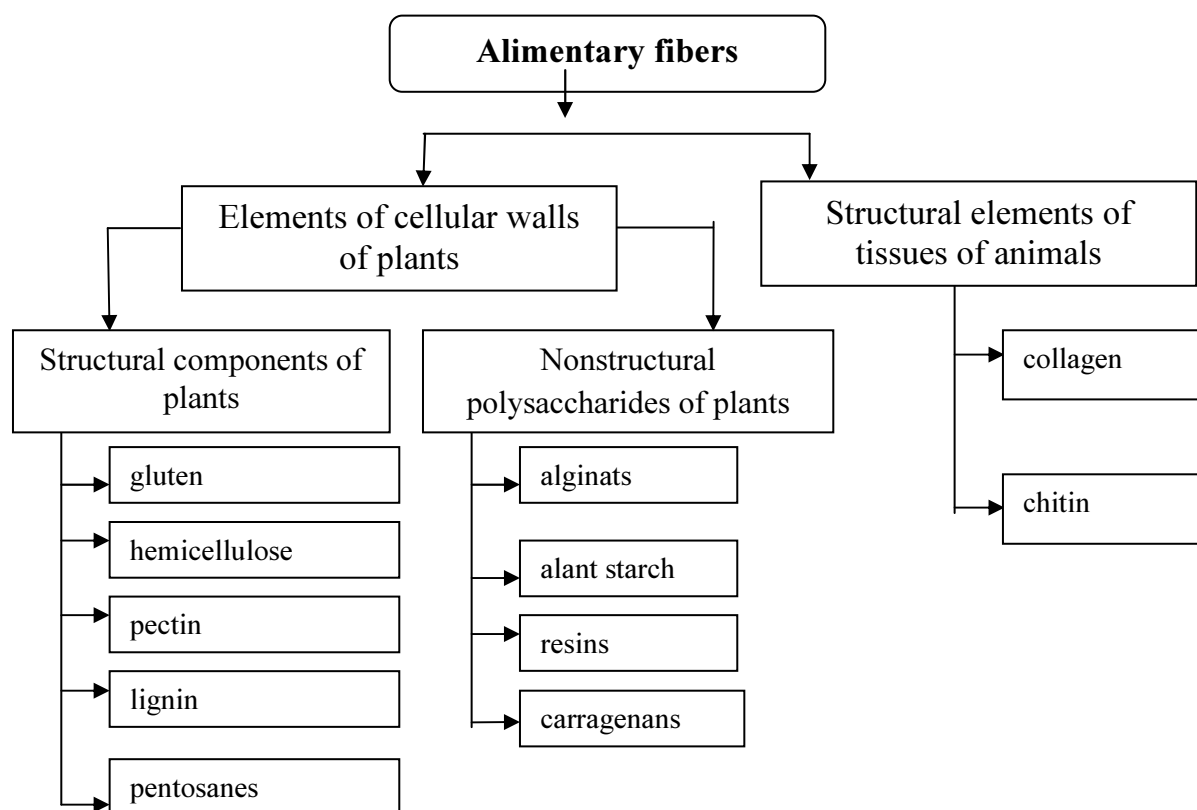
## **2.2 Dietary fibers**

The *first* one is that consumption of coarse-fibered meal decreased considerably during the last 100 years. Thus, it was of 13.2 grams per day in 1879, but was reduced now to 5 grams because of decreasing of quantities of consumed products made of coarse milled grain, vegetables and, partly, of fruits. The deficit of dietary fibers in food leads to rise of quantity of various sicknesses, especially to genesis of stones in kidneys, diabetes, and illnesses of bowels, heart and tubules. Meantime, consumption of sufficient quantities of dietary fibers permits to heal constipation, diverticulum of bowels, hypercholesterolemia etc. there exist also the data on favorable action of dietary fibers on passing of processes of metabolism of hydrocarbons in gastrointestinal tract of men of good health and diabetic, sorption of cations, choleric and volatile acids.

The *second* cause of rapt attention to problem of consumption of dietary fibers is augmenting of volumes of produced “artificial” food, spreading of assortment of products that contain the components that intensify their flavor and taste. The role of dietary fibers In these cases is forming of structure of foods that assists in its better digestion. The correct choose of type of dietary fiber or formation of appropriate nutritional composition permit to develop formulations of foods enriched by fibers character by pleasant taste.

The *third* cause is accomplishing of comprehensive research, which have the purpose of introduction in rations of men of insufficiently studied yet sources of vegetative raw materials, which are the by-products of processes of reprocessing of grain (its scalping), fruits (apple', pear', grape' and other residues of squashing), vegetables that contain the considerable quantities of dietary fibers, polysaccharides (pectins, xylans, cellulose) and products of their hydrolysis, disoxidation and oxidization, as well as products of microbiological synthesis.

Presence of hemicelluloses and pectins adds the albuminous substances one more property – they influence positively on processes of digestion. Dietary fibers are by their nature the complex hydrocarbons contained in cellular walls, which are not digested in gastrointestinal tract of men. There exist some types of their classification and one of such systems is presented on Figure 2.15.



**Figure 2.15** *Classification of dietary fibers*

The polymers may be subdivided conditionally by their structure by the homogenous (cellulose, pectin, lignin, alginic acid) and heterogeneous (lignin of cellulose, hemocelluloselignin etc.). Dependently of type of raw material used in producing of fibers, they may be subdivided as such that were produced of inferior plants (seaweed, fungus) and higher plants (cereals, grass, wood). Subdivision by physicochemical properties gives classes of soluble in water (pectins, gums, soluble hemicelluloses,  $\beta$ -glucans, carragenans, laminarin, pululan, lignin, stable starches).

The cellulose has the antioxidant properties, what influences on process of stabilization of fatty component of sausages. Such its property is necessary in producing of products made of meat obtained in boning of birds and meat products of prolonged term of storage including those that is stored in frozen state. The important

sources of its producing are cases of grain of wheat, rye, rice. The cellulose extracted from carrot, wheat and lemons may be used in formulations of certain meat products as substitutes of basic raw materials. The tasty traces of lemon, beet and carrot cellulose assist in forming of the harmonic taste of meat and liver pastes and liver sausages.

The wheat scalping obtained in treating of grains of various kinds have approximately same quantities of dietary fibers. They contain about of 0.8 % of pectin, 26 % of insoluble hemicelluloses, 8 % of cellulose, 4 % of lignin. The smallest quantities of dietary fibers contain scalping produced of oat. The corn scalping are rich by hemicelluloses. The content of dietary fibers in flour depends of grade of milling of grain and sieving of flour. Vegetables, excluding their fabaceous kinds, contain less of 5% of dietary fibers represented mainly by hemicelluloses. Such fibers contain less cellulose and only small quantities of lignin. The scalping of soy are rich by pectin (up to 6.9 %). Polysaccharides of hemicelluloses are formed mainly of pentoses and uronic acid, what assists in their high cationic activity (Table 2.9).

**Table 2.9**

***Content of dietary fibers in some products of reprocessing of cereals***

Product	Content of dietary fibers in dry product, %	Components of dietary fibers, %			Components of hemicellulose, %		
		hemicellulose	cellulose	lignin	hextoses	pentoses	uronic acid
White flour (72%)	3.5	80	19	1	80	11	9
Dark flour (90-95%)	8.7	72	18	10	44	45	11
Unscreened flour (100%)	11.5	74	20	6	38	49	13
Treated scalping	30.6	75	16	9	32	57	11
Coarse scalping	43.0	74	18	7	19	69	12
Oat groats	7.2	83	12	6	62	26	12
Rice	2.7	78	22	Слїди	82	9	9
Rye	12.7	71	11	1.3	46	45	9

Fruits contain lesser quantities of dietary fibers as compared with vegetables. Their biggest constituent parts are polysaccharides of hemicelluloses rich by pentoses and uronic acid. Some fruits (e.g. banana) contain also big quantities of cellulose (Table 2.10).

Dietary fibers are not food additives and are not the ingredients that have be declared by the "E" index in its presence in the product. Such substances are put in Europe in the label that lists ingredients contained in the foodstuff. Such information confirms that the product provides in its consumption the numerous healing and prophylactic effects and is enriched by ballast substances useful for organism. The dietary fibers contain polysaccharides of hemicelluloses, xilans, xiloglucans, arabinates, various galactans and mannans but not mannose. Processes of extraction

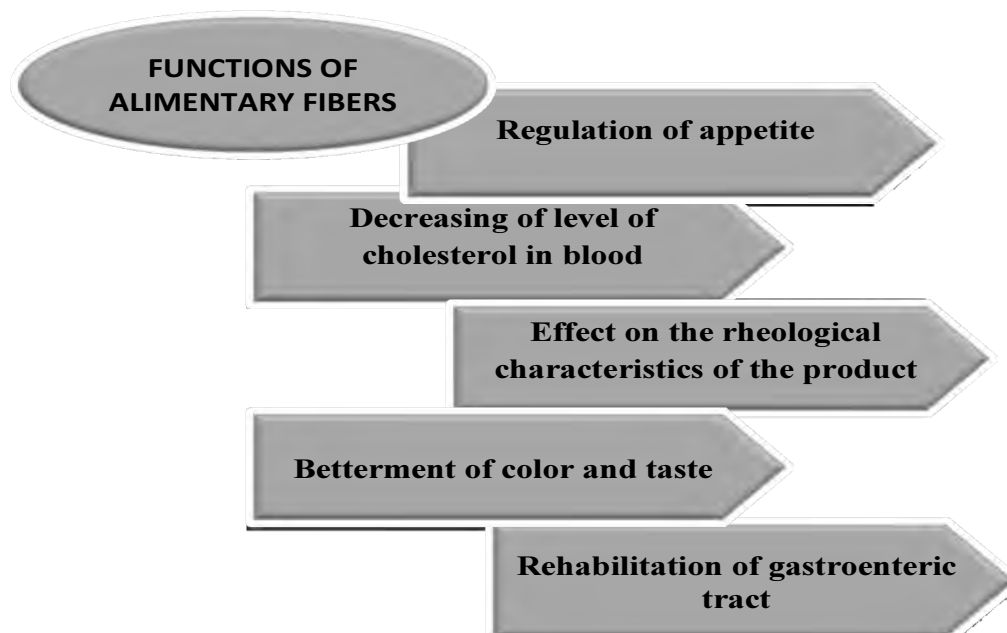
of dietary fibers from raw materials in use of solutions of alkaline metals and results obtained in their acidic hydrolysis in soft conditions cannot give the reliable information on nature of the fiber because of differing of mechanisms of their digesting of those that occur in digesting of vegetative food in gastrointestinal tract of mammals. Meantime, the concrete properties of dietary fibers depend of structure of constituents that form their polymeric structure. Therefore to obtain information on their structure, experimenters use in most cases the method of their heating in presence of surface-active agents.

**Table 2.10**

***Characteristic of dietary fibers of some fruits and berries***

Fruits, berries	Quantity of dietary fibers, g/kg		Components of fibers, %			Components of hemicellulose, %		
	Raw mass	Dry mass	Hemicellulose	Cellulose	Lignin	Hexoses	Pentoses	Uronic acid
Fresh apples	1.4	9.2	66	33	1	20	35	44
Bananas	1.8	6.0	64	21	15	54	19	27
Cherries	1.2	6.7	74	20	6	25	35	39
Grapefruits	0.4	2.4	78	9	13	17	43	40
Oranges	1.9	13.7	71	14	15	19	37	43
Pears	2.4	14.7	54	28	19	20	46	35
Plums	1.5	9.3	65	15	19	28	46	25
Strawberries	2.1	19.1	46	16	38	22	33	45

The principal functions the dietary fibers discharge in producing of meat products are shown on Figure 2.16:



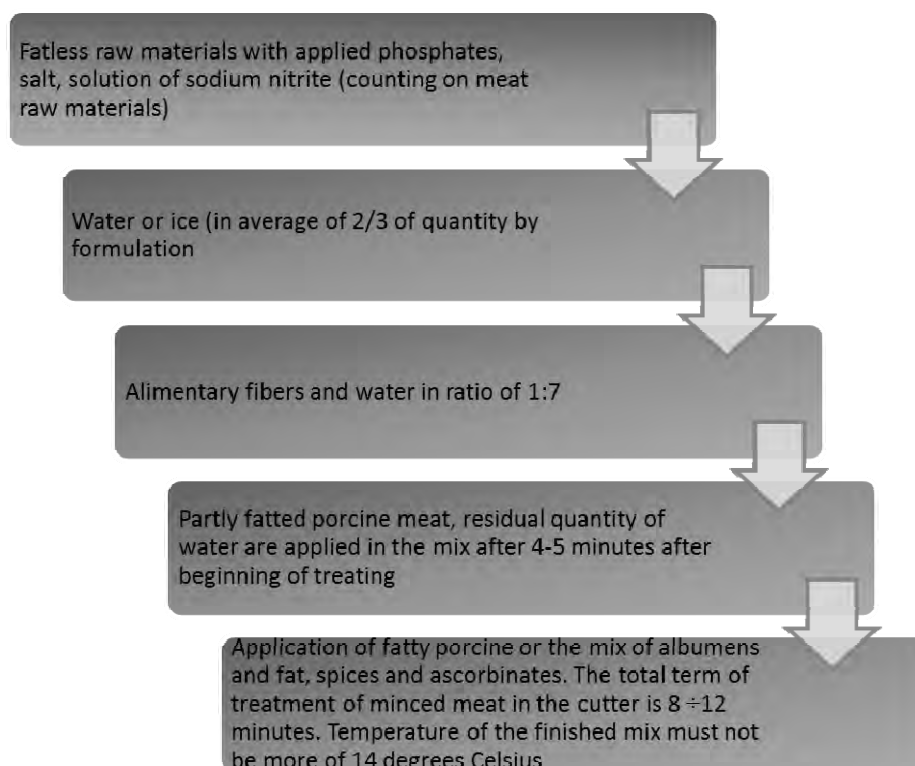
**Figure 2.16 Basic functions of dietary fibers**

Tests showed the positive effects that originate in use of dietary fibers produced in reprocessing of grains of cereal crops as components of combined meat

products. Their presence permits to raise the nutritional and biological value of products and stability and uniformity of mass of modified compositions, assists in simplifying of work in development of their new formulations, minimize losses in process of manufacturing. Therefore, the amalgamated effect of said factors gives technologists the power to develop the product of stable quality.

As the example, one may inform that there was development the series of semi-smoked sausages that contain  $2 \div 5$  % of wheat, rice, barley or oat flour, as well as the numerous kinds of boiled sausages, frankfurters and small sausages, which contain up to 15 % of hydrated groats (milled barley, oat, pea) instead of meat raw materials. Such products are character by stable quality and good nutritional properties. The same quantities of starch and wheat flour may be applied into the minced bacon products. There are carried out also works in development of technologies of producing of various combined meat products, which would contain the risen quantities of dietary fibers. Scientists developed also formulations of pastes and minced semi-finished products, which contain  $6 \div 10$  % of rice and corn flour. There was developed also the new type of anti-anaemic sausage, which consists of beef, liver, blood plasma and up to 10 % of wheat flour. Results of investigations show that the biological value of this product is 100 % and level of assimilation is 94.2 % as compared with the standard product (doctor's sausage). The ingredients of vegetative nature are used in many cases instead of meat in various products, which were produced in earlier time exclusively of meat raw. The example is meat-balls that contain about of 60 % of meat and some "wheat fibers".

Dietary fibers are applied into the meat compositions in certain fixed order (Fig. 2.17):



**Figure 2.17 Order of application of dietary fibers**

The carrot, wheat and lemon celluloses are applied into the formulation of the product as the substitutes of meat. their capability to absorb the considerable quantity of water permits to use them as stabilizers of structure of minced meat in producing of products that contain hydrated albumens of vegetative and zoic nature and their emulsions. The cellulose possess by the antioxidant effect in relation to fats recommended to use in sausages. This property is especially important in fabrication of products made of meat of birds obtained by method of mechanical boning and products of prolonged term of storage, including those that are stored in frozen state.

Use of cellulose extracted from beet in milled in the meat semi-manufactured products decreases losses in process of their frying upon 50 % as compared with this component free compositions. At the same time the fried products retain their succulence and nice appearance. It's expedient to use also dietary fibers in producing of the wide spectra of liver sausages and pastes, as well as the canned meat products. The tasty nuanced of lemon, carrot and beet celluloses assist in obtaining of harmonic taste of meat and liver pastes, liver sausages, and permit to decrease at the same time their prime cost. Applying of as small quantities of cellulose as 0.2 % results in considerable rise of capability of the composition to hold water and because water accumulates in capillaries of cellulose, the consistency of the mix remains unchanged. Stability of the product ensures owing to high emulsifying properties of cellulose added in pastes, blood-puddings and liver sausages, where this substance may fully replace emulsifiers used in this products traditionally. The wheat cellulose is added usually in mince pastes made of coarse-milled meat products, and senses of its adding are decreasing of caloricity of finished products, rising of viscosity of the mince meat, what permits to stabilize the process of formation of semi-manufactured products of milled consistency. Table 2.11 gives information on some properties and recommended quantities of cellulose to be added in some compositions.

**Table 2.11**

***Organoleptic and functional properties of vegetative celluloses in meat products***

Composition and characteristic of the product	Type of cellulose				
	soy	wheat	oat	apple	orange
<b><i>Organoleptic characteristics</i></b>					
Color	white	white	white / yellow	light brown	yellow orange
Taste	neutral	neutral	neutral	apple	bitter
Mass part of dietary fibers, %, including the soluble ones	65 12	98 3	96 3	60 11	36 40
mass part of albumens, %, not less of	17 ÷ 20	0.4	3.0	4.6	6.0
<b><i>Functional</i></b>					
Capability to hold water	1 : 9÷10	1 : 6-8	1 : 5-6	1 : 8-10	1 : 10-15
Capability to form fatty emulsions	1:8-10	1:5	1:4	1:5	1:5
Sphere of use	Meat, fish, milk, confectionary industries, producing of frozen semi-manufactured products, producing of macaroni and canned products culinary, vegetable calf, imitating products			Confectionery and milk industries, producing of canned products, sauces and drinks	

### 2.3 Hydrocolloids

Producers of meat products operate presently in conditions of supply of raw materials of unstable quality. Therefore, they are forced to use in their work the food additives and ingredients, what has to improve so the capability of compositions they produce hold water, make better the taste of finished products and raise their output. The one classes of additives used in it since 1980-s are *hydrocolloids* – polysaccarides having to stabilize and improve the structure of meat compositions. Such class additives used the most often includes starches, gums, agars, pectines and carrgenans.

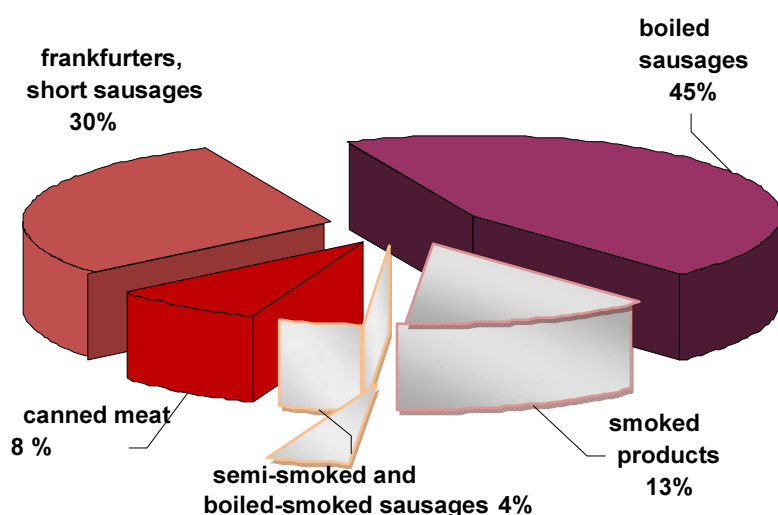
The class of hydrocolloids represents itself the group of hydrophilic high-molecular compounds, which unlike zoic albumens, may dissolve partly in water to form highly viscous solutions and stable stiff gels of minced meats.

Hydrocolloids are used in purposes of thickening of watery solutions, forming of gels, stabilizing of foams, emulsions and suspensions, retard or even prevent crystallization of ice and sugar, intensifying of flavor of products etc. The capacity of the market and proportions of their use in producing of some types of meat products are given in Table 2.12 and Figure 2.18.

**Table 2.12**

***Capacities of market and dosing of hydrocolloids in producing of various meat products***

Type of finished product	Capacity of Output for the state of 01.01.2010, tons	Dosing, %	Potential, tons
Frankfurters, short sausages	61435	up to 0.6	451.3
Boiled sausages	102134	up to 0.6	683.8
Smoked products	29920	up to 0.6	201
Semi-smoked and boiled smoked sausages	43520	up to 0.15	65.5
Canned meat	15102	up to 0.1	124
<b>Capacity of the market</b>			<b>1525.6</b>



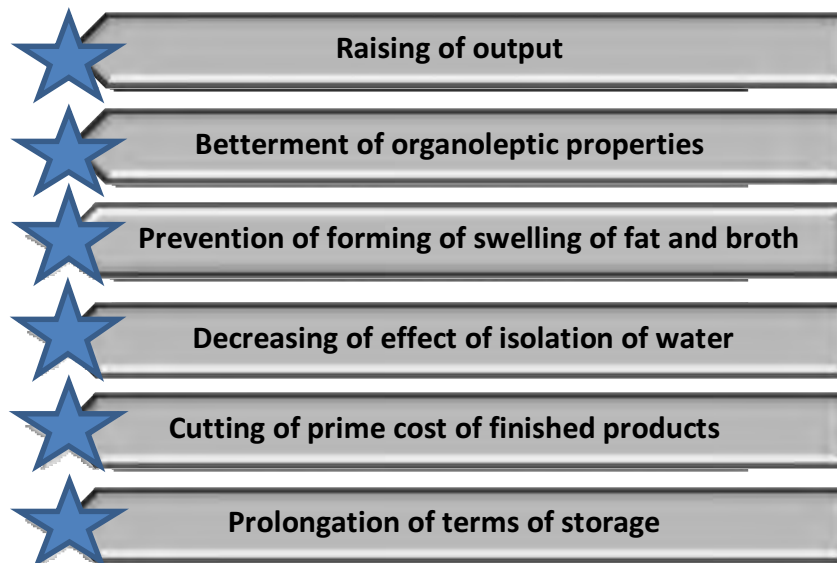
**Figure 2.18** *Capacity of market of hydrocolloids used in producing of some types of meat products*

The principal purpose of adding of hydrocolloids is forming of required structure and organoleptic properties of finished products. Their use influences



positively on processes of digestion and removal of cholesterol and toxic substances out of organism.

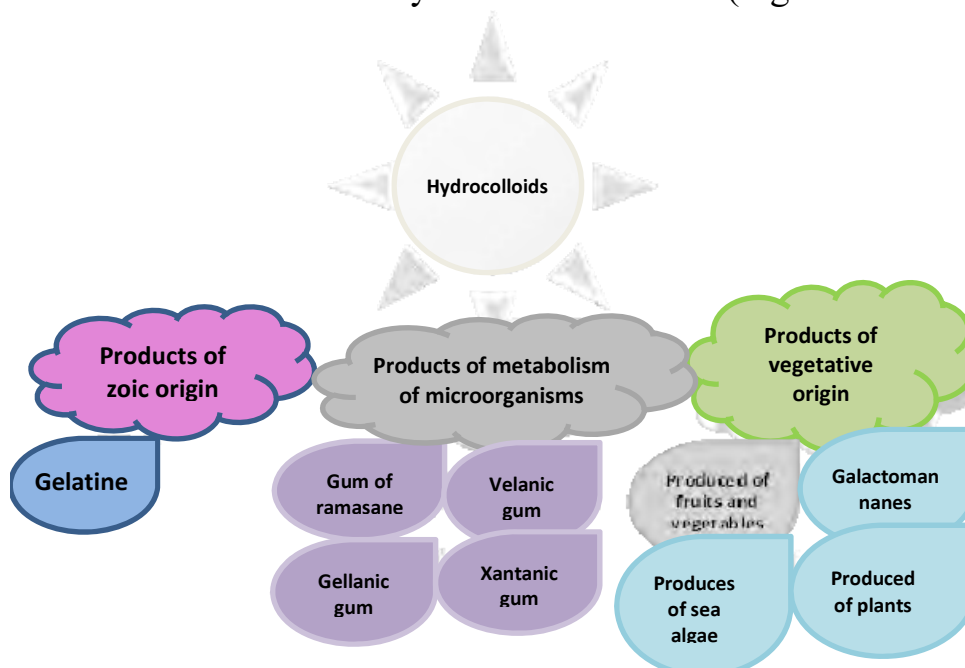
Use of hydrocolloids in purposes of stabilizing of meat systems permits to reach the effects as follows (Fig. 2.19):



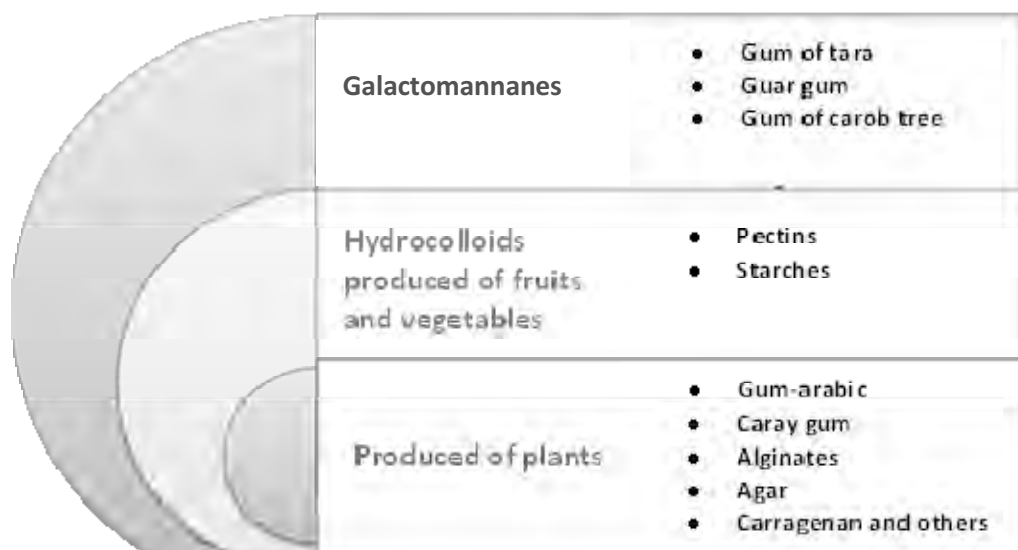
**Figure 2.19** *Functions of hydrocolloids in meat products*

The polymeric molecules of hydrocolloids may roll in balls and form so the three-dimensional structure that form the intermolecular bonds in heating. Fixing of their relative position forms the volumetric structure, which fix water in its intermolecular spaces. The phenomenon of forming of three-dimensional structure leads to densifying of the solution and forming of gelatinous structure. Hydrocolloids do not influence on properties of meat albumens and the principal purpose of their use is fixation of water in the mass.

Hydrocolloids are characterized by clear classification (Figures 2.20 and 2.21):



**Figure 2.20** *Classification of hydrocolloids by their nature*



**Figure 2.21** *Hydrocolloids and gums produced out of vegetative raw materials*

The example of hydrocolloid of zoic origin is gelatin and hydrocolloids produced of plants may be subdivided conditionally by three groups as follows:

- *galactomannans* (extracts of seed of plants), e.g. gum of carob tree, guaric gum, gum of tara tree,
- *the plants proper* (sea algae), agar, furcelan, gum-arabic, alginates, carragenan etc.,
- *hydrocolloids produced of fruits and vegetables*: starches, pectins.

The hydrocolloids produced in microbial syntheses are character by the wide spectrum of properties and the most of such substances have the unique structure. The examples of such products are:

- xantanic gum,
- velanic gum,
- gelanic gum,
- gum of ramazan etc.

The hydrocolloids used typically in producing of meat products are starches, gelatin, carragenans and some kinds of gums.

### **Gums**

The class of *gums* includes products obtained from insections and fractures of various plants, otherwise in processes of their industrial reprocessing, as well as the polysaccharide-based preparations obtain in result of vital activities of microorganisms. The examples are xantanic gum (the only polysaccharide produced industrially as the result of microbial biosynthesis carried out in anaerobic



conditions); gum-arabic gum obtained in process of reprocessing of seed of plant of *Ceratonia Siligua*. These substances do not digested in gastrointestinal tract of men, therefore they may be reckoned as the safe ballast substances.

There are not the prescribed norms of round the clock consumption of gums and their quantities applied in meat products depend of technological purposes. The basic missing of their use is regulation of viscosity of minced meats and stabilization of consistency, plasticity and texture of finished products. Gums are used also in purposes of stabilization and plasticization of albumen and fat emulsions and their application does not change technologies of their preparation. The gums are added at initial stages of composing of minced meat synchronously with adding of some water or ice. Viscosity of mixes that contain gums decrease in conditions of intense treating of the product, e.g. in its cutering. However molecules of gums quickly restore the initial structure of the mix after cessation of such treatment, what secures the high viscosity of the mince meat systems. The finished products that contain gums are character by better stability of structure in processes of their thermal treating and following storage.

One has to take into consideration that products that contain gums may form in process of their producing films on the surface of added aqueous phase. To exclude such possibility, one has to use the high-speed mixing equipment (more that 3000 rpm.). besides it is expedient to mix gums with other free-flowing substance used by formulations, what permits to enlarge the distance between particles of the mix and prevent their agglomeration.

All gums are the substances of class of polysaccharides. However, their properties and chemical compositions vary appreciably. For instance there exist gums, which dissolve in water completely (Arabian gum), gums character by small solubility but capable to swell considerably (gums of plum, cherry etc.) and insoluble in water (gums of oleaster, tragakant). It's necessary to describe in details properties of the most often used gums – the gum of xantane.

*Gum of xantane* is the substance of white of cream color produced in form of powder soluble in cold and hot water but does nor soluble in most of organic solvents. The character feature of its use in industry is those that it is capable to regulate rheology of aqueous solutions. Solutions of xantanic gum are more viscous as compared with solutions of other polysaccharides even at its small concentrations, what permits to recommend use it as the high-performance thickener and stabilizer. Because of high pseudoplasticity, solutions of xantanic gum are not thixotropic and the initial viscosity of its solutions restores fully just after cessation of influence of exterior influences. Its solutions are very stable at various values of pH and are equally stable both in acidic and alkaline solutions. Thermal stability of xantanic gum surpasses, as a rule, the respective index of solutions of other polysaccharides soluble in water.

The commercial use of gum of xantane is based on maximum use of naturally occurring processes of fermentation occurred in solutions, which contain hydrocarbons, compounds of nitrogen and alimental salts. After finishing of process of fermentation, the bouillon must be sterilized. The finishing stage of the process is deposition of xantanic gum from the solution and its drying and grinding.

In meat industry, the gum of xantane is used in producing of pastas and sauces, as well as is the component of mixes that stabilize the mass of sausages (Table 2.13).

**Table 2.13**

***Functional properties, dosing and spheres of use of gums in food industry***

<b>Sphere of use in food industry</b>	<b>Content in the mix, %</b>	<b>Functional properties</b>
Meat products	0.1-0.5	Holds water, improves structure
Frozen meat products	0.05-0.2	Ensures thermal stability in freezing
Sauces	0.1-0.5	Ensures small outflow and good adhesion
Milk products	0.2-0.5	Stabilizes emulsions
Products of small fatness	0.1-0.5	Improves texture, stabilizes products

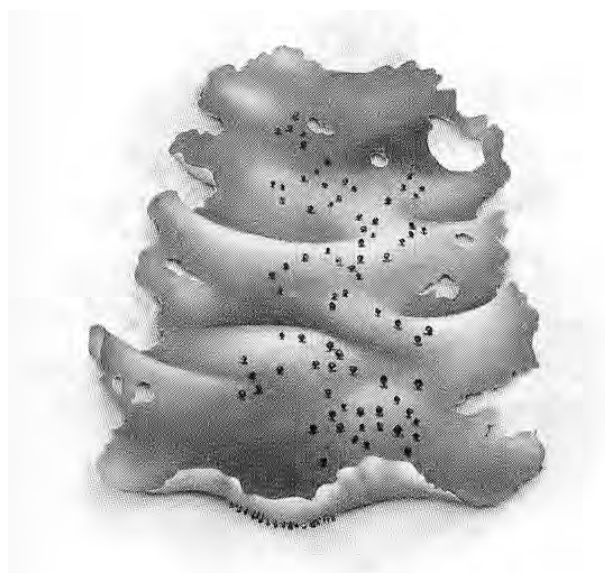
The xantanic gum is used also in producing of dietetic products, where holds water, improves their texture and organoleptic properties without rising of content of calories because of its very small caloricity (0.6 kilocalories per gram).

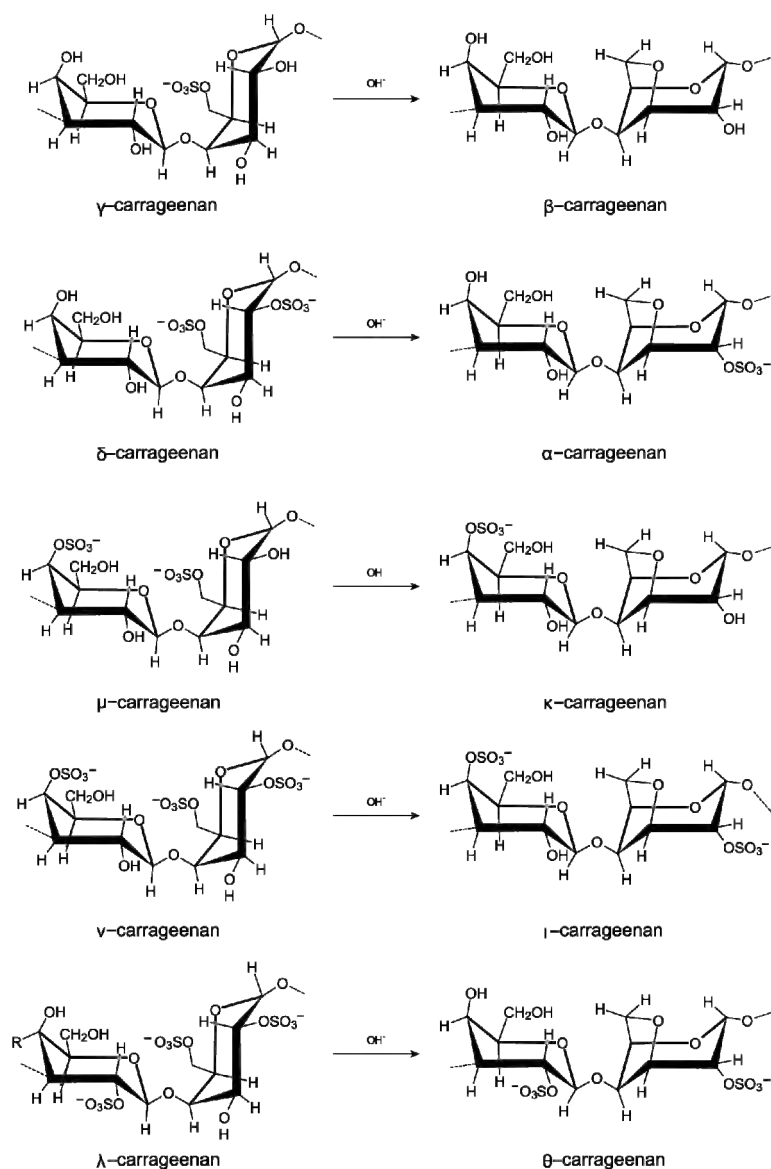
**Carragenan (carragen)**

Carragenan (Irish moss) is the polysaccharide formed mostly by sulphate-forms of calcium, magnesium, potassium, sodium and ammonium ethers of D-galactose and co-polymers of 3,6-dehydrohalactose. Carragenan is the food additive obtained in reprocessing of seaweed of class of *Rodofitia*. This category additives include the group of sulfurized polysaccharides of linear structure extracted from seaweed and purified of organic and other impurities by method of manifold depositions, filtrations and flushing by water of ethyl alcohol. This additive was titled by name of seaweeds that grow near the coasts of Ireland. Presently carragenans produced of red seaweeds of *Chondrus crispus* and *Gigortina mamillossa* harvested near coasts of Asia, North America and France. These weeds are panted also in Philippines and Spain. Carragenan is the natural substance capable to form gels and registered as the food additive of "E-407". The most often used its type is the kappa-carragenan. The FAO/WHO Expert committee by food additives established the "unlimited" daily norm of its consumption.

The additive is used as thickener, emulsifier of milky and watery environments, substance that forms gels and stabilizers of structure of such products as boiled sausages, semi-manufactured meat products and ingredient of brines used in production of smoked products, fish galantine etc.

The structural formulas of basic types of such class additives are shown on Figure 2.22.





**Figure 2.22** *Structural formulas of basic types of carragenans*

However, practice of commercial use of food additives is not limited by use of this additive only and with it technologists use stabilizers of structure of meat products, agents that hold water and intensify their aroma, regulators of acidity, emulsifiers etc. At the same time, carragenan is not the only additive capable to form structure of products, because meat systems contain always albumens, regardless zoic or vegetative, capable to structure the system.

The most important technological properties of preparations of carragenans are their capability to form stable gels and quantity and minimize quantities of water exuded from the mix in process of its standing (*syneresis*). Table 2.14 cites data on coefficients of holding of water in meat compositions in use of carragenans applied together with ingredients of various natures:

Table 2.14

*Functional and technological properties of carragenans*

Names of raw materials (ingredients)	Coefficient of holding of water
emulsion of porcine skin	0.5
MDM meat	0,10
dry blood plasma (77 ÷ 83 %)	10
frozen blood plasma (13 ÷ 18 %)	1
albumen of skin	8
concentrate of functional albumen	5
isolate of vegetative albumen	5
concentrate ( <i>usual</i> ) of vegetative albumen	3,5
diary albumen (casein)	8
milk powder	1,5
wheat flour	1
potato flour	1.5
modified starch	3
guar	25
xantane	12.5
gum of carob tree	20
tara	20
purified carragenan	40

The one of new spheres of use of carragenans is their use in products of small content of fat and cholesterol. The molecular mass of carragenan used in production of foodstuffs is 106 and its role in such foods is replacing of fats in conditions of preservation of properties of meat. The best result is reached in combined use of carragenans and soy and vegetative concentrates (isolates). Dependently of method of use, there may be subdivided two methods of application of carragenans into the meat mass as follows:

- together with the brine, and
- without brine.

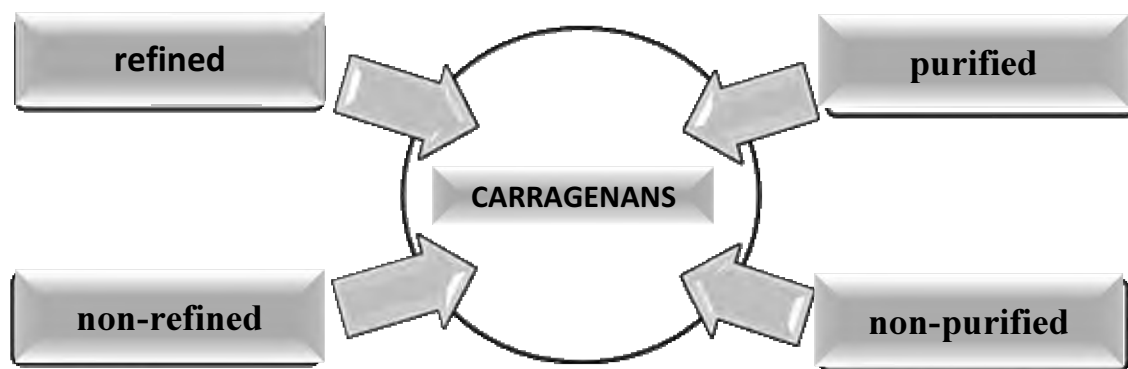
➤ *Production with use of brine (extrusion)*. The condition of realization of this technology is thorough dispersion of all components, especially carragenans, in water, what has to assist in avoiding of high viscosity of the brine that may cause problems in process of extrusion. Moreover the additive of carragenan must be applied into the solution the last to avoid its probable negative influence on dissolution of other components.

➤ *Production without use of brines*. In use of this technology, carragenans are applied into the meat and the important condition is producing of the homogenized mix at stage of its preparation in the drum (of cutter or mixer). Doing so, ones must add them step-by-step at continuous mixing by small portions.

The technologies of producing of carragenans are continuously developed and optimized. So, the modern technologies of semi-purified products (contained about of

90 % carragenans and 10 % of seaweed cellulose) are developed in more details that technologies of producing of pure commercial products. The reason is that partly purified products are produced at more merciful thermal and chemical conditions as compared with those that are used in production of pure carragaenans. The one of positive effects and the main reason of use of such technologies is cutting of prime cost of commercial products.

The carragenans may be classified by grade of their purity as follows (Figure 2.23):



**Figure 2.23**      *Classification of carragenans by grade of their purity*

Studying of peculiarities of forming of structure of gels of carragenan in presence of various additives showed that their capability to form gels depends considerably of presence of components, which do not capable to forms gels themselves but are character by high solubility in water what assists in forming of gelatinous structure of the resulted mix. There exist some models of forming of gels. The most often used is the two-stage "domain" model. This one surmises that the intermolecular association of doubled helices results in forming of the short-chained clusters ("domains") partly dissolved in water. The next stage of forming of the gelatinous structure is including of cations in structure of domains and their association in three-dimensional spiral frame. The additive used in this purpose the most often is the kappa-carragenan, which is capable to form the most strong gels in presence of ions of calcium and potassium. The additive is capable to interact with the milk albumens and form in it the complexes of "albumen-polysaccaride". Because of such electrostatic interaction with the positively charged areas of molecules of albumen and kappa-carragenan, one may use lesser quantities of mixed additive required for forming of gel as compared with the additive, which does not contain the albuminous component: respectively  $0.05 \div 0.1 \%$  and  $0.5 \div 1.0 \%$ .

The sodium ions impart gels the property of fragility and prevent formation of gels at all if present in big quantities, what is especially necessary in cases of use of sodium chloride as the spice. It was found also that in simultaneous use of carragenans together with ingredients capable to form gels independently, the additive shows the synergetic effect in presence of up to 2 % of NaCl and is in "competition" in holding of water with additives of vegetative nature and starch (Table 2.15).

**Table 2.15**

***Influence of kitchen salt, food additives and ingredients on capability of the carragenan to form gels***

Appellation of the component	Mass part of the component in the mix of "carragenan – water"	Relative value of capability of carragenan to increase (+) or to decrease (-) the capability to form gels, %
Kitchen salt	0 ÷ 1	0 to +150, respectively
Kitchen salt	1 ÷ 4	+150 to 0, respectively
Kitchen salt	4 ÷ 6	0 to -100, respectively
<i>Inhibiting action in presence of 2 % of kitchen salt</i>		
Dry milk	0 ÷ 20	0 to -91, respectively
Starch	5 ÷ 20	-41 to -90, respectively
Soy albumen	5 ÷ 20	-50 to -90, respectively
Mix of two phosphates (E450, E451)	0.30	-20
<i>Intensification in presence of 2 % of kitchen salt</i>		
Mix of two phosphates (E450, E451)	0.15	+ 10
Sodium tripoliphosphate*	0 ÷ 0.15	0 to +15, respectively
Sodium pyrophosphate*	0 ÷ 0.30	0 to +15, respectively
Potassium chloride	0.10 ÷ 0.20	+50 to +75, respectively
Zoic albumen "Skanpro T95"	1.5 ÷ 7.5	+97 to +533, respectively
Zoic albumen "Belkol"	2.5 ÷ 7.5	+29 to +726, respectively

\* counting on  $P_2O_5$

Investigations showed that carragenans forms the gels stable in pure water during 3 days in its concentration of 3 %, and its optimal concentration in 2.5 % solutions of sodium chloride is 0.75 ÷ 1.0 %. The work in studying of stability of gels formed by carragenan in presence of potassium chloride showed that the optimal concentration of this salt is 0.4 %. The following work was devoted to studying of complex systems, which contain both sodium and potassium chlorides, what permitted to recommend to use the stabilizing system, which optimal composition is:

$$\text{carragenan+gum} : \text{NaCl} : \text{KCl} = 1 : 3 : 0.57$$

Thus, the physicochemical characteristics of gels formed by carragenans depend of its type, concentration, presence of other hydrocolloids, sugars, as well as of pH and ionic strength of the solution, temperature, presence of ions of metals etc.

However, practice of commercial use of food additives in meat products is not limited by use of carragenan only. Besides, the recommended compositions of additives contain typically stabilizers, agents capable to hold water, regulators of acidity, intensifiers of taste and flavor, emulsifiers etc.

### **Starches**

Starch and products of its modification are used in food industry as important food additives. Their principal role is densification and binding of alimentary compositions in preservation of their good organoleptic properties. Such



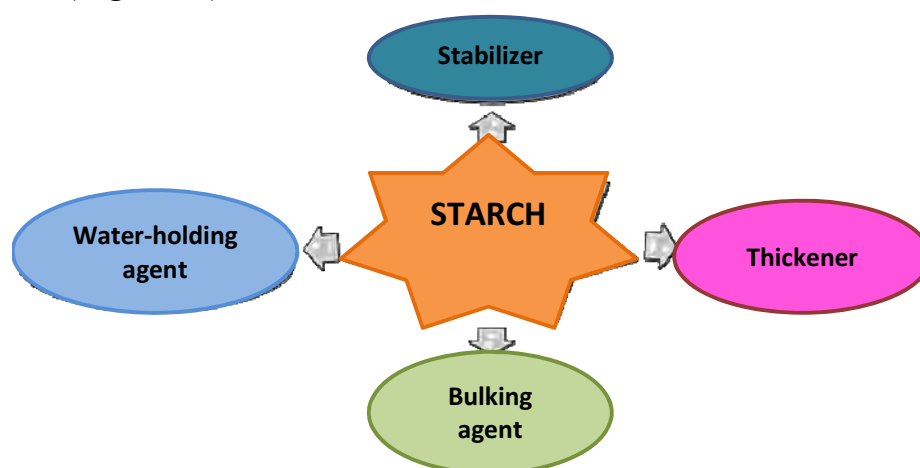


additives raise the capability of meat compositions to form gels, assist in rising of their viscosity and preserve transparency of liquids contained in these mixes. The one of reasons of use of starches in producing of meat products is often the need of reprocessing of meat of poor functional properties: after its prolonged storage in frozen state, meats that cannot hold big quantity of water, meats that contain big quantities of connective tissues. Meantime starch absorbs big quantities of water and retards processes of dehydration of meat compositions.

Besides, the assortment of market of meat products includes the considerable quantity of products of the “economy-class” produced with use of starches, which are their indispensable ingredients because of their small prices: the cost of starch is 3 ÷ 3.5 times less of cost of beef of second class of quality and twice less of cost of soy isolate. Use of starch is the most expedient in technologies of producing of sausages of poor quality, where it is applied in purposes of holding of uncombined water that can release in their heating. However, the maximum content of starch to be applied into the minced meat is 10 % of its mass because bigger quantities of this ingredient may result in:

- occurrence of rubber-like consistency,
- alteration of tasty properties,
- abnormality of acid-base balance in digestive tract in result of bacterial fermentation and decreasing of level of pH.

Starches function in meat compositions as their stabilizers, thickeners and bulking agents. They have no the emulsifying properties but may hold big quantities of water released in process of thermal treating of meat mixes in process of forming of meat pastes (Fig. 2.24).



**Figure 2.24 Technological functions of the starch**

Starches are produced of organs of plants where it is deposited as the reserved hydrocarbon. It is the free-flowing powder of white or slowly-yellow color. The energetic value of 100 grams of starch of potato is 1251 kilojoules, corn starch – of 1376 kilojoules. Cells contain starches in form of dense formations and grains. Dependently of type of plants and conditions of surrounding nature in period of forming, grains of starch may differ by their structure, shape and dimensions. At that,

grains of bigger size are of better quality. The properly washed and not spoiled starch has no taste what is its positive property in use in producing of meat products.

It was found also that various types of starches, for instance those that were obtained in reprocessing of corn, potato and other sources, differ by their properties and structure of grains, what permits to identify the source of their origin. thus, grains of starch of potato are of relatively big dimensions ( $15 \div 100$  micrometers and more), have the oval shape and furrows on their surface. The potato starches begin to hold water at lower temperatures as compared with the corn ones; hence their use is preferable in operation at low temperatures. The grains extracted from horny parts of endosperm of grain of corn are of polyhedral shape, and those that were extracted from its mealy part are of round form. Their size is of  $5 \div 25$  micrometers. The wheat starch consists of grains of two fractions: big with dimensions of  $20 \div 35$  micrometers, and small – of  $2 \div 10$  micrometers, elliptical and round, respectively. The opening situated in the center of the grain is seen only in grains of big size. The rye and barley starches have the view similar with the wheat one. The starch obtained in reprocessing of rice consists of polyhedral grains smallest of all listed species and are of  $3 \div 8$  micrometers size. The wet starches obtained in initial reprocessing of raw materials cannot be stored during the prolonged time, therefore they must be dried.

The process of producing of *potato starch* includes some operations:

- preparation of raw materials to reprocessing (washing, separation of needless residuals),
- breaking of tubers,
- separation of obtained mass (pulp) and juice and broken cells (squash),
- purifying of starch.

To open cells of tissues of tubers and alleviate separation of grains of starches, potato is milled and sent to centrifuges to separate juice, which presence causes darkening of the product, decrease of viscosity of paster produced of non-washed starch and progress of microbiological processes. The quality of starch depends also of its following purification of small particles of squash and other impurities, e.g. sand by method of its sieving. The next operations are separation of mechanical impurities in hydrocyclone and repeated washing to remove residues of soluble substances. The finishing stages of purification of the starch have the purpose of decreasing of content of spots – the small dark inclusions seen by the inaided eye and mechanical outpressing of water. The wet product produced by this technology contains about of 50 % of water.

The quality of produced starch deteriorates considerably in presence of increased content in tubers of vegetative albumens, amino acids and solanin. Albumens, if present, retard processes of washing and deposit in grains of starch in form of flakes polluting so the product. Oxidation of amino acid of tirozin leads to forming of melanins sorbed by starch, what worsen its color. Solanin present in starch forms the stable foams. Residues of ash in starches influence negatively on viscosity and adhesive properties of pasters produced of such starches.

*Producing of corn starch includes the stages as follows:*

- separation of impurities,

- soaking of grains in 0.2 ÷ 0,3 % solution of sulfuric acids at 50 °C to soften the raw and remove the extractive substances,
- milling of grains to wash off free starch and separate embryos,
- fine grinding of parts of grains to obtain the corn suspension,
- washing of the mass and separation of squash. The process results in forming of so-called “milk” – the polydispersed suspensions of grains of starch, gluten (insoluble albumen), grains of corn, small particles of squash and sand. The mix contains also dissolved extractive substances,
- separation of gluten of grains of starch in flotation machines,
- washing of starch to separate finally the dissolved substances and residual water in vacuum-filters or screw centrifuges.

To prevent development of microbiological processes in suspensions of starch, technologies add into the mix sulfuric acid in quantities at least of 0.1 % the properly washed starch must contain no more than 0.35 ÷ 0.5 % of insoluble albumens, 0.1 ÷ 0.15% of ash and 0.05 ÷ 0.1 % of sum of soluble substances.

*Producing of wheat starch includes the stages of:*

- mixing of flour with water,
- separation of starch and gluten,
- purifying of starch of impurities,
- removal of gluten.

Separation of starch and gluten accomplish in the paste or separate components of suspensions based on different densities of starch and gluten. Technologists wash wet starches once more and remove water mechanically to its residual content of 32 ÷ 38 % dry the powdered products by warmed air till obtaining of its set humidity. The conditions of drying influence considerably on quality of finished product. The starch heated to temperatures over 45 ÷ 50 °C gives pasters of small viscosity. The wet starch heated to temperatures 60 ÷ 70 °C may produce pasters and in heating to 80 °C grains of dry starch fissure and lose the character brilliance.

The dried starch is sieved to liberate it of groats, big pieces, sporadic impurities and pass through magnetic separators. The ready starch is packed or stored without packing in storage silo – the special vessel. Depending of its organoleptic and physicochemical properties, starches are subdivided by grades of quality, e.g. starch potato of "Extra", upper, first and second (technical grade) classes, corn starch of upper, and first classes, wheat – of “Extra”, upper and first classes of quality.

The commercial grade starch is packed by masses of 25, 50 and 60 kilos in clean dry bags made of linen, kenaf, jute etc. The exterior surface of packing is coated by paste of starch to prevent infiltration of powder through the fabric and sewed. To sell starch in nets of retail trade, it is packed by portions of 250 or 1000 grams in packs of paper or polyethylene and put packs in clean boxes by portions of 30 kilos. The term of guaranteed storage of potato and corn starches is two years, and the wheat starch may be stored not more than one year.

The important organoleptic property of starch is its color. It depends of type and quality of the product. The potato starch is of white color. The products of “Extra” and upper grades have thy typical brilliance conditioned by capability of big

grains of starch to reflect the light. The contaminated potato starch is grey. The corn and wheat starches are slightly yellow.

The density of various types of starches differs:  $1.61 \text{ kg/dm}^3$  for the corn product and  $1.5 \text{ kg/dm}^3$  for the potato one. The mass of  $1 \text{ m}^3$  of potato starch of 20 % humidity is about of 650 kilograms. The starch molecule consists of big quantity of residues of simple sugars and represents itself the mix of macromolecules formed by two types of polymers – amylose and amylopectin. Their ratios define the capability of starches to dissolve in warming and form the colloid systems named as pastures (Table 2.16).

**Table 2.16**

***Temperatures of forming of pasters by the main types of starches***

Type of starch	Temperature, °C	
	initial	final
Wheat	58	64
Potato	59	68
Corn	62	72
Rice	68	78

Heating of starch in presence of water results in forming of its pasture: there is failed the inner structure of grains of starch, dissolves and partly extracted the polysaccharide amylose and greatly swells amylopectin. The first stage of forming of pasters begins at temperatures of  $50 \div 65 \text{ }^\circ\text{C}$ : water permeates inside grains of starch, dissolves amylose and invokes swelling of amylopectin. Dimensions of grains increase tenfold and considerably more, but preserve their shape. Rising of temperature of forming of pasters leads to breaking of their structure. Part of polysaccharides dissolves in water. Starches form the solvated jellylike structured balls of pasture capable to hold big quantities of water and bonding of part of minced meat. Being mechanically stable, thin interlayers of gels present in the minced meat emulsion prevent the coagulating interaction of particles of the mix, what assists in its stabilization. This property makes starches the important additive used in producing of meat products, which output rises in their use by factor of about of 25 %.

At the same time the starches capable to form gels are character by some imperfections too: they are sensitive to influence of elevated temperatures, disposed to syneresis (process of spontaneous irreversible compression of its structure accompanied by release of water) and are insufficiently stable in process of storage.

The carbohydrate composition of starch influences of viscosity of pasters they form. The amylose fraction forms less viscous pasters as compared with the amylopectinic ones. Viscosity of pasters formed by the potato starch is considerably bigger of those that form corn and wheat starches. The starch pasters of sufficient concentration ( $6 \div 8 \text{ } \%$ ) form jellies after their cooling and their stability depends of capability of amylose to retrogradation which is the less the higher temperature is. The potato amylose retrogrades slower than the corn and wheat starches. The gel formed by the potato starch is transparent, colorless, and ropy, the corn starch has the milk-white color.

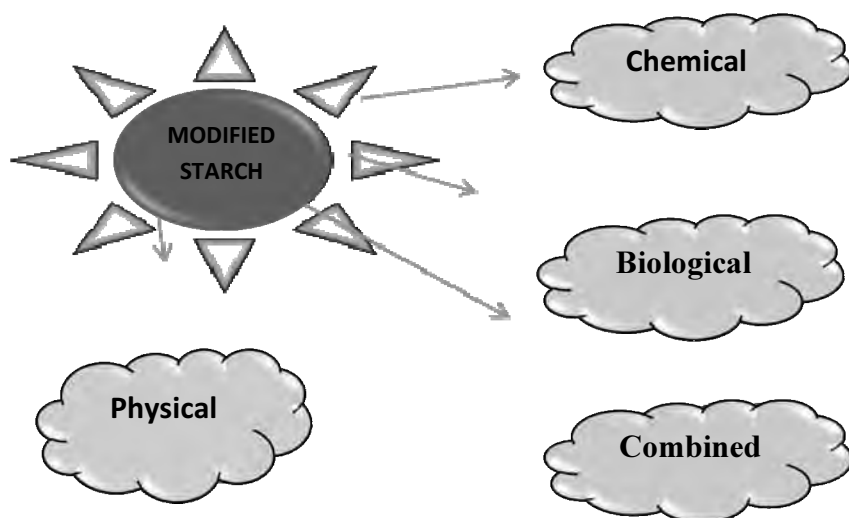
The natural starches are not the pure hydrocarbons but contain 2 ÷ 4 % of other substances too. Their presence influences considerably on properties of commercial products, e.g. the phosphoric acid (concentration of about 0.25 %) forms esters with amylopectin and influences on its acidity holding cations of alkaline and alkali-earth metals. Cations of alkaline metals cause transparency and rise viscosity of starch pasters but cations of alkali-earth metals decrease values of these properties. The starched produced of grain crops contain compounds of fatty acids (0.6 %) sorbed by polysaccharides, which influence of smell and color of starches and decrease so the quality of products produced with their use.

*The manufactures that produce meat products use various types of starches dependently of kind of product that contain this ingredient, for instance:*

- corn starch is used usually in products that consist of big pieces of meat, as well as in poultry that consists mainly of big pieces. The potato starch character by big granules assists in retaining together of filaments of meat,
- corn starch is used in producing of beef products durable in their cutting by bits because amilose does not lose its strength after jelling of the mix,
- the starch produced of corn of waxy ripeness is recommended for use in producing of meat products that contain big quantities of water, such as smoked sausage and frankfurters.

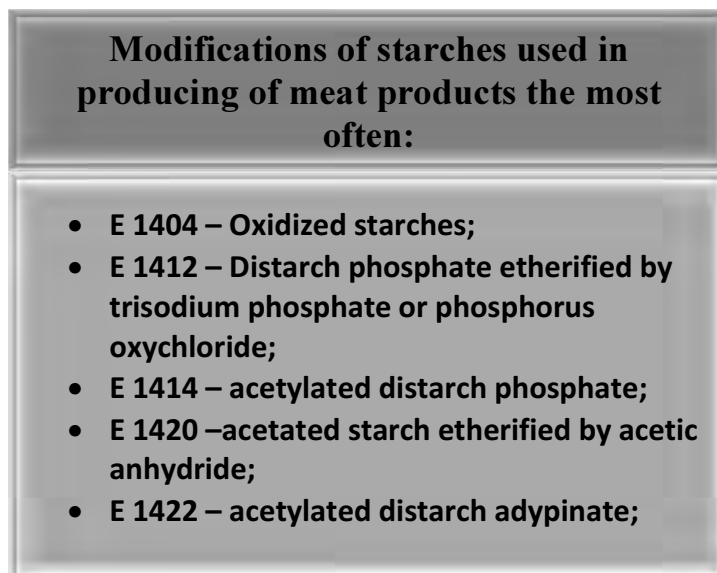
Small quantities of mix starches are used in producing of marinated products. However, to decrease the temperature of its jellification, such technologies require of use of mix of usual and quick-dissolving starches. Mixing of such compositions with marinade followed by their introduction in meat in vacuum or by injection permits to to realize the process of hydration without of loss of viscosity of injected products.

The modern technologies of producing of meat compositions use the most often the so-called *modified* starches character by the specially amended properties. There are produced dozens of types of modified starches used in producing of foodstuffs in pure state, and as components of multicomponent functional additives. The modified starches are produced in way of their chemical, physical and combined methods of treatment (Fig. 2.25):



**Figure 2.25** *Principal methods of modification of starch*

The annual quantity of modified starches produced in USA reaches 700 thousand tons, in Japan – 200 thousand tons. Some of modified starches are closely similar by their composition and properties with their natural analogues. Their main types are the deodorized, friable starches, their kinds character by altered color etc. (Fig. 2.26):



**Figure 2.26** *Modifications of starches used in producing of meat foods*

To modify (i.e. produce) the listed types of starches, technologists use the substances as follows:

- a) oxidizers (for instance, potassium permanganate), which split chains of molecules of starch,
- b) sodium metaphosphate and phosphorus oxychloride,
- c) anhydride of adipinic acid,
- d) anhydride of acetic acid.

The oxidized starches are produced typically in treating of starch by oxidizing agents (hydrogen peroxide, potassium permanganate etc.), what results in splitting of chains of molecules of natural polymers. The substances named in points *b)* and *c)* are used typically for cross-binding of polymeric molecules of starch, and the acetic anhydride (point *d)* – in etherification of polysaccharides of starch to obtain ethers and esters.

Because of considerable chemical activity, these substances react till their exhausting, therefore do not influence on state of health of men. Such starches form solutions character by higher transparency and stability but decreased viscosity.

The chemically modified starches are not the modified live organisms and have no any relation to forming of new albuminous formations produced by methods of genic engineering and their appellation of “modified” is only some accordant to the extensively used term of “genetically modified organisms”. Further we’ll describe briefly the main types of modified starches used in technologies of producing of meat products.

Starches modified by acids are produced by method of heating of their aqueous solutions that contain hydrochloric, phosphoric or sulfuric acid to temperatures less

of point of beginning of forming of pasters of the mix. The distinctive feature of pasters formed by such starches is those that in heated state they have the considerably smaller viscosity as compared with the analogous solutions of usual starches and form durable gels after their cooling.

Bonderized starches obtained after acidic treatment of starches by phosphorous acid permit to obtain pasters character by increased stability in process of mixing, small pH values, prolonged term of storage and stability in cycles of “freezing – defrosting”.

Acetylated starches form pasters of decreased viscosity that are character at the same time by increased stability and capability to form films. They are used as thickeners and components that form regular structures of gels.

Stabilized starches are products of interaction of natural starches with functional reagents by hydroxyl groups of their glucose radicals. The products of such reactions contain the ether- or ester- bond and their solutions are character by decreased temperature of beginning of forming of pastures, high solubility, increased transparency and stability of gels they form.

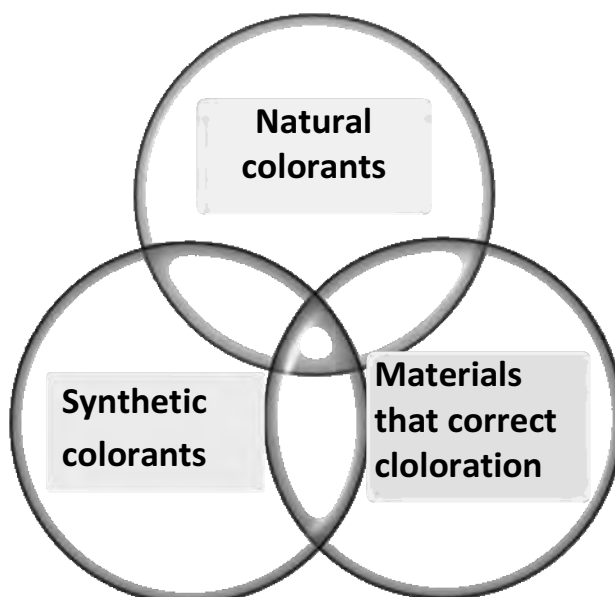
Cross-linked starches are produced in forming of cross-links between the polymer molecules of starches in interaction of their hydroxyl groups with various organic reagents. Such modification decreases solubility of modified starches but permits to produce the strong three-dimensional grid of gels.

The modified starches are produced of traditional (potato, corn) and non-traditional (pea, sorghum, wheat) raw materials. Choosing the most appropriate type of starch, technologists must take into consideration the chemical composition and structural and mechanical properties of products to produce, specific features of processes of manufacturing (parameters of temperature, pH of mixes, intensity of mechanical operations etc.), conditions of storage and realization (freezing-defrosting, packing of finished products into the vacuum packaging) etc.

## **2.4 Colorants**

Consumers are accustomed to certain colors of foodstuffs and associate them with their quality. The products thermally treated by norms of modern alimentary technologies (boiling, sterilization, heating in microwave furnaces etc.) change their initial coloration accustomed to consumers. Sometimes, its variation produces the non-aesthetic appearance what decreases their attractiveness, influences on appetite and processes of digestion. To give treated foodstuffs their traditional coloration, technologists use substances, which influence on appearance of meat products. These ones may be the natural and synthetic (organic and inorganic) alimentary colorants, stabilizers of color, as well as substances that refine their natural color (Fig. 2.27).

The natural colorants are produced of vegetative and zoic sources. Sometimes they are treated chemically to improve their technological and consuming properties. The character examples of such substances are carotenoids: the red and yellow colorants of vegetative nature, which form coloring of some vegetables and fruits.

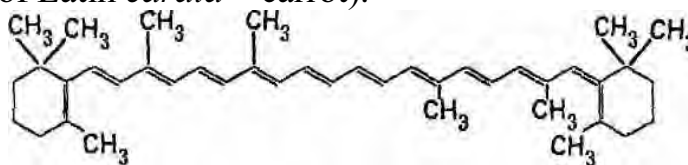


**Figure 2.27 Basic groups of alimentary colorants**

The synthetic alimentary colorants, in contrast to the natural ones, have no biological value and do not contain the flavoring substances. At the same time they have the considerable technological advantages over the natural ones. Such substances are soluble in water, less sensitive to conditions of technological treatment, remain stable in variation of acidity of mixes, do not decompose under the influence of elevated temperatures and light and are stable in process of storage of products. Besides, they are cheaper in most cases of natural colorants. To simplify work with such substances, commercial preparations of synthetic colorants contain usually such filling materials as kitchen salt, sodium sulfate, glucose, saccharose, lactose, starch, alimentary fats etc.

**Natural alimentary colorants** are pulled out from vegetative and zoic products by physical methods. The raw materials used in their producing are berries, flowers, leaves, edible roots, wastes of reprocessing of vegetative raw materials and so on. To improve their technological and consuming properties, they expose sometimes to chemical modification. Usually natural colorants represent itself the mix of compounds, which composition depends of sources of raw materials and technologies of their reprocessing. Therefore, compositions of these substances may vary in wide range.

The most important classes of natural colorants are carotenoids, antocianes, flavinoids, chlorophyll and some other. At the same time some of alimentary colorants or their mixes and compositions have the biological value and function also as flavoring and aromatic substances. The natural colorants are not toxic, as a rule. However there were established permissible levels of daily consumption of some of such substances. The character example of natural colorants is  $\beta$ -carotene (its appellation origins of Latin *carata* – carrot).



**$\beta$  - carotene**



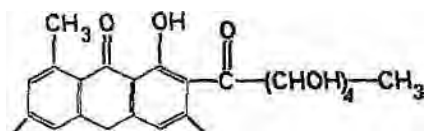
*Carotinoides (carotens)* – are hydrocarbons of isoprene raw that have the general formula of  $C_{40}H_{56}$ . Such compounds and their derivatives yellow-reddish colorations are of vegetative origin and contain acidic groups. Carotinoides are stable in changing of pH of environment, and action of reductive agents but oxidize at temperatures above 100 °C or in irradiation by sunlight. The most important types of such pigments are:

- Licopin (E160d),
- Lutein (161B),
- Zeaxantin,
- Astazantin.

To give foods (fish and meat products, simulated caviar and some other products) of character coloration, technologists use carotinoids extracted from carrot, hips, pepper and their analogues produced by microbiological or synthetic technologies.

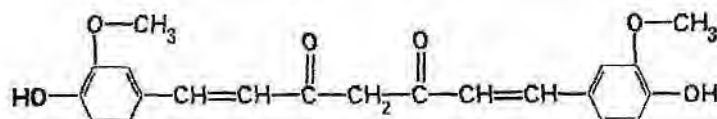
*Carmine red* (basic component – carminic acid) – E120 – derivative of tetraoxyantraquinone:

*Carminic acid*



The source of natural carmine is dried and triturated worms of cochineal – insects of genus of *Coccus Sactic*, which live on cactuses that grow in South America and Africa. However this colorant is produced presently in most cases synthetically.

*Turmeric* – natural colorant of yellow color (E100) extracted from long-lived grassy plants of family of gingery - *Curcuma longa*, L:



*Turmeric*

Turmeric does not dissolve in water and is used in food industry in form of its solution in ethyl alcohol.

*Enocolorant* is produced by extraction of squeezing of dark kinds of grape (E-163ii) and elder-berries. The preparative form of this colorant is the liquid of intense red color. This is not the individual compound but mix of brightly colored organic compounds of various chemical classes, especially antocianes and catechines. Its tint varies in changing of pH of the mix: red in acidic environments and blue in neutral and lightly alkaline ones. The modern trend of coloring of foods is use in this purpose of yellow and rose- and red-colored antocianic pigments contained in juice of dogwood, red and black currants (E-163III), cranberry, whortleberry, pigments of tea, as well as the dark cherry-colored colorant extracted from beet (E-162).

*Shugar's color (caramel, E-150)* – darkly colored product of caramelization of various sugars produced by various technologies. Its solutions in water represent themselves the dark brown liquid of pleasant flavor. The product is used in producing of some types of sausages.

*Riboflavin* (riboflavin proper and the sodium salt of riboflavin-5-phosphate, E101) is used as the yellow alimentary colorant. It is the most often used colorant of natural origin. this pigment is character by stability at elevated temperatures; does not changes its color in storage; resistant to attacks of sunlight, oxidation variations of pH and influence of ions of metals. It is the less expensive colorant of all additives of artificial and natural origin.

*Fermented rice* is the only of red analogues capable to form coloration of meat products the most close to their natural color does not changed even at durational storage of sausages. Use of fermented rice in producing of boiled sausages of first class of quality assures increasing of bettered reproducing of red sector of spectrum and assist so in rising of intensity and brightness of finished products as compared with products produced with use of carmine and colorants of synthetic origin. The fermented rice is used in meat industry as the preservative and has certain medicinal properties. Because of this property, this additive is used by big foreign manufacturers of albuminous preparations as the ingredient, which influences positively of state of cardiovascular system as carrier of the substance of monacoline character by positive effect in cure of coronary sickness of heart and cardiovascular sicknesses resulted of hyperglyceridemia and atherosclerosis. Consumption of fermented rice assists in quick decreasing of content of cholesterol and triglycerides in blood, stimulates processes of digesting and circulation of blood, as well as influences positively on state of spleen and stomach. Today, the fermented rice is the unconditional leader in use in meat industry used as the safe and useful for health additive rich by nourishing substances.

**Synthetic alimentary colorants** unlike the natural ones have not biological activity and do not contain flavoring substances. At the same time they are characterized by considerable technological advantages over additives of natural origin: they are less sensitive to influence of conditions of their technological reprocessing, stable in storage and influence of elevated temperature, give brighter colors and well soluble in water. In most cases they are cheaper of natural colorants. Stability of coloration of finished products depends of fatness and grade of their density; content of alcohol and sugars that have the reducing ability; presence of mesophilic and sour-milk ferments; microbiological indices. To simplify operation, the commercial preparations of synthetic colorants are diluted usually by filling materials (kitchen salt, sodium sulfate, glucose, saccharose, lactose, starch, alimentary fats etc.). to give meat products desirable coloration, technologists use aqueous solutions of alimentary colorants, as a rule.

The most often synthetic colorants used in practice are:

*Brightly red 4R (Ponso 4R)*. Its aqueous solution is red. The principal spheres of use: producing of fish- and meat products, dairy products, sausages and minced meat semi-finished products, sauces.

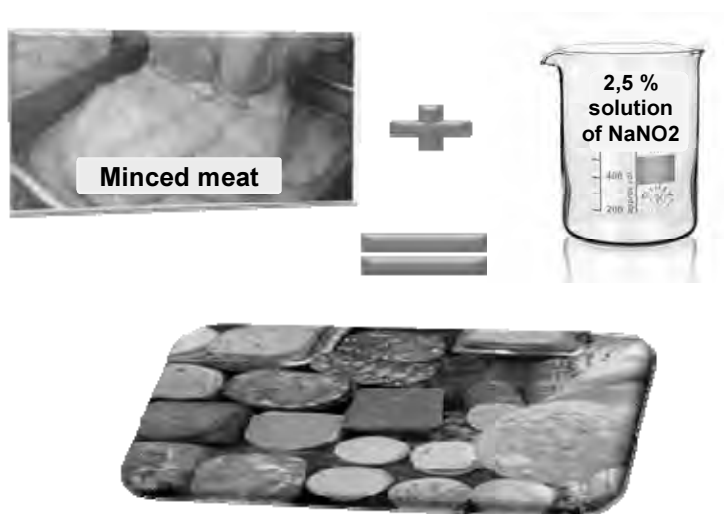
*Quinolinic yellow*. Its aqueous solution is of lemon-yellow color. The principal spheres of use: fish-, meat and dairy products, cheeses, sauces.

The maximum permissible dosing of individual kinds of synthetic alimentary colorants used in pure condition or in mixes is 100 grams per ton of finished foodstuff and varies usually (dependently of types of pair colorant and finished product) in limits of 5 ÷ 50 grams per ton.

Before one will use the colorant of synthetic origin, he has to certain that it is safe from the toxicological point of view. Particularly, Ukrainan authorities prohibited use of such synthetic colorants as red colorant "Amaranth" (E-123) and "Citric red 2" (E121).

Meat products have red color conditioned by presence of myoglobin. However the natural red color of meat after its being at fresh air or after heating changes and became brown or grayish-brown because of formation of metamyoglobin, what deteriorates organoleptic properties of meat products. to prevent forming of metamyoglobin and preserve the natural coloration of fresh meat, technologists used extensively substances that stabilize red coloration of treated meat products and correct their color. The compounds used in this purpose the most often are sodium and potassium nitrites and nitrates (European codes – E249 ÷ E252). These compounds excite passing of complicated chemical and fermentation processes, which include liberation of nitrogen oxide from molecules of nitrite (or nitrate after it would have been reduced to nitrite), which interacts with myoglobin to form nitrosomyoglobin that gives meat products the character color of red salted meat stable in prolonged storage and thermal treating of products.

The finished meat products, especially minced meats, have the unattractive grey color if do not contain nitrites but have the coloration inherent ot fresh meat in its presence (Fig. 2.28):



### *Stable natural color*

**Figure 2.28** *Influence of sodium nitrite on color of sausages*

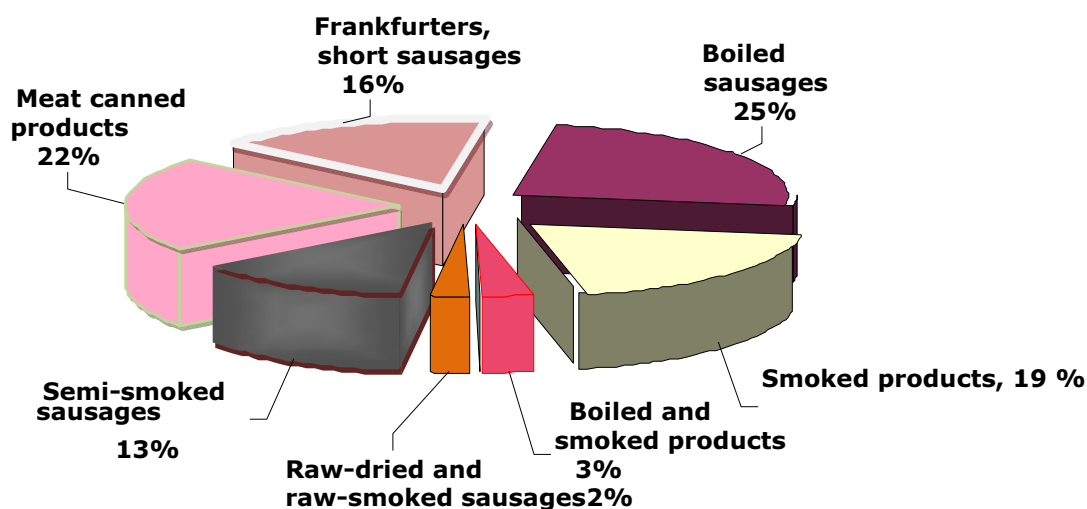
The analogous mechanism of influence has potassium nitrate reduced in potassium nitrite under the influence of enzyme nitroreductaza produced by microorganisms. To establish the environment necessary for their vital activity technologists add saccharose into the brine. However, nitrosomyoglobine may transform into nitrozomiochromogene, which add products greenish or brown tint. To prevent such transformation, technologists apply into the mass nitrates and nitrites in mix with the kitchen salt ("*mix for salting*").

Dependently of assortment of produced foodstuffs, capacity of the market of sodium nitrite varies within the limits of 12.3 to 34.4 tons a year (Table 2.17, Fig. 2.29).

**Table 2.17**

***Dozing and capacity of the market of sodium nitrite used in producing of various types of meat products***

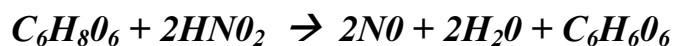
Various types of meat products			
Type of finished product	Capacity for the state of 01.01.2010, tons	Dozing, %, potential, tons	Demand for sodium nitrite, tons
Frankfurters, short sausage	61435	Dozing, %	0.003-0.0075
		Potential, tons	2.3-5.6
Boiled sausages	102134	Dozing, %	0.003-0.0075
		Potential, tons	3.4-8.5
Smoked products	29920	Dozing, %	0.006-0.02
		Potential, tons	2-6.7
Boiled and smoked products	11435	Dozing, %	0.0075-0.01
		Potential, tons	0.8-1.1
Raw dried and raw smoked sausages	8160	Dozing, %	0.0075-0.01
		Potential, tons	0.5-0.7
Semi-smoked sausages	43520	Dozing, %	0.0075-0.01
		Potential, tons	3.3-4.4
Meat canned products	15102	Dozing, %	0-0.006
		Potential, tons	0-7.4
Capacity of the market, tons			12.3 – 34.4



**Figure 2.29** ***Capacity of the market of sodium nitrite used in producing of various types of meat products***

However, use of nitrites and nitrates causes presently objections of physicians because their use results in occurrence of complex of problematic effects, which has to be studied in more details.

**Ascorbic acid (E 300)** assists in speeding of process of decomposition of nitric acid and emission of nitrogen oxide:



Adding of ascorbic acid, or its salts, or its ethers speeds processes of forming of stable red coloration of the desired tint. At the same time this acid inhibits processes of formation of peroxides that can oxidize mioglobin to metamioglobin functioning so as synergist of antioxidants and assists in prolongation of terms of storage of finished products.

## **2.5. Aromatizing and flavoring additives**

The class of *flavorings* includes spices, chemical substances, certain parts of biological products of vegetative origin and their mixes. They are used as ingredients of foodstuffs in purposes of refinement of their taste and flavor, betterment of processes of digestion and assimilation of food, as well as prolongation of terms of their storage.



The flavoring additives may be of natural or synthetic origin. The category of flavoring includes spices, salt, sugar, some flavorings, sauces, products prepared for consumption (ketchup, mustard, horse-radish). To prepare species, one uses various parts of plants, e.g. their fetus (black pepper), germs of flowers (carnation), leaves (bay leaf), roots (parsley), rhizome (ginger), bulbs (onion, garlic) and others. The category of spices includes also fresh or dried and milled overground parts of plants (fennel, coriander), seed (anise, poppy, mustard), fetus and seed (anise and anise-tree), rind (cinnamon). The natural products are used both in fresh (fetus, seed, stalks, rhizome) and dried state, milled in many cases in powder. The one more category of flavorings are oily mixes (oil mixed with mustard, anchovy, crayfish; green oil etc.), which refine taste of meat products and rise their caloricity. Some chemical substances, e.g. sodium glutamate, citric acid and essence of vinegar diluted by water, are used as flavorings too.

Compositions of some flavoring additives are standardized, so they may be included in special category of “food additives”.

The alimentary additives used the most often are *spices* – fresh or dried parts of spicy and aromatic plants, mostly of tropical origin, which contain various spicy and volatile aromatic substances. Such products have no nutritional value, as a rule and are used in purposes of adding of their small quantities into the food of its specific taste and flavor. The one of basic advantages of tasty additives is those that they preserve some properties of products, which may be loosed in process of their producing or preparation. Flavorings may also imitate the tasty properties, which emerge in processes of specific preparation, e.g. in smoking, grilling, roasting of meat.

There are used as flavorings also dried, slurred and liquid multicomponent compositions used traditionally by many nations. These ones are the feeding mustard, khmeli-suneli, tkemali, mayonnaise, adzhika and other products. Many flavorings and spices contain tasty and aromatic volatile oils, starch and tanning agents. The

substances that generate the character properties of spices should refer glycosides, terpenoids, ethers and esters, as well as some carotenoids and organic sulfides (e.g. diallylsulphide).

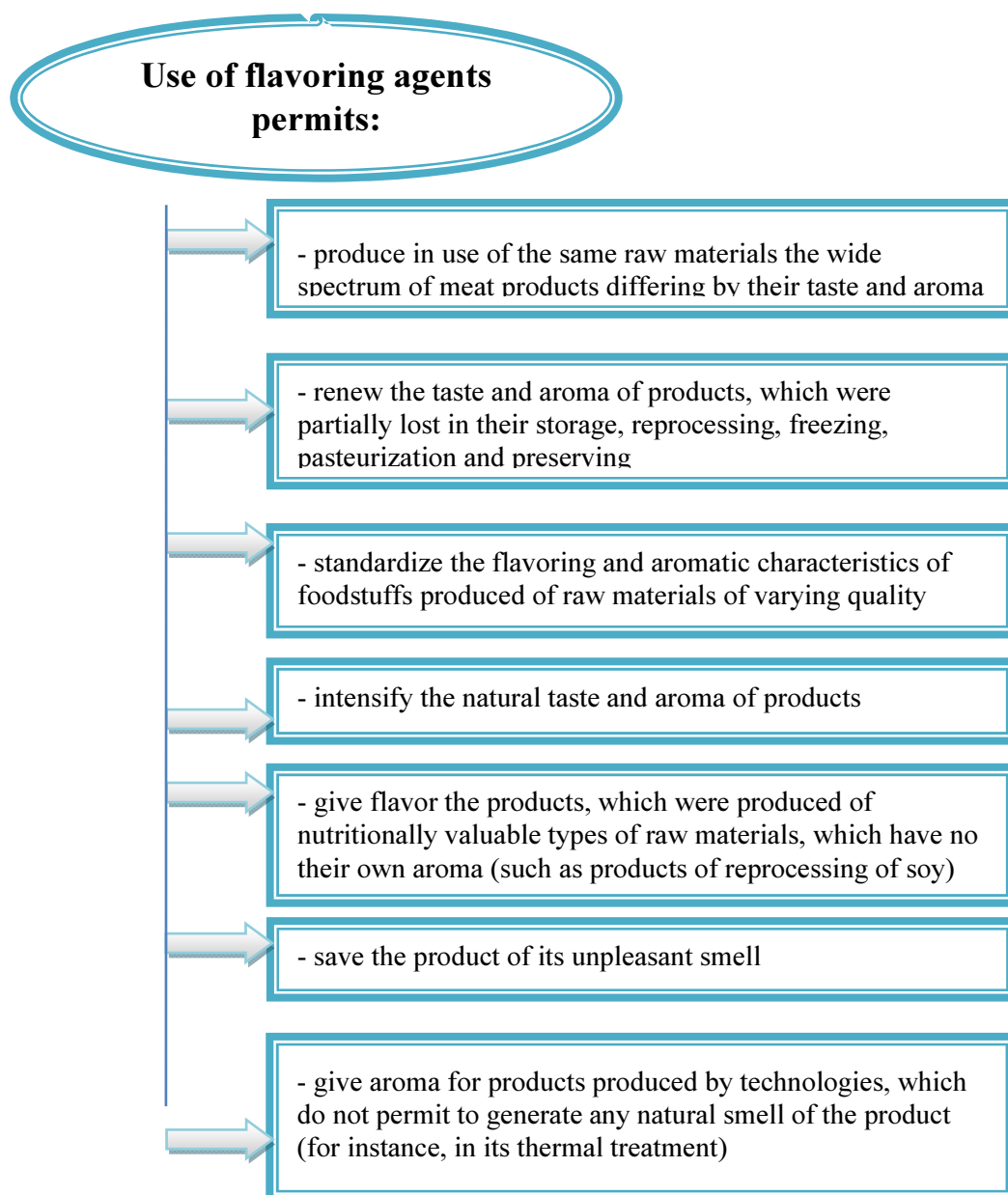
The flavoring additives raise the nutritional value of meat products because of establishing of strong and clear contour of the food. The flavoring additives used in this purpose are produced in different forms – as dry powders, liquids and pastes. The most stable forms of additives in their prolonged storage are pastes composed of mix of salt and concentrated meat bouillon.

Applying in meat products of flavoring additives may be done by different methods, e.g. by their *pickling*. The marinade, i.e. the liquid that contain spices, may be injected into the meat mass at usual pressure or under the vacuum. The last method is preferable because permits to inject the liquid deeper and ensure its more intense interaction of albumens with water and other constituents of the injected brine. Technologies choose the method of injection dependently of existed equipment, type of product (fillet, chicken, meat on bones etc.) and desired properties of finished product. Marinades may contain antimicrobial components, such as sodium lactate, potassium lactate, sodium acetate, which assist in prolonging of guaranteed term of storage of the product. The tasty and functional additives may be applied into the meat products also with sauces, tempura, by method of rubbing and so on. Such preparations may contain also various emulsifiers and adhesive components.

The additives used in producing of sausages, which contain big quantities of surrogates of meat, e.g. sodium glutamate or hydrolyzed vegetative albumen, contain also the agents that intensify taste of commercial products.

Flavoring agents mean substances, which add their own flavor or intensify the existing smell of finished meat products. the principal spheres of their use are (Fig. 2.30):

The flavoring agents may be segregated conditionally by classes of natural and synthetic identical by their structure with the natural ones and imitate their natural smells. The natural agents are extracted typically from fruits, vegetables and plant as their juices, essences of concentrates, and the second class substances are produced synthetically. The class of natural flavoring agents includes essential oils, gummous oils, essences, extracts, hydrolyzed albumens or any product obtained in processes of roasting or heating of raw that contain tasting and flavoring components. The raw materials used in producing of the last category flavoring agents are spices, fruits of fruit juices, vegetables or vegetable juices, alimentary yeast, grasses, rinds, buds, roots of plants, leaves or similar materials of vegetative nature, meat, seafood, poultry, eggs, dairy products, as well as products obtained in fermentation of listed kinds of raw materials. The principal function of their application in foodstuffs is giving them character smell, but not rising of their alimentary value.



**Figure 2.30 Principal purposes of use of flavoring agents**

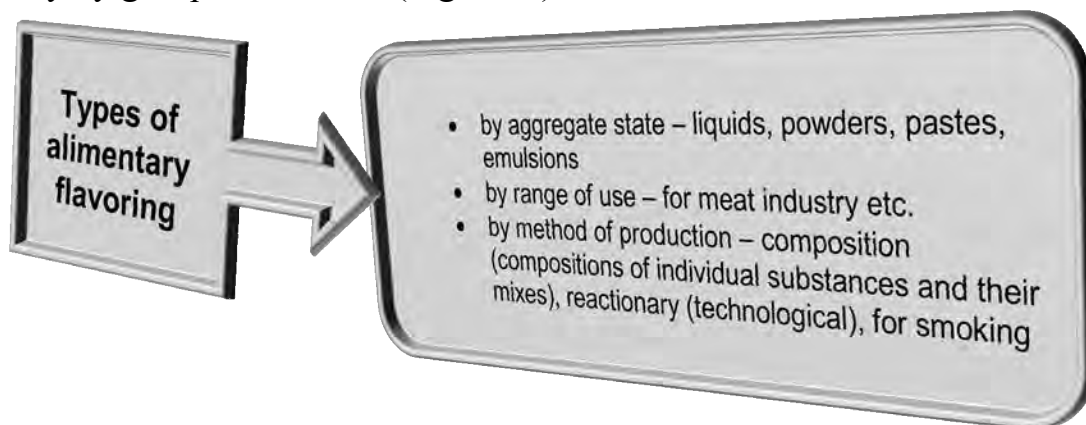
Flavoring agent identical to natural analogue – means the preparation, which tasty or aromatic part contains some aromatic substances identical to their natural analogues, as well as the natural aromatic substances too. Their properties, composition of basic flavoring components and chemical structures are identical to those that are character for natural flavoring agents. At the same time, part of their components or even the flavoring agent proper, e.g. vanillin, is produced synthetically.

Flavoring agents used for smoking are concentrates of smoking fume in purified water.

Artificial flavoring agent – means the alimentary product that contains one or more flavoring substance produced synthetically.

Ukrainian State prohibits use of synthetic flavoring agents that intensify the aroma inherent to natural products, as well as their application into the foods for nutrition of children. Besides, flavoring substances that are used in some products must be tested repeatedly for their safety in use in other products.

The alimentary flavoring agents used in Ukraine may be subdivided conditionally by groups as follows (Fig. 2.31)



**Figure 2.31**     *Classification of flavoring agents*

The one more type of classification is their ranking by source of genesis.

The natural flavoring agents are produced by physical methods (pressing, extraction, distillation) out of materials of vegetative or zoic origin. The dried powders of plants (e.g. of garlic) are produced in removal of water from the well-milled plant or its juice by method of its sublimation or spraying in hot air.

It is not possible to produce meat products in many cases in use of natural flavoring agents only because of their high cost, limitation of sources of their production and weakness and instability of natural aromas. To solve these problems, technologists use the flavoring substances identical to their natural analogues.

Flavoring agent identical to natural means the preparation, which some components or the substance in whole are produced artificially. The examples are vanillin, para-oxyphenyl-3-butanone (the basic component of flavoring agent that has the smell of raspberry). The optimized and purposeful realization of enzymatic processes and growth of certain types of microorganisms permit to obtain smells of cheese, butter, mustard, horse-radish etc.

Flavoring agents used for smoking are produced in most cases by extraction by water from gases of smoking fume seconded by concentrating of produced extract. To produce such agents, one uses preferably the wood of foliage trees. However there exist some cases of use for this purpose of wood of specially treated conifers. It is known also the methods of producing of liquids of smoking flavoring agents made of specific raw materials, e.g. from lignin or gluten, but not of wood.

Artificial alimentary flavoring agent – means the mix of one or some of synthetic tasting and flavoring substances. Some of flavoring substances do not exist in nature, and some may contain also the natural preparations or preparations identical to natural ones. The artificial flavoring agents contain at least one substance not existing in nature and produced synthetically. The artificial flavoring agents are

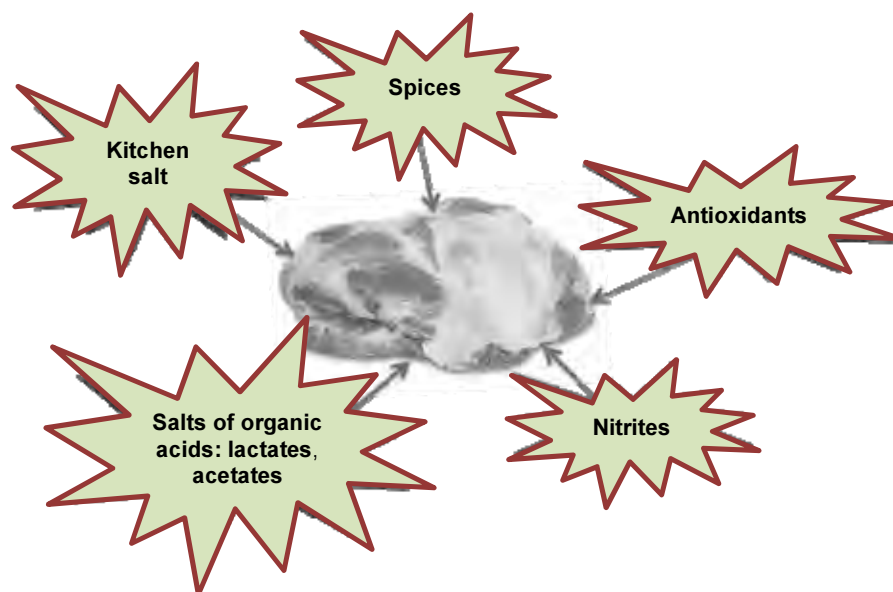


character by stability, intense flavor and cheapness. The example of artificial flavoring agent is arovanillon used extensively in industry all over the world.

## 2.6 Preservatives

The last time tendency in sphere of alimentation of men is their aspiration to consume fresh foodstuffs. Observing their desires, the meat industry works for shorten the way from their producers to consumers and prolong the guaranteed term of preservation by meat products of attributes of freshness. The loss of quality (i.e. deterioration) of food raw materials and finished products is the results of passing of complex physicochemical, microbiological, hydrolytic and oxidation processes. They are closely interrelated with one other and probability and rapidity of their passing depends of many factors. Therefore, preserving of proper quality of meat raw materials in process of their storage is reached by different methods: physical (decreasing of their humidity, use of low temperatures, heating, greasing, smoking) and chemical, which are based on use of special substances, the so-called *preservatives*, which delay metabolism and development of flora of bacteria, mold fungi and yeasts, prolonging so terms of storage of products and preserving them of deterioration.

The substances used the most often in these purposes are shown on Figure 2.32.



**Figure 2.32**     *Types of preservatives used in meat industry*

The methods of preservation of freshness of meat used traditionally are its cooling and freezing if products should be stored for the prolonged time. Meantime, the modern tendencies in development of methods of preservation of products permit to regard that in future there would be used the more “soft” methods, especially chemical methods of their preserving. The latter methods are less harmful for health as compared with those that are based on use of synthetic preservatives and are based on use of natural preserving agents extracted out of plant or antimicrobial substances synthesized by microorganisms. The principal demand asserted to this class compounds is their safety for human organism and absence of influence on organoleptic properties of the meat product to store. The positive effect of application

of synthetic preserving agents is those that quantities of energy spent in process of storage of products are usually considerable lesser of those that are spent in use of physical methods of their preservation.

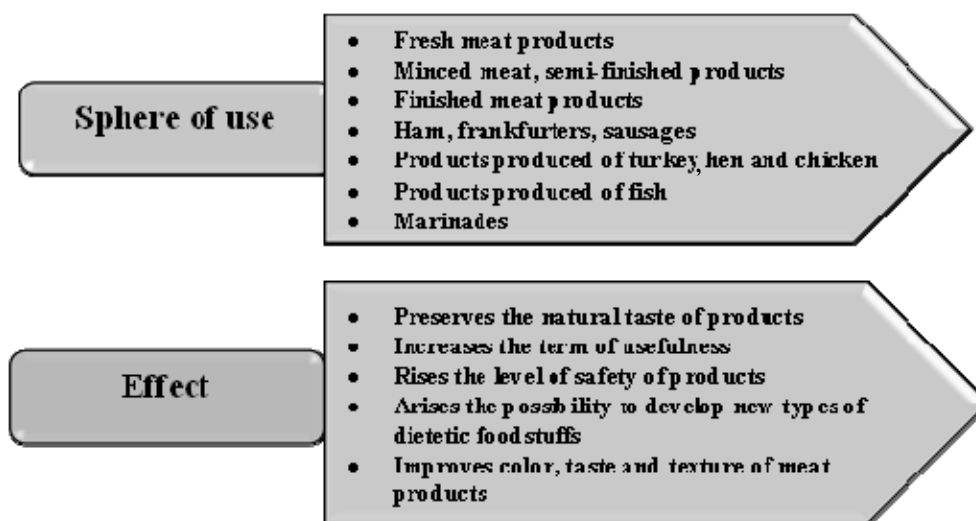
The mechanisms of action of preserving agents may be growth of fungi) and bacteriostatic (inhibition of reproduction of bacteria). The effectiveness of action of preservatives is not the same in their action on processes of metabolism of mold fungi, yeasts and bacteria, i.e. it cannot be effective in general case in its influence on reproduction of all probable agents that cause deterioration of meat products. most of preservatives used presently inhibit first of all generation of yeasts and mold fungi. Some agents are ineffective in respect of certain types of bacteria because their small activity in diapason of pH (often the neutral ones) optimum for reproduction of bacteria. Therefore, to reach the desired effect in increasing of grade of influence of change of mechanism of influence of some agents, there are used in certain cases compositions of preservatives. It is necessary in most cases to put into practice the complex method, which presumes combining of methods of use of complex of preservatives and physical methods of preservation: their heating, cooling, freezing, irradiation, drying, treatment by microwaves or impulse electric fields.

The grade of effectiveness of use of preserving agents may vary under the influence of substances that change acidity of the environment or activity of water, as well as the natural components of products capable to inhibit reproduction of bacteria themselves. The alimentary preservatives are stable, as a rule, and do not decomposed in meat products during the whole term of their guaranteed storage. Therefore there were changed motives of their use: in earlier time they were applied in preservation of foodstuffs to cut expenses, but now the main purpose of their application is inhibiting of reproduction of bacteria that produce toxins. In fact, use of preserving agents has the prophylactic character because they prevent the early corruption of foods, so decrease the level of hazard of generation of toxins.

The effectiveness of action of preservatives depends of composition and physicochemical properties of meat product. According to norms of their application and output of concrete groups of meat products, their biggest quantities are used in producing of boiled sausages, meat semi-finished and smoked products. To check effectiveness of their influence, there were developed two methods of control used successively, as a rule: control test carried on nutrient medium and practical tests. Testing on nutrient mediums are carried out obligatorily in studying of compounds, which properties are unknown. The experimenter puts in nutrient substrates different quantities of tested material and seeds them by pure culture of microorganism used as the object of control. After passing of some days of incubation, he studies differences in reproduction of microorganisms to determine the concentration of potential preservative sufficient for inhibition of development of concrete microorganism.

Next we will view the chemical preservatives only. Their adding permits to delay reproduction of microflora. The antimicrobial substances may have the bactericidal effect (i.e. annihilate microorganisms) or the bacteriostatic one (do not annihilate microorganisms but slow down their reproduction). The effectiveness and methods of use of preservatives depend of their chemical structure, concentration and sometimes of pH of medium. Many preservatives are more effective in acidic

environments, therefore to raise their preservative effect technologists may apply in foods the alimentary acids (acetic, malic, lactic, citric and others). The sphere of use of preservatives in meat industry and effects got in their application are too extensive (Fig. 2.33).



**Figure 2.33** *Sphere of use and effect of preservatives*

It is expedient in many cases to take into consideration the peculiar properties of products to preserve and use the mix of some preservatives, if necessary. There are no universal substances appropriate for prolonging of term of fitness of all types of meat products. At the same time, there exist some restrictions in use of preservatives in meat industry, e.g. they are prohibited for use in cases as follows:

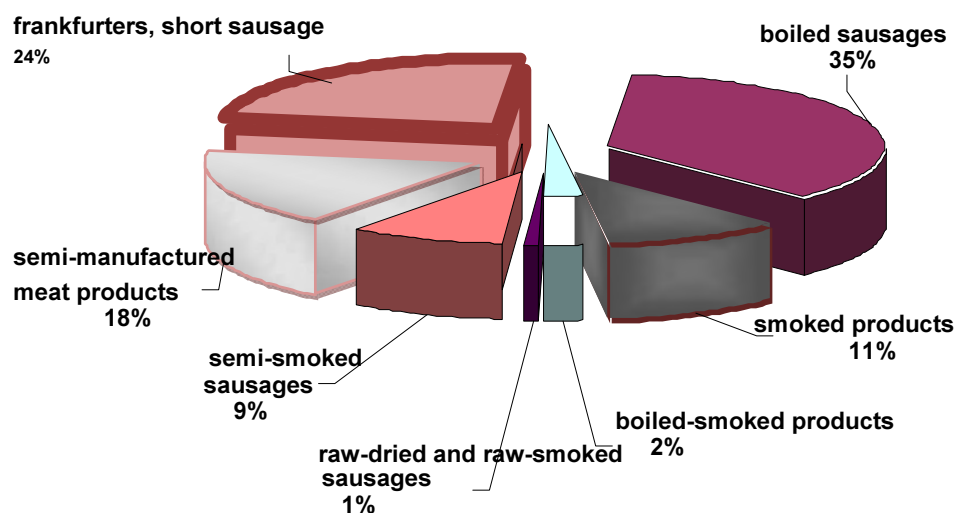
- if meat is fresh and sold under the mark of “fresh”, “natural”, therefore products must not be subjected to any treatment
- in producing of products for dietetic and childish consumption.

Preservatives are used extensively in producing of sausages and other type meat products. The volumes of their dozing and capacity of market of their use are given in Table 2.18 and Figure 2.34.

**Table 2.18**

***Volumes of dozing and capacity of market of preservatives in producing of various types of meat products***

Type of products	Production quantity for the state on 01.01.2010, tons	Dozing of preservatives, %	Mass of preservatives, tons
Frankfurters, short sausages	61435	up to 3	2256.6
Boiled sausages	102134	up to 3	3419
Smoked products	29920	up to 3	1003
Smoked and boiled sausages	11435	up to 2	218.9
Raw dried and raw smoked sausages	8160	up to 1	67
Semi-smoked sausages	43520	up to 2	873.9
Semi-manufactured meat products	73302	up to 2	1664
<b>Capacity of the market</b>			<b>9502.4</b>



**Figure 2.34 Capacity of market of preservatives used in producing of various types of meat products**

The basic types of preservatives used in producing of meat products are:

Sodium (potassium) lactate – food additive (E325), which acts in meat masses as synergists of antioxidants and regulator of acidity and humidity. Unlike other preservative agents, e.g. sodium and potassium nitrites and nitrates, which use leads to raising of level of risk of occurrence of oncological sicknesses, lactates are free of harmful influence on state of health of men. They are use in quantities of 5 ÷ 7 grams per kilogram of minced meat. The mechanism of its effect is that this compound hydrolyzes partly in water environments and remains In state of equilibrium with lactic acid, which salt it is. The acid formed in this process migrates into the cells of microorganisms, raising so their acidity. As a consequence, they perish, what assists in prolongation of term of fitness of the product. Thus, the term of fitness of boiled sausages, which contain lactates and are produced by norms of GOST R 52196, is up to 7 days for products packed into the natural covering and up to 10 days for products packed into the albuminous/cellophane covering. Lactates have also the antioxidant properties, what permits to use them in producing of frozen products that have the [prolonged term of storage in purpose of inhibiting of processes of oxidation of fats.



Sorbic acid is the natural preservative, which conforms to all norms of safety. This compound is added into the meat composition the most often in form of potassium sorbate well soluble in water. This acid is used also for treating of materials used in packing of foodstuffs. The acid is character by wide spectrum of mechanism of inhibiting of metabolism of microorganisms. *For the first*, it depresses the processes of synthesis of ferments in cells of microorganisms, including the most

important agents of carbohydrate metabolism – enolase and lactatedehydrogenase. *For the second*, sorbic acid effectively but not specifically depresses the cycles of metabolism of malatedehydrogenase, fumarase aspartaze, isocytratedehyfrogrenase and succinatedehydrohenase. *For the third*, the acid that has the double bond inactivates action of enzymes owing to the covalent bonding of their sulfatethydrillic groups. The one more “target” of sorbic acid are membranes of cells destroyed partly under its action. This effect intensifies the process of migration of protons into the cell and it spends more energy on compensation of changes of its acid-base potential.

Sorbic acid depresses the most effectively the processes of metabolism of yeasts and mold fungi; therefore 10 ÷ 20 % solution of its potassium salt is used in this purpose for treatment of consistent sausages and short sausages.

The principal spheres of use of nitrites dozed in technological mixes in quantities of up to 250 mg/kg are producing of sausages and meat products (salted, boiled, smoked and canned products). Nitrites assist in formation of necessary coloration and specific aroma of meat products and protect at the same time them against oxidation and deterioration because of germination of bacteria. Nitrates inhibit the most effectively reproduction of botulism bacteria of genus of Clostridium. The “*Hygienic norms of use of food additives*” established that the maximum residual quantity of nitrites in meat products sold in trading network (sausages and other type meat products, minced meat, canned goods) is of 50 mg/kg.

The significant and widely applicable preservative is sodium chloride (kitchen salt) used for preserving of meat, fish and other foods. The physical state of this compound is uncolored odor-free cubic crystals of salty taste. Salt as the food additive of religious character was mentioned as early as in Old Testament and was used during centuries as the most important (unless the unique) preservative of meat, fish and vegetables. The kitchen salt was used for preserving of foodstuffs it was well known in Ancient Egypt, Ancient Rome and countries of Near East. There exist some types of salt that differ by sources of their origin: the marine, rock and evaporated (extracted) salts. Its solubility is about of 36 grams per 100 grams of water and concentration of its saturated solution is 26.5 %. 100 cm<sup>3</sup> of such solution contains 31.8 grams of sodium chloride and its density is of 1.20 g/cm<sup>3</sup>. Dependently of composition of impurities, pH value of the solution varies in the range of 6.7 ÷ 7.3.

The commercial product is produced out of rock salt or seawater. Its global geological reserves are practically inexhaustible. The biggest quantities of sodium chloride are kept in waters of seas and oceans (about of  $3.8 \times 10^{16}$  tons), which content is of about of 26 ÷ 30 grams in one liter.



There exist some classes of quality of kitchen salt, namely the salt of extra-, first and second classes of quality. The mass fraction of sodium chloride in these salts must not be less of 99.7 %, 97.7 % and 97.0 %, respectively. Its commercial preparations may contain the additives of sodium and potassium fluorides, and potassium *I*<sup>-</sup> and *S*<sup>-</sup> iodides. Adding of compounds of iodine in commercial salts is considered in meat industry positively because dependently of state of organism men, the daily norm of consumption of this element is of 100 ÷ 200 micrograms.

The normalized content of sodium chloride in salts used in alimentation must not be less of 97.5 %. The example of the product used in these purposes is salt get from the brine of salt Lake of Sasyk, which contains 97.98 % of NaCl. This compound is the basic component dissolved in seawater in lesser quantities (of about of 2 %) together with other salts – potassium and magnesium chlorides, calcium sulfate and some other. At the same time, content of toxic elements of the 1<sup>st</sup> and 2<sup>nd</sup> categories of harmfulness is less of this that is character for commercial kinds of rock salt (Table 2.19).

**Table 2.19**

***Content of toxic elements in various samples of rock salt, mg/kg***

Index	Kind of salt					
	Established norm	Seaside salt of first class of purity		Established norm	Kitchen salt of first class of purity	
		2012.	2013		2012	2013
Lead	2.0	0.019	<0.02	2.0	<0.02	<0.02
Cadmium	0.1	0.00066	<0.0007	0.1	<0.007	<0.0007
Arsenic	1.0	0.019	0.029	1.0	0.025	<0.025
Mercury	0.01	0.003	0.007	0.01	0.003	0.001
Copper	3.0	0.068	0.07	3.0	0.07	0.09
Zinc	10.0	0.023	0.05	10.0	0.06	0.9

The matrix of sea salt contains the live organics of sea and big quantity of microelements including such necessary for vital activity as iron, copper, iodine, bromine, fluorine. Besides, their proportions are close to optimum for assimilation by men's organisms. The unique properties of sea salt qualify worldwide its high rank as the elite product used in alimentation, medicine and cosmetics. It is the "live" salt enriched by many macro- and microelements of ocean, what differs it against of rock salt, which losses practically all its useful properties during millions of years of its being in depths.

The basic methods of producing of salt are its evaporation under the sunlight and producing of brines, which part of each one on the global market is about of 35%, and the part of its deep mining is about of 30%.

Kitchen salt influences some negatively on reproduction of microflora and the most this effect is seen at its big concentrations. Technologists use the preserving effect of concentrated solutions of salt in processes of salting of fish- and meat products. to guarantee their safe storage, one has to ensure the stable plasmolysis of cells of microbes, what is possible only at relatively big concentrations of NaCl (10 ÷ 12 %). This method is used only in salting of fresh and good quality meat got in

processing of animals in good health. The optimum temperature of salting of meat is 2-4 °C.

It realizes the process of exchange diffusion in process of salting: salt migrates in contact with meat in its mass and some water diffuses outside. This results in accumulation of salt in meat and passing into the exterior brine of water and extractive components of meat. Depending on concentration of salt brines are ranked as lightly salted (14-16%), normal (18%) and saltish (20%) ones. Rising of concentration of kitchen salt leads to rising of amount of extractable water from the salted meat, which quantity reaches maximum for fifth to seventh day of salting. At the same time at small concentration of salt it is seen the reverse effect of watering of meat, what assists in rising of its succulence. The crucial condition of salting is that concentration of used brines must not be less of 12%, otherwise the product may go bad. On the contrary, use of highly concentrated brines leads to unfitness of meat for consumption even in cases of its durational soaking. Besides, the process of salting supplements by intensive reproduction of salt-tolerant microflora.

Spices contain substances capable to inhibit reproduction and vital activity of microorganisms. The interest for their use in processes of preservation of foodstuffs is based on widespread but erroneous conception that natural substances are more safe for health than the synthetic ones. Meantime additives of natural origin may be hazardous from the toxicological point of view. The components of spices that have the antimicrobial effect include such class compounds as aldehydes, organic acids, phenols and volatile oils. Some of such substance are pooled under the appellation of "phitoncides" but this name has no any concrete sense.



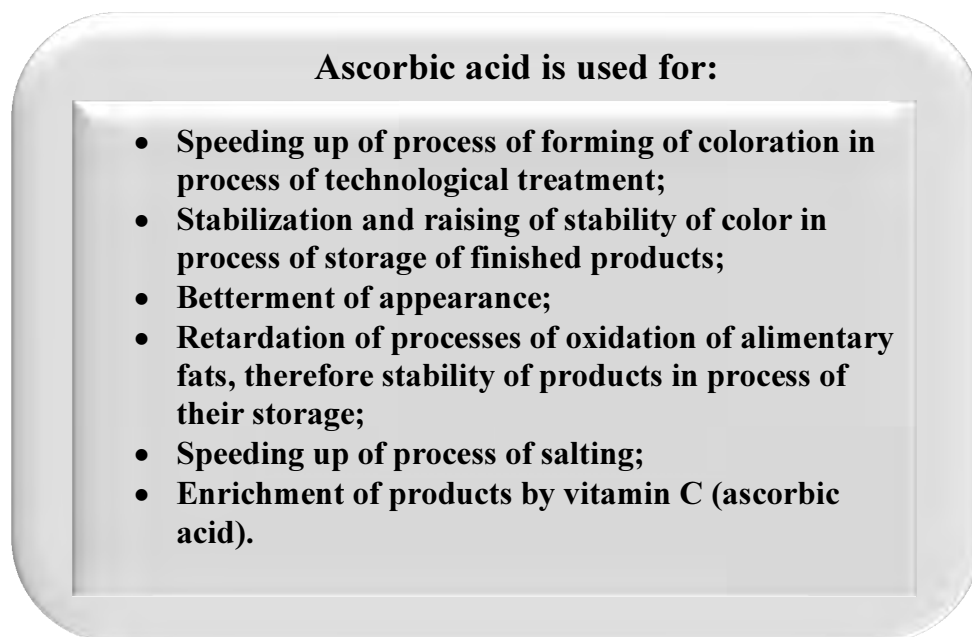
The preserving activity of listed compounds is deficient for practical use because most of foodstuffs that contain spices are disposed to deterioration. Besides, many spices (milled first of all) are greatly polluted by microorganisms and may be applied into foodstuffs only after their sterilization. The extensive use of spices as preservatives is limited both by their insufficient antimicrobial efficiency, and their intense influence on smell and taste of products, what breaks the rule that preservative must have the negligible influence on organoleptic properties of foods.

Antioxidants are substances, which inhibit or even prevent oxidation of substances contained in foodstuffs. Most of such compounds refer to class of *alimentary acids* substances capable to emphasize of give foods certain taste and prolong at the same time the guaranteed term of their storage because of the preservative properties. There is absent the strict normalization of permissible contents of these substances because more of this category compounds are natural



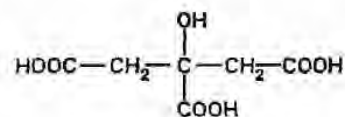
components of foodstuffs. The most known of alimentary acids used in preservation of foods are as follows.

*Ascorbic acid* (vitamin C) is one of the most effective antioxidants used in food industry. This compound represents itself the white crystalline powder of granules. Its effect as the antioxidant depends of its property to link free radicals preventive so their ruinous effect on tissues of organisms. Besides, ascorbic acid is synergist of other antioxidants and intensifies effect of such ones as selenium and vitamin E. Ascorbic acid is used extensively in food industry, especially in fabrication of meat products (Fig. 2.35).



**Figure 2.35 Spheres of use of ascorbic acid**

*Citric acid* is used as acidifier of foodstuffs, which accentuates the natural smell of products and add them the pleasant acidic flavor. This substance assists in regulation of acidity, acts as antioxidant and



synergist of other antioxidants and may form also the complex compounds. The citric acid is the softest acidifying agent by its taste as compared with other alimentary acids, and so is used widely in producing of meat- and fish canned products. The advantages of this acid are possibility of its storage in solid state till the moment of use and absence of irritative effect on mucous tunic of digestive tract. The dosing and capacity of the market of alimentary acids in producing of various types of meat products are given in Table 2.20 and Figure 2.36.

*Non-reagent preservation of foodstuffs.* The serious problem to be solved by specialists, who work in meat industry, is development and introduction of principles of environmental safety of technologies of operation and finished products, especially the maximally possible decreasing of quantity of chemical additives used in producing of meat products. Water present in live tissues is the most universal substance and the base of functioning of biological systems of organisms. Therefore, many of native and foreign enterprises, which operate in food industry, focus their

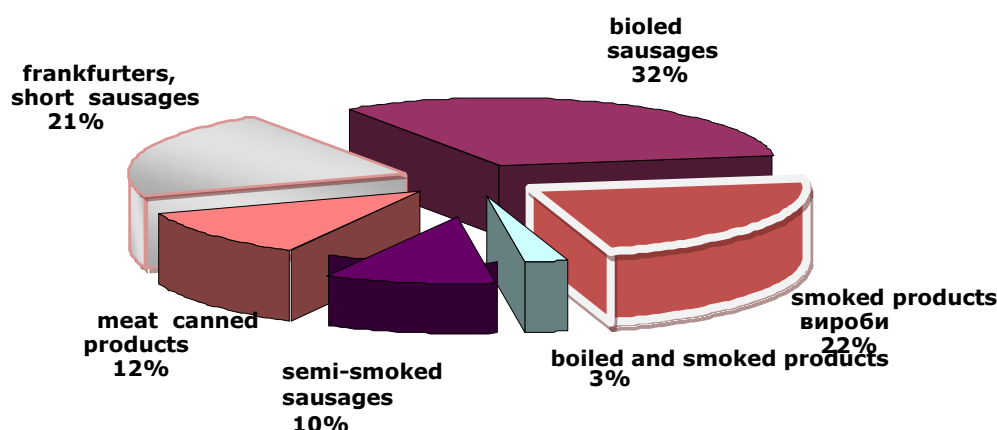


attention presently on quality and methods of purification of water they use in manufacturing, because its physicochemical properties and organoleptic and microbiological indices determine directly quality, safety and output of finished products. The modern trend in work in changing of properties of water carried out in purposes of obtaining of its desirable quality is its treatment without use of reagents to obtain the so-called “active” water character by its amended structure.

**Table 2.20**

***Dosing and capacity of the market of alimentary acids in producing of various types of meat products***

Type of finished product	Output for the state of 01.01.2010, tons	Dozing, %	Capacity, tons
Frankfurters, short sausages	61435	0.02-0.03	15-23
Boiled sausages	102134	0.02-0.03	23-34
Smoked products	29920	0.02-0.072	6.7-24
Boiled and smoked products	11435	до 0.025	до 2.7
Semi-smoked sausages	43520	до 0.025	до 10.9
Meat canned products	15102	до-0.01	до-12.4
<b><i>Capacity of the market, tons</i></b>			<b><i>45-93.4</i></b>



***Figure 2.36 Capacity of the market of alimentary acids used in producing of various types of meat products***

The index of activity of water ( $a_w$ ) represents itself the specific part of all water present in the product, which is not linked with the substances dissolved in it and capable so to take part in passing of chemical reaction in the system. This index is the principal criterion used in developed countries in evaluation of quality of meat products. development of methods of producing “active” water may be purposefully used in finding of methods of prolongation of terms of storage of products and formation of “chart of stability” of meat products.

The numerous experiments showed that usual water may influence on kinetics of passing of chemical interactions after it was exposed to some physical exposures: its magnetization, affecting by sound, stirring, heating or cooling, removing of weighted impurities, freezing and following defrosting. The same may be said about its biological activity and capability to assist in medical cure, what permitted to name it as the *activated* water.

It is recognized that the most promising and environmentally safe method of its producing is technology of electrochemical activation, which permits to avoid of use in meat industry of chemical reagents. Use of activated water permits also to optimize and shorten duration of technological processes, improve the ecological state of manufacture and rise quality and safety of finished products.

Because water is the component that contains in meat products in the biggest quantity, and properties of the activated liquid used in manufacture differ of properties of usual water, it may be used in meat industry in purposes of purposeful regulation of technological properties of raw materials, albuminous additives, complex multicomponent preparations and prolongation of terms of storage of finished products.

Many researchers propose to use the anodic fraction of electrochemically activated water (anolyte) that has the pH value of 2 as the antiseptic. Its use would permit to decrease considerably the quantity of microorganisms present of surfaces of slaughtered carcasses and inhibit germination of residual bacterial flora, what would permit to prolong the guaranteed term of storage of meat for some days. The anolyte is not harmful for cells of men but has the antibacterial, antiviral, antimycosis, antiallergic, antiphlogistic, antineoplastic, antiscratch and drying properties, as well as show the cytological and antimetabolic activities. The biocidic substances present in the electrochemically activated anolyte are not toxic for somatic cells because are represented by oxidants similar to those that produce cells of live organisms.

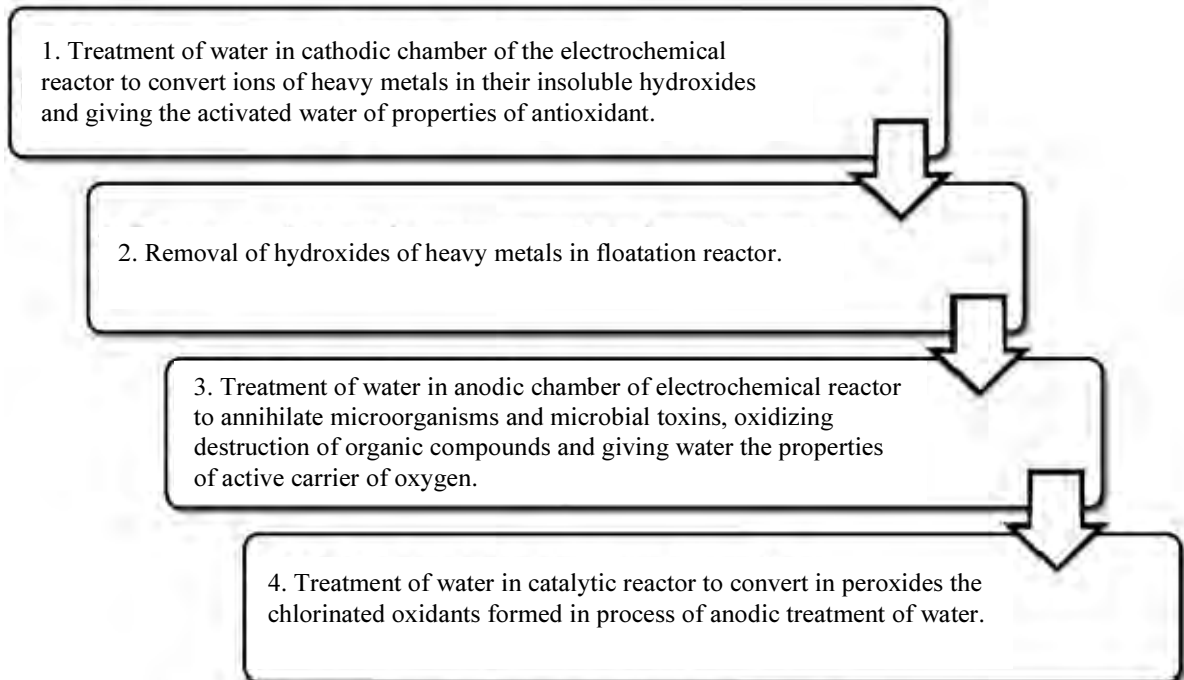
The process activation of water and water-based solutions in non-reagent influences results in appearance of their anomalous characteristics and abnormal reactivity. Such environments are used in various spheres of public economy. Thus, agricultural farms use activated water in producing of environmentally pure nitrogen fertilizer, preplant treatment of seed in purposes of control of pests, technologies of decontamination of grain and grain products, storage of citrous fruits, stimulation of increment of weight of animals and poultry, as well as in purposes of prolongation of terms of storage of fruits and vegetables.

The electrochemically activated water is used in food industry, technologies of hydrolysis of starch, producing of dry concentrate of tea, producing of carbonated beverages and pectin, inversion of sugar, regeneration of oxidized fats, producing of macaroni, bear, medicinal preparations and biologically additives. The activated water is used in sanitary treatment of water pipes and technological packing etc.

However the data on use of electrochemically activated water in technologies of producing of meat products is still limited, what shows on actuality and perspectiveness of the following studying of this problem. The method of electrochemical activation does not require of big expenses of labor. To activate water, operator passes its stream through the diaphragm electrolyzer. The liquid

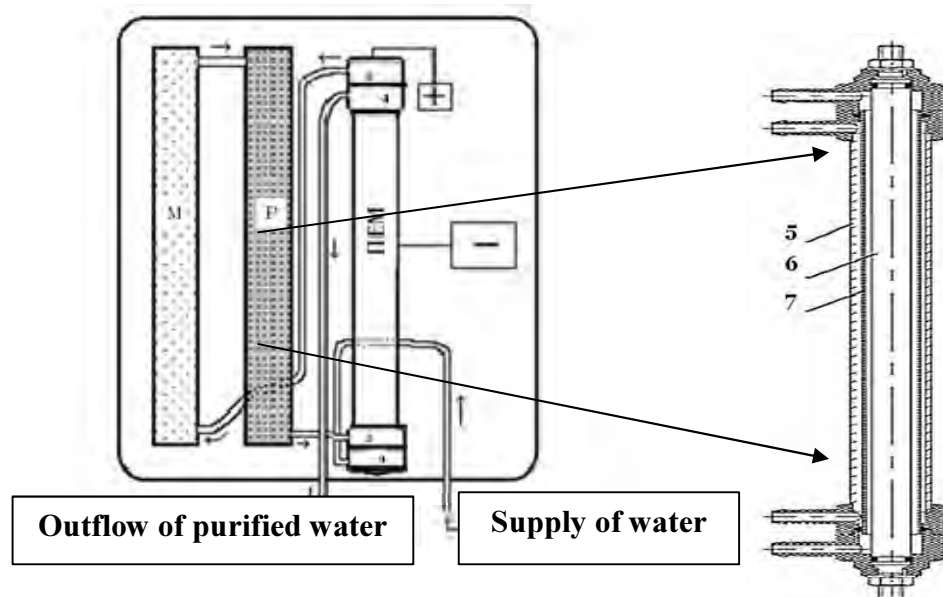
passes in influence of electric field of high voltage into the metastable (activated) state character for high oxidizing properties of anolyte and reducing properties for catholyte.

The process is realized in activators of various types in sequence as follows (Fig. 2.37).



**Figure 2.37** *Technological scheme of electrochemical activation of water*

The typical functional scheme of electrochemical activation of ware is shown on Figure 2.38.



**Figure 2.38** *Typical functional scheme of electrochemical activation of water*  
 1, 2, 3, 4 – connecting pipes, 5 – cathode, 6 – anode, 7 – diaphragm, M – half-way container, P – catalytic reactor, IEM – flow-through electrochemical modular element

Water passes from the pressure tank by connecting pipe 1 into anodic chamber of free-flowing electrochemical modular element and comes out to half-way container M from its anodic chamber by connecting pipe 2 located in the bottom part of electrolyzer. The preliminary treated water spills over the upper part of container M by short branch pipe into the upper side of catalytic reactor P. After passing of its volume, water passes from its bottom part into cathodic chamber and flows out of it by connecting pipe 4. ПЕМ is the most important element of installation, which consists of 5 – cathode, 6 – anode and 7 – diaphragm.

The anodic treating of water results in forming in it during part of second by the highly reactive oxidizers of  $\text{Cl}_2$ ,  $\text{ClO}_2$ ,  $\text{HOCl}$ ,  $\text{O}_2$ ,  $\text{O}_3$ ,  $\text{H}_2\text{O}_2$ ,  $\text{OH}^\cdot$ ,  $\text{HO}_2$ . Depending of grade of mineralization and speed of flowing of water, concentration of oxidizers may vary in limits of  $15 \div 150 \text{ mg/dm}^3$ . *This process results in annihilation of all microorganisms*, which decay to absolutely safe substances, especially water and carbon dioxide. Such technology leads also to decomposition to safe substances of toxic organic compounds, e.g. phenols, microbial toxins etc.

Water that was treated in the cathode chamber preserves its property of donor of electrons for the term of up to 48 hours. Therefore, the cathodically treated water, which does not contain any outside additive and preserves its biological compatibility with live cells, obtains the properties of effective antioxidant that assists in normalization of function of cell's membranes of organisms of men and animals. The redox potential of such water is close to those of cells of men, what permits to normalize the energetic balance of their organisms and ensure the favorable conditions of passing of all necessary biological processes.

The anolyte has the clearly expressed bactericidal properties and the catholyte – the strong alkaline ones similar to those that form in applying in meat raw materials of phosphates. Such its properties assist in strengthening of capability of meat raw materials to bond and hold the additional quantities of water. Treatment of meat by catholyte permits to inhibit negative processes of microbiological and hydrolytic character, what permits to prolong terms of storage of products. Use of procedure of electrochemical activation assists also in decreasing of hardness of water and content of toxic elements in it, what is the important factor in rising of environmental goodness of produced products.

Scientists found the cardinal solution, which permitted to rise considerably effectiveness of processes of treating of meat bulks and prolong terms of their storage in cooled state in decreasing at the same time of spending of energy because of origination of possibility of rising of temperature of their storage. This effect is reached in initial treatment of meat by the composition of anolyte and mustard prepared in certain ratio of components. Such type composition must have the pH value not more of 3, redox-potential minimum of 1000 mV, and content of active chlorine at least of 0.03 %. The technology of preparation of bulks for storage presumes their washing by suspension of mustard in anolyte during  $8 \div 10$  minutes or soaking into the tank with this suspension for the term of  $3 \div 6$  minutes. The quantity of suspended mustard, redox-potential of anolyte and temperature of storage depend of the set term of storage of meat (Table 2.21).

Table 2.21

*Terms of storage of meat treated by suspension of mustard in anolyte, days*

Properties of anolyte		Concentration of mustard in the suspension, %				
pH	Redox-potential, mV	0	1,0	1,5	2,0	2,5
<i>Temperature 1°C</i>						
2.0	1200	17	17	18	19	19
2.5	1080	16	16	16	18	18
3.0	1000	14	14	15	16	16
<i>Temperature 5 °C</i>						
2.0	1200	13	13	14	16	16
2.5	1080	12	12	14	15	15
3.0	1000	10	10	12	13	13

There exists also the information on use of electrochemically activated water in processes of reprocessing of meat of poultry. The catholyte with values of pH = 10 and more, redox-potential of 700 mV and less is used for twofold washing of technological equipment and manufacturing premises with interval between treatments of 5 minutes and total time of exposition of 12 minutes.

The neutral anolyte that have the redox-potential of 800 mV and biocatalytic activity at least of 150 mg/dm<sup>3</sup> is used for disinfection of technological equipment and manufacturing premises, treating of surface of eggs to eat in their immersing into the solution for the term of 6 minutes, treatment of bulks of broilers before they would be put on storage in refrigerating chambers. The one more sphere of application of electrochemically activated water is its use in producing of milled meat of poultry.

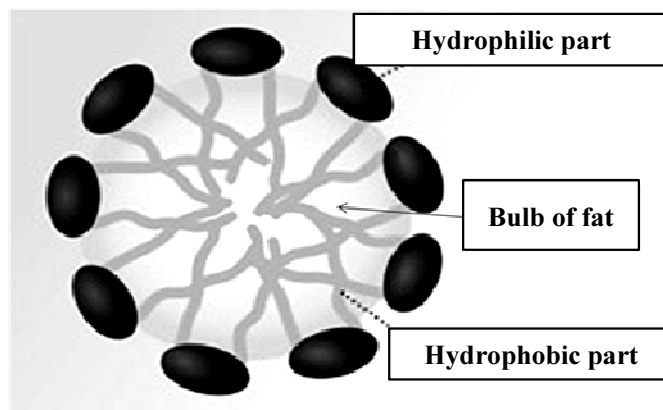
## **2.7 Emulsifiers and stabilizers**

The category of *emulsifiers* includes substances, which simplify the process of emulsifying and add stability for the formed emulsions. Such their action is conditioned by their property to accumulate on the interface of two liquid phases, decrease the interphase tension and form the protective layer on surfaces of droplets, what prevent coagulation and coalescence of milled particles. Emulsifiers are, for example, components of protective acid-base mantle of skin. Their presence assists in keeping of its natural humidity and prevents penetration of infections inside. The protective mantle of normal skin represents itself the emulsion of type of “oil in water”, and the emulsifying agents present in it are the fatty acids.

The natural emulsifiers are produced from lecithin of lanolin, some of emulsifiers of new generation have the composition closely similar to those ones of animal and vegetative origin and are the derivatives of sugar and glycerol (e.g. glycerol or polyglycerol esters of fatty acids). Use of emulsifiers decreases considerably the probability of emerging of technological defects in producing of sausages. The favorable influence of emulsifiers is based on effect of forming of protective membrane around the fatty bulbs. The boiled sausages prepared with use of emulsifiers are more stable in mechanical and thermal treating. Besides, the

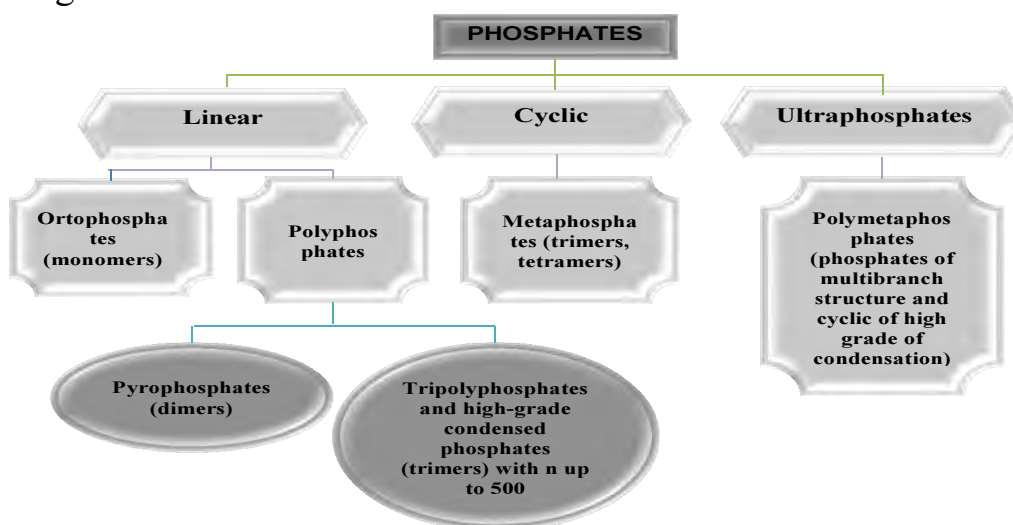
finished products have the bettered organoleptic properties because of eliminating of forming in it of separated phases of jellies and fats.

Emulsifiers decrease considerably also the probability of emerging of technological defects in process of producing of boiled sausages and other type meat products. The favorable influence of emulsifiers on quality of minced meats has the base of forming of protective film around the bulbs of fat (Fig. 2.39):



**Figure 2.39** *Mechanism of action of emulsifiers*

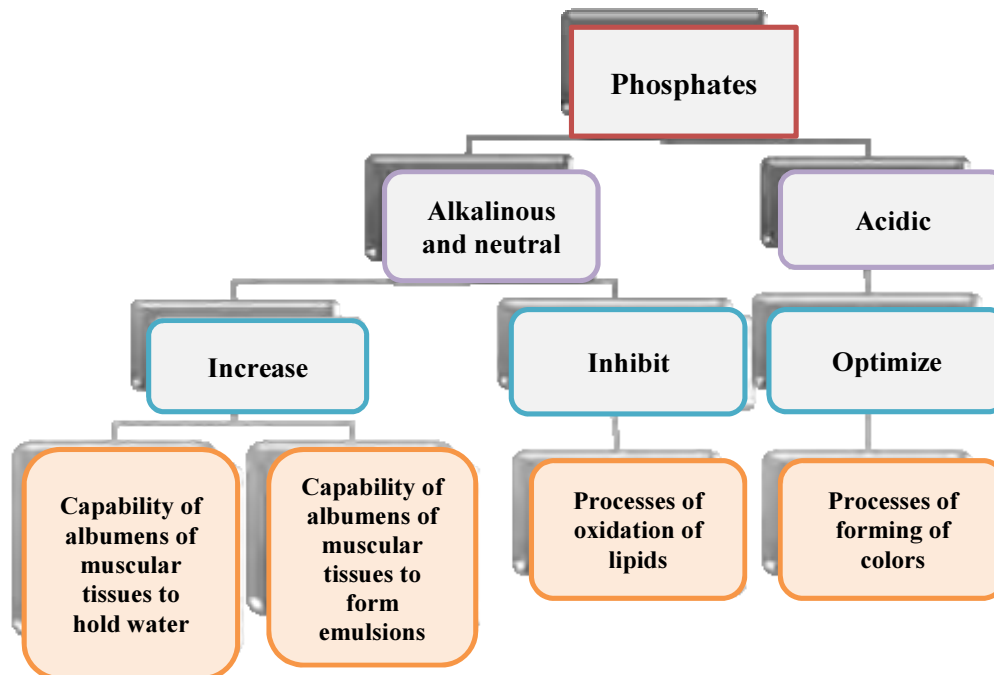
The typical examples of emulsifiers of natural origin are phospholipids. The most often used its form is the mix of natural lecithines (mix of fractions of phosphatides extracted by physical methods, e.g. those that are based on use of enzymes, from objects of zoic or vegetative origin) and their synthetic analogues – ammonium phosphatides.. The functional additives used in processes of producing of meat products the most often are phosphates, which have the high emulsifying potential and stabilize state of foodstuffs. The alimentary phosphates used in processes of producing of meat products are sodium and potassium salts of phosphorous acids ( $H_3PO_4$ ,  $H_4P_2O_7$ ,  $H_5P_3O_{10}$  and  $HPO_3$ ), which classification is shown on Figure 2.40.



**Figure 2.40** *Classification of phosphates by their structure*

The influence of listed compounds on conditions of meat fats and albumens depends considerably of level of acidity of the system. The acidic phosphates may

worsen the capability of meat to hold water, neutral ones are not enough active, and the alkalinous phosphates may shift pH of the mix into the alcalic side, what may lead to destruction of albumens and dissociation of fats, what would give products the unpleasant taste (Fig. 2.41).



**Figure 2.41** *Technological effects of phosphates*

Therefore, use of the only one type of phosphate cannot assure in most cases of reaching the desirable effect and the preferable method of operation in this case is use of mixes of acidic, neutral and alkalinous phosphates. Use of such mixes permits to rise and stabilize capability of meat mixes to hold water and retain its pH on level of not more of 6.5, what permits to preserve their organoleptic properties practically the invariable.

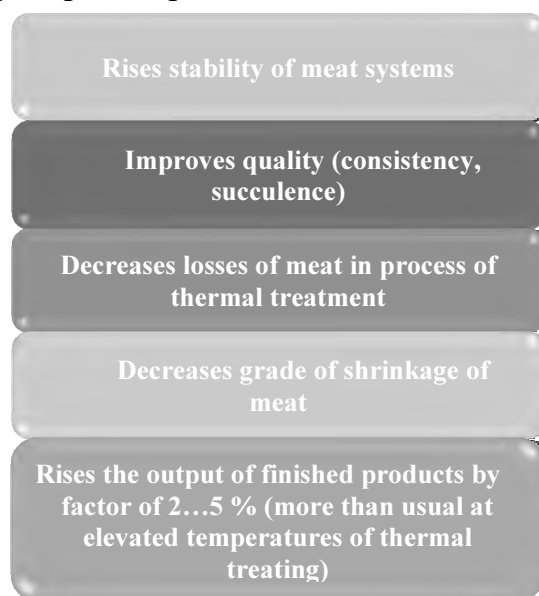
Rising of capability to hold water may be explained by those that in usual state of meat ions of calcium present in the system form “bridges” between the polypeptide chains of meat, which block access of water to polar groups of albumens. Presence of phosphates results in breaking of these links because of binding of calcium ions in compounds insoluble in water. As a result, the polypeptide chains stray of one other, what simplifies passing of water to polar groups liberated in removal of calcium.

The one of principal causes of deterioration and worsening of taste and flavor of meat and meat products is development of processes of oxidation. The effect of phosphates as antioxidants is conditioned by their capability to bind ions of bivalent metals, primarily of iron present in pigments of meat and blood, and inhibit so the rate of processes of oxidation of lipids of meat. The most effective oxidants of this class are sodium and potassium piro- and tripolyphosphates. Besides, phosphates assist in intense swelling of muscular albumens and augment viscosity of minced meats.

The mechanism of influence of phosphates on properties of meat products is of multifactor character. Rising of level of pH of the environment above the isoelectric potential of muscular albumens assists in rising of level of holding of water but

complicate forming of color conditioned considerably by progress of processes of oxidation taking place in lipid and pigment systems of meat. Because polyphosphates (alkalinous and neutral) have properties of antioxidants, their use assists in stabilization of coloration of finished meat products. The acidic phosphates make better color of meat articles but one has to use them in limited quantities and do it in mixing with the alkalinous phosphates to prevent the excessive acidification of minced meat, hence decreasing of quantity of water and prevention of forming of swells of bouillon and fat in finished products after their thermal treatment.

Therefore, use of phosphates permits to attain the numerous effects (Fig. 2.42).



**Figure 2.42** *Effects of use of phosphates in meat systems*

Use of phosphates is the most effective in reprocessing of frozen meat and raw materials that have indications of PSE. Because of considerable increasing of such meat during last years there arose the need of broadening of critical pH diapason of used phosphate preparations from  $6.9 \div 7.0$  recommended in earlier time to 9.0.

The norms of used technologies demand of use of phosphates that have the following properties:

- high solubility,
- absence of nubbins formed in process of storage,
- absence of exterior taste.

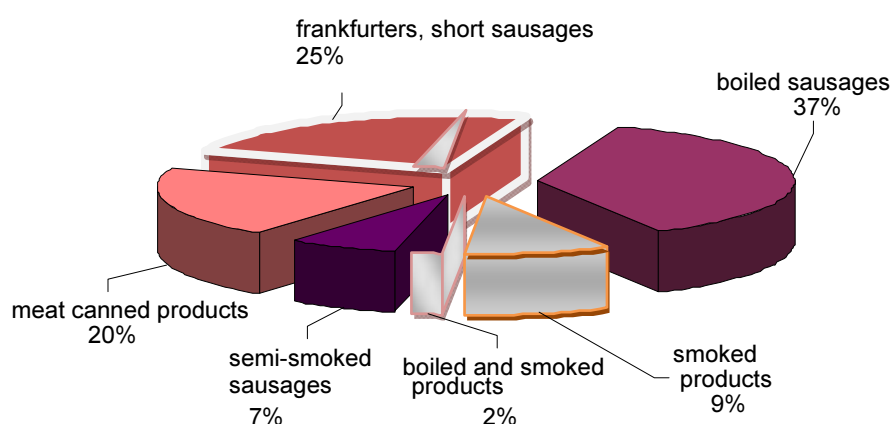
Dozing phosphates, technologists have to take into consideration such their characteristic as concentration of  $P_2O_5$  and maximum permissible norms of their content in finished products. For example, the standard of DSTU "Boiled sausages. Specifications" establishes that the mass fraction of total content of phosphorus in such products (in recount on  $P_2O_5$ ) must not be more of 1.0%. The norms of SanPiN 2.3.2.1293-03 "Hygienic norms of use of food additives" established that quantity of phosphates added into meat products must not be more of 5 grams of  $P_2O_5$  per kilogram of meat raw materials (0.5 %). Capacity of market of phosphates used in producing of various kinds of meat products show the Table 2.22 and Figure 2.43.



Table 2.22

***Dosing and capacity of market of phosphates and phosphate preparations used in production of various kinds of meat products***

Type of finished product	Output for the state of 01.01.2010, tons	Dosing, %	Capacity, tons
Frankfurters, short sausages	61435	0.3-0.6	225.6-451.3
Boiled sausages	102134	0.3-0.6	342-683.8
Smoked products	29920	0.2-0.5	67-167.2
Boiled and smoked products	11435	0.3	33
Semi-smoked sausages	43520	0.3	131
Meat canned products	15102	0.3	371
<b><i>Capacity of the market, tons</i></b>			<b>634.6-1837.3</b>



***Figure 2.43 Capacity of market of phosphates used in producing of various kinds of meat products***

**Phospholipides.** The most often used substances of this group of emulsifiers are natural lecithins (E322), which have the synthetic analogue realized under the commercial grade of "ammonia phosphatides" (E442). The norms of EU Directive establish that such group compounds represent itself the mix of fractions of phosphatides extracted out of objects of zoic or vegetative nature by physical methods including those that are based on use of enzymes. The content in this mix of phospholipids insoluble in acetone must not be less of 56 ÷ 60 %.

**Esters of sorbite (E491-496)** is the group of food additives used in all branches of food industry represented by esters of hexatomic alcohol sorbite mixed with its partly dehydrated derivatives and saturated fatty acids – lauric, palmitic, stearic and oleic. This group stabilizers includes also esters formed by succinic, vinic, citric, oxalic and acetylcitric acids with saturated alcohols that has the paired quantity of atoms in their carbon chains (cetilic, stearinic etc.).

**Stabilizers** are represented by substances or groups of substances applied into meat products in purposes of stabilization of their consistency. They are used in

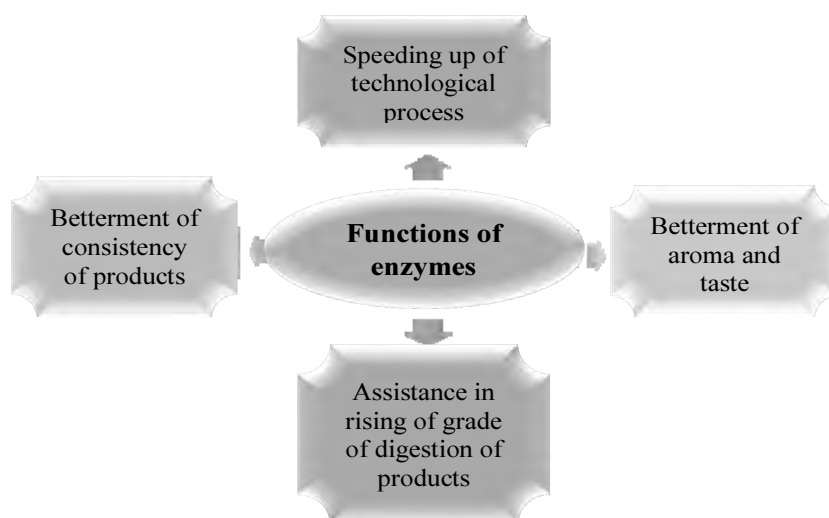
producing of all types of sausages, semi-manufactured and canned products, hams in and without cases etc. Besides, they are used as components of brines used for injecting of delicacy products.

Stabilizers represent itself the fine powders of white or beige color that have no the clearly expressed smell and taste. The meat industry uses presently the more often the combined preparations, which composition is such that its components complete and amplify effect of one other and carry at the same time some technological functions. The examples of such mixes are compositions of emulsifiers, stabilizers and stiffeners. Their qualitative composition and ratio of components may vary widely and depends of properties of products to produce, its destination of use, technology of fabrication, conditions of storage, methods of realization and so on.

The typical components used in these mixes are carragenans stabilized by potassium chloride, as well as gums of guar, xantan, tara, carob tree. It is possible to discriminate the group of products that contain mixes of hydrocolloids and functional additives such as phosphates ascorbates, saccarides.

## 2.8. Enzymes

Many of traditional processes realized in the meat—processing industry are revised presently because of need of introduction of novel techniques of operation and betterment of quality of produced foods. To reach these goals, there were developed various technologies character at the same time by shortening of terms of their producing. For example, producers of sausages use fixers of mioglobine and various additives put in semi-finished products at various stages of technological process. The one of kinds of additives used in said purposes are enzymes and enzyme preparations that carry the numerous important functions (Fig. 2.44). The enzyme preparations differ of enzymes by presence in their formulations of ballast substances.



**Figure 2.44**     *Functions of enzymes put in meat products*

Enzymes are the organic catalysts of albuminous nature used in providing of optimum sequence and interrelation of numerous biochemical transformations in cells

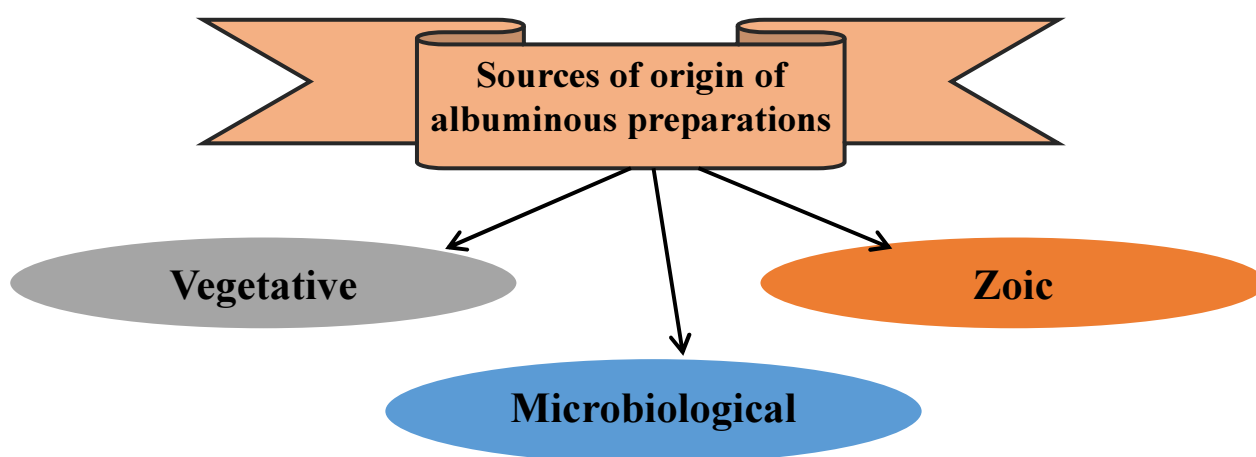
of live organisms. To produce enzymes, there are used mostly certain types of microorganisms – bacteria, mold fungi, yeasts etc., which synthesize enzymes in process of their vital activities. Being extracted from their cells by special methods, enzymes may be used in food industry. Most such preparations contain the mix of basic enzyme with some complementary ones. However there exist also the preparations that contain the sole enzyme.

The accepted nomenclature assigns all enzymes the ending of *"aza"*. The enzyme is named after the substrate it transforms or by reaction it accelerates. Thus, enzymes, which split albumens (proteins) are named as proteases and enzymes that split fats (lipids) are named as lipases and enzymes that accelerate reactions of hydrolysis are named as hydrolases.

The need of use of enzymes is conditioned by those that composition and structure of meat varies, as well as contains in addition to muscular tissues the collagen and elastin fibers of connecting tissues, which have the considerable hardness and toughness. Use of enzymes permits to improve the consistency of meat because they soften structures of coarse and strong fibers of muscular and connecting tissues and assist in the same time in rising of grade of digesting of products and improving of their taste and flavor. The principal spheres of use of enzymes are producing of stiff and semi-manufactured products, sublimated meat and many kinds of sausages, which need of their afterripening (raw-dried and raw-smoked products). It is obvious that use of enzymes in producing of meat products is safe because these ones are products of albuminous nature and loss so their activity after thermal treating of meat – its boiling, baking, roasting etc.

The enzyme preparations to be used in producing of meat products have to be capable to influence on structure of muscular connecting tissue, be active at possibly high temperatures, function in subacid and subalkaline environments and be nontoxic for men.

Enzymes are classified by their origin (Fig. 2.45).



**Figure 2.45**     *Classification of enzyme preparations by features of their origin*

The category of *enzymes of zoic origin* includes preparations extracted out of endocrinous enzyme system of pancreatic gland (pancreatin, trypsin and chemotrypsin) and mucous membrane of stomach (pepsin). The enzyme the most often used in meat industry is pancreatin extracted out of porcine pancreatic gland,

which has the considerable collagenous and elastase activity. Said enzymes are used in treatment of beef and other raw materials character by the increased quantity of connecting tissues. Such its application is conditioned by those that tripsin, pepsin and chemotripsin do not influence of kinetics of hydrolytic destruction of collagen and elastin because this preparation remains the only one that may be used in this destination.

The most often used enzymes of vegetative origin used in producing of meat products papain, ficin and bromelain.

- papain is the soluble in water yellow powder extracted out of juice of papaya, which is active in range of  $\text{pH} = 5 \div 7$  and temperatures up to  $70^\circ\text{C}$ . Heating to temperature more of  $80^\circ\text{C}$  leads to its inactivation. This enzyme shows the biggest activity in respect of actomiosin, but is capable to hydrolyze collagen and elastin at temperature of  $60^\circ\text{C}$ . The last property stipulates its use in purposes of softening and speeding of process of afterripening of stiff meat,
- bromelain is proteinaza extracted out of fetus on pineapple. It is the most active in range of  $\text{pH}$  of  $6.0 \div 7.0$ . the enzyme is stable in the wide range of temperatures and is character by high optimum of temperatures of operation. The product has properties closely similar with those of papain. The enzyme actively influences on collagens and elastases present in denatured albumens,
- ficin is the enzyme extracted out of juice, stems and leaves of papaya. The optimum of its activeness appears in neutral environments at temperatures of  $60 \div 65^\circ\text{C}$ . If temperature is lower, this enzyme provokes quick hydrolysis of muscular tissues and is active in destruction of denatured collagen and elastin.

Microbiological enzymes – oryshin and teryzin are extracted by chemical methods out of products of vital activity of bacteria of genus of Bacillus, micromicets Micor, Aspergillus, Rhizopus, Penicillinus, as well as numerous actinomicets. Most of preparations are inefficient as regards to native collagen and elastin, but actively hydrolyze albumens of muscular fibers. The biggest collagenous activity have enzymes synthesized by bacteria of genus of Clostridium Histolyticum.

Use of enzyme preparation in technological practice is realized by methods as follows:

- injection of solutions of enzymes into the blood-vascular system of animals in  $8 \div 10$  minutes before they would be slaughtered. This method ensures good its distribution in all parts of their bulks by circulating blood. Use of enzymes shortens the period of afterripening of meat, improves quality of raw and assists in rising of output of meat. Concentration of enzyme preparations is of  $0.05 \div 0.1\%$ , as a rule, but there are known the cases of use abroad of proteolytic enzymes in aqueous solutions, which concentration may be of up to  $3\%$ . However this method may result in overdosing of enzymes and abnormal functioning of organisms, e.g. of excessive softening of liver, what makes it unusable,

- treatment of surface of raw materials (in use of aerosols or in their immersion into the working solutions). This method is especially effective in work with the preliminary tenderized meat and complex use of technologies of its treatment by enzymes, tenderization done with use of knives, pricking, striking, massaging, tumblering,
- injection of enzymes in meat raw together with multicomponent brines. This method is effective and the simplest of listed ones, therefore used the most often.

### **Checking questions**

1. Give characteristic of basic groups of food additives.
2. How do you understand the fact of multifunctionality of food additives ?
3. List the basic ingredients use in modern technologies of meat-processing industry.
4. What information must be put on packing of foodstuff in obligatory manner ?
5. What are the perspective sources of alimentary albumens ?
6. What is the mechanism of influence of finely soluble additives on stability of minced meat? Substantiate your answer.
7. What are the positive effects of use of zoic albumens in producing of sausages ?
8. What was variation of quality of meat products occurred in Ukraine in process of intensification of methods of producing and expansion of their assortment ?
9. What is the essence of ideology of consumption of albumens ?
10. What are principal factors that cause the need of use of albuminous preparations in producing of meat products ?
11. Give the short characteristic of types of soy albumens used in meat-processing industry.
12. Describe the classical technology of producing of boiled meat products.
13. Describe the modern technology of producing of boiled meat products.
14. Mention the positive effects of use of zoic albumens in processes of producing of sausages.
15. What are the principal causes of use of dietary fibers in modern technologies of fabrication of meat products ?
16. What are the basic functions of dietary fibers in meat products ?
17. Name the basic functions of hydrocolloids in meat systems.
18. Mention the methods of introduction of tasty additives in meat products ?
19. Name the reasons of use of flavoring agents.
20. What are antioxidants ? Give examples of such substances.
21. What is the principal destination of use of emulsifiers in meat systems ?
22. Mention the principal reason of use of stabilizers used in producing of meat products.
23. List and characterize the principal functions of enzymes in meat systems.
24. What groups exist in classification of foodstuffs by their nutritional value ? give examples for each group.
25. What is the biological value of meat product ?
26. What are differences of zoic and vegetative albumens ?

27. What is the biological value of meat product ?
28. What are the biologically active additives ?
29. What substances contain the biologically active substances ?
30. What are nutricevtics ? Give the brief characteristic of their effect.
31. Mention the rational methods of compensation of deficit of vitamins in meat products.
32. What restriction in production of biologically active additives do you know ?

### Literature

1. Азрилевич М.Р. Заменители сахара // Пищевые ингредиенты. 2002. — №1. — С. 42—45
2. Баль-Прилипко Л.В, Лозова О.М Удосконалення технології м'ясних продуктів за допомогою комплексних функціональних сумішей, Київ: НУБІП України. Матеріали міжнародної науково-практичної конференції молодих вчених, аспірантів і студентів. 20-22.04.10, с. 92
3. Баль-Прилипко Л.В, Лозова О.М "Магічні" речовини в харчовій промисловості: використання функціональних добавок при виробництві м'ясних виробів, Киев: Мясное дело. - №3, 2010, с. 34-36
4. Баль-Прилипко Л.В. Актуальні проблеми м'ясопереробної галузі / Л.В. Баль-Прилипко: Підручник. — Київ, 2011. — 288 с.
5. Баль-Прилипко Л.В. Інноваційні технології якісних та безпечних м'ясних виробів / Л.В. Баль-Прилипко: Монографія. — Київ, 2012 — 207 с.
6. Березов Т.Т., Коровкин Б.Ф. Биологическая химия: Учебник / Под ред. С.С. Дебова — М.: Медицина, 1983. — 752 с.
7. Биологически активные добавки в питании человека / Упельян В.А., Суханов Б.Н., Андриевских А.Н., Поздняковских В.М. — Томск: Научно-техническая литература, 1999. — 229 с.
8. Баль-Прилипко Л.В. Інноваційні технологічні рішення при виробництві варених ковбас / Л.В.Баль-Прилипко, Б.І. Леонова, О.П. Гармаш // Продовольча індустрія АПК. - 2012.- №3.- С. 20-23.
9. Баль-Прилипко Л.В. Сучасні концептуальні принципи інноваційних технологій виробництва якісних та безпечних м'ясних виробів /Л.В. Баль-Прилипко //Продовольча індустрія АПК-2011.- №4.- С. 10-13.
10. Баль-Прилипко Л. В. Сучасні функціональні інгредієнти для м'ясних продуктів / Л. В. Баль-Прилипко, Б. І. Леонова , В.О.Корсун // Мясное дело. — 2013. — № 3-4. —С. 27 — 29.
11. Баль-Прилипко Л.В. Технологічні аспекти якості продуктів нового покоління / Л.В. Баль-Прилипко, Я.І. Бабенко //Мясное дело. — 2012.- № 10. — С.18-20.
12. Баль-Прилипко Л.В. Характеристика та класифікація біологічно активних добавок (частина 1) / Л.В. Баль-Прилипко //Мясное дело. — 2011. - №2. — С. 36-39.
13. Баль-Прилипко Л.В. Характеристика та класифікація біологічно-активних добавок (частина 2) / Л.В. Баль-Прилипко // Мясное дело. — 2011. - № 3. — С. 24-27.

14. Бугай М. Харчування і здоров'я нації. Для нормальної життєдіяльності людини потрібні екологічно чисті і безпечні продукти / Бугай М.П.// Виробництво і економіка, №2 – К., 2006. – С. 8
15. Бурштейн А.И. Методы исследования пищевых продуктов.- К. Медицина, 1963.-515 с.
16. Вивчення жирнокислотного складу м'яса та ковбасних виробів при зберіганні з комбінованими консервантами / Л.В.Баль-Прилипко та ін.- "Харчова промисловість". Міжвідомчий тематичний науковий збірник, №42. - К.: "Урожай", 1996, с. 120-124.
17. Виды и классификация ГМО, Электронный ресурс:  
<http://gmoobzor.com/stati/vidy-i-klassifikaciya-gmo.html#ixzz40Pp0X0Fn>
18. ВОЗ. Серия технических докладов №738. Оценка некоторых пищевых добавок и контаминантов. 41 доклад Объединённого комитета экспертов ФАО/ВОЗ по пищевым добавкам. – Женева, 1993. – 314 с.
19. Гигиенические требования по применению пищевых добавок: Санитарно-эпидемиологические правила и нормативы. – М.: Федеральный центр Госсанэпиднадзора Минздрава России. СанПиН 2.3.2.1293-03
20. Головні засади формування смаку, аромату й післясмаку готових м'ясопродуктів, БальПрилипко Л.В, Тернополь: World Meat Technologies. - №4 2010
21. Голубев В.Н. Основы пищевой химии. — М.: Биоинформсервис, 1997. — 223 с.
22. Даниленко И.П. Справочник по качеству продуктов животноводства. - К.: Урожай, 1988
23. Дефіцит білка можна поповнити / Л.В. Баль-Прилипко.- К.: Харчова і переробна промисловість, №5, 2000, с. 20-22
24. Долгая М.М. Пищевые добавки и их использование в производстве продуктов питания. – М.: ВНИИЦентр, 1987
25. Жаринов А.И., Соколова Н.А. Мясопродукты, потребитель и некоторые аспекты современного маркетинга // Вестник «Аромарос-М». – 2005. - №3. – С. 53-62
26. Жаринов А.И., Ивашкин Ю.А. Проектирование комбинированных продуктов питания // Все о мясе. – 2004. - №2, №3. – С. 16-21, С. 6-15
27. Журнал "Пищевые ингредиенты. Сырье и добавки" 2001-2004
28. Закон України від 24.02.1994 № 4005-ХІІ "Про забезпечення санітарного та епідемічного благополуччя населення" /// <http://www.zakon.rada.gov.ua>
29. Закон України від 23.12.1997 № 771/97-ВР "Про безпечність та якість харчових продуктів" /// <http://www.zakon.rada.gov.ua>
30. Закон України від 14.01.2000 № 1393-ХІV "Про вилучення з обігу, переробку, утилізацію, знищення або подальше використання неякісної та небезпечної продукції" /// <http://www.zakon.rada.gov.ua>
31. Закон України від 24.10.2002 № 191—IV-2002 "Про внесення змін у Закон України "Про безпечність та якість харчових продуктів"/// <http://www.zakon.rada.gov.ua>,

32. Закон України від 01.12.2005 № 3161-IV "Про захист прав споживачів" /// <http://www.zakon.rada.gov.ua>
33. Закон України від 31.05.2007 № 1103-V "Про державну систему біобезпеки при створенні, випробуванні, транспортуванні та використанні генетично модифікованих організмів" /// <http://www.zakon.rada.gov.ua>
34. Заяс Ю.Ф. Качество мяса и мясопродуктов.- М.: Легкая и пищевая промышленность, 1981 .-480 с.
35. Зонин В.Г. Современное производство колбасных и солёно-копченый изделий. – СПб.: Профессия, 2006. – 224 с.
36. Інноваційні технології бездимного копчення при виробництві ковбасних виробів, Баль-Прилипко Л.В, Шокун В.В., Київ: НУБІП України. Матеріали міжнародної науково-практичної конференції молодих вчених, аспірантів і студентів .20-22.04.2010, с.93
37. Исупов В.П. Пищевые добавки и пряности. – СПб.:ГИОРД, 2000.
38. Колобаев Р.В. Справочник по закупкам продуктов животноводства. – М.: Колос, 1981
39. Наказ Державного комітету ветеринарної медицини від 17.12.2009 р. № 535 "Порядок видачі міжнародних ветеринарних сертифікатів для експорту м'яса птиці в країни ЄС" /// <http://www.zakon.rada.gov.ua>
40. Наказ Мінагрополітики від 01.10.2012 № 590 "Про затвердження вимог щодо розробки, впровадження та застосування постійно діючих процедур, заснованих на принципах Системи управління безпечністю харчових продуктів (НАССР)" /// <http://www.zakon.rada.gov.ua>
41. Настанови щодо застосування ДСТУ ISO 9001-2001 у виробництві харчових продуктів та напоїв. (ISO 15161:2000). ДСТУ ISO 15161:2004. – К.: Держспоживстандарт України, 1993. – (Національний стандарт України)
42. Нечаев А.П., Траубенберг С.Е., Попов М.П. Пищевая химия: Курс лекций: В 2 Ч. – М.: МГУПП, 1998. – 258 с.
43. Люк Э. Консерванты в пищевой промышленности. Свойства и применение./Пер. с нем. Сарафановой Л.А.. – СПб.: ГИОРД,1998
44. Мухаровський М. Система безпеки харчових продуктів / Мухаровський М. // Держстандарт України, № 4 – Харків, 2001. – С. 55
45. О способах обработки колбасных изделий жидкими консервантами / Л.В.Баль, В.С. Гуц, В.Н. Вендичанский.-К.: Пищевая промышленность №3, с. 34-36, 1987
46. Оцінювання відповідності – Настанова щодо використання систем управління якістю організації під час сертифікації продукції. (ISO/IEC Guide 53:2001). ДСТУ ISO/IEC Guide 53:2005. – К.: Держспоживстандарт України, 2005. – (Національний стандарт України)
47. Оцінювання відповідності – Основні принципи сертифікації продукції. (ISO/IEC Guide 67:2000). ДСТУ ISO/IEC Guide 67:2004. – К.: Держспоживстандарт України, 2004. – (Національний стандарт України)



48. Перспективные технологии XXI века: монография / [Баль-Прилипко Л. В., Абдуллин И.Ш., Абуталипова Л.Н. и др.]. – Одесса: КУПРИЕНКО СВ, 2013. – 162 с.
49. Пищевая биотехнология: научно-практические решения в АПК: монография / А.И. Жаринов, И.Ф. Горлов, Ю.Н. Нелепов, Н.А. Соколова. – М.: Вестник РАСХН, 2007. – 476 с.
50. Подобедов А.В. Уникальные свойства сои / А.В. Подобедов // Достижения науки и техники АПК. -2002. - №6. - С. 42-45
51. Постанова Кабінету Міністрів України: Про затвердження переліку харчових добавок, дозволених для використання у харчових продуктах
52. Продукти збагачені соєю – вживання їх запобігає виникненню злоякісних новоутворень / Л.В.Баль-Прилипко та ін. К.: Харчова і переробна промисловість, 2000, №5, с.20-22
53. Рослинні композиції для м'ясних консервів / Л.В.Баль-Прилипко та ін.-К.: Харчова промисловість, №6, 2000, с. 21-22
54. Санитарные правила и нормы 13-10 РБ 2002 "Гигиенические требования к качеству и безопасности пищевых добавок и их применению"
55. Санитарные правила и нормы. Гигиенические требования по применению пищевых добавок , Омега-Л, 2007 г.
56. Сарафанова Л.А., Кострова И.Е. Применение пищевых добавок.
57. Семенова А.А. Комплексная оценка технологического качества пищевых добавок, применяемых в мясной промышленности. / Семенова А.А. // Все о мясе. – 2009, №2. – С. 26-32
58. Система сертифікації УкрСЕПРО. Порядок проведення сертифікації продукції. ДСТУ 3413-96. – К.: Держстандарт України, 1996. – (Національний стандарт України)
59. Система сертифікації УкрСЕПРО. Процедура визнання результатів сертифікації продукції, що імпортується. ДСТУ 3417-96. – К.: Держстандарт України, 1996. – (Національний стандарт України)
60. Системи управління безпечністю харчових продуктів. Вимоги. ДСТУ 4161-2003. – К.: Держспоживстандарт України, 2003. – (Національний стандарт України)
61. Срок годности пищевых продуктов: Расчет и испытание / Под ред. Р.Стеле, пер. с англ. В.Широкова, под общ. ред. Ю.Г.Базарной. – СПб.: Профессия, 2006. – 480 с.
62. Соеві компоненти в м'ясних виробках /Л.В.Баль-Прилипко.-К.: Харчова і переробна промисловість, 1999, с. 24-25
63. Сучасний стан питання якості та безпечності зерна та зернопродуктів в Україні, Баль-Прилипко Л.В, Хомічак Л.М., Слива Ю.В - Киев: Хлебопекарское и кондитерское дело.- №5, 2010, с.
64. Семенова А.А. Структурирование понятия технологического качества пищевых добавок. / Семенова А.А. // Все о мясе. – 2009, №3. – С.
65. Семенова А.А. "Методология комплексной оценки качества пищевых добавок и обоснование их адекватного применения в мясной промышленности", Специальность 05.18.04 – технология мясных,

молочных, рыбных продуктов и холодильных производств, Диссертация в виде научного доклада на соискание ученой степени доктора технических наук

66. Указ Президента України від 13.07.2005 "Про заходи щодо вдосконалення діяльності у сфері технічного регулювання та споживчої політики" /// <http://www.zakon.rada.gov.ua>
67. Хоменко В.І. Ветеринарно-санітарна експертиза з основами технології і стандартизації продуктів тваринництва, т. 1 / Хоменко В.І. – К.: Фірма "ІНКООС", 2005. – 416 с.
68. Commission Regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labeling of organic products with regard to organic production, labeling and control
69. Directive 2001/18/EC "On the deliberate release into the environment of genetically modified organisms"
70. Directive 2001/95/EC "On general product safety"
71. Directive 2004/95/EC "On environmental liability with regard to prevention and remedying of environmental damage"
72. EU Council Directive 93/43/EEC "On hygiene of foodstuffs"
73. EU Council Resolution 834/2007 (EC) of 28 June 2001 on organic production and labeling of organic products and repealing of Regulation (EEC) N0 2092/91
74. EU Directive 2008/1/EC concerning integrated pollution prevention and control

## INTRODUCTION AND USE OF BIOLOGICALLY ACTIVE SUBSTANCES IN TECHNOLOGIES OF PRODUCING OF MEAT PRODUCTS

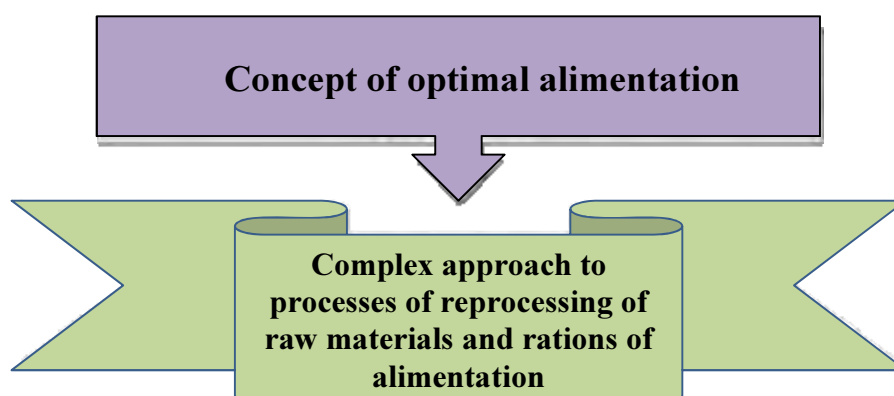
Analysis of global tendencies of progress of food industry shows that one of its perspective trends is development of functional foodstuffs, i.e. products that are characterized by their specified properties.

The character example is the experience of US scientists who developed as early as in 1930-s the national program of amendment of structure of alimentation. It was recommended to bring in ration of men biologically active substances (BAS) and now these additives consume about of 80 % of population of USA and 50 % of European population consume regularly the biologically active additives (BAA) and biologically active substances. Such practice results in practically total disappearance of illnesses induced by deficit of vitamins, microelements, dietary fibers and other substances necessary for normal vital activity. American specialists valued that means spent for buying of bakery enriched by vitamins are recompensed by factor of 5 to 10 in economy of means spent of cure of illnesses that evolve on base of avitaminosis.

Scientists explore the state of alimentation in conditions of scantiness of alimentary resources and specificity of structure of alimentation in modern conditions and proposed on base of collected information the concept of optimal alimentation.

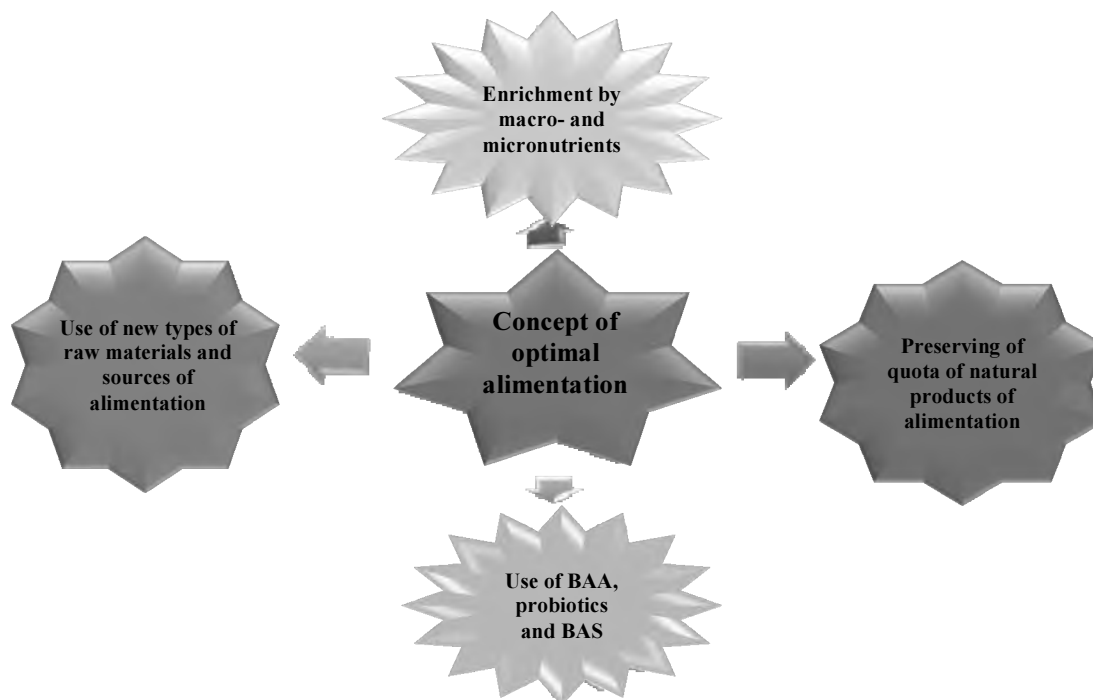
### 3.1 Essence of Concept of Optimal Alimentation

The steady progress of the human society is possible on modern stage of progress of economy only on condition of use of approach to development and introduction of technologies of complex reprocessing of food raw materials and formulation of optimal rations of alimentation (*concept of optimal alimentation*). The fundamental principle of this concept is maintaining of health of nation and assuring of progress of national economy even in conditions of deficit of albumens, vitamins and micronutrients in rations of most of inhabitants (Fig. 3.1).



**Figure 3.1** *Basic principle of concept of optimal alimentation*

The concept includes the constituent elements as follows (Fig. 3.2):



**Figure 3.2** *Concept of optimal alimentation*

The character feature of modern stage of development of food industry is those that men decrease in change of mode of living considerably consumption of energy for their everyday needs but retain their needs in basic nutrients. Such amendments lead to need of essential correction of formula of feeding, namely of more precise definition of data on energetic value and norms of consumption of basic alimentary substances, micronutrients, pre- and probiotics. The special attention has to be devoted in it to need of individualization of structure of alimentation of individual groups of population, role of BAS and minor substances in rising of resistivity of organisms of men, betterment of their health and problems of safety of foods. Taking this ideology into consideration, the dietitians focus their attention to culture and conditions of alimentation, which influence considerably of effectiveness of reflectory reactions (discharge of gastric juice, activity of enzymes etc.), level of digestion and assimilation of food.

The notion of structure of alimentation may be characterized by four basic indices: multiplicity of feeding, intervals between the time of accepting of food, time of eating and distribution of caloricity in structure of meal. The especial significance in process of alimentation have the need of observance of routine of feeding, what assists in generation of behavior reflexes, discharge of full-value gastric juice and betterment of processes of digestion of meal. The optimal factor of repetition of meal (in %) for adults is four-time alimentation in interval of not more of  $5 \div 5.5$  hours between (Fig. 3.3):

1 variant:  
breakfast – 30, dinner – 35-40, afternoon snack –  
10, supper – 20-25



2 variant:  
breakfast -25, second breakfast – 15,  
dinner – 35-40, supper – 20-25

**Figure 3.3** *Optimal variants of distribution of caloricity of ration in four-time alimentation*

The optimal variant of caloricity of meal in practice of three-time eating is as follows: breakfast –  $20 \div 25$  %, dinner –  $45 \div 50$  %, supper not more of  $25 \div 30$  % of daily ration.

Choose of daily ration of any individual is conditioned mainly by social, economic, ethnic, psychological, manufacturing and other factors. This means that most of consumers do not take into consideration in concrete everyday conditions the grade of value of their alimentation. Thus, the data of sociological opinion poll show that 13% of students do not take breakfast at all, 12 % meal twice a day, 41% do not take dinner and 34 % take their supper in the late evening. At the same time most of students meal unsystematically, what results finally in occurrence of their chronic diseases. If s, the industrial processes of producing of foodstuffs must be oriented on fabrication of foods that would be capable to satisfy the physiological needs of men in macro- and micronutrients.

The notion of nutritional value of foods is the characteristic of complex of properties directed on maximum satisfying of physiological needs of men in energy and basic nutritional substances. Respectively, the experimenter has to begin evaluation of this property of concrete foodstuff, set of foodstuffs or daily ration of alimentation in identification of its general chemical composition, determine the grade of its conformity to formula of balanced alimentation and ratio of quantitative content of basic nutrients in it (albumens : fats =  $1 : 1 \div 0.8$ , albumens : hydrocarbons =  $1 : 4 \div 5$ ) and found the so-called integral score. The principle put in the base of such calculation is identification of grade of compliance of each of the most important component of the foodstuff to formula of balanced alimentation calculated in knowing of its chemical composition (quantity of albumens, fats, hydrocarbons, mineral substances and vitamins). At the same time there is possible to identify the energetic value of the product as well. Doing so, one has to take into consideration that the concept of rational alimentation sets that the part of energy liberated in oxidation of albumens in the organism must not be more of 10% of total caloricity of daily ration.

The role of basic sources of energy in foodstuffs belongs to macronutrients – albumens, fats and hydrocarbons, and each one has the certain level of its energetic

value. The coefficients of value of each group of nutrients calculated in taking into account of their average coefficient of assimilation (depends of chemical composition, used method of culinary treatment of the foodstuff etc.) are given in Table 3.1:

**Table 3.1**

***Coefficients of energetic value of macronutrients***

<i>Nutrients</i>	<i>Averaged level of assimilation, %</i>	<i>Coefficient of energetic value</i>	
		<i>Kcal/g</i>	<i>kJ/g</i>
Albumens	84.5	4.0	16.7
Fats	94.0	9.0	37.7
Hydrocarbons:			
➤ assimilated	95.6	3.75	15.7
➤ dietary fibers	-	1-1.5	4.2-6.2

Thus, the knowledge of general chemical composition, mass of the product and coefficients of its assimilation and energetic value permits to calculate its caloricity (energetic value):

$$E = \sum e_i m_i$$

where E means the energetic value of 100 grams of the product, Kcal,

$e_i$  means coefficient of energetic value of component of the product,

Kcal/g,

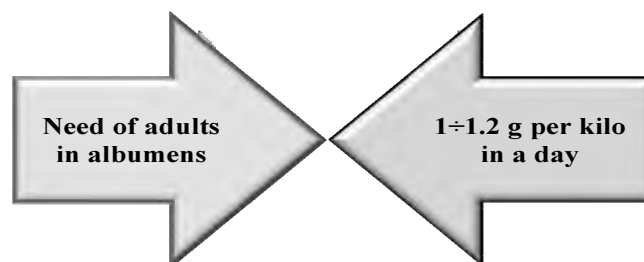
$m_i$  means mass part of the component in the product, %

Foodstuffs are conditionally subdivided by their energetic values by groups as follows:

1. Extraordinary energetic - 400-900 Kcal/100 g.
2. Highly energetic - 250-400 Kcal/100 g.
3. Intermediately energetic - 100-250 Kcal/100 g.
4. Of low energy – up to 100 Kcal/100 g.

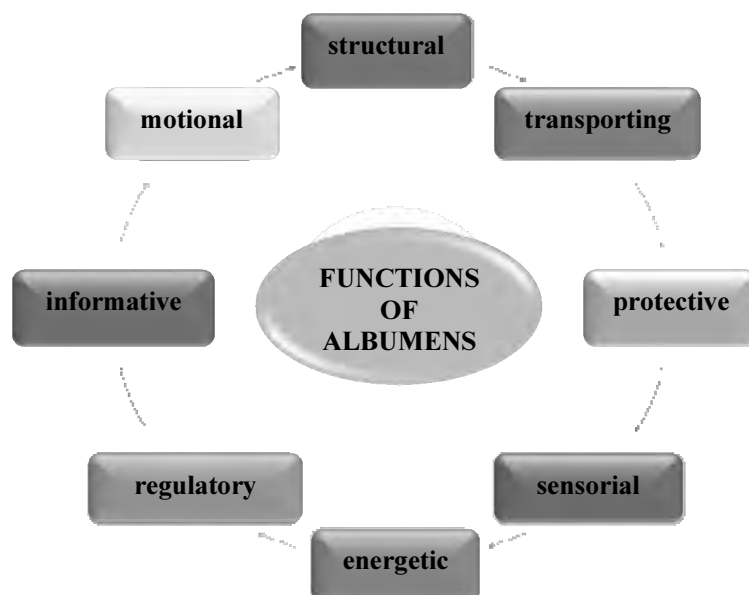
However, despite its importance, work in calculation of energetic value does not give clear understanding of level of *biological value* of the product and its individual components too.

Biological value is the property, which permits to characterize the qualitative composition of the foodstuff. This one represents itself the set of indices of capability of the organism to digest the consumed albumens, as well as compliance of composition of amino acids of consumed product to norms that permits the organism to synthesize albumens, which are necessary to assure its proper functioning (Fig. 3.4):



**Figure 3.4** *Need of adults in albumens*

Albumens are the substances that form the material base of functioning of any live cell and play in the organism the complex of functions as follows (Fig. 3.5):



**Figure 3.5 Basic functions of albumens in the man's organism**

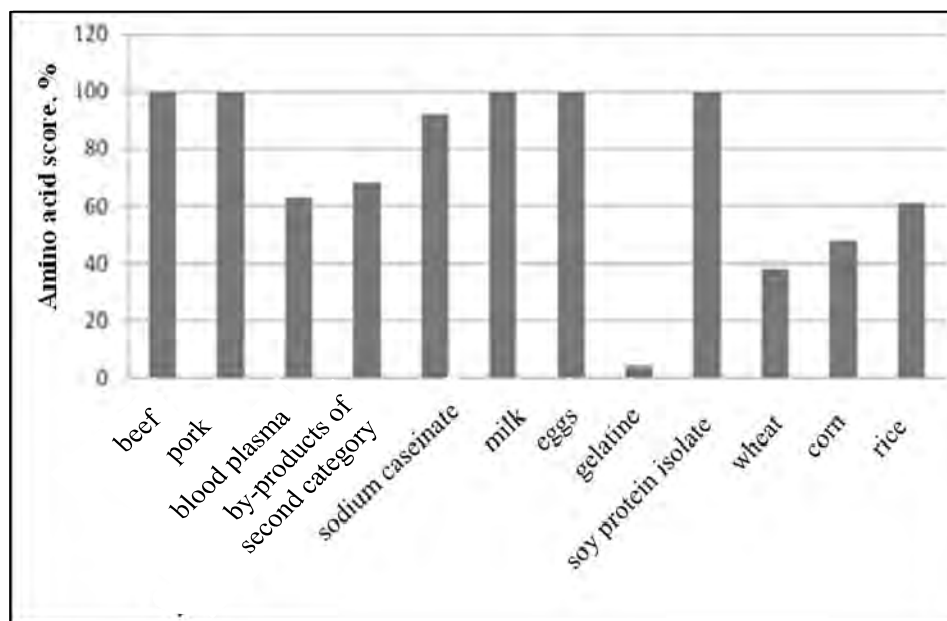
The quantity of consumed albumens has to be rigorously controlled. In its deficit there may occur the morphological and functional changes in mode of functioning of the organism (the most often of nonreversible character), e.g. the mental and physical delay of evolution of personality, abnormality of functioning of hormonal and nervous system, dystrophy etc.

The specific technological feature of albumens contained in meat raw is those that independently of variation of their chemical composition and properties, each their type has the specific score of amino acids (the factor that determines the biological value of the product as the whole one) and functional properties (capability to form gels and emulsions, hold water and so on). The complex of these factors determines the structural, mechanical and organoleptic properties, as well as output of finished products. The principal functions of albumens in live organisms from the medical and biological points of view:

- are source of indispensable and replaceable amino acids irreplaceable as the source of “constructive material” in process of biosynthesis (especially for children),
- are source of energy liberated in their biological oxidation in the organism (though their use as the energetic material is irrational),
- function as “predecessors” used in processes of synthesis in organisms of hormones, porphyrines and other biologically active compounds and substances.

The annual demand of organism for valuable albumens is of 20 to 26 kilograms. At the same time each personality need to obtain in meal not the abstract albumen but the albumen character by certain score of amino acids, especially eight of indispensable ones (those that are not synthesized in the organism). These acids are valine, leucine, isoleucine, tryptophan, methionine, lysine, phenylalanine and treonine. The zoic and vegetative albumens contain the same amino acids but their score differs considerably by their ratios and levels of biological value. The amino acidic score of muscular and lactic albumens is close by their composition to

composition of albumens of men. Therefore, most of zoic albumens are valuable whereas the vegetative ones are character by small content of lysine, tryptophan, treonine and other indispensable amino acids (Fig. 3.6):



**Figure 3.6** *Score of amino acids contained in nutritional albumens*

To guarantee the normal state of vital activity of adults, the quantity of indispensable amino acids in his daily ration of albumens must be of  $36 \div 40$  %, what is assured in ratio of zoic and vegetative albumens of 55% : 45 %.

Thirosine, cysteine, arginine and hystidine are reckoned as conditionally indispensable (or partly indispensable ones) because they are slowly synthesized in the organism. The insufficient level of consumption of arginine and hystidine with food does not influence on activity of adults but their deficit may lead to occurrence of eczema or disorder in synthesis of hemoglobin. Meantime organisms of children have the need in continuous receipt of these amino acids and the quantity of indispensable amino acids their ration is ten. It was found that deficit of indispensable amino acids in ration may cause the serious disorders of health (Table 3.2).

The daily needs in indispensable amino acids in the “etalon” albumen for some age groups of population are given in Table 3.3.

All kinds of raw materials used in meat industry differ considerably by content of albumens and scores of their amino acids, what complicates processes of production of meat products of balanced composition. At the same time, despite the products that constitute the summary daily ration of men would contain all indispensable amino acids (IAA), this does not mean that all these compounds will be assimilated. This is linked with those that the organism has no the “depot” for accumulation of indispensable amino acids and synthesis of albumens in own organism is possible only on condition of their simultaneous presence. Moreover these acids have to be present in the strongly fixed quantitative ratio and absence or deficit of any one will cause the negative balancing of compounds of nitrogen, hence disorder in functioning of central nervous system, interruption of growth, hard



clinical consequences (e.g. avitaminosis) and postponing of assimilation of other amino acids. This regularity obeys the law of Libikh, which sets that development of live organisms depends of value of quota of indispensable substance present in the least quantity.

**Table 3.2**

***Functions of indispensable amino acids in the organism***

<b>Indispensable amino acids</b>	<b>Biological functions</b>	<b>Consequences of deficit or excess</b>
Valine	Participates in metabolic processes in muscular tissues, influences of coordination of functions of motion	Deficit leads to abnormality in coordination of motion, raising of sensitivity of skin to irritation. Excess leads to emergence of hallucinations, feeling of creep of skin
Isoleucine	Participates in processes of synthesis of hemoglobin, stabilizes level of sugar in blood	Deficit leads to occurrence of negative balance of compounds of nitrogen, displaying of signs of psychical and physical disorders, decreasing of level of resistance and persistence of the organism
Leucine	Influences of processes of growth, regulates level of sugar in blood, assists in development of cells of skin and bones, intensifies processes of synthesis of hormones	Deficit leads to occurrence of abnormalities in functioning of thyroid gland and kidneys, display of signs of dystrophy
Lysine	Participates in synthesis of albumens, antibodies, hormones and enzymes, assists in regeneration of tissues, influences on processes of growth and circulation of blood. Being consumed in complex with vitamin C prevents progress of atherosclerosis and cardiac infraction	Deficit leads to emergence of preconditions of degeneration of muscular tissues and deposition of calcium in bones, progress of anemia, fall-out of hair, diseases of mucous tunic of eyes, loss of appetite, occurrence of irritability, distress of reproductive function
Methionine	Participates in metabolism of fats, phospholipids, vitamins, synthesis of choline-liotropic substances that protect liver and arteries against their fatness; capable to withdraw heavy metals from organism; decreases level of influence of radiation; assists in secretion of adrenaline by adrenal gland	Deficit leads to occurrence of features of fatness and rheumatic onsets
Treonine	Influences on processes of physical growth, strengthens the immune system, assists in synthesis of antibodies, enriches processes of functioning of liver	Deficit leads to occurrence of features of fatness, decreasing of level of resistance of organism
Tryptophan	Influences on processes of growth, regeneration of tissues; participates in metabolism of albumens and synthesis of hemoglobin and albumens of plasma of blood	Deficit leads to occurrence of depression, sleeplessness, rising of irritability, loss of appetite
Phenylalanine	Stimulates and tones up nervous system, improves sentiments, decreases level of feeling of pain	Deficit leads to disorder of functions of thyroid and adrenal glands, occurrence of hormonal diseases, depression and arthritis

Table 3.3.

*Daily norm in indispensable amino acids, g/100g of albumen*

Irreplaceable amino acid	FAO/WHO (1985)		
	Babies of 2-5	Children of 10-12	Teenagers
Isoleucine	2.8	2.8	1.3
Leucine	6.6	4.4	1.9
Lisine	5.8	4.4	1.6
Methionone + cysteine	2.5	2.2	1.7
Phenylaniline + thirosine	6.3	2.2	1.9
Treonine	3.4	2.8	0.9
Tryptophan	1.1	0.9	0.5
Valine	3.5	2.5	1.3
Hystidine	1.9	1.9	1.8

The biological value of albuminous component of meat product calculated for each concrete group of consumers depends of correspondence of grade of correspondence of quantities of indispensable amino acids (the so-called amino acid score – AAS) present in it and balanced etalon albumen found in result of longstanding medical and biological research. The factor of AAS is represented usually in percents or as the value expressed by ratio of content of each IAA in the studied albumen to its quantity present in etalon albumen:

$$AAS = \frac{[IAA]_{\text{product}}}{[IAA]_{\text{etalon}}} \times 100, \%$$

where  $IAA_{\text{product}}$  – means the content of each indispensable amino acid in albuminous fraction of studied product, g/100 g of albumen,  
 $IAA_{\text{etalon}}$  - means the content of each indispensable amino acid in albuminous fraction of etalon (ideal) albumen g/100 g of albumen

The amino acid which score is less of 100% (or 1.0), is considered as the limiting in assimilation of the albumen. The indispensable amino acid, which score is the least, is named as the first limiting one. This acid establishes the maximally possible level of assimilation of the albumen and is the compound that determines biological value of the product. The excess of other amino acids that form the albumen in question may be used as the source of non-specific nitrogen or for generation of energy needed for functioning of the organism.

The usual method of evaluation of biological value of meat products is calculation of score of all indispensable amino acids or in some cases in relation to the most deficient ones: lysine, tryptophane and sum of acids that contain sulfur (methionine + cysteine).

One should note that the deficiency of indispensable amino acids depends both of composition of raw materials (e.g. the blood albumen contains small quantities of methionine and isoleucine; wheat albumens are character be deficiency of lysine and treonine but excess of methionine; milky casein contains the excessive quantities of lysine; dried milky serum – of valine, tryptophan treonine and lysine), and of grade of influence of external factor on processes of assimilation of their albumens. The work in producing of finished products assures in modern conditions in observance of principles of operation as follows:

- use of "soft" conditions of operation ("barrier" technologies), what assists in saving of potential biological value of raw materials,
- use of computerized methods of projecting of compositions of meat products based on choose of ingredients, which compensate deficiency of each amino acid in the ration (Table 3.4 and Table 3.5).

**Table 3.4**

***Ratio of albumens, which combination assures the effect of their mutual enrichment***

Type of albumen	Whole milk	Milk serum	Blood plasma	Soy	Lucerne	Wheat gluten	Corn	Oat	Rice	Buckwheat	Sunflower
Whole milk						73:27					
Milk serum						57:43	49:51	40:60		44:56	
Blood plasma						41:59			26:74		14:86
Soy						70:30	53:47	51:49	32:68		
Lucerne						63:37					20:80
Wheat gluten	27:73	43:57	59:41	30:70	37:63						
Corn		51:49		47:53							
Oat		60:40		49:51							
Rice			74:26	68:32							
Buckwheat		56:44									
Sunflower			86:14		80:20						

**Table 3.5**

***Ratio of by-products in mixed products, which assure the maximum adequacy of composition of set of amino acids of integrated albumen to medical and biological norms***

Characteristics of mixes	Compositions of mixes of by-products							
	1	2	3	4	5	6	7	8
<b>Composition, %</b>								
beef lips	30	24	22.5	7	7	15	25	20
fourth stomach	20	15	14	5	5	10		10
meat of gullet	50	39	37	12	12	20	25	20
lungs		22	20.5	7		5	25	20
spleen			6	2		10	25	20
first stomach				67	76	10		10
meat of beef heads						15		
meat of porcine heads						15		
<b>Mass part of the component, %</b>								
water	75.9	74.7	74.9	78.3	78.5	73.3	78.9	75.8
fat	5.5	4.5	4.4	3.9	4.0	7.0	1.8	5.1
integrated albumen	18	17.4	17.3	15.6	15.6	17.4	12.9	13.7
including albumen of connecting tissue	6.6	5.2	5.3	6.6	7.0	5.3	5.3	5.2

It is possible also to control in projecting of combined meat products the mass part and qualitative composition of indispensable albumens in finished products to produce.

The analytical calculation of mass part of albumens in finished products is calculated by formula:

$$S_0' = \frac{\sum_{i=1}^n X_i S_i}{\sum_{i=1}^n X_i},$$

where  $S_0'$  - mass part of albumens in finished products, %,

$S_i$  – mass part of albumens in  $i$  component of the formulation, %,

$X_i$  – mass part of  $i$  component of the formulation, %

Specifying the output of finished production (in taking into consideration quantities of added water or mix of water and ice, as well as losses of water because of its evaporation in process of thermal treating), technologists use the corrective coefficients. The following calculation of quantitative composition of indispensable amino acids in albuminous component is carried out by formula:

$$A_j = \frac{\sum_{i=1}^n X_i S_i M_{ij}}{\sum_{i=1}^n X_i S_i}$$

where  $M_{ij}$  – content of  $i$  indispensable amino acid in  $j$  albuminous component of the product, g/100 g of albumen,

$X_i$  – mass part of  $i$  component that contain albumens in the formulation, %,

$S_i$  – mass part of albumen in the  $i$  component of the mix, %,

$n$  – quantity in the mix of components that contain albumens

The data that characterize the totalized chemical composition of raw materials (especially the content of albumens in it) and information of compositions of amino acids in each ingredient of the product may be found experimentally or taken from the reference literature. Knowing the quantitative content of each of indispensable amino acids and using the formulas above, technologists may calculate the value of score of amino acids in the product to produce.

One should note that the fact of knowing of composition of albuminous component permits to evaluate its probable biological value and no more because the men's organism will assimilate not their total income, but that its part, which will be digested in the gastrointestinal tract, absorbed by walls of bowels and pass in blood.

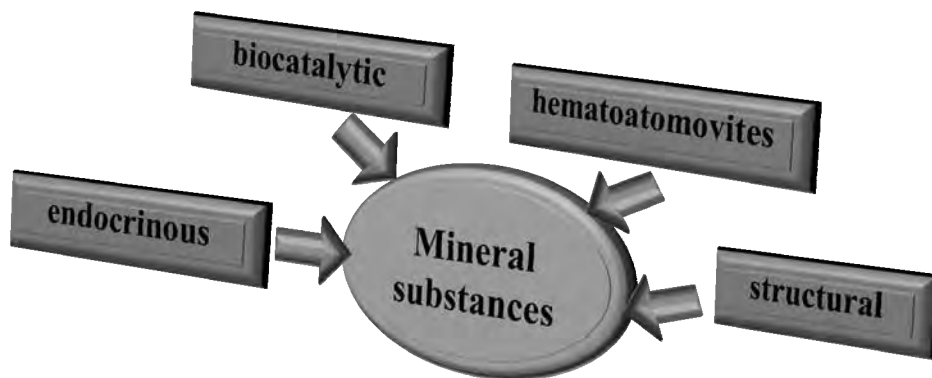
Besides of indispensable amino acids, unsaturated fatty acids, vitamins, the consumed products contain also such irreplaceable ingredients of alimentation as inorganic substances. Said components of food realize in the organism various functions: they take part in constitutive metabolic processes (aqueous-saline and acid-base turnovers), sustain osmotic pressure in cells, influence on muscular activities, processes of hemogenesis, fibrillation, forming of immunity, function of reproductive system and so on. Part of mineral substances is the structural element of bones and teeth, some are the prosthetic enzymes and some are catalysts of inhibitors of biological and physiological processes.

The mineral substances contained in foodstuffs may be subdivided by groups as follows (Fig. 3.7):

- structural ( $Ca, P, C, H, N, Na, K, Mg, Cl, O, S, Si$ ), which function as the constructive and plastic materials of cells and tissues of organisms. The

elements that form the structure of live beings are named as macroelements because of their presence in big quantities,

- biocatalytic (Cu, Zn, Mn, Sr, Co, Se), which take part in metabolism as constituents of molecules of enzymes, vitamins and pigments,
- endocrinous (I, C<sub>2</sub>, F, B<sub>2</sub>), which are the constituents of molecules of hormones,
- hematoatomovites (Fe, Cu, As), which take part in processes of hematogenesis and functioning of reticuloendotelial systems.



**Figure 3.7**    *Classification of mineral substances*

The mineral substances, which form the last three groups are named as microelements. The daily norm of their consumption is not more of some milligrams or even micrograms. Seventeen of this group elements (Fe, I, Cu, Zn, Co, Cr, Mo, Ni, V, Se, Mn, As, F, Li, B, Br) are essential for maintaining of normal functioning of metabolic processes and have to come to the organism with meal, water or air.

The content of mineral substances in ration must satisfy the basic physiological needs of men calculated by formula of balanced alimentation. The excess or deficit of each macro- and microelement may cause abnormalities of metabolism and provoke occurrence of numerous illnesses (Table 3.6, Table 3.7).

There exist the numerous competitive (antagonistic) and synergetic interrelations of micro- and macroelements, which define mechanisms of functioning of organisms, their required ratios, grade of necessity and quantitative norms of consumption. It was shown especially the existence of competitive “relations” of mineral substances as follows: zinc competes with calcium for influence on the same receptors of suction in bowels, iron replaces copper, manganese – molybdenum, copper – zinc and molybdenum etc. The example of consequences of antagonistic relations of zinc and manganese with iron is the fact of decreasing of level of assimilation of the latter element in organisms by 40 ÷ 50 %, as well as crucial decrease of grade of assimilation of calcium in case of disbalance in the system of calcium : phosphorus : magnesium, what is seen the most clear in absence in ration of fat that contains vitamin D.

The most deficient mineral substances in ration of modern population are calcium, iron, iodine, selenium and fluorine. The elements that are present in rations in excess are sodium and phosphorus. The ration of students contains in general case 48% of calcium necessary for normal vital activity, 76 % of [phosphorus, 62 % of magnesium, 55 % of iron, 57 % of chromium, 31 % of copper. Deficit of iodine is of 82%, selenium – 88 %.

**Table 3.6**

***Biological functions of macroelements***

Mineral substances	Daily demand, g	Functions in organisms	Effect of deficit/excess
1	2	3	4
Sodium	4 ÷ 6	Stabilizes osmotic pressure of intercellular liquid, takes part in creation of buffer volume of blood, regulates metabolism of water and blood pressure, improves functioning of muscles, activates some enzymes	Excess of sodium (NaCl) rises arterial pressure, provokes occurrence of cardiac infraction
Potassium	2.5 ÷ 5.0	Potassium takes part in processes of metabolism of cells, passing of nervous impulses, regulates acid-base balance of blood, intercellular osmotic pressure, activity of some enzymes, decreases level of binding of water by tissues of organism, improves mental activity. Potassium is the antagonist of sodium in many physiological processes, i.e. assists in its removal from organism	Excess of potassium in meal leads to intense removal of sodium from organism. To assure the normal passing of processes of metabolism, the ratio of potassium and sodium shall be of 1:2. Deficiency of ions of potassium leads to retaining of water in organism and occurrence of edemies; deficiency of sodium leads to dehydration of organism
Calcium	0.8 ÷ 1.2	Up to 99 % of calcium is located in bones and teeth, about of 1% - in blood, tissues and biological liquids of organism. Calcium takes part in building of bone tissue, functioning of cellular membranes, processes of traction of muscles and fibrillation of blood, passing of nervous impulses. Calcium rises activity of numerous enzymes, enhances protective functions of organism	Deficit of calcium results in delay in growth of bones, rising of blood pressure, speeding of cordial pulsation, decreasing of physical activity, occurrence of caries, osteoporosis, rachitis. The excess of calcium leads to occurrence of urolithiasis
Phosphorus	0.9 ÷ 1.5	Phosphorous is the element that is the part of albumens, lipids, nucleic acids. It participates in formation of bone tissues, energy metabolism, retention of acid-base balance, assists in normalization of processes of functioning of nervous cells, enzymes, sweat glands, cordial muscles, normal metabolism of cells	Excess of phosphorus in meal leads to intense elimination of calcium from organism. To ensure the normal metabolism, ratio of calcium and phosphorus shall be of 1:1.5
Magnesium	0.3 ÷ 0.6	Activates activity of some enzymes, normalizes muscular activity, assists in vasorelaxation, assists in decreasing of level of cholesterol in blood, stimulates peristalsis of bowels, increases the level of discharge of bile, participates in metabolism of water, hydrocarbons and phosphorus, rises stability of mucous tunic and cutaneous covering to infiltration of bacteria and toxic substances	Participates in metabolism of substances. deficit of magnesium leads to occurrence of muscular convulsions. Excess of magnesium leads to deterioration of metabolic processes, postponing of growth, decreases grade of assimilation of calcium. The optimum ratio of calcium and magnesium is of 1 : 0.5

1	2	3	4
Chlorine	2 ÷ 6	Regulates metabolism of water and acid-base balance, assists in preservation of proper level of osmotic pressure in plasmas of blood and lymph, activates activity of numerous enzymes, participates in generation of gastric juice, forming of blood plasma	Deficit of chlorine in meal leads to abnormality of metabolic processes
Sulfur	1 ÷ 4	Sulfur is the element that is present in molecules of some vitamins and amino acids. Participates in metabolic processes, assists in normalization of acid-base balance and neutralization of toxic substances	Deficiency/excess of sulfur results in occurrence of abnormalities of metabolic processes

**Table 3.7**

***Biological functions of some microelements***

Mineral substance	Daily demand, mg	Function in organism	Effect of deficiency/excess
1	2	3	4
Iron	10 ÷ 18	Enters into compositions of hemoglobin and some enzymes	Deficiency of iron leads to decreasing of concentration of red blood cells, anemia, decreasing of activity of enzymes that contain iron in their formulas, disorder of nervous system, decreasing of potency
Zinc	10 ÷ 15	Enters into compositions of insulin and numerous enzymes, which participate in process of metabolism of hydrocarbons, reproduction and breathing	Deficiency of zinc results in retardation of growth and pubescence, sleepiness, decrease of appetite and occurrence of dermatologic diseases
Iodine	0.1 ÷ 0.2	Regulates quantity of enzymes of thyroid gland, influences on metabolic and regenerative processes	Deficiency of iodine leads to retardation of metabolism, abnormality of functioning of thyroid gland what results in impediment of growth, occurrence of goitrous disease, psychical and physiological deflections. Excess of iodine influences negatively on activity of enzyme systems
Fluorine	0.5 ÷ 2.5	Participates in formation of complexes with magnesium, calcium, nucleotides and other activators of enzyme systems; inhibits activity of lipase. Interacts with bone tissues, participates in forming of teeth enamel	Deficiency of fluorine leads to occurrence of caries, excess results in occurrence of fragility and spotting of teeth enamel

1	2	3	4
Copper	1.8 ÷ 2.2	Copper is necessary for function of numerous enzymes that participate in metabolism of energy, amino acids and fatty acids. Participates in processes of hematogenesis and pigmentation of hair	Deficiency of copper leads to occurrence of anemia. Excess of copper leads to occurrence of sharp toxic effects, abnormality of functioning of liver, derived anemia, debilitation of arteries, disorder of reproductive function
Cobalt	0.1 ÷ 0.2	Participates in processes of metabolism and hematogenesis, enters into compositions of numerous enzymes	Deficit of cobalt may lead to occurrence of malignant anemia

Because atoms of sodium come to organism mostly in form of kitchen salt, there is seen the global tendency of decreasing of quantities of this compound in technologies of production of foodstuffs. At the same time, there are intensely progress the trends of solving of problems of decreasing of deficit (avoiding of excess) of microelements and macroelements in ration of modern population as follows:

1. *Accomplishing of strong control of observance of norms of balanced feeding by meat products that contain the indispensable nutrients.*

2. *Use of special measures of processing, which minimize losses of macro- and micronutrients in meat raw materials and ingredients used in process of manufacturing.* This relates first of all to optimization of parameters of their defrosting and thermal treating (boiling, blanching, sterilization) and so on.

3. *Correcting of composition of traditional meat products and development of group of functional foodstuffs* based on use of principles of purposeful introduction in their formulations of mineral substances, special kinds of raw materials and biologically active additives. The examples of effective realization of such trends are techniques directed of prophylactics of deficit in rations of men who live in certain regions of iodine and iron, insufficiency of vitamins A, E, C, numerous microelements (copper, manganese, selenium, molybdenum and some other) and amino acids (in conditions of consumption of inadequate quantities of zoic albumens). The meat raw materials were reckoned traditionally as the source of iron easily accessible for consumption. However the last-time investigations showed that content of iron in meat of beef, hogs and turkeys decreased by factor of 55 ÷ 60 % as compared with 1940, what is the result of introduction of intense methods of breeding of cattle and poultry and amending of rations of their fattening. Therefore there occurred the need of compensation of deficit of these elements just in the process of producing of meat products.

Regulation of content of calcium (in products of childish alimentation, in rations of pregnant women and women who feed babies, sportsmen etc.) may be done in introduction in their rations of calcium gluconate or additives that contain this element. The last category compounds may be produced in use of raw materials of zoic origin: defatted bone powder or specially treated eggshell. At the same time, the



grade of assimilation of calcium in organisms depends of acidity of meal and presence in it of calcium and vitamin D. The grade of absorption of calcium in bowels is more effective in lightly alkaline and neutral environments. Otherwise this element may deposit in form of stones in kidneys, urinary and gall bladders.

4. *Development of special rations of alimentation to be used by concrete groups of population* in observance of character of their engagement, physiological singularity and/or place of habitation. Particularly, men who work in conditions of elevated temperatures of environment (heat-treaters, metallurgists and others), have to consume the increased quantities of potassium, sodium, chlorine and other mineral substances, which intensely get out of organism with sweat.

The last time knowledge obtained in process of intense development of science on alimentation witnesses the important role of ultraelements, which are present in products in vanishingly small quantities but play the important role in processes of vital activity.

For example, the enzyme of glutathionperoxydaza, which contains selenium is synthesized in the organism only in presence of enough quantity of this element that gets in it with food and water. Therefore there were developed some methods of enrichment of foodstuffs by this essential microelement. The biggest concentration of this element among natural products is garlic (about of 200 micrograms per kilo) and its relatively big quantities contain seafoods, eggs, porcine and beef kidneys, pleurotus, Brussels sprouts and broccoli, where the bivalent selenium is present in form of biologically active compounds of selenocysteine and selenomethionone. The most effective method of producing of products that would contain selenium in biologically accessible state is enrichment of meat of animals in their fattening. This problem is solved in most cases in way of adding in forages of salts of selenium (sodium selenite or selenate) or yeasts enriched by selenium. It was found that use of such method of enrichment of forages permits to accumulate of up to 147 micrograms of selenium in muscular tissues of poultry,  $130 \div 135$  mcg/kg in meat of beef and rabbits and 150 mcg/kg in meat of hogs. The Korean, Japanese, Irish and US farmers already produce pork, beef, milk, eggs and fish that contain the increased quantities of selenium.

The special attention scientists devote to processes of balancing of macro- and microelements in development of formulations of functional foods. Enrichment of rations of alimentation by biologically active metal-organic compounds of magnesium, manganese, cobalt, iron, copper, zinc, selenium, which are the elements of active centers of intracellular enzymes and named as vitacites, permits to rise the energetic potential of cells and balance their energetic and constructive metabolism.

The purposeful work in enrichment of foodstuffs by micro- and macroelements may be done only in agreeing with officials of the Ministry of Protection of Health of Ukraine and under the strict control of observance of their normalized dosing and procedures of application because many of minor substances may be toxic in nonobservance of established norms and procedures (Table 3.8).

Table 3.8

*System of regulation of inflow of some chemical elements in organisms of adults*

Chemical element	Lethal dose, grams per day	Toxic	Normal	Deficient
		milligrams per day		
Heavy metals				
Cd	1.5-9.0	3-330	0.07-0.30	unidentified
Co	unidentified	500	0.005-1.8	0.0002
Cr	3-8	200	0.001-1.2	0.005
Cu	0.175-0.250	unidentified	0.5-6.0	0.03
Fe	7-35	200	6-40	6
Pb	10	unidentified	0.06-0.50	unidentified
Zn	6	150-600	5-40	5
Other biogenous elements				
F	2	20	0.3-5.0	unidentified
I	35-350	2	0.1-0.2	0.015
Mg	unidentified	unidentified	250-380	12
Se	unidentified	0.8-5	0.05-0.07	0.006

One should take into consideration that the role of mineral substances in live organisms is not limited by their biological functions. It's necessary to know that variations of content of some of these elements (first of microelements) in meat systems may influence considerably on properties quality of finished products. For example, absence of appropriate incoming inspection of qualitative composition of such well-known ingredients of meat products as water and kitchen salt may result in application in technological mixes of increased quantities of ions of calcium and magnesium. These events lead to activation of processes of autolysis – biochemical afterripening (supplemented by betterment of taste and aroma characteristics and coloration of raw materials). However this leads in the same time in provoking of intermolecular interactions of albumens dependent of presence of calcium (myosin, fibrinogen, casein), what results in decreasing of holding of water, hence decrease of output of finished production, as well as the excessive strengthening of structure of meat product and other negative consequences.

The increased content of ions of potassium may assist in passing of processes of forming of gels in presence of hydrocolloids used widely in technologies of producing of sausages. At the same time their presence may result in decreasing of intensity of coloration and occurrence of friability of meat products. Presence in technological water of admixtures of salts of iron, sodium chloride and nutritional phosphates leads, as a rule, to occurrence of such defect as pigmentation of color of meat products. Besides, most of ions of bivalent and trivalent metals are the active catalysts of process of oxidation of lipids, what results in considerable worsening of quality of finished products in process of their storage.

The given examples witness clearly that processes of producing of meat products have to be realized in conditions of steady control of grade of purity and content of dissolved salts in food additives and ingredients used in process of their fabrication.

### 3.2 Characteristics and classification of biologically active additives

The process of development of innovative technologies of producing of foodstuffs character by set level of biological value and products of dietetic, medicinal, prophylactic and functional destination of use initiates rising of interest of specialists who operates in meat-processing industry to use in their work of biologically active substances and other food additives.

*Foodstuffs for special dietetic consumption mean foods, including the products for children and aged persons, which are not the medical preparations but were specially treated in purposes of satisfying of concrete dietetic needs, which result of specific physical or physiological conditions of men and/or their specific illnesses or disorders*

*Foodstuff consumed in special medical purposes means the product developed and produced specially in purposes of curing and consumed under the supervision of physician. Such product is assigned for the partial or total substitution of ingredients of usual ration of nutrition of patients, who has the limited, broken or inadequate capability to eat, digest and assimilate the usual foods, or their certain nourishing ingredients, or their metabolites. The foodstuffs assigned for use in special medical purposes may be prescribed for the partial or full-scale alimentation of patients who has the special needs identified by physicians in impossibility of satisfying of their needs in modifying of usual ration*

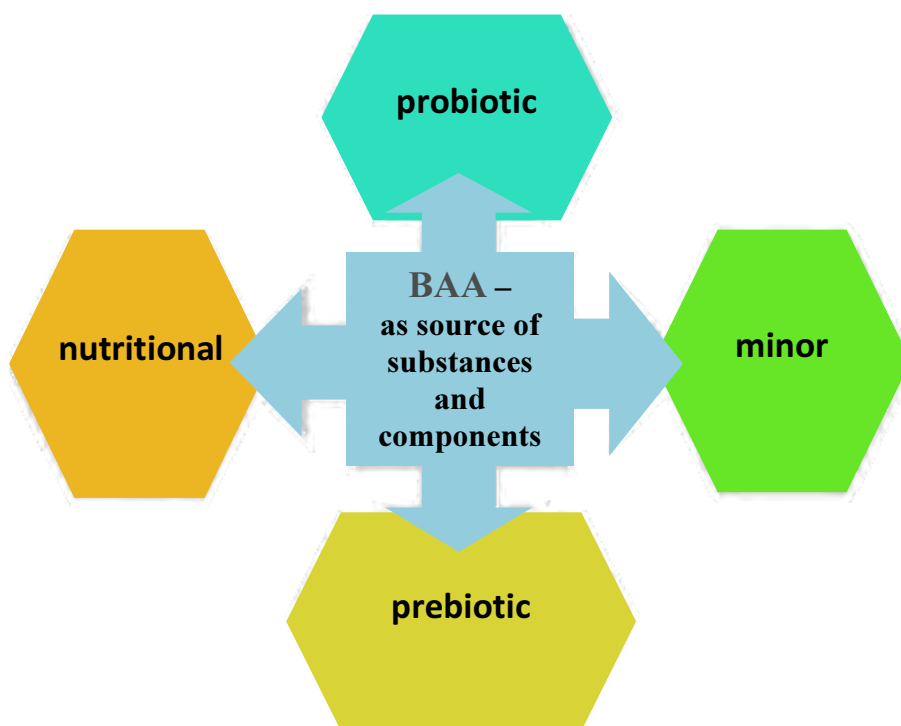
*Functional foodstuff means the food, which contains the medical preparation(s) as the constituents added in purposes of prophylaxis and/or softening of illness*

Functional alimentation presumes systematical everyday consumption of foodstuffs, which are formulated in purposes of removal of deficit in organism of energetic, plastic or regulatory alimentary substances. such products influence on physiological functions, biochemical reactions and psychosocial behavior of men. Consumption of functional foods assists in maintaining of physical and mental health of men and decreasing of level of risks of occurrence of illnesses.

The functional orientation of alimentation is formed by way of introduction in usual foods of biologically active additives (BAA), i.e. micronutrients that have the pro- and prebiotic properties. The term of "*biologically active additives to meal*" was proposed a short time previously in process of impetuous progress of new science of pharmaconutriciology closely coupled with the science on alimentation (nutriciology) and pharmacology. It was established that the term of *biologically active additives* is used in relation to natural or identical to natural biologically active substances, which should be consumed directly or added to foodstuffs in purposes of enrichment of ration by biologically active components and complexes that assure betterment of nutritional status of men, strengthen their health and decrease the risk of occurrence of numerous illnesses (Fig. 3.8).

The BAA used in enrichment of foods are named as *food supplements*, *food additives*, *nutritional additives*, as well as *functional products*. These terms are often coupled with the term of *enriched*.

Thus, the BAA proper, which contain small quantities of reactants are not positioned as drugs and market of BAA functions by more liberal rules as compared with those that are used in the market of medicinal preparations. Therefore their registration and regulation of procedures of circulation and are carried out by the simplified procedure.



**Figure 3.8** *Biologically active additives as sources of substances and components*

There exist some systems of classification of BAA based on differences of their composition and destination of use. The last principle of their differing is used the most often and is the base in systematization of new category of foodstuffs – the functional products. This kind classification differs BAA, which are permitted for use in producing of foodstuffs by the following groups.

*First one* has to compensate the deficit of biologically active substances in the organism. *Second group* have to assist in betterment of tonicity of organism and normalize functional activity of its systems and organs. These additives have no pharmacological influence on the organs of men with pathologies, but have the prophylactic effect on their health. *Third group* establishes the dietetic background and permits to decrease the risk of occurrence of certain illnesses. Additives of *fourth* group assist in germination of useful microflora in men's organisms and supports normal functioning of their gastrointestinal tracts.

The system of functional alimentation was introduced first more than 20 years ago in Sweden and Japan and spread gradually on other countries. The level of consumption of products of functional destination (or biologically active additives) is now of 36 % in Germany, 22 % in United Kingdom, 15 % in France, 24 % in Japan and up to 80 % in USA. Experts suppose that 10 years later approximately 40 % of foodstuffs sold on markets of developed countries would contain BAA and may be classified so as the functional ones.

The mass media sources inform widely on “usefulness” of various kinds of foodstuffs. Thus, the international magazine of *"Health"* considers that the most effective ingredients used in producing of “healthy” products such ingredients as olive oil, soy, lentil and yoghurt.

The assortment of products of functional destination may be subdivided conditionally by some branded groups as follows:

The first one combine the group of products that were produced of environmentally safe raw materials produced exclusively out of natural ingredients and in absence of food additives coded as "E" (especially of preservatives and colorants). The meat industries that function in many foreign countries the product of this group the most popular among all groups of consumers is so-called "*organic meat*" taken out of animals, which fattening was done in absence in their rations of genetically modified soy, hormones, stimulants of growth etc. The organic meat products are not new category of foods but rather their consumption is the new ideology in alimentation. Its essence is founded on those that persons who saved money begin to spend them on preservation of remains of their health. Consumers became aware the simple fact that presently nobody do not knows in details what he eats. Therefore he wants to obtain products of proper quality and safety and is ready to pay for this right.

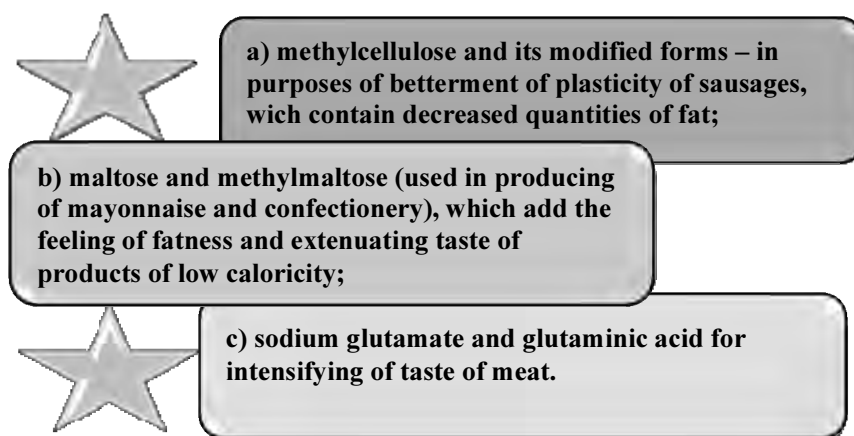
The organic foods cost usually more of their usual analogues by factor of 30÷100%: the price of meat of ecologically pure animal (cow, for example) is two times more as compared with usual beef. However, the demand for such product continuously rises. The global market of organic products is now of about of 30 billion US dollars and its capacity increases each year by 16-20 %, that is 4 times swiftly as compared with the market of food in whole. To normalize procedures of operation on the food market with organic production, governments of EU countries began to develop since 1980-s the related recommendations and approved in 1991 the original document of "*EU Eco-Regulation*". The analogous program was later approved in Japan (2001). In 2002 USA approved the national program of organic agriculture and now branch-offices of service of "*Organic food*" function in 72% of supermarkets.

The market of organic products has grown dramatically since 1990, and reached now the value of about \$55. This resulted in increasing of area of organically managed farmland over the past decade at a rate of 8.9% per annum. Thus, in 2007 the principles of organic agriculture were used on area of 30.5 million hectares worldwide, but for the year of 2009 it was enlarged to 37,000,000 hectares, what represented approximately 0.9 percent of global farmland area. European manufacturers farm 23 percent of global organic farmland seconded by Latin America (19 %), Asia (9.5 %), North America (7.2 %) and Africa – 3 %. The countries, which have the biggest organic farmlands are Argentina (3.1 million hectares), China (2.3 million hectares), the United States (1.6 million hectares) and Australia (1,180,000 hectares), followed by Spain, Germany, Brazil, Uruguay, and the UK. Appraisals show that quota of organic production in global output of products of agriculture would reach 20 ÷ 25 % by the mid-XXI century, and their total cost will be of about 200 ÷ 250 billion US dollars per annum.

The area of organic farming In Ukraine was of 270,320 hectares for the beginning of 2011, what exceeded twice the respective index for the period of 6-7 years before. Ukraine is ranked in it now as the 21<sup>st</sup> worldwide. Therefore, Ukraine has preconditions to take one of leading positions in producing and supply of

environmentally safe foods to Europe. The practice of development, propagation and use of principles of environmentally pure agriculture is based in Ukraine on use of norms of such documents as "UN Convention on Environment and Development" (1992), "UN Declaration of Millennium" (2000), documents of Universal Summit by Sustainable Development (Johannesburg, 2002), State laws "On priorities in progress of science and technique", "On priorities in progress of innovative activities in Ukraine", "On organic agriculture", "On Saving of Energy", "On Protection of Environment", "On Environmental Audit", "On Wastes", and Decrees of Supreme Soviet of Ukraine. At the same time, most of organic foods produced here are not consumed domestically, but exported in view of continuous rising of demand for the environmentally pure food in EU countries.

Unfortunately, the group of products produced out of organic meat sold in native market is represented presently only by solitary kinds of products. The examples are products character by decreased by 30 ÷ 80 % level of energetic value reached, as a rule, in use in formulations of meat products of meatless raw materials, interchanging of fatty component by "artificial" (imitative) fats produced out of vegetative oils, adding of albumens of milk, dietary fibers, ballast substances and mixes of vegetables. The content of fat of animal origin in such products is typically of 3 ÷ 12 %, what permits manufacturers to announce low caloricity of their products that contain at the same time the decreased quantities of cholesterol. Taking into consideration that removal of fat of animals out of meat disperse systems influences negatively on their structural, mechanical and organoleptic properties of finished products, technologists have to correct their formulations and add in mixes in this purpose the substances as follows (Fig. 3.9):



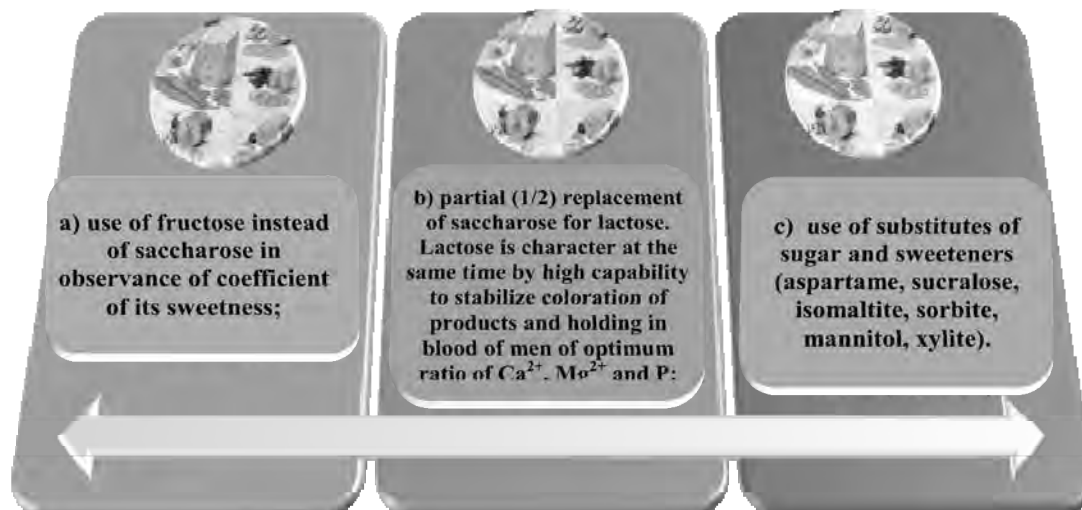
**Figure 3.9** *Substances used in purposes of correction of properties of disperse systems*

The functional products of the second group include those ones that contain decreased quantities of sugar and salt. At that, quantity of kitchen salt in such products must not be more of 1.5 %. At first sight, the problem of decreasing of quantity of salt in the formulation may be solved very simple. However such change is coupled with numerous serious problems: reduction of quantity of added salt results in "dissolution" of taste of meat products and alteration of mechanisms of passing of set of biochemical and microbiological processes, decreasing of grade of

expressiveness of basic functional and technological properties of muscular albumens (their capability to hold water and form emulsions, producing of gels, variation of values of adhesion and cohesion). There arises also the hazard of germination of putrefactive bacteria. That if one intends to introduce limitations on content of kitchen salt in finished products, it is useful to make its partial replacement on salt mixes (e.g. of  $2/3 \text{ NaCl} + 1/3 \text{ KCl}$ ), otherwise refuse its adding and use in these purposes mixes of potassium, magnesium and calcium salts of organic and inorganic nutritional acids. The most often such “prophylactic” salt contains 68.4 % of NaCl mixed with KCl (26.3 %) and  $\text{MgSO}_4$  (5.3 %). Consumption of prophylactic salt improves activity of heart and kidneys, assists in decreasing of mass of body, prophylactics and cure of hypertension, diabetes and osteochondrosis.

The same function carry also the substitutes of kitchen salt – compositions based on use of potassium bitartrate, fumaric acid, silicon dioxide, trisodium phosphate, potassium iodide and potassium glutamate. However each their composition does not provide the full imitation of taste of kitchen salt and is not capable to compensate its technological properties.

Use of sugar leads to rising of caloricity of foods, so products that contain saccharose cannot consume persons ill for diabetes mellitus. Therefore decreasing of content of sugar in meat products may be done by some methods (Fig. 3.10).



**Figure 3.10** *Methods of decreasing of content of sugar in meat products*

**Third** group of functional foods contains biologically active additives produced out of raw materials of vegetative and zoic origin and may be positioned by different categories: "*Health from nature*", "*Healthy digestion*" and "*Healthy heart*". The foodstuffs of functional destination of use are identified and classified in observance of their positive influence on certain functions of organisms of men, for instance:

- growth and development,
- metabolism of certain substrates,
- conditions of cardiovascular system,
- physiology of gastrointestinal tract,
- conditions of immune system.

Their classification is given in SanPiN 2.3.2.1290-03 *"Hygienic Norms of Organization of [Processes of] Manufacturing and Circulation of Biologically Active Additives to Foodstuffs (BAA). Sanitary and Epidemiological Rules and Specifications"*, which classifies such additives by preassembled groups as nutriceutics, prebiotics (parapharmaceutics) and probiotics (eubiotics).

### **3.2.1 Nutriceutics**

Nutriceutics represent itself the essential nutrients (indispensable alimentary substances) and are the natural ingredients of meal. Their use permits:

- effectively liquidate deficit of essential alimentary substances in ration of most of men,
- individualize rations of alimentation of men in short time in observance of their needs, sex, age, intensity of physical and/or mental demand, professional factors, genetic peculiarities of biochemical constitution of each concrete individual, his biorhythms and physiological specificities (e.g. in being of state of pregnancy, stress situation etc.),
- purposefully amend processes of metabolism and maximally satisfy the varied physiological needs of ill men in meal, as well as bypass the damaged area of metabolism by way of metabolic shunting,
- rise the nonspecific resistance of organism to influence of unfavorable factors of environments in way of enforcement of activity of enzyme elements of protection of its cells,
- activate processes of bonding and withdrawal for organism of xenobiotics, which may hit in it from outside – with drinking water and meal that contain 500 and 600 contaminants, respectively, as well as from environment, where there exist more of two thousands of contaminants.

Many of nutriceutics are character by immunomodulating activity. The complex of their listed properties is used widely in technologies of producing of products of medical alimentation used in purposes of primary and secondary prophylactics and cure of fatness, atherosclerosis, illnesses of cardiovascular system, cancerous newgrowths, taking of patients from state of deficit of immunity etc.

There are used presently in category of biologically active additives in practice of producing of foods the following six basic types of functional nutriceutics:

- albuminous preparations,
- dietary fibers (soluble and insoluble),
- vitamins (A, group of B, D and others),
- mineral substances (calcium, iodine, iron, zinc, selenium and others),
- polyunsaturated fatty acids (vegetative oils, fish oil,  $\omega$ -3 fatty acids),
- antioxidants –  $\beta$ -carotene, ascorbic acid, tocopherol (vitamin E).

One should note that preparations that contain the albuminuous component of vegetative origin (standardized by content of albumen and composition of amino acids) are used widely in formulations of meat products in purposes of correcting of level of biological value of mixes of albumens and the most rapt attention is devoted in it to balancing of content of indispensable amino acids.

The additional sources of albumens and amino acids character by level of assimilation of  $90 \div 98$  % and used in preparing of such mixes the most often are



concentrated and isolated forms of soy albumens, diary albuminous preparations, hydrolizates, dried mixes of albumens with fats, hydrocarbons and minerals, all character by high concentration of albumens and balanced by composition of indispensable amino acids. It is necessary to take into consideration that some albumens have the multifunctional character. Such ones are, for example, soy albumens character by balanced composition of indispensable amino acids, capability to diminish content of cholesterol in blood and decrease risks of occurrence of cancerous growth, what is conditioned by presence of isoflavinoids and oligosaccharides (rafinosa, stacchiosa). Soy ingredients have also the antidiabetic properties thanks to presence of dietary fibers and antiosteoporosis effect because they contain the decreased quantities of amino acids that contain sulfur what prevents the excessive removal of calcium from organism. Finally, these ingredients have the hypoallergenic properties and immunomodulating effect because of presence of soy lecithin and improve so the memory of persons who consume these products regularly.

The last tendency of development of meat industry in the world is introduction of technologies of purposeful use in meat compositions of certain types of raw materials that contain the excessive quantities of some indispensable amino acids, what permits to compensate their deficit in albumens of commercial products (Table 3.9).

**Table 3.9**

***Mechanisms of action of indispensable amino acids, which come to organism with foodstuffs***

<b>Type of raw material, source of its inflow</b>	<b>Excessive amino acid</b>	<b>Functional properties, medicinal and prophylactic effects</b>
Meat of birds, fish, liver, nuts (almonds, cashew), eggs and egg products, lentil	<b>Isoleucine</b>	Regulates content of sugar in blood, rises physical and psychological stability of organisms
Mushrooms, cereals, peanut, soy	<b>Valine</b>	Rises resistivity of skin to its irritation, decreases level of stupefacient dependence
Haricot, soy, unrefined rice, nuts	<b>Leucine</b>	Regulates functioning of liver, kidneys, thyroid gland and level of sugar in blood
Eggs and egg products, cheese, haricot, diary albuminous preparations, soy, potato	<b>Lysine</b>	Combined use of listed products with vitamin C protects organism against progress of atherosclerosis and cardiac infraction, assists in regeneration of tissues
lentil, pulse plants	<b>Methionine</b>	Withdraws heavy metals, protects against progress of fatness
Eggs and egg products, milk, diary albuminous preparations, soy	<b>Treonine</b>	Reinforces immunity, protects progress of fatness
Peanut, soy, cheese	<b>Tryptophan</b>	Rises stability against stresses, assists in overcoming of depression
Cereals, cheese	<b>Argirine</b>	Stimulator of secretion of hormone of growth, assisting in producing of insulin and glucogene
Eggs and egg products, fish, cheese, cereals	<b>Phenylaniline</b>	Assists in overcoming of depression, decreases level of feeling of pain

The purposeful enrichment of quantitative content of some indispensable amino acids in way of introduction in meat products of certain types of nutritional raw materials rises biological value of finished products and permits to position them as such that have the medicinal and prophylactic properties. At the same time, the enzyme systems of men do not produce enzymes capable to split dietary fibers, therefore assimilate products of their destruction as source of energy and plastic materials. However such fibers represent themselves the materials that assure functioning of numerous important systems of organism, which take part in processes of digestion and metabolism. So, the FAO/WHO declare that products, which contain more of 3 % of dietary fibers are the valuable source of alimentation and if this content is 6 % and more, the foodstuff is considered as the product enriched by this functional ingredient.

The work in enrichment of meat products by ballast substances is carried out usually by two methods as follows:

1. In way of introduction in formulations of milled semi-finished products, sausages and others of filling materials of vegetative nature:

- a) homogenized puree of boiled or raw vegetables,
- b) scalping of cabbage, cereals, mushrooms, haricot etc.

2. In way of introduction in formulations of meat products of preparations of dietary fibers produced industrially (fibers of carragenans, alginates, pectin, gums, cellulose, xantane, gum-arabic etc.).

The problem of especial interest to which technologists devote last time is use of fruit- and galactooligosaccharides, especially alant starch and lactulose.

Alant starch is the high-molecular hydrocarbon soluble in water, which contains in tubers of topinambour and dahlia, in roots of dandelion and chicory. Alant starch stimulates germination and activities of bifid- and lactobacteria; rises level of assimilation of calcium in large bowel assisting so in decreasing of level of risk of progress of osteoporosis; influences on metabolism of lipids; decreases level of risk of progress of diabetes mellitus and atherosclerosis of cardiovascular system; has the anti-carcinogenic effect; normalizes metabolism of hydrocarbons and fats; withdraws radionuclides and salts of heavy metals from the organism.

Lactulose is the synthetic prebiotic capable to hydrolyze in large bowel to monosaccharides under the action of bacterial disaccharidases. This leads to stimulation of germination of bifido- and lactobacteria and forming of lactic acid. The process supplements by decreasing of level of pH and rising of osmotic pressure in bowels, what augments quantity of saccharolytic microflora and oppression of activities of conditionally pathogenic microorganisms, e.g. of *B. Clostridia* and coliforms of bacteria. The one more result is decreasing of grade of germination of carcinogenesis resulted of presence of pathogenic microflora of bowels. Presence of lactulose makes better the functional state of bowels what intensifies the process of biosynthesis of indispensable amino acids, vitamins of B-group and vitamin K, rises stability of immune system and antioxidant potential of organism etc.

Vitamins. Meat raw materials contain the full set of vitamins soluble in water (B<sub>1</sub>, B<sub>2</sub>, PP, B<sub>6</sub>, B<sub>12</sub>, C, pantothenic acid, biotine, folic acid) and in fats (D, E, K, A, F). However the finished meat products are not reckoned as the source of their basic

source because most part of their quantity decay in process of technological treatment (heating, freezing, variation of value of pH, irradiation by light, oxidation, action of sodium chloride etc.), what is especially character for the water-soluble group of vitamins. Besides, introduction of intense technologies in cultivation of plants and farming of livestock resulted in practically overall disappearance of vitamin A in meat of cows and birds, loss in it of 50 % of thiamine (vitamin B<sub>1</sub>), 35 % of iron and 20 % of magnesium.

Respectively, the goal of specialists who develop and introduce modern technologies of producing of meat products is realization of concept of compensation of deficit of vitamins. The set problem may be solved by some methods as follows:

1. *Bringing in the mass of ingredients character by presence of augmented quantities of necessary vitamins* (Table 3.10) in quantities that guarantee remaining of their normalized values in finished products. This principle is realized the most often in processes of producing of foodstuffs to be used in alimentation of children and foods of special, medicinal and prophylactic destination of use.

**Table 3.10**

***Kinds of foods that contain the enhanced quantities of vitamins***

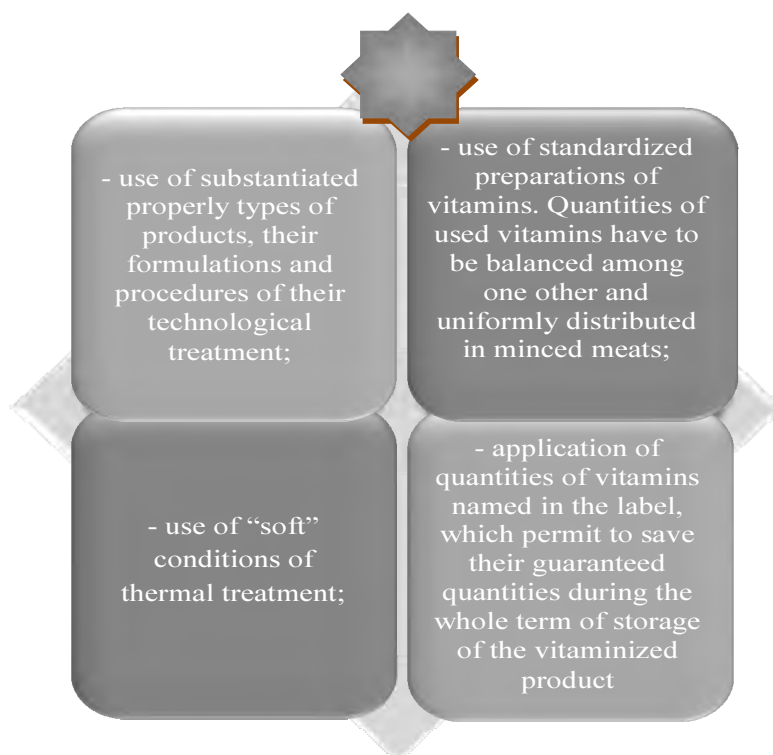
Type of the product	Vitamin	Functional properties, medicinal and prophylactic effect
Liver, egg products, carrot, cheese	A	Assuring of immunity of organism, betterment of eyesight, normalization of state of skin and mucous membranes
Birds, rice, vegetables	B <sub>1</sub>	Betterment of memory, digestion, enforcement of nervous system
Diary and egg products	B <sub>2</sub>	Enforcement of nervous system and state of nails and hair
Flower of coarse milling, beef liver, mushrooms	PP	Regulates processes of metabolism (redox processes, bloodstream) and level of cholesterol
Yolk of eggs, haricot, beer yeast	B <sub>6</sub>	Stabilizes state of nervous system, assists in hemogenesis and functioning of liver
Meat, cheese	B <sub>12</sub>	Stimulates growth of organism, assists in hemogenesis
Liver, eggs, butter	D	Assists in strengthening of bones and teeth
Vegetative oils, cereals, flour, nuts	E	Influences on functions of reproductive and endocrinous glands, protect cells against influence of active radicals, retards processes of aging, decreases level of risks of occurrence of cataract on eyes
Yolk of eggs, rice, soy beans	H	Regulates level of sugar in blood, influences on state of skin, hair and nails
Vegetative oils, white cabbage	K	Regulates processes of turning of blood

1. *Use of commercial preparations of vitamins identical to natural ones.* The forms used in producing of sausages the most often are bagged vitamins of B-group, vitamins E, C, H (biotine) and their combinations in mixes with spices. There exist preparations of  $\beta$ -carotene and vitamin E, which have at the same time the antiallergen effect.

The European country, which leads in use of procedure of vitaminization in producing of meat products, especially bringing of vitamins B<sub>1</sub> D and folic acid, is Germany.

2. Softening of procedures of technological treatment directed on decreasing of level of losses of vitamins in process of manufacturing activities.

3. The requirements to be observed in process of vitaminization of meat products are (Fig. 3.11):



**Figure 3.11 Requirements to be observed in vitaminization of meat products**

Mineral substances. The basic mineral substances present in ration have to satisfy the physiological needs of men. The excess or deficit of any micro- or macroelement may result in disorder of metabolism and provoke occurrence of numerous diseases.

The elements that come into organism in excessive quantities are in most cases sodium and phosphorus. The sodium ions come usually in form of kitchen salt and decreasing of level of its consumption is the top priority in work of technologists.

The most deficient mineral substances present in ration now are calcium, iron (for 54 % of women and 17 % of men), selenium and fluorine (for 85% of children), and iodine (for 80 % of children). Elimination of deficit of the last element is solved in introduction in formulations of foodstuffs of ingredients, which contain iodine – iodinated salt, iodine-active and iodine-casein preparations, dried Japanese laminaria (210 micrograms of iodine per 1 gram) (see Table 3.11). the natural substances that contain considerable quantities of iodine are some hydrocolloids produced out of raw materials of aquatic origin: the semi-refined and refined carragenans contain 3.7 and 1.4 mg/kg, respectively, alginates – 4 to 6.3 mg/kg. The one of promising methods of producing of albuminous preparations enriched by iodine is immobilization of this element on collagenic albumen of zoic nature.

**Table 3.11*****Types of oodstuffs, which contain the increased quantities of mineral substances***

<b>Mineral substance</b>	<b>Type of raw material, source of origin</b>
<b><i>Macroelements</i></b>	
Calcium	Cheese, milk, eggs, fabaceous plants (haricot, soy), nuts
Phosphorus	Cheese, fabaceous plants, cereals, eggs, meat of birds and domestic animals, mushrooms, nuts
Magnesium	Cereals, wheat scalping, soy, meat, eggs, fabaceous plants, nuts
Potassium	Fabaceous plants, potato, meat, mushrooms
<b><i>Microelements</i></b>	
Iron	Meat, liver, kidneys, eggs, potato, ceps
Zinc	Meat, by-products, eggs, fabaceous plants, wheat scalplings
Iodine	Spirulina, laminaria, diary, buckwheat, potato, walnut

Because display of deficit of iodine may intensify in existence of deficit of iron, vitamins A, E, C, numerous microelements (copper, manganese, selenium, molybdenum and others), as well as amino acids (in conditions of insufficient level of consumption of zoic albumens), it is necessary to make corrections of content in ration of the listed components too. One should take into consideration in the same time that thyroid gland assimilates iodine present preferably in form of its organic compounds but not inorganic salts. Besides, such preparations as iodine-active and iodine-casein do not accumulated in the organism, therefore do not influence negatively on its metabolic processes. Overdosing of inorganic iodine (iodinated salt, bread, water) may cause hyperthyreosis supplemented by rising of temperature and arterial pressure, intensification of heartbeat, atonia and neurosis.

To enrich products by the easily assimilated iron,. It was recommended to add in products preparations of whole blood, hemoglobin and black nutritional albumen. Their use does not lead to occurring of overdosing of iron and its accumulation in tissues because the quantity of such form iron assimilated in one-time consumption is not more of 2 milligrams. At the same time consumption of iron contained in foods in form of inorganic compounds (gluconate, sulfbivalent iron) used widely in polyvitamins and food additives leads to assimilation by organisms of up to 20 milligrams of iron, what may cause risks of development of cordial and cancerous illnesses.

It was found also that bivalent iron is assimilated by organism much better (by  $37 \div 38 \%$ ) than the trivalent one (5.3 %). Reductants such as organic acids (ascorbic, citric) and zoic albumens transform trivalent iron into its bivalent state and increase so the level of its assimilation. At the same time, the level of assimilation of iron decreases in presence of sodium, phosphates and gluten.

The most often producers enrich foodstuffs by calcium (what is especially character for rations recommended for alimentation of children, pregnant women and sportsmen). This operation is carried out usually in putting into formulations of foods of raw materials, which contain calcium, as well as those that were produced in use of natural ingredients of zoic origin: defatted bone powder of specially treated eggshell. The positive result of work in enrichment of foodstuffs by calcium is reached in

conditions of introduction in their formulations of dried ingredients produced of milk, where content of calcium is much more usually of daily norm of its consumption (1000 mg).

The product enriched by calcium must contain at least  $15 \div 19$  % of its daily norms, what is about of 200 mg of  $\text{Ca}^{2+}$  on each 100 grams of finished product. At the same time one has to take in mind that level of assimilation of calcium by the organism depends of presence in the consumed product of phosphorus and vitamin D, as well as of level of pH of medium. For example, assimilation of calcium in bowels is more effective in slightly alkaline and neutral environments. Otherwise it may deposit in kidneys, urinary and gall bladders in form of stones, so, the peculiarities of passing of such processes have to be taken into consideration in development of compositions of vitaminized mineral complexes.

The contemporary advances of science on alimentation forced researchers to study the role of ultraelements (vanadium, chromium, molybdenum, selenium and some other) present in foods in minor quantities but are necessary for normalization of vital activities of live organisms and make necessary correction in rations. For example, it was recommended to use some types of raw materials that contain the risen quantities of this microelement in purposes of rising of content of chromium in foodstuffs. Particularly, the products that may be used in it are nuts ( $120 \div 140$  micrograms per kilogram of wet mass), cheeses ( $10 \div 130$  mcg/kg), wheat scalping ( $30 \div 60$  mcg/kg), beef, porcine ( $10 \div 60$  mcg/kg), egg yolk ( $180 \div 220$  mcg/kg).

The one of the most important components of ration of contemporary man is polyunsaturated fatty acids (PSFA). Their consumption permits to protect the cordial muscle and cells of brain against air hunger and destruction of vitally important organs under attacks of uncombined radicals. On the contrary, deficit of said acids leads to development of atherosclerosis, hypertension, arrhythmia, trombophlebitis, psoriasis, occurrence of cancerous growths, initiation of processes of untimely ageing etc. The physiological norm of consumption of PSFA is of 2 to 6 grams per day. At that, the  $\omega$ -6/ $\omega$ -3 ratio of consumed fatty acids must be in limits from 8:1 to 10:1. However the real their ratio in rations of native consumers varies from 10:1 to 30:1, i.e. the  $\omega$ -3 fatty acids in ration of contemporary are in evident deficit. This situation may be improved in way of direct enrichment of foodstuffs by introduction in their composition of various types of vegetative oils: the soy, sunflower, corn, pumpkin ones etc. doing this job, technologists use deodorized vegetative oils as direct ingredients of formulations of meat emulsions, artificial slab bacon, etc.

the last time tendency in solving of this problem in producing of meat products is use of red palm oil that contains big quantities of carotenoids (473 mg/kg), vitamin E (730 mg/kg) and co-enzyme  $\text{Q}_{10}$  (4.3 mg/kg). This kind oil is character by big content of oleic acid (47.6 % of total quantity of fatty acids), linoleic pro- (12 %) and linoleic  $\omega$ -3 acids ( $1.3 \div 0.5$  %), in which connection the ratio of  $\omega$ -6/ $\omega$ -3 acids in it is close to the optimal one. It was found also the big efficiency of nutritional linen oil character by high content of  $\omega$ -3 fatty acids in decreasing of level of cholesterol in blood, elimination of allergic reactions, prophylactics of trombophlebitis, diabetes and carcinogenic diseases.

It was developed also formulations and technologies of producing of sausages to be consumed in medicinal and prophylactic purposes, which fatty component is represented by mix of porcine fat and false flax oil, what permit to optimize the ratio of  $\omega$ -6/ $\omega$ -3 fatty acids in finished products. Optimization of ratio of said acids in foodstuffs may be reached also in use of PSFA obtained out of fish raw materials and put in mixes in encapsulated form.

### 3.2.2 **Probiotics**

*Probiotics* (or *eubiotics*) are the biologically active additives to foods, which represent itself live microorganisms, substances of microbial and other origin. Being added to meal, they assist in optimization of microecological status of organism, improves passing of its physiological functions and biochemical and behaviorial reactions. The class of probiotics includes mostly line non-pathogen and non-toxigenic microorganisms, which assist in normal passing of microbiocenosis in bowels of men and natural symbiotic associations, which help to hold the normal composition and biological activity of microflora of digestive tract.

The functions that probiotic microorganismw (mostly of types of , Lactobacillus, Lactococcus, Propionibacterium) execute the set of important functions as follows:

- morphocinetic action,
- regulation of pH and rheological characteristics,
- participation in aqueous-salt metabolism, including the processes of fractionating of isotopes of chemical elements,
- assurance of initial immunological tolerance to nutritional antigens,
- participation in metabolism of albumens, fats and hydrocarbons; participation in processes of supply of energy to eucariotic cells (function of regulation of liberation of heat),
- regulation of recirculation of choleric acids and other macromolecules,
- producing of biologically active substances (amino acids, peptides, amines, hormones, vitamins, fatty acids, defensives, neuropeptides, and other microbial modulines). For the example, the bifid bacteria synthesize vitamins of group of B B (B<sub>1</sub>, B<sub>2</sub>, B<sub>12</sub>, folic acid), vitamin K, some othe indispensable amino acids,
- immunogenic function,
- detoxication of exogenic and endogenic toxic substances and compounds,
- mutagenic/antimutagenic function,
- regulation of replication and expression of genes of procariotic and eurocariotic cells.

Bifid- and lactobacteria (which constitute usually more of 80% of total quantity of microorganisms) play the important role in development of disbacteriosis, which process is supplemented by occurrence of abnormalities of equilibrium of motion of microflora present in bowels. Decreasing of its population in bowels there arises quantity of other bacteria clostridium, proteidae, nonpathogenic coli, what results in negative changes in processes of digestion: there are initiated reactions of putrefaction supplemented by formation of gases (ammonia, hydrogen sulfide), skatole, indole and origination of meteorism and intensifying of stressing of liver to be exact, on its neutralizing function). Occurrence of disbacteriosis leads to

colonization by microorganisms both of thick bowels, but thin too that are typically contain minimum of microorganisms. There is interrupted the normal process of metabolism, prime circulation of present mineral and lipid substances, as well as processes of assimilation and secretion of nourishing substances of meal.

➤ Use of preparations that contain drugs in form of specially selected probiotic microorganisms, biologically active additives to meal or foodstuffs that contain probiotics, permits to correct of purposefully influence of populations of microbial microflora present in bowels. After coming to bowels, bacteria, which are the principal effective agents of probiotics, begin to invade gradually in gastrointestinal tract and assist in renewing of its normal microflora. The functional roles of probiotics in support of homeostasis of men is shown in Table 3.12.

**Table 3.12**

***Functions of probiotics in ration***

<b>Probiotics</b>	Antagonism to conditionally pathogenic and pathogenic bacteria, viruses, fungus and yeasts
	Optimization of balancing of microorganisms in gastroenteric tract, elimination of disbioses and disbacterioses
	Synthesis of vitamins: K, biotine, niacin, pyridoxine, folic acid; hydrolysis of choleric acids, regulation of level of cholesterol; participation in circulation of reproductive hormones of women
	Optimization of processes of digestion and motorial function of bowels
	Detoxifying and protective functions in relation to negative influence of radiation, contaminating of meal and water by pollutants of chemical nature, influence of carcinogenic factors, toxic endogenic substrates, unusual and stress situations
	Participation in morphogenesis and functioning of immunocompetent cells and tissues of organism as carriers of protective antigens

The preparations that contain probiotics are subdivide conditionally by groups as follows:

- probiotics that contain live organisms (monocultures and their associations),
- probiotics that contain metabolites or structural elements of microorganisms of normal microflora,
- probiotics that contain compounds of microbial or other origin that stimulate growth or activity of bifidobacteria and lactobacillus of normal microflora,
- probiotics that contain the organisms of normal microflora,
- probiotice that consist of complex of live microorganisms, their structural components, metabolites mixed in various ratios and compounds that stimulate growth of normal microflora,
- probiotics mixed with amino acids, microelements, mono- and disaccharides etc.

The types of microorganism that are used in producing of probiotics are: Bacillus subtilis, Bifidobacterium adolescentis, B. bifidum, B. breve, B. infantis, B.



longum, Enterococcus faecalis, E. faecium, Escherichia coli, Lactobacillus acidophilus., L. casei, L. delbrueckii subsp. Bulgaricus and some other.

Technologists use in most cases the preparations as follows: dried bifidumbacterine (liophilic mix of bifidobacteria of type of *Bacillus bifidum* culture of 1789 LVL-3), dried bificol (contains bifidobacteria and coli of culture of M 17), lactobacterine (liophilic form of preparation of lactobacteria), enterol (dried saccharomycets or yeasts character by antagonistic effect in relation to pathogenic and conditionally pathogenic microorganisms), lactusan and some other. The start cultures are used the most often in producing of raw smoked and raw dried sausages, what permits to realize the pobiotic effect and speed up processes of their afterripening, forming of structure and drying, vary grade of expressiveness of their organoleptic properties (color, taste, aroma, consistency), as well as to rise the level of biological safety and assimilation of finished products.

The positive effect of use of bifidobacteria of kind of B. longum B379M and their complexes is seen also in producing of boiled and smoked products of reprocessing of beef that has characters of DFD. Introduction of start cultures dissolved in saline solutions products by method of extrusion permits to normalize the level of pH of meat compositions, stabilize color and make better their taste and aroma, decrease the residual content of sodium nitrite and nitrozoamines and inhibit oxidation of lipids in process of storage of finished products. Planning to use probiotics in practice, one should take into consideration that the optimum conditions of germination of most of their kinds are temperature of  $37 \div 41$  °C and pH =  $6 \div 7$  and if values of pH would be less of 4.5 and more of 8.5, such microorganisms stop their germination.

### **3.2.3 Prebiotics**

The group of prebiotics (parapharmaceutics) includes nutritional substances, which stimulate selectively growth and biological activity of protective microflora of bowels (first, of bifidobacteria and lactobacteria). The result of their activities is improvement of passing of various physiological functions and metabolic reactions, what decreases the risk of occurrence of carcinogenic diseases in thick bowels, rises biological assimilation of calcium and magnesium, normalization of metabolism of substances that regulate nervous activity etc. the basic types of prebiotics are listed in Table 3.13.

Prebiotics are stimulators of growth of probiotics and are the effective regulators of processes of microbiocenosis of gastrointestinal tract. This group substances include also the biologically active additives that assist in decreasing of energetic value of ration or regulate appetite, what permit to use them in prophylactics and cure of fatness. Prebiotics are also highly effective in adaptation of men to external conditions of staying and as the means of supporting therapy.

To enrich various foodstuffs, technologists use prebiotics in most cases in pure form, or in compositions of additives, or mixed with prebiotic microorganisms. Such kind compositions (microorganisms + prebiotics) are known also as synbiotics.

**Table 3.13*****Basic types of prebiotic compounds***

<b>Group</b>	<b>Stimulating substance</b>
Monosaccharides, alcohols	Xylitol, melibiosa, xylibiosa, sorbitol and others
Oligosaccharides	Lactulosa, lactitol, raphinosa, soy oligosaccharide, latyto-oligosaccharide, fructosooligosaccharide, galactooligosaccharide, isomaltooligosaccharide, dixyloligosaccharide and others
Polysaccharides	Pectin, dextrin, inulin, khytozan, gums, guar, carragenans, derivatives of cellulose and others
Enzymes	$\beta$ -microbial galactozidases, proteases, saccharomycetes and others
Peptides	Substances produced out of soy, milk etc.
Amino acids	Valine, arginine, glutaminic acid and others
Antioxidants	Vitamins A, C, E, $\alpha$ -, $\beta$ -carotenes, other carotinoids. Glutathione, ubiquinone, salts of selenium and others
Organic acids	Propionic, acetic, citric and others
Vegetative and microbial extracts	Extracts of carrot, potato, corn, rice, pumpkin, garlic, yeasts and others
Others	Lecithin, paraaminobenzoic acid, lysozyme, lactoferrin, gluconic acid, starch syrup and others

The typical sources of physiologically active substances (prebiotics and paraproducts) are various kinds of plants, animals and minerals. This category substances includes traditionally the mixtures of biologically active additives prepared out of spicy, aromatic and medicinal plants and used in dried (powders, tablets, teas) or liquid form (aqueous-alcoholic tinctures, extracts, balsams). The positive results were obtained also in introducing in meat formulations of various vegetables and fruits, e.g. of such untraditional cultures as pumpkin, topinambour, nut, mustard, aubergine, sweet pepper, potato, corn, mixtures of fruits and vegetables, hearts of seeds of sunflower, beet, tomato, carrot, roots of licorice, mushrooms. Their use permits to produce the biologically active complexes of amino acids, which assure their full physiological value and high level of assimilation, as well as influence positively on organoleptic, structural and mechanical properties of finished products, passing of processes of forming of coloration, oxidation, fermentation etc. Besides, vegetative components of formulations permit to decrease caloricity of products and enrich them by natural vitamins and dietary fibers. Such their peculiarities are used in producing of special types of alimentation, especially of foods prepared for childish and dietetic consumption.

Specialists center also their attention on possibility of multipurpose use in food formulations of biological potential of spicy and aromatic plants. The plants used in these purposes the most often are the peppermint, common valerian, creeping thyme, pot marjoram, sage, manna grass, absinth, dill, which use have also the medicinal effect. The positive results were obtained also in introduction of formulations of canned products and sausages of such spicy and aromatic components as sweet sorghum, cornflower, marigold, celery, parsley, balm, parsnip, catnip, geranium, juniper, lovage, thyme, angelica, turmeric. Their use permits in many cases to obtain the desired organoleptic properties and decrease in the same time (especially in case of simultaneous use of ascorbic acid and salts of potassium) the probability of

formation of nitrozoamines and add so for the finished product of prebiotic properties. It was shown also the effectiveness of use of aqueous extracts of leather bergenia in producing of boiled and smoked porcine products.

It's necessary to note that the spicy, aromatic, medicinal and technical vegetative cultures are closer by their compositions to men's tissues than additives of synthetic origin. They influence on metabolic processes softer, their physiological activity is broader, so their correct use assures absence of minor effects on vital functions. Therefore, the biologically active additives (both probiotics and prebiotics) are not the medicinal preparations but being added to meal can effectively normalize processes of homeostasis. However one should take into consideration that their use has to be properly substantiated and guarantee biological safety of consumers of products that contain such components.

The new trend occurred in sphere of producing of functional foodstuffs is beginning of products destined for consumption by men who suffer of allergies. The foreign agencies inform on global rise of number of consumers who has allergies for certain foodstuffs or their ingredients caused by inflow into their organisms of some specific albumens or compounds of albumens with hydrocarbons. The one of methods of elimination of allergies is choose of foods free of such allergens. However the suffered man has to understand clearly their diagnosis and specificity of allergic reactions of their organisms on certain ingredients of foods. At the same time manufacturers of such foodstuffs has to take into consideration such nuances in development of formulations of products that may cause risks for consumers.

It was cleared that meat causes allergies in extremely rare cases because potential allergens it contains decompose in heating. However this class compounds (especially the biogenic amine histamine) may be present in raw-smoked products.

The most dangerous products from the viewpoint of containing of allergens are cereals that contain gluten, seafoods (crabs, shrimps, fish), eggs, lactose, mustard, greens (first of all celery), spices (pepper), paprika, nuts and some others. Some food additives are capable to cause pseudoallergy exhibited after accumulation of certain quantity of substance that cause allergy in the organism.

The principal measures used in practice of producing of meat products are (Fig. 3.12):

- remove from formulations ingredients that contain gluten, lactose, eggs and egg products;
- limit rigidly dosing of green spices, black, red and odorous pepper and other plants, which pollen causes occurrence of allergic reactions;
- extract from products glutaminic acid and glutamates, which cause occurrence of pseudoallergic reactions;
- include in formulations the ingredients, which have the antiallergic effect.

**Figure 3.12** *Practical measures used in producing of products for men who suffer of allergies*

Besides, the label on the product to be used by men who suffer of allergies contains, as a rule, the detailed information on its composition.

### **3.3 Components, formulations and norms of producing of biologically active additives**

Components of biologically active substances contain many compounds and here is description of some of these substances used in meat industry the most often.

Bezoar (chololith) stone (*Bos taurus domesticus*) is formed in bowels of bulls, goats, sheep, camels and other animals in sickness of liver and gall bladder. This substance is the solid formation of size of grain of wheat and more. The stone is of round or uncertain form and has the rounded or sometimes peaky edges. Its color is yellowish-brown and has greenish, reddish and bluish tints. The surface of the stone is lusterless or lightly shiny. The bezoar stone consists of calcium hydrocarbonate and carbonate and contains admixtures of crystals of hydroxyapatite and organic compounds (albumens and organic acids). The Chinese medicine uses it as antitoxic and strengthening agent in cases of overfatigue, abatement of memory and in illnesses supplemented by occurrence of high temperature and convulsions.

This stone is the component of additives recommended for receiving by persons who suffer of hypertension as strengthening and lightly tonic preparation, as well as the auxiliary means in curing of chronic illnesses of joints.

Lyophilic powder of muscular tissues of beef. Muscular tissues are the important product of alimentation because it contains the valuable albumens (in quantities of 14 ÷ 24 %) and indispensable amino acids, considerable quantities of iron, phosphorus and vitamins A, B<sub>6</sub> and B<sub>12</sub>. Its red color is conditioned by presence of albumen of myoglobin that contains iron. Consumption of biogenic amines of meat assists in betterment of tonus of blood vessels, what is confirmed by those that intake of meat inhibits progress of hypertonic illness. At the same time, the excessive consumption of meat may cause progress of podagra of persons who suffer of abnormality of metabolism of uric acid. Meat is the source of big variety of acidic radicals, therefore its consumption shifts the acid-base equilibrium in the organism to acidic side. This event provokes disorder of metabolism and assists in untimely ageing of the organism. That is why it is recommended to consume meat together with vegetables, particularly green ones. The lyophilic powder is the component of biologically active additives recommended for use in purposes of general strengthening of organism as the source of valuable albumen.

Gall. Preparations of gall contain the natural gall of heavy beasts of hogs. Gall is the secretion synthesized by cells of liver. It may be subdivided conditionally as the substrate of liver and of cholecyst. The liver gall is less concentrated, has lighter coloration and differing chemical composition. The content of water in liver gall is of 97.6 % and in cholecyst – 86 %, the concentration of gall acids is of 0.6 and 7 %, respectively. The density of liver gall is 1.009 and of cholecyst -1.026, the level of pH in these galls is of 7.5 and 6.8, respectively. Besides, gall contains small quantities of mineral salts, cholesterol (about of 0.5 %), lecithin, fatty acids, neutral fat, urea, uric acid, pigments of gall, phosphotaza, tyroxine and some other substances. The lightly alkaline reaction of gall is conditioned by secretion

synthesized by mucous cells that cover the gall tracks. Gall, if contains mucus, became viscous and is of dark green or black color. The Tibetan and Chinese medicine recommend to use gall in form of powder, tablets, tinctures in purposes of cure of illnesses of liver, including hepatitis, cirrhosis helminthosis, various chronic and infectious illnesses of gastrointestinal tract, abnormalities of digestion, diarrhea, irritation of mucosal tunics of eyes and nose, as well as in occurrence of abscesses and cankers.

Gall is the component of biologically active additives recommended for strengthening of organism of women who has the menstrual disorders, as means that assist in normalization of processes of digestion and betterment of assimilation of albumens, fats and hydrocarbons.

Bone tissue. The basic constitutive material of bone tissue is ossein – the substance that contains salts of calcium (20 to 70 %) and is close by its chemical composition to collagen. The bones of basin and porous extremities of tubular bones contain considerable quantities of extractive substances, which stimulate secretory activities of gastrointestinal tract. Bone tissues are used in medical practice as natural source of lightly assimilated calcium. This material is used in producing of bone flour or highly concentrated by calcium fermentolizat. He bone flour is used in preparation of biologically active additives recommended as source of calcium, the preparation that assist in decreasing of level of sugar in blood, as well as prophylactic reparation used in cases of increased mental loading.

Blood of animals. Blood of backboned animals consists of plasma and forming elements – red blood cells (erythrocytes), white blood cells (leucocytes) and blood pallets (thrombocytes). It is viscous opaque (because of presence in it of dispersed forming elements) liquid of red color. blood has the lightly alkaline reaction ( $\text{pH} = 7.3 \div 7.9$ ) specific odor, saltish taste and is very valuable product because its dry component contains up to 17 % albumens including such important for vital activity as hemoglobin, serumal albumen and globulin. The plasma and serum of blood contain also big quantity of extractive substances, fatty acids, mineral salts, enzymes, hormones and vitamins.

Thrombocytes of blood destruct in passing of blood form blood vessels and emit in this event the enzyme of thrombokinaza present in blood at all times. In presence of salts of calcium this ferment transforms into ferment thrombin (fibrin-ferment). The newly formed thrombin transforms fibrinogen – the albuminous substance present in blood at all times – into insoluble albumen fibrin, which deposits in form of threads. At the same time the caked blood emits liquid of color of straw (serum or blood plasma), which contains albumin and globulin but is free of fibrin and forming elements.

The corresponding biologically active additives contain blood of beasts and sika deer. They are recommended as strengthening, restorative and anti-anaemic means to be used in purposes of rising of mental and physical ability to work and regulation of metabolism.

Foremilk represents itself milk obtained in period of first seven days after childbirth. Foremilk obtained in first days is much more dense of usual milk, has yellow color and lightly saltish taste. The foremilk of cows contains  $6.25 \div 4.15$  % of

fat,  $15 \div 16$  % of albumens and  $4 \div 5$  % of milk sugar. The foremilk is rich by biologically valuable proteins, immunoglobulins (IgG, IgA, IgM), contains important components of immune system. The antitoxic antibodies, which are in foremilk, rise resistance of organism to influence of negative factors. Foremilk contains also big quantities of vitamins, especially A and D, microelements, enzymes, hormones, especially of hormone of frontal part of hypophysis, and hormone of follicles. This preparation is used in purposes of assuring of valuable alimentation by proteins and as regulator of functioning of immune system of organism. Preparations of foremilk are used as components of biologically active additives as the means of strengthening of organism.

Milk is the indispensable product of everyday alimentation for most of men, as well as the medicinal preparation used for curing of many illnesses. The milk of cows contain in average 87.5 % of water, 12.5 % of dry substances, 3.8 % of fat, 3.3 % of albumens (including 2.7 % of casein and 0.6 % of serum albumens), 4.7 % of lactose and 0.7 % of mineral salts. Milk contains also 12 vitamins including such important ones as vitamins A, D, D<sub>2</sub>, B<sub>2</sub>, and carotene. Milk and dairy products may satisfy all needs of organism in vitamins A and group of B, as well as partly – by vitamins C and D. The most important mineral substances dissolved in milk are salts of calcium and phosphorus. Besides, milk contains compounds of cobalt, copper, fluorine, sulfur, zinc, bromine, iodine, manganese and molybdenum. The milk albumens are rich by balanced and very well assimilated irreplaceable amino acids. The albumens of serum of milk are character by high content of the most deficient amino acids of lysine and triptophane, which are present in rations of men in insufficient quantities. Casein transforms in process of digestion in active peptides and one of such compounds, the so-called casein glycomacropeptide inhibits functions of secretion and motor of stomach. The process of assimilation of milk of cows may be supplemented by formation of peptides, which activity would be similar to this one of opiates ( $\beta$ -casomorphines), which regulate circulation of blood in brain. There were extracted also from milk casein substances, which decrease the blood pressure, what was used in complex curing of ischemia and atherosclerosis of venous, peripheral and cerebral vessels, as well as in treatment of hypertensive sickness of II and III stages. However, the excessive consumption of casein raises content of cholesterol in blood and assists in development of atherosclerosis.

Milky fat is assimilated by organism of men the best of fats of zoic nature. It contains relatively small quantities of irreplaceable polyunsaturated fatty acids but presence of deficient arachidonic acid and considerable quantities of phospholipids and vitamins A and D rises its biological value. Milk has the clearly expressed antiacidic action and is recommended for consumption of men who suffer of hyperacidic gastritis character by increased acidity, and have ulcers of stomach and duodenum.

Hydrocarbons of milk are represented mostly by lactose (milk sugar), which quantity varies in limits of  $4.5 \div 5$  %. This saccharide slowly assimilates in bowels stimulating so germination of bifido- and lactobasillus – the basic component of microflora of bowels strengthening so resistance of organism to colonization by bacteria, what is especially important if alimentation of infants in arms. Lactose

disintegrates under influence of enzymes of stomach and bowels on glucose and galactose, which are absorbed in blood and are the source of energy. Besides, milk and milk products provide the daily demand of men for calcium by factor of about of 80 %.

The disadvantage of milk is that it fibrillates in stomach, which event opposes to digestion of other foods.

Milk is the component of biologically active substances recommended for strengthening of organism, normalization of composition of microflora of bowels and prevention of development of dysbiosis.

Defatted dry milk is produced in process of separation of whole milk on fractions of fatty part (cream) and defatted milk to be dried in future. The defatted milk contains much more albumens as compared with whole milk and is almost free of fat. Therefore its albumens have the bigger biological value. The defatted milk is character also by big content of lyotropic and antisclerotic substance cholin and considerable content of dry substances, what use it in producing of biologically valuable products. Dry milk is the component of many biologically active additives that assist in decreasing of level of sugar in blood and recommended as strengthening means, source of iron, iodine and vitamins of group B inflowing in organisms in insufficient quantities.

The today's R&D works in development and producing of biologically active additives to meal are carried out on base of concept of rational, balanced, dietetic, medicinal, prophylactic and functional alimentation. The valuable work in this direction is possible only at the turn of such directions of progress of science as nutriciology, medicine, sociology, ecology, biochemistry, biotechnology and some other. Developing new products, scientists are guided by the same principles, which were used in development of products of dietetic and prophylactic alimentation enriched by valuable ingredients, as well as in development of products of functional alimentation, medicinal preparations and phytopreparations. Formulations of biologically active additives to meal are developed in observance of provisions of preliminary specifications directed on avoiding of deficit of indispensable components of foods caused by evolutionary changes in structure of consumption of essential and other biologically valuable active substances, changes in mode of living, degradation of environment and deterioration of state of health of men.

To produce biologically active additives to meal, technologies use certain products of vegetative, zoic and mineral origin, their components or synthetic analogues as follows:

- products, which mankind used during certain historical periods of development of society,
- products that are the constitutive part of ration of modern men,
- extracted and purified components of foodstuffs and their synthetic analogues,
- conditionally eatable and nonfood products, which contain biologically active substances necessary for normal vital activity of organisms.

The important condition of use of products of vegetative, zoic, mineral and microbiological origin in producing of biologically active additives to meal is their

non-toxicity for organism of man. Therefore there is prohibited to use in producing of such additives of raw materials, which contain hormones, antibiotics toxic, stiff and narcotic substances. It is not permitted also to produce biologically active additives in use of vegetative and zoic raw materials produced out of genetically modified organisms (transgenic products) if there is no special permission on this work of Ministry of Protection of Health of Ukraine.

The crucial problems, which have to solve scientists and producers of biologically active additives to meal, are:

- studying of composition and properties of products, which constitute ration of modern men,
- studying of biochemical and pharmacological activity of biologically active substances, especially essential and minor ones, which are components of foodstuffs,
- analysis of historical, archeological and literal sources of information to be done in purposes of identification of products, which were used in earlier time,
- studying of influence of foodstuffs and their components or analogues on state of organism of healthy and ill men in conditions of unfavorable influence of environment,
- accumulation and analysis of information on results of epidemiological studies of influence of composition of ration of alimentation or individual types of foods on state of health of certain groups of population,
- identification of concentrations of macro- and micronutrients in foodstuffs and choose of doses optimum for use in formulations of biologically active additives.

There exist now some schools of developers of biologically active additives to meal as follows (Fig. 3.13):



**Figure 3.13** *Schools of developers of biologically active additives*

The base of European mode of development of biologically active additives is use of combination of modern principles of alimentation with those that are used since the earliest times. The additives produced in Europe in use of the attest achievements of alimentary science represent themselves the multicomponent systems, which contain 3÷25 ingredients. These formulations contain typically 2÷3 “core” components used typically in traditional combinations. Scientists work in parallel in studying and selection of untraditional types of raw materials, which affect on vital activities of interrelated systems of organism. Such formulations do not contain in most cases the preparations of zoic origin and natural mineral compounds because they are used typically synthetic analogues of biologically active substances, organic and inorganic compounds.



The Russian school of developers of biologically active substances follows to workings of European specialists but introduce in practice of their development numerous specific elements of native science on alimentation. The formulations of biologically active additives developed in Russia rarely contain exotic plants and synthetic components, what may be explained by accessibility of their natural analogues. The number of components in additives developed in Russia is not usually more of ten, what may be explained by complications in choose of composition of multicomponent collection of ingredients where its elements would not inactivate one other or be antagonistic to natal activities of organism. In addition to nutritional substances, most of biologically active substances contain vitamins, microelements, bioflavinoids and other substances, which intensify the functional influence of basic components of additives on interrelated systems of organism, strengthen its immune and adaptive capability, prolong activities of consumed in the same time drugs and decrease the level of their harmful influence on organism.

The Oriental (Asian) school of development of formulations of biologically active additives is base on use of millennial experience of development of drugs. The typical formulations of biologically active additives recommended for commercialization contain in most cases components of vegetative and zoic nature exotic for Europeans (these ones are scorpions, ants and others) but consumed traditionally by local population. Such compositions are legalized often as biologically active additives because they may contain also the components of foods.

The American school of development of formulations of biologically active additives to meal unifies elements of European and Oriental schools. The additives developed by its methods represent themselves the multicomponent systems that contain in many cases up to 100 ingredients. The constituent products of their formulations are usually synthetic compounds and purified forms, which may be combined into the unified preparation in required ration with big complications only. Therefore developers of such preparations recommend usually to consume not the mix combined in the single tablet, but to consume separately or in one time 3, 4, 5, 6, 8 and more tablets of different formulations. So, there arises the actual problem of identification of mechanism of influence of components on one other in their simultaneous consumption. The publicly accessible scientific articles by this problem do not give clear answer, but there is certainly known that consumption of biologically active additives to meal and educational work on necessity of introduction of healthy mode of life assisted in general rehabilitation of health of the nation. The one more specific feature of American school of development of biologically active substances that differs it of Russian and Ukrainian schools is use of overvaluated doses of active substances.

Developers and manufacturers of biologically active substances to meal have to solve the set of the following problems before they may be commercialized:

- development and optimization of the formulation, choose and preparation to producing of BAA of raw materials, identification of norms of preservation of quality and ensuring of proper conditions of carrying out of processes of producing and safe storage of finished products,

- standardization of composition, development of methods of analysis of commercial forms of preparations and identification of guaranteed terms of their fitness for use,
- development of method of producing of commercial form of the preparation,
- clinical substantiation of effectiveness of effectiveness of finished product and development of recommendations on its consumption.

The work in producing of biologically active additives to meal may be carried out at enterprises of food, pharmaceutical and biotechnological industries. the norms of their production are developed in observance of norms of operation of enterprises of food industry. The manufacturer has to guarantee compliance of composition and properties of the additive it produces to norms that establish the needed medical and biological effects of its influence, set indices of its quality and safety and preservation of fitness during the guaranteed term of its storage. The work in production of biologically active substances has to be carried out in observance of requirements of normative and technical documentation and comply with norms of sanitary rules and norms that guarantee their quality and safety, what must be verified in certificate of its quality. The additive must be registered by the Ministry of Protection of Health of Ukraine, what has to be witnessed by the hygienic conclusion of the State Sanitary and Epidemiological Service of Ukraine before would be began serial producing of the preparation.

Stocking, purchasing, standardization and storage of raw materials used in producing of biologically active substances must be accomplished in observance of standards of nutritional or medicinal orientation. Such works include the set of operations that began in harvesting (producing) of raw materials and finished in their storage in observance of normalized conditions. In absence of absence of standards on quality of raw material in question, its producer must develop the necessary documentation on such material (i.e. specifications of the enterprise) and register it by the established procedure.

The work in harvesting of parts of plants to be used in producing of BAA has to be done in terms of their vegetation when they plant contains the maximum quantity of biologically active substances. The work in initial treatment of raw materials consists in disposal of admixtures, defective parts of plants, as well as in preparation of raw to storage done by methods of dehydration (grasses, some fruits and roots), freezing (fruits, grasses), putting in storehouses (fruits, vegetables) and granaries.

The work in drying of vegetative raw is carried out in purposes of prolongation of terms of its storage and fitness to reprocessing. Depending of qualitative composition of raw materials and content of liable substances in it, there are used the methods of dehydration as follows:

- drying if natural conditions,
- forced drying,
- sublimation.

After the material would have been dried, it is selected (inspected) by kinds of property and sent to storage.

The work in freezing is based on storage of raw materials (the most often of berries, fruits and grasses) at temperatures that are lower of point of their freezing. This procedure inhibits passing of numerous biochemical and microbiological processes, what permits to decrease considerably losses of nutritional and biologically active substances they contain. The technology of freezing includes stages of classifying, calibration, washing of raw materials, their mechanical and chemical treating, blanching, freezing, packing and marking.

The work in storage of processed raw materials is accomplished in storehouses equipped by ventilating equipment in conditions of controlled temperature, humidity and, if possible, in special gas environments.

The products of animal origin are collected in apiaries, milk-producing plants, meat packing factories, fishing vessels. Depending of nature and physiological properties, such kind raw materials are stored in boxes, containers, piles etc.

The honey is stored in dry and dark premises in honeycombs or in extracted state in tightly closed wooden, glassy or non-corrosive capacities. The bees royal jelly taken out of the queen cell is put in glassy jars supplied by tightly ground smooth or curved stoppers and freeze as soon as possible or liofilize (dry it in frozen state in vacuum to sublime the excessive quantity of water). The bee wax is produce at apiaries in way of remelting of honeycombs remained after extraction of honey in way of solar irradiation in special capacities (in use of qualitative raw material) or put it in boiling water and outpress then in presses to remove the remaining water. Propolis – the substance used by bees for keeping of sterility of beehive – is collected out of walls of beehivers, frames, trays etc. The bee pollen is collected by special traps, dried and stored in dry cool places.

Some types of raw materials are stocked by original technologies in specially equipped places. For example, the meat tissues, testicles, liver, adrenal glands, gall, bone tissues, blood, colostrums, gall-stone, cartilage tissues etc. are stocked directly at meat-processing plants. The taken tissues and organs of animals cannot be stored for the long time because of fast rotting. Therefore are subjected to immediate reprocessing of preserving, freezing, drying or treating by kitchen salt, acetone or ethanol. The method of their preservation used the most often is freezing of liofilization.

The raw materials, which contain minerals is very variegated. Here is given the brief characteristic of some of its types.

Native raw materials similar to shilajit, brakshun (stone oil, literally juice of rock, named so in Mongolia and Tibet) procurers scrape away of rocks where it is cumulated. To get rid of insoluble impurities, one dissolves the raw material, filtrate the solution and concentrate filtrate at 70<sup>0</sup> C. to produce more pure preparations technologists have to use other methods of purification.

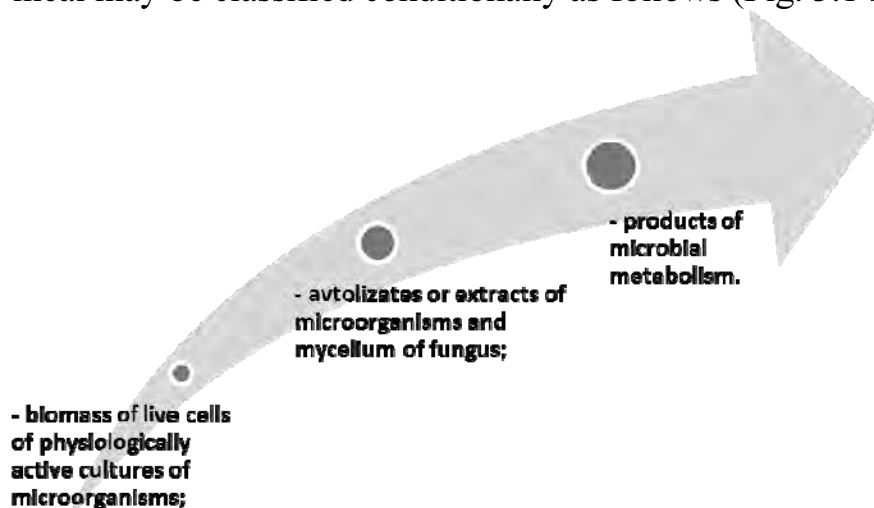
Clay materials (kaolin, bentonite) are purified out of impurities of quartz, silicates and others. The first step in this work is mixing of the material by eight-tyenfold quantity of water, heat to 80<sup>0</sup> C and then cool, decant, filter the resulted suspension on press, dry the solid fraction at 110 ÷ 200<sup>0</sup> C and mill.

Chalk used in preparation of additives represents itself the fine-grained soft white chalkstone mined by open method or in mines.

Kitchen salt (NaCl) is the crystalline product got by various methods (digested salt, lake-salt, rock-salt).

Marble is the rock formed in recrystallization of limestone and dolomite and mined by open method or in mines.

The kinds of raw materials used in producing of some biologically active additives to meal may be classified conditionally as follows (Fig. 3.14):



**Figure 3.14**     *Raw materials used in producing of some biologically active additives*

The one more class of substances used in preparation of BAA and named as modified raw materials are enriched by microelements unicellular alga (e.g. arthrospira) and yeasts. The procedure of enrichment consists in planting of said organisms on nutritional medium, which contains microelements. After finishing of planting the enriched biomass is extracted from the system by method of sedimentation, flushed by physiological solution and dried.

The examples of modified raw material are cultures of symbiotic microorganisms enriched by bifidogenic components.

### **3.4     Organizational and technological principles of enrichment of foodstuffs by biologically active additives**

The processes of development and producing of “healthy” foodstuffs (whether functional, enriched by any substances, medicinal, prophylactic, children’s and specialized) is linked indivisibly with the need of solving of arising fundamental problems, first of medical, biological, organizational and technological character as follows:

1. To develop such products, one has use only those micronutrients, which are really deficient in the region of their realization, and the products to enrich the first, are the foodstuffs of mass demand.

2. Scientists argue that the daily norm of consumption of the enriched product must cover of about of 10 ÷ 50 % of physiological demand of organism in respective micronutrient.

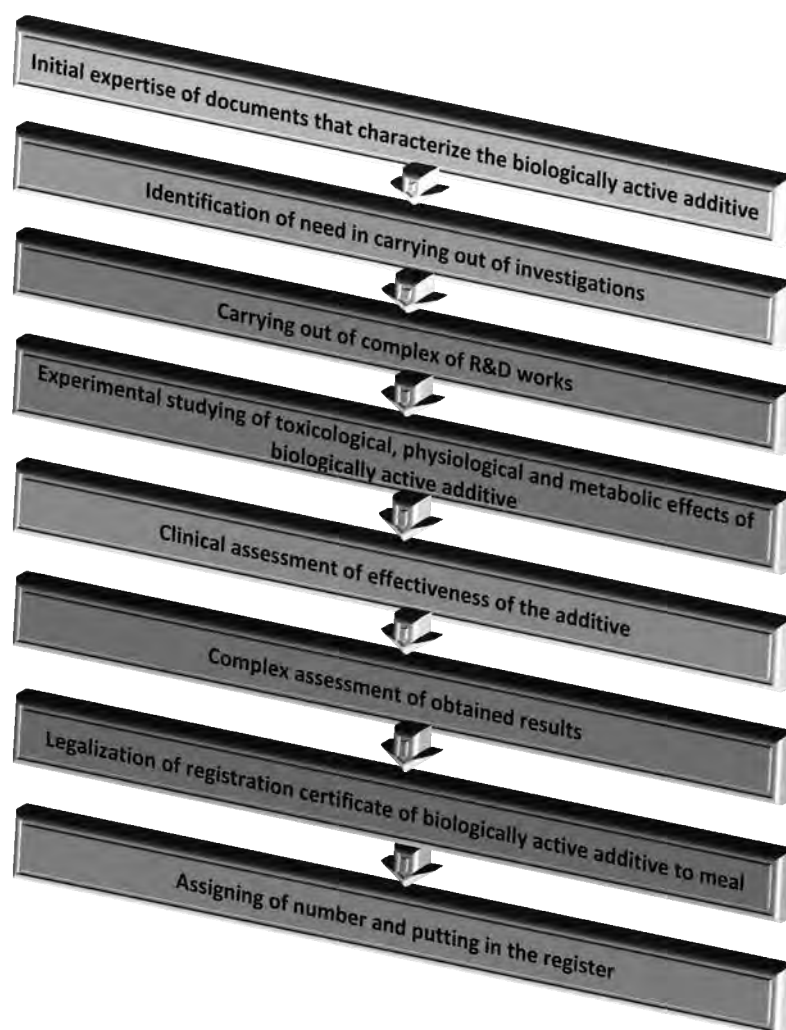
3. The work in choose of value of dose of micronutrient and method of its introduction in organism has to be done in observance of demands and recommendations substantiated from the scientific point of view.

4. The technological parameters used in work in manufacturing and storage of foodstuffs must ensure the maximum level of preservation of micronutrients applied into the product and their guaranteed content in the finished product.

5. The event of introduction of micronutrients in foodstuffs must not worsen their consuming properties, e.g. decrease the content and digestibility of other nutritional substances, vary considerably their taste, aroma and freshness, as well as to shorten the guaranteed term of their storage.

6. The factual effectiveness of product as the source of micronutrients may be approved by results of medicinal and biological investigations carried out in process of approbation of action of the product on state of health of representative groups of men.

The additives and objects that contain the biologically active substances (raw materials, additives to meal), have to ensure their specific effectiveness and do not influence negatively on state of health of men. To be permitted for use, each additive has to be tested by services that accomplish their hygienic expertise and registered in the State register (Fig. 3.15).



**Figure 3.15** *The sequence of carrying out of work in hygienic expertise and State registration of biologically active additives to meal*

One has to take into consideration that enrichment of the products cannot be done in many cases by simple adding of the additive into the foodstuff of the nutritional system because of differences in their physicochemical characteristics (especially values of pH), incompatibility of tastes, instability of the additive in concrete conditions of treatment of raw materials, probability of undesirable interaction of the additive with other ingredients of the mix etc., what requires use of special forms of introduction of additives, for instance in form of microcapsules.

Technologists accumulate in their work the practical experience in producing of functional meat products, especially the assortments of such kind meat products assigned for mass production is formed basically on use of two principles as follows:

- regulation of content in meat products of certain kinds of nutrients (decreasing of content of salt, sugar, fat etc.),
- enrichment of sausages and semi-finished products in introduction in their formulations of preparations of iodine, iron, calcium, dietary fibers, lactose, vegetative oils, albuminous preparations etc.

The work, which is executed in parallel with spreading of assortment of functional products, is studying of potential of existing resources of vegetative, zoic and mineral raw materials and hydrobionts. Scientists develop new types of biologically active additives based on use in their work of modern chemical and biotechnological methods (molecular biology, genic engineering, molecular genetics, cellular engineering).

### **Checking questions**

1. What are the dietary fibers ?
2. What are the basic causes of use of dietary fibers in modern technologies of producing of meat products ?
3. Give examples of meat products, which formulations include dietary fibers.
4. What properties of gluten permit to use it in meat systems ?
5. What are gums ? What are sources of their producing ?
6. What is the principal purpose of use of gums in meat systems ?
7. What is carragenan ?
8. What is the principal function of carragenans in meat systems ?
9. What is the main cause of use of starch in meat industry ?
10. What is the event of forming of pasters ? What is its importance ?
11. What types of starches are used in meat industry the most often ?
12. What substances are determinative in forming of colors of finished meat products ?
13. What is the need of use of colorants of foods ?
14. What groups of colorants do you know ?
15. Describe properties of fermented rice as the colorant of meat products.
16. What are the synthetic colorants of foods ? Name the representative substances of this group compounds.
17. What is the purpose of use of sodium nitrite ?
18. Describe the mechanism of functioning of sodium nitrite in meat systems.
19. What are the tasty additives and flavoring substances ?
20. Which substances includes the category of flavoring substances ?

21. What is marinating ?
22. What is the flavoring agent ?
23. Name the causes of use of flavoring agents.
24. What is the difference of natural flavoring agent of the agent identical to the natural one ?

### Literature

1. Баль-Прилипко Л.В, Лозова О.М Удосконалення технології м'ясних продуктів за допомогою комплексних функціональних сумішей, Київ: НУБІП України. Матеріали міжнародної науково-практичної конференції молодих вчених, аспірантів і студентів. 20-22.04.10, с. 92
2. Баль-Прилипко Л.В. Вдосконалення використання жировмісної сировини при виробництві ковбасних виробів /Л.В. Баль-Прилипко, О.М. Гармаш // Мясное дело. – 2011. - №2. – С. 12-13.
3. Баль-Прилипко Л.В, Лозова О.М "Магічні" речовини в харчовій промисловості: використання функціональних добавок при виробництві м'ясних виробів, Киев: Мясное дело. - № 3, 2010, с. 34-36
4. Баль-Прилипко Л.В. Актуальні проблеми м'ясопереробної галузі / Л.В. Баль-Прилипко: Підручник. – Київ, 2011. – 288 с.
5. Баль-Прилипко Л.В. Використання біоконсервантів для м'ясних продуктів. /Л.В. Баль-Прилипко, Н.Г. Машенцева, Б.І. Леонова // Продовольча індустрія АПК-2012.- №2.- С. 21-24.
6. Баль-Прилипко Л.В. Інноваційні технології якісних та безпечних м'ясних виробів / Л.В. Баль-Прилипко: Монографія. – Київ, 2012 – 207 с.
7. Баль-Прилипко Л.В Вплив поліфункціональних харчових добавок на якість м'ясної продукції /Л.В. Баль-Прилипко - Продовольча індустрія АПК-2011.- №5.- С. 12-15.
8. Баль-Прилипко Л.В. Впровадження та використання біологічно активних добавок при виробництві м'ясних продуктів / Л.В. Баль-Прилипко // Мясное дело.- 2011.- №1.-С.10-12.
9. Баль-Прилипко Л. В. Дослідження перспективних функціональних інгредієнтів для м'ясних продуктів / Л.Баль-Прилипко, Б.Леонова, Д. Грек, О. Гаврилюк, А. Головін, М. Козка, В.Назаров // Мясное дело. – 2013. – №7. – С. 27–29.
10. Баль-Прилипко Л.В. Інноваційні технологічні рішення при виробництві варених ковбас / Л.В.Баль-Прилипко, Б.І. Леонова, О.П. Гармаш // Продовольча індустрія АПК. - 2012.- №3.- С. 20-23 .
11. Баль-Прилипко Л.В. Колір, як важливий показник якості. Сучасні способи зниження вмісту нітриту натрію у м'ясних продуктах/ Л.В. Баль-Прилипко, Б.І. Леонова //Мир продуктов .- 2015.-№ 9(118).– С. 32-35
12. Баль-Прилипко Л.В. Перспективи застосування фітопрепаратів у м'ясній промисловості / Л.В. Баль-Прилипко, Ю.Ю. Долгоп'ятова // Мясное дело. – 2011. - № 9. – С. 18-19.
13. Баль-Прилипко Л.В. Сучасні методи ін'єктування м'ясної сировини розсолами /Л.В. Баль-Прилипко // World Meat Technologies. - № 4. - 2011. - с. 22-24.

14. Баль-Прилипко Л. В. Сучасні напрями використання альгінатів в м'ясній промисловості / Л. В. Баль-Прилипко, Б. І. Леонова, Д.О. Грек // Мясное дело. – 2013. – №2. – С. 8 – 9.
15. Баль-Прилипко Л. В. Технологічні аспекти застосування солі у сучасній м'ясній промисловості /Л. В. Баль-Прилипко, Е.Р. Старкова, І. Грод, М. Соломчук // Продовольча індустрія АПК. – 2015. – №1-2. – С. 14–18.
16. Баль-Прилипко Л.В. Характеристика та класифікація біологічно активних добавок / Л.В. Баль-Прилипко //Мясное дело. – 2011. - №2. – С. 36-39, № 3. – С. 24-27, № 4. – С. 30-33.
17. Биологически активные добавки в питании человека / Упельян В.А., Суханов Б.Н., Андриевских А.Н., Поздняковских В.М. — Томск: Научно-техническая литература, 1999. — 229 с.
18. Бурштейн А.И. Методы исследования пищевых продуктов.- К. Медицина, 1963.-515 с.
19. Вивчення жирнокислотного складу м'яса та ковбасних виробів при зберіганні з комбінованими консервантами/ Л.В.Баль-Прилипко та ін. - "Харчова промисловість". Міжвідомчий тематичний науковий збірник, №42. - К.: "Урожай", 1996, с. 120-124
20. Головні засади формування смаку, аромату й післясмаку готових м'ясопродуктів, БальПрилипко Л.В, Тернополь: World Meat Technologies. - №4, 2010
21. Дефіцит білка можна поповнити /Л.В. Баль-Прилипко. - К.: Харчова і переробна промисловість, № 5, 2000, с. 20-22
22. Долгая М.М. Пищевые добавки и их использование в производстве продуктов питания. – М.: ВНИИЦентр, 1987.
23. Жаринов А.И., Соколова Н.А. Мясопродукты, потребитель и некоторые аспекты современного маркетинга // Вестник "Аромарос-М". – 2005. - № 3. – С. 53-62
24. Жаринов А.И., Ивашкин Ю.А. Проектирование комбинированных продуктов питания // Все о мясе. – 2004. - № 2 С. 16-21, № 3 С. 6-15
25. Інноваційні технології бездимного копчення при виробництві ковбасних виробів, Баль-Прилипко Л.В, Шокун В.В., Київ: НУБІП України. Матеріали міжнародної науково-практичної конференції молодих вчених, аспірантів і студентів .20-22.04.2010, с. 93
26. Исупов В.П. Пищевые добавки и пряности. – СПб.:ГИОРД, 2000.
27. Крижова Ю.П. Розробка продуктів оздоровчо-профілактичного призначення / Ю.П. Крижова, Л.В. Баль-Прилипко // Продовольча індустрія АПК. – 2015. – №6. – С. 29-44.
28. Перспективные технологии XXI века: монография / [Баль-Прилипко Л. В., Абдуллин И.Ш., Абуталипова Л.Н. и др.]. – Одесса: КУПРИЕНКО СВ, 2013. – 162 с.
29. Нечаев А.П., Траубенберг С.Е., Попов М.П. Пищевая химия: Курс лекций: В 2 Ч. – М.: МГУПП, 1998. – 258 с.
30. Люк Э. Консерванты в пищевой промышленности. Свойства и применение./Пер. с нем. Сарафановой Л.А.. – СПб.: ГИОРД, 1998



31. Пищевая биотехнология: научно-практические решения в АПК: монография / А.И. Жаринов, И.Ф. Горлов, Ю.Н. Нелепов, Н.А. Соколова. – М.: Вестник РАСХН, 2007. – 476 с.
32. Постанова Кабінету Міністрів України: Про затвердження переліку харчових добавок, дозволених для використання у харчових продуктах
33. Продукти збагачені соєю - вживання їх запобігає виникненню злоякісних новоутворень /Л.В.Баль-Прилипко та ін. К.: Харчова і переробна промисловість, 2000, № 5, с. 20-22
34. Рослинні композиції для м'ясних консервів / Л.В.Баль-Прилипко та ін.-К.: Харчова промисловість, № 6, 2000, с. 21-22
35. Санитарные правила и нормы 13-10 РБ 2002 "Гигиенические требования к качеству и безопасности пищевых добавок и их применению"
36. Санитарные правила и нормы. Гигиенические требования по применению пищевых добавок , Омега-Л, 2007 г.
37. Сарафанова Л.А., Кострова И.Е.Применение пищевых добавок.
38. Срок годности пищевых продуктов: Расчет и испытание / Под ред. Р.Стеле, пер. с англ. В.Широкова, под общ. ред. Ю.Г.Базарной. – СПб.: Профессия, 2006. – 480 с.
39. Соеві компоненти в м'ясних виробках / Л.В.Баль-Прилипко.- К.: Харчова і переробна промисловість, 1999, с.24-25
40. Терминологический словарь-справочник по пищевым добавкам и специям - Д.А. Васильев, Л.П. Пульчаровская, Г.Н. Зеленов; Кафедра микробиологии, вирусологии, эпизоотологии, ветеринарно-санитарной экспертизы, Кафедра биотехнологии и переработки сельскохозяйственной продукции Ульяновской государственной сельскохозяйственной академии
41. Яременко В.В., Артюхов В.Г., Дроговоз Г.К. К вопросу о применении заменителей сахара – аспартама ацесульфама К в пищевой промышленности и медицине // Химия и технология пищ. продуктов. - 1991. № 3. С. 97—102

## DEVELOPMENT OF INNOVATIVE TECHNOLOGIES IN THE BRANCH-INDUSTRY

### 4.1 Use of activated aqueous systems in purposes of ensuring of microbiological stability of meat products

The serious problem that exists in food industry is rising of level of environmental safety of used technologies of producing of finished products, especially of minimization of quantities of chemical additives and ingredients used in their production. The one of principal methods of realization of this task is modification of composition of water, which is the constituent component of minced meats used in producing of meat products. Being the solvent, water influences considerably on consistency and structure of the product, its appearance, taste and stability in process of storage.

Thanks to physical interaction with albumens, polysaccharides, lipids and salts, water influences considerably on texture of finished products, therefore many of native and foreign enterprises of food industry devote big care to quality of water used by technologies and methods of its purification because it was shown that physicochemical, organoleptic and microbiological indices of quality of water have the big influence on safety and output of finished products.

Water has the molecular mass of about of 18.02 and may exist in form of ice, liquid and vapor. The principal physical properties of water are given in Table 4.1.

**Table 4.1**

***Physical properties of water at 20 °C***

Index	Value
Density, kg/m <sup>3</sup>	998.2
Index of equilibrium of water with regard to distilled water, units	1.001
Coefficient of thermal expanding, 1/K	$30.2 \times 10^{-5}$
Surface tension, N/mm	$72.75 \times 10^{-3}$
Pressure of saturated vapor, Pa	2337
Heat capacity, J/kg·m	4.18
Dielectric constant, units	80.36
Thermal conduction, J/m·s·K	$5.98 \times 10^2$
pH, units	6.5
Thermal conductivity, m <sup>2</sup> /s	$1.4 \times 10^{-5}$
Redox potential, mV	200 ÷ 400

Water is the most universal substance of those ones that are present in inner ecological by-systems and is the base of their functioning. Quality and composition of water used in purposes of manufacturing influence considerably on forming of composition of foodstuffs. However, the set of impurities present in water to drink does not conform in many cases to established norms, what results finally in presence

of their overrated quantities in finished products of undesirable macro- and micronutrients. This phenomenon states the problem of introduction in technology of the stage of preliminary purifying of water what is executed in most cases in use of use of chemical reagents. Its realization results in removal of certain quantities of undesirable impurities but leads to simultaneous contamination of technological water by residual quantities of chemicals used in process of purification.

Therefore, there becomes the more popular the idea of variation of properties of water in way of reshaping of its structure. More of experimental works showed that usual water obtains new properties under influence of physical influences such as its magnetization, insonifying, stirring, defecating, heating or cooling, freezing followed by its defrosting, what influences on kinetics of chemical interactions in aqueous environments. It was shown also the increased biological and medicinal activity of water what gave the motive to name it as the *activated* one. So, one has to understand the event of activation of water and aqueous solutions in process of reagentless influence on their structure, which leads to occurrence of their anomalous characteristics and ability to influence of kinetics of chemical reactions. The one of methods used in this purpose is electrochemical activation. The activated aqueous systems are used presently in many branches of public economy. Particularly in agriculture such waters are used in fabrication of ecologically pure nitrogen fertilizers, preplant treatment of seed, in control of vermin and pests, in technologies of decontamination of grain and grain products, in purposes of stimulation of growth of animals and birds, prolongation of terms of storage of fruits, vegetables and citrus plants etc.

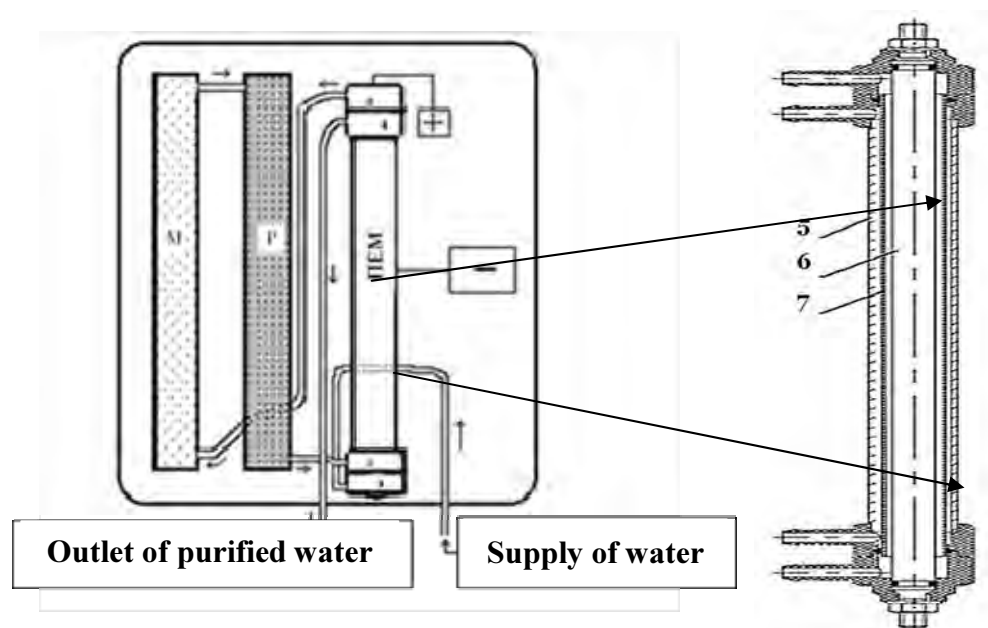
Technologists use in food industry the activated water produced electrochemically in processes of hydrolysis of starch; producing of dry concentrates of tea and carbonated beverages; fabrication of pectin; inversion of sugar; regeneration of oxidized fats; producing of macaroni, bear, drugs and biologically active substances used in food industry. The activated water is used also in purposes of sanitary treatment of technological equipment, pipes and packing.

Because water is the most voluminal component of meat systems and physicochemical properties of electroactivated liquid differ considerably of properties of usual water, it may be used in meat industry for purposeful regulation of technological properties of raw materials of raw materials, albuminous additives, multicomponent preparations, preservation of proper quality and extending of terms of storage of finished products. The numerous investigations showed that use of electroactivated water is the most prospective and environmentally friendly method of reaching of listed goals. Use of activated water use permits to decrease greatly or even exclude the use of chemicals and may be introduced in technologies directed on betterment of quality of finished products, modernization and reaching of environmental friendliness of existing technologies, shortening of terms of carrying out of works in producing and raising of safety of foods.

However, information on use of electroactivated water in technologies of producing of meat products is still limited, what witnesses the high actuality of studying of this problem. the method of electrochemical activation of water does not need spending of big expenses of labor. The process is realized in special devices –

the electrochemical activators, which consist of two chambers divided by porous diaphragm.

The general functional scheme of electrochemical activation of water is given on Figure 4.1 below.



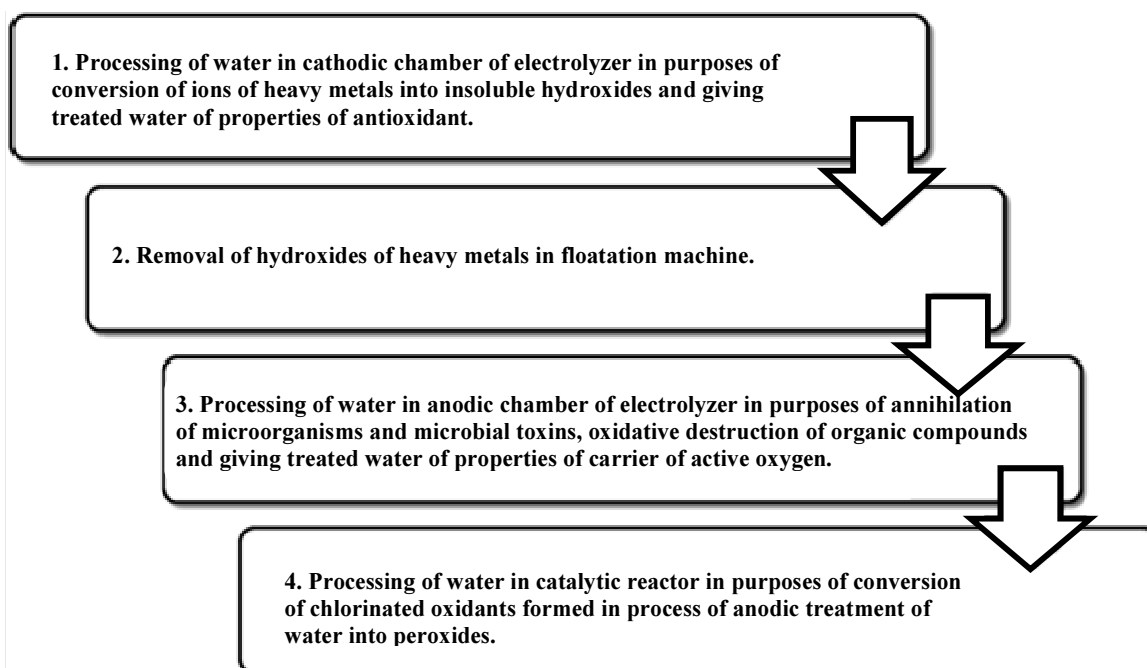
**Figure 4.1** Generalized functional chart of electrochemical activation of water and of running apparatus used in it

*1, 2, 3, 4 – connecting pipes, 5 – cathode, 6 – anode, 7 – diaphragm, M – half-way capacity, P – catalytic reactor, ИЕМ – continuous flow electrochemical modular element*

The running water flowing from the downstream capacity flows by connecting pipe 1 into the anodic chamber of continuous flow electrochemical modular element by connecting pipe 2 attached to the down side of half-way capacity M. Then water flows by short pipe from the upper side of capacity M into the upper side of catalytic reactor P reactor P and flows out of its down side by connecting pipe 3 into cathodic chamber of reactor and flows out of it from connecting pipe 4.

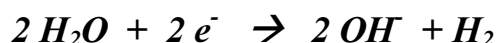
ИЕМ is the most important element of this installation. It consists of 5 – cathode, 6 – anode and 7 – diaphragm. The solution taken from anodic chamber is named as anolyte or acidic fraction of electroactivated water, and solution taken from cathodic chamber – catholyte or its alkaline fraction.

The water, which passed the diaphragm electrolyzer, turns in result of influence of high-voltage electric field in metastable (activated) state. Its anodic fraction has the anomalously high oxidizing properties, and cathodic fraction – the reducing ones. The process of activation is realized in sequence as follows (Fig. 4.2).



**Figure 4.2** *Technological scheme of electrochemical activation of water*

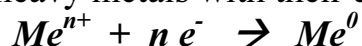
The one of basic processes occurred in process of electrochemical activation of water is its reducing on cathode:



and oxidation on anode:

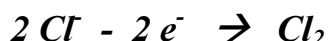


The cathodic process is supplemented by simultaneous discharging of ions of copper, zinc, nickel and other heavy metals with their depositing on the electrode:



At the same time the considerable part of these ions do not pass to cathode because of transport limitations, react in the volume with the newly formed ions of hydroxyl and deposit practically in full on the bottom of apparatus as insoluble hydroxides. Therefore the process of treatment on water on cathode permits to decrease greatly its hardness and decrease the content of toxic elements in water used in producing of foodstuffs.

If solutions contain ions of chloride, there is possible passing of anodic process of forming of gaseous chloride:



The electrode processes are passed stages of forming of monatomic chlorine and oxygen character by extremely high reaction ability, which interact just after their forming and form in aqueous environments the highly active oxidizers of  $ClO_2$ ,  $ClO\cdot$ ,  $HOCl$ ,  $O_3$ ,  $Cl_2$ ,  $H_2O_2$ ,  $OH^-$ ,  $HO_2^-$ . Depending of grade of mineralization and speed of flowing of water, their concentration may vary in limits of  $15 \div 150 \text{ mg/dm}^3$ , what is enough to annihilate *all types and forms microorganisms*. The process of electrolysis is supplemented also by decomposition on simple substances of all harmful admixtures, e.g. of phenols, microbial toxins etc. and variation of **pH** of waters that passed out of cathodic and anodic chambers of the electrolyzer. Anolyte has the

acidic reaction and catholyte – the alkalotic one. Such event is considerably important for manufacturers because the parameter of active acidity (**pH**) is one of the most significant indices of quality of water used in various technologies of producing of foods, especially the meat-processing processes.

Waters that passed the stage of electrochemical activation preserves properties of donor of electrons during the long time (up to 48 hours) and functions as effective antioxidant compatible with live organisms that assist in absence of any additive in normalization of functioning of their cellular membranes. The redox potential of water activated on cathode is close in most cases to respective parameter of tissues of men, what permits to normalize the energetic balance of organism and ensure the friendly conditions of passing of all vitally important biological processes.

The anodic fraction of water has the clearly expressed bactericide properties and permit at the same time to hold its bigger quantities in meat raw materials increasing so output of finished products. for the other hand, the cathodic fraction of electroactivated water has the strongly alkaline reaction close to this one of solutions of phosphates in meat environments. Therefore, treatment of meat by catholyte results in inhibiting of passing of negative processes of microbiological and hydrolytic character, what permits to prolong terms of storage of finished products. Use of electroactivated water assists also on decreasing of hardness of water and reducing of content of highly toxic elements in it what in the sufficiently important factor from the viewpoint of environmental friendliness of produced products.

Many scientists propose to use the anodic fraction of electrochemically activated water that has the pH value of about of 2 as the antiseptic means. Such it application would permit to decrease considerably quantity of microorganisms on surface of bulks and inhibit germination of residual microflora and prolong terms of storage of meat on some days. Anolyte is character by antibacterial, antiviral, antimycosis, antiallergic, antihydrotic, antiscratch and predrying effects. It may display also cytotoxic and antimetabolic action but not cause any harm for cells of tissues of men. The biocidic substances present in electrochemically activated anolyte are not toxic for somatic cells because they are represented by oxidants similar to those that are produced by cells of supreme organisms. Scientists found the cardinal decision that permitted to raise considerably effectiveness of treatment of meat bulks and prolong terms of their storage in cooled state at temperatures higher of those that are used in this purpose usually, what gave the effect of decreasing of quantities of energy spent in it. Said effects are reached in way of introduction of stage of initial treatment of meat by suspension of mustard in anolyte. The upper value of pH used in such treatment is 3, redox potential of the solution is about of 1000 mV and content of active chlorine is more of 0.03 %. The meat bulks prepared for storage are rinsed by this technology by suspension of mustard in anolyte during the term of  $8 \div 10$  minutes or in way of their immersion in baths with this suspension for  $3 \div 6$  minutes. The quantity of mustard in suspension, redox potential of anolyte and temperature of post-treatment storage were chosen dependently of set term of storage of meat. To increase terms of guaranteed storage of meat, one has to decrease temperature of its standing and rise concentration of mustard what leads to increasing of redox potential of anolyte and content of active chlorine in it (Table 4.2).

**Table 4.2**

***Terms of storage of meat treated by suspension of mustard in anolyte, days***

Properties of anolyte		Concentration of mustard in suspension, %				
pH	Redox potential, mV	0	1.0	1.5	2.0	2.5
<i>Temperature of 1°C</i>						
2.0	1200	17	17	18	19	19
2.5	1080	16	16	16	18	18
3.0	1000	14	14	15	16	16
<i>Temperature of 5 °C</i>						
2.0	1200	13	13	14	16	16
2.5	1080	12	12	14	15	15
3.0	1000	10	10	12	13	13

The neutral anolyte that has the redox potential of 800 mV and minimal biocatalytic activity of 150 mg/dm<sup>3</sup> is used for disinfection of technological equipment and manufacturing premises, decontamination of eggshell by immersion of eggs into this solution for 6 minutes and treatment of carcasses of broilers during 15 ÷ 20 minutes before they would have been put in freezing chambers. Said solution is used also instead of usual water in process of fabrication of minced meat made of poultry. There exists also data on its use in technologies of reprocessing of meat of birds. The catholyte that has parameters of pH of 10 and more, and redox potential less of 700 mV is used for cleaning of technological equipment and manufacturing premises, which has to be rinsed twice with interval of 5 minutes and minimal time of exposition of 12 minutes.

One should take into consideration that parameters of quality and properties of activated solutions, especially their *pH* and redox potential, spontaneously vary (relax) in time even in absence of mass exchange with the outer space. The signs of anomaly of solutions disappear after finishing of process of relaxation and liquid returns in state of classical thermodynamic equilibrium.

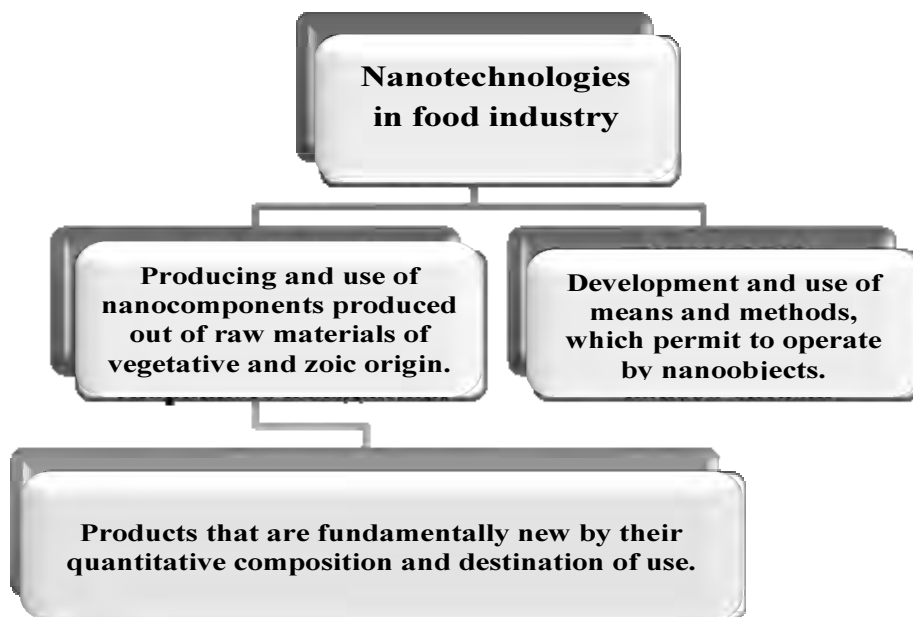
It was found that catholyte relaxes in state of rest and returns to normal conditions of pure water during two hours. To prolong this time, one has to store and carry catholyte in closely tight vessels poured up to the top. Storage of the solution in such conditions permits to prolong term of preservation of its properties up to 2 ÷ 3 days. Anolyte may be stored some weeks or even months both in open and closed vessels (except of those that are made of copper). The less is volume of activated liquid, the quicker passes its relaxation. The last process considerably accelerates aeration of liquid, its pouring out of the vessel, varying of temperature (cycles of heating and cooling), what decreases effectiveness of action of activated solutions.

Thus, it's desirable to use the specific properties water obtains in result of its converting in metastable state just after termination of process of its electroactivation. To do so, one has to place the electrolyzer in close vicinity to place of producing of the product. Using this phenomenon scientists proved efficiency of this methods and studied the effect of various modes of activation of water on functional and technological properties of albuminous preparations produced out of natural raw

materials that contain collagen and are used in technologies of producing of emulsified meat products. It was shown that the optimal parameters of activation of drinking water is its two-time activation seconded by cavitational disintegration and driving it to pH values of  $10 \div 12$ .

#### **4.2 Actuality of use of nanotechnologies, preconditions and basic tendencies of their introduction**

Mankind works all time on betterment of conditions of its existence. To improve conditions of living, men who lived in pristine societies used various means of labor and domesticated in later time wild animals. Founders of ancient classical directions of progress of medicine understood that nutrition influences considerably on health of men and may be used for their cure or result, vise versa, in their ache. The famous ancient doctor Hippocrates said: "Let your meal be your drug but not drugs are your meal". Needs of men changed in passing of time and most of us cannot imagine our life in absence of comforts of creature, achievements of science, technique and medicine. The same may be said about the food industry and the next step in its progress would be mastering of nanotechnologies, especially use of objects of extremely small size, which would be capable to observe "commands" of men. The prerequisites of their introduction and beginning of fundamentally new level of operation in producing of foods are (Fig. 4.3).



***Figure 4.3 Basic direction of use of nanotechnologies in food industry***

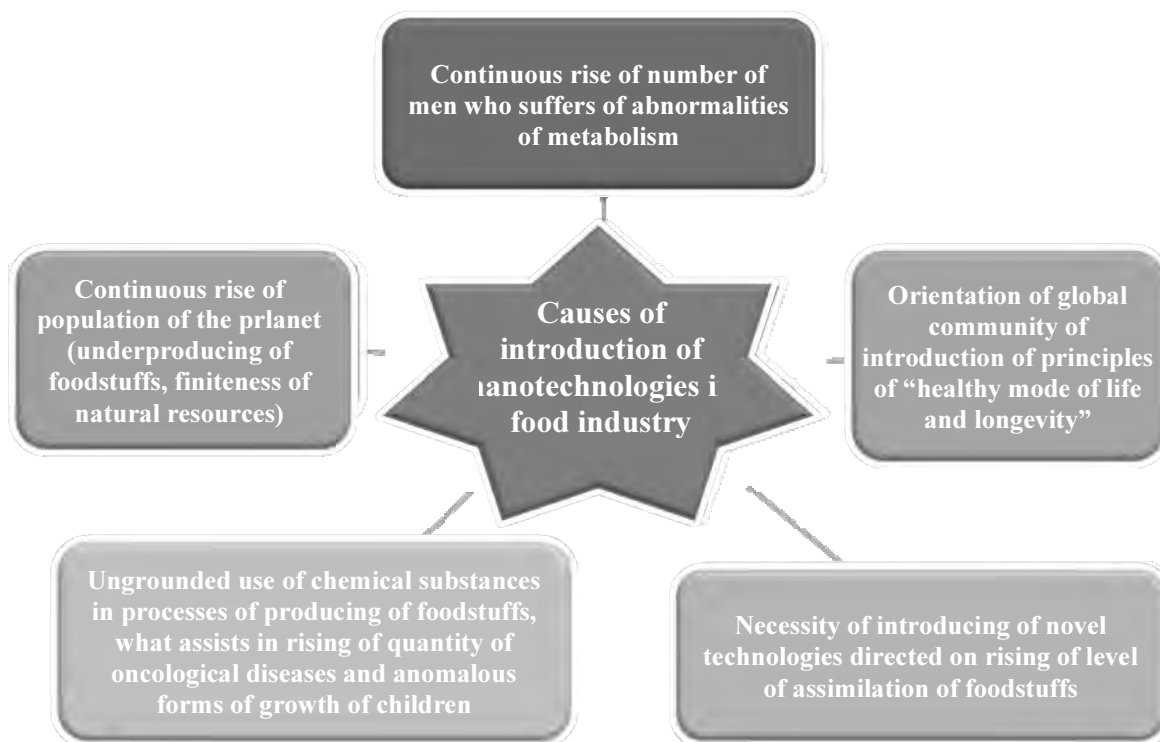
The work in introduction of nanotechnologies in food industry is realized in observance of factors as follows:

- social and economical aspects of alimentation,
- observance of fundamental and practical principles of realization of technologies and biotechnologies of producing of foodstuffs,
- nutritional aspects of alimentation.

Extensive use of modern achievements of science and technique, including progress of works in sphere of nanotechnologies, assists in solving of nutritional problems of mankind. WHO announced that more of 1.5 billion of adults have the



excessive weight and their quantity would increase for 2020 up to 2.3 billion. Fatness is the main cause of occurrence of “plague of XX century” – the complex of pathologic appearances of biochemical, hormonal and clinical nature that result finally in events of origination of diabetes of II type. The main cause of its progress is those that most types of meal contain big quantities of hydrocarbons and fats of zoic nature. The second factor of initiation of aches is urge of manufacturers to prolong terms of fitness of products and giving them of certain organoleptic properties. The method used in it is putting in foodstuffs of chemical additives and substances, which influence in many cases negatively on state of their health.



**Figure 4.4** *Basic causes of introduction of biotechnologies in food industry*

Existence of disbalance of nutritional and biologically active substances in structure of alimentation leads to decreasing of resistance of organism of man to influence of negative factors of environment. The considerable factor of influence is in this case consumption of refined products and foodstuffs produced by technologies and formulations, which decrease their nutritional and biological values. Therefore, one of present-day tasks of scientists and technologists is development of formulations and technologies of producing of functional foodstuffs and one of directions of progress in this sphere is elaboration of biotechnologies of their fabrication (Fig 4.4).

The notion of nanotechnology has no monosemantic definition. However analogy with microtechnologies used presently one may interpret it as technologies of operation by objects of extremely small size, which is in most cases is about of some nanometers. Use of nanotechnologies is now one of key directions of progress of human society, which permit to produce purposefully the set of products, which have

the prescribed molecular structure. Synthesis of such substances gives the possibility of fabrication of products of any destination, e.g. eggs and meat of birds without use of traditional raw materials but directly out of atoms and molecules. However it is not the dogma because prospective methods of development of related technologies may be assessed only on base of predictable but not experimental data. Meantime practice shows that if predictions were made on base of properly studied regularities, the probability of their trueness is too big. Therefore passing of technologies from stage of “micro” to stage of “nano” makes real the possibility to operate by molecules (groups of molecules) to produce products that would have the desirable properties.

This process was begun in 2000 when the American company "Krafts Food" founded the first nanotechnological laboratory and consortium of "Nanotek" that unified activities of 15 universities of various countries and national R&D laboratories. For the time of 2004 there were developed in the world more of 180 workings in sphere of nanotechnology, which results are now at stage of commercialization. Ukrainian specialists began their operation in this sphere in 2007 and most of works are carried out presently in sphere of veterinary and medicine.

The term of “nanoscience” is used now in relation to investigations executed on atomic and molecular level, which have the principal goal of development of methods of producing of nanoproducts. Unlike traditional technologies, development of methods of nanoengineering requires of carrying out of fundamental investigations, hence big expenses, as well as need of use of achievements of adjoining spheres of science and technique. The specific characteristic of this work is impossibility of solving of set problems by method of “trial-and-error method”.

The base of modern concept of alimentary nanotechnology is theory of balancing of nutrition, which sets conditions of assuring of basic needs of men in energetic, plastic and other components, as well as is used in development of rations of rational nutrition formulated in observance of needs of concrete groups of population, their physical exercise and specific norms of alimentation.

The novel methods of development of compositions and properties, hence technologies of producing of foods in use of advances of nanotechnologies have to be developed in observance of basic needs of organisms of men in all nutritional substances and energy. The founder of science on nanotechnology is famous American physicist and laureate of Nobel Prize Richard Feinman. Most of macro- and micronutrients decompose under influence of external factors hence lose their useful properties. However if such substances would be put into special microcapsules as components of microemulsions, their stability will rise in great extent, e.g. such associates are not decomposed at temperatures up to 200 ° C. The first products produced by such technologies were fabricated by company of "Campina". The dairy product, which contained nanoparticles, it proposed, assists in speeding of process of assimilation of calcium. It was produced also the experimental batch of bread enriched by nutritional substances contained in specially added nanocapsules of fat of tuna but not smelled by fish. The specific characteristic of such and similar products is that they do not



contain GMO and permit at the same time to balance the men's rations and enrich traditional foods by additional doses of biologically active substances necessary for normalization of vital activities of live organisms.

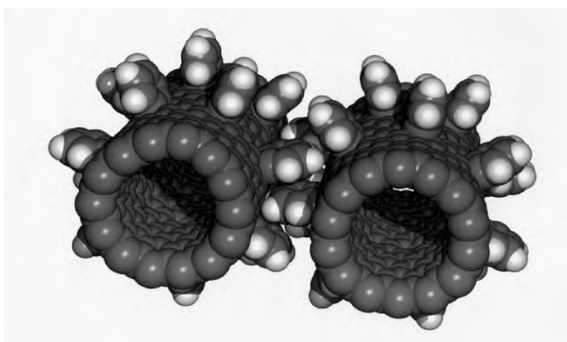
It is possible to point the advantages of nanoproducts over their analogues that do not contain nanoparticles but passed the stage of homogenization only. The biggest worth of nanocomposition is that the food additive, e.g. any substance put inside the capsule of cyclodextrin may be extruded outside by other components of environments, which have the bigger affinity to molecules that form capsules. Such process may pass even in mouth. The analogous mechanism is character for complexes of hydrophobic vitamins of A, D, E and K, which may be consumed in such form in absence of fats. Therefore, macro- and micronutrients placed inside the cyclodextrin chamber obtain bigger stability and biological availability for consumption. For example, solubility of vitamins E, B<sub>2</sub>, A in water at room temperature increases by factor of 3 ÷ 6.

The role of protector and ability to transport vitamins, probiotics and antioxidants successfully play globular albumens, especially those that are contained in serum of milk. They grasp and wrap particles of food additives and increase so their biological accessibility. The substances that may be used as carriers of vitamins of fat of fish and co-enzyme Q10 is nanopowder of silicon. Its use permits to rise accessibility of nutrients and nanoparticles of silicon dissolve on bowels and form so silicic acid necessary for forming of bone tissues. The milk produced in use of advances of nanoscience contains particles of fat, which have size of 200 nanometers. Its main advantage is that such product may be stored at room temperature during six months in ansence of preservatives.

It is seen the crucial rise of realization of nanoproducts in sector of producing of foods and forecasts show retaining of such tendency in future. However it is not the time to affirm that technologies will be introduced in food industry widely because this problem needs of detailed and extensive studying.

#### **4.2.1 Perspectives of introduction of nanotechnologies in agriculture and animal husbandry**

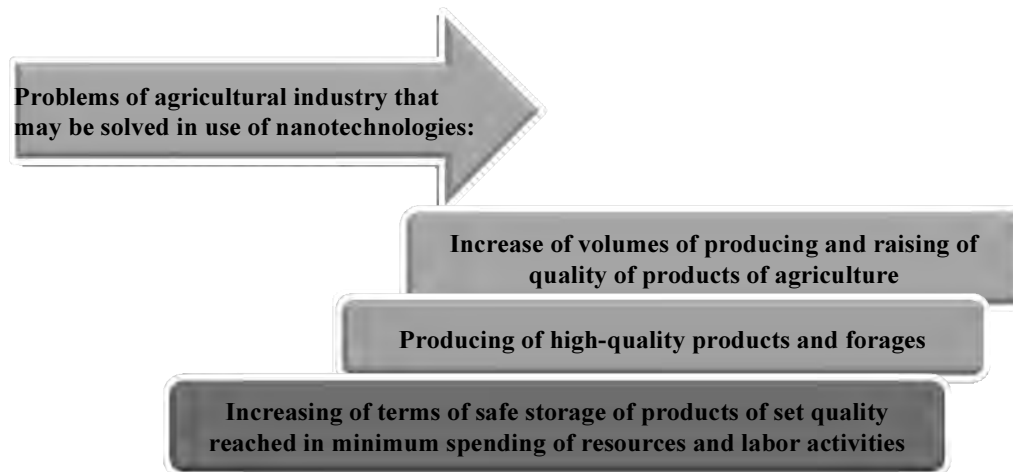
Use of nanotechnologies permits to generate in agriculture the real revolution. It's forecasted that works carried at molecular level would permit to produce foods and it will give the possibility to replace in it agricultural plants and domestic animals. For example, modern technologies permit to produce milk without cows in use of grass as the raw material. Such "agriculture" does not depend of conditions of weather and need not hard physical work. At the same time its productivity is such that



introduction of technologies of producing of such milk would permit to solve the food problems once and forever. However there still exist problems of commercialization of results of these investigations and products produced by these technologies are too expensive. Really, such and some other results of research are the top advances of

modern science. However, there begins the step-by-step introduction of advances of nanoscience in sphere of producing of products of agriculture. So we will describe the most significant advances in progress of modern nanotechnologies.

The principal directions of use of nanotechnologies in agriculture are linked with reproduction of cultivated kinds of products, betterment of quality and development of technologies of their producing (Fig. 4.5).



**Figure 4.5** *Problems of manufacture that may be solved in use of nanotechnologies*

Nanotechnologies are used now in purposes of disinfection of air and other materials including forages and finished products of husbandry of animals, in treating of seed and harvests etc. Use of their advances assists in stimulation of growth of plants, curing of animals and betterment of quality of forages. The published data inform on use of such technologies in purposes of decreasing of capacity of energy in processes of manufacturing, optimization of methods of treating of raw materials and increasing of output of finished products. Nanotechnologies are used in producing of new packing materials, which use permits to prolong terms of storage of finished products.

The biological nanochips of substances that have the antibacterial properties, such as nanoparticles of silver, would permit to accomplish diagnostics of somatic and inflectional illnesses including the work in identification of kinds of agents that cause occurrence of more than usual infections and formation of toxins. Such particles are used also in agricultural practice, e.g. in milking machines, purification of contaminated filters of conditioners etc.

Husbandry of animals is the base of supply of raw materials to be used in meat industry. Therefore introduction of advances of nanoscience is too necessary to optimization of work in this sphere of public economy. The principal spheres of their use would be technological processes of forming of microclimate in premises for keeping of domestic animals. Their use permits to replace the powerful influx-and-extract system of ventilation by the system of purification of air that would permit to remove the undesirable smells and be character by keeping of normalized indices of temperature, humidity, dustiness and microbiological pollution.

The expressive example is introduction in Russia of environmentally pure nanotechnology of preservation of mass of silo of green forages in use of

electroactivated preservative instead of expensive organic acids, what permits to reach the level of their preservation in storage up to 95 %. Use of advances of nanoscience in work in producing of forages for domestic animals and poultry permits to rise their productivity by factor of  $1.5 \div 3$  and increase at the same time their resistivity to stresses that decreases their losses twice. The nanodevices that may be implanted into plants and animals permit to automate many processes and pass the necessary data for control in conditions of real time. Some workings done in sphere of nanotechnologies for use in agriculture arte still at stages of planning but some of these works are approbated in certain spheres of economy, e.g. in keeping of poultry.

The battery farms use at this time the more often mathematical models of operation and produce eggs and meat of birds on base of principles of fifth technological level (nanolevel). The products the most competitive on global markets now are enriched by nutritional substances and microelements. To attract attention of consumers and guarantee profitable work is possible if manufacturer would produce safe foods, which comply with norms of international standards. Therefore presence of certificate of quality is some type “admission” of products made of meat of birds on global markets, as well as the document that witnesses their adequate quality and safety for health of consumers.

The most reasonable method of betterment of state of providing of population by deficit elements of alimentation is introduction in rations of animals of additives and forages that contain big quantities of biologically active substances. Therefore, most of European countries, USA, Canada, New Zealand and Japan produce extensively forages enriched by various microelements, vitamins, irreplaceable fatty acids. Meantime, the work in producing in Ukraine of forages enriched by these components is still in the very beginning and there exists the crucial problem of development of technologies of manufacturing and control of quality of forages for animals of such type. at the same time Russian scientists use the *biologically*



*resonance technologies*, which permit to activate processes of assimilation of natural microcomponents of forages and obtain in it meat character by bettered ratio of albumens and fat, as well as raise increase of weight of animals and birds in conditions of diminished spending of forages.

The biologically resonance technology is the special type of nanotechnologies based on influence on state of biologically active substances – vitamins, microelements, enzymes, hormones of spectra of electromagnetic waves resonance to those that are character for functioning of live organisms. Influence of such waves activates absorption and assimilation from forages of substances, which state conforms to the state settled by organisms in process of their evolution. As the result, quality of meat of chickens produced by technologies that presume use of method of biologically resonance technology is better of this that was produced by traditional methods by all controlled indices. The especial interest expresses the ratio of

albumens and fat. The proposed method of fattening permits to produce meat that contain up to 7 % more of protein and less to 26 % of fat as compared with the traditional level of quality. At the same time, the level of assimilation of calcium by experimental birds was raised by factor of 12.5 %, iron – by 36.6 %, sodium – by 44%. It was shown also the increased level of assimilation of manganese and zinc.

Influence of biologically resonance frequencies influences positively on rate of fattening of birds during the whole term of their life. The same is seen in grade of assimilation of forages (1.52 in use of new technology and 1.44 – in use of traditional ones). The average daily increase of weight of chicken in age of 14 days was 42 g, what is more by 5 grams of overweight attained in their traditional fattening. The average daily increase of weight of hen during the whole term of their fattening of hen (35 days) was of 53.4 g in use of traditional technologies and 55.2 g – in use of technology of influence of resonance waves, what permitted to obtain 67 grams of life mass per one bird. One should note that advantages of such technology are approved in conditions of real manufacture and calculation of economic efficiency of use of novel technology shows that the term of payback of investments in it including expenses on technical and scientific support is about of 2 months only.

The clear advantages of use of environmentally safe and energy saving methods of business operation will assist in introduction of new perspective directions of advancement of nanoindustry. Use of new principles of operation gives the possibility to realize the whole genetic potential of birds grown commercially, decrease spending of forages and improve quality of finished products. Introduction of novel technologies will permit to modernize the structure of growing of birds, what should help in reaching of competitiveness of Ukrainian production in global market of agricultural products and speeding of processes of solving of priority problems of progress of agricultural complex of the country.

Correctness of such statements approve results of works of Russian scientists carried out in sphere of aviculture, what permits to make some conclusions and forecast the perspectives of development of this branch of agricultural industry as follows:

1. The pledge of farming of poultry lies in realization of principle of its inclusion in the continuous turnover of energy in nature and operation in its observance in purposes of increasing of output of produced eggs and meat of birds and decreasing of spending of energy in realization of technological processes.

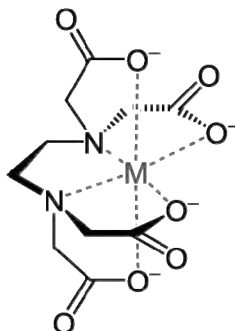
2. The process of continuous search of reserves and introduction of innovations in technologies of producing of eggs and meat, what permits to realize the principle of non-linear rise of output of finished products.

3. The work in development of producing facilities is carried out in realization of norms of amending of principles of farming and concentration of reserves to be spent in solving of arising problems.

It's forecasted that traditional methods of aviculture will be replaced by nanotechnological ones till the end of XXI century, especially in Omsk province (Russian Federation) such change is awaited during the period of 2048 ÷ 2092 and since 2092 the traditional methods of keeping of poultry would be ended. The battery

farms will be the nanoidustrial enterprises, what lies in stream of progress of global agricultural nanoscience.

The one more perspective direction of progress of nanoscience in sphere of agriculture is work in development of medicinal and prophylactic means to be used in farming of livestock, which work became the especially actual in view of progressing pollution of environment and germination of microorganisms and fungus stable to attacks of antibiotics. It was proposed to use in these purposes the nanoaquachelates of some metals serially produced in Ukraine. The class of chelates (origins of Latin *chela* – chela) includes compounds formed in catching of ions of metals inside the chambers formed by some donating centers that exist in molecules of some ligands (Fig 4.6):



**Figure 4.6** Chelate that consists of ion of metal coordinated with the molecule of ethylenediaminetetraacetic acid (Trylon B)

Chelates may be formed also by some amino acids. The example may be  $\alpha$ -aminoacetic acid (glycine), which interacts with copper hydroxide and forms in it the stable complex of bluish-violet color. The class of nanoaquachelates of metals include the set of functional nanomaterials, which represent itself various types of solutions – starting from colloid solutions of hydrated nanoparticles of metals and up to true solutions of nanocarboxilates of metals.

Some of such substances are used in animal husbandry even now, what induced the need in their approbation from the viewpoint of their influence on quality of meat of slaughtered animals. Thus, it was found that consumption of nanoparticles of citrates of Ag, Cu, Zn, Fe, Mg and Co leads to rising of mass of and absence of any changes in anatomical structure and topography of inner organs of experimental animals as compared with the animals of control group. Their meat was properly drained of blood, had no hemostazes and hemorrhages. The lymphatic glands of experimental animals had no morphological changes, their meat was of pale rosy color, and surface of meat after cutting was slightly wet and elastic. Fat of experimental animals was of white color, soft and elastic, and had no odor. The difference of meat of the control group of animals with those of animals that consumed nanoaquachelates of metals was those that the latter contained more lipids and albumens and less of ash constituents.

Therefore, results of ecological estimation of influence of nanoaquachelates of metals on state of morphological, bacteriological, biochemical and gistological indices of tissues of calfs and pigs showed their identity with state of organs of animals whose ration did not contained such substances. The results of research witness also that nanoaquachelates of metals have no toxic influence of organisms of

animals, what permits to state that their use in purposes of betterment of quality of meat of animals may be recommended for commercialization.

#### **4.2.2 Practice of realization of principles of nanotechnology in meat industry**

The enterprises of meat industry produce many types of products and introduce in practice of their production numerous innovations. Such practice was begun in process of development of functional foodstuffs that have the prescribed medicinal and prophylactic properties and their everyday consumption assists in reinforcement and correction of state of health of consumers. It was clearly identified the phenomenon of decreasing of concentration of cholesterol in blood, assisting in preservation of healthy state of teeth and bones, decreasing of rate of sickness by some forms of cancer etc.

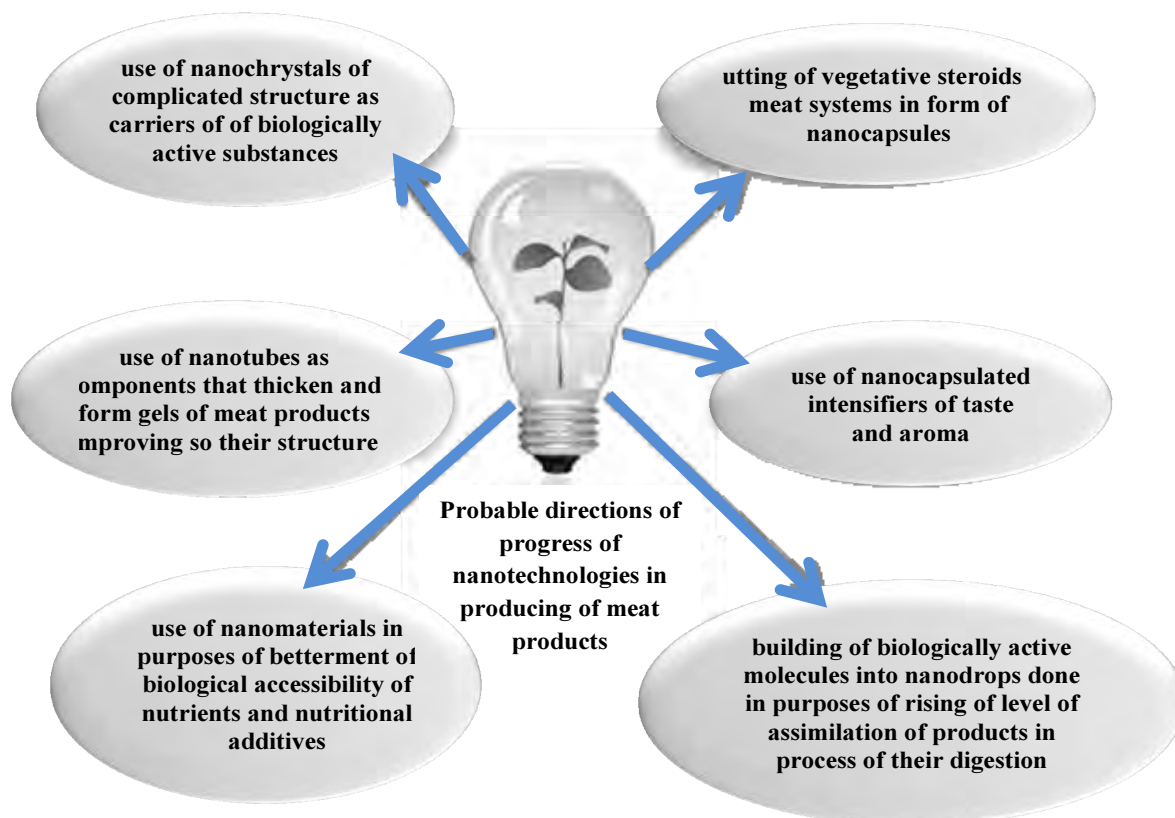
The class of functional products is represented typically by stable multicomponent biologically active systems assigned for durational storage. Such their properties are realized in way of development of meat products of balanced composition, which are enriched at the same time by complexes of additives, e.g. vitamins, probiotics, functional additives and some other ingredients, character by addressed influence on state of organism.

Nanomaterials are used the most in aviculture; however they are used some in the sphere of reprocessing of meat too. For the first, it is their use in technologies of packing of meat and meat products. it is not strange because to reach success in mass use of nanotechnologies in meat industry, one has to begin from the very beginning. Besides, nanotechnologies are used presently in other branches of industry (Fig. 4.7).

The one more necessary aspect of innovations to be developed in future is creation of artificial meat to be produced in use of the last advances of nanotechnologies. The Dutch scientists took out of hogs live cells of myoblasts as “predecessors” of artificial meat, which are capable to turn into “usual” muscular cells in their segmentation. The taken biomaterial was cultivated in special nutritional medium. Finally investigators obtained sheets of muscular tissues. However, the raised tissues are rather similar now to rotten meat. the rules of work in laboratories prohibit to eat products they produced but authors reckon that the meat they made artificially is similar to the natural one.

Works by development of technologies of producing of muscular tissues *in vitro* were approved by companies that produce frankfurters and other meat products. These activities are welcomed also by vegetarians and ecologists. The projects accomplished under the aegis of UN Organization showed that quantities of methane thrown in atmosphere out of farms in process of fattening of cattle constitute about of 18 % of its total quantity released in process of economic activities of mankind. Meantime this gas is capable to intensify the greenhouse effect by factor of more of 20 as compared with carbon dioxide. However, despite the positive effects, practice of producing of artificial meat may have some negative consequences unknown for the time being. So, these works are in initial stages of development of industrial technologies and it is too early to make any estimation of positive and negative effects of their commercialization.





**Figure 4.7** *Prospective directions of commercialization of nanotechnologies in meat industry*

As it was shown, there exist some innovative direction of innovations in meat industry and all of them need the following probation and substantiation of expediency and safety of their introduction and results of use. To find the optimum method of preservation of freshness of meat and meat products, technologists have to take into consideration the set of important factors and the first one is the stage of ripening of fresh meat. The initial stage is after-ripe occurred under the action of enzymes contained in fresh meat, prime glycogen that decomposes into lactic acid. The complex of chemical transformations permits to obtain finally meat delicious and juicy meat that contains nitrogenous extractive and aromatic substances. the prime task of operators is to stop this process in optimum moment and preserve fresh product without loss of its properties as long as possible. Meat is the product that rots in a short time and preserves its properties at usual temperature ( $20 \div 25$  °C) not more of a day and to prolong this term one has to avert influence of numerous effects of environmental conditions of its staying.

To assure safety and long-term preserving of useful properties of new kind meat products, there may be used special tare and packing materials, as well as protective



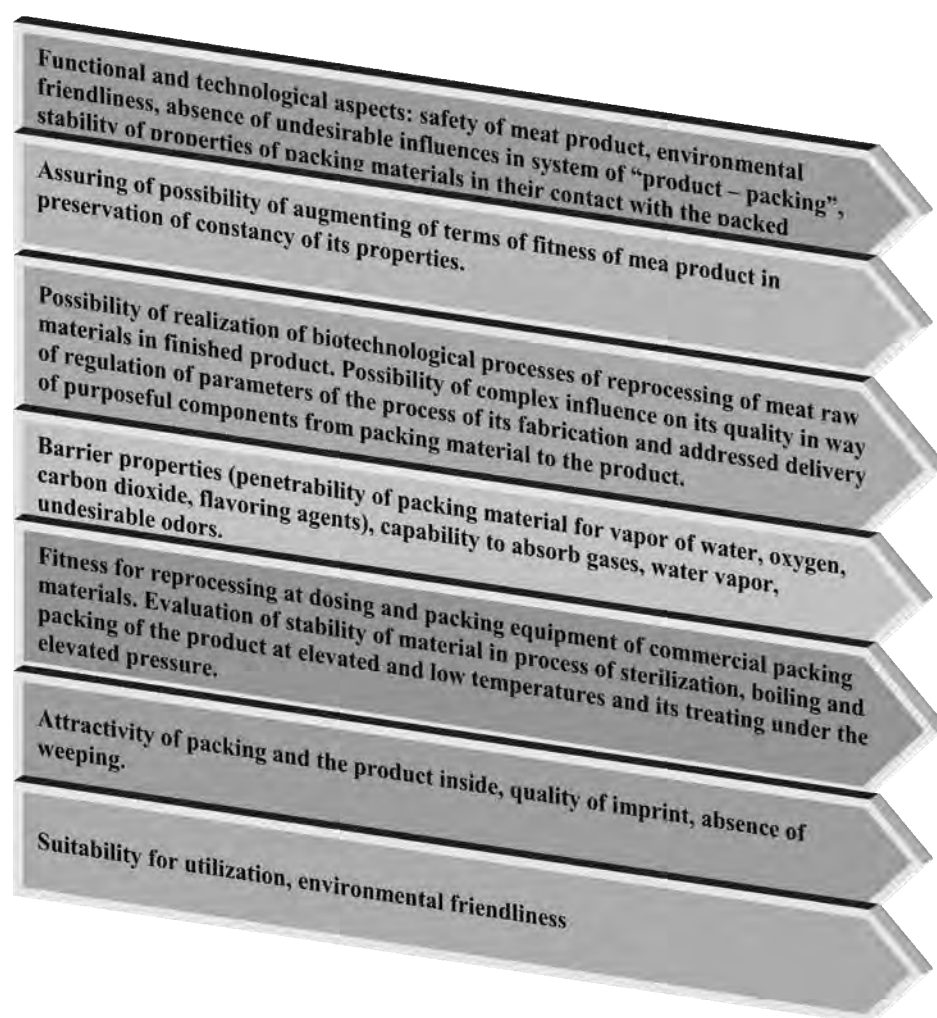
covers to be developed simultaneously with new functional products. The work in development of materials to be used for packing of meat and meat products is one of actual tasks of modern technology. Development of market of packing materials during last decades was character by some peculiarities because quick growth of volume and composition of packed products lead to variation of technologies and equipment used in their packing. So, many enterprises reconstruct and/or build new packing facilities and use for packing of their products wrappers that contain nanomaterials, which development is one of the most perspective directions of works centered on the purpose of prolonging of term of safe storage of meat.

There exist for the present the great variety of systems of packing and materials and technologies used for wrapping of finished products. However, no one method and material are optimum because changes in compositions of products lead to need of development of specialized types of wrapping materials to be used in their packing. The one more function of new type packing materials as the most understandable means of communication of producer and consumer is informing of buyers on properties and composition of products they purchase.

At the same time there were amended requirements to properties of packing materials used in wrapping of meat and meat products. They are based presently on its functions and place in structure of manufacturing, storage and realization of production, expanding of sphere of their use and tendencies of progress of industry by producing of packing materials. First, it is enforcement of their protective and hygienic properties, ensuring of environmental friendliness, prolonged term of preservation of suitability for consumption of packed materials, comfort in use and betterment of economical aspects. The basic requirements to quality of packing materials are as follows (Fig. 4.8):

The requirements listed above have the generalized character and have to be individualized dependently of destination of use of the material and equipment used in wrapping, as well as of concrete type and properties of meat products to pack.

The listed properties may be realized in use of advances of science on nanomaterials. The one of principal results of use of its advances is development of technology of producing of packing materials that have the essentially new complex of properties. These ones are the so-called "*active*" or "*clever*" pack character by bettered functional characteristics, fundamentally differing composition and structure of materials reached in transition of technologies from level of operation with substances of traditional size to nanomaterials where operation is realized on level of atoms. Processes of their development presume creation of sensing systems put directly in wrapping material. Their existence permits to identify sources of deterioration of products just on the stage of their beginning and use measures of preventing of their origination. Use of "clever" materials permits so to increase the guaranteed term of storage of sausages packed in it by factor of 2 - 3.

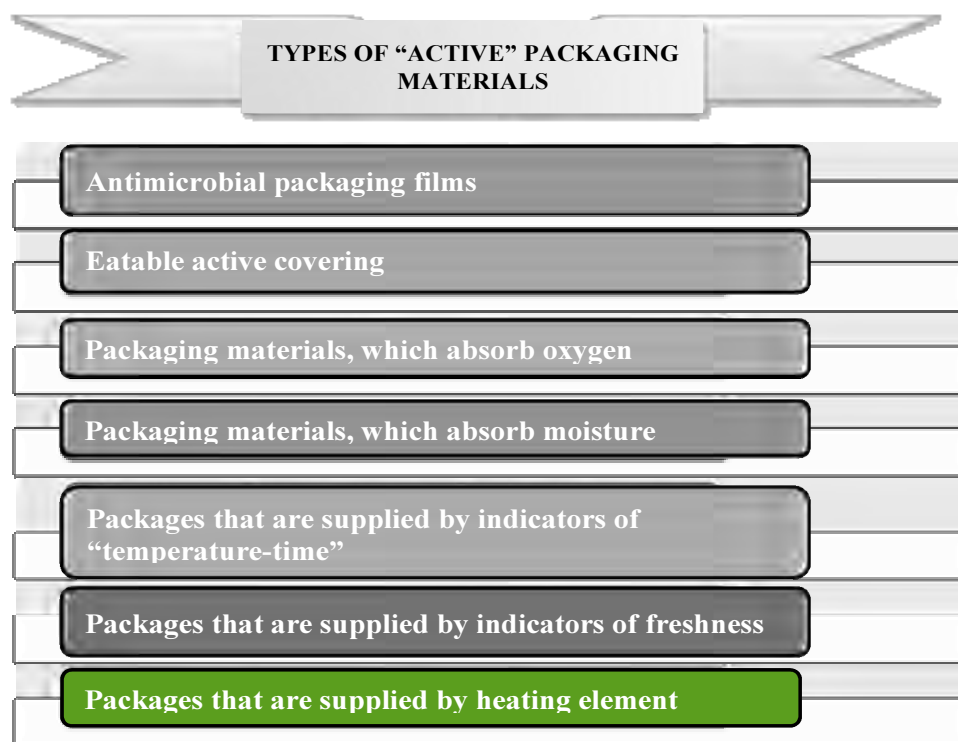


**Figure 4.8** *Modern requirements to quality of materials used in packing of meat products*

The packs modified at the molecular level contain materials that decompose under the influence of agents of biological nature in short time just after their use. Commercialization of such materials in should permit to decrease expenses of utilization of used packing materials and their harmful influence on environment. Besides, the modified packing materials provide the addressed and controlled delivery in packed meat products of functional additives included in their formulations. These ones may be the antibacterial, aromatic and vitaminous complexes, as well biofunctional complexes of selective absorption of excessive moisture.

This direction of research is seemed as actual because inclusion of functional ingredients not in meal but in matrix of polymer case permits to prolong terms of influence of the additive in way of regulation of speed of its diffusion in mass of meat product packed in it. The important advantage of "active" packs, some of which may that contain potentially harmful for health additives (absorbers of gases and moisture, flavoring agents, antimicrobial and enzyme preparations), is those that speed of their migration into the packed product is minimal (or regulated on the optimum level)

because of immobilization of added components. Therefore use of "active" packs may be reckoned as the innovative novelty of expanded spectrum of service. The today's dominating types of such products are packing materials that absorb oxygen, barrier packs and multilayer films that have the interlayer of absorber of moisture. The promissory direction of work is development of packs that have indicators of freshness and markers of indices of "temperature – time".the principal types of packing materials developed for the time being are shown on Figure 4.9.



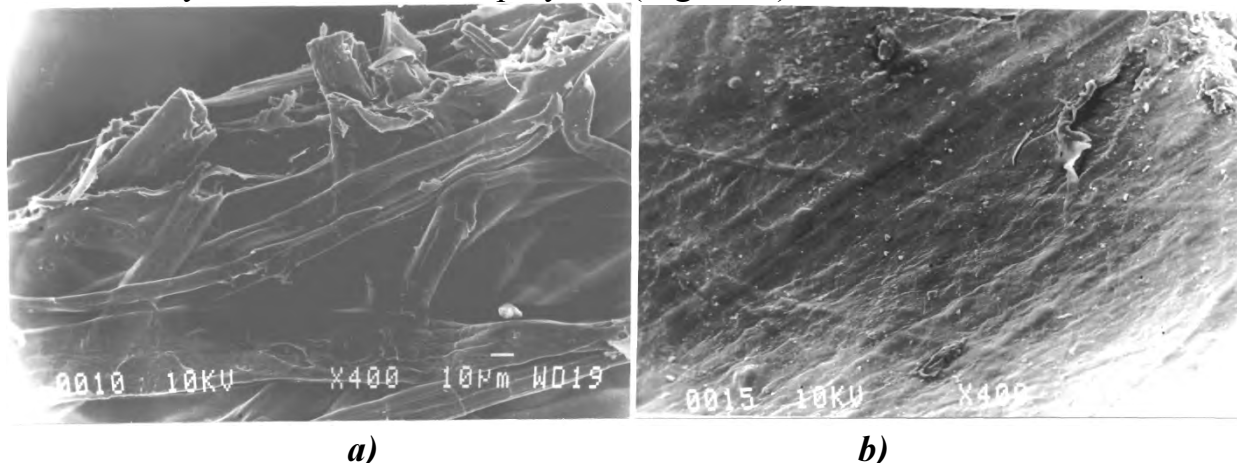
**Figure      Basic types of "active" packing materials**

#### Antimicrobial packing films

To protect meat products against the unfavorable influence of pathogenic microorganisms and toxic products of their vital activity, technologists use packing materials that contain bactericidal compounds. The example of realization of such mode of use of antimicrobial protective systems based on use of safe latexes are compositions that contain nanoparticles of silver that are capable to annihilate up to 99.99 % of bacteria present in the product initially. The proposed film protects consumers against unfavorable influence and inhibits germination of coli, golden staphylococcus, salmonella and some types of mold fungi. The antimicrobial effect of the film is seen during the whole time of its contact with the packed product. At the same time, particles of silver that are contained in the film has no any influence on its quality.

There was produced the set of modified polymer polymeric albuminous matrixes (based on use of collagen and viscose) enriched by nanoparticles of silver and studied basic mechanisms of forming of wrapping materials used in commercial packing of sausages. To evaluate effectiveness of action of chosen mechanism of enrichment of the matrix and choose the most appropriate one, scientists studied their

structure along the whole length of the sample, its capability do elongate till the break (in initial state and after its soaking in water during 10 minutes), as well as kinetics of swelling of the film and in water and kinetics of desorption of silver out of it. It was shown that treatment of films by solutions of silver leads to ordering and densifying of structure of microfibrs, which form the spongy structure of microrelief of surface and inner layers of matrix of the polymer (Fig. 4.10):

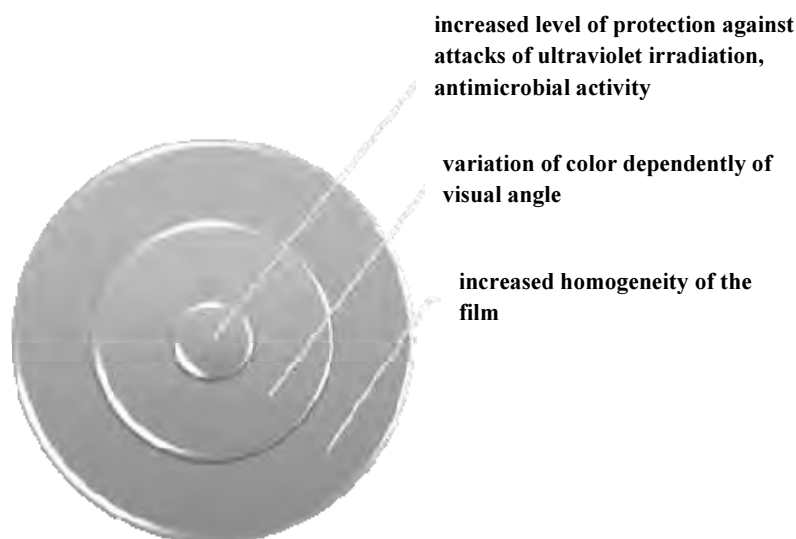


**Figure 4.10** *Microstructure of cutoff of viscose film (photo made by method of scanning electron spectroscopy) a – control, b – modified sample*

The taken data permit to conclude that modification by nanoparticles of silver of materials used as tare and package (e.g. the envelope of sausages of albuminous nature) gives advantages as follows:

- intensifies antimicrobial activity of the envelope,
- improves indices of quality and safety of enveloped products,
- prolongs considerably terms of safe storage of finished products.

The ultrafine films possess also by the fundamentally new properties (Fig. 4.11):



**Figure 4.11** *New properties of coverings modified by nanoparticles of silver*

Eatable coverings

Use of eatable coverings is very perspective direction of progress of technology of packing. The materials of base of films used in this purpose are natural polymeric polysaccharides produced out of cellulose or modified starches. Such envelopes retard the process of evaporating of moisture and decrease so loss of mass of packed meat product. Such envelopes create also certain barrier in infiltration inside the product of oxygen and other substances inhibiting so processes of its deterioration. The eatable films, which material consists of natural polymers are character by high capability to absorption, what causes their positive physiological influence on organisms of men. After they ingress into the organism, its substances absorb ions of radionuclides, and other harmful compounds and assist in their egesting out of organism playing so the role of detoxicants.

Injecting in the polymer matrix of special additives (flavoring agents, colorants), technologists may regulate the tasty and aromatic properties of foodstuffs. It is especially important in consumption of products of medicinal and prophylactic destination of use, for example these ones may be meat products that contain decreased quantities of fat and saccharose and products enriched by vegetative (e.g. soy) albumens. Besides, capability of eatable film to contain various compounds permits to enrich products by mineral substances, vitamins, complexes of microelements etc, what permits to compensate the deficit of components of meal necessary for normal vital activity.

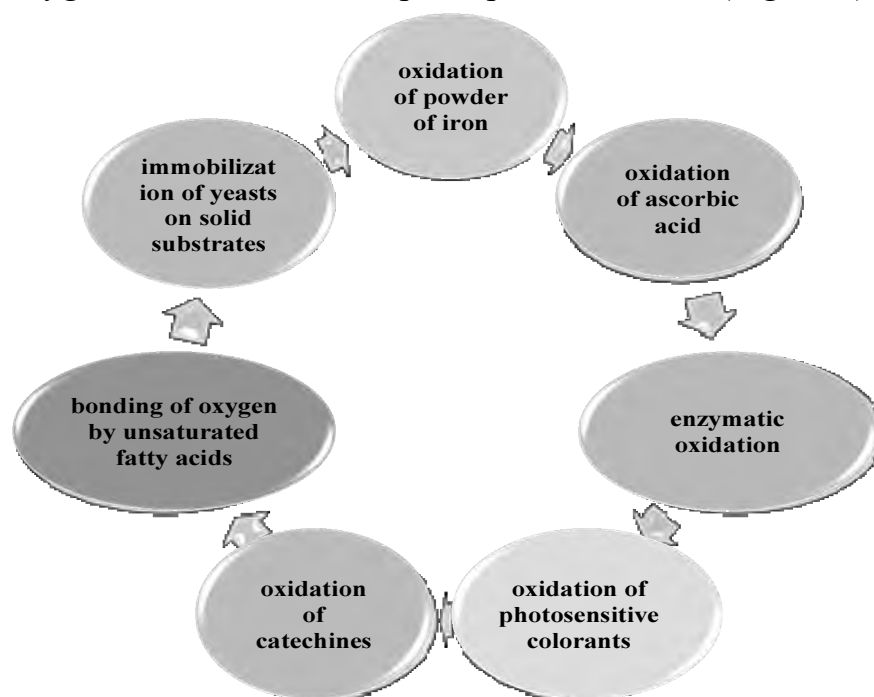
The examples of eatable films based on use of natural polymers are coverings put on frozen meat products. one should note that drastic freezing is the best method of storage of meat (e.g. beef may be stored at minus 18 °C during a year, and at temperature of minus 30 °C – up to two years). However if products were not packed, they loss in process of storage of about of 1 to 3 % of their mass because of freezing-out of water and are exposed to other negative changes. At the same time forming of covers of carboxymethyl cellulose on blocks of frozen meat inhibits considerably the listed negative effects. Moreover, use of such envelopes prevents pollution of environment by withdrawals of used package because the following reprocessing of meat is carried out together with the enveloping material.

The US scientists developed the eatable film to be used in protection of meat products, which consists of purees made of fruits or vegetables and enriched by additives of fatty acids, alcohols, beeswax and vegetable oil. Such kind packing material assists in prolonging of term storage of products, betters their taste and has at the same time the attractive appearance. The film has the fashion of non-transparent sheet of paper colored in orange (made of carrot and tomatoes), red (red Bulgarian pepper, strawberries) green (broccoli) and other colors. Despite other eatable thin films, this one is very flexible but do not contain any plasticizers. The authors of this development propose to prepare such tasty envelopes in advance in form of caddies and put the products inside. It was proposed to envelope meat in caddies made of peach puree, what would permit to obtain the fragrant glaze of the dish after its heating.



### Absorbers of oxygen

One of prospective directions of work in rising of duration of guaranteed terms of storage of meat products is development of methods of control of composition of gas contained inside their packing. The principle of "active" control of composition of atmosphere is based on use of phenomenon of absorption and removing of specific gases formed in process of storage by their binding by chemical or enzymatic methods. The materials used in this purposes the most often are films, which absorb oxygen present inside the space of packing, what postpones germination of aerobic microorganisms and development of processes of oxidation supplemented by changing of color of meat products. Use of such systems permits to decrease concentration of oxygen inside the pack to values less of 0.1 %. The technology of absorption of oxygen is based on use of principles as follows (Fig 4.12):



**Figure 4.12 Principles of technologies of absorption of oxygen**

The materials used in purposes of absorption of oxygen represent themselves the most often the permeable for gases porous cushions glued inside the pack. This spacer contains in its composition oxide of bivalent iron, which oxidizes in contact with oxygen to  $Fe^{3+}$ . The method of using of application cushion is used often together with the technique of filing of packs by gases of modified composition. It is necessary to note that absorbers of oxygen are the accessory means of prolongation of terms of suitability of packed meat products but not inform consumers by information on level of freshness of the product. This information may be obtained in use for packing of so-called "indicators of oxygen", which give interested parties during the whole term of storage of packed product the additional information on integrity of its packing and deviation of composition of gas inside out of its normalized composition. The typical visual indicator consists of colorant capable to change its color dependently of state of its oxidation and its use permits to identify the damaged packs by change of color of indicator in its transition from normal to oxidized state.

### Absorbers of moisture

Presence of excessive water in meat products results in occurrence of undesirable effects, e.g. deterioration of their consistency. For the other hand, big loss of water leads to origination of negative consequences, especially for their drying. The means used in solving of said problems is use of absorbers of moisture, which assist in removal of melt water from frozen products, inhibition of rate of germination of microorganisms, prevention of condensation of water and decelerating of kinetics of oxidation of fats. The agents used traditionally in purposes of absorption of water are silica gel and alumogel placed inside the cloth. It was developed now also sorbents of water used as components of polymeric composition of membranous packing material. The examples are such substances as Desimaxtm (Multisorb Technologies), Flo-Techtm (Grace Davison) and others. Besides there were developed packing materials that permit to keep inside the pack the level of humidity of 10-60 % and produced now serially by firm of United Desiccant under the trade mark of Desipack. The character peculiarity oif such packing materials is that they change their color in rising of level of humidity from blue to pink.

### Indicators of "temperature – time"

The first samples of such indicators were developed as early as in 1932. The principle of work of indicators of system of "temperature – time" is based on registration of events occurred in passing of physical, chemical, microbiological and enzyme reactions supplemented by change of color of indicator. Such visible changes of coloration of slips put on labels permit to trace the history of storage of packed meat products. Thus, being in conditions of high temperatures results in quick change of indices of quality of stored products and their storage at low temperatures retards their decay.

However quantity of such materials is still too small and they are not used in practice of serial manufacturing. The principal problems that block their commercialization are absence of simple methods of their treatment (activation, storage) and lack of trustworthiness of information they give. Besides, such kind materials must not be toxic, sensible to influence of external factors, e.g. of level of humidity, lighting etc. Though such indicators are used now only in USA and France. Besides, the World Health Organization uses such kind labels in purposes of control of quality of vaccines in process of their transporting to place of destination.

### Indicators of freshness

The indices of quality of meat products are varied just after finishing of their production, what deteriorates their freshness because of germination of microorganisms and accumulation in meats of products of their vital activity such as carbon dioxide, sulfur dioxide, ammonia, ethanol, organic acids and certain types of toxins. The principle of indication of freshness of meat products is based on phenomenon of interaction of certain types of listed metabolites with special indicator introduced in structure of packing material. There exist now three systems of such indication as follows.

1. Indicator of *Fresh Tag* (USA. The system reacts by change of its color resulted of emission from the mass of product of volatile amines, which concentrate in the unfilled volume of packing. The indicator represents itself the plastic chip



filled by reagent, which is connected with the tightening weight. In placing of the nameplate on packing, the hook put inside the label pierced the unfilled upper side of packing and gas in it begins to contact with the label. In presence of amines, the indicator contained in the nameplate changes its color and intensity of such variation permits to evaluate the grade of freshness of the meat product.

2. System of *Food Sensinel* (USA). The principle of its work is based on indication of results of passing of immune chemical reaction. To indicate freshness of the product, producers introduce the complex of antibodies inside the system of indication of bar-codes. In presence of certain types of microorganisms, coli and salmonella, there appears the dark band onto the bar-code don't seen by scanner in purchasing of packed product. The system is developed in University of State of Louisiana (USA) and may be used in purposes of control of state of freshness of meat products.

3. Indicating film of *Toxin Guard* permits to disclose presence of pathogenic microorganisms because it contains the immobilizing antibodies. This packing material is sensible to presence of four types of dangerous bacteria, especially of salmonella, Campylobacter, coli bacteria and listeria, i.e. all types of microorganisms that affect meat products. The film consists of three layers. The bottom one, which lies down on the product is permeable for microorganisms. Passing this layer, bacteria enter into the second layer filled by nutritious gel, which contains albumens capable to visualize certain strains of microorganisms that stain the third layer of packing film in their moving in it.

There are known also other systems of packing, which give the interested party the possibility to prove existence in packed products of pathogenic microorganisms and other undesirable changes of quality of meat products, especially changes of their genic structure.

#### Thermal packs

The one of perspective directions of expanding of assortment of "active" packing materials is development of packs supplied by embedded cooling or heating element and USA and United Kingdom began serial production of one of types of such thermal packs. These ones represent themselves the multilayer jointless plastic container equipped inside by some elements, which provide the automatic heating in process of passing of exothermic chemical reaction of grinded limestone with water that begins after purchaser uncovered the foil and press onto the ground of the container.

The conceptual idea of such packing is not new – such kind packs were produced in United Kingdom for militaries as early as in 1939. Heating of products was done in process of burning of cordite (the smokeless fuel). However the proposed method of heating was too dangerous though was not commercialized. Meantime the proposed method of heating of meat products is too actual and there exists the perspective of beginning of serial production of packs capable to maintain the set thermal regime for each type of the product.

The work in introduction of "active" packs in practice of producing of meat products is too interest because the heating reagents are put into the polymer film but not in the product. Such decision assists in considerable rising of quality of packed

products and prolongs the guaranteed term of its storage. Besides, use of “active” packs permits to obtain the additional information on freshness of foodstuffs (indicators of freshness), conditions of their storage (indicators “temperature – time”) and composition of gas inside the pack (indicators of concentration of oxygen).

#### **4.2.3     Safety of nanomaterials**

The extensive use of nanotechnologies, nanoproducts and nanomaterials opens new perspectives for mankind. However their commercialization brings also new hazards, which cannot be predicted in advance and hardly identified after their occurrence. Therefore scientists began to develop the concept of carrying out of toxicological investigation of safety of materials that contain nanoparticles. The latter may be subdivided conditionally by two categories as follows.

The *first* ones are the natural bioadditives, which present in food is not harmful for the organism. Such substances may be the natural ingredients dispersed up to size of nanoparticles (nanodispersions of propolis, kinds of green tea character by risen antioxidant activity, carotenoids), as well as the traditional nanoobjects (globular albumens, oligosaccharides).

The class of *second* category additives includes nanodispersions of selenium, silver, zinc oxide, titanium dioxide and other inorganic substances uncharacteristic for traditional meal and experts reckon that these compounds may be dangerous for health of men.

##### *The factors that define toxicity of nanomaterials:*

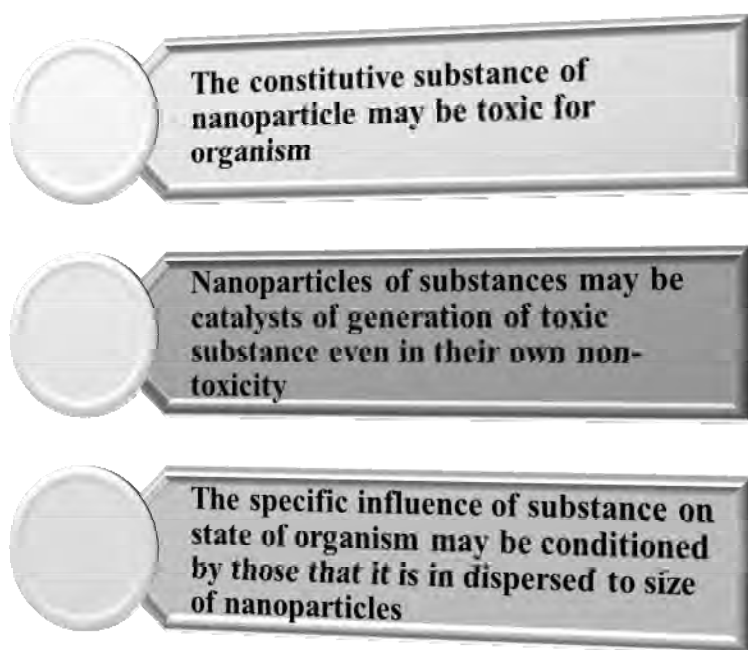
- Migration of nanomaterials through cellular membranes across the small diameter pores and their inserting into the DNA molecule, what may result in amending of processes of their functioning.
- Presence of nanomaterials character by extensive surface assists in rising of chemical potential of substance milled to size of nanoparticles, hence their anomalous solubility and increased capability to come onto chemical interactions. Such phenomenon may be too dangerous because of presence in organism of big quantities of dissolved harmful compounds.
- Assistance in infiltration of other contaminants. Nanomaterials are capable to absorb in some cases certain compounds that may be poisonous for the organism and transport them inside the cell what increases considerably their toxic effect.
- Accumulation of nanomaterials in objects of environment. If such substance do not take part in processes of metabolism of microorganisms and are not detoxicated, these harmful compounds are accumulated in organisms of plants, animals and microorganisms, hence raise the level of their entry into men’s organisms in consumption of contaminated products.

The property of nontoxic substances to become unsafe for health of men in dispersed state was known in early time. Thus, men suffered of zinc fever in melting of this metal because of inspiration of aerosol of zinc oxide. It is well-known also the harmful affection of fume of asbestos, which inspiration leads to events of occurrence of cancers of lungs and stomach. One should note also that being infiltrated in organism, nanoparticles of nontoxic substances may function as catalysts of forming of toxic compounds. Therefore, studying of problems of nanotoxicology and

biological safety of uncombined nanoparticles and their colloidal solutions is one of priorities in development of medical science.

It is well-known that protective systems of organism are not capable to resist to attacks of nanoparticles. These ones may easily migrate in organism through skin, respiratory and gastrointestinal tracts, cells of epithelium, spread through the appendages of nervous cells, by circulatory and lymphatic tubules. The particles of nanometric size hit lightly inside lungs and migrate then into blood. The hazards of affection of unbounded nanoparticles are conditioned by their physicochemical properties, high grade of dispersion and character of their interaction with elements of live cells. Effects of influence of nanoparticles on live organism are exhibited in occurrence of inflammatory processes in certain organs and tissues, decreasing of immunity, possibility of appearance of chronic inflammations. Because the science of nanotoxicology is still in early stages of its development, investigators have to keep the balance in development of technologies of producing of products that contain nanoparticles and advances in studying of grade of toxicity of nanomaterials they develop.

There exist three principal causes of occurrence of toxic effect of unbounded nanoparticles on live organisms (Fig. 4.13).



**Figure 4.13** *Principal causes of toxicity of nanoparticles*

There are also unknown the after-effects of lasting influence of unbounded particles of organisms of men, animals and other live objects. Such uncertainty stipulates the condition of careful work in use of nanoparticles of biogenic metals or their colloidal solutions because they may fall into the nutritional raw of men and cause the uncontrolled forming of harmful compounds. This is true also for branches of cultivation of plants, breeding of animals, keeping of poultry and fish industry.

Besides, scientists reckon that toxicity of nanoparticles may be linked indivisibly with their pollution by toxic admixtures, which may be more harmful for live organisms in form of tiny particles. Moreover, being too small, they may be more

toxic as compared with nanoparticles of purposeful elements. Therefore one of principal conditions of carrying out of work in development of nanomaterials is keeping of the most possible purity of working environment. For instance, the toxic action of nanomaterials may occur in use of distilled water instead of more pure deionized one in preparation of colloidal solutions of metals.

Summarizing, it's necessary to note that quantity of nanotechnologies introduced in branches of food industry and producing of packing materials used in it steadily increases. At the same time, there are absent global norms of obligatory marking of products that contain nanomaterials as it is done in producing of genetically modified organisms.

The work on studying in Ukraine of toxicity is on early stages of development. So, investigators have to take all possible precautions in work with such objects because of still unknown mechanisms of their influence on live beings. The one of possible methods to recommend is establishing of breaks for 3-7 days after finishing of work with such materials to avoid their accumulation in the organism of physically and biologically active nanoparticles. It is also necessary to foresee use of special measures of prevention of emission of nanoparticles from places of their formation or their removing from working premises, as well as to introduce the prophylactic measures in relation to persons who work with nanomaterials.

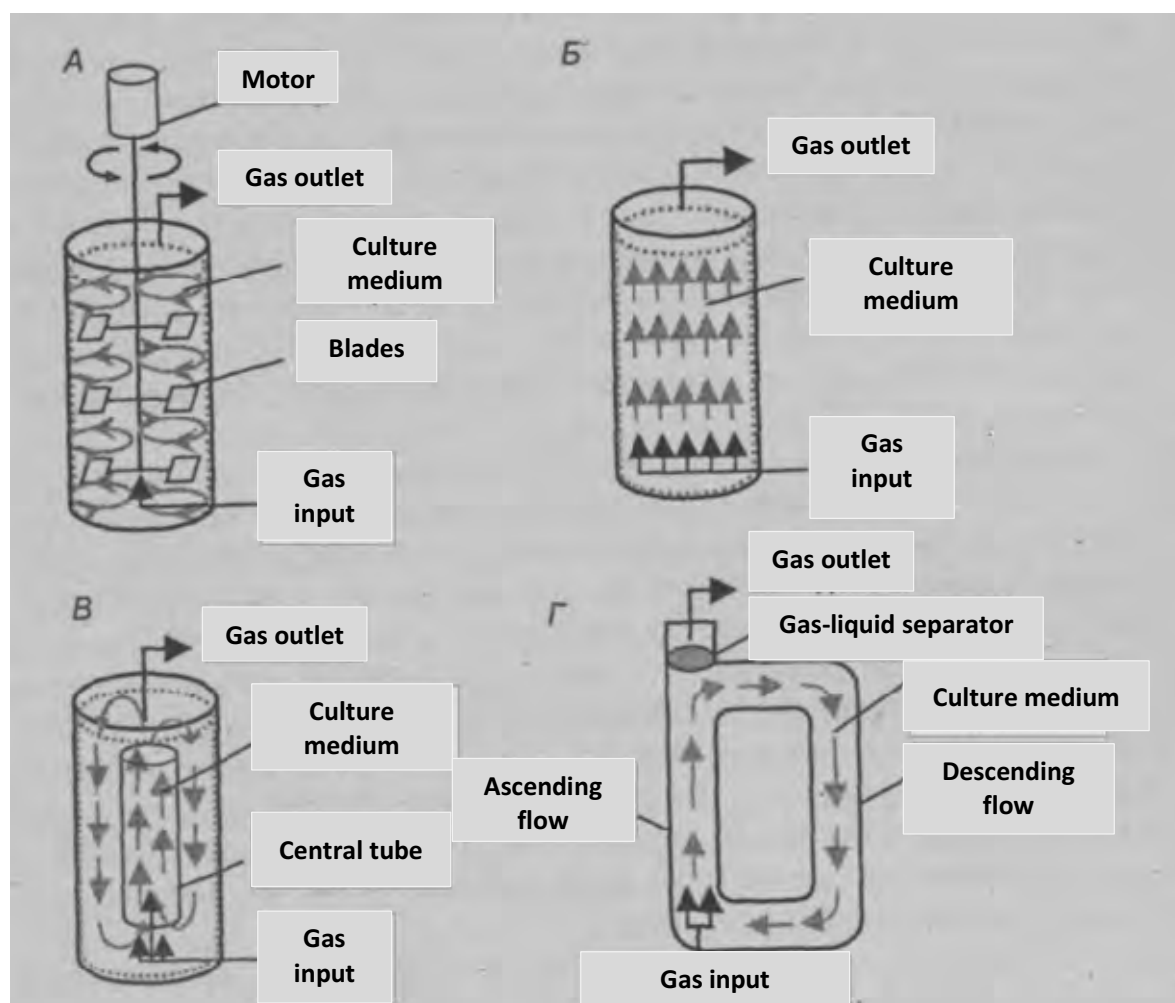
### **4.3 Progress of biotechnology in the sphere of reprocessing of meat**

#### **4.3.1 Screening of data on use of biotechnological processes in the meat-processing industry**

Use of basic principles of biotechnology permits to solve the actual tasks of meat-processing industry, especially in need of development of innovative technologies of producing of environmentally pure products of high quality that posses by properties set in advance. Specialists reckon in it that the most actual and perspective direction of development of methodology of use of advances of biotechnology in meat industry is use of bacterial preparations in its basic spheres of operation.

The modern biotechnological processes are linked indivisibly with advances in genic engineering, e.g. in development of new types of highly efficient forms of genetically modified microorganisms. The serial producing of biological preparations represents itself the highly complicated complex of interrelated physical, chemical, biophysical, biochemical and physicochemical processes, which may be put in practice only in use of modern equipment integrated in productive lines amalgamated by streams of passing of materials and energy. The character examples are biological reactors (fermenters), which are the basic devices in producing of biological preparations. There are known three basic types of such apparatus (Fig. 4.14):

- reactors equipped by mechanical agitators,
- bubbled columns, where reaction intermixtures are mixed by stream of air,
- air-lift reactors equipped by devices for inner or outer circulation.



**Figure 4.14** *Schemes of bioreactors of various types: A – reactors equipped by mechanical agitators, Б – bubbled column, B – air-lift reactor equipped by devices of inner circulation, Г – air-lift reactor equipped by devices of outer circulation*

It's necessary to note that rate of agitation of cultural environments plays the considerable role in regulation of kinetics of passing of biotechnological processes. The too big rate of mixing may cause mechanical breaking of biological objects, and the small one will require too big expenses of energy.

The specific cultures of microorganisms may be used in meat industry in various applications as follows:

- guarantee high level of microbiological safety in view of inhibiting of processes of germination of harmful and pathogenic microflora,
- accomplish biochemical transformations of components taken initially supplemented by amendment of their physicochemical properties and forming of prescribed characteristics of quality of finished products,
- raise the nutritional value and biological accessibility of products,
- raise the level of environmental safety of production in way of excluding or minimization of quantity of used food additives (intensifiers of taste, fixers of color etc.),

- give meat products the medical, prophylactic and probiotic properties.

The most important problem to be solved in this work is guaranteeing of microbiological safety of production, what shall be one of basic criteria of “quality” of modern meat products. The principal cause of their deterioration is germination of putrid microflora of aerobic and anaerobic nature, which may be represented on the surface of meat products by bacteria of classes of micrococcus, streptococcus, lactobacillus, spore aerobes. The quality of meat products depends from the sanitary viewpoint of presence in it of both pathogenic (salmonella, enterotoxic staphylococcus, hemolytic streptococcus and such spore microorganisms as *Bac. Cereus*, clostridia of classes of *Cl. Botulinum*, *Cl. Perfringens* and others), and conditionally pathogenic microorganisms (*Pfoteus vulgaris*, *E. coli* and others). The meat products are corrupted in many cases under the action of bacteria of type of *Broclitrix thermospacta*, which vital activity assist in breakdown of albumens and fats supplemented by forming of unpleasant smell of the product.

The microbiological control of quality of most of meat products consists in identification of content of mesophilous and facultative aerobic organisms, bacteria of coli group, clostridia that produce sulfides, salmonella, staphylococcus and listerias. Microorganisms use in their nutrition the constituents of meat: its hydrocarbons, albumens and fats, and convert them in compounds suitable for their consumption in use of their exoenzymes. The hydrocarbons represented in meat mainly by glycogen disintegrate in this process to monosaccharides and are assimilated then by the microbial cell. The microorganisms present in meat possess by different cultural peculiarities and are capable to induce the considerable nutritional poisoning and infections. Thus, the American Meat Institute informs that the form of *Listeria monocytogenes* causes of about of 28 % of lethal events out of total quantity of nutritional poisonings.

To avoid such events, microbiologists produced with use of methods of genic engineering the specific cultures of microorganisms capable to synthesize the specific biologically active compounds, namely organic acids, bacteriocines, enzymes, vitamins and some other. The substances synthesized in this way inhibit vital functions of pathogenic microflora playing in it the role of biological preservatives. Their presence assists in rising of level of safety of finished product and better indices of their quality, especially aroma conditioned the most by presence of carbonyl compounds (aldehydes, ketons), compounds of polyfunctional character (ketonic acids), compounds that contain sulfur (mercaptans), organic acids, phenols, alcohols, ethers etc. these compounds are synthesized mainly by representatives of family of micrococcus and some cultures of lactobacillus – *Lactobacillus curvatus*, *Lactobacillus sakei*, *Lactobacillus plantarum*, *Pediococcus acidilactici*, *Staphylococcus xylosus*, *Staphylococcus carnosusta* and others.

It was found also that the biotechnological process of treatment of meat raw materials by cultural liquid, which contains viable cells of specific microorganisms influences considerably on speeding of process of their ripening and betterment of some functional and technological properties in process of salting, optimizes characteristics of quality of finished products, increases capability of minced meats to hold water and inhibits processes of oxidation of meat.

The principal mechanisms used in work that guarantees microbiological safety of meat products is organization of conditions of producing by cultures of microorganisms of bacteriocins – the special types of albumens or peptides synthesized on ribosomes, which possess by antimicrobial activity and are capable to replace pathogenic organisms. Said mechanisms are reckoned as factors of antagonism of certain types of microbes, which assure normal conditions of germination of bacteria and resistance of organism to uncontrolled breeding of undesirable microflora.

The lactic-acid starting cultures are the substances traditionally used in technologies of producing of raw-smoked and raw-dried sausages. Perspectivity of their use in these destinations was shown by Russian scientists who concluded that minced meats are the favorable environments for their germination. Cultures of lactic-acid bacteria are capable to reproduce in anaerobic conditions and are character by high antagonistic activity to pathogens and capability to decompose their toxic metabolites. The microorganisms that are contained in starting cultures disintegrate sugar and form in this process lactic acid, what results in decreasing of value of pH, inhibiting of germination of undesirable microflora, speeding of process of denitrification, stabilization of processes of forming of color and forming of specific organoleptic characteristics. The compound formed in process of fermentation of hydrocarbons in biggest quantities is lactic acid. Its accumulation influences favorably on consistency, physicochemical characteristics and organoleptic properties of meat systems. The by-products of this process are some aromatic compounds and reductive substances, which presence assists in betterment of smell of meat products. The bifid- and lactobacillus are the intense regulators of active acidity of mince meats in processes of their collapse and salting. The character peculiarity of their actions is preservation of its nice quality and capability to bind oxygen present in mass, what permits to decrease considerably its redox-potential and prevent oxidation of lipids.

The results of work in studying of possibility of complex use of propionic-acid and lactobacillus in purposes of betterment of quality and rising of safety of meat products showed that the process of growth of microflora of starter of processes of fermentation of mince meats prevents development of germination of coli bacteria at earliest stages of producing of boiled and smoked sausages and improves the sanitary and hygienic indices of quality of finished products. It is shown also that results of vital activities of bifid bacteria protect lipids of meat against their oxidation and improve consistency and organoleptic properties of boiled and smoked sausages.

It's known the mutagenic activity of nitrites that form toxic nitrozoamines in acidic environments of stomach. The incomplete reduction of nitrites occurred in meat products before they would have been consumed may result in accumulations in organism of men of compounds detrimental to health. Respectively, there became too actual the work in development of environmentally safe meat products to be produced by methods of biotechnology that are based on use of cultures of microorganisms that reduce nitrite-ion and decrease so its content in finished products. Use of denitrifying cultures of microorganisms in meat industry permits to decrease concentration of nitrite-ion in finished products to level of 3–5 mg-% after it as added in technological mixes in quantity of  $7.5 \div 13.0$  mg-%. Technologists use in

such cases the probiotic microorganisms character by active antimutagenic activity, especially the culture of *Staphylococcus carnosus*, which principal function is reducing of sodium nitrite to nitrogen oxide (II). Particularly, Russian scientists cultivate in this purpose the special culture of *Staphylococcus carnosus* LIA-96 that produces the enzyme nitritereductase, which use initiates the complete reduction of nitrite-ion in finished meat products.

The numerous works of scientists by chemical modification of meat raw materials of poor quality in way of its fermentation witness the expedience of use of proteolytic enzymes, especially of pepsin, in technologies of producing of salted meat products and hydrobiontes, which action results in tenderization of meat and occurrence of morphological changes in structure of muscular, collagen and elasin fibers of meats. It's well-known, for example, the process of treatment of raw materials by pepsin in technologies of producing of delicate meat products in use of beef of second category, mutton and horseflesh of first and second category. Such works are carried out typically in environments enriched by bacteria of classes of *Lactobacillus plantarum* and *Micrococcus caseolyticus*. The stage of their short-term salting at temperature of  $14 \div 18^{\circ}\text{C}$  assisted in rising of activity of enzyme preparation and producing of finished products that have the adequate sanitary and hygienic characteristics.

The meat-processing industry of United States of America uses extensively the alcoholic extracts of papain in producing of products made of beef. Studies carried out by other scientists showed that use of vegetative proteinases (bromelaine, ficine) speeds the process of afterripening of meat, improves its quality and assists in cutting of expenses of their manufacturing. Investigations carried out by Japanese scientists showed that the enzyme of actinidine influences of variation of consistency of meat analogously to the enzyme of chemotripsine. Both these enzymes hydrolyze both muscular and connecting albumens (mostly collagen). The results of experiments on use of enzyme of transglutaminase of microbial origin in complex with starting cultures in technologies of producing of meat products showed their positive influence on processes of treatment of raw materials that contain considerable quantities of collagen.

The examples of modern biotechnological processes mentioned above witness that the mainstream of their progress consists In use of bacterial preparations of starting cultures.

#### **4.3.2 Basic directions and experience of use of starting cultures in processes of production of meat products**

The one of basic tendencies of progress of food industry is creation of enterprises that produce functional foodstuffs. The products used in this purpose the most often are sour-milk products that contain probiotic microorganisms. The “dry” sausages and ham, which were nor subjected to heat treatment in process of their producing also may play the role of carriers in gastrointestinal tract of men of probiotics, which represent themselves the bacterial cultures used in purposes of starting of processes of fermentation of meat raw materials, which results should be reaching of desirable gastronomical properties and inhibiting of processes of



germination of undesirable microflora. The bacterial cultures used in these purposes contain microorganisms of different types including lactobacillus, pediococcus, staphylococcus, micrococcus, yeasts and filamentous fungi.

The basic technological property of such organisms is their capability to ferment hydrocarbons contain in meat raw materials into lactic acid. Action of these cultures leads in breakdown of albuminous components and forming of peptides and free amino acids instead. The result of passing of these processes is softening of the product, reaching of desirable consistency and simplifying of processes of their digestion. At the same time forming of aromatic substances assists in forming of characteristic taste and smell of meat products. The one more important property of starting cultures is inhibiting of germination of undesirable microflora, which presence leads to deterioration of quality of products because they form lactic acid in mix with numerous by-products, especially acetic acid, carbon dioxide, ethyl alcohol and others, which influence negatively of processes of fermentation of meat raw materials.

To form the desirable color of meat products, technologists has to use the starting cultures that contain the denitrifying bacteria, mainly staphylococcus and micrococcus, which decompose nitrites and nitrates to nitrogen oxide (II). The latter compound reacts with the meat myoglobin, what gives the product the stable pinkish-red coloring, and acidification of the products resulted of said interactions assists in preservation of its stability in storage of the finished product. The staphylococcus present in the product synthesizes the enzyme catalase, which assists in prevention of deterioration of the product because of its oxidation as times goes by. Yeasts and filamentous fungi are used in purposes of forming on surfaces of meat products of white velvety deposit, which protects them against undesirable efflorescence, regulate kinetics of evaporation of water in drying and assist in forming of specific of aroma of the products under the action of their proteolytic and lipolytic enzymes.

#### Use of starting cultures at meat-processing plants

The starting cultures are produced in liquid, frozen and dry (sublimed) state, which became active after their dilution by water. being added to mince meats, they assist in shortening of terms of afterripening of dry smoked sausages, what permits to decrease the term of process of their producing from 45 to 20 days.

The quality of such preparations depends of quantity of viable cells in it, their resistance to negative influences of environment, observance of recommended regimes of storage till the moment of use, methods of packing (it's desirable to pack them in vacuum or in neutral gas environments). The quantity of viable cells in commercial products may reach of  $10^{10} - 10^{12}$  per gram.

#### Choose of starting cultures to be used in meat collections

There exists now the wide variety of starting cultures. These ones include cultures of various taxonomic groups as follows: *Lactobacillus curvatus*, *Lactobacillus sakei*, *Lactobacillus casei*, *Lactobacillus plantarum*, *Pediococcus acidilactici*, *Pediococcus pentosaceus*, *Pediococcus claussenii*, *Staphylococcus carnosus*, *Staphylococcus xylosus*, *Penicillium camemberti*, *Debaryomyces vanriji*, *Debaryomyces polymorphus*, *Debaryomyces hansenii*, *Candida famata*. The work in choose of microorganisms to be used in meat collection is began in selection of fine

cultures, which use would satisfy fancies and preferences of consumers of meat products. The obligatory stage of this work is the comprehensive control of their safety and evaluation of grade of competitiveness of products produced with their use. In positive conclusions, the chosen microorganisms may be used as components of starting cultures recommended for use in meat industry.

To be recommended for commercialization, the starting culture must possess by properties as follows:

- absence of toxicity and pathogenicity,
- genetic stability,
- big rate of germination in cultivation and capability to synthesize the required quantities of necessary metabolites,
- resistance to influence of undesirable factors of environment (variations of pH, temperature of germinating etc.).

*Selection of cultures, which have no factors of stability localized on mobile genetic elements*

The traditional concept of full absence of any hazards for health of men in industrial use of lactobacillus is revised now because many microorganisms used in such application are capable to revive in gastrointestinal tract in ingress with meal and react there with its compensational and transitory microflora.

The starting cultures used in commercial applications, same as other lactobacillus and probiotic cultures, are capable to be reservoirs of genes of men and animals and assist in occurrence of their resistance to action of antibiotics, e.g. for tetracycline (tetM), erythromycin (ermAM), chloroamphenicol (cat), streptomycin (str), streptogramin (sat). The long-term condition of their use in industry was absence of factors of pathogenicity and toxicogenity, as well as suitability for use in commercial scale. Meantime, there occurred the phenomenon of increasing of resistance of microorganisms to action of antibiotics resulting in decreasing of effectiveness of cure of many of illnesses, complication in their treatment, amplification of aggressive properties of pathogens etc. Therefore, there arose the modern tendency of selection of used commercially microorganisms in observance of criterion of absence of their resistivity to attacks of antibiotics spread in horizontal transmission of undesirable genes of lactobacillus to pathogenic microorganisms and vice versa.

The last-time investigations of problems of spreading of lactobacillus, which possess by transmissible resistivity to attacks of antibiotics, were recognized by WHO as one of priorities and many countries, especially USA, reckon this phenomenon as one of factors that threaten to their national safety. Therefore, selectionists of starting cultures focus their attention on choose of cultures, which do not possess by factors of stability to attacks of antibiotics localized on mobile genetic elements (plasmids and transposons) that may be transferred to other microorganisms.

*Safeguarding of meat products in use of amino-negative starting cultures*

The one more obligatory criterion use in selection of safe starting cultures is absence of their capability to synthesize biogenic amines over the established quantitative norms during the whole term of work in their producing and storage. The mentioned substances are formed in foodstuffs in way of detachment of  $\alpha$ -carboxylic

group of amino acids under the influence of microorganisms that synthesize the specific enzymes known as decarboxylases (Fig 4.15):



**Figure 4.15** Mechanism of decarboxylation of amino acids

The amines formed in detachment of carboxylic group under the influence of microorganisms represent themselves the pharmacologically active substances. At the same time, some of such substances are powerful poisons and excess of their presence in the organism influences negatively on state of its health. Their influences may reveal in form of some type neuralgias, nausea, diarrhea, intensification of generation of gastric juice, increasing of rate of heartbeat, decreasing of diastolic pressure of blood, cerebral depression, inhibiting of reproductive activity, vasodilatation, arterial hypertension, leucotaxis, initiation of occurrence of cases of cancer etc. The big microbial number character for fermented products leads in many cases to inevitable accumulation in organism of biogenic amines, e.g. of tyramine, 2-phenylethyl amine, tryptamine, cadaverine, gystamine and putrescine. The last compound is formed in decarboxylation of amino acid of ornithine, cadaverine – of diamino acid of lysine ( $\alpha$ ,  $\epsilon$ -diaminecapronic acid). The last two mentioned compounds are poisonous (relate to class of ptomaines formed in decay of dead bodies). Decomposition of tyrosine in process of its decarboxylation leads to forming of tyramine, and decomposition of gystidine leads to forming of gystamine.

The class of amino-positive cultures includes the microorganisms that form in nutritional environments the biogenic amines in quantities of more of 350 mg/dm<sup>3</sup>. Otherwise, the cultures that form lesser quantities of such amines are named as amino-negative ones. However, one should note that quantity of biogenic amines in different samples of the same product may vary over the wide range. Values of such quantities depend of numerous factors of influence, e.g. of quality and ratio of ingredients present in the system, composition of microbial flora, physicochemical parameters and hygienic state of the environment, presence of substances (related amino acids), which precede to chemical transformations passed in the system etc.

The biogenic amines are inactivated in nature by aminooxidases present in it, as well as under the action of enzymes generated by cells of various kinds of bacteria, fungus and animals capable to catalyze oxidation of amines to aldehydes, hydrogen peroxide and ammonia hydroxide.

The potential role in fermentation of foodstuffs by products of vital activity of microorganisms character by activity in oxidation of amines is interruption or inhibiting of speed of forming of biogenic amines in the system. Therefore such their property is reckoned as necessary in selection of starting cultures used in producing of fermented foods.

Filamentous fungi used in purposes of protection of surface of meat products by biological methods

The principal goal of technologies in work in selection of cultures of filamentous fungi to be used in fermentation of meat raw is choose of such ones that are not capable to produce the poisonous micotoxins, i.e. metabolites, which deteriorate processes of metabolism of host organisms, decrease their immunity and raise receptivity to infectious disease. The character microorganism capable to influence negatively on state of live organisms is the filamentous fungi of *Penicillium camembertii*, which produces two kinds of micotoxins, namely the cyclopiazonic acid and rugulovasins A and B. The rate of forming of certain toxin depends not only of type of fungi, but also of specificity of its certain cultures. So, choose of cultures that are not capable to form micotoxins is the obligatory stage of work in development of technologies of fermentation of meat products.

#### Probiotic and technological properties of starting cultures

After the selected cultures of lactobacillus, staphylococcus, yeasts and filamentous fungi had been recognized as safe in use in technologies of producing of meat products, one has to identify their technological and probiotic properties.

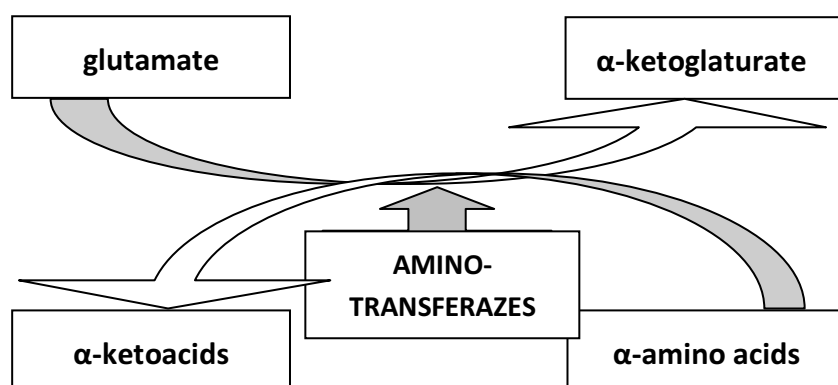
The set of probiotic properties (the starting cultures and products enriched by such microorganisms used in this case relate to category of alimentary probiotics) includes the parameters of resistance to attacks of acids, gall and gastric juice, rate of adhesion to epithelium and assimilation in digestive tract, assistance to rising of level of immunity, antagonistic activity with respect to pathogenic microorganisms and antimutagenic properties.

The principal properties of starting cultures exhibited in processes of producing of meat products are their capability to ferment hydrocarbons to lactic acid, cutting down of terms of their afterripening, increasing of output of finished products and extension of terms of their storage, rising of grade of denitrification of products and some other. One has to note also the antagonistic activity of these cultures to pathogenic microflora, capability to synthesize flavoring substances, bacteriocines and compounds similar to antibiotics by their action on pathogens (preservatives of microbial origin), antioxidant effectiveness (because their cells discharge such enzymes as katalaza, peroxidaza and superoxydedimutaza capable to bind oxygen) and capability to initiate processes of lipolysis and proteolysis.

#### Amino acidic catabolism

**Catabolism** (origins of Greek *καταβολή* – dumping, degradation, energy exchange, dissimilation) means the process of metabolic degradation, decomposition of certain substance to more simple substances, which is supplemented usually by emission of energy in form of heat and synthesis of adenosine triphosphoric acid. Passing of process of amino acidic catabolism leads to formation of specific aroma of fermented meat products conditioned by synthesis of aldehydes, alcohols and acids formed in decomposition of aromatic amino acids – phenylalanine, tyrosine, tryptophan, and amino acids that have the branched chain – leucine, isoleucine, valine, and products of decomposition of amino acid methionine that contain sulfur. The aromatic substances formed in result of passing of process of microbial catabolism influence considerably on forming of summary aroma of fermented meat products. The process of catabolism of methionine and aromatic acids that have the

branched chain passes in result of passing of reaction of trans-amination (Fig. 4.16), where the amino group transfers from donating acid to accepting  $\alpha$ -ketonic acid.



**Figure 4.16** *Mechanism of passing of process of catabolism*

Realization of this process is the key factor of forming of aromatic components obtained in decomposition of amino acids under the action of lactobacillus. The grade of influence of microorganism on kinetics of this reaction is the primary criterion in choose of microorganisms that form aroma of meat products and may be used as starting cultures or co-cultures in intensification of process of its forming.

The today's practice of choose of cultures of microorganisms, which assist in forming of aroma of meat products, is the most of empirical character and does not guarantees reaching of success. The one of the most necessary problems now is uncovering of mechanisms of fermentative activity of some types of microorganisms, which assist in forming of the desirable smell of products. Its solving would permit to select the most efficient cultures and shorten terms of producing of meat products fermented in their use. It's necessary to note, that glutaminic acid is the most abundant of amino acids, which are contained in meat raw. Therefore the prime task of technologists is choosing of cultures character by high activity of enzyme of glutamatedegidrogenasa.

#### Choose of cultures, which produce bacteriocines

The one of the most important functions of starting bacterial cultures is prolongation of term of fitness of fermented products. To assist in solving of this problem, technologists keep the set values of humidity, temperature and circulate air in premises for their storage. Observance of set parameters of storage of meat products permits to prevent germination of pathogenic bacteria and microorganisms nonpersistent in conditions of staying at low temperatures and influence of acids and some other factors. The one of possible methods of reaching of set goal is realization of idea of purposeful influence of lactobacillus that synthesize in process of its metabolism such antibacterial substances as organic acids, carbon dioxide, hydrogen peroxide and bacteriocines. The complex of such properties assures their antimicrobial activity, what permits to use this culture as preservative of foodstuffs of natural origin.

#### Antioxidative properties of starting cultures

The process of deterioration of meat products because of their oxidation is supplemented by activation of reactions of oxidation of lipids under the influence of

peroxides, as well as denaturation of hydrocarbons and albumens in attacks of free radicals (the particles that have the unpaired electrons). Radicals are formed in meat products in passing of processes of exogenous physicochemical and biological character, i.e. under the influence of light, oxygen of air, elevated temperature, in presence of traces of ions of metals of variable valence (iron, copper), which initiate forming of atomic oxygen, hence acceleration of processes of corruption of meat. The radicals occurred in such systems the most often are:

- $O_2^{\bullet}$  – molecule of oxygen, which carries the additional unpaired electron,
- $H_2O_2$  – hydrogen peroxide,
- $OH^{\bullet}$  – radical of hydroxyl.

To inhibit processes of oxidation of meat raw materials, technologists use various types of antioxidants. The mechanism of influence of this class substances used the most often is breaking under their action of chains of reactions because antioxidants react with active radicals and form the non-active neutral molecules. The starting cultures that are used in processes of fermentation of meat raw materials are very sensitive to attacks of free radicals and feel the considerable oxidative stress in contact with these particles. Aerobic and facultative anaerobic microorganisms (i.e. the starting cultures proper) contain the setoff enzymes including the enzymes of catalaza and/or peroxidaza capable to eliminate the toxic effect of free radicals. Uses of starting cultures character by antioxidative activity permits to decrease the quantity of reactive oxygen in meat products and prevent so their corruption under the influence of atomic oxygen. Therefore, search of microorganisms character by high antioxidative activity is one of priorities in work in selection of starting cultures to be recommended for commercialization in meat industry.

#### Formation of color of meat products in process of bacterial denitrification

The components that are used in meat industry are sodium nitrites and nitrates, which presence influences considerably on formation of such quality properties of finished products as their color, taste and aroma. Preserving of character pinkish-red color of meats is conditioned by interaction of nitrogen oxide formed in decomposition of sodium nitrite with mioglobine of meat. Moreover, the meat products salted in nonuse of nitrite have no character red coloring and aroma and taste character. Addition of sodium nitrate in meat products permits to inhibit oxidation of lipids, germination of microflora and formation of toxins.

One of categories of meat products consumed by men in biggest quantities are sausages, which are the basic sources of inflow of nitrites and nitrates in man's organism. Meantime, their consumption leads to negative consequences for health because they transform in organism into toxic compounds that have the nitroso-group in their structure. Regular consumption of nitrites and nitrates may lead to genesis of cancerous growth of antrum of mouth, gullet, stomach, bowels, pancreatic gland, kidneys, central and peripheral nervous systems, skin, heart and system responsible for formation of blood.

Existence of such hazards initiated the considerable rise of quantity of investigations of methods of decreasing of residual quantities of nitrites in finished products. The principal ways of search are finding of methods of decreasing of dosing of nitrites in minced meats in simultaneous use of additives that intensify

processes of coloration of meat, simultaneous use of nitrite and reducing substances, replacing of nitrites and nitrates by nutritional colorants and other substances, use of denitrifying cultures of microorganisms.

The principal cultures used for denitrifying are microorganisms of family of micrococcus, such as *Staphylococcus carnosus*, *Staphylococcus xylosus* and *Micrococcus varians*. These ones are the grampositive and catalasapostive cultures, which have no any characters of virulence confirmed in long time of use in industry as starting cultures. Correspondingly, one of principal tasks in work in choose of cultures recommended for commercial application is search for kinds of microorganisms that are character by high activity in processes of denitrification.

#### Development of starting cultures that have the prescribed genotype

The complex work in selection of new cultures of microorganisms, studying of grade of their safety, technological and probiotic properties, as well as identification of enzymatic activity they have, permits to choose the starting cultures, which use permits to obtain the best results in their commercial use.

It's necessary to note that the cultures of microorganisms used in food industry till now were of natural origin. Scientists searched for active culture of microorganisms and then developed the specific biotechnology of their use elaborated in observance of their biosynthetic potential. Progress of methodology of genic engineering permitted to extend considerably the sphere of work in reorganization of genomes of microorganisms, what creates the fundamentally new base of selection of organisms that would have the set properties. So, biotechnologists are capable now to convert the genic program of cells by such mode that they will produce the necessary product (for instance, the enzyme that will have the prescribed properties) but not wait for their accidental mutations. The work in introduction of heterologic genes in genomes of microorganisms gives scientists the possibility to construct purposefully new mechanisms of their metabolism and create cultures character by novel fermentative, transport and regulatory properties.

To reach the desirable results, investigators work extensively in identification of genetic determinants, which code technological properties of starting cultures. The principal purpose of such work is development of cultures character by set of desirable properties necessary for organization of high-performance manufactures. The character example of the microorganism is modification of culture of *Staphylococcus carnosus* resulted in development and commercialization of culture of super-producer of enzyme of nitritereductase, which permits to quicken twice the process of denitrification of dried fermented sausages.

#### Practical experience of use of starting cultures in technologies of producing of meat products

Studying of properties of basal types of microflora used in producing of meat products showed that the basic cultures of bacteria present in dried and smoked sausages, smoked ham and brines are lactobacillus, which character property is generation of enzymes of katalaza and nitritereductaza.

The investigations carried out as early as in the beginning of XX century showed that the cultures of microorganisms that the main role in producing of raw- and dry-smoked sausages in use of traditional technologies play lactobacillus of

cultures of *Lactobacillus plantarum*, *Lactobacillus brevis* та *Lactobacillus fermenti*. The culture of *Lactobacillus plantarum* relates to class of streptobacillus capable to decompose glucose and produce small quantities of acids. This category microorganisms are capable to germinate at temperatures of  $15 \div 45^{\circ}\text{C}$  and the optimum temperature of their reproduction is  $30^{\circ}\text{C}$ . The cultures of *Lactobacillus brevis* and *Lactobacillus fermenti* represent themselves the homofermentative bacillus of group of  $\beta$ -bacteria, which synthesize small quantities of acids in process of their vital activities. The resulting decreasing of pH of meat system assists in considerable speeding of processes of afterripening of sausages assigned for prolonged storage. Besides, these cultures have the intense antagonistic activity in relation to pathogenic microflora and agent of processes of corruption of meat products.

Technologists used intensely since 1957 as starters and substances of processes of forming of aroma of meat products the cultures of *Pediococcus cerevisiae*. In presence of sugar they synthesize lactic acid and assist in the same time to forming of specific aroma of sausages. Use of culture of *Pediococcus cerevisiae* permits to decrease the term of producing of sausages to 48 hours, and usual technologies presume preliminary exposing of raw materials used in producing of smoked sausages at  $7 \div 10^{\circ}\text{C}$  during 3-7 days and then their smoking at  $27 \div 44^{\circ}\text{C}$  during 2-3 days more.

The cultures of microorganisms used extensively in industrial applications are lactobacillus of cultures of *Lactobacillus acidophilus* and *Lactobacillus bulgaricus*. They are used in producing of numerous dairy products and semidried and raw dried sausages. Because of resistivity in environments that contain acids and kitchen salt, they are capable to germinate in relatively wide diapason of temperatures both in presence and in absence of oxygen of air. The bacteria of such cultures contain in their cells big quantities of riboflavin, hence produce acids and are stable at levels of pH of  $3.0 \div 3.5$ .

Unlike lactic streptococcus, lactobacillus contain complex of peptidases and proteinases, hence possess by high fermentative proteolytic activity. Therefore they are capable to transform in soluble form up to 25 % of casein, and the raw of activity of different cultures of lactobacillus in their capability to hydrolyze casein is as follows: *Lactobacillus bulgaricus*, *Lactobacillus acidophilus*, *Lactobacillus helveticum*, *Lactobacillus lactis*, *Lactobacillus casei* and *Lactobacillus plantarum*.

The starting culture the most interesting from the viewpoint of its ability to form aroma of sausages in the whole volume of the product is capable to germinate in anaerobic environments and produce in it precursors of their future smell.

In addition to bacteria of cultures of *Lactobacillus* and *Pediococcus*, US technologists use culture of *Micrococcus* capable to reduce nitrates to nitrites and improve so color and taste of finished sausages. It is shown also that the grade of fermentation of minced meat used in producing of raw-smoked sausages increases in adding of culture of *Lactobacillus plantarum* NRRL – B-5461 as the source of synthesis of lactic acid. This effect is intensifies in simultaneous use of its composition with cultures of *Pediococcus cerevisiae*, *Streptococcus lactis*,



*Leuconostoc citrovorum* and *Streptococcus diacetylactis*. Germans produce the raw-smoked sausages in use of bacterial preparations of Bactoferment 61, Duploferment H, Pokelferment 77, which contain denitrifying micrococcus and microorganisms capable to produce lactic acid, hence capable to decrease in minced meats the content of nitrite and decrease terms of producing of sausages. The United Kingdom technologists produce fermented sausages in use of mixes of *Lactobacillus* and *Micrococcus* taken in ratio of 50 : 50.

The raw-smoked sausages produced in Bulgaria, Germany and France in use of micrococcus are character by delicious aroma and delicate acidulous taste, what is reckoned as the criterion of high quality of this kind products. Processes of vital activity of this kind cultures lead to decomposition of albumens and forming of free amino acids, what is especially necessary in forming of prescribed taste of the product. At the same time, the lipolytic activity of the same cultures leads to forming in technological mixes of volatile low-molecular fatty acids, which are oxidized to peroxides. The latter class compounds transform then under the action of micrococcus into carboxylic compounds, what assists in forming of character taste of the product.

The specialized enterprises located in USA, Germany and Spain produce series of bacterial preparations under the trademark of SAGA. The compositions of SAGA-1 and SAGA-III represent themselves the mixed cultures of bacteria of *Pseudomonas acidilactici* and *Lactobacillus* recommended for use in producing of raw-smoked sausages. The product of SAGA-444 contains the pure culture of bacteria of *Micrococcus varians*, and SAGA-75 contains the cold-resistant *podiococcus* recommended for use for inoculation in sausages ripen at low temperatures.

The Russian scientists showed the positive effect of use in producing of raw-smoked sausages of culture of *Lactobacillus plantarum* 22II stable in saline environments and *Micrococcus caseolyticus* 883 active in processes of denitrification. The mix of these two cultures of bacteria assures amplification of their activities, intensifies forming and stabilization of coloration, decreasing of residual concentration of nitrite-ions, what assists in betterment of quality and hygienic properties of produced products. The one more perspective direction of using of starting cultures in Russia is use of dry bacillary preparations of "Lactoplant" and "Mikrok", which contain the combination of cultures of *Lactobacillus plantarum* denitrifying micrococcus of *Micrococcus caseolyticus*. The products of their vital activity are lactic and methylsuccinic acids, which generation results in considerable decreasing of pH of meat systems, betterment of quality and reducing of terms of their fabrication. The investigations devoted to finding of methods of betterment of quality of raw-smoked sausages carried out in Russian Federation showed the hopeful results of use of fungus of *Penicillium canescens* in surface treatment of sausages by its suspension. The result was obtaining of relatively dense layer of mycelium of white color, which presence improves quality of finished products.

The scientists who work in laboratories of firm of R. Muller (Germany) tested in producing of dried sausages the novel bacterial culture of *Lactobacillus pentosus*. Effectiveness of its use was compared with the related indices of action of bacterial

cultures as follows: *Petrostreptococcus parubus*, *Lactobacillus plantarum*, *Pediococcus acidilactici* and their combinations with the culture of *Streptococcus carnosus* MIII. It was shown the high effectiveness of tested culture expressed in quick decreasing of pH, obtaining of attractive color and delicate acidulous taste of the product that had the distinctly pronounced meat aroma. The optimal results from the viewpoint of organoleptic properties of Turkish Raw-smoked sausages were obtained in use of mixed leaven that contained 90 % of culture of *Streptococcus carnosus* and 10 % of *Lactobacillus plantarum*. The satisfactory results were obtained also in use of culture of *Pediococcus pentosaceus*.

To quicken the process of afterripening of sausage of salami, Portugal scientists used cultures of microorganisms of *Staphylococcus xylosus* and *Pediococcus pentosaceus*. The process of their fermentation at values of  $\text{pH} = 8.0 \div 9.5$  continued 5 days. Decreasing of value of pH in result of their vital activities provided their microbiological conservation and improved the physical and organoleptic properties of the product. It was studied also the role of starting leavens and endogenous enzymes of meat in processes of lipolysis of dried fermented sausages. The loest values of pH were obtained in use of culture of *Lactobacillus plantarum*. However the tested samples of inoculated sausages contained the increased quantities of fatty acids as compared with the standard compositions.

The last time tendency in investigation of processes of producing meat products is wide use of bacteria injected into the biologically active additives. Thus, the typical dietetic additive used in producing of meat products represents itself the combination of mineral component of powder of eggshell and symbiotic leaven of bacteria of *Lactobacillus plantarum*. It was shown that milled eggshell is the important factor of germination and development of microorganisms and stimulates at the same time processes of passing of basal biochemical reactions of components of minced meats. The meat products that are subjected to heat treatment may be enriched by the newly developed complex of ingredients of vegetative nature. The proposed method presumes fabrication of food additive in use of mix of grinded carrot, cabbage, wheat scalping fermented by cultures of bifid bacterium of *Bifidobacterium adolescentis*, propionic-acid bacteria of *Propionibacterium shermanii* and lactobacillus of *Lactobacillus acidophilus* and *Lactobacillus plantarum*. The products of metabolism of microorganisms decrease considerably the level of pH of vegetative substrate and transform the composition of irreplaceable amino acids in direction of rising of content of leucine, isoleucine and treonine.

#### **4.3.3 Analysis of conceptual principles of theory of “barrier technologies”**

The strategical purpose of the State is forming of healthy mode of living and rational alimentation, what define among others actuality of the problem of producing of meat products of high quality. Producing of meat products is the complicated process, which may be realized only on base of use of concept “from afield to the table”, which introduction guarantees the safety of raw materials, semi-finished and finished foodstuffs at all stage of technological raw. To realize this concept, businesspersons introduce the specialized systems of control: the systems of *Hazard*

*Analysis and Critical Control Points (HACCP)*, *International Food Standard (IFS)* and *Food Safety Standard ISO 22000*. However, use of no one of listed systems cannot guarantee the 100 % safety of production. To prevent deterioration of quality of finished products after finishing of productive cycle, manufacturers use in many cases various techniques of their preservation.

The category of dangerous contaminants of meat products includes various substances of chemical (toxic elements, pesticides, nitrozoamines, polychlorinated biphenyls etc.), biological (mold fungi, micotoxines, bacteria and bacterial toxins, yeasts etc.) and physical nature and the most dangerous compounds of this category are factors of microbiological origin. These types hazards are not isolated of one other because deterioration of quality of products induced by passing of processes of any type may assist in development of processes of corruption of other type. It's necessary to indicate the progressive raise of toxicity of products of vital activity of toxins generated by microorganisms conditioned by quick adaptation to variable conditions of their existence and resistance to attacks of conditionally pathogenic and pathogenic microorganisms, which get to products of meat-processing industry from raw materials and other sources. Scientists reckon that this is the consequence of mutations of microorganisms occurred in influence of systematic shocking influences of environment (e.g. in their being in conditions of prolonged terms of fitness of foodstuffs), what results in reorganization of genic apparatus of bacteria. Germination of such forms of pathogenic bacteria causes the continuously increasing quantity of poisoning by foods. Therefore, the persons who develop modern technologies of producing of meat products have to focus their attention on use of complex of specific factors, which assist in inhibiting of germination of pathogenic microflora. Therefore the concept of use of "barrier technologies" became one of crucial factors taken into consideration in this work.

The theory of "barriers" was stated first in Germany. Its basic positions are based on principle of joint use of complex of factors that block reproduction of microorganisms and have the purpose of extension of terms of preservation of proper quality of products. The principal action carried out in realization of this goal is control of germination of pathogenic microflora linked indivisibly with stabilization of other parameters that guarantee fitness of products for consumption.

The notion put in base of this theory is "homeostasis", i.e. the inner balanced state of cell of microorganism, which distress blocks its reproduction. The correctly chosen combination of various "barriers" disturbs the normal homeostasis of the cell for the long time. Therefore it tries all time to restore the state of balance of its functioning but not generation of new organisms. The resulting disorder of processes of metabolism leads to breakage of capability of functioning and extinction of the cell. The result is the self-sterilization of the foodstuff, what preserves its microbiological stability and safety.

The most influential "barrier factors" used in processes of fabrication of meat products are: low grade of initial microbiological infection of raw materials, sufficiently big acidity (pH) and activity of water contained in the product, certain diapason of redox potential of the system, presence of preservatives and

bacteriostatics, presence of oxygen and observance of established temperatures of storage and thermal treating.

The value of initial level of microbial pollution of meat raw and consumables, as well as level of safety of finished products, depends considerably of temperature of environment and methods of preparation of basic materials to reprocessing. The bigger is quantity of bacteria capable to corrupt the product, the more effective is action of combination of “barriers” used in process of manufacturing because they would block reproduction of microorganisms of initial microflora. If the effect of any “barrier” is too low, it has to be magnified, but such action must not be used if it would decrease the effectiveness of influence of other “barrier” factors. The character example is regulation of level of pH of fermented sausages: it has to be sufficiently low to prevent reproduction of undesirable microflora, but not too small to avoid occurrence of its negative influence of organoleptic characteristics of finished product.

It was shown that the active acidity of almost all microbial cells is about of neutral values ( $\text{pH} = 7$ ). Therefore, the key components of their cells – deoxyribonucleic acid and adenosine triphosphoric acid – are in state of equilibrium at levels of acidity close to this value. At the same time, the pathogenic bacteria are more sensitive to variations of pH than yeasts and molds. Most of meat products have the level of pH of  $5 \div 7.5$ , what is optimal for development pathogenic microflora. Therefore technologists inhibit its preproduction in use of methods of biotechnology injecting in meat masses the cultures of lactic bacteria, which produce organic acids. The latter migrate in microbial cells, dissociate there and acidify so their inner environment. The result is passing of the undesirable cells in stress conditions and increasing of their sensitivity to influence of other barrier substances.

Index of activity of water ( $a_w$ ) is the parameter identified as ratio of pressure of vapors of water over the surface of nutritional substrate to respective index of pressure over the surface of pure water at set temperature. This parameter characterizes the grade of accessibility of free water for microorganisms and correlates with rate of passing of numerous destructive reactions (including the Maillard reaction) passed in products. Each type of microorganisms is character by certain maximal, minimal and optimal values of activity of water inside. Any deviation of its value out of optimal value results in inhibiting of processes of their vital activity. It was shown that no one culture of microorganisms cannot reproduce if  $a_w$  is less of 0.6 and almost all their types can germinate at values of  $a_w$  more of 0.95. The content of biologically accessible water contained in raw materials depends of breed of cattle, its age and ration of feeding. Therefore, meat products produced out of the same breeds have differing numerical values of  $a_w$ , what influences considerably on their stability in process of storage.

Temperature is one of important “barrier” factors of influence on processes of reproduction of microflora. The cultures of bacteria that decompose albumens the most effective relate to class of mesophilous microorganisms. The processes of corruption of meat raw materials and finished products occur under their influence at temperatures of  $25 \div 40$  °C. Hence, these processes may be decelerated considerably

in quick cooling of meat bulks to temperature of about of 15 °C, which phenomenon is used usually as method of prolongation of terms of storage of meat after slaughtering of cattle, but the temperature recognized as the “barrier” one and used in storage and reprocessing of meat is 0 ÷ 4 °C.

The one more “barrier” factor used in reprocessing of meat raw is its *thermal treating*. It was shown that up to 99 % of conditionally pathogenic microflora perishes in heating of meat products in process of their boiling after reaching of temperature inside the meat loafs of 68 ÷ 72 °C and quantity of residual microflora depends considerably of level of initial microbial semination of raw materials taken for reprocessing.

The microbiological stability of meat products may be risen also in their *smoking*, what leads to penetration inside the product of fractions of fume that are characterized by intense bactericidal and bacteriostatic activities.

*Redox* is the quantitative parameter that characterize capability of the system to accept/donate free electrons. Redox potential may be reckoned as the measure of free energy of biochemical reactions necessary for separation of electrons out of donating compound seconded by their following bonding by accepting molecules. Loss or bonding of electrons is the most widespread mechanism of chemical transformations occurred in biological systems. Thus, if two molecules contact one with other, they interchange by energies: the molecule of donor transfers its electron to molecule of acceptor and oxidizes and the molecule that accepted the electron reduces in this process. The value of redox potential of meat products depends mainly of conditions of basal raw materials, physicochemical properties of water used by technology, quantity of air hit in the meat system in process of preparation of minced meat (the value of redox potential may be decreased considerably in vacuuming of the mass) and conditions maintained at the following stages of preparation of the product.

Regulation of value of redox potential, as well as maintaining of optimal values of pH of the system and activity of water in it may be the effective “barrier” factors in process of reproduction of microorganisms in meat products. Keeping of negative values of redox potential permits to inhibit reproduction of aerobic microorganisms viable in presence of sodium nitrite and assists in germination of lactobacillus. However, the facultative microorganisms are capable to reproduce both at positive and negative values of redox potential. Therefore regulation of value of this parameter have to be carried out in complex with realization of other “barrier” technologies dependently of peculiarities of composition of microflora of processed meat products.

It was shown that redox potential of meat systems decreases under the influence of factors as follows: injection in the system of ascorbic and isoascorbic acids and their salts, use in formulations of meat products of activated water and certain types of amino acids. The listed means influence positively of state of the system: they intensify and improve color of the product, assist in quick and complete exhausting of sodium nitrite, prevent generation of carcinogenic nitrosoamines, have the clearly expressed antioxidant effect and prolong terms of fitness of finished products. At the same time, hydrocarbons present in the system decrease its redox

potential directly or indirectly because they assist in forming of environments acceptable for living of useful microorganisms (for instance of lactobacillus).

So, the list of the most effective “barriers” includes the following factors:

- through choose of raw materials and consumables used in fabrication of meat products, balancing of their formulations (especially use in technological purposes of high-quality water only),
- use of bacteriostatic additives and starting cultures, antioxidants and their synergists,
- choose of the most appropriate regimes of duration and temperatures of thermal treating of semi-finished products,
- packing of finished product under vacuum or into packs filled by modified atmosphere,
- pasteurization of finished products.

#### **4.4 Use of genetically modified organisms in food industry**

The fundamental tendency of development of modern market of foodstuffs (including the meat products) is refusing of use of ingredients that had not passed the thorough control of their safety for health of living and future generations of men. European consumers were first who began to demand to mark foodstuffs by marking witnessing their safety and good quality by combination of words of “clean product” and in later time the same information of packs of foods began to put Ukrainian manufacturers too. The increasing interest of men to consuming of environmentally pure products produced in avoiding of use of chemical additives and ingredients results in rising of quota of organic products present in the market. The one of measures used in realization of this policy is control and limiting of access on the market of genetically modified organisms (GMO).

The practice of fabrication of meat products is complicated by those that many of ingredients used in producing of composite additives, especially mixes that contain albumens, may have GMO in their formulations but their user even does not knows about it. Besides it is known that genetically modified organisms may contain such usual albumen-free additives as lactic acid (E 270), ascorbic acid (E 300), vitamin E (tocopherol, E 307), lecithin (E 322), citric acid (E 330), xantanic gum (E 415), sodium glutamate ((E 621), aspartame (E 951) and others. At the same time, mechanisms of influence of genetically modified organisms of vital activities of men are not studied in details yet. This problem is the topic of intense investigations because it is problematically to expand considerably the area of planting of “organic” production and “organic” domestic animals because estimates show that the planet Earth cannot feed in this mode of management more of 4 billion of men what is greatly less of up-to-date count of men. This phenomenon inevitably puts the problem of finding of alternate variants of overcoming of global deficit of meal and one of methods to use is marketing of new types of foodstuffs.

To solve this problem, farmers used during last decades the advances of modern biotechnology in development and significant extension of practice of producing of new types of genetically modified products that have in their

albuminous structure new combinations of genes, i.e. sections of molecules of deoxyribonucleic acid.

In the beginning of work in genic engineering, the formations character by new combination of genetic material were named as the "*live altered organisms*", but the Directive of European parliament and EU Council 2001/18/EU of 12<sup>th</sup> of March 2001 renamed them in later time as the "*genetically modified organisms*", the appellation used now everywhere. The basic terms used in sphere of circulation of GMO are:

*Organism means any biological entity capable to replicate or transmit its genic material to other organisms*

*Genetically modified organism means any organism except of hominal one, which genetic material was modified by mode unnatural and/or not occurring in nature*

*Intentional passage [of genic material] means any mode of introduction of GMO or combination of GMO in nature character by absence of strict limiting of their direct contact with natural populations*

*Placement on market [of GMO] means giving third parties of free and payable possibility to contact with GMO*

To harmonize terms used in this sphere with those that are used worldwide, Ukraine introduced just the same term (Law of Ukraine of 31.05.2007 # 1103-V "On State System of Biological Safety in Creation, Testing, Transporting and Use of Genetically Modified Organisms") and classifies GMO by categories as follows.

*Genetically modified organism means the live being, which has genetic apparatus not occurring in nature and produced by artificial transfer of genes by methods of:*

- *recombination, i.e. forming of new combinations of genetic material in placing of outside molecules of nucleon acids inside any virus, bacterial plasmoid or other vector system and their following introduction into the host organism capable for long reproduction,*
- *direct introduction of hereditary material, i.e. forming of the modified object by methods of macro injection, micro injection and microencapsulation of genic material in it,*
- *cell fusion, i.e. hybridization of genic material of live organisms in new combinations, when the altered cells are formed by unnatural fusion of two or more cells or their fragments (including the cases of fusion of their protoplasm)*

The possibility of hatching of organisms, which have the sufficiently altered genic structure, was identified as early as in 1946, but the first real GMO was produced almost 40 years later, in 1983. It was the kind of tobacco stable to negative influence of antibiotics, but this plant was not marketed, and the first commercialized GMO was the tomato *FlavrSavr* (1994). However, it did not contain any introduced foreign gene. Instead, its genic apparatus was modified by extraction from it of gene of polygalacturonasa responsible for dissolution of walls of cells of vegetables in storage resulting in shorting of terms of keeping of capacity of non-modified vegetables.

The genetically modified organisms known for this time may be classified by three basic groups as follows.

1. Genetically modified plants. This is the biggest group of organisms by criteria of their diversity and sphere of use. The stimulating motive of their generation was the desire to solve the problem of elimination of starvation of mankind that originates in conditions of quick growth of numbers of global population especially actual for the countries of "*Third World*". Therefore, the most of efforts of biotechnologists were centered on development of kinds of plants capable to vegetate in almost all climatic conditions (in conditions of permafrost, saline, arid steppes, and even in deserts). The one more condition was their resistivity to attacks of vermin and influence of herbicides and pesticides in process of planting and capability for storing during the prolonged time after their harvesting. The desirable characteristics of new types of GMO plants were also their bettered tasty and nourishing values. The one more direction of investigations was creation of plants, which may be used as sources of medicinal preparations.

2. Genetically modified animals. Such category organisms include first mice created especially for testing of various preparations and identification of potentially dangerous effects resulted of use (consumption) of plants. Said modifications of animals were created preferably by methods of "extraction" from biotope of certain genes. There exist already modified cows capable to give milk, which composition is in close conformity with the men's one, modified salmon character by bigger size and speeded evolution, modified hogs, which manure minimally damages structure of soils, flies does not capable to reproduction and so on.

3. Genetically modified microorganisms. This is the smallest group of modified organisms created in purposes of use in medicine, as a rule, and information on their existence and properties is minimal because pharmaceutical companies wish to keep it in secret.

The genetically modified organisms may be grouped also by various categories and the most often used criteria in their subdivision are spheres of using, grade of effectiveness and so on. Here is given one of variants of such grading based on criteria of their prevailing use.

a) Resistant to attacks of insects. Attacks of insects damage plants and decrease their productivity increasing so their prime cost. The typical measure used by manufacturers to decrease such kind losses is application of pesticides into the cultivated farmlands. In certain cases this measure is effective, but most of used chemicals are toxic for the useful types of insects including those that are not vermin. Moreover, these chemicals are toxic for men and animals.

To decrease quantities of applied pesticides or even avoid their use, some plants were purposeful modified by such mode that the albumens they produce became harmful for the undesirable forms of insects. The examples are plants, which genome obtains the gene of bacteria of *Bacillus Thuringiensis*, which annihilate caterpillars.

b) Resistant to action of herbicides. Herbicides are chemical compounds that annihilate weed, which compete with cultural plants for use of water, nutritive substances, solar energy and space. If the planter would not control their reproduction, his harvests would be sufficiently less. Because most of weeds are in close biological similarity with cultural plants, there exists the crucial problem of finding of herbicide character by selective influence on weed and not causing of



damage for the purposeful culture. To solve this problem, bioengineers use technologies that permit to produce organisms, which have the acceptable prime cost and are not sensitive to influence of herbicides used in quantities sufficient for annihilation of undesirable plants. The example is the transgenic kind of soy GTS-40-3-2 resistant to influence of herbicide "Roundup" sold under the trademark of Roundup Ready (RR).

c) Character by the bettered nutritional properties. Men are not capable to produce most of vitamins essential for normal passing of metabolic processes. At the same time, basic cereal crops used in rations of men, such as rice, do not contain vitamins at all. The problem cannot be solved by consumption of fruits and vegetables because of their high prices. Therefore the task of improvement of nutritional value of grain was solved in some cases by way of modification of its genic apparatus, e.g. in rearing of "golden rice" enriched by vitamin "A". This culture is not planted extensively yet, but is promising in view of possibility of decreasing in its consumption of level of sicknesses caused by deficit of this vitamin. There exists also tomatoes character by bettered tasty and nutritional properties, e.g. the sweet tomato, as well as the violet tomatoes character by increased content of antioxidants capable so to protect their consumers against falling in cancer as their developers manifest.

d) Resistant to affections. Plants, same as animals, are exposed to diseases, which may sometimes progress uncontrollably. This is especially inherent for modern agricultural systems character for crops character by low genic diversity of cultures planted on large areas. Because traditional methods of selection are character by the long-term duration, services of genic engineers permit to decrease terms of introduction of necessary elements in genic apparatus of plants to give them resistivity to influence of certain illnesses. The examples are the modified manioc and papaya.

e) Character by the bettered characteristics the after-harvesting time. The main problem of some cultures is the need of preservation of their integrity in transporting and guaranteeing of prolonged term storage during the after-harvesting period. The usual methods of cooling, thorough treating and/or use of chemical agents assist in their retardation and protect products in process of their storage and transporting. However these techniques deteriorate in many cases quality of products and increase considerably their prime cost. Meantime, methods of genic engineering permit to amend genic apparatus of such crops to avoid such disadvantages. The examples are the tomato "Flavr Savr", arctic apples and potato "Innate", which enzymes assist in afterripening and preserving of properties in storage.

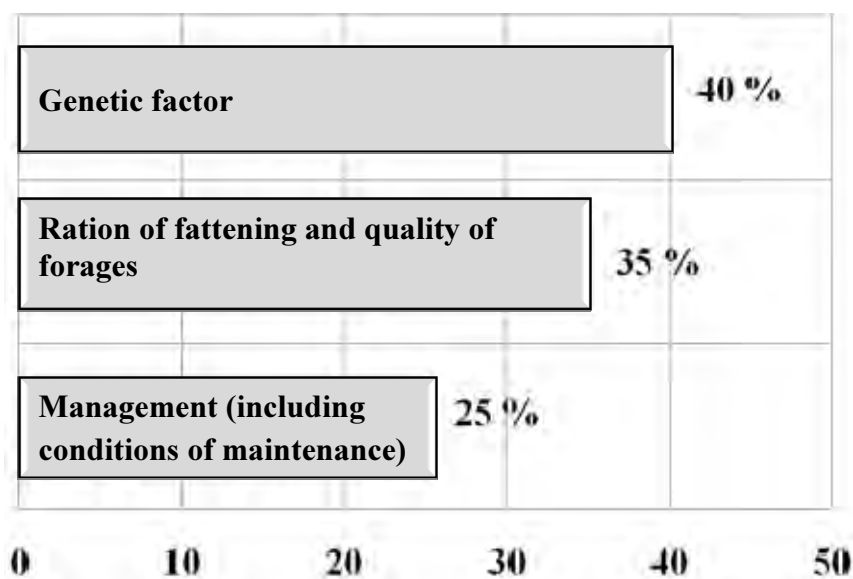
e) Resistant to climatic and weather influences. These ones are the modified cultures, as a rule, which are capable to survive in arid areas, saline soils, regions character by big quantity of precipitations and low temperatures (frost-resistant cultures).

f) Medicinal agents. The most known drugs and vaccines created with use of GMO are insulin, hormones of thyroid gland and vaccines used in treatment of hepatitis. They are cheaper in production, therefore more available for their users.

g) Food additives. The most known representatives of this class compounds are aspartame and yeast. Moreover, numerous ingredients of foods contain the ingredients produced with use of GMO as well.

h) Modified animals and men. This category organisms include both domestic and many wild animals, especially those that have the improved visual characteristics (color of fur, scale, capable to shine in dark etc.), as well as animals character by the bettered tasty and nutritional characteristics (e.g. those that have bigger size, therefore contain more nutritive materials). Such GMO include also animals breed for laboratory investigations, which are character by the specially given "deviations" to simplify interpretation of results obtain in this work.

It's known that quality of raw materials influences considerably on quality of finished meat products. Therefore, specificities of technologies of farming, practical use of advances of genic engineering and purposeful use of genes in producing of new genotypes influence considerably on development and ratio of quantities of various tissues in organisms of domestic animals and output and quality of marketable meat. The last time investigations showed that methods of genic engineering permit to increase productivity of meat raw and raise at the same time its quality and the conditional interrelation of each of intravital factors of influence on quality of meat raw materials is shown on Figure 4.17 below:



**Figure 4.17 Distribution of grade of influence of intravital factors used in breeding of animals on quality of their meat**

Scientists identified some genes, which form quality of meat, especially of pork, and may be reckoned conditionally as specific “markers” of its goodness. One of such “markers” is the so-called *Halothane gene*, which presence assures rising of quota of muscular tissue in the organism. The same effect may be reached in way of deletion form albumens of gene of GDF 8 (miostatine). Besides, quantity of meat increases and its quality improves in presence of gene of hormone of growth of GH, and hormone of leptine and its receptor (LEP and LEPR). At the same time, gene of *Halothane* is character by certain recessive influence on vital activities of organisms

and is capable to induce the stressful syndrome of hogs and intensify influence of gene of RN, which main function is increasing of content of water in meat, hence deterioration of its quality.

It's necessary to note, that modification of genic structure of domestic animals is capable to amend their intravital characteristics of quality. Therefore it's possible to breed transgenic animals character by quick fattening and accumulation of big quantity of muscular tissues, what is the promising direction of work in finding of ways of increasing of output of meat capable to satisfy need of meat-processing industry in qualitative raw materials.

As to men, the United Kingdom became the first country, which officially legalized technologies of amending of the embryonic line of men (if the child has genes of three parents: two women and one man) and there already exist the first modified men who finished secondary schools in 2015. This is one of the most problematic themes of discussion in modern science because such works open the way to creation of "eugenic children".

The genetically modified organisms are character by quicker ripening and bigger productivity, lesser content of harmful compounds, increased resistance to pathogenesis (events of occurrence and progress of wide spectra diseases– starting out of molecular abnormalities and up to alteration of organs and systems of organisms) and other positive effects. The principal results of transgenic modification of plants are increasing of their resistance to influence of herbicides, insecticides and viruses. The modified organisms are character in many cases by new consuming properties. Their planting permits to decrease quantities of pesticides used in practice, therefore, their residual quantities in finished products, cut expenses and spent resources, shorten time of carrying out of operations of reprocessing of products of agriculture and decrease losses of harvested products.

It is recognized now that introduction of GMO have certain advantages, and one of the most expressive examples is the cotton seed that contains up to 20 % oil, which may be, in theory, the significant source of feeding of more of half billion people. However, its regular consumption is limited now because of richness by terpenes poisonous for heart, liver and reproductive system of men. Use of methods of conventional agriculture permits to select the kinds of this plant free of harmful compounds, but they will be sensitive to attacks of vermin. At the same time, methods of genic engineering permitted to select plants character by unchanged content of terpenes in all their parts except of seed, where this one was decreased to level of less of 1 % of its content in traditional kinds of the plant. The one more example of positive effect of cultivation of genetically modified cotton is reaching of resistance of the plant to attacks of cotton borer, the vermin the most dangerous for this culture.

The principal advantages of use of genetically modified organisms and foods, which contain GMO, are:

- chance to solve the problem of hunger, for they give bigger harvests,
- speeding of processes of ripening of products of agriculture,
- rehabilitation of environment owing to planting of cultures, which are not sensible to attacks of vermin, hence may be grown in use of decreased

- quantities of toxic chemicals,
- retardation of processes of deterioration of products, hence decreasing of losses in their producing, transporting and storage,
- expanding of areal of planting of cultures, which are planted usually in hot climate and medium latitudes (e.g. strawberries in conditions of frosts),
- enrichment of foods by minerals and vitamins (the most expressive example is the "golden rice" enriched with vitamin "A").

To realize such possibilities, the human society accomplishes the extensive R&D works, but the accessible information on probable negative influence of genetically modified organisms on health of men is too contradictory and not detailed yet.

At the same time, the published results of works in studying of influence of GMO on conditions of nature and state of live organisms, which consume GMO, are doubtful till now because researchers use usually the dubious methods of studying of aftermath of feeding of some dozens of rats, mice or rabbits but not the alternative of studying of effects of consumption of GMO by the men-volunteers. Besides, most attempts of identifying of grade of safety of GM-products were mediate, so, even the induced effects they revealed are thoughtful.

Thus, in 2002 scientists published the information of results of comparative analysis of rate of sickness caused by consumption of foods in USA and Sweden. It was stated, that conditions of living of population of these two countries are character by relatively high standards of life, the closely similar ration and use of the same level medical services. However, *"... the US doctors fixed that during some years after beginning of intense use of GMO as foods, the 3-5 times bigger quantity of intoxications of US consumers as compared with the Swedish statistics"*. The discussions by problems of safety of transgenic cultures were intensified since the end of 1998, when the *Institute of Nourishment of the Russian Academy of Sciences* published the information that *"... rats, which ate transgenic potato had after passing of six months of experiment the unconditionally less mass, anemia and dystrophic changes of cells of liver"*. At the same time, conclusions of some scientific teams are the diametrically opposite, what does not permit to make the unambiguous decision on recognition of safety of extensive introduction of GMO in practice of alimentation.

Generally, scientists reckon that the principal risks in consumption of genetically modified organisms as foods are:

1. *Inhibiting of immunity and occurrence of allergic reactions and metabolic disorders as the direct result of consumption of transgenic albumens.* The mechanisms of influence of albumens, which contain specially introduced foreign genes on conditions of health, are still unknown because men never consumed them before in big quantities. Moreover, it is not known in advance, whether they are allergens or not. The representative example is the attempt of interbreeding of genes of Brazil nut into the genic apparatus of soybeans to rise the content of protein. However the resulted combination became the powerful allergen and the modified soy was extracted from circulation.

2. *Potential sterility of hybrid generation of transgenic plants* in transmission of new genes, so impossibility to use their seeds in their reproduction in future.

3. *Various dysfunctions in conditions of health resulted of consumption of GMO-modified albumens or influence of toxic products synthesized in their metabolism.* The example is development in USA in the end of 1980-s of technology of producing of food additive *tryptophan* with use of the genetically modified bacterium created specially for this purpose. However this one began to synthesize simultaneously with the purposeful product of by-product of *ethylene-bis-tryptophan*. Consumption of such mix produced chronic aches of 5,000 men, which 37 persons died and 1,500 became invalid.

4. *Emergence of resistance of men's pathogenic microflora to attacks of antibiotics.* Developing new types of GMO, breeders introduce in many cases in their genic structure fragments, which produce resistance of microflora of bowels to action of antibiotic, what results in medical problems in cure of some illnesses shown in experiments.

5. *Deterioration of health because of accumulation of herbicides and other dangerous substances in man's organism.* Most of known transgenic plants are capable to accumulate sufficient quantities of agricultural chemicals used in their planting, e.g. the GMO-modified sugar-beet resistant to action of herbicide glyphosat accumulates its toxic metabolites.

6. *The ultimate carcinogenic and mutagenic effects.* Each case of inserting of foreign gene into the live organism is in fact its mutation that may cause undesirable consequences.

7. *Uncontrolled influence of altered genic structures of certain live organisms on conditions of living of other organisms,* for instance their toxicity for other biological forms. It was published in 1999 the information on intoxication of rats, which ate potato that contained in its genic apparatus the gene of snowdrop *Glantus nivalis* introduced in purposes of giving it of capability to resist to attacks of nematode. The one more example may be occurrence of indirect threat in result of generation by the plant of albumen, which is not toxic for certain kinds of insects but poisonous for birds, which ate them together with eaten GMO and products of their metabolism they accumulated.

8. *Advantages in capability of GM-plants to accommodate to influence of abiotic factors,* what may result in suppressing of growth of traditional cultures. Alteration of climatic conditions, presence of certain specific salts in places of planting and so on may result in giving the hybrid plants, e.g. the plant, which received the gene of resistivity to influence of pesticide in cross-pollination with the genetically modified plant, enough advantages as compared with the usual kinds of local plants and transform it in aggressive weed.

To minimize the probability of negative influence of listed factors on conditions of nature, each country gives permissions on access of GMO on her national market after use of preventive measures as follows:

- a) creation of structure of guarded objects or regions, which conditions of functioning preserve the structure of existing biological diversity,

- b) development of guiding principles of choose and creation of guarded objects,
- c) assisting in conservation of conditions of ecosystems and natural places of existence and living of viable populations,
- d) assuring of integrity of biological resources at guarded territories and outside and introduces the necessary measures of regulation of their rational functioning,
- e) maintaining of environmentally friendly evolution of populations in guarded and neighboring regions,
- f) rehabilitation and restoration of degraded ecosystems to their normal conditions and assisting in saving of beings, which are under threat of disappearance,
- g) establishing of norms of work in minimization of grade of risks, which may arise in introduction in nature of GMO capable to influence negatively on health of men and existing conditions of ecosystems,
- h) maintains innovations necessary for preservation and stable use of biological resources.

The work on confirming of safety of novel products and minimization of probability of emerging of delayed effects of negative character became the prime task in putting of GMO in circulation since the moment of their origination as such, and it was the decision of international community to hold the 1992 World Summit in Rio-de-Janeiro by problems of conservation of biological diversity. Its basic decision was to recommend governments to prevent release of genetically modified organisms to open systems till all effects of their influence on conditions of health of live beings and state of nature would have been studied in details. The delegates of the Summit approved also the document known as the *Convention on Preservation of Biological Diversity* opened for signing 5<sup>th</sup> of June 1992. The Convention entered into force 29<sup>th</sup> of December 1993 and ratified for the present by 192 countries (plus EU as its solidary member). Its principal goal is to preserve the existing biological diversity of ecosystems for the sake of receiving of mutual and equitable benefits of use of preserved genic resources. It was pointed, that the main directions of genic engineering to be carried out in guaranteeing of conditions of biological safety are:

- operation with GMO in closed systems in avoiding of their contact with population and objects of environment, and
- prevention of release of GMO in environment (excluding cases of State testing and studying of their "behavior" in open systems).

*Biological safety means the condition of safety of men character by absence of negative influence of exterior biological, chemical and physical factors on biological structure and vital functions of present and future generations, as well as absence of nonreversible negative influence of conditions of nature (biosphere) on vital functions of other biological objects*

*Genetic safety means existence of conditions of environment character by absence of any unnatural and uncontrolled influences on genomes of objects of biosphere, men, agricultures, domestic animals and microorganisms cultivated in industry, which may affect negatively on conditions of their vital activity*

*Closed system means the space organized for work character by modification of genic apparatus of living beings, their cultivation, treating, storage, use, transporting, annihilation and burial in avoiding of contact with the outside population and objects of environment*

*Open system means the space of work in genic engineering where genetically modified organisms may contact freely with the outside population and objects of environment in their planned use in agricultural practice, industry, medicine and other spheres of business operation*

Because the problem of influence of GMO on state of nature was not studied properly, 600 participants of 60 countries met as early as 19<sup>th</sup> of October 1998 at the XII Scientific conference in Mar-del-Plata (Argentina) and approved the norm of prophylactics in prevention of introduction of GMO in open systems and "... basing on principle of preservation of biological diversity and adequate conditions of health of global population" took unanimously the Declaration on avoiding of use of genetically modified organisms and products, which contain GMO:

*We, the undersigned participants at the 12th Scientific Conference of the International Federation of Organic Agriculture Movements (IFOAM) at Mar del Plata, Argentina, call on governments and regulatory agencies throughout the world to immediately ban the use of genetic engineering in agriculture and food production since it involves:*

- *Unacceptable threats to human health*
- *Negative and irreversible environmental impacts*
- *Release of organisms of an unrecallable nature*
- *Removal of the right of choice, both for farmers and consumers*
- *Violation of farmers' fundamental property rights and endangerment of their economic independence*
- *Practices, which are incompatible with the principles of sustainable agriculture as defined by IFOAM*

In accordance with the Charter on founding of the United Nations and principles of international law, the parties of the Convention have the sovereign right to exploit freely the resources pursuant to their own environmental policies in their territories, but must not cause any damage to environmental conditions of areas beyond the limits of their national jurisdiction. The norms of the Convention regulate also the procedures of safely move of products of modern biotechnology through the national borders, and one of its principal conditions is normalization of procedures of reprocessing and use of GMO in avoiding of probability of emergence in ecosystems of uncharacteristic types of life, which may cause potentially the undesirable changes in their stable functioning. Following this principle, the GMO and products of their reprocessing are considered as the potentially hazardous objects till their safety will be confirmed by all normalized methods, and to avoid the irremediable harm for health of men and biological diversity, the genetically modified organisms have to be treated in absence of reliable information in observance of all precautionary measures of their uncontrollable release into the open systems.

To minimize influence of GMO on environmental conditions, each Contracting Party shall, as far as possible and as appropriate:

(a) Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity,

(b) Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity,

(c) Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use,

(d) Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings,

(e) Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas,

(f) Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, *inter alia*, through the development and implementation of plans or other management strategies,

(g) Establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking also into account the risks to human health,

(h) Prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species,

(i) Endeavour to provide the conditions needed for compatibility between present uses and the conservation of biological diversity and the sustainable use of its components,

(j) Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices,

(k) Develop or use the necessary legislative and/or other regulatory norms in force in protection of species and populations existing under threat of disappearance, and

(l) Regulate or manage the relevant processes and categories of activities in identification of significant adverse effect of natural conditions on biological diversity.

Despite the taken Resolution prohibits unambiguously release of GMO into open systems, such norm is applicable now in the organic agriculture only, and genetically modified products are used extensively in global economical processes and spheres of their circulation were delimited by clauses of the Protocol on Biological Safety, the document known as the Cartagena protocol signed 1999 in Colombian city Cartagena-de-Indias and put in force in Montreal in 2000 as the supplement to the Convention on Biological Diversity. The main goal of its taking was normalization of conditions of accomplishing of actions declared by Principle 15



of the Preventive approach approved at the Rio-de-Janeiro World Summit as "... assisting in assuring of adequate level of protection of biological diversity and guaranteeing of its safely development in observance of existing risks for health of men and peculiarities of safe transboundary move, reprocessing and use of live organisms modified by methods of modern biotechnology". The document declares:

*"... Nothing stated in this Protocol must not cause damage for sovereignty of States in their territories, exclusive territorial zones and shelves ...*

*... The Party, which takes the decision to use in own territory the live modified organism, which may be the object of cross-border movement as a foodstuff or forage, has to inform on it all Parties in fifteen days term and give the written copies of related information materials to their National information centers."*

The fact of joining of the country to the Cartagena protocol does not put her any hindrance in commercialization of new types of genetically modified products domestically. The parties are free in cultivation in their territories of genetically modified plants and breeding of domestic animals character by modified genic apparatus. The signatories of the Convention on Biological Diversity and the Cartagena Protocol are free at the same time in normalizing of maximum permissible norms of content of GMO in foodstuffs consumed in their countries (see Table 7.2), which observance permits domestic manufacturers to declare, that their products are *"free of GMO"*.

**Table 7.2**

***Permissible contaminations of GMO in foodstuffs in some countries***

<b>Country</b>	<b>Permissible level, %</b>	<b>Mode of marking</b>
USA	5	Voluntary
Canada	5	Voluntary
Japan	5	Obligatory
Brazil	4	Depends of province
Norway	2	Obligatory
Switzerland	1	Obligatory
EU	1	Obligatory

The only condition is that each signatory of the Protocol has, as far as possible, to *"...establish and maintain workability of means of regulation, control and limitation of grade of risks of use and release of GMO in open systems. The parties have to take into consideration the risks of consumption of live organisms modified by methods of modern biotechnology and their undesirable influence on conditions of preservation and sustainable development of biological diversity"*. The typical sequence of marketing of GMO that are permitted for commercialization normalized the provisions of the European directive of 2001/18/EU *"On the deliberate release into the environment of genetically modified organisms"*, which states that any businessperson, which intends to put the new type of GMO on the native market of his country has to give its authorized State body the data as follows:

- information on GMO to be marketed,
- information of general character (including the data on the engaged personnel and its qualification in sphere in question),
- information on conditions of marketing of the organism and probable mechanisms of its influence on conditions of nature,

- technical specification of risks that may occur in marketing of new type GMO,
- plan of monitoring of influence of GMO on health of men and state of nature,
- information on procedures of control and methods of elimination of undesirable effects, methods of treating of wastes and plan of operation in extreme situations,
- brief information on content of the applied dossier.

Obtaining this information, the authorized State body has to send to the Eurocommission during 30 days the brief description of notification it received. The Commission disseminates, in turn, this information in period up to 30 days among all EU countries, which may return during 30 days their remarks and inquiries directly to the country of potential naturalization of GMO and/or send them to the Eurocommission.

To issue permission on marketing of GMO and/or the product, which contains its combination with other ingredients, the authorized State body of country, where these objects would be marketed for the first time, has to identify the comprehensiveness, correctness and compliance of content of information it obtained to established norms and inform on it other EU countries by topics as follows:

1. Information of general character: the name and juridical address of person of economy, which intends to market the GMO, as well as the information on qualification and professional experience of its specialists responsible for this work.
2. Information on recipient of new genes and/or mother plants:
  - name, type, kind, subspecies, mode of cultivation,
  - mode of breeding: mode and specific factors of reproduction, term of generation, capability to interbreed with other plants,
  - information on vitality: data on structures capable to survive or fall into hibernation and the data on specific factors of influence on these events,
  - information on potential expansion of GMO in nature: ways and intensity of expansion (e.g. grade of spreading of pollen or seed dependently of distance out of the mother plant), and specific factors, which influence on their spreading (if exist),
  - predictable areal of existence of the plant, information on its predators, parasites, competitors and symbiotic plants,
  - possible interreactions of GMO with inhabitants of ecosystems of its probable vegetation, including data on its toxic influence on health of men, animals and other live organisms.
3. Information on variation of genic apparatus:
  - description of used method(s) of modification of genic apparatus,
  - nature and source of used vector of variation,
  - dimensions, source of origination (name) of the donor organism and foreseen vital functions of fragments to insert.
4. Information on the genetically modified organism:
  - specific features and characteristics planned to modification,
  - data on inserted/deleted fragments of genic apparatus, information on constituent parts of vector of modification or carriers of foreign DNA, dimensions and structure of fragments of modification, methods of their characterization and identification,

- if the work in modification presumes extraction of genic fragments out of structure of DNA, the dossier has to contain information on presumable functions of the modified plant and place of deletion of such fragments,
- data on inserted fragment: information on its functions during the life cycle of the GM-plant and list of its parts, where the expression occurs (roots, stem, pollen etc.),
- data on difference of vital functions of genic apparatus of the modified plant and the recipient, mode and speed of reproduction and dissemination,
- genic stability of the insert,
- capability of the modified plant to transfer its genic material to other organisms,
- toxic or other unfavorable influences on health of men resulting of genic modification,
- safety of the modified organism for health of animals in their use as forages,
- mechanisms of interrelation of fragments, which modify genic structure of the plant, with the target cells,
- potential influence of modified organisms on abiotic objects of their surrounding,
- data on preliminary events of release of genetically modified organisms in environment, if existed.

Besides, the notification must contain the following information:

- predictable risk of release of GMO into open systems,
- conditions of marketing of product, information on specific conditions of its handling and use,
- proposed term of validity of permission on marketing of GMO (not more of 10 years),
- schedule plan of control actions,
- proposed method of marking and informing of consumers on presence of GMO in it,
- proposals on methods of packing,
- brief content of the dossier.

After obtaining of the notification, the authorized competent body of the interested country has to prepare the report on assessment of its content and send it in term of 90 days to its sender and the Eurocommission, which, in turn, has to inform the authorized bodies of all EU member-countries on information thereof.

If the authorized competent body, which prepared said report, would not obtain from the Eurocommission her motivated objections on marketing of the declared product in term of 60 days (which may be prolonged in extreme cases to 105 days), it issues the permission on use of GMO in open systems. The next step in its commercialization is informing on its content, of applicant, Eurocommission and other EU countries to be done in the term of 30 days.

In existence of information on potential negative influence of the product to be marketed on men's health and/or conditions of environment, the country, which had such intentions, has to limit or prohibit its use and/or sale in her own territory and inform on it her citizens, Eurocommission and other EU countries. The

information to be sent in it must inform on causes of taking of this decision and content of works she had done in evaluation of risks of marketing of GMO in question.

The main problem, which arises in extensive introduction of products of bioengineering, especially of GMO, as foods and/or their ingredients, is their probable hazard for health and life of live organisms. That is why the problem of use in economy of GM-products, prime forages, is the subject of systematical investigations. The principal factor to be revealed in this work is tracing of variations of state of health of domestic animals in systematical consumption of GMO, for this may be the index, which will permit to predict their probable influence on vital functions of men. However, at present stage of development of analytical chemistry, it is not still possible to identify in many cases the fact of presence of GMO in foods. Moreover, despite the increasing sensitivity and precision of methods of investigation, there was not found yet any difference in quality of eggs and meat of animals fed by forages, which contained GMO as one of their ingredients, and their traditional analogues. The root of the problem is that almost all works in studying of safety of GMO finance big corporations, such as "Monsanto", "Bayer", which produce genetically modified products and are interested in positive results of their testing.

At the same time, the European Department of Safety of Foods reported on results of independent investigations, which witness safety of consumption by men of meat and milk of genetically modified animals. Similarly, the General Directorate of European Commission by Science and Technology reported: *"The principal conclusion of more of 130 R&D works carried out by more of 500 research groups during 25 years is that the GMO-products are not more dangerous as compared with products of traditional technologies of planting"*. The WHO made therefore the conclusion that *"... the genetically modified organisms present in international market were comprehensively tested, and probability of their harmful influence on health of men is too small as compared with their traditional analogues"*. So, there were eliminated the principal objections for use GMO in public economies, and countries became free in their development and commercialization. One should note, however, that said works were carried out in the short-time series of investigation and were done in absence of studying of delayed effects of their consumption.

Despite this notice and taking into consideration the fact that the infrastructure of agriculture in underdeveloped countries is too poor, the UN Food and Agriculture Organization recognized expedience of introduction of technologies of production and use of genetically modified organisms in these regions as foods. The reason of taking of this decision is that it may be the key factor in ensuring of the reasonable level of healthy nourishment of their growing population. It is reckoned, for example, that consumption of the *"golden rice"* (*Oryza sativa*), which grains contain big quantity of vitamin "A", would permit to improve the quality of feeding of people, who live in countries of "third world", what is critically necessary, because deficit of this component in foods they consume results in losing of sight of up to half million people each year in Africa only.

Meantime the sizeable part of livestock and poultry is fed now by forage, which contains residues of GMO, mostly of the modified rape and soybean seed, which contain the modified albuminous component (e.g. the fraction of meat produced EU countries from the livestock fed by such forages constitutes roughly 40 %). The country leading in commercialization of GM-products is the USA, which permitted since 1995 planting of rape resistant to action of herbicide bromoxynile, soybean resistant to herbicide glyphosate, tomatoes resistant to rotting and other genetically modified cultures. For the state of 2013, USA planted 25 kinds of agricultural products subjected to genic modification, e.g. fraction of modified corn in total area of its cultivation in this country was of 85 %, and soybeans – of 91 %. As informs the National Center of problems of alimentation and agrarian policy in Washington (district Columbia), the American farmers got benefits in introduction of:

- Genetically modified soy (decrease of quantity of herbicides used annually by 28.7 million pounds = 13,018.3 ton, and reducing of prime cost of the total output of production on 1.1 billion US dollars),
- BT-cotton (decrease of annual use of insecticides by 1.9 million pounds = 861.8 ton, an increase of harvests on 185 million pounds = 83,916 ton),
- BT-sorts of corn (decrease of annual use of insecticides by 16 million pounds = 7,257.6 ton, an increase of harvests of grain on 3.5 billion pounds = 1,587,600 ton),
- BT-papaya resistant to affect of virus of annular blotch. The decrease of expenses on planting of this kind plant in Hawaii in 1998 only was of 17 million dollars).

It is recognized now that introduction of GMO have certain advantages, and one of the most expressive examples is the cotton seed that contains up to 20 % oil, which may be, in theory, the significant source of feeding of more of half billion people. However, its regular consumption is limited now because of richness by terpenes poisonous for heart, liver and reproductive system of men. Use of methods of conventional agriculture permits to select the kinds of this plant free of harmful compounds, but they will be sensitive to attacks of vermin. At the same time, methods of genic engineering permitted to select plants character by unchanged content of terpenes in all their parts except of seed, where this one was decreased to level of less of 1 % of its content in traditional kinds of the plant. The one more example of positive effect of cultivation of genetically modified cotton is reaching of resistance of the plant to attacks of cotton borer, the vermin the most dangerous for this culture. The agrotechnical practice used usually in control of its population is intense, up to 8 times per season, treating of sowing by insecticides. Meantime, introduction of gene of *Bt*-toxin inside the genome of cotton permits to decrease the periodicity of such treating fourfold. The same phenomenon is character for other plants too, so the areas used for cultivation of herbicide-resistant cultures reached 79 million hectares as early as in 2008. For the state of 2009, there was permitted the commercial cultivation of 33 kinds of transgenic plants: soy – 1, corn – 9, rape – 4, cotton – 12, sugar-beet – 1, papaya – 2, pumpkin – 1, paprika – 1, tomato – 1, rice – 1, and more of 90 kinds of potato, plum, lucerne, haricot, wheat, peanut, mustard, cauliflower, pepper chilly etc. are on stage of commercialization. The information on GMO-cultures cultivated in some countries and areas of their planting show Table 4.4:

**Table 4.4*****Areas of cultivation of genetically modified plants in some countries***

<b>№№</b>	<b>Country</b>	<b>Area, million hectares</b>	<b>Culture</b>	<b>Part in total area, %</b>
1	USA	64.0	Soy, corn, cotton, rape, squash, papaya, sugar-beet, lucerne	38
2	Brazil	21.4	Soy, corn, cotton	36
3	Argentina	21.3	Soy, corn, cotton	66
4	India	8.4	Cotton	5
5	Canada	8.2	Rape, corn, soy, sugar-beet	18
6	China	3.7	Cotton, papaya, paprika	3
7	Paraguay	2.2	Soy	51
8	Republic of South Africa	2.1	Soy, corn, cotton	14
9	Uruguay	0.8	Soy, corn	57
10	Bolivia	0.8	Soy	22

The GM-plants were officially cultivated in 2013 in 25 countries, including Australia, Burkina-Faso, Chile, Colombia, Costa-Rika, Czechia, Egypt, Honduras, Mexico, New Zealand, Philippines, Poland, Portugal, Romania, Russian Federation, Slovakia, South Korea, Spain, and some other EU countries. The total area of their planting reached 134 million hectares (about of 9% of the cultivated fertile soils, what is 1.7 times more as compared with 2009). The USA produces presently more of 150 GMO-cultures. The most often it is the modified soy, which is used in producing more of 3,000 types of foodstuffs including soups, paps, potato chips, sauces for salads, canned fish etc. the genetically modified cotton and rape are used in producing of vegetable oils, genetically modified potato – in producing of French fries, tomatoes of prolonged afterripening – in producing of ketchup etc. it is expected that most of foods consumed in USA would contain GMO during the nearest 10 years.

New technologies of development and breeding of transgenic domestic animals and birds become the more important because their principal goal is rising of productivity and optimization of physicochemical properties of their tissues. Thus, more of 500,000 of cows breed in purposes of producing of milk obtain regularly the recombinant hormone of growth of beasts (rBGH). The possibilities of genic engineering permit to amend the structure of their meat, what has bigger content of fat and became capable to hold after it reprocessing more water, and have the bettered tasty and aromatic properties, what gives technologists the possibility to broaden the diapason of parte of bulks suitable for reprocessing in industrial purposes. Besides, it's becomes possible to increase resistance of animals and birds to influence of unfavorable factors of environment and attacks of diseases, as well as purposefully amend their hereditary attributes.

Our country joined to the Cartagena Protocol in 2002 witnessing so her support of practice of carrying out of coordinated protective actions in creation, testing, processing, circulation, trans-boundary move and use of GMO. The basic principles of the State policy used in Ukraine in this sphere are:

- observance of norms of biological and genetic safety in creation, investigation and practical use of genetically modified organisms,
- priority in care for protection of health of men and preservation of existing conditions of nature over the desire to obtain economical advantages,
- State support of investigations by problems of practical use of GMO,
- control of circulation of GMO-products in borders of the Ukrainian custom territory.

Procedures of circulation of GMO in Ukraine regulate norms of documents as follows:

- Law of Ukraine of 31.05.2007 # 1103-V "On State System of Biological Safety in Development, Testing, Transporting and Use of Genetically Modified Organisms",
- Decree of Council of Ministers of Ukraine of 18.02.2009 # 114 "On Procedures of State Registration of Genetically Modified Organisms and Sources of Foods, Foodstuffs, Cosmetics and Drugs, which Contain such Organisms or were Made with their Use".

The norms of Ukrainian legislation state that works in genic engineering must be licensed and carried out initially in closed systems. To ensure the maximum level of biological safety, the State founded the *Commission by Biological and Genetic Safety* responsible for preliminary evaluation of probable risks, which may arise in their commercialization. The accountable GMO material unsuitable or prohibited for use, as well as the GMO material obtained in process of testing, have to be utilized, annihilated or neutralized by procedures established by the Ministry of Education and Science of Ukraine and the Ministry of Ecology and Natural Resources of Ukraine.

After finishing of the laboratory stage of work, novel kinds of GMO have to be undergone to expanded State testing, which purpose is identifying of possibility and expediency of their commercialization. The essence of this work consists in studying of interconnection of new organisms with wild plants at places of their probable vegetation, exploring of dynamics of infestation of crops in conditions of uncontrolled reproduction of GMO and identification of probability of generation in their vegetative and generative organs of specific substances, which can stimulate breeding of pests and produce conditions of occurrence of epizooties. The investigations specific for each kind of GMO have to be carried out by procedures agreed with the Ministry of Ecology of Ukraine and Ministry of Protection of Health of Ukraine, and approved by the Ministry of Agricultural Policy of Ukraine. Such norms have to take into consideration the specificity of tested GMO and their differing of traditional sorts of plants, establish mechanisms of passing of materials to be tested to persons who would do this work and settle terms of their approbation. The obligatory condition of introduction of GMO in open systems in Ukraine is existence of the attested methods of their identification and analysis by norms of international standards. To approbate GMO in open systems, the authorized person has to obtain the respective license of the Ministry of Ecology and Natural Resources of Ukraine and permission of the Ministry of Agriculture of Ukraine. The full set of documents to apply to obtain such permission includes:

- comprehensive technical characteristic of the genetically modified organism to test and its predecessor,
- recommended procedures of monitoring and control,
- conclusions of the State ecological and the State sanitary and epidemiological expertise of grade of biological and genetic safety of GMO,
- report on results of testing of safety of the object of expertise in closed systems.

After they would have been received by the Ministry of Agricultural Policy of Ukraine, the latter issues the Conclusion on level of safety of the organism in question and gives it to the applicant. This document has to contain also the information on probable changes, which may occur in emerging of GMO in areal of vegetation of wild plants, risks of infestation of crops of cultural plants with it and other undesirable effects of uncontrolled reproduction of GMO.

The next stage of introduction of genetically modified plant in circulation is its State approbation and registration to be done by the Ministry of Agricultural Policy of Ukraine. The objects subordinated to the State registration are:

- kinds of GMO-plants and domestic animals produced with their use,
- means of protection of plants produced with use of GMO,
- GMO-sources of foods, cosmetics, drugs and products produced with their use,
- GMO-sources of forages, food additives, veterinary preparations and products produced with their use.

The State registration of GMO may be cancelled and products made with their use withhold in case of obtaining in later time of scientifically substantiated information on their probable hazard for health of men or danger for conditions of environment.

If the product or any its ingredient contains GMO in quantities more of 0.9 % or was produced out of genetically modified organisms, its marking must contain the mark of "Contains GMO". The operator of the market has also the right to mark his product by the sign "Without GMO". The condition of such marking is the documented proof of its absence issued in observance of norms of Ukrainian legislation in force.

#### **4.5 Problems of purification of wastewaters of meat-processing enterprises**

##### **4.5.1 Quality of superficial waters of Ukraine. Problems of supply of drinking water for inhabitants**

The sharp amplification of technogeneous burdening of conditions of environment leads to occurrence of real threat on ecological crisis, first in supply of population by drinking water. The fact of pollution of superficial water as the principal source of sully of drinking water occurring everywhere became the important factor of risk for state of health of men worldwide. Thus, documents of International Organization for Standardization state that *"the problems of [assurance of good quality] of water are ones of the most important and complicated among*



*those that arise in living on our planet. However, the considerable improvements may be reached in use of optimized technologies and systems of management".*

The results of cited and other investigations permit to state that preservation of existing structure of business operation carried out in absence of substantial raising of consciousness of active part of population would result in accumulation of wastes and degradation of environment. There will arise new risks and increase the probability of intensification of influence of existing ones first because of worsening of quality of superficial and groundwater because of quick intensification of anthropogenic loading and their systematical replenishment by wastewaters formed in result of business and domestic activities of population.

Ukraine is one of European countries provided with watery resources the less. This problem is the most sharp for urbanized regions of the country. The program of "Drinking water of Ukraine" states that regions, which " ... are character by the biggest deviations of quality of water out of established norms ...", are prime the Dnipropetrovs'k, Donetsk, Kiyv, Luhansk, Mykolaiv, Odesa and Cherkasy provinces.

The basic norms of quality of superficial water to be used in drinking establish the system of national standards including the norms of interstate, regional and international categories harmonized in Ukraine, which state methods of investigation (testing) of its quality and safety. Norms of such documents are developed, validated and revised in observance of norms of Law of Ukraine of 15 of May 2015 #1315-VII "On Standardization". Being in process of integration in European structures, Ukraine establishes in most cases norms of safety and certain indices of quality of drinking water similar with norms of international standards, instructions, recommendations and other documents of corresponding international organizations, or in observance of requirements of legislation of European Union to quality of drinking water. The planned revision of norms of quality of drinking water is accomplished once per five years, as a rule, and in occurrence of extraordinary situations, revision of norms is carried out in earlier time.

The basic norms of environmental safety of aquatic objects, which establish the maximum allowable concentrations of organic and mineral substances contained in sweet and salt waters (e.g. of biochemical oxygen demand during 5 days after taking of the sample – БСК<sub>5</sub>, chemical oxygen demand – ХСК, suspended matters, mineral phosphorus and ammonium nitrogen) for fresh and drinking waters are established by the document of State Sanitary Norms and Rules DSanPiN 2.1.5.980-00 "Hygienic norms of work in protection of superficial water" (Table 4.5):

**Table 4.5**

***Normalized indices of quality of fresh water in Ukraine***

<b>№ №</b>	<b>Index</b>	<b>Dimensionality</b>	<b>Normalized value</b>
1	БСК <sub>5</sub>	$mgO/dm^3$	3.0
2	ХСК	$mgO/dm^3$	50
3	Suspended matters	$mg/dm^3$	25
4	Ammonia nitrogen	$mg/dm^3$	1.0
5	Mineral phosphorus	$mg/dm^3$	0.7

The principal causes of pollution of superficial waters in Ukraine are disposal of non-purified and inefficiently purified wastewaters of municipal, domestic and industrial wastewaters into the watery objects directly or through systems of urban sanitary piping; inflow in watery objects of polluting substances in process of drainage of water from surfaces of build-on territories and agricultural lands; erosion of soils on water intake territories. The annual quantity of inefficiently purified waters thrown down in basins of Ukraine are about of 9.6 billion m<sup>3</sup> including 2.9 ÷ 4.0 billion m<sup>3</sup> of unpurified waters.

As provided the international standard ISO 24511, wastewaters are the run-off waters, which are formed in result of use or consumption of water. Respectively, the main sources of their origination are domestic wastes, industrial enterprises, institutions and business shops. The wastewaters and run-off waters egested from industrial enterprises may be divided conditionally by their composition by three categories: the industrial (those that are used in technological processes and formed in result of mining of treasures of the soil), domestic (formed in sanitary arrangements of industrial and non-industrial constructions and shower baths placed at territories of enterprises) and atmospheric ones (rainy and those that are formed in melting of snow). The last category of waters may be reckoned as such because they fall into open basins and bring dissolved and weighed pollutants and pathogenic organisms, which hit in it from air or surface of soils before they will fall into the systems of collecting of wastewaters.

The water supplied to consumers has certain chemical composition and admixtures it contains may be classified by categories as follows:

- chemical substances present usually in natural waters: sodium, potassium, chloride, carbonate, hydrocarbonate, iron, fluorine, copper, zinc, mercury, lead, molybdenum, nitrate, hydrogen sulfide etc.,
- chemical substances that remain in water after its purification with use of reagents, such as coagulants (aluminum, iron), flocculants (polyacrilamide in most cases), reagents that are added to water to prevent corrosion of water-pipes (tripolyphosphate), residual quantities of chlorine or hypochlorite-ion,
- chemical substances that hit in surface waters together with wastewaters (domestic and industrial), runoff of waters from plants treated by chemical means of protection of plants, herbicides, mineral fertilizers etc.

At that, the level of purification of waters is now extremely small. The existing purifying utilities are capable to extract even in use of biological methods of treating not more of 10 ÷ 40 % of inorganic substances (40 % of nitrogen, 30 % of phosphorus and 20 % of potassium) and are practically ineffective in extraction of salts of heavy metals. It was shown that the annual egesting of wastewaters in river Dnieper is about of 360 million m<sup>3</sup> of polluted wastewaters or 14 % of their total volume in Ukraine. This phenomenon leads to considerable decrease of quality of water and influences negatively on fish industry, what may result in loss by Dnieper in XXI century of status of supplier of drinking water.

Work of industrial enterprises is supplemented by generation of big quantities of wastewaters. At the same time all run-off water formed in their activities has to be

thrown down to open basins. In result of this event their water became conditionally suitable and in some cases not suitable for drinking and household use, irrigation of agricultural areas and use in fish industry. The polluted rivers and basins cannot be used for watery kinds of sports and rest because they become in many cases the sources of infectious diseases. Therefore, organization of work in protection of environment is one of the most actual problems of the present.

The admixtures that hit in watery objects together with wastewaters may be subdivided as mineral, organic and biological ones.

The category of mineral pollutants includes solutions and emulsions of salts, acids, alkalis, mineral oils and other inorganic compounds. They worsen physicochemical and organoleptic properties of water and intoxicate fauna of basins. The less toxic are mineral substances such as sand, clay, ash and others that have no specific toxic effect. Many of components of industrial wastewaters cannot be decomposed in passing of biological processes occurred in basins, what may lead to their accumulation in natural waters and result in crucial changes of their composition and properties. The insoluble pollutants can, in turn, penetrate into biological systems and accumulate in trophic chains.

The category of organic pollutants includes gums, phenols, colorants, alcohols, aldehydes, naphthenic compounds, organic compounds that contain sulfur and chlorine, pesticides washed from agricultural soils, synthetic detergents and others. Because live organisms are biological structures, they are especially sensitive to presence of such substances in drinking and economic waters, what was formulated as early as in the Middle ages as the principle of *"similar is dissolved in similar"*.

The category of biological pollutants includes pathogenic bacteria, viruses and agents of diseases. They hit in basins together with domestic run-off waters and wastewaters of some industrial enterprises. Using of such water for drinking and in everyday use provokes occurrence of serious diseases: cholera, infectious hepatitis, dysentery, enteric fever, infestation by various types of helminths and so on.

Thus, problems of rational using of aqueous resources and protection of cleanness of basins became the topics of prime interest of the society and the one of important aspects of solving of problems of environmental safety of Ukraine is utilization of wastes formed in operation of enterprises of food branch of public economy. The wastewaters that are formed in their work contain organic substances, which concentration is too big. At the same time, their composition, conditions of initiation, volumes and physicochemical properties differ considerably of run-off waters that are formed in operation of enterprises of other branches of economy. So, the peculiar feature of system of drainage mounted on met-processing enterprises is that rate of flow of polluted waters depend not only of capacity of the enterprise, but of assortment of produced products too. The enterprises of this sector of economy generate wastewaters of four types as follows: *i*) polluted industrial waters that contain fats, *ii*) polluted industrial free of fats but containing sand, particles of sludge and manure, *iii*) wastewaters formed in process of maintenance of equipment, and *iv*) residential waters.

Intensification of industrial burdening on environment and quick degradation of nature in Ukraine and worldwide, initiates the interest of society to work in protection

of natural conditions, introduction and certification of systems of “*environmental management*” in process of producing and reprocessing of production. It was found, especially, that sizeable parts of 33 controlled indices of quality (physicochemical characteristics) of superficial waters of Ukraine exceed their maximum allowable concentrations. The principal conclusion to make is that the considerable part of population, which uses the superficial waters for drinking, is in zone of risk because of steady exceeding of content of toxic admixtures in drinking water. The sanitary norms valid in Ukraine state that “... *water objects used for drinking, domestic and recreation use are reckoned as polluted ones if indices of their composition and properties of waters in points of taking were amended under the direct or mediate influence of business activities and/or domestic use and became unfit for consumption by population partly or in full*”. The clear conclusion to make is that there exists the crucial need in universal introduction of effective systems of purification of wastewaters, which hit finally in open basins.

All measures used in protection of the maximally possible cleanness of water may be divided conditionally by three groups:

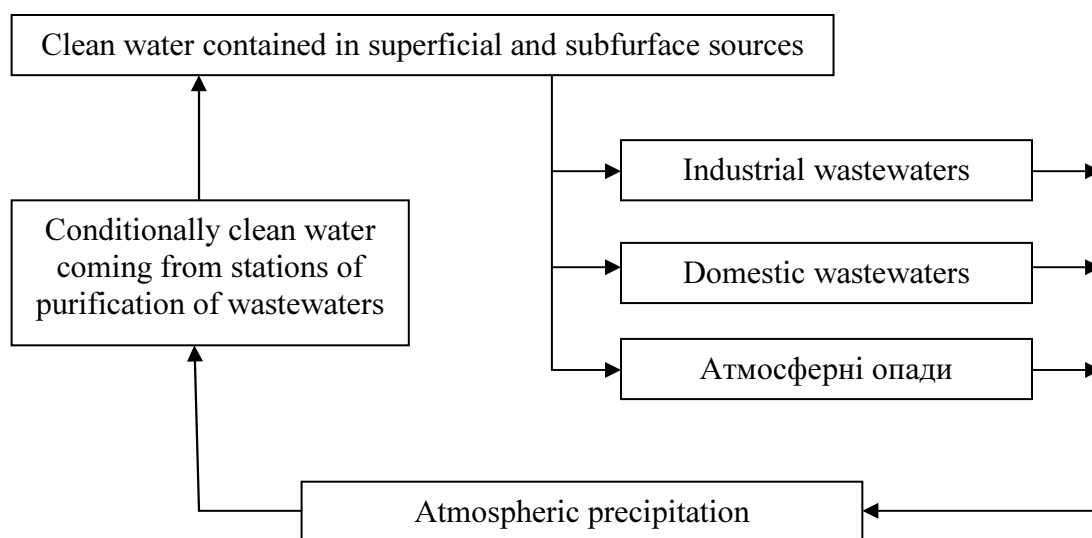
- *prophylactic*, which principal goal is prevention of pollution, contaminating and exhausting of sources of clean water or decreasing of grade of pollution by measures as follows: *i)* development of schemes of complex use and protection of cleanness of accessible resources of used water, *ii)* studying of grade of influence of state of areas used for housing on quality of sources of water, *iii)* rational allocation of objects of business activity, *iv)* optimization of technologies of manufacturing and observance of normalized conditions of their operation,
- *diagnostic*, which principal goals are: *i)* normalization of parameters of supply and drainage of water, *ii)* normalization of maximum allowable concentrations of various substances in waters used for drinking, fishing and other purposes, *iii)* control of conditions of drainage of wastewaters and ecological state of watery objects,
- *procedural*, which principal goal is elimination of causes of pollution of water and minimizing of anthropogenic pressure on state of cleanness of water in use of actions as follows: *i)* organization of wastewaters-free manufactures, *ii)* use of closed cycles of use of water, *iii)* utilization of valuable substances, *iv)* purification of melted and shower waters, *v)* fining of businesspersons for pollution, contaminating and exhausting of sources of clean water and their closing in extreme cases.

In considerable grade of pollution by wastes of waters used for consumption, there may emerge the considerable risk of origination of ecological catastrophes and rising of rate of sickness of population. The experience cumulated worldwide witnesses that quality of aqueous resources depends not of quantity of standardized norms of purification of wastewaters introduced at the enterprise, but of correctness of structure of realized processes, which has the goal of steady decreasing of grade of polluting of environment, i.e. realization of norms of standards of environmentally friendly operation of DSTU ISO 14001:2006 “Systems of environmental management. Requirements and guides by their use”. This leads to need of

introduction of continuous monitoring, which will take into consideration the grade of influence of negative factors on state of environment, hence quality of aqueous resources as well. This factor was considered as the crucially important in development of State program of “*Drinking water of Ukraine*”, which sets that regulation of quality of water is the important factor of regulation of safety of conditions of living. The valid hygienic norms set that “ ... *it is prohibited to hit in watery objects of wastewaters, which formation may be eliminated in way of organization of low-wasted manufactures, introduction of rational technologies, maximal use in systems of cycling and irrigations of purified and decontaminated waters spent on previous stages of technological processes realized in industry and municipal services*”.

The one of priorities in assuring of steady progress of economy is development of optimal forms of management by environmental safety based on studying of grade of compliance of existing and forecasted environmental conditions to established norms of protection of health of men. This work is linked indivisibly with activities in evaluation of grade of environmental risks in operation in purification of industrial wastes (including wastewaters) and search for methods of decreasing of technogeneous burdening on results of men’s activities on state of neighboring nature. The recipients of results obtained in this work are:

- men,
- flora and fauna,
- atmosphere, hydrosphere and lithosphere,
- urbanized and rural territories,
- objects of recreation,
- specially guarded territories (national parks, reserves, historical and cultural memorials etc.),
- other material objects of any form of property.



**Figure 4.18 Life cycle of drinking water**

Solving of problem of attaining of set goals must begin from activities of each individual enterprise, because its activities influence on state of health and duration of living of its personnel, conditions of environment and level of ecological welfare of population. The criterion used in evaluation of grade of safety of its operation is the fact of decreasing of potential danger of its influence to admissible level: " ... *the wastewaters, which cannot be used in systems of repeated use and recirculation in existing technological cycles in industry, municipal services and other destinations may be thrown down to watery objects only after their purifying to the established sanitary norms of quality of waters of open basins and guaranteeing of observance of norms of quality of water valid in places of use of water*". The life-cycle of water supplied to stations of preparation of drinking water may be represented by scheme shown on Figure 4.18 below:

#### **4.5.2 Principal methods of purification of wastewaters**

Enterprises, which operate in eat-processing industry of Ukraine, may be ranked conditionally by type of their work by four basic categories as follows:

- old complete cycle of reprocessing of meat raw,
- old meat-packing factories that operate by incomplete cycle of reprocessing of meat raw, factories that produce sausages and battery farms,
- new meat-packing factories that operate by advanced technologies, preferably bought by licenses of foreign firms,
- slaughtering shops.

Wastewaters that formed at enterprises of all four categories contain blood, muscular and fatty tissues, manure, mineral admixtures, spices and detergents and disinfectants used in cleaning of manufacturing and domestic premises. Such waters have the neutral reaction, as a rule, are character by increased concentrations of biogenic elements and do not contain toxic substances of first and second class of danger. It was shown that the typical concentrations of pollutants in wastewaters formed at meat-processing plants reach 1500 mg/dm<sup>3</sup> of weighed substances, 400 mg/dm<sup>3</sup> of fats (contained mostly in form of emulsions and suspensions), phosphates – up to 100 mg/dm<sup>3</sup>, ammonia nitrogen – 150 mg/dm<sup>3</sup>, and valued of Chemical Oxygen Demand (COD, XCK in Ukrainian) may reach values of 15000 mgO/dm<sup>3</sup>, and Biological Oxygen Demand (BOD, БСК<sub>5</sub> in Ukrainian) – of 2500 mgO/dm<sup>3</sup>. So, contents of all listed pollutants in unpurified wastewaters are dozens of times bigger of concentrations established by sanitary norms. Therefore this fact puts in order of the day the demand of construction at enterprises of local installations by purification of wastewaters. If such systems would be insufficiently effective in decreasing of content of impurities to set norms, administrations of enterprises has to transmit the partly purified waters to municipal installations of cleaning of domestic wastewaters. To solve the problems arising, technologists of enterprises has to choose in each concrete situation the method of purification of wastes the most appropriate in the current situation.

There exist some variants of solving of the problem as follows: i) purification of wastewaters, which contain impurities potentially hazardous for functioning of local natural complexes, *ii*) repeated use in technical and economic purposes of

wastewaters, which do not contain hazardous impurities, *iii*) introduction of circulating and closed systems of use of water, *iv*) introduction of advanced technologies, which permit to decrease quantities of formed wastewaters or even to prevent their formation.

The typical process of purifying of wastewaters may be divided conditionally by four basic stages as follows:

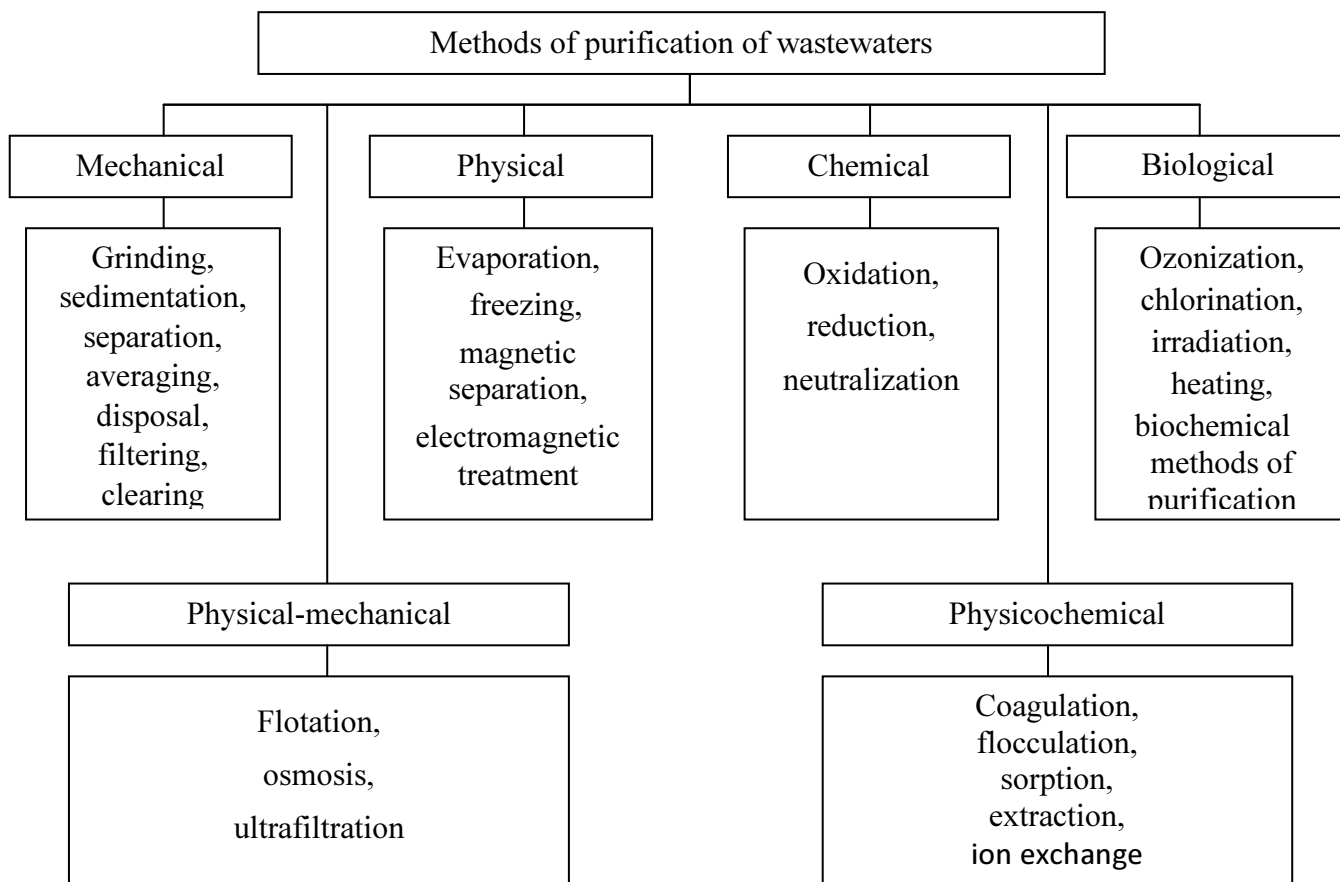
1. The first stage of purification includes the work in removal of films of oils, big particles and numerous mechanical impurities done by physical and mechanical methods of operation.

2. The second stage of purification consists in removal of most of weighed particles and pollutants including those that are dissolved in the wastewater. Many of pollutants have the organic nature; therefore they may be extracted by physicochemical methods and techniques of biological oxidation.

3. The third stage of purification consists in removal of smallest particles and pollutants including salts of metals. Technologists use at this stage the physicochemical methods, e.g. osmosis, electrodialysis, filtration through the layer of absorbent etc.

4. The fourth stage includes operation of removal of excessive water from obtained sludge to decrease maximally its volume and mass.

The technologies of purification of wastewaters may be divided conditionally by some groups. These ones are methods mechanical, chemical, physicochemical, biological and those that include some of listed methods (Fig. 4.19):



**Figure 4.19 Basic methods of purification of wastewaters**

**Mechanical methods of purification** are used for separation of insoluble admixtures out of liquid phase. The typical methods used for their separation are:

- *grinding* of pollutants of big dimensions in use of mechanical devices as the first stage of their separation out of the system,
- *sedimentation* of grinded pollutants in sand catchers, fat catchers and in precipitation tanks. Use of methods of sedimentation permits to extract the coarse admixtures, which deposit on the bottom of the vessel used in precipitation. At the same time small particles of pollutants float to the surface of the tank and are removed from the system by the superficial scrapers and/or other devices of similar design,
- *separation* of water and pollutants in centrifuges, hydrocyclones etc.,
- *averaging* of content of wastewaters of instable composition done in purposes of obtaining of their conditionally stable composition. This operation is carried out in most cases before wastewaters of averaged composition would have been purified by technologies realized at the enterprise,
- *disposal* of residuals quantities of mechanical impurities deposited in dead zones of apparatus used in purification (for instance, in sedimentation tanks) in use of lattices, bottom scrapers etc.,
- *filtering* of wastewaters through lattices, sieves, filters done in purposes of removal of caught residuals of mechanical particles passed out of sedimentation tanks,
- *clearing* of purified flow of fluid by method of its passing through the layer of sand, filtering cloth, layer of filtering material applied on filtering lattice, composite materials capable to sorb weighed particles, composite filters etc.

Choose of concrete method of mechanical purification and stages used in this process depend of type and quantity of pollutants, prescribed grade of purification etc. Use of physical methods permits to reach the grade of extraction from domestic wastewaters up to 60 % of insoluble substances, and clearing of industrial wastewaters permits to raise this index up to 90 ÷ 95%.

**Physical methods of purification** may be classified by basic categories as follows:

- *evaporation* means the method of treating of wastewaters carried out in purposes of separation of particles of solvent (water) from solutions, their concentrating and crystallizing out of dissolved substances. this method is not used practically in processes of purification of wastewaters. Instead, many chemical products produced in liquid state as suspensions and emulsions must be freed of solvent and evaporation is the optimal method of solving of this problem,
- *freezing* means obtaining in solid state of the solvent in freezing of the solution. This method is used in concentrating of solutions. The process includes crystallization of solvent and separation of formed crystals, what results in separation of the initial solution by two parts – the concentrated solution of purposeful component and frozen solvent. The dominant sphere of this method is chemical technology, especially processes of producing of



salts in use of natural raw materials, producing of concentrated juices in food industry etc. The technology of freezing is used also in process of demineralization of salt waters. After freezing of saline under the temperature of its crystallization, there are formed crystals of ice, which are separated, flushed and melted to produce desalinated water,

- *magnetic separation* means the method of separation of materials based on use of phenomenon of differing of their magnetic properties (magnetic perceptibility) and different response of materials on influence of magnetic field, what amends the gravitational trajectory of materials. The principal sphere of use of procedures of magnetic separation is extraction of undesirable inclusions (those that influence negatively on quality of finished products or cause events of breakage of technological equipment) out of raw materials used in technological processes,
- *magnetohydrodynamic treatment (of water)* means the method of influence of magnetic field on stream of mineralized electroconductive water, which result is induction of electric current resulted of migration of charged ions that causes alteration of local concentrations of negatively and positively charged ions in cathodic and anodic chambers of used installations. Use of this effect may cause changes of local *pH* of the solution (done in purposes of decreasing of corrosive activity of stream of water), forming of local supersaturation of concentration of certain ions in local volumes of water (done in purposes of transformation of excessive quantities of dissolved salts of hardness into the fine-dispersed crystals and prevention of their depositing on surfaces of pipes and technological equipment).

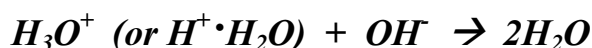
**Chemical methods of purification** are based on purposeful adding in wastewaters of reagents, which react with pollutants and form is such interactions insoluble or less toxic substances. Chemical methods of purification are used independently or before of the following stages of physicochemical or biological treatment of wastewaters. The methods used the most often are methods of oxidation and neutralization. The main goal of their use is decreasing of corrosion activity of objects of treatment, their disinfection, removal of admixtures of heavy metals etc.

- *oxidation* means chemical reaction, which passing includes the stage of loss by atom or molecule of some electrons (the obligatory stage of reaction of oxidoreduction, when electrons of one of atoms of donating compound are accepted by atom of other molecule. This reaction is used mainly in processes of disinfection and decontamination of wastewaters out of admixtures of organic compounds.

The appellation of the term origins of practice of use of such reactions at initial stages of progress of chemical technology, when it was used in relation to cases of interaction of oxygen with other elements or substances supplemented by forming of related oxides. The reaction of oxidation is carried out in use of elements capable to accept electrons (active chlorine, ozone, oxygen of air etc). The technologies of purifying of wastewaters formed at meat-processing complexes by chemical methods are based mainly on oxidation of fragments of so-called “fatty” acids remained in

water in dissolved and, partly, in weighed state after it passed traps of grease and other devices used in preliminary purification of wastewaters. The final product of chain of interaction occurred in process of their oxidation is forming of acetic acid soluble in water,

- *reduction* means the process used in bioorganic chemistry used in industry preferably in purposes of synthesis of valuable bioorganic compounds. If the object is wastewater, the processes of reduction are carried out in purposes of obtaining of elemental metals and their compounds, reduction of organic acids to aldehydes and alcohols, as well as hydrogenation of fats. The reagents used in it are hydrogen, carbon, and other substances,
- *neutralization* is chemical reaction of substance that has properties of acid with substance that has properties of alkali, which result is loss of character properties of both compounds. The reaction of neutralization carried out the most often is reaction of hydrated ions of hydrogen with ions of hydroxyl:



**Biological methods of purification** are based on processes of mineralization of wastewaters under attacks of microorganisms. The expanded concept of this class processes includes in this category also the reactions carried out in purposes of annihilation of bacterial flora of wastewaters. The character examples are methods of ozonization and chlorination by technologies as follows:

- *ozonization* means the method of purification of technological solutions based on use of active oxidizer ozone produced out of oxygen of air. To generate this gas, technologists pass air through chambers, which under the influence of intense electric field or hard roentgen or other type irradiation. Contacting with ozone, substances capable to oxidize decompose on less toxic compounds, sediment on the bottom of reaction vessel or evaporate in gaseous state. The contact of ozone with microorganisms leads to their death. However, both ozonization and ultraviolet irradiation have no aftereffect and are active only in moment of their direct influence on technological environments.
- *chlorination* is the method of disinfection of treated environments and oxidation of admixtures present in solutions. This method is used along with other method of ozonization and is used in disinfection of water and its preparation to following use in processes of:
  - purification of solutions by method of oxidation of dissolved substances (e.g. polyatomic organic molecules such as albumens, fats and so on) under the influence of atomic oxygen formed in process of decomposition of hypochlorous acid *HOCl* formed in dissolving of gaseous chlorine in water,
  - disinfection (asepsis) of water,
- *heating* means the induced of natural process of raising of temperature of the material occurred at the expense of inner energy or owing to supply of outside energy. The principal modes of heating:
  - by steam,

- by hot liquids,
- by electric current,
- by irradiating etc.

The main purpose of use of technique of heating in chemical technology is acceleration of speed of passing of chemical transformation and intensification of processes of transfer of mass. Use of process of heating in technologies of purification of wastewaters has the principal purpose of eradication of microflora and partial evaporation of solvents from solutions of restrictedly soluble solutes,

- *biochemical methods of purification* are based on use of microorganisms in processes of purifying of wastewaters. These methods are based on event of mineralization of organic compounds that may be oxidized under the influence of microorganisms to simple mineral products, primarily to carbon dioxide and water. This process passes in presence of oxygen and is called as "*biochemical oxidation*" or "*biochemical purification*". The initial stage of these processes is removal from wastewaters of weighed particles. The second and the final one is treatment of obtained deposits by microorganisms to mineralize the deposited organic compounds.

The practice of biochemical purification is used extensively in removal of organic and some inorganic compounds out of wastewaters formed at enterprises of pulp and paper, woodworking, alimental and other branches of industry. Details of this method are in close similarity with natural processes, for instance, with process of biological purification of organisms (biocenosis), which contain many kinds of bacteria (simple and highly organized) associated with one other by complex interrelations. The principal agents equipped in passing of such processes are microorganisms, which quantity in one gram of dry biomass varies in limits of some hundreds of thousands to millions. The quantity of genus of bacteria may be of  $5 \div 10$  and quantity of cultures – be of some dozens to some hundreds. Such multiplicity of cultures of bacteria is conditioned by presence in wastewaters of organic substances of various classes and if any wastewater contains one or small quantity of similar organic compounds there may exist cases of development of monocultures of bacteria.

The mechanism of extraction of organic substances out of wastewaters and their reprocessing by microorganisms is too complicated and is not studied in details yet. It's reckoned now that it passes by three consecutive stages as follows: *1)* exchange by masses and sorption of substrate on the surface of microorganisms, *2)* diffusion of substrate inside the microorganism through its cellular membrane, *3)* metabolism of substrate in the cell.

The maximal effectiveness of processes of biological purifying of wastewaters is secured at conditions as follows:

- temperature inside the cleaning cisterns is  $20 \div 30$  °C,
- pH of reaction mixture is  $5 \div 9$  (optimal diapason of acidity of the system is  $6.5 \div 7.5$ ),

- optimal concentrations of cardinal elements necessary for nutrition of bacteria, namely of organic carbon (COD), nitrogen and phosphorus is of COD : N : P = 100: 5:1,
- optimal level of COD of  $100 \div 300$  mg per 1 gram of ashless substance or on  $1 \text{ m}^3$  of the cleaning cistern,
- maintaining of concentration of oxygen dissolved in water not less of  $2 \text{ mg/dm}^3$ ,
- the dose of toxic substance present in the system must not be capable to influence of passing of biological processes.

The finishing stages of mineralization of organic compounds that contain nitrogen (i.e. albumens) are processes of mineralization and denitrification. The first one passes under the influence of nitrifying bacteria, which oxidize the ammonia nitrogen to nitrites and then to nitrates.

The oxygen that is contained in these compounds is spent under the influence of denitrifying bacteria on oxidation of residual quantities of organic compounds present in water. The principal condition of passing of this process is presence of organic compounds, contact them with dissolved oxygen and neutral or subalkali reaction of the solution. The process of denitrifying of compounds that contain nitrogen consists of many consecutive stages, which include the stage of forming of ammonia. The example is the process of decomposition of carbamide (urea):



The variant of this technology realized the most often is the process of purifying of wastewaters by activated sludge, which contains both aerobic and anaerobic microorganisms. The processes of biological purifying are carried out in natural conditions at special polygons – the so-called fields of filtration (fields of watering) or in special equipment – biofilters and aerated tanks. The industrial process of purification of wastewater may be divided by two sequential processes: *i*) interaction of settled waters with oxygen of air in presence of particles of activated sludge. The one of variants of realization of this process is bubbling of air through the mass of settled wastewater during  $4 \div 24$  hours and more. The time of aerating depends of type of wastewater, set grade of its purification and type of technological process, and *ii*) separation of purified water and activated sludge in apparatus of settling type and recirculation of sludge in process.

**Physico-mechanical methods of purification** are used first in extraction from wastewaters of suspended and emulsified admixtures. The basic processes of this group methods used in treatment of solutions/suspensions/emulsions by physical and mechanical methods are flotation, osmosis and ultrafiltration.

- *flotation* represents itself the process based on use of difference of capabilities of weighed components of the system to keep on the surface of contact of phases (e.g. water and air, water and solid substance etc.). to realize the event of flotation, one has to pass the stream of air through the volume of liquid. The result is adhesion of bubbles of gas to particles that watered poorly and their floating on the surface of liquid. The next step is

scraping of floated particles and their passing for the following reprocessing, utilization or burial. The process of flotation is used extensively in chemical, petrochemical and alimental industries, especially in processes of deletion of organic compounds and weighed particles out of water, as well as in processes of separation of mixes.

- *osmosis* is the process of diffusion of substance in one set direction through the semipermeable membrane, e.g. diffusion of molecules of solvent to the side of bigger concentration of dissolved substance. The appellation of “semipermeable” relates to membranes, which have relatively big permeability only for certain types of molecules present in the system, for instance, for molecules of solvent, which molecules are character by bigger speed of migration through the diaphragm. Realization of process of osmosis leads in this case not to concentration but to dilution of solution of certain admixture present in the system. Therefore, this method may be recommended only to cases when concentration of undesirable component is slightly bugged of the established norm. Otherwise, technologists use in processes of purifying of wastewaters the phenomenon of *reversed osmosis*. *Reversed osmosis* represents itself the process, when molecules of solvent migrate under the outside pressure through the semipermeable membrane from the side character by more concentration solution to the side character by its less concentration, i.e. in reversed direction as compared with the event of usual osmosis.

The character peculiarity of both processes is that membrane is permeable for molecules of solvent but is impassable for compounds dissolved in it. The method is used for producing of drinking water from sea water, obtaining of extra pure water to be used in medicine etc.,

- *ultrafiltration* is method of extraction under the influence of high pressure of fine particles from suspensions or colloid solutions. The molecules of small size, ions and water are forced through the semipermeable membrane in direction reverse to gradient of concentration and big molecules cannot pass through the membrane. The ultrafiltration is in fact the membraneous process, which have the intermediary position between the reversed osmosis and microfiltration used typically in separation of macromolecular components from their solutions. The smallest molecular mass of particles that can be extracted reaches some thousands of atomic units of mass.

**Physicochemical methods of purification** constitute the considerable part of technologies used in purifying of wastewaters. They may be used independently of other methods of purification and be pooled with mechanical, chemical and biological methods. The basic physicochemical methods used in this sphere are coagulation, flotation, absorption, ion exchange, extraction, rectification, evaporation, distillation, reversed osmosis, ultrafiltration, crystallization, as well as methods associated with the event of applying of electric field – electrocoagulation, electroflotation, electrolysis and other. These methods are used in purposes of removal from wastewaters of fine-dispersed and weighed solid and liquid particles, dissolved gases, mineral and organic compounds.

- *Ion exchange* is one of basic methods of purifying of water out of ionic admixtures. The method is based on exchange by ions amongst admixtures and ion exchangers (ion exchanging gums) on the interface.

Ion exchangers represent themselves the solid substances insoluble in working environments, which have in their structure the functional (ionogenic) groups capable to ionize in solutions and exchange in this form by ions with dissolved electrolytes. Ionization of functional groups leads to forming of two subkinds of ions: the first ones are hardly fixed on the frame (matrix) of ion exchanger, and the second type of ions that have the opposite electric charge (counter-ions) are capable to migrate into the solution being replaced by the equivalent quantity of ions extracted from the solution that have the same electric charge. Existence of wide diversity of ion exchangers permits to solve the tasks of highly effective purifying of waters of various compositions. Moreover, it is the sole method, which permits to extract selectively from solutions some components, e.g. salts of heavy metals and salts of hardness of water. The ion exchangers may be classified by properties of their ionogenic groups by four basic types:

- cationites,
- anionites
- ampholytes,
- selective ion exchangers.

*Cationites* mean ion exchangers that have in their structure anions of ion exchanging groups fixed on matrix and capable to exchange with exterior phase by cations dissolved in it. If the cationite exists in  $H^+$  form, it is capable to extract all cations dissolved in water and the latter gains in it the acidic reaction. In process of moving through the layer of sorbent of solution, which contains the ix of such cations as *Na*, *Ca*, *Mg*, *Fe* (typical natural water), there occurs formation of fronts of sorption of each of cations and their non-simultaneous “overshoot” into the filtrate. The processes of purification of waters are finished in practice after emergence in filtrate of ions, which must not be present in the purified environments. Then the ion exchanger rich by this ion is put of regeneration carried out by its washing by dissolved solution of acid and the *eluate* obtained in such rinsing contains in concentrated state the cations extracted in process of purification.

*Anionites* represent themselves ion exchangers that contain cations or cation-exchanging groups fixed in their matrices and capable to exchange with the exterior phase by anions dissolved in it. If the anionite exists in the hydroxyl ( $OH^-$ )-form, the solutions sent on purifying passed in most cases before the columns filled by cationites in  $H^+$ -form that have the acidic reaction. This permits to extract from the purified solution all present anions and the purified solution has typically the neutral reaction. Passing through the layer of anionite of solutions that contain mix of anions of  $Cl^-$ ,  $SO_4^{2-}$ ,  $PO_4^{3-}$ ,  $NO_3^-$ , there occurred formation in its layer of fronts of sorption of each of present ions and their non-simultaneous “overshoot” into the filtrate. The process of purifying

of water is finished after emerging in the filtrate of the ion, which must not be present in the purified environment.

*Ampholites* means the ion exchangers that contain in their structure both anionic and cationic ion-exchanging groups and may play dependently of conditions of exploitation both the role of cationite or anionite.

*Selective ion exchangers* contain in their matrices the specially chosen ionogenic groups that are character by big specific energy of interaction with any one or certain group of ions. Such materials may be used in processes of purifying of water out of ions of certain type, e.g. boron, heavy metals and radionuclides.

- *sorption* is the process of selective intake of components of the system by *sorbents* (substances capable to intake certain materials inside their volume) – activated carbon, ash, alumogel, clay etc. The capability of sorbents to intake certain materials depends of structure of pores of the material, their length and volume, nature of material and is characterized by quantity of intaken material (*sorbate*) by unit of its volume or mass. There are discriminated three types of processes of sorption – the adsorption, absorption and chemisorptions. *Absorption* is the process of intake of substances by the whole mass of *absorbent*, fir instance, by liquid. *Adsorption* is the process of sorption realized due to capability of holding of retained molecules on surface of pores of *adsorbent*, the most often of activated carbon, by forces of intermolecular interaction of contacted materials. The process of *chemisorption* of pollutants is supplemented by forming on surface of sorbent of layer of new substance or phase.

The process of physical absorption is reversible and may be repeated many times because increasing of concentration of sorbate on interface is conditioned by non-specific forces of intermolecular interaction. On the contrary, the process of chemisorptions is selective and is non-reversible in most cases. Therefore the material used in sorption cannot be used again.

The specific procedure of processes of sorption is regeneration of sorbents by special solvents – *eluants* – after the material used in sorption exhausted its specific capability to intake the purposeful component of the solution. The process is supplemented by forming of *eluate* – the concentrated solution in used eluant of extracted material. Such solutions are subjected to regeneration and may be used then by the same destination. The one more problem is search for method of utilization of the material extracted from purified environments.

- *extraction* is the method of removing of any substance from solutions or dry mixes in use of suitable solvent. The solvents used in extraction must not mix with substances (mixes), which contain the purposeful component. The solvent to use have to be chosen in each case in taking into consideration of concrete composition of working system. Dependently of nature of chosen solvent and its quantity necessary for high-grade removal of pollutant, process of extraction may be carried out by some consecutive stages. The most serious drawback of process of extraction is pollution of the working system by residuals of *extractant* and, again, the need in regeneration of the solvent used for

extraction and utilization of the mix that contain the extracted pollutant in concentrated form.

- *coagulation* is the process of aggregation of fine particles of pollutants in conglomerates after applying in the system of so-called "*coagulants*".

The operation of coagulation represents itself the process of integration of fine particles of dispersed phase in aggregates occurred owing to adhesion in their clash. Such collisions are occurred because of their Brownian movement, mixing of the liquid phase, imposing of electric field (electrocoagulation) etc. The result of collision of two small particles of sol (the so-called first-order particles) is forming of bigger particle of second order, which can, in turn, join with other particles and form particles of third order and so on.

Concentrating of mass in the volume leads to occurrence of instability of formed mixes and depositing of aggregated solid phase on the bottom of the reaction vessel or simplifying of their removal in mechanical filters. The [process of purifying of the polluted solution includes typically the stages as follows:

1. Adding in polluted water of solution of coagulant(s).
2. Mixing of the system done in purposes of assuring the maximally possible quantity of clashes of particles of hydrolyzed coagulant with particles of pollutants.
3. Sedimentation or filtration of formed conglomerates.

The character peculiarities of coagulation are increasing of turbidity of the system and appearance of flakes of solids, the so-called *floccules* (this phenomenon is known as *flocculation* used in many times as the synonym of term of coagulation). There is began the process of stratification of the system stable initially to sedimentation of weighed particles and forming of solid phase of coagulate (deposit). Its result is formation of friable aggregates of various sizes. The large aggregates began to deposit on the bottom of the reaction vessel under the influence of force of gravity, i.e. there is began the process of *sedimentation*. The technique of coagulation assures the effective retention of formed solids in mechanical filters and similar devices, or their effective sedimentation and following decantation of clarified liquid over the formed deposit.

The coagulants used un purifying of wastewaters the most often are sulfates and chlorides of trivalent aluminum and iron. These salts hydrolyze in contact with water and form insoluble compounds and "centers" of their aggregation are fine colloid particles, i.e. organic components present in wastewaters of meat-processing enterprises. The resulting volumetric flakes may be lingered by industrial filters.

- *flocculation* is the process of aggregation of small particles of pollutants weighed in water with flocculants supplemented by forming of *floccules* (cellular structure of flakes).

The process of flocculation has no the fundamental difference with process of coagulation and is in fact its variant. Flocculants differ of coagulants by form, density and dimensions of formed flakes. However, technologists do not differ



these classes of precipitants and named coagulants in many cases as flocculants and vice versa. The most often used variant of flocculation is the process carried out in aqueous environments in use of high-molecular polyelectrolytic or nonionogenic flocculants. The most probable explanation of forming of big flakes is the process of so-called absorptive flocculation, i.e. depositing of insoluble particles present in the system on separated segments of high-molecular chain of flocculent.

There exist inorganic and organic flocculants. The only inorganic flocculent used in industry is polysilicic acid and in overwhelming majority of cases technologists use in flocculation compounds of organic nature. The class of organic flocculants includes the wide variety of synthetic or natural homo- and co-polymers that have the molecular mass of  $1 \times 10^4 \div 1 \times 10^7$ . Some of such compounds may dissociate and some not, therefore they are classified as ionogenic (polyelectrolytes) and non-ionogenic ones.

The synthetic flocculants used the most often are polymers and co-polymers of acrilamide, for instance, technical polyacrilamide that contains 3 ÷ 8% of chains, which contain carboxyl groups formed owing to hydrolysis of amide groups in process of synthesis of the polymer. This compound is used in industry in most cases in non-ionogenic variant, but there may be synthesized its anionic and cationic variants, which may be more effective in certain specific uses.

The process of flocculation is used extensively in processes of purifying of wastewaters and the most often they are used in complex with coagulants, e.g. it is known the variant of simultaneous use of aluminum sulfate and polyacrilamide.

Analyzing the methods of purification of liquids described above, one may make the conclusion that the most expedient technology of purification of wastewaters of meat-processing enterprises includes the stage of mechanical removal of big particles carried with stream of liquid followed by applying in the partially clarified liquid of mix of coagulant and flocculent and filtration of resulted suspension. The next stage of purification of cleaned wastewaters to sanitary norms has to be done by biological methods on local or municipal stations of purification of water polluted by organic compounds, what is highly desirable because wastewaters of meat-processing enterprises may be contaminated by pathogenic organisms – viruses, bacteria, fungus and mold.

#### **4.5.3 Fundamentals of theory of purifying of wastewaters in use of physicochemical methods**

The wastewaters formed in process of producing of meat products represent themselves the disperse systems, which structure is character by wide diversity (emulsions, suspensions, foams, blood). Such systems are classified by aggregate state of dispersed phase and dispersive environment (solid, liquid and gaseous), as well as by dimensions of particles of dispersed phase.

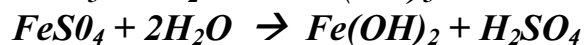
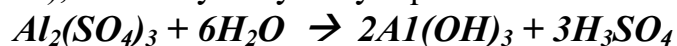
Carrying out of work in mechanical purification permits to remove without problems the particles, which size is more of 10 micrometers but practically all

colloidal and fine-dispersed particles remain in the system in dissolved and weighed state. Therefore, wastewaters that passed the process of mechanical purification represent themselves at most of enterprises the metastable systems. To continue their purification, technologists use usually the method of coagulation what perturb stability of the system and assist in forming of relatively big aggregates of insoluble particles that may be removed mechanically.

The most widespread wastewaters formed in practice of producing of meat products are the dispersive systems that contain mixes of weighed liquid and solid admixtures. Such systems are character by constancy in time of balanced distribution of dispersed phase in volume of the system, what is conditioned by constancy of ration of intermolecular forces of attraction and repulsion of dispersed phases (theory of coagulation of Deriagin-Landau-Fairway-Overback). All admixtures present in water may be subdivided by categories of:

- insoluble particles various by their dimensions (visible and invisible by unaded eye), which may be separated by methods of filtration or settling,
- dissolved substances that cannot be removed by methods of purification named above. This category admixtures includes also various types of biological contaminating (microbes, viruses, bacteria etc.).

To concentrate admixtures and convert them in form insoluble in water, technologists add to wastewaters the special substances, the so-called *coagulants*. The coagulants used for purification of wastewaters including the water formed at meat-processing enterprises, are salts of metals capable to hydrolyze with generation of volumetric deposit of respective hydroxide. It was found empirically that the coagulating force of the ion is the bigger the more is its charge (rule of Shultse – Gardi) and limiting values of thresholds of coagulation (concentrations of beginning of the event of coagulation) of inorganic bivalent ions as compared with the univalent ions is less by one and trivalent – by two orders of magnitude less. Respectively, the coagulants used in practice the most often are trivalent salts of iron and aluminum (chlorides and sulfates), which hydrolyze by equations as follows:



Because these reactions are occurred in alkaline environments, acids formed in hydrolysis are neutralized and form the neutral salts dissolved in the solution. Therefore, substances that activate beginning of process of coagulation are fresh deposits of hydroxides, which absorb on their extended surface the fine-dispersed particles of weighed sols and gels. The formed aggregates expand in volume and stick together to form large conglomerates. The one more aspect of choose of coagulant is realization of possibility of bonding of products of hydrolysis with ions of heavy metals present in the system in chemical compounds (ferrites, aluminates), what permits to rise the grade of removal from the system of substances hazardous for state of health and conditions of environment.

In positive hydrodynamic conditions, the formed deposits are withdrawn mechanically out of the system in use of techniques of their sedimentation or

flotation. However the particles of deposits formed in process of coagulation (the so-called "*floccules*") are in most cases too small. Therefore use of methods named above may be realized only in use of too big equipment or filters what complicates technologies used in purification of wastewaters.

To avoid the unjustified complications coupled with slow depositing of formed aggregates, the process of application of coagulants is supplemented by adding to wastewaters of *flocculants* of non-ionogenic, anionic or cationic nature. The process of flocculation is the transporting stage, which is carried out with use of flocculants – substances, which principal function is assisting in conglutination of stable fine-dispersed stable particles in their clashes. The result is passing of the process of *flocculation* of flaxes of hydroxides formed in hydrolysis of *coagulants*, which absorbed fine particles of admixtures and forming of large friable three-dimensional aggregates that have, as a rule, the bigger linear dimensions as compared with structures formed in coagulation. Such conglomerates may be easily withdrawn out of treated wastewaters by techniques of sedimentation, filtration or flotation.

The *anionic flocculent* used in the meat-processing industry in most cases is the partially hydrolyzed polyacrilamide, which contains in its macromolecule of about of 20÷40 % of carboxyl groups R-COOH, which combine in their structure two functional groups – the carbonyl ( $>C=O$ ) and hydroxyl (-OH) ones, which influence reciprocally on one other. The electronic density of carboxyl is shifted to atom of oxygen of carbonyl group, what leads to polarization of chemical bond of O-H, correspondingly localization of positive charge on the surface of this functional group and polymeric molecule on the whole. Therefore this group reagents assists in more effective extraction from solutions of compounds charged positively as compared with the non-ionogenic flocculants.

Besides, this group compounds includes products of partial alkalotic or acidic hydrolysis character by differing proportion of hydroxyl, amidic and carboxyl groups and presence of homo- and co-polymers of acrylic acid with metacrylic acid. The group of anionic flocculants that contain the carboxyl group includes also co-polymers of maleic and fumaric acids etc.

The *cationic flocculants* are especially effective in processes of treating of disperse systems, which contain positively charged particles owing to chemically modified polymeric molecules of flocculants contain cationic groups charged negatively in aqueous systems. The category of weak cationic flocculants, which contain in their structure the primary, secondary and tertiary atoms of nitrogen, includes polyvinylamine, polyethyleneimine, polyvinylpyridines and others. The molecules of strong flocculants represent themselves polyelectrolytes that have in their structure the quaternary ammonia or pyridine groups, e.g. those that contain up to 10 % of functional acidic groups of formula of  $[-CH_2-CH(COONa)-]_n$ . Such products are produced by method of complete alkylation of atoms of nitrogen of weak flocculants, e.g. polyacrylamide, which contains in its structure up to 30 % of amide, carboxyl, metoxyl and nitrile groups.

It is known that cationic flocculants modified by groups of **NO** used by their destination may also form in neutral solutions the insoluble particles of gel that

contain atoms of some metals and are so the compounds that play the role of agents used for purifying of solutions out of saline component.

#### **4.5.4 Basic principles of work in purifying of wastewaters of meat-processing enterprises**

Wastewaters of meat-processing enterprises are the aggregate multicomponent systems, which cannot be purified in use of any single device. The technology of their purification includes some consecutive operations, and their main characteristic peculiarities are:

- irregularity of inflow,
- variation of composition and concentrations of admixtures,
- presence of organic compounds disposed to quick decomposition (albumens, fats and others).

Such their peculiarities are depend of cyclic character of processes of reprocessing of meat products (washing of raw materials, tare and equipment, cooling of production, defrosting of meat raw etc.), variation of quality and percent of losses of raw and auxiliary materials, as well as effectiveness of operation of equipment. The wastewaters formed in operation of serial manufactures represent themselves the emulsions or suspensions of small concentration, which contain colloidal particles with dimensions of  $0.001 \div 0.1$  micrometers, fine-dispersed particles with dimensions of  $1 \div 10$  micrometers, as well as particles, which size is more of 10 micrometers.

To realize any scheme of purifying of wastewaters of meat-processing enterprises, developers have to solve the problem of first and foremost withdrawal out of industrial suspensions of weighed particles of big size, what may be done by procedures of sedimentation, decantation and filtration. However the partially purified water remains contaminated by dissolved organic compounds decomposed in nature by bacteria (there occurs the process of their aerobic biochemical oxidation supplemented by generation of carbon dioxide). At that, there occurs spending of oxygen dissolved in water. However, if content of organic compounds in basins would be too big, most of oxygen spends on biochemical transformations, what results in death of live organisms (e.g. fish) because of shortage of oxygen. To prevent such undesirable events, technologists have to decrease the content of organics dissolved in wastewaters to any set level. To developed technology of refinement of wastewaters, there has to be established the permissible grade of their pollution. The index used in such setting if the criterion of *chemical oxygen demand (COD)*. The quantitative measure of contamination of water is the index of quantity of milligrams of consumed oxygen per cubic decimeter of water –  $\text{mgO}/\text{dm}^3$ .

Being the integrated index, this one is reckoned now as one of the most informative indices of anthropogenic polluting of wastewaters. This criterion is used in one way or another in control of quality of natural waters, studying of processes of purifying of wastewaters and so on. The grade of pollution of superficial water by criterion of COD normalized in Ukraine is  $15 \div 30 \text{ mg}/\text{dm}^3$ . Therefore, the grade of contamination of water expressed in value of COD may be used as criterion of its goodness. Thus, very clean basins contain of abut of  $1 \div 2 \text{ mg}/\text{dm}^3$ , reasonably clean

– 3 mg/dm<sup>3</sup>, contaminated – more of 15 mg/dm<sup>3</sup>. At the same time, the statistical data on quality of wastewaters of meat-processing enterprises shows that grade of their contaminating by index of COD is of 4000 ÷ 5000 mg/dm<sup>3</sup> even after they passed the devices of trapping of big particles of organic nature (grease traps and similar apparatus).

The work on preliminary purifying of wastewaters is carried out on mechanical grids or sieves that have apertures of up to 3 mm, as well as in apparatus equipped by devices of automatic collecting and unloading of collected solid wastes. The typical devices used in this purpose in the meat-processing industries are the apparatus of type of MZhU and AZhU (Gig. 4.20). The experience of their exploitation shows that the grade of removal of weighed particles and fats is of 50 ÷ 70% in passing through the apparatus of 1 ÷ 50 m<sup>3</sup> of wastewater per hour, what permits to decrease levels of their COD and BOD by factor of 20 ÷ 30 %.



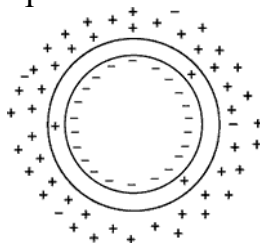
**Figure 4.20**    *Grease trap of AZhU-45*

The wastewaters partially purified out of solid admixtures in devices of mechanical purification represent themselves colloidal solutions of organic compounds, as a rule. Such systems are not segregated in their settling and dissolved particles of colloidal size do not sediment because they are too small and all time are “pushed” by molecules of solvent in their Brownian movement.

Meantime, comparing of real level of COD of wastewaters with its normalized value witnesses the crucial need of organization of local stations of withdrawal of dissolved organics present in the system mainly in colloidal form.

The particles of colloids represent themselves the pool of big quantity of molecules of contaminant dispersed in wastewater in metastable state oqing to they are stabilized by layer of water that covers them in their movement. The colloidal particles absorb from wastewater ions charged, preferably, uniformly on their

developed surface, what decreases considerably their free specific energy. The ions located in layers adjacent to the core of colloidal particle form the so-called “inner adsorptive layer”. This one may contain also small quantity of ions charged inversely. However the summary charge of ions of the latter category does not compensate the value of charge of inner absorptive layer of ions. Therewith, to upper frontier of absorptive layer around the core of the particle charges, what leads to its enveloping by diffusion layer of molecules of water that contain the ions charged oppositely, which quantity is sufficient for compensation of charge of the inner layer (Fig. 4.21):



**Figure 4.21** *Schematic view of micelle of dissolved albumen*

Therefore, developers of technologies of purifying of wastewaters have to solve the problem of neutralization of superficial charge of micelles, what would permit to ensure their aggregation in relatively big conglomerates. The method used in this work the most often is interlinking of colloidal particles of fat and albumens by electrolytic compounds used in practice of purifying of water.

Analysis of methods of purifying of solutions named above and existing practice of their use in industry show that the best results may be obtained in use of method of *coagulation* the physicochemical process of agglomeration of pollutants by volumetric flakes of hydroxides formed in hydrolysis of *coagulants* introduced in the system.

The processes of coagulation of electrically stabilized hydrophobic colloids (e.g. of object of our discussion) studied in details and used in practice the most often are carried out in use of coagulants that have properties of electrolytes. The coagulating effect of electrolytes may be explained by lowering of energetic barrier because of partial shielding of superficial charge of colloidal particles by ions absorbed in the double electrical layer located close to the interface of solid and liquid.

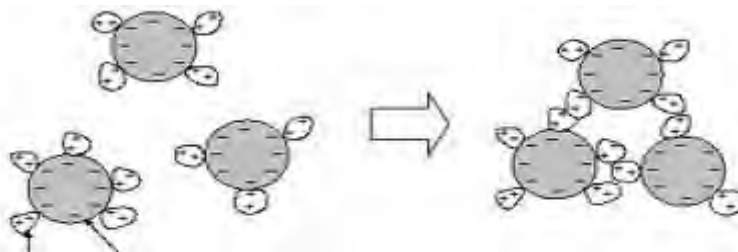
The rapprochement of particles of dispersed phase necessary for initiation of process of coagulation is hampered by electrostatic repulsion of colloidal particles and ions of the same sign of charge, as well as interaction of solvate shells of counterions of the diffusion layer. The negative influence of this factor eliminates in adding to sol of solution of electrolyte, what leads to increasing in dispersive environment of micelle of concentration of ions of antipodal charge of its core.

The process of development of industrial technology requires of choose of methods of relieving of superficial charge of weighed admixtures. The one more factor of complication is that studied wastewaters contain pollutants not only coarse particles that may be withdrawn by filtration of the solution, but the colloidal particles too.

Therefore, scientists and technologists, who develop and introduce technologies of purifying of wastewaters, have to realize the process of *heterocoagulation*, when two disperse systems present in the solution coagulate one other because of reciprocal adhesion of particles of two different nature charged oppositely. The agents used in this purpose in most cases are salts of polyvalent ions that may hydrolyze and form in it colloidal solutions of their hydroxides. The character peculiarity of such process is that effectiveness of coagulating force of the electrolyte increases in parallel with rise of value of charge  $Z$  of coagulating ion. The reagents used typically in these cases are hydroxides of trivalent iron and aluminum.

The essence of process of treatment of water by these compounds consists in hydrolytic decomposition of salts supplemented by forming of positively charged sols of hydroxides of iron and aluminum and their following adsorption on the surfaces of dispersed pollutants that lose in this event the charge of their surface. At that, the particles weighed in the solution lose their capability to push aside in close neighborhood, stick together and form relatively big conglomerates that deposit then in sedimentation basins or are removed out of the system mechanically.

Technologists used simultaneously in most cases as the precipitating agents coagulants that destabilize the ionic system and form microflakes, and  $0.01 \div 0.5 \text{ mg/dm}^3$  of *flocculants*, which use intensifies processes of aggregation of weighed particles and their withdrawal from solutions in form of macroflakes. The small particles present in the solution consolidate after adding in the system of flocculants in bigger conglomerates, which have form of flakes or so-called "*floccules*" (Fig. 4.22):



**Figure 4.22** *Scheme of flocculation of coagulated particles*

*Flocculation* is one of the most effective and efficient methods of concentration, enrichment, dehydration and betterment of capability to filtration of industrial suspensions, purifying of circulating and waste waters. This process is closely similar with the event of heterocoagulation. Flocculants represent themselves soluble in water polymers of linear structure, which molecules consist of big quantity of groups and have the length of their chain of up to 1 micrometer. The molecular mass of flocculants may reach values of up to some millions and grade of polymerization is of  $500 \div 5000$  and more.

The event of flocculation is used extensively in processes of purification of wastewaters. The main goal of their application is assisting in forming of aggregates or flakes, which consist of finely dispersed colloid particles that form the solutions stable in time. Flocculation is in fact the stage of transport of particles formed at previous stages of purifying of solutions, which supplements by the event of forming of aggregates, which may be easily withdrawn from treated wastewaters.

The initial stages of use of flocculants began in 1930, and the agents used in this purpose had mainly inorganic character. Technologists used in this process in most cases active silicic acid – the partially structured colloidal solution (sol) of silicon dioxide of general formula of  $x\text{SiO}_2 \cdot y\text{H}_2\text{O}$ . However, in progress of chemical technology, technologists ceased its use and began to apply in this purpose the non-corrosive synthetic substances. Moreover, their use permitted to decrease the used quantities of flocculants by factor of  $30 \div 50$  and quantity of foams formed in it was decreased to  $1 \div 3\%$  of volume of the treated system.

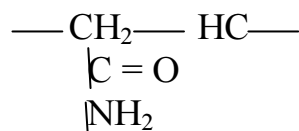
The principal mechanism of action of flocculants is adsorption or specific interaction of molecules of flocculent with superficial centers of colloidal and weighed particles, which form in it the cellular structure and their aggregation owing to influence of forces of Van-der-Vaals. The principal cause of forming of such structures is adsorption of macromolecules of flocculent on some particles supplemented by forming of polymer bridges between.

The process of adsorption passed by two stages as follows. Each molecule attaches at *the first one* by its some segments to one of particles weighed in the solution (primary stage of adsorption). At the *second* stage, free segments of flakes formed in hydrolysis fix on surfaces of other particles and bond them by polymeric bridges (secondary stage of absorption).

The flocculants soluble in water may be in non-ionized state or dissociate and form ions. The latter their category is named as soluble polyelectrolytes. Dependently of composition of polar groups, flocculants are subdivided by the following groups:

- 1) **non-ionogenic** flocculants are those that contain n on-ionogenic groups, e.g.  $-\text{OH}$ ,  $-\text{CO}$  (starch, oxyethylcellulose, polyvinyl alcohol etc.). The category of synthetic flocculants used the most often includes polymers and co-polymers of acrilamide, for instance, polyacrilamide of technical grade of purity (PAA), which molecule contains  $3 \div 8\%$  of carboxylate structural elements formed in result of hydrolysis of amide groups in process of its synthesis. After its chemical modification technologists obtain flocculants of other types and destinations.

The monomer unit of the polymer has the structural formula as follow (Fig. 4.23):



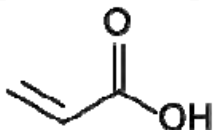
**Figure 4.23 Monomer unit of polyacrilamide**

The molecule of polyacrilamide as such has the non-ionic character and chemical modification of its polymeric chain is carried out in purposes of giving its capability to come into bonding or specific interaction with ions present in solutions to withdraw them from the system. The derivative compounds of polyacrilamide may carry the localized charge – positive or negative (cationic and anionic flocculants, respectively).

- 2) **anionic flocculants** represent themselves the class-of polymers, which contain in their structure the anionic groups, e.g.  $-\text{COOH}$ ,  $-\text{SO}_3\text{H}$ ,  $-\text{SO}_3\text{H}$  and others



(active silicic acid, sodium polyacrylate, lignosulfates etc.). the anionic flocculants used in industry the most often is partially hydrolyzed PAA that contains in its molecule 20÷40 % of carboxyl groups; products of incomplete alkaline hydrolysis of polyacrylonitrile that contain various quantities of nitrile, amide and carboxyl groups; homo- and co-polymers of acrylic and metacrylic acids. There are used in some applications also flocculants that contain strong acidic groups (for instance sulfogroups) bonded on polymeric chains of polystyrene, polyacrylamide and other polymers.



The anionic types of polyacrilamide-based flocculants are produced in process of copolymerization of acrylamide with acrylic acid:

This functional group has the mobile atom of hydrogen and act so as anionite (see the Chapter of *adsorption*). However most of commercial sorts of anionites have the neutral reaction in their aqueous solutions because atom of hydrogen in their molecules was replaced by atom of sodium. The quantity of specific groups where there was done such replacement is called as grade of hydrolysis of polymer, which varies typically in limits of 2 ÷ 40 %.

3. **cationic flocculants** represent themselves the class of polymers that contain cationic groups, for instance,  $-\text{NH}_2$ ,  $=\text{NH}$  (polyethyleneimine, co-polymers of vinylpyridine and others). The cationic flocculants are especially effective in treatment of disperse systems that contain the positively charged particles. The subalkaline cationic flocculants, such as polyvinylamine, polyethyleneimine, polyvinylpyridines and some other contain the primary, secondary and tertiary atoms of nitrogen, and the strongly alkaline polyelectrolytes have the quaternary ammonia groups in their molecules. The one more class of cationic flocculants are compounds synthesized in processes of consecutive chlorometilation of polystyrene or polyvinyltoluene modified by formaldehyde or secondary amine of PAA.

Because their surface is charged positively, cationic polyacrilamide flocculants are used successfully in purposes of intensification of processes of purifying of wastewaters as follows:

- gravitational deposition of coagulated impurities,
- coagulation and flocculation of pollutants contained in wastewaters in form of colloidal solutions,
- clearing at installations for sedimentation,
- flotation,
- densifying of deposits formed at various stages of purifying of wastewaters,
- dehydration of deposits on screw installations, in bend and chamber filter-presses and in centrifuges.

- 4) **amphoteric flocculants** represent themselves the class of polymers, which contain both anionic and cationic functional groups (hydrolyzed polyacrilamide,

albumens and others). The symbol of charge of their macroions depends of *pH* of environment.

The most perspective flocculants are now *N*-substituted polyacrylamides owing to their relative simplicity of producing, high effectiveness, universality, absence of corrosive activity and small toxicity. Both anionic and cationic flocculants are recommended for use in processes of aggregation of inorganic and some types of organic deposits. However, cationic flocculants showed their bigger effectiveness in influence on organic compounds and anionic are used preferably in flocculation of inorganic substances.

Dissociation of polyelectrolytes leads to forming of complex high-molecular polyvalent ion and simple ion of small valence. The anionic flocculants give in this process the complex polymeric anion of organic or inorganic nature, and flocculants of cationic type – the complex polymeric organic cation. The amphoteric flocculants dissociate by acidic or alkaline mechanism dependently of reaction of environment.

So, there are possible various mechanisms of bonding of macromolecules of flocculants on surface of solid particles present in the system. The nonionic polyelectrolytes are fixed by polar groups (hydroxyl in most cases) owing to forming of hydrogen bonds between atoms of hydrogen of hydroxyl with atoms of oxygen, nitrogen and some other atoms located on the surface of particles. The anionic flocculants are capable to fix on surface of particles both because of forming of hydrogen bonding, but also because of chemical interaction of anions and cations located on the surface of particles.

Dependently of type of used flocculent, its polymeric molecules are capable to fix on surface of particles not only due to forming of hydrogen bonds, but also owing to electrostatic interaction of functional groups of polymer chains with positive and negative charges localized on surface of weighed and, partly, dissolved particles of pollutants. This phenomenon assists in rising of effectiveness of flocculation and because their surface carries electric charge, the formed conglomerates are capable to absorb from solutions the charged ions, e.g.  $H^+$ ,  $Al^{3+}$  and others.

The one of the most important properties of flocculants, which influence considerably on stability of disperse systems in process of sedimentation, is their molecular mass that may vary in limits from tens of thousands to some millions. It's obvious, that the bigger molecular mass of flocculent is, the bigger its effectiveness in bonding of weighed particles, what assists in increasing of grade of clarification of solutions. This is conditioned by those that bigger molecules are capable to bond with bigger quantity of particles through the newly formed polymeric bridges, therefore form bigger flakes, what assists in more effective sedimentation. Therefore technologists try to use in flocculation of flakes, including those that are formed in processes of purifying of wastewaters, the synthetic polymers, which molecules have the possibly longer chains. Besides, the event of rising of effectiveness of flocculation permits to decrease quantities of reagents used in it.

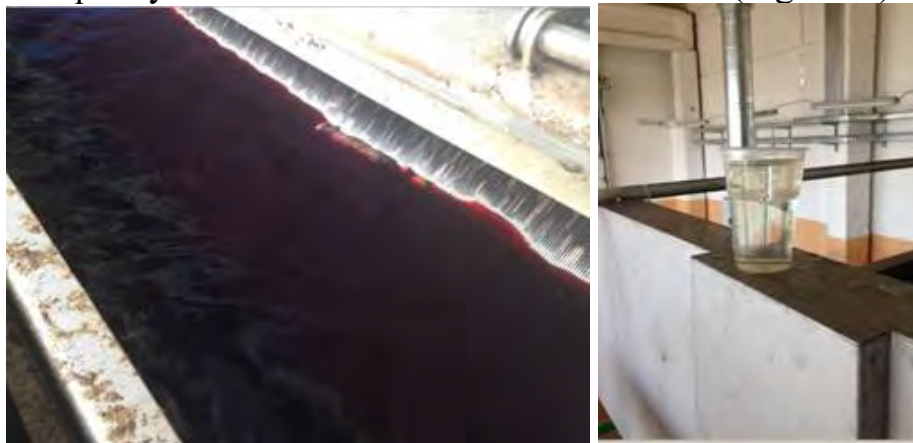
Calculations show that twofold increasing of dimensions of the macromolecule permits to increase the rate of flocculation tenfold. It was calculated that to assure the effective flocculation, of suspensions, technologists have to use molecules, which length would be of about of  $10^{-7}$  meters.

The practice of purifying of wastewaters of meat-processing enterprises shows that to increase effectiveness of their purification, one has to use the mix of inorganic coagulant (salts of iron or aluminum) with anionic flocculent because the latter not only preserve its activity in consolidation of formed flakes but permits also to remove from solutions some quantities of such their typical pollutants as phosphates and sulfates.

#### **4.5.5 Typical technological schemes of purifying of wastewaters of meat-processing enterprises**

The differences of details of technological processes introduced in meat-packing factories result in considerable variation of volumes and grads of pollution of wastewaters in different time due to variation of composition of used raw materials and types of production to be produced in different time. The quantity and quality of wastewaters varies also because of use of different cleaning agents and detergents. Such phenomenon causes the need of certain universalization and complexification of schemes of installations used in purifying of wastewaters. The latter represent themselves typically the complex erections assigned for extraction from waters of admixtures hazardous from the sanitary viewpoint and/or valuable as the secondary raw.

There exist now many various industrial schemes of such installations and choose of concrete method and development of effective technology of purification is in some cases too complex because of existence on many variants of solving of problem of reaching of set grade of purity of water thrown down in open basins. The local installation of purifying of wastewaters of meat-processing enterprise has to correspond to set parameters of environmental friendliness, economical effectiveness and saving of energy. The technologies used in practice are character by individuality for each enterprise and were projected in observance of specificity of its work and requirements to quality of waters to be thrown down outside (Fig. 4.24).



***Figure 4.24 Wastewaters before and after their purifying***

The technological schemes used in meat-processing industry the most often are based on use of processes of sedimentation, flotation, coagulation and flocculation. Their constructions include assemblages of removal of dispersed coarse particles of fat by methods of flotation and sedimentation, blocks of converting of admixtures in

insoluble form by method of coagulation by salts of iron at controlled values of *pH*, assemblies for removal of coagulated admixtures by methods of flotation or sedimentation, as well as final clearing of water in its filtering through layers of grained materials and conditioned dehydrated deposits on vacuum filters (Fig. 4.25, Fig. 4.26).



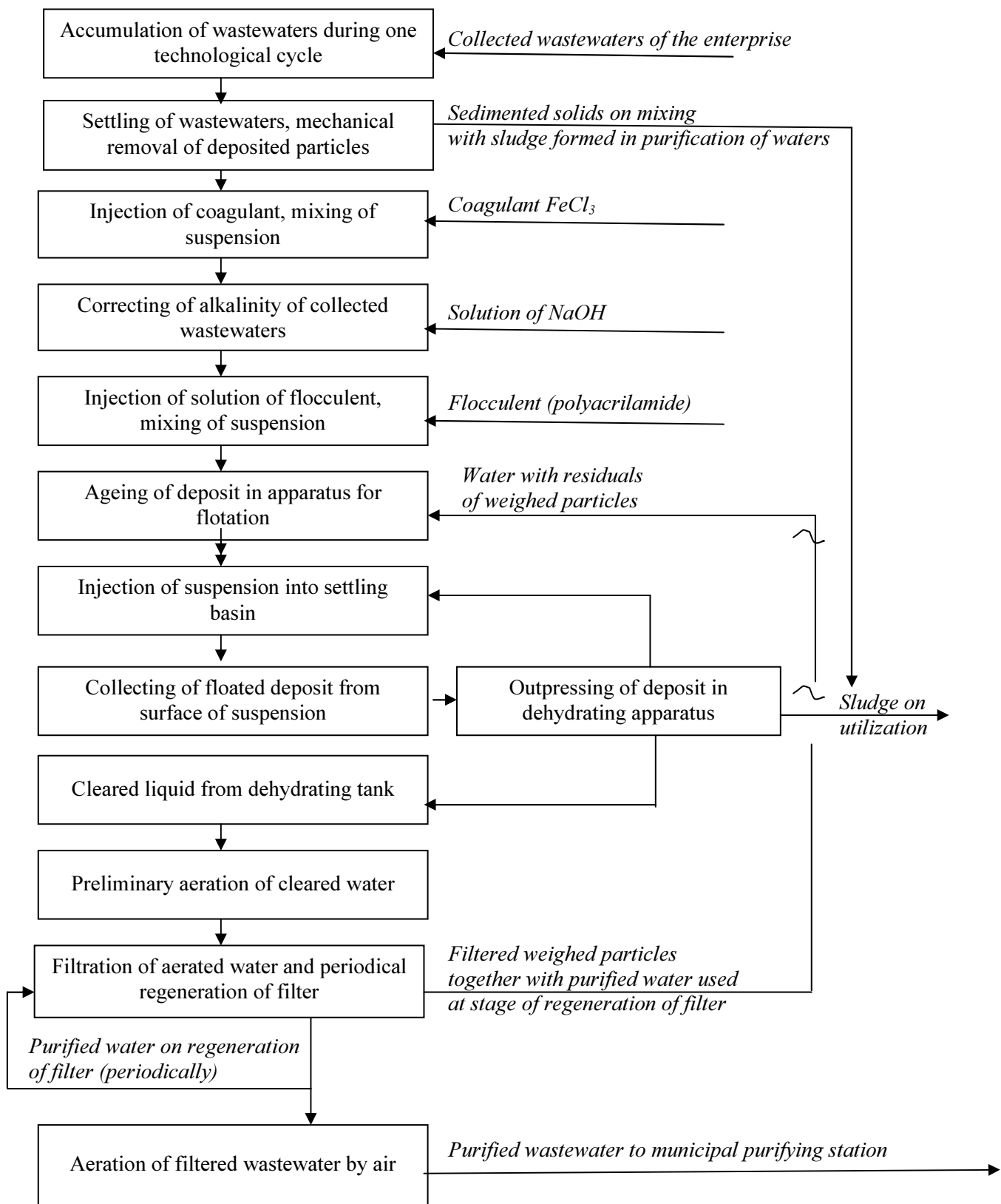
**Figure 4.25** *General view of block of flotation of coagulated deposit*



**Figure 4.26** *Dehydrated deposit*

Analysis of schemes of purifying of wastewaters realized in industry, one should note that there exists the wide variety of types of installations based on use of mechanical, physicochemical, biochemical methods of operation. The quantity of stages and methods of purification may vary, but all of them use the stage of mechanical purification and one or more physicochemical method (for instance the stage treatment of waters by reagents seconded by operation of pressurized flotation). If norms of quality of purified water are too severe, the used technology has to include the stage of biological afterpurification and disinfection of purified water. At that, the schemes of purification contain in their projecting the same assemblages and elements combined in different variants. However, each method of purification

presumes use of some apparatus connected by various streams and recycles. One of possible variants of such installations is shown on Figure 4.27 below:



**Figure 4.27 Principle circuit of purification of wastewaters of meat-processing enterprise**

### **Checking questions**

1. What is "electroactivated water" ?
2. Mention the methods of producing of electroactivated water
3. Name the mechanism of protective activity of electroactivated water
4. What is the principal advantage of use of water conditioned without use of reagents in preservation of meat products over other methods of their preservation ?
5. Which are new possibilities of businesspersons who work in food industry in use of advances of nanotechnologies ?
6. Mention the basic directions of use of nanotechnologies in food industry
7. List the principles of use of nanotechnologies in producing of alimentary products
8. Mention the basic reasons of introduction of nanotechnologies in food industry
9. Who is the founder of nanotechnologies ?
10. What are the basic tasks of use of nanotechnologies in agriculture ?
11. Describe the global experience in introduction of nanotechnologies in agriculture
12. What is the bioresonance technology ?
13. Mention the medicinal and prophylactic measures used in breeding of cattle with use of advances of nanotechnology
14. What are the actual problems of use of nanotechnologies in meat industry ?
15. Name the possible directions of use of nanotechnologies in meat industry
16. What are the modern requirements established to packing of meat products ?
17. How do you understand the notion of "active packing" ?
18. List views of "active packs" you know
19. Give the fundamentally new properties of coverings that contain nanoparticles of silver
20. What principles of absorption of oxygen put in base of modern technologies of preservation of meat products ?
21. What principles of genic engineering are used in meat industry ?
22. Describe the sense of notion of "genetically modified organisms"
23. List the basic principles of Cartagena protocol and Convention on biological diversity
24. List the functions, which execute in meat products the microorganisms created by methods of genic engineering
25. What are the "barrier technologies" ?
26. What procedures have to be observed in process of marketing of GMO in Ukraine ?
27. Describe the state of purity of superficial waters in Ukraine
28. What are the principal sources of pollution of superficial waters ?
29. List the basic methods of purifying of wastewaters
30. List the principal pollutants, which are contained in wastewaters of meat-processing enterprises
31. What methods of purifying of wastewaters of meat-processing enterprises are used the most often ?

### Literature

1. Абрамов К. М. Использование электроактивированной воды при переработке мяса птицы: автореф. дис / К. М. Абрамов. – М., 2008. – 145 с.
2. Активированные водные растворы и возможности применения их в мясной промышленности. Обзорная информация / Горбатов В.М., Пироговский Н.А., Хакимджанов А.Б., Князева В.А. – М.: ЦНИИТЭИмясомолпром, 1986, вып. 3. – 47 с.
3. Аналіз актуальних чинників погіршення якості питного водопостачання в контексті національної безпеки України. Аналітична *записка* / О.М. Вергун // Національний інститут стратегічних досліджень при президентові України, електронний ресурс: <http://www.niss.gov.ua/articles/1037>
4. Андриевский Р.А. Наноматериалы: концепция и современные проблемы // Российский химический журнал. 2002. Т. 46, с. 50-56
5. Андриевский Р.А., Рагуля А.В. Наноструктурные материалы. М.: Академия, 2005
6. Антипова Л. В. Положительное воздействие коллагеназы на структуру мясного сырья / Л. В. Антипова, А. И. Албулов, А. А. Донец // Мясная индустрия. – 2002. – №2. – С. 9–10
7. Аронов И.З. Анализ безопасности услуг на основе методологии FMEA / И.З. Аронов, Г.В. Панкина // Методы менеджмента качества. – 2001. – № 5. – С. 27-29
8. Арсланов В.В. Полимерные монослои и пленки Ленгмюра-Блоджетт. Успехи химии. 69 (10). 200. С. 963-979
9. Бактериоциноподобные вещества и локализация генов, контролирующих их синтез, у новых кандидатов в пробиотики: материалы Международного конгресса ["Пробиотики, пребиотики, синбиотики и функциональные продукты питания. Фундаментальные и клинические аспекты"], (Санкт–Петербург, 15–16 мая 2007 г. ) / Е. С. Дорофеева [и др. ]. – СПб. : ГАСТРО, 2007. – 38 с.
10. Баль-Прилипко Л.В. Актуальні проблеми м'ясопереробної галузі / Л.В. Баль-Прилипко: Підручник. – Київ, 2011. – 288 с.
11. Баль-Прилипко Л.В. Інноваційні технології якісних та безпечних м'ясних виробів / Л.В. Баль-Прилипко: Монографія. – Київ, 2012 – 207 с.
12. Баль–Прилипко Л. В. Сучасна біотехнологія м'ясних продуктів // Вісник НТУ «ХП». Серія: Нові рішення в сучасних технологіях. – Х: НТУ «ХП». – 2013. – № 70 (1043). – С. 160–166
13. Баран А.А., Тесленко А.Я., Флокулянты в биотехнологии, Л., "Химия", 1990
14. Бахир В.М. Медико-технические системы и технологии для синтеза электрохимически активированных растворов. М.: ВНИИИМТ, 1988, вып. 3. – 80 с.
15. Бахир В.М., Цикоридзе Н.Г., Спектор Л.Е. и др. Электрохимическая активация водных растворов и ее технологическое применение в пищевой промышленности. // Серия: Пищевая промышленность. – Тбилиси: ГрузНИИ научно-технической информации, 1988, вып. 3. – 81 с.

16. Бахир В.М. Электрохимическая активация. Ч. 1 – М.: ВНИИИМТ, 1992. - с. 189-195
17. Бахир В.М. Медико-технические системы и технологии для синтеза электрохимически активированных стерилизующих, дезинфицирующих и моющих растворов. // Дисс. докт. техн. наук. – М.: ВНИИИ мед. техники, 1997. – 75 с.
18. Білявський Г. О., Фурдуй Р. С., Костіков І. Ю. Основи екології. - К.: Либідь, 2005. - 408 с.
19. Біологічне очищення стічних вод, електронний ресурс:  
[http://pidruchniki.com/1333122241666/ekologiya/biologichne\\_ochischennya\\_stichnih\\_vod](http://pidruchniki.com/1333122241666/ekologiya/biologichne_ochischennya_stichnih_vod)
20. Біотехнологія молочних продуктів [Л.В. Баль-Прилипко, О.А.Савченко, Н.М.Слободянюк, О.А.Привиденнікова] К: Видавничий центр НУБіП України, 2016. – 332 с.
21. Богданов В.Д. Пищевые структурообразователи: учебное пособие. Находка: Институт технологии и бизнеса, 2000. – 96 с.
22. Болдова Т. А. Разработка технологии варено–копченой колбасы с использованием молочнокислых микроорганизмов: автореф. дис. ...канд. техн. наук: 05. 18. 04. / Татьяна Андреевна Болдова. – М., 1999. – 197 с.
23. Большаков А.С., Сарычева Л.А., Борисенко А.А. Технологические свойства активированной воды // Пищевая технология. – 1992. - № 2
24. Бондаренко, В.М. Дисбиозы и препараты с пробиотической функцией. / В.М.Бондаренко, А.А.Воробьев // Журн. Микробиологии – 2004. - № 1. – С. 84-92
25. Брагин Ю.В. Путь QFD: Проектирование и производство продукции исходя из ожиданий потребителей / Ю.В. Брагин, В.Ф. Корольков. – М., 2003. – 352 с.
26. Бучаченко А.Л. Нанохимия – прямой путь к высоким технологиям нового века // Успехи химии. 2003. Т. 72. С. 419-437
27. Бухтияров В.И., Слинько М.Г. Металлические наночастицы в катализе // Успехи химии. 2001. Т. 70. С. 167-171
28. Вейцер Ю. И., Минц Д. М., Высокомолекулярные флокулянты в процессах очистки природных и сточных вод, 2 изд., М., "Химия", 1984
29. Вестник Московского университета. Серия 2, Химия. 2001. Т. 42. № 5
30. Визначення ступенів екологічного ризику в умовах природо-техногенного хімічного забруднення поверхневих вод / Козловська Т.Ф // Екологічна безпека. – 2009. – с. 118-124
31. Влияние культуральной жидкости пропионовокислых бактерий на формирование качества вареных колбас / И. С. Хамагаева [и др. ] // Все о мясе. – 2011. – № 5. – С. 37–39
32. Вода. Значення у формуванні показників якості та безпеки сировини і продуктів харчування: навчальний посібник / [Л.В. Баль-Прилипко, С.Д. Мельничук, Д.Ю. Прасол, О.С. Віннов]. – К.: 2012 - 116 с.



33. Воробьева Л. И. Антимутагенные свойства бактерий / Л. И. Воробьева, С. К. Абилов // Прикладная биохимия и микробиология. – 2002. – № 2. – С. 115–127
34. Высококачественные мясные изделия без остаточного содержания нитрита натрия / И. А. Лаптев [и др. ] // Мясная индустрия. – 2007. – № 12. – С. 25–28
35. Галиахметов, И.Р. Комплексному мониторингу показателей здоровья – законодательную основу / И.Р. Галиахметов, Б.Х. Ланда // Материалы конференции "Здоровье населения Российской Федерации. Проблемы законодательного обеспечения". – М.: Комитет по образованию и науке Федерального собрания Российской Федерации, 2005
36. Ганина В.И. Пробиотики. Назначение, свойства и основы биотехнологии: монография. – М.: МГУПБ, 2001. –169 с.
37. Галямов Б.Ш., Завьялов С.А., Куприянов Л.Ю. Особенности микроструктуры и сенсорные свойства нанонеоднородных композитных пленок.//Журн. физ. химии 2000. Т. 74 . С 459-465
38. Горбатов А.В. Структурно-механические характеристики пищевых продуктов / А.В. Горбатов, А.М. Маслов, Ю.А. Мачихин и др. – М.: Легкая и пищевая промышленность, 1982. – 296 с.
39. Гридчин А.М., Севастьянов В.С., Лесовик В.С., Михайличенко С.А., Поманович А.А., Колесников А.В. Малотоннажные технологические модули для комплексной переработки природных и техногенных материалов. Журнал Нанотехника №1 (9) 2007 – 45
40. Димань Т. М. Екотрофологія. Основи екологічно безпечного харчування. Навчальний посібник / Т. М. Димань [та ін. ]. – К. : Лібра, 2006. – 304 с.
41. Джигирей В. С. Екологія та охорона навколишнього середовища. К.: Т-во "Знання", КОО, 2007. - 422 с.
42. Долгов В. А. Методические аспекты оценки качества и безопасности пищевой продукции и продовольственного сырья / В. А. Долгов, С. А. Лавина. – М. : [б. в. ], 2003. – 162 с.
43. ДСТУ ISO 14001:2006 "Системи екологічного керування. Вимоги та настанови щодо застосування"
44. Дунченко Н.И. Безопасность сырья и пищевых продуктов: Учебное пособие / Н.И. Дунченко, А.В. Бердутина, С.В. Купцова. – М.: МГУПБ, – 2005. – 160 с.
45. Екологічна безпека гідросфери регіонів, очищення стічних вод та утилізація шламів водоочищення/ О. М. Адаменко, Л. І. Челядін, В. Л. Челядін, М. Р. Скробач// Экотехнологии и ресурсосбережение. - К.: 2007. - № 6. - С. 68-73
46. Екологічні збитки від забруднення земель внаслідок впливу на них мулових карт із осадами стічних вод / О.Г. Левицька / Вісник НТУ "ХП".- 2013. с. 67 – 70
47. Електронний ресурс  
[www.pidruchniki.com/10611207/ekologiya/zahodi\\_ochischennya\\_poverhnevih\\_pidzemnih\\_vod\\_ukrayini\\_kontrol\\_yakistyu\\_vodi](http://www.pidruchniki.com/10611207/ekologiya/zahodi_ochischennya_poverhnevih_pidzemnih_vod_ukrayini_kontrol_yakistyu_vodi)

48. Електронний ресурс:  
[www.http://pidruchniki.com/12991010/ekologiya/sposobi\\_ochischennya\\_stichnih\\_vod](http://pidruchniki.com/12991010/ekologiya/sposobi_ochischennya_stichnih_vod)
49. Електронний ресурс: [www.ekologprom.com/lekczi-materiali-z-nzhinerno-ekolog/39-metodi-ochishhennya-stichnix-vod.html](http://www.ekologprom.com/lekczi-materiali-z-nzhinerno-ekolog/39-metodi-ochishhennya-stichnix-vod.html)
50. Електронний ресурс: <http://www.xumuk.ru/encyklopedia/2/4784.html>.
51. Електронний ресурс: <http://www.admchem.com/eyu/asp/Aboutf.asp?ID=24>
52. Електронний ресурс: <http://www.viven.ru/poliakrilamid>
53. Електронний ресурс:  
[https://nomitech.ru/himicheskie\\_reagenty/flokulyanty/flokulyant-kationnyy-poliakrilamid/](https://nomitech.ru/himicheskie_reagenty/flokulyanty/flokulyant-kationnyy-poliakrilamid/)
54. Егоров Е. С. Бактериоцины: Образование свойства, применение / Е. С. Егоров, И. Н. Баранова // Антибиотики и химиотерапия. – 1999. – № 6. – С. 33–40
55. Жаринов А. И. Пищевая биотехнология: научно–практические решения в АПК / А. И. Жаринов, И. Ф. Горлов, Ю. Н. Нелепов, Н. А. Соколова. // Монография. Москва: Вестник РАСХН, 2003. – 384 с.
56. Журавская Н. К. Использование протеолитических ферментов и антиоксидантов для производства рубленых полуфабрикатов / Н. К. Журавская, О. В. Изотов // Мясная индустрия. – 2002. – № 9. – С. 23–25
57. Загальнодержавна цільова програма "Питна вода України" на 2006 – 2020 роки: затверджена Законом України № 2455 – IV від 3 березня 2005 р. // Уряд. кур'єр. – 2005. – 13 квітня - №14. – С.1
58. Закон України "Про безпечність та якість харчових продуктів" № 771 / 97 – вр: підписано 23 груд. 1997 р. / Верховна Рада України. – Офіц. вид. – К. : Офіційний вісник України, 2008. – № 3. С. 13 – (Бібліотека офіційних видань)
59. Закон України "Про внесення змін до деяких законодавчих актів України щодо харчових продуктів" від 22.07 2014 № 1602-VII
60. Закон України від 15 травня 2014 р. № 1315-VII "Про стандартизацію"
61. Закон України від 20.10.2011 р. № 3933-VI "Питна вода України на 2011-2020 роки"
62. Запольский А.К., Баран А.А., Коагулянты и флокулянты в процессах очистки воды. Свойства, получение, применение, Л.: Химия, 1987 г.
63. Зинина О. В. Технологические приемы модификации коллагенсодержащих субпродуктов / О. В. Зинина, М. Б. Ребезов // Мясная индустрия. – 2012. – № 5. – С. 34–36
64. Значение перспективных нанотехнологий для пищевых продуктов и их упаковки. Издательский дом "РЕАЛ-ПРЕСС" 2004 С. 1-3 ([www.real-press.com/article.php?aid=237](http://www.real-press.com/article.php?aid=237))
65. Зонтаг Г., Штрэнге К., Коагуляция и устойчивость дисперсных систем, пер. с нем., Л., "Химия", 1973, 152 с.
66. Ивакин А.Н. Значение воды в формировании ионного и физико-химического состава пищевых продуктов и медицинских препаратов // Мясная индустрия. – 1999. - № 5. – с. 38-40

67. Иванкин А. Н. Современные методы оценки качества и безопасности мясного сырья и мясопродуктов / А. Н. Иванкин, Т. Г. Кузнецова // Все о мясе. – 2005. – № 4. – С. 26–30
68. Изменение соединительной ткани под воздействием ферментного препарата и стартовых культур / М. Б. Ребезов [и др. ] // Вестник мясного скотоводства. – 2011. – № 64. – С. 78–83
69. Изучение возможности использования пропионовокислых бактерий при посоле мясного сырья: материалы межрегионального постоянно действующего научно – технического семинара [«Экологическая безопасность России»], (Пенза, 27–28 апр. 2000 г. ) / Л. И. Заиграева [и др. ]. –П. : Приволжский дом знаний, 2000. – 106–107 с.
70. Использование денитрифицирующих методов при производстве сырокопченых и сыровяленых мясных продуктов / [М. Ю .Минаев, Ю. Г. Костенко, Г. И. Солодовникова, и др.]/// Мясная индустрия. – 2004. – №9. – С.33-35
71. Использование коллагенового гидролизата в технологии производства мясного хлеба / Ребезов М. Б. [и др. ] // Вестник «ТГЭУ». – 2011. – № 3. – С. 134–140
72. Кабаяси М. Введение в нанотехнологию / пер. с японск. – М.:БИНОН. Лаборатория знаний, 2007 – 134 с.
73. Кайм Г. Технология переработки мяса. Немецкая практика / Г. Кайм; пер. с нем. Г. В. Соловьёвой, А. А. Куреленкова. – СПб. : Профессия, 2006
74. Кантере В.М. Развитие пищевых предприятий в современных условиях / В.М. Кантере, В.А. Матисон, Е.В. Крюкова // Пищевая промышленность. – 2003. – №4. – С. 6-7
75. Ковальчук В.А., "Розвиток наукових і практичних засад ідентифікації роботи споруд для флоатаційної та біологічної очистки стічних вод м'ясопереробних підприємств", автореферат дисертації на здобуття наукового ступеня доктора технічних наук, Рівне, 2011, електронний ресурс: [www.irbis-nbuv.gov.ua/.../cgiirbis\\_64.exe?](http://www.irbis-nbuv.gov.ua/.../cgiirbis_64.exe?)
76. Козаченко Н. П. Разработка технологии соленых мясопродуктов с применением ферментного препарата пепсина: автореф. дис. ... канд. техн. наук: 05. 18. 04 / Надежда Петровна Козаченко. – Москва, 1985. – 24 с.
77. Костенко Ю. Г. Листерии – критерий безопасности мясных продуктов / Ю. Г. Костенко, Т. С. Шагова, К. С. Янковский // Мясная индустрия. – 1997. – №3. – С. 23–24
78. Кравченко Ю. Пресс-конференция. Государство снимает с себя ответственность за качество // Стандарты и качество. – 2003. – № 1. – С. 16
79. Красуля О. Н. Соли молочной кислоты–надежный барьер для безопасности мясных продуктов // Мясная индустрия. – 2002. – № 5. – С. 19–21
80. Кузнецова Г. А. Создание нового бактериального препарата и его использование для интенсификации технологии сырокопченых колбас: автореф. дис. .канд. техн. наук: 05. 18. 04 / Галина Анатольевна Кузнецова. – Москва, 2000. – 345 с.

81. Липович В.Г., Полубенцева М.Ф., Алкилирование ароматических углеводов, М., "Химия", 1985, 272 с. ил.
82. Литвинова Е. В. Теоретические и практические основы разработки технологии функциональных продуктов с антимуtagenными свойствами: автореф. дисс. ... на соиск. уч. степ. д. т. н. : 05. 18. 04 / Елена Владимировна Литвинова. – М. : ВНИИМП, 2003. – 34 с.
83. Методологічні підходи до визначення економічних втрат промислового підприємства від негативного впливу на навколишнє середовище / Ремешевська І. В. // Екологічна безпека. – № 1./2014 – с. 9 - 13]
84. Модифицированные белки вторичных продуктов убоя животных в производстве продуктов функционального назначения: материалы Международной научно–технической конференции [«Пищевой белок и экология»], (Москва, 14 апр. 2000) / Л. В. Антипова, И. А. Глотова. – Москва, 2000. – С. 171–172
85. Молекулярные основы продукции и действия бактериоцинов / Л. П. Блинкова [и др. ] // Журнал микробиологии. – 2007. – № 2. – С. 97–10
86. Молочнокислые бактерии – биофункциональный фактор в технологии мясных продуктов: материалы IV Международной научно–технической конференции [«Пища. Экология. Человек»], (Москва, 2001) / И. А. Рогов, Н. В. Нефедова, Ю. И. Ковалев. – Москва, 2000. – С. 101–102
87. Монисов А. А. Проблемы безопасности пищевых продуктов / А. А. Монисов, В. А. Тутельян, С. А. Хотимченко // Вопросы питания. – 1994. – №3. – С. 33–39
88. Наказ Міністерства аграрної політики та продовольства України від 30.07.2012 р. № 471
89. Наказ Міністерства охорони здоров'я України "Про затвердження Державних санітарних норм та правил "Медичні вимоги до якості та безпечності харчових продуктів та продовольчої сировини" № 88 / 22620 підписано 29 груд. 2012 р. / Верховна Рада України. – Офіц. вид. – К. : Офіційний вісник України, 2013. – №6. – 356 с. – (Бібліотека офіційних видань)
90. Нетреба В.П., Флокуляция минеральных суспензий, М.: Недра, 1983
91. Нефедова Н. В. Изучение функциональных свойств колбас со стартовыми культурами / Н. В. Нефедова, М. П. Артамонова, А. Н. Помиков // Мясная индустрия. – 2003. – № 11. – С. 48–49
92. Нечаев А. П. Пищевая химия: учебник / А. П. Нечаев, С. Е. Траубенберг, А. А. Кочеткова. – СПб. : Гиорд, 2001. – 592 с.
93. Пат. 2367685 Российская Федерация МПК<sup>8</sup> C12N 1/20. Препарат бактериальный для производства ферментированных мясных изделий и биотрансформации мясного сырья / Хорольский В. В. , Машенцева Н. Г. , Баранова Е. А, Семёнышева А. И. , Васильченко А. А. ; заявитель и патентообладатель МГУПБ. – заявка № 2007146645; заявл. 19. 12. 2007; опубл. 20. 09. 2009, Бюл. №2
94. Пат. 2095990. Российская Федерация МКИ6 A22C11/00 Способ производства сырокопченых колбас/ Костенго Ю. Г. , Солодовникова Г. И.

- , Кузнецова Г. А. ; заявитель и патентообладатель ВНИИМП. – № 95104767/13; заяв. 03. 04. 95; опубл. 20. 11. 97, Бюл. № 32
95. Потапова К. В. Пробиотические культуры для сырокопченых колбас/ К. В. Потапова, Н. Н. Левина, Г. Г. Страхова // Мясная индустрия. –2003. – № 5. –С. 30–31
96. Особенности использования стартовых бактериальных культур в производстве мясопродуктов: материалы IX Международной научно–технической конференции, [«Техника и технология пищевых производств»], (Могилев, 25–26 апр. 2013) / науч. ред. А. А. Соловьева, О. В. Зинина, М. Б. Ребезов. – Могилев: МГУП, 2013. – 105 с.
97. Пат. SU 1821961. Российская Федерация С12N1/20 Способ получения бактериального препарата бп–вкк для производства варено–копченых колбас / Солодовникова Г. И. , Лисицына Н. М. , Осипова В. И. , Терешина О. В. , Анисимова И. Г. , Кононенко В. В. , Косарева Г. В. , Лагода И. В. , Герасимова Л. Н. – заявл. 03. 04. 95. ; опубл. 20. 11. 97, Бюл. № 32
98. Патракова, И. С. Безопасность сырья и продукции мясной промышленности / И. С. Патракова. – Кемерово: Кемеровский технологический институт пищевой промышленности, 2010. – 15 с.
99. Пашков А. П., Проблеми забруднення поверхневих, підземних і стічних вод та заходи щодо його ліквідації і запобігання в Україні, електронний ресурс:  
[http://www.ekmair.ukma.kiev.ua/bitstream/123456789/1058/1/Pashkov\\_Problemy%20zabrudnennia%20poverkhnevykh.pdf](http://www.ekmair.ukma.kiev.ua/bitstream/123456789/1058/1/Pashkov_Problemy%20zabrudnennia%20poverkhnevykh.pdf)
100. Пищевая химия / Под ред. Д.т.н. проф.А.П. Нечаева. – Санкт-Петербург: ГИОРД, 2003. – 632 с.
101. Прикладная биотехнология: учебное пособие / Л. В. Антипова [и др. ]. – СПб. : Гиорд, 2003. – 288 с.
102. Прилуцкий В.И., Бахир В.М. Электрохимически активированная вода: аномальные свойства, механизм биологического действия. – М.: ВНИИИ мед. техники, 1997. –232 с.
103. Прилуцкий В.И., Шоль В.Г., Фисинин В.И. и др. – Сергиев Посад, 1995. – 29 с.
104. Применение электроактивированной воды в птицеводстве. Методические указания / Филоненко В.И., Рогов И.А., Горбатов А.В., Свинцов В.Я. Дисперсные системы мясных и молочных продуктов. – М.: Агропромиздат, 1990. – 320 с.
105. Прищеп Т. П. Основы фармацевтической биотехнологии: Учебное пособие/ Т. П. Прищеп, В. С. Чучалин, К. Л. Зайков, Л. К. Михалева. – Ростов–на–Дону: Феникс; Издательство НТЛ, 2006. – 256 с.
106. Рогов И. А. Пищевая биотехнология. Основы пищевой биотехнологии / И. А. Рогов, Л. В. Антипова, Г. П. Шуваева. – М. : Колос, 2004. – 440 с.
107. Рогов И. А. Синбиотики в технологии продуктов питания: монография / И. А. Рогов [и др. ]. – М. : МГУПБ, 2006. – 236 с.

108. Розанцев Э. Г. Растительные протеазы и качество мясных продуктов/ Э. Г. Розанцев, И. М. Акперов. – М. : Мясная промышленность, 1994. – №4. – С. 78–79
109. Розпорядження Кабінету Міністрів України «Про затвердження плану заходів щодо розроблення, впровадження і функціонування систем управління якістю, екологічного управління та інших систем управління» №492 / 2013 – р: підписано 19 чер. 2013 р. / Верховна Рада України. – Офіц. вид. – К. : Урядовий кур'єр, 2013. – №131. – (Бібліотека офіційних видань)
110. Рябцев В. Е. Про якість питної води та стан безпеки водних ресурсів України / В. Е. Рябцев, Ю. Л. Коваленко, Л. О. Тарасенко // Проблеми водопостачання, водовідведення та гідравліки. – 2005 - № 5. – С. 4 – 14
111. Савицкая, Т. А. Пособие для самостоятельной работы над лекционным курсом Коллоидная химия: вопросы, ответы и упражнения. Пособие для студентов химического факультета / Т. А. Савицкая, Д. А. Котиков. – Минск: БГУ, 2009. – 140 с.
112. Сазыкин Ю. О. Биотехнология: учебное пособие для студентов высш. учеб. заведений / Ю. О. Сазыкин, С. Н. Орехов, И. И. Чакалева – М. : Издательский центр «Академия», 2008. – 348 с.
113. Самеджима К. Гидролиз мышечных белков актинидином / К. Самеджима, И. Чое, М. Ихифоши. – Т. : Ниппон секухин коге гаккайси, 1991. – №4. – С. 45–46
114. СанПіН 2.1.5.980-00 "Гігієнічні вимоги до охорони поверхневих вод"
115. Семінар "Глобальні проблеми води. Як можуть допомогти стандарти ISO" // Стандартизація, сертифікація, якість. - 2012. - № 5. - С. 16
116. Семенова А. А. Основные факторы повышения стойкости мясопродуктов к микробиологической порче. / А. Б. Лисицын, А. А. Семенова, М. А. Цинпаев // Все о мясе. – 2007. – №3. – С. 16–23
117. Современные представления о безопасности мясопродуктов. Адаптация к условиям АПК РФ общей методологии отслеживания интегрированного контроля качества и безопасности мясных продуктов: материал VII Международной научной конференции, (Москва, 2004 г. ) / А. И. Жаринов. – М. : РАСХН, ВНИИМП, 2004. – Ч. I. – С. 144–149
118. Сорокин, О. В. Определение активности воды в пищевых продуктах / О. В. Сорокин, Е. В. Фатьянов : Биотехнология, пищевая промышленность мат. междунар. студ. конф. «Научный потенциал студенчества – будущему России»- Ставрополь, СевКавГТУ: 2007. – 189 с.
119. Сперанский В. В. Схемы микробиологического анализа мяса, продуктов убоя животных и мясопродуктов (колбас, консервов): практическое пособие / В. В. Сперанский, Л. В. Мархакшинова. – Улан-Удэ: Издательство ВСГТУ. –2005. – 60 с.
120. Стеле Р. Срок годности пищевых продуктов: Расчет и испытание / под ред. Р. Стеле. – СПб. : Профессия, 2006. –480 с.

121. Технологический регламент регулирования кислотности молока и жидких молочных продуктов методом униполярной активации. – Ташкент: Фирма "Эсперо", 1991. – 92 с.
122. Указ Президента України "Про заходи щодо підвищення якості вітчизняної продукції" № 113 / 2001: підписано 23 лют. 2001 р. / Верховна Рада України. – Офіц. вид. – К. : Офіційний вісник України, 2001. – №9. – 27 с. – (Бібліотека офіційних видань)
123. Україна. Екологічні проблеми природних вод. – Київ: Всеукраїнська Екологічна Ліга, Центр екологічної освіти та інформації, 2000. – 165 с.
124. Фактори і ризики забруднення довкілля та їх вплив на показник екологічної безпеки об'єкта / Л.І. Челядин, Л.І. Григорчук, В.Л. Челядин // Науковий вісник ІФНТУНГ.-2009. - № 1. - с. 189-195
125. Федонин М. Ю. Разработка технологии формованных продуктов из говядины с использованием ферментного препарата: автореф. дис. ... канд. техн. наук: 05. 18. 04 / Михаил Юрьевич Федонин. – Москва, 2000. – 28 с.
126. Хамагаева И. С. Использование пробиотических культур для производства колбасных изделий / И. С. Хамагаева, И. А. Ханхалаева, Л. И. Заиграева. – Улан-Удэ: Изд-во ВСГТУ, 2006. – 204 с.
127. Чичков, А. А. Розробка технології варених ковбас з використанням активованих білковмісних систем: автореф. кандидата технічних наук / А. А. Чичков. – Ставрополь, 2004. - 24 с.
128. Шоль В.Г., Филоненко В.И., Офицеров В.А., Богатов О.В. Релаксация электроактивированной воды // Материалы всероссийской конференции "Методы и средства стерилизации и дезинфекции в медицине" – М.: МИС-РТ, 1992. –www.mirst.ru
129. Abdulatef M. Ahhmed Impact of transglutaminase on the textural, physicochemical, and structural properties of chicken skeletal, smooth, and cardiac muscles / M. Ahhmed, N. Tetsuo, M. Michio // Meat Science, 2009. – №. 83. – P. 759–767
130. Akhmed A. Transglutaminase polymerizes meat proteins at –35°C and may have industrial applications as a biological protective film / A. Akhmed [et al.] // Cereal Foods World. – 2004. – P. 56–62
131. Barnes E. M. Changes in the oxidation – reduction potential of the sternocephalicus muscle of the horse after death in relation to the development of bacteria / E. Barnes, M. Ingram // Journal Science Food Agricultural –1955. – № 6. – P. 448–4
132. Barnes E. M. The effect of redox potential on the growth of Clostridiutn welchii strains isolated from horse muscle. / E. Barnes, M. Ingram //Appl. Bacterial. – 1956. – № 19. – P. 117–12
133. Chirife J. A critical review of some non–equilibrium situations and glass transitions on water activity values of foods in the microbiological growth range / J. Chirife, M. Buera. – К. : Journal of Food Engineering, 1995. – №25 (4). – P. 531–552

134. Chirife J. Water activity, water glass dynamics, and the control of microbial growth in foods / J. Chirife, M. Buera // *Critical Reviews in Food Science and Nutrition* . – 1996. – №36(5). – P. 465–513
135. Chiya K. Transglutaminase: its utilization in the food industry / K. Chiya, K. Yamazaki, Y. Susa. // *Food reviews international*. – 2001. – №17 (2). – P. 221–246
136. Coagulation and Flocculation in Water and Wastewater Treatment, электронный ресурс: [www.floculant.ru/content/files/Teoriya\\_primeneniya.pdf](http://www.floculant.ru/content/files/Teoriya_primeneniya.pdf)
137. Christian J. Water activity and the growth of microorganisms. In *Recent Advances in Food Science* / J. Christian, M. Leitch, D. Rhodes. – London: Butterworths, 1963. №. 3. – 248 p.
138. De Vuyst L. Bacteriocins from Lactic Acid Bacteria: Production, Purification, and Food Applications Luc / L. De Vuyst, F. Leroy // *Mol. Microbiol. Biotechnol*, 2007. – №. 13. – P. 194–199
139. Food: from farm to fork statistics // Luxembourg: Publications Office of the European Union, 2011. – 164 p .
140. Franz C. Enterococci in foods – a conundrum for food safety / C. Franz, M. Stiles, K. Schleifer, W. Holzapfel // *Int. J. Food Microbiol*, 2003. – №. 88. – P. 105–122
141. Gill A. O. Interactive inhibition of meat spoilage and pathogenic bacteria by lysozyme, nisin, and EDTA in the presence of nitrite and sodium chloride at 24 C / A. O. Gill, R. A. Holley// *International Journal of Food Microbiology*. – 2003. – № 80 (3). – P. 251–259
142. Hammes W. New developments in meat starter cultures / W. Hammes, C. Hertel. // *Meat Science*, 1998. – №. 49. – 199 p.
143. Hierro E. Contribution of microbial and meat endogenous enzymes to the lipolysis dry fermented sausage / E. Hierro, D. la Hoz. Lorenza, J. Ordonez // *Agro and Food chemistry*. – 1997. – № 8. – P. 2989–2995
144. Influence of temperature, water activity, and pH on growth of some xerophilic fungi / M. A. Gock [et al.] // *International Journal of Food Microbiology*. – 2003. – №81 (1). – P. 11–19
145. ISO 24511:2007 Activities relating to drinking water and wastewater services — Guidelines for the management of wastewater utilities and for the assessment of wastewater services
146. ISO 24511:2007 Activities relating to drinking water and wastewater services — Guidelines for the management of wastewater utilities and for the assessment of wastewater services
147. Jay J. Modern food microbiologi / **J. Jay**, M. **Loessner**, J. Martin, A. David // Springer. –2000. – № 36 (5). – P. 376–3153
148. Leistner L. Hurdle effect and energy saving. In: *Food Quality and Nutrition*/ L. Leistner. – London:Applied Science Publishers, 2002. – P. 345–350
149. Leistner L. Combined methods for food preservation / L. Leistner. – New York: CRS Press, 2007. – P. 457–485



150. Meat products with minimal nitrite additions, storable without refrigeration: Proceedings of 26th European Meeting of Meat Research Workers, (Colorado, 1980) / L. Leistner, I. Vukovic, J. Dresel. – USA: Springs, 1980. – №. 2. – P. 230
151. Neubauer H. Molecular characterization of the nitrite-reducing system of *Staphylococcus carnosus* // Journal of Bacteriology. – 1999. – №. 5. – P. 30–31
152. Norma Moss GRIC Brian Dymond LRIC: Flocculation: Theory & Application. электронный ресурс: [www.siltstop.com/pdf/flocculation-theory\\_application.pdf](http://www.siltstop.com/pdf/flocculation-theory_application.pdf)
153. Okayama T. Wirkung einer Glutaminaseanfibereitung aus *Bacillus subtilis* GT auf die sensorischen Eigenschaften von Fleischfermenten / T. Okayama, V. Nabae, M. Yamanoue // Fleischwirtschaft. – 1997. – P. 68–69
154. Poeta P. Virulence factors and bacteriocins in faecal enterococci of wild boars / P. Poeta [and other. ] // J. Basic. Microbiol. – 2008. – №. 48. №5. – P. 385–392
155. Ratkowsky D. A. Relationship between temperature and growth rate of bacterial cultures / D. A. Ratkowsky et al. – A. : Journal Bacteriol, 1989. – 149 p.
156. Robinson R. K Encyclopaedia of Food Microbiology / R. K. Robinson, C. A. Batt, P. D. Patel. – NY: Academic Press, 2000. – 157 p.
157. Sakharov I. Comparative Biochemistry and Physiology. / I. Sakharov, F. Litvin, 1990. – №. 97. – P. 407–410
158. Sautour M. Comparison of the effects of temperature and water activity on growth rate of food spoilage moulds / M. Sautour et al. // Journal of Industrial Microbiology and Biotechnology. – 2002. – №28 (6). – P. 311–315
159. V. Steven Green, D.E. Stoff, Polyacrylamide: A Review of the Use, Effectiveness, and Cost of a Soil Erosion Control Amendment, электронный ресурс: <http://www.terramarebeheer.nl/tudelft/Polyacrylamide,%20A%20Review%20of%20the%20Use,%20Effectiveness,%20and%20Cost%20of%20a%20Soil%20Erosion%20Control%20Amendment.pdf>
160. Trailer J. A Water relations of foodborne bacterial pathogens: an updated review / J. A. Trailer. – C. : Journal Food Protect, 1986. – P. 656–670

## QUALITY AND SAFETY OF MEAT AND MEAT PRODUCTS

### 5.1 Concept of Quality

The one of serious problems of public economy, which exists since the earliest stages of its development is perfecting of quality of marketed production and resulted finally in clearer understanding of need of continuous revision and perfecting of principles of work, the thought expressed by ancient thinker Zaratustra in form of axiom: "The snake not capable to change its skin is doomed to die". Therefore, up to 25 % of expenses of typical industrial manufacture were spent on identification and removing of defects of produced products. This need became the more understandable in intensification of global competition and quick change of demand of consumers in conditions of oversaturated market.

The quality of products of men's activities depends of influence of numerous accidental, local and subjective factors. To decrease the grade of their influence on conditions of business operation, persons of economy use complex of measures directed on the continuous control of process of fabrication of the product (giving of services). Being in competitive conditions, each enterprise must reconsider periodically style of its operation reckoning a priori that the principal norm of reaching of effectiveness of operation is "satisfying of needs of consumers in receiving of qualitative production". To satisfy needs of men, the consumable has to have certain properties and the grade of their compliance to the existing demands of consumers may be correlated as the ratio of its cost and value:

$$\textbf{Quality} = \textbf{Satisfying of needs of consumers} = \textbf{Value / Cost}$$

*Quality means the grade of satisfying of needs and expectations of consumers by the complex of character properties of production*

However, most persons of economy and consumers have no clear understanding of sense of "proper level of quality" yet, what requires of concretization of quantitative parameters of its evaluation. Initially, at first stages of serial producing, the main criterion in evaluation of quality of products taken into consideration was grade of observance of the complex of their normalized properties. However, rising of complexity of construction and composition of produced items resulted in augmentation of quantity of criteria to be controlled, and the principal question to be cleared in this work became what group of properties is crucial in evaluation of quality of production, and the main accents in its quality control were shifted on comprehensive inspection of functional characteristics of consumables in conditions of their mass production. The principal object of control became the entire set of character properties of totality of produced items, but not the parameters of each one. The way used in it was introduction of modern principles of quality management, i.e. organization of coordinated operation of administration, managers, engineers and laborers of the enterprise to be carried out

in minimum spending of used materials, energy and live work. The measures used to reach this goal were rising of qualification of engaged laborers, optimization of structure of spending of finances, betterment of quality of products, introduction of innovative projects of business operation and intensification of activities in marketing of finished products.

*Quality management means the activity in setting of objectives to be reached in operation of the enterprise, clear distribution of responsibilities of executors of basic works and optimization of principles of general guidance directed on continuous betterment of quality of its production*

Planning quality of products (services, procedures of operation etc.), one has to take into consideration the fundamental principles of business activities as follows:

- normalizing and steady improvement of regulated indices of quality of production,
- centering of work in betterment of parameters of quality of production on, which define its goodness,
- observance of established norms of operation and steady elimination of found unconformities and drawbacks,
- improvement of conditions of labor as one of the main priorities in work.

Guaranteeing of high quality of production is the crucial factor of operation in conditions of international competition, what influences sufficiently on the state of national safety, forming of foreign policy of the State and assuring of satisfactory conditions of life of population. The basic parameters of quality are formed mainly under the influence of factors as follows: 1) use of advances reached in scientific and technical progress, 2) use of creative potential of personnel realized in its training, and systematical raising of qualification, 3) extensive use of material and moral methods of motivation, psychological compatibility of laborers, 4) analysis and consideration of needs of domestic and international markets. Despite their variety, they have the common features. First, it is consolidation of staff of the enterprise in functional groups. Second is mobilization of laborers of the enterprise on solving of concrete tasks and reaching of common goals. Third, mutual work of members of labor collectives permits to coordinate and unify their activities, what assists in forming of the staff as the integrated unit, which totalized capability exceeds greatly the sum of capabilities of its individuals. All these features were unified in realization of the central idea of advanced Japanese concept of quality (Figure 5.1), which declares that the "WAY TO QUALITY IS ENDLESS".

USA was the pioneer State in organizing of national leagues of quality organized first in 1899. The analogous trend found its continuation after WW II, when the consumer's cooperative organizations of Australia, Belgium, Netherlands, United Kingdom and USA unified their activities and founded in 1960 the *International Organization of Unions of Consumers (IOCU)*, which lists now more of 200 organizations worldwide. The basic principles of its policy is development of norms of observance of right of persons on safety and information, right to be heard on their needs, right on satisfying of their basic interests and compensation of losses, right on education and life in healthy environment. Using said norms as a model, the

UN General Assembly approved (April 9 1985) the document of "*Guiding Principles of Protection of Interests of Consumers*", which gave the priority level for the rights of consumers in regulation of conditions of functioning of the society. Shortly, their content is as follows:

Right on safety – protection of consumers against marketing of production and giving of services hazardous for their health and life.

Right on information – acquainting of consumers with their basic rights and obligations, introduction of norms of protection of citizens against dishonest advertising, marking and labeling of products (services) they use.

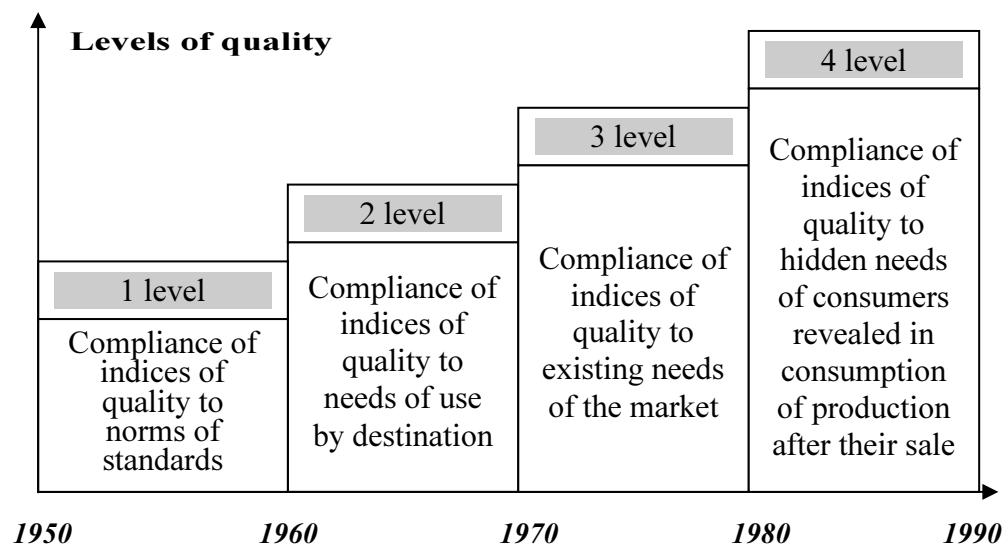
Right on satisfaction of basic needs – right on access to goods and services necessary for normal vital activity.

Right to inform on needs – right on driving of information on interests of consumers in development of market policy of the State.

Right on compensation of losses – right on fair policy in solving of substantiated claims of men for replacing of falsified goods (services of improper quality) for the qualitative ones.

Right on education – right on obtaining of knowledge and skill necessary for the informed behavior in vital situations.

Right on healthy environment – right of present and future generations of mento live in the environment safe for their life and health.



**Fig. 5.1 Progress of principles of ensuring of quality according to Japanese concept**

Observance by the State of rights of consumers is the constituent part of freedom of individuals, and the UN Organization recognized this principle as the fundamental criterion in evaluation of quality of life. The basic elements in its realization are the rules and norms of contracts, which normalize typically procedures of establishing, amending or cancellation of material and other kind duties of businesspersons in assuring of proper quality of products (services) they propose at all stages of their life-cycle. The event of concluding of contract gives its parties juridical guarantees of observance by contracting parties of taken obligations and permits to take into consideration the peculiarities of their interrelations. If the

contracting party would violate any provision of the contract, it has to pay the suffered party all financial losses and compensate its missed profit.

To detail norms of observance of provisions of quality standards, the EU governing structures developed directives, which establish norms of responsibility of persons of economy for supply of poor-quality production on European markets, namely:

- reducing of prices of sale,
- elimination of found unconformities of quality of defective production in established term at expense of supplier,
- free replacing for the suffering parties of defective production for the qualitative one,
- forced annulling of validity of contract on sale and compensation of committed harm.

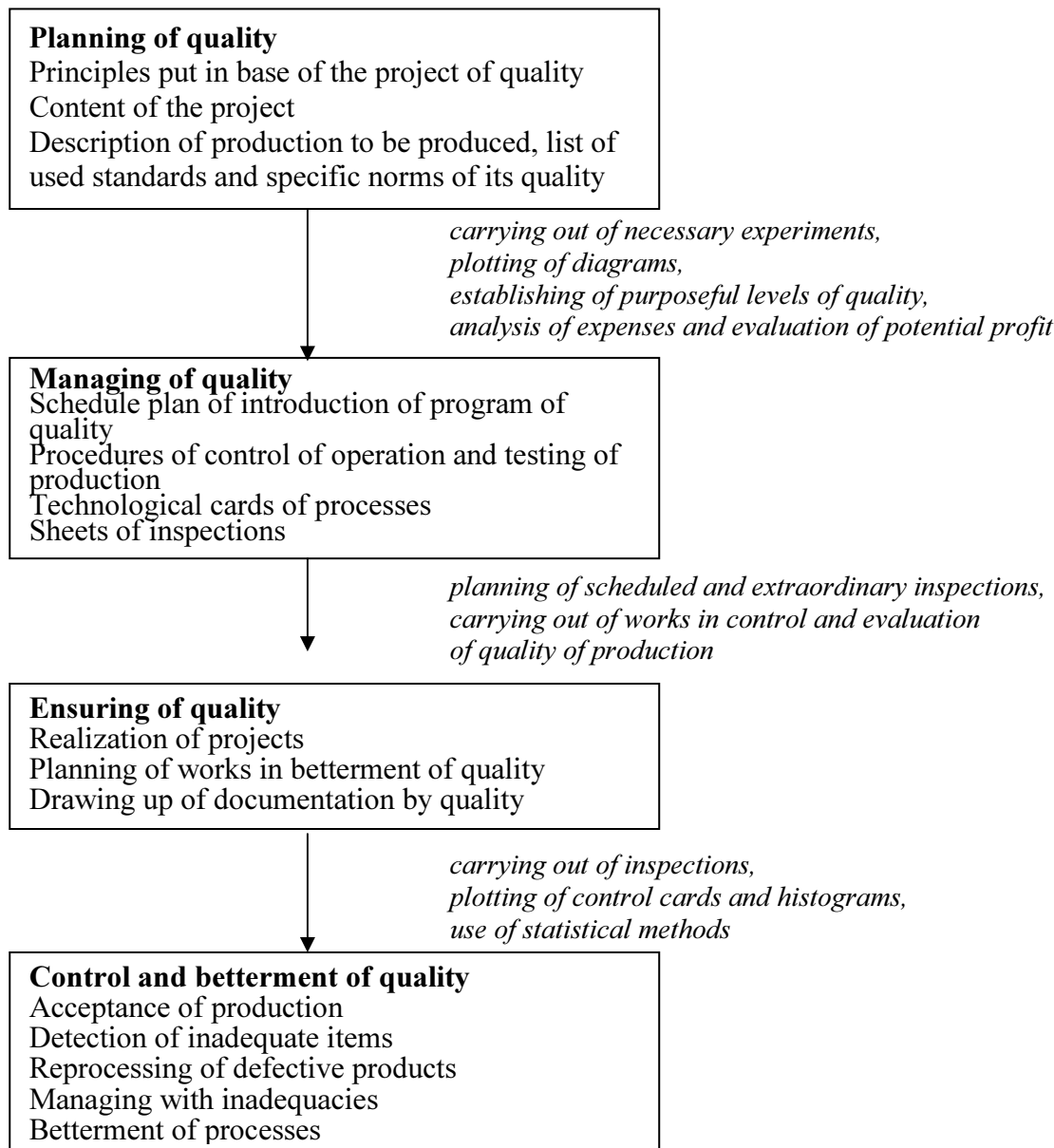
In progress of processes of globalization of economy, there arose the urgent problem of unification of norms of quality management worldwide. The result was development in 1980-s of group of international quality standards known as standards of ISO 9000 series. These documents establish norms of carrying out and documenting of processes, which influence on quality of production. Use of norms they established permits persons of economy to detail procedures of productive work and improve the style of operation of the enterprise. The essence of this series standards is guaranteeing of reaching of three basic objectives as follows:

- fabrication of production and giving of services, which quality would meet the norm of steady satisfying of existing and prospective aspirations of consumers,
- steady confidence of upper managing persons in proper quality of production of their enterprise,
- steady confidence of consumers in proper quality of production they buy.

To survive on the market and be competitive, the enterprise must periodically reconsider the existing practice of its functioning and introduce the advanced principles of work to be carried out in observance of rigorously documented procedures of business operation. P. Drucker, one of the most known ideologists of contemporary principles of management, formulated such objectives some strangely: *"Management is the specific kind of operation, which transforms the non-organized crowd into the effective purposeful and organized group"*. This term is used usually in meaning of complex of actions the enterprise carries out in control of quality of its production and correctness of procedures of operation at all stages of manufacture, which starts in obtaining of raw materials and finishes in dispatching of finished products to their consumers. Henceforth, the key problem of management is development, introduction and certification of system of guaranteed producing of qualitative production (*"quality management system"*, the modern term used instead of earlier *"system of managing of quality"*).

*Quality system means the complex of interrelated and interacting elements of organizational structure, mechanisms of responsibility, distribution of authorities and procedures of operation of the organization*

The typical structure and norms of accomplishing of such kind works are shown in Figure 5.2.



**Figure 5.2 Structure of system of management of quality**

Scientists assert that XXI century will be the century of quality in all its displays, i.e. the century of quality of products and services, quality of work, quality of environment and qualitative standards of life. The same relates also to the sphere of producing of meat products, which assortment consists mainly of sausages produced of minced meats mixed with fat, kitchen salt, spices, kitchen herbs and other ingredients.

## **5.2 International standards of quality**

Increasing of quantity of meat-processing enterprises and rising of level of consumption of meat and meat products puts the foremost problem of guaranteeing of proper quality of products that have to understand by norms of Ukrainian legislation as:

*Quality means the grade of satisfying of needs and expectations of consumers by the complex of character properties of production*

Evaluating quality of meat products, consumers have to take into the mind that these products are foodstuffs. Therefore the first and the main characteristic of their goodness is conformance to this destination. The second criterion of their proper quality is nutritional value and the third – complex of factors dependent of specific characters of their finished appearance to be given in process of fabrication.

The modern purchasers carefully read labels before take the good from shelves of markets to evaluate its composition and term of fitness. However it is not the absolute guarantee of avoiding of mistakes and we eat products of improper quality and even do not know about it. The inspecting persons find systematically in control of meat products, meat and fish produced domestically defects of their quality, as well as unconformities to norms of standards (Table 5.1).

**Table 5.1**

***The defects of foodstuffs produced in Ukraine found the most often***

<b>Name of product</b>	<b>Defects found the most often</b>
<b>Sausages</b>	Meat, which has to be used in sausages and frankfurters is replaced in many cases by albuminous raw materials of poor quality (for instance, by tendons) and soy additives
<b>Refrigerated meat</b>	The unfair producers make injections of additives that retain water in meat, what permit them to obtain the additional profit
<b>Refrigerated and frozen fish</b>	Violation of conditions of safe storage, what results in deterioration of taste. Substitution of expensive kinds of cod and zander by cheaper ones, e.g. by Alaska pollak

The systematical violation of norms of quality in conditions of globalization of processes of manufacturing and international barter results in need of establishing of uniforms norms of operation, respectively development of documents, which would normalize compliance of produced of products to norms of good operation and recognition of their proper quality worldwide. The basic criteria of proper quality of works carries out the businessperson are:

- compliance of indices of quality of production to set requirements or its destination,
- satisfying of needs of consumers,
- conformity of parameters of operation to provisions of used normative documents,
- observance of norms of protection of environment.

The basic criteria of proper quality of works carries out the businessperson are:

- compliance of indices of quality of production to set requirements or its destination,
- satisfying of needs of consumers,
- conformity of parameters of operation to provisions of used normative documents,
- observance of norms of protection of environment.

The objects of attestation in this kind work are production (goods and services) and processes of their manufacturing (giving). The basic norms of operation, otherwise procedures of quality management, use the businesspersons are:

- cooperation of administration and laborers in introduction of scientific principles of organization of work and norms of operation based on their use,
- use of scientific criteria in engagement of laborers and attestation of their qualification and professional skill,
- continuous rising of levels of qualification and education of personnel,
- assuring of atmosphere of psychological compatibility and friendly relations of employees.

The spheres of responsibility in execution of productive works are: 1) optimization of procedures of activities and structure of spending of finances, 2) introduction of innovative processes and 3) betterment of indices of quality and methods of marketing of finished production based on use of four groups of methods of operation as follows:

1. *economical* – development of new and betterment of existing designs and norms of manufacturing. This group methods include procedures of pricing, giving of credits, imposing of sanctions for nonobservance of established norms etc.,
2. *initiative* – inducing of work in development and fabrication of qualitative production and imposing of sanctions for losses resulted of marketing and use of poor quality products,
3. *organizational* – administrative methods, which character depends of grade of observance of norms of documents of regulative character (directives, guides etc.),
4. *educational* – measures, which result in improvement of methods of manufacturing and introduction of advanced techniques and technologies.

In progress of processes of globalization of economy, there arose the urgent problem of unification of norms of quality management worldwide. The result was development in 1980-s of group of international quality standards known as standards of ISO 9000 series. These documents establish norms of carrying out and documenting of processes, which influence on quality of production. Use of norms they established permits persons of economy to detail procedures of productive work and improve the style of operation of the enterprise. The essence of this series standards is guaranteeing of reaching of three basic objectives as follows:

- fabrication of production and giving of services, which quality would meet the norm of steady satisfying of existing and prospective aspirations of consumers,
- steady confidence of upper managing persons in proper quality of production of their enterprise,
- steady confidence of consumers in proper quality of production they buy.

The essence of quality standards may be formulated as follows: all processes that can influence on quality of finished products must be documented. The normalized norms have to be carried out under the systematical control of specially



appointed persons who carry the personal responsibility for their observance. The principal problems to be solved in introduction of norms of quality standards are:

- reaching of mutual understanding and confidence of suppliers and consumers in their contracting,
- reaching of mutual recognition of validity of certificates on quality systems issued in observance of international norms by the specialized accredited bodies of different countries,
- assistance and methodological servicing of enterprises of various size, forms of property and spheres of activities in development and introduction of effective quality systems.

The first document, which established norms of assuring of quality, was the US military standard of MIL-Q 9858 developed in the end of 1950-s and taken as a base in development of British standards of BSI 5750 series approved in 1979 that were replicated in later time in observance of international norms. Now they are known as the international standards of ISO 9000 series in version of 1987:

- ISO 9000 "Quality management systems – Fundamentals and vocabulary",
- ISO 9001 "Quality management systems – Requirements",
- ISO 9003 "Quality system. Model for quality assurance in final inspection and test".

The following revision of norms of international quality standards accomplishes the ISO Technical committee 176. This series standards were amended many times, and presently there are known their versions as follows:

- the initial versions approved in 1987,
- the second one validated in 1994 as the edited versions of standards of 1987 series,
- the third revision of standards in 2000 is the result of thorough editing of provisions of documents of 1994 versions,
- the fourth version of standard of ISO 9001 was published in 2008 and standard of ISO 9004, which normalizes procedures of this document, was developed and validated in 2009. These ones represent itself the coordinated pair of normative documents, which detail norms of operation of enterprises in observance of modern trends of progress of global economy.

The basic normative document used in identifying of capability of the enterprise to operate effectively in global markets and certification of quality systems is the standard of ISO 9001. It consists textually, of eight chapters. The first three: "*Sphere of use*", "*Normative references*" and "*Terms and definitions*" are of "auxiliary" character and do not contain any regulative norm. The real procedures recommended for observances by businesspersons list its chapters 4 ÷ 8 addressed to the following concrete groups of their laborers:

Chapter 4 "*System of quality management*" is addressed to the whole staff of the enterprise and contains the generalized norms of its operation and procedures of their documenting.

Chapter 5 "*Responsibility of administration*" details procedures of work of upper managing personnel.

Chapter 6 "Management of resources" regulates procedures of operation of managers of "second level" of responsibility and methods of optimization of infrastructure of the enterprise and rising of skill of its personnel.

Chapter 7 "Producing of production" contains provisions of unconditional observance of the standardized norms of manufacture and/or servicing, registration of their results and methods of control of quality of production understood as succession of actions carried out in observance of norms of used technologies. Such recommendations have the addressees of the "second rank" administrative persons and concrete executors of productive works.

Chapter 8 "Measurement, analysis and improvement" relates to the following works:

- continuous monitoring of operation of the enterprise and carrying out of necessary corrections,
- procedures of identification of unconformities, their unconditional elimination and identification of probable causes of their origination to prevent their repeated occurrence.

The developers of these standards took into consideration initially the existing norms of contracting, conditions of purchasing and sale of marketed products, procedures of documenting and carrying out of corrective actions, as well as periodicity and norms of audit. However, clauses of documents of 1987 version did not reflected all specificities of operation in fabrication of many kinds of products, first of all norms of use of software to be included into the revised versions of standards, as well as the key problem, which arose in progress of global economy – the need of satisfying of demands of consumers on technical servicing of products they bought during their whole life cycle. The second versions of standards published in 1994 normalized also the concept of permanent improvement [*of quality of production*]. The following versions of standards approved in 2000 put in practice the concepts of *control of quality* (oriented on product) and *attesting of quality* (oriented on process), which main idea was avoiding of ineffective operations and causes of origination of inner conflicts. However, it became clear soon that norms of standard ISO 9001 in version of 2000 require of detailing, what was taken into consideration in the next revision of standards in relation to actions to be done in perfecting of procedures of quality management. To close this gap, the International Organization for Standardization make in the text of standard of ISO 9001 the necessary corrections (2008) and developed also the standard of ISO 9004 "*Managing for the sustained success of an organization — A quality management approach*", which concretizes the procedures of management oriented of solving of own problems of the enterprise, which are out of sphere of regulation by norms of standard ISO 9001. This standard foresees the synchronous consideration of potency and effectiveness of functioning of system of quality management realized at the enterprise hence point on methods of optimization of its procedures.

Therefore, the strict observance of norms of standard ISO 9001 guarantees goodness of operation of businesspersons at all stages of their work, what would witness the goodness of production of their enterprises independently of their size, form of property and sphere of responsibility. Seeing advantages of operable management, this series standards harmonized presently more of 190 countries.

In Europe, standards of ISO 9000 series were adapted to local conditions and are known as standards of EN 29000 series, namely:

- EN 29000 "General management of quality, and standards of quality. Directions on choose and use",
- EN 29001 "Systems of quality. Model of ensuring of quality in projecting and/or development, manufacturing, assembling, and servicing activities",
- EN 29002 "Systems of quality. Model of ensuring of quality in outgoing inspection and testing",
- EN 29003 "General management of quality, and elements of quality systems. Directions",
- EN 29004 "General management of quality and elements of quality systems. Guides".

The philosophy of material production varied many times from the early time of existence of systems of quality. The principal phases of progress of such systems in the modern “community of consumption” are: 1) screening of products of proper quality, 2) control of quality of serial products, 3) control of quality of operation of the enterprise, 4) introduction of systems of quality management in operation of the enterprise, 5) introduction of norms of quality management in their operation in conditions of environmental friendliness. Respectively, their history includes conditionally five stages as follows:

The *first* stage was begun in introduction in beginning of XX century of the system of Taylor character by conditional subdividing of processes of manufacturing of machines for the simplest operations. There were normalized dimensions of their assemblies (details) in form of fields of tolerances and stencils, as well as formalized their permissible limits. Because of use of work of non-qualified laborers, the managing personnel of the enterprise had to control observance of the established norms of their operation at each stage of work. To assure the successful work, administration of enterprises were forced to introduce positions of controllers of quality, who became the first professional functionaries, who operate in this sphere. The main points of their activities was control of quality of serial products and screening of items not conforming to normalized indices of quality, which had be sent to rework, but not identification of causes of origination of their defects.

The system of motivation of personnel included the practice of fining and dismissal of workers who committed the repeated drawbacks and defects, which resulted of their guilt. Meantime, such practice needed services of numerous qualified checkers, whose stuff had grown sufficiently in parallel with rising of level of complexity of fabricated products. Finally, the number of checkers in big companies became comparable with the number of productive personnel, what induced the need of development of new methods of assuring of quality.

The *second* stage was began conditionally in 1924, when businesspersons introduced the practice of analyzing of information on found unconformities obtained in use of statistical methods of control of quality and organized in this purpose departments specialized in assuring of quality of operation of the enterprise. The pioneer in this work was the “Bell Telephone Laboratories” company (now AT & T),

which organized the specialized group, which task was to develop the fundamental principles of statistical system of managing of quality. The novelties they introduced were use of control cards proposed by V. Suharto and founding of new specialty – the engineer by quality, whose main job was to control observance of normalized parameters of quality of production directly in process in its manufacturing, plot respective diagrams, find causes of origination of defects and unconformities and the optimum ways of optimization of manufacture.

The character peculiarity of progress of industry at this stage was those that consumers began to take into consideration not only the factors of cost, but indices of quality of proposed production too, what lead to complications of manufacturers in its selling. As the result, producers began to project the prospective properties of products, detail processes of their fabrication, organized the specialized departments responsible for purchasing of qualitative raw materials, auxiliaries and consumables, as well as services responsible for selling of finished products. Therefore, inspectors of quality of production began to execute also the functions of control of quality of processes of projecting and manufacturing, incoming control of quality of raw materials, evaluation of reliability of finished products in their after-sale use and analysis of committed failures.

The advantages of this system were recognized worldwide, especially in Japan, what assisted greatly in success of economical revolution in this country in the after-WW II period.

The *third* stage. The American scientist A. Feigenbaum proposed in 1950-s the concept of Total Quality Control (TQC) to be used in conditions of severe competition of persons of economy and oversaturation of global markets by goods of similar destination of use. The essence of this technology is the detailed analysis of state of global markets and demands of consumers to quality of production they buy, what forced manufacturers to tough their demands to quality of auxiliaries and materials supplied by their counteragents.

Introduction of systems of quality permitted their users to foresee the events of occurrence of potential unconformities of production at all stages of its projecting and manufacturing up to stage of its post-manufacture servicing. The novel scheme of quality management sufficiently changed the practice of operation of businesspersons, who founded central departments of “managing of quality” and gave their chiefs the highest possible rank of vice-presidents by quality. This stage of progress of quality systems is character by the detailed distribution of authorities and responsibilities of laborers, and encouraging of close intercommunication of quality managers with the administration of the enterprise.

This system was perfected in later time in Japan, where professor Ishikawa proposed to take into consideration the relations of businesspersons with consumers of production they produce. The main idea of this system he proposed is that the principle of ensuring of quality is the central in management. Its realization requires of participation of all employees of the enterprise and decreasing of role of material factors in favor of measures of moral stimulation. Since 1950-s, Japan began founding of so-called “groups of quality”, what had the purpose to raise effectiveness

of manufacturing in use of services of the specially trained laborers and introduction of three basic principles of work as follows:

- to engage laborers in work in optimizing of structure of manufacture,
- to create the joyful working environment based on mutual respect to each laborer and content of works they execute,
- to assist in development of maturity of men.

The fourth stage. It was 1980-s, when principles of the novel system of Total Quality Management (TQM) replaced norms of concept of TQC. The new system was based on the idea of continuous optimization of structure and principles of manufacture but not on its final result ("3P" concept: "the process of permanent perfecting"). The new concept presumed carrying the continuous control of observance of conditions of purposeful and coordinated processes of productive work and unconditional elimination of committed deficiencies, drawbacks and causes of their origination. To manage quality, enterprises founded the specialized departments of quality management, which principal functions are:

- development of effective systems of quality management and introduction of standards of enterprises on elements of management they use,
- steady inspection control of conditions of manufacture,
- distribution of information on current level of quality and state of acceptance of finished products,
- continuous metrological control of state and scheduled verification of means of measurement.

The persons responsible for ensuring of proper quality of processes of operation had to explain laborers the content of work they will execute and trace correctness of works they carry out. The new form of attestation of quality introduced at this stage became certification of systems of quality management by norms of international standard of ISO 9001.

The fifth stage began conditionally in 1990-s is character by intensive introduction of principles of TQM in all spheres of functioning of persons of economy including their activities in administration, logistics, operation and marketing. The practice of carrying out of works they execute have the prime purpose of prevention of errors, but not their identification and correction after they would have been committed. Assurance of quality became the task of not the department of quality only, but the priority in work of all structural units of the enterprise and each its laborer is accounted now for guaranteeing of proper quality of his work and the items he produces. This stage of development of the system of material production is character by intensifying of influence of community on routine of operation of businesspersons in producing of qualitative healthy production in conditions friendly for environment. This resulted in development and publishing in 1996 of first five ISO standards of 14000 series, which extended norms of management on sphere of protection of nature and permitted to raise attractiveness of enterprises, which certified conditions of their work by norms of standard ISO 14001 ISO 14001 *"Systems of environmental management. List and description of documents, and directions on their use"*.

The persons of economy give in parallel more attention to solving of problems of rising of safety of work and betterment of conditions of life of laborers, hence introduce norms of specialized standards OHSAS of 18000 series (normalization of methods of protection of health and assurance of safety of productive work) and SA 8000 (use of norms of social accountability), what permitted to decrease levels of traumatism and sickness of laborers and the population in whole. The enterprises became interested, in turn, in introduction of norms of said standards too because this event assists in cutting of nonmanufacturing expenses, therefore rising of competitiveness of their operation.

The modern principles of managing of quality are based on postulate that such activities are effective in regulation of processes of productive operation and have to be done also at stages, which precede its beginning. The one of vital conditions of successful work of enterprises is certification of existing quality systems because neglecting of this work worse conditions of marketing of production or even makes it in certain cases impossible. The collected experience shows also that putting in force of quality systems, effective correcting of found drawbacks and prevention of their repeated origination, as well as monitoring of stability of operation in process of manufacturing permits to declare the manufacturer compliance to established norms of all kinds of items produced by the enterprise, what is more effective as compared with use of practice of outgoing inspection of quality of each type of finished products it produces. The desire of businesspersons to obtain such advantage leads to strengthening of tendency of certification of systems of quality and narrowing of sphere of attestation of conformity of each type of individual products produced by the enterprise. The purposes of their development, introduction and certification have typically the goal of improvement of norms of operation, effective analysis of current activities and making of in-time corrections of used technologies in observance of factors as follows:

- taking into consideration of present and future needs of users (consumers) of finished production,
- continuous control and analysis of business processes,
- clearing of causes of variation of current indices of quality of production and in-time elimination of found unconformities,
- evaluation (benchmarking) of results of own works and activities of competitors and making of necessary corrections.

The typical stages of execution of this work establish the norms of standard of DSTU 3419-96 *"System of certification of UkrSEPRO. Certification of quality systems. Procedures"*. The example of their use is the typical succession of work in development and introduction of quality system used by the servicing enterprises:

1. *Organizational stage*. Appointing of the person responsible for coordination of works in development and validation of quality system to be done in close contact with laborers of all departments of the enterprise.

2. *Identification of needs of consumers*. Identification and detailing of used procedures of servicing, methods of inspection of processes of their giving, identification of probable unconformities in this work and setting of necessary

corrective actions and forms of registration of results of operation in prospective sphere of authorization.

3. *First stage of development.* Examining of existing structure of system of servicing and identifying of grade of compliance of its procedures to norms of quality standards. Identification of structure of processes of servicing and establishing of quantitative characteristics by each index of operation of the enterprise (if possible).

Classification of works by groups of:

- processes of management (on-line planning and development of strategy of evolution of the enterprise, procedures of monitoring and analysis of results of its activities, periodicity of audits etc.),
- processes, which occur during the life cycle of given services (analysis of needs and expectations of consumers, development and introduction of new type services etc.),
- control of processes of management and betterment of conditions of servicing.

The finishing work to be done at this stage is development of working documents. Doing so, one has to take into consideration that the more complicated and detailed document is, the more chances exist on its amending and modernization in future. Therefore, to decrease probability of faulty use of their obsolete versions, it is strongly recommended to introduce the “*cascade*” of short and interrelated documents, as well as to decrease their quantity, what is necessary for more effective and univocal understanding of content of the work to do. The principal norms to be observed in managing of documentation are:

- actualization of new versions of documents and abolition and clear identification of those that lose their urgency,
- optimizing of schemes of withdrawal of invalid documents and distribution of actual ones instead,
- establishing of the uniform format of records on business operation and clear indentifying of places and terms of their storage.

4. *Perfecting of system of planning and analysis* is the principal direction of work in optimization of norms of quality managing systems to be revised at least annually. To observe the established principles of declared policy, the administration identifies purposes and generalized indices to be used in evaluation of results of work of the enterprise and schemes of their monitoring.

5. *Training and motivation of personnel.* Participation of all employees in realization of planned policy of progress of the enterprise is the principal condition of successful operation of the system of management. To assist in involving of laborers in this work, the authorized persons give them the necessary information materials and taught employees themselves directly on workplaces and/or invite in this purpose the exterior tutors and lecturers. The one more method used in rising of level of education is training of employees at the outside courses of rising of level of their professional skill. To stimulate them to raise their qualification, the administration introduced such methods of motivation as material stimulation, granting of gratitude and valuable presents etc.

6. *Introduction of procedures of documentation, carrying out of internal audits.* After approval of new documents to be used in optimization of structure of administration, the upper level managing persons discuss with the staff the expediency of introduction of amendments in existing system of operation, issues orders on validation of the optimized norms, and organize the inner audit of compliance of activities of enterprise to the newly approved procedures. By results of inspection, auditors draw up the report on its results and give proposals on carrying out of actions by elimination of identified nonconformities.

The possible variants of conclusions to be taken by results of inspection of the existing system of management are:

- the quality system wholly complies to the normalized criteria of operation,
- the system complies to the normalized conditions of operation in most criteria but there exist some unconformities, which may be eliminated in term of up to six months,
- the system is character by serious unconformities, which elimination needs the prolonged time, hence presently its certification is impossible.

7. *Successive perfecting of the system.* The administration has to carry out the periodical thorough analysis of activities of the enterprise and find the directions of amending or revising of the existing structure of management.

After the recommended work in optimization of structure of management would have been finished, administration of the enterprise applies for certification of quality system, and the certifying body gives the applicant in positive conclusion the certificate of its conformity and registers it in the Register of the System.

To normalize the recommended routine of operation of business persons, ISO develops more of 10 normative and technical documents, the so-called “*auxiliary*” standards and guides, which detail the basic procedures of use of standards of ISO 9000 series in concrete conditions of manufacturing, servicing and trade:

1. DSTU ISO 9000-2001 Systems of quality management. Basic concepts and vocabulary
2. DSTU ISO 9001-2001 Systems of quality management. Requirements
3. DSTU ISO 9004-2001 Systems of quality management. Procedures of perfecting of activities
4. DSTU ISO 10011-1-97 Guidelines for auditing quality systems. Part 1. Auditing
5. DSTU ISO 10011-2-97 Guidelines for auditing quality systems. Part 2. Qualification criteria for quality system auditors
6. DSTU ISO 10011-3-97 Guidelines for auditing quality systems – Part 3: Management of audit programmes
7. ISO 10012:2002 Measurement management systems. Requirements for measurement processes and measuring equipment
8. DSTU ISO/TR 10013-2002 Guidelines for quality management system documentation
9. DSTU 3921.1-1999 (ISO 10012-1:1992) Procedures of ensuring of quality of measuring technique. Part 1. System of metrological servicing of means of measuring technique



10. DSTU 3921-2-2000 (ISO 10012-2:1997) Procedures of ensuring of quality of measuring technique. Part 2. Methods of control of measurement

The set of these standards is formed in certain sequence, i.e. each its next document narrows the sphere of regulation normalized by the previous standard.

The works in attestation of professional skill of applicants accomplish accredited profile bodies, which had certified for the present more of 70,000 firms worldwide and activities of attested persons control more of 10,000 auditors accredited by international norms. Ukrainian services use the same principles and rules of organization of work by development, introduction and validation of systems of management by quality, which were put in force in 2001 and coincide with the norms used internationally.

*Validation – examination and objective demonstration of those that the planned routine of execution of any type operation, including those that are established by the legal deed, standard and method of investigation (testing), would give the desirable result in obtaining of the set purpose*

Certification of quality systems raises the level of confidence of consumers to quality of products produces the enterprise and investors in correctness of its operation. Carrying out of this action is also the crucial requirement in obtaining of the State order on purchasing of production of the enterprise, its shipping for military, space and related purposes of use, as well as guarantees partners the certitude in stability of work of the enterprise and confirmation of its possessing by the necessary technical base and qualified personnel.

### **5.3 Concept of total quality management**

The modern systems of management are mostly of organizational character but have some nuances of social and psychological character, what requires of development and introduction at the enterprise of purposeful policy of quality management. However development of such activities was complicated greatly because of crucial worsening of ecological situation worldwide, therefore deterioration of quality of foodstuffs too. Therefore the modern stage of progress of society is character by emerging of need of assuring of their safety in observance of specific conditions of their production, but also of condition of minimizing of harmful influence of conditions of their manufacturing on state of neighboring nature.

The modern systems of assuring of quality are of predominantly organizational type character by normalization of some nuances of social and psychological character. The procedures of operation of persons of economy in modern conditions differ of those that were used traditionally because of difference in their structures because norms of standards of ISO 9000 series identify *what* to do, but not fix *how* to do it. To answer on the last question, there was developed the system of Total Quality Management (TQM) – the effective and comprehensive system, which permits to guarantee the proper quality of products produced by the enterprise in free choose by the operators of methods of reaching of set goals. Use of term "total" in the latter expression means involvement in business processes of all laborers of the enterprise, the term "quality" denotes care for satisfying of needs and interests of consumers in their realization, and the term "management" means use of modern principles of

operation in reaching of planned level of quality of processes of operation and their products.

The processes put in base of systems of management used in most enterprises are administrated by structures formed by principle of pyramid, as a rule. Their typical structure and functions are:

1. *Upper managers*. These ones are the administrative persons and managers of upper rank responsible for coordination of operation of all structures of the enterprise and planning of directions of its progress. Upper managers play the determinative role in attracting of outside resources and carry responsibility for realization of goals set by its stockholders, control and coordinate everyday activities of structural departments of the enterprise, fix budgets and define specificities of their operation, develop schedule plans of carrying out of planned works, appoint the medium level managers, as well as coordinate interrelations of the enterprise with its counteragents, bodies of local administration, mass media sources, stockholders and other interested parties.

2. *Managers of intermediate level of administration*. These ones are represented typically by chiefs of structural departments of the enterprise. Their principal business is organization of works set by upper managing structures and development in collaboration with managers of upper and lower levels of administration of prospective plans of work of their departments. Their principal functions are:

- assisting the upper managing structures in rising of effectiveness of operation of their departments and the enterprise as the whole one,
- development of criteria of successfulness of works they execute,
- identification of existing problems and development of methods of their mastering,
- development and agreeing with managers of upper rank of systems of stimulation of laborers by results of their work.

3. *Chiefs of groups*, which are the non-formal units of structural departments of the enterprise (third-level managers) concentrate their efforts on control and managing of current activities of subordinated laborers, give them the necessary methodological assistance in execution of everyday tasks, control quality of their work and quantity of production they fabricate and develop recommendations on methods of solving of problems arising in carrying out of current work,.

The principal norms of work of the enterprise in planning of its current activities are:

a) Attention to interests of customers. The principal norm used in it is fabrication of products, which quality would satisfy and even surpass expectations of customers.

b) Leading role of upper management. Administration of the enterprise collects opinions and desires of staff members and develops principal procedures of their satisfying.

c) Maximum involvement of employees as the “basement” of the organization in realization of set policy.

d) Processual approach presumes carrying out of all works centered on fabrication of qualitative products. The processual model of operation includes the

work in development and introduction of the optimized business-processes, which executors are all structural departments and functionaries of the enterprise. The fundamental points of control in these activities are quality of used processes and terms of execution of planned works. The processual approach to practical realization of norms of quality systems presumes carrying out of actions as follows:

- identification of resources to be used in the chosen system of management,
- identification of sequence and details of interdependence of processes,
- identification of criteria to be used in work in evaluation of conformity,
- identification of methods of guaranteeing of effectiveness of functioning of introduced processes and control of their realization,
- use of sufficient informative resources in monitoring of processes of operation,
- control and analysis of adequacy of used procedures of management,
- use of corrective and preventive measures.

e) Systemic approach to management. To raise effectiveness of work, the enterprise develops the system of coordination of interrelated processes of its operation.

f) Permanent perfecting of operation. The enterprise traces events of occurrence of problems in its functioning and develops measures, which use would permit to prevent causes of their repeated origination in future.

g) Taking of decisions based on analysis of trustworthy facts obtained in process of inner audits of functioning of quality system.

h) Interrelations with suppliers. The enterprise and its suppliers are the mutually dependent parties. Therefore, their favorable relations assist in rising of capabilities of the manufacturer in fabrication of items of improved quality.

The principal advantage of this work is the permanent control of linkage and coupling of individual processes of manufacturing. The basic points of concept of TQM are 14 principles formulated by the internationally known scientist E. Deming in his book "Quality, productivity, competitiveness" published in USA in 1982:

1. *The changeless purpose of the enterprise should be improving of quality of production it produces* because existence of severe competition of producers of analogous products requires of continuous perfecting of style of operation. This work presumes such mode of dispensing of resources, which, the most probable, will not give quick profit but would guarantee reaching of the long-term advantages in stable producing of qualitative production.

2. *To improve quality of production and services*. It is necessary to introduce the philosophy of inadmissibility of mismatching. The administration must understand the need of continuous introduction of innovations and take leadership in realization of such style of management, which excludes delays, layups, errors, and defects.

3. *To exclude dependence of total control of quality*. It is necessary to demand of suppliers of continuous confirmation of proper quality of materials and component parts used in manufacture and collaborate with them in atmosphere of long-term confidence and mutual understanding, what would result in improvement of quality

of operation. To cut expenses coupled with control of quality of each unit of finished production, manufacturers have to introduce statistical methods of its control.

4. *To cease practice of purchasing of the cheapest component parts and raw materials.* The low price must not be the sole criterion in choose of products used in manufacturing, because negative consequences of such practice may reveal later, when their purchaser will be forced to cull defective materials and replace buyers of products produced with their use incongruous articles.

5. *To improve each process.* The administration must continuously improve each aspect of work of the enterprise at each stage of process of manufacturing and post-manufacturing servicing, as well as forecast probability of origination of problems dependent of practice of producing of products of improper quality and make in-time corrective actions but not wait of their origination.

6. *To train all laborers including the administrative persons.* It is necessary to use new methods of training and guarantee acquainting of laborers with all novelties in manufacturing of items of the same destination of use.

7. *To introduce new methods of managing.* The foremen and inspectors must center their attention on helping employees in use of existing equipment the best.

8. *To drive the fear away.* It is necessary to encourage the close bilateral relations of ordinary laborers with their managers in effective collaboration in interests of the enterprise.

9. *To destroy the unnatural barriers between structural units of the enterprise,* which result of aspiring of managers to hide the existing problems.

10. *To cancel use of slogans and appeals.* Some managers do not analyze their own actions and specific conditions of manufacturing and reckon that productivity of labor and quality of production depend of orders they give, hence ignore the fact that the main causes of fabrication of poor-quality production are disadvantages of style of management but not deficiency of qualification and lack of industriousness of their subordinates.

11. *To exclude quantitative norms of output as the sole criterion of productivity of labor,* because results of work of each laborer depend not only of his personal abilities, but mainly of structure of manufacture, working conditions of equipment, quality of used materials etc.

12. *To eliminate barriers, which impede men to be proud of their qualification.* The existence of barriers insuperable for laborers finally leads to extinguishing of their creative abilities. It is necessary therefore to give anyone the possibility to make his own deposit in general business and be proud of personal qualification.

13. *To stimulate interest to education and self-perfection.* The primordial property of men is aspiration to make their work better, and managers must help laborers in realization of their productive abilities.

14. *Clearly identify duties of administration in sphere of assuring of quality.* The routine of work in steady optimization of conditions of operation of the enterprise and betterment of quality of its production depends mainly of decisions taken in the manager's room, therefore, planning of related works cannot be entrusted to subordinates.

The listed postulates compose the interrelated complex, and rejecting of any one will influence negatively on realization of all other constituents of successful operation. It was Deming, who first pointed that *"maximum 6 % of problems of operation are in sphere of responsibility of laborers. Instead, 94 % of problems are caused by imperfection of system of management"*.

The TQM principles are character by dynamicity and permit to solve the problems of:

1. Achieving of level of quality of production, which guarantees satisfying of demands of both manufacturers and consumers and minimizing of risks in conditions of spending of reasonable expenses.
2. Creation of base of mutual confidence of all persons interested in proper quality of works they execute.
3. Assuring of positive image of the enterprise and recognition of proper quality of its production on markets of goods and services.

#### **5.4 Basic notions, factors of influence and principles of evaluation of quality of meat products**

The modern enterprises operate in conditions of establishing by the State of the more tough norms of quality of foods. Because risks for health of consumers may arise at any stage of nutrition raw, the norm of adequate management of processes of their manufacturing became invariant since the earliest times of men's civilization. Really, the historical data witness the existence of systems of control of quality of foods already in ancient states of Assyria, Egypt, Ancient Greece and Rome. Nevertheless, the first laws, which regulated norms of quality of foodstuffs, were approved in XIX century only, when the condition of analysis of foods became the constitutive norm. The first known set of documents, which regulated the procedures of work based on scientific principles of control of quality of foods was the codex of standards of *"Codex Alimentarius Austriacus"* developed in Austria-Hungary during the period of 1897 ÷ 1911. The next step in progress of global system of guaranteeing of quality of foods was made in the end of 1950-s, when Austria agreed with the EU and EFTA member-countries the decision on development of European regional codex of standards on foods of *"Codex Alimentarius Europeaus"*. This idea was favored at the first FAO regional conference of 1960 when the Council of Codex Alimentarius Europeaus took in 1961 the resolution on subordination of its activities to FAO and WHO. The initial idea was finally transformed in founding of new global organization operating safety of foods – the *Commission "Codex Alimentarius" (CAC)*.

The problem found its continuation when the modern norms of work in control of safety of foods developed the British Consortium of Retail Traders (BRC) on base of the document of *"Technical standard on foods"* and put them in force in 1998. The main idea of this work was development of basic principles of attestation of quality of foods to be sold in the net of supermarkets under brands of their manufacturers. The norms of the standard are based on principles of HACCP, and its basic points are:

- description of procedures of HACCP recommended for introduction,
- recommended procedures of quality management,

- standardized climatic conditions of manufacturing premises,
- standardized procedures of control of quality of production,
- recommended means of control and procedures of their use,
- requirements to personnel.

The BRC developed in addition the series of standards used internationally, e.g. the “*BRC Global Standard – Food Storage and Distribution*”, “*BRC Global Standard – Consumer products*”, “*BRC Global Standard – Food Packaging and other Packing Materials*” etc. The one more standard of safety of safety of foods used worldwide is the “*International Food Standard*” (IFS) developed in 2002 by the German *HDE (Hauptverband des Deutschen Einzelhandels)* Association together with the *French Association of Traders and Distributors (FCD)*. Same as BRC, the IFS standard has the goal of normalization of conditions of guaranteeing of safety of foods and assigned for use by the manufacturers, which sell their products under brands of supermarkets. The basic norms of guaranteeing of safety of foodstuffs established by this standard are:

- responsibility of upper management for organization of proper operation of the enterprise,
- introduction of system of HACCP,
- observance of norms of individual hygiene by personnel,
- use of raw materials, which are supplemented by the due form specification only,
- supplementing of finished production by certificate of its quality,
- identification of potential sources of pollution of foods and use of measures by prevention of their contamination,
- introduction of system of traceability in processes of producing, safe storage and distribution of foods,
- carrying out of regular inner audits and elimination of found unconformities,
- indisputable use of corrective actions.

*Traceability means the possibility of identification of personality of operator of the market, time, place, commodity and other factors sufficient for identifying of source of origination of food rows, animals that would be used in production of foodstuffs, materials that may contact with foodstuffs or substances which would be or may be used as their ingredients at any stage of work in their production, reprocessing and circulation*

However, the universally recognized norm of progress of modern society is introduction by persons of economy of systems of quality management by norms of standard ISO 9001. This is especially significant for those ones, which produce, treat and pack foodstuffs and drinks. Therefore, it is the standard of ISO 15161:2001 “*Guide on use of standard of ISO 9001:2000 in processes of manufacturing of foodstuffs and drinks*”, which norms assist in regulation of procedures used in its use in Ukraine as the sole document that normalizes conditions of operation of manufacturers of foods. The normative document used in Ukraine in solving of these and analogous problems initially was the national standard of DSTU 4161-2003 “*Systems of management of safety of foodstuffs. Norms*” applicable in the food

industry, public catering and other spheres of circulation of foodstuffs. The document was developed in observance of most of provisions of the European Directive of 14.06.1993 # 93/43 *"On Hygiene of foodstuffs"* and the document of *"Codex Alimentarius and UN Food and Agriculture Organization Basic Texts on Food Hygiene"*. For the present, this document becomes, however, antiquated and needs actualization or replacement by norms of national standard of DSTU ISO 22000 "Food safety management systems – Requirements to any organization in the nutrition raw" introduced in practical use 01.08.2007. However, there exist some complications in it (for instance, the norms of standard DSTU 4161 permit manufacturers to use the rented premises, what is prohibited by norms of standard 22000). Therefore, presently both these documents are in parallel use. The one more argument in favor of continuing of use of norms of standard DSTU 4161 is that this document, same as standard ISO 15161, is based on the norms of use of concept of HACCP and attributed programs-preconditions. So, the enterprises, which operated already in observance of norms of standard DSTU 4161, may simplify their work in introduction of norms of standard DSTU ISO 22000 as compared with those ones that begin this work from nothing.

*Program-precondition means the complex of basic norms of maintaining of proper hygienic conditions of the working environments at all stages of nutrition raw, which use permits to produce and supply foods safe for consumption*

Use of programs-preconditions is the basic norm of the Order of Ministry of Agricultural Policy of 01.10.2012 *"On Approval of Norms of Development, Introduction and Steady Use of Procedures of System of Management of Safety of Foodstuffs (HACCP)"*, which sets that manufacturers *"... have to develop and introduce effective systems of HACCP, what would permit them to control all hazardous factors potentially present in foodstuffs"*. The principal practices to be used in it are GMP, GHP and SOP (standardized operative procedures), which basic principles are:

- configuring of productive, auxiliary and accommodation spaces in conditions, which would permit to avoid the cross-pollution of foods by exterior admixtures,
- normalization of sanitary conditions of premises and development of norms of safety in works in repair, maintenance and calibration of used equipment,
- assuring of safety of water, ice, vapor and auxiliary materials used in producing (reprocessing), storage and transporting of foodstuffs,
- regular cleaning (washing, disinfection) of auxiliary and common use premises,
- assuring of norms of hygiene of personnel,
- steady control of observance of norms of used technologies.

Doing so, businesspersons must take into consideration that some groups of people (babies, children, pregnant women, aged persons, diabetic etc.) are especially sensitive to probable negative consequences of consumption of certain kinds of foods they produce. Therefore, suppliers of foods have to devote the especial attention to

their needs and put into the parcels with the finished products they propose the clear instructions on recommended methods of their treating and consumption.

Introducing the HACCP norms, enterprises must observe the following norms of Ukrainian legislation:

- The organization has to introduce, maintain and document the effective system of management of safety of foodstuffs.
- The organization has to identify the range of use of introduced system of operation and guarantee safety of products to be operated with.
- The organization has to carry out the actions as follows:
  - a) identify, evaluate grade of influence and eliminate the probability of occurrence of direct or indirect harm for consumers of the food safety hazards, which may arise with the sufficient grade of probability in products, which are in sphere of its management,
  - b) give the unbiased information by problems of safety of their products to all participants of work in structure of nutrition raw;
  - c) give interested persons the comprehensive information on existence and norms of assuring of safety of foodstuffs.
- d) The standard ISO 22000 normalizes procedures of detection of risks, methods of their elimination and norms of evaluation of grade of hazard in use of newly developed foodstuffs and/or their ingredients, as well as the grade of compatibility of procedures of their production with norms of good practices (Table 5.2):

**Table 5.2**

***Procedures of control used in development of new products***

Stage of work	Procedure to use	Note
Inspection	Control of accuracy of observance of carrying out established norms of planned works	Predicting of probability of reaching of the desired result
Control	Continuous process, which includes the work in steady control of correctness of operation at all stages of manufacture and/or comparison of quality of the exemplary and pilot samples of production	Convincing in compliance of controlled indices of products to their normalized values
Approval	Attestation of compliance of indices of the product to established norms	The condition of approval is assurance in admissibility of consumption of the product by certain groups of population (e.g. by infants) in absence of harm for their health

The objects of control in process of manufacturing are:

- procedures of producing of primary products of agriculture (fattening of cattle, initial treatment of grain etc.),



- hygienic state of manufacture, especially conditions of equipment, packing and other materials, particularly properties of chemicals, which may contact with foods,
- grade of contamination of finished products and pollution of environment,
- quality of water and ingredients of foods used in process of business operation,
- observance of norms of processes of manufacturing,
- auxiliary operations (e.g. the specified methods of their packing),
- criteria of operation of testing laboratories,
- procedures of storing of raw materials, semi-manufactured products and finished products,
- procedures of safe storage, transporting and distribution of finished products.

Planning his work, the businessperson has to introduce the necessary preventive measures to decrease the grade of ingress in foods of biological, chemical and physical pollutants, what would permit to raise quality of his products and decrease quantity of inspections of off-site parties. As early as before beginning of planned works, the chairman of the enterprise has to appoint the group of experts experienced in managing of safety of foodstuffs, which has to describe the characters as follows:

- a) biological, chemical and physical properties of substances/materials contacting with foods,
- b) specifications of purchased materials and ingredients,
- c) methods of preparation and/or treatment of raw and auxiliary materials,
- d) composition of multicomponent ingredients (including the used additives and auxiliary materials),
- e) technologies used in process of business operation,
- f) methods of packing and supply of finished production, as well as term of their fitness for consumption.

The enterprise has to introduce the system of traceability, which would permit to identify causes of origination of deficiencies and drawbacks in its work, as well as to clear the grade of dependence of quality of finished products of composition of used raw materials, methods of their treating and history of supply. It is necessary to develop also the block-diagram of processes of producing of safe foods and fix the information as follows:

- a) succession and interrelationship of processes of manufacturing,
- b) details of processes of manufacturing, information on used raw materials, ingredients and semi-manufactured products, methods of their treating and procedures of removal of wastes,
- c) methods of reprocessing of production incongruous to established norms, and recommended methods of repeated use of reprocessed products,
- d) works executed out of manufacturing premises, including those that are carried out by subcontractors.

The persons, who have the sufficient skill in profile works have to analyze the data obtained in monitoring of processes of manufacturing, trace conditions of

operation in critical control points and issue recommendations on corrective actions to be done (if necessary). The enterprise, in turn, has to document procedures used in identification and elimination of found unconformities, particularly:

- a) identify the found unconformities and causes of their origination,
- b) analyze tendencies of variation of results of work of the enterprise and identify probable risks of loss of managing and recommend procedures of work directed on exclusion of probability of their origination,
- c) fix results of corrective actions.

The finishing stages of manufacturing have to be executed in the following sequence:

- a) packing of products by the contractual methods,
- b) control of placing on packs of necessary marks,
- c) safe storage of finished products till the moment of their shipping in observance of the normalized climatic conditions, especially of parameters of temperature and humidity,
- d) informing of interested parties on guaranteed terms of storage of finished products and use of measures by prevention of risks of their contamination,
- e) carrying out of hygienic and invasive control up to stage of packing of finished foods.

The documents, which supplement parcels with finished products, have to contain the following information:

- a) name of the product, its composition, normalized term of fitness and recommended conditions of storage,
- b) biological, chemical and physical factors, which may influence on its safety,
- c) characteristic of packing,
- d) potential harmfulness of foodstuffs and/or instructions on their preliminary treatment, preparation to use and conditions of consumption.

The enterprise has to carry out regular inner audits, what would permit to control the fact of observance of norms of quality system it uses, and identify and reprocess batches of poor-quality production (if exist) by methods as follows:

- a) reprocessing of production by consent of its owner,
- b) utilization of production, or
- c) its alternative use.

To make the in-time withdrawal of poor-quality products taken from batches prepared for shipping, administration of the enterprise has to appoint persons responsible for this work and establish the following rules of operation:

- introduction of norms of informing of interested parties and/or consumers on existence of products of improper quality,
- establishing of procedures norms of reprocessing of withdrawn products still stored in warehouses, and
- documenting of methods of reprocessing of poor-quality products.

The culled products must be stored under the strict control up to stage of their annihilation or alternate use, or be recognized as safe for use by destination, or be reprocessed by methods, which would guarantee safety in their following use. The procedures used in such cases normalize the international standards as follows:

- DSTU-P ISO/TS 22003:2009 "Food safety management systems – Requirements for the bodies providing audit and certification of food safety management systems",
- DSTU-N ISO/TS 22004:2009 "Food safety management systems – Guidance on the application of ISO 22000:2005",
- DSTU ISO 22005:2009 "Traceability in the feed and food chain – General principles and basic requirements for system design and Implementation".

The ISO technical committees continued this work and developed the next documents, which principal goal is detailing of mechanisms of guaranteeing of food safety:

- ISO/DTS 22002-2:2013 "Prerequisite programmes on food safety — Part 2: Catering",
- ISO/AWI TS 22002-6:2014 "Prerequisite programmes on food safety — Part 6: Transport and storage",
- ISO/AWI TS 22002-7:2014 "Prerequisite programmes on food safety — Part 7: Food packaging manufacturing".

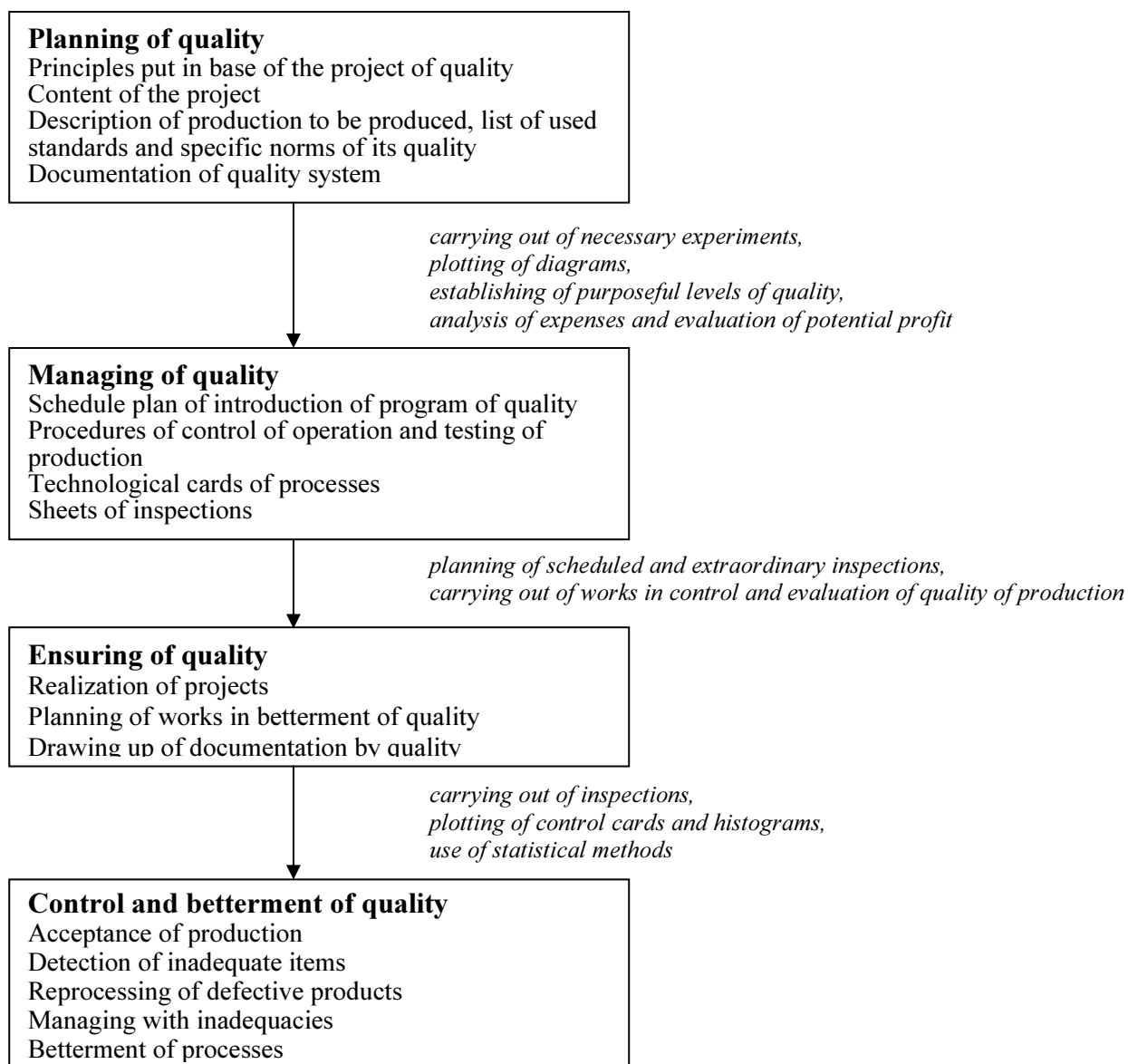
The designations used in coding of these documents are: DTS – Draft Technical Specification, and AWI – Approved Work Item.

Because hazardous factors may exist at any stage of nutrition raw, the crucial factor of management is the adequate securing of procedures of operation against risks, which may occur in process of manufacturing, transporting and storage of finished foodstuffs, as well as in producing and supply of forage and primary products. this work has to be done not by producers and suppliers of listed products only, but also by persons specialized in retail trade and public catering (together with the adjoining organizations, such as manufacturers of equipment, packing materials, cleaning agents, additives and food ingredients). The important factors in identification and elimination of risks and hazards in consumption of products they propose are informing of all interested persons on probable after-effects of their use. One of possible variants of structure of channels of exchange by such information normalized by this standard illustrates Figure 5.3.

All requirements normalized by standard ISO 22000 are of general character and may be used by producers of forage, harvesters, farmers, manufacturers of foodstuffs and their ingredients, retailers, catering organizations, suppliers of production, as well as organizations, which operate transporting, storage and distribution of foods. The best results may be achieved if the organization operates in observance of norms of standard ISO 9001, which use permits:

- a) to guarantee safety of produced foodstuffs,
- b) to observe interests of customers,
- c) to plan, introduce, maintain and renovate systems of management of safety of foods,
- d) to demonstrate the compliance of parameters of safety of their production to norms of legal, regulatory and normative documents in force,
- e) to take into consideration the messages of customers, suppliers and other interested parties on hazards non-identified before,

- f) to certify the proper quality of foods, or certify the norms of used system of quality management.



**Fig. 5.3 Structure of system of management of quality**

The successful introduction of system of management of safety of foodstuffs gives the enterprise the advantages as follows:

- possibility of certification of system of management of safety of foodstuffs on conformity to international norms, therefore their free sale in international markets,
- decreasing or even excluding of probability of origination of nonconformities,
- documental approval of safety of conditions of manufacture and its production,
- getting of advantages in tender competition,
- raising of level of confidence of consumers to its production.

The information given above permits to make the conclusion that quality of materials proposed on the modern market has to be ensured and guaranteed by the manufacturer himself. It was reckoned in 1960-1970-s that pawning of the success of manufacturers of meat products lies in abundance and cheapness of produced products. However, it was evident in 1980-s that the crucial factor in successful operation is competition of quality of products but not of their prices and the time when purchasers took decisions of expedience of purchasing in looking on prices had passed.

The notion of “*quality*” of foodstuffs has its standardized interpretation and is specified as follows.

*Quality means the complex of characteristics of foodstuffs, which are capable to satisfy need in meal of man, who lives in usual conditions of their consumption*

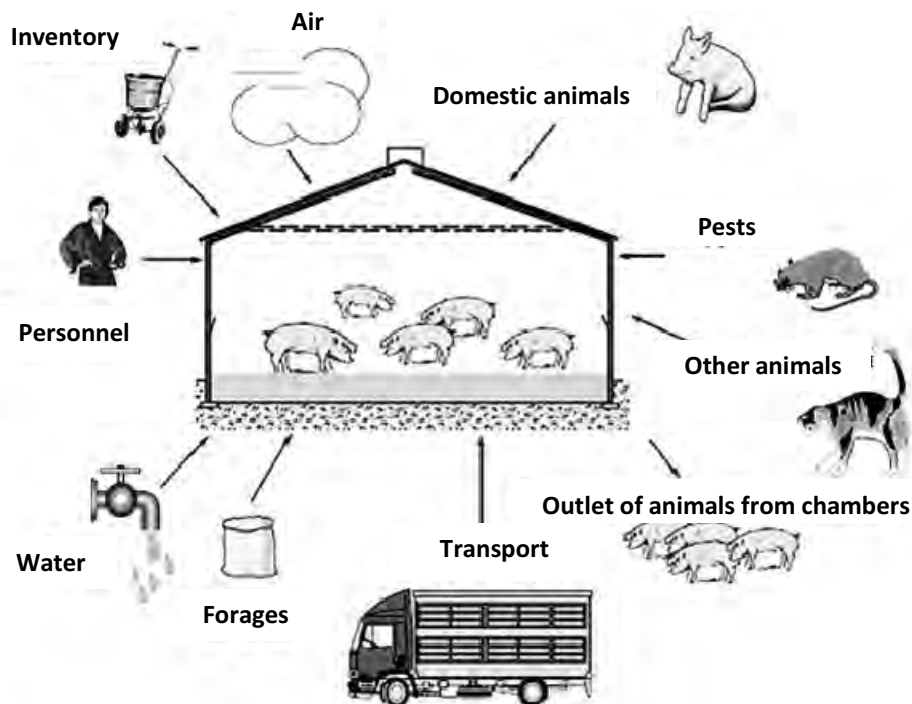
**Level of quality** is the quantitative characteristic of measure of capability of any meat product to satisfy the concrete demand of purchasers and comply at the same to basic norms of their quality. The work in evaluation of level of quality of production presumes carrying out of fixing of its absolute, prospective and optimal characters. To do this job, ones use certain system of generalized indices.

Dutch scientists *J Van Ettinger* and *J Sittig* developed the special branch of science, the so-called *qualimetry* on methods of measurement and quantification of indices of quality. Methods of qualimetry permit to rate numerical values of products. Its basic principle is those that level of quality depends of big quantity of properties of product in question. To valuate quality of the product, one has to evaluate both normalized indices of quality of the product and conditions of its realization and consumption. *J Van Ettinger* and *J Sittig* reckon also that quality of the product may be quantified numerically if its consumer will group properties in sequence of their importance. They considered that quality is the value that may be measured, hence the measure of its nonconformity to normalized requirements may be expressed in use of the universal measure – its **price**.

The majority of total amount of produced meat products is realized in form of sausages. The effectiveness of enterprise that produces such products depends not only of specificity of used technologies and equipment used in manufacture, but also of organization of processes of its operation, rationality of use of raw materials and used systems of ensuring of quality and safety of products.

The one more important property of meat raw materials is their biological safety. The biological safe materials obtain in slaughtering of healthy animals. The work in ensuring of biological safety presumes carrying out of complex of measures directed on avoiding of introduction of infections in animal husbandry, as well as limitation of extension of diseases that already exist at the farm. Figure 5.4 displays the basic sources of deterioration of state of safety shown by the example of farm by breeding of hogs.

The persons who wish to evaluate quality of meat and meat products have to keep in mind that these ones are products of alimentation. Therefore, the first and the main feature of their quality is their fitness to their destination. For the second, one has to observe the requirements of set of factors that form their nutritional value, and for the third – the complex of factors that add foods certain nutritional properties classified as follows (Fig. 5.5):



**Figure 5.4** *Main factors of deterioration of biological safety of meat raw*

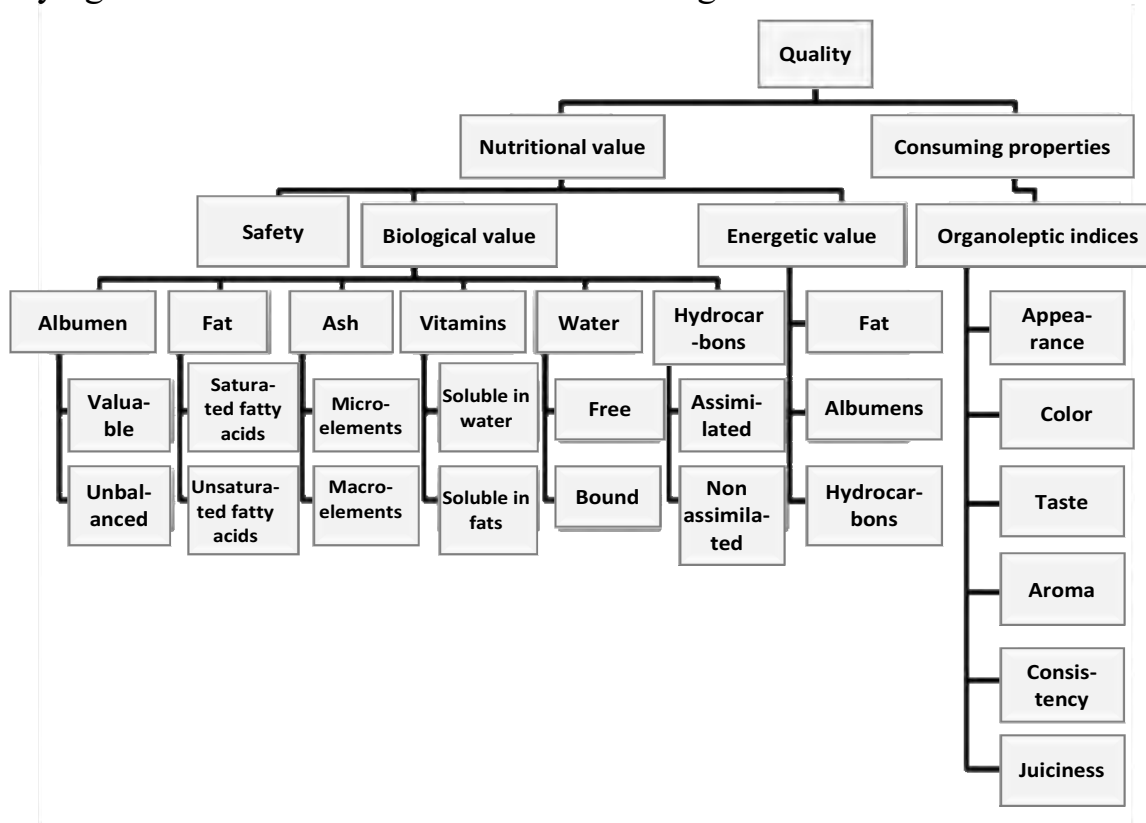


**Figure 5.5** *Factors of influence on quality and safety of meat products*

The legal persons, who carry responsibility for keeping of proper quality of sold foods in Ukraine, are their manufacturers and stores. However, the main problem is that this kind responsibility is in most cases imagined and is finished on the stage of issuing of certificate of their proper quality. However, works in control of quality of meat, meat products and fish display permanently their nonconformity to norms of standards. At the same time, European countries introduce the practice, which shows that not each piece of meat may be reckoned as meat. It is not the tautology: meat of beasts must not contain more of 25 % of fat and 25 % of connective tissues (tendons, chords and gristles). Meat of hogs may have more these components by 5 %, and

meat of birds and rabbit less: up to 15 % of fat and up to 10 % of connective tissues, what is fixed in related documents of European Union.

The main properties of foodstuffs are reckoned such ones that assure their sensory and organoleptic fitness and permits interested parties to identify their consumer properties, nutritional value and safety for men. The schematic chart of identifying of such indices of foods is shown on Figure 5.6.



**Figure 5.6** *Principal indices of quality of foodstuffs*

The category of *consumer* properties includes such ones that ensure their sensory and organoleptic fitness, as well as compliance to directions of use by traditional destination.

The category of *nutritional value* includes the complex of properties of meat products, which satisfy physiological needs of men in energy and basic alimentary substances, especially the group of indices energetic value and quantities in the product of basic nutrients. The most important characteristic used in evaluation of nutritional value of the product is its capability to satisfy the medical and biological needs of the organism. The category of nutritional value includes also such notions as "biological" and "energetic" values understood in meanings as follows:

- *biological value* means the index of quality of albuminous components of foodstuffs, which characterize the grade of balance of content of amino acids in it and level of their digestibility and assimilation by the organism,
- *energetic value* characterize the part of energy, which releases in process of metabolism of nutritional substances and used for satisfying of physiological functions of the organism.

Therefore the integrated notion of quality of meat products includes the wide variety of properties, which characterize their nutritional and biological values, organoleptic, sanitary hygienic and other characters of products, which are interrelated in their influence on state of the organism and can influence on it independently. All factors of influence may be combined by four groups as follows:

1. Technical, which characterize the level of skillfulness of work in projecting, perfection of technologies of products and norms of their realization.

2. Organizational, which characterize the structure of distribution of work and grade of specialization of laborers, forms of organization of processes of manufacturing, rhythmicity of processes of operation, forms and methods of control and forms and methods of transporting and storage of finished products before their shipment from the enterprise.

3. Economical, which characterize the amount of means spent on projecting and creation of manufacture, cost of works by mounting and adjusting of technological equipment, primary cost and selling price of finished products, forms of payment and amount of remuneration, extent of rising of productivity of labor etc. The significance of economical factors is especially important for countries that are in process of transition of their economies to principles of operation in conditions of market economy. This group indices characterize the control, analytical and stimulating characters of manufacture in one time. The first group of mentioned characters permit to evaluate the amount of work carried out in process of manufacturing, quantity of spent raw materials, auxiliary materials and means used in reaching of set level of level of quality of meat products. The influence of stimulating factors permits to rise or decrease the level of quality of finished products, and the most influential factors in this group indices are prime cost of finished products and size of salary of engaged personnel. The correctly pricing stimulates works in rising of level of quality of products. at the same time, the n[ ]better is quality, the higher is their cost.

4. Subjective, which influence depends considerably of qualification of personalities, who produce the concrete product, level of their professional skill, their physiological and emotional peculiarities. It's necessary to note that the level of professional skill of persons engaged in work in projecting of manufacture, development of commercial compositions, control of observance of norms of technologies and producing of finished products determine the technical level of the manufacture in whole. Meantime, the grade of influence of this group indices became the less at present level of development of technique and technologies because they need the less of men's activity in production of finished products.

It's reckoned now that XXI century will be the centennial of quality in all its displays – quality of products, and services, quality of work, quality of environment and quality of life in whole. As to meat and meat products, the principal indices of their quality accepted by sense bodies and interested for consumers are their color, taste, aroma, delicacy and juiciness.

Color of meat is one of principal characters of quality in eyes of consumers as the crucial factor of quality of the product, which may witness also on facts of occurrence of certain chemical transformations of meat. Color of meat depends of



nature of its colorants and may vary from white (fat of hogs) to various tints of yellow, yellowish-brown, brownish-red and red colors.

Meat of cows is of bright red color, meat of young heavy beasts of up to 1.5 years age – pale red, meat of hogs is red. The intensity of coloration of meat depends of breed, sex, age and mode of feeding of the animal. Color of meat depends of level of its pH and is the measure of variation of color of muscles from light to dark tint. The dark coloration of muscle tissues is the result of lesser losses of juices in their following heating, i.e. such meat is character by capability to hold relatively big quantities of water.

The process of vital activity of microorganisms may influence on color of meat indirectly. Appearance of green coloration of non-salted meat is conditioned by change of structure of porphyrin rings, or influence of peroxides formed in fat, or action of hydrogen sulfide resulted of passing of process of forming of sulfomioglobine.

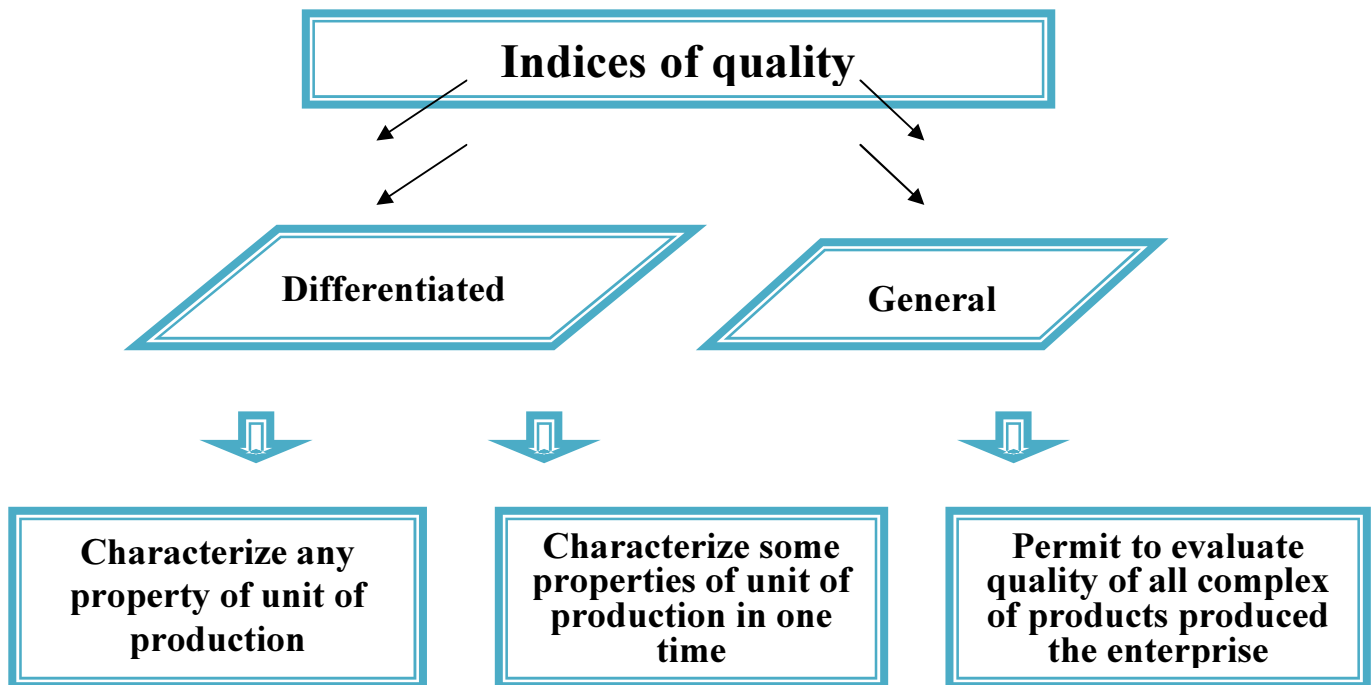
**Taste and aroma of meat** are the important indices of quality of meat, which influence indirectly on nutritional value of the product, its digesting. These characters depend of content of various classes of organic compounds present in meat in minor quantities. The basic classes of such substances are compounds of carbonyl nature, organic acids, amines, phenols and ethers.

The specific aroma and taste of boiled meat depends of content in it of extractive volatile and non-volatile substances. The non-extractive volatile substances form the basic taste of meat in process of its thermal treating. The taste and flavor of meat depends also of age of the animal, presence of fatty tissues and quantities and mode of distribution of fat in the meat. Meat of young animals has no the pronounced taste and flavor, but meat of elder animals has usually more expressive taste and less pleasant aroma as compared with meat of younger animals. Fresh meat has the specific, some sweetish taste. The considerable differences in tastes and aromas of various kinds of meats may be explained by differences in content and correlation of extractive substance in meat of beasts, hogs and muttons, or by various reactions of their forming, or by presence of various products formed in processes of their storage and cooking.

**Consistency of meat.** the basic positive characters of quality of consistency of meat is its delicacy, softness and juiciness. These properties are revealed in most cases after cooking of the product, but may be detected also in fresh meat. the juiciness, delicacy taste and other merchandising and technological characteristics depend greatly of capability of the product to hold water. The dark kinds of meat are more juicy, as a rule, and loss less quantities of juice in process of its boiling owing to bigger values of pH in it.

Variation of level of pH of meat just after slaughtering of animals showed that the muscular tissues character by low level of pH ( $5,8 \div 6,2$ ) is more hard and requires longer time of afterripening supplemented by decreasing of its hardness as compared with tissues character by bigger values of pH ( $6,7 \div 7,1$ ). The level of delicacy of meat decreases in parallel with increasing of content in bulks of lean meat, as well as with decreasing of level of its marmoraty. The level of juiciness of meat depends of content of fat inside the muscular fibers and groups of muscles.

Therefore, there rises in parallel the role of organizational factors, where the subjective element plays the considerable role in setting of proper level of quality and safety of meat products in their consumption in limits of hygienic and physiological norms. Taking these circumstances in consideration, one may subdivide all indices of quality of meat products by groups as follows (Fig. 5.7):



**Figure 5.7** *Characteristics of indices of quality of meat products*

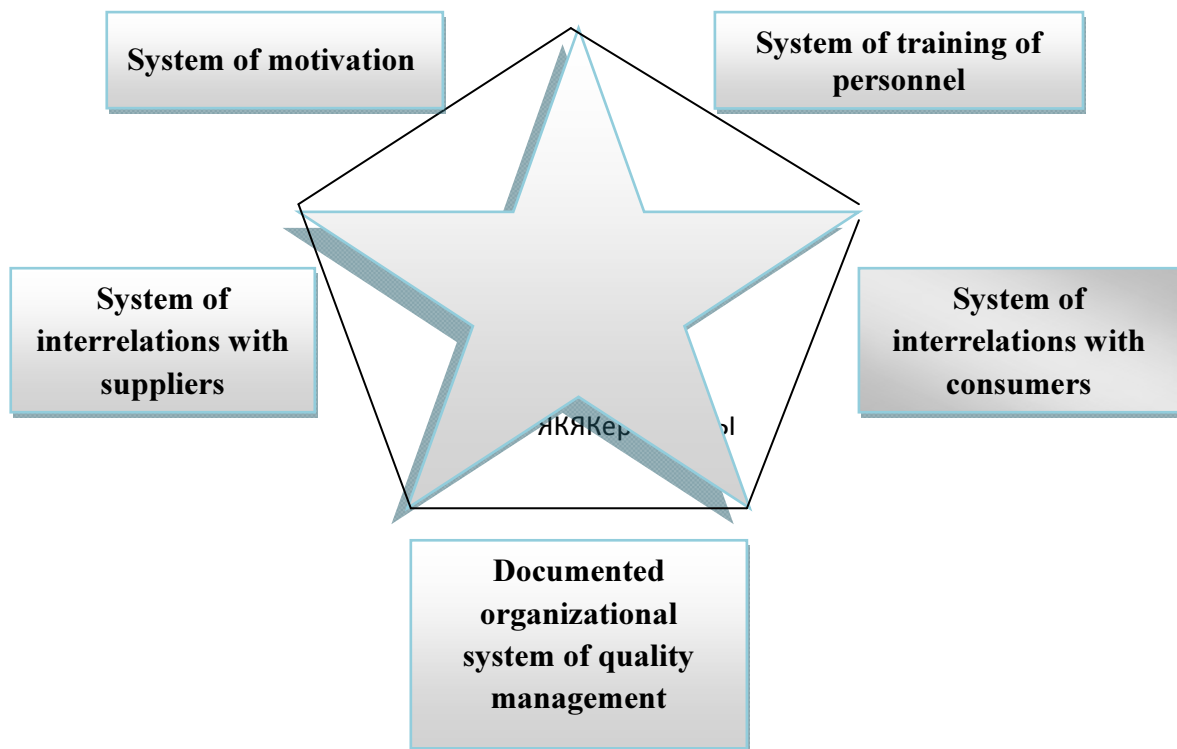
Technologists have to know in their everyday operation not only the total set properties of individual products they fabricate, but also the modern level of quality of analogous products produced everywhere. To evaluate the grade of significance of each of such indices, one uses the system of generalized characters of products and the basic ones are:

- quota of fundamentally new (advanced) products in output,
- coefficient of renovation of assortment of meat products,
- quota of products of certified quality,
- quota in output of meat products intended for export,
- quota of defective products,
- relative quota of products of seasonal demand.

### **5.5 Methods of evaluation of quality of meat products**

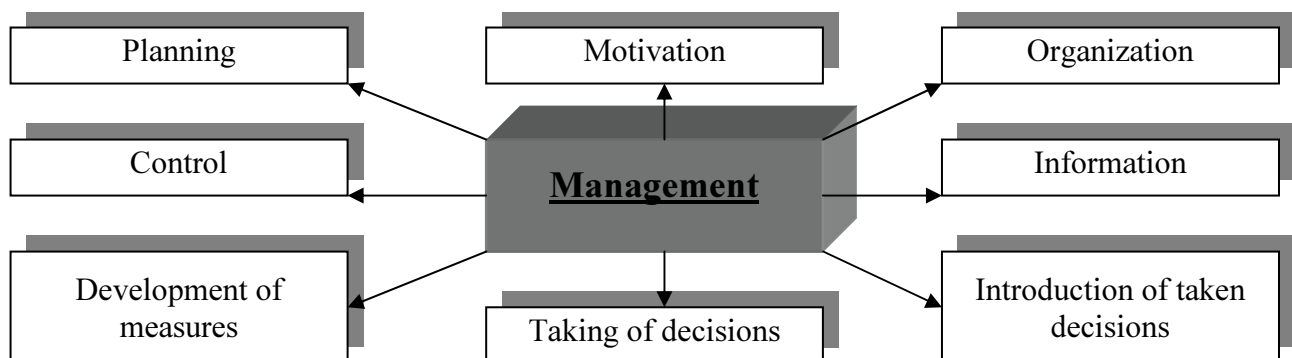
Unlike general practice of industrial operation, processes of producing of foodstuffs cannot be realized in full absence of deviations of normalized methods of their fabrication. The principal obstacles of realization of technologies free of deviations are variations of composition of raw materials and use of laborers, what is the factor of uncertainty. As provided norms of national legislation, control of finished products is carried out selectively, what results in occurrence of unjustified risks. Therefore, the modern norm of organization of manufactures of foodstuffs both in Ukraine and abroad is introduction of systems of managing of quality. To visualize

basic stages of their development and introduction interested persons use the so-called "*Star of quality*" (Fig. 5.8):

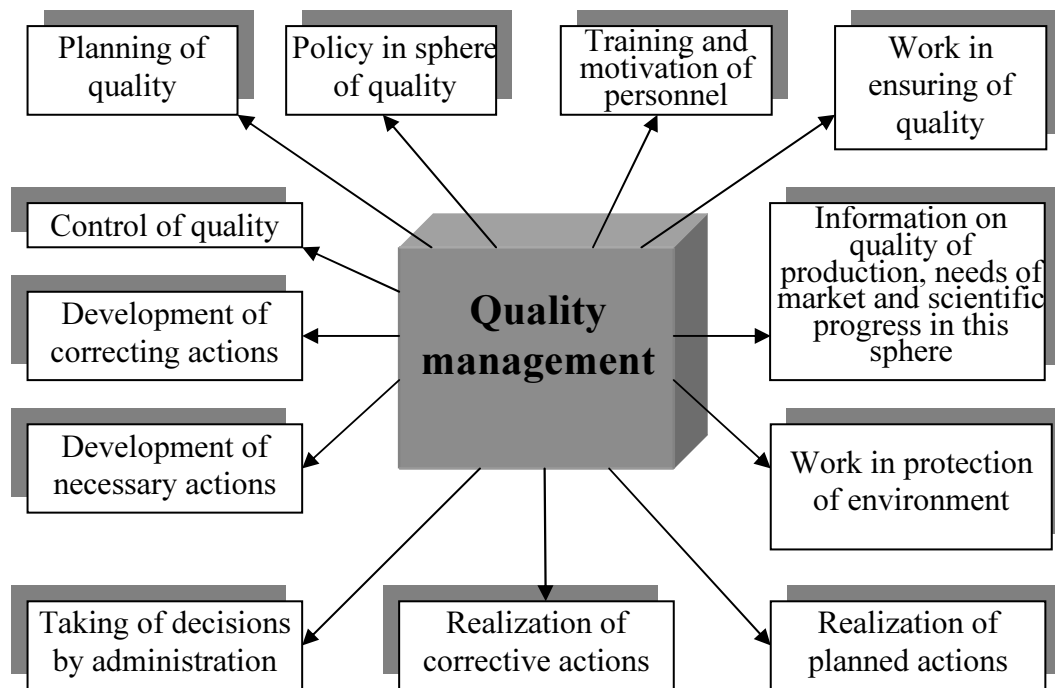


**Figure 5.8** "*Star of quality*"

The work in assuring of quality requires of spending of considerable means. The basic part of expenditures was till the last time linked with salary of engaged personnel. However, presently this problem is solved in realization of functions of management in involvement of scientists, engineers and managers. Each process of management in this case is the process of optimization of quality, which includes stages of planning, organization, control, information, development of novel procedures, taking of decisions and their introduction (Fig. 5.9):



**Figure 5.9** *Functions of management*



**Figure 5.10 Functions observed in work in quality management**

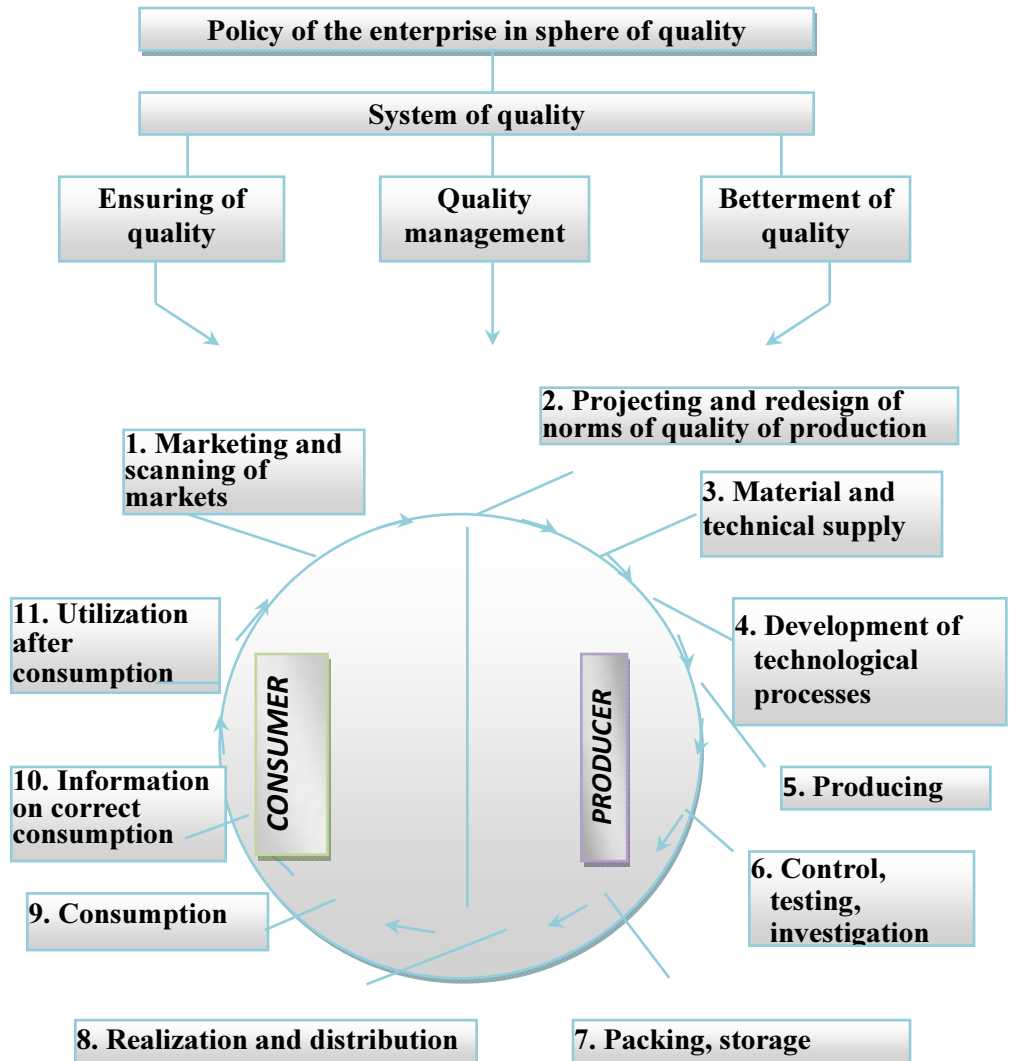
It's known that the process of management includes three elements as follows: subject of management, object of management and mechanism of influence. The subject of management is the personnel of the enterprise and the object of management is the process of manufacturing. The mechanism of management is realized through realization of functions shown on Figure 5.10 below:

The main goal to be solved in use of this system is finding of deviations (defects) out of established norms of quality of products and services and taking of decisions on modes of use of defective items. These works comprise also doing of actions on prevention of cases of repeated origination of deviations based on development and realization of corrective measures.

The system of quality management is the constituent part of system of organization of manufacture, planning and managing by its operation, system of material and technical supply, financial system etc. This system functions in parallel with other types of activities that influence on quality of production and/or services. The work in quality management presumes use of methods and types of activities of operational character directed both on operation by processes and elimination of causes of inadequate functioning of the system at all stages of life cycle of item (loop of quality), which have the goal of reaching of economical effectiveness of operation (Fig. 5.11) and includes the types of activities as follows:

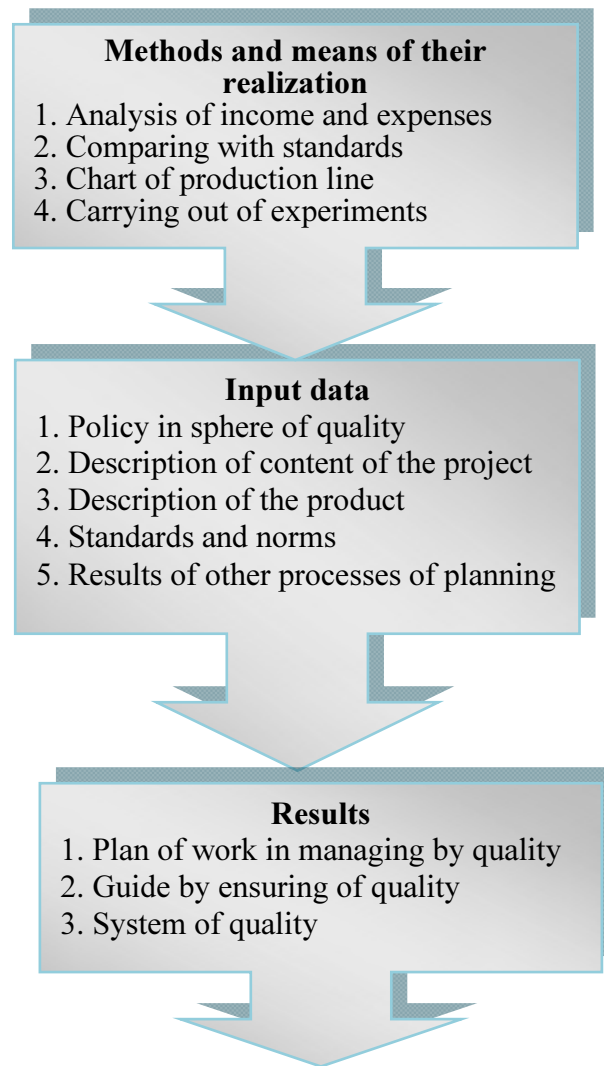
- marketing, scanning and studying of markets,
- projecting and development of concrete types of production,
- material and technical supply,
- development of technological processes and mounting of manufacturing facilities,
- work in manufacturing,
- control of quality of finished products,

- packing and storage of finished products,
- carrying out of inner and outer audits,
- realization of production,
- informing on recommended methods of consumption,
- consumption,
- utilization after consumption (use).



**Figure 5.11 Loop of quality**

The systems of managing by quality and planning of work in its betterment is the constitutive part of system of management by work of the enterprise directed on betterment of quality of work of laborers and increasing of effectiveness of operation of the enterprise owing to concentration of efforts at key manufacturing functions and processes of operation. *Planning of quality* includes the constituent of determining of normative documents, which have be used in work in betterment of its level. The structure responsible for this work must know that one of fundamental principles of modern practice of quality management sets that *quality is planned but not controlled* (Fig. 5.12):



*Figure 5.12 Logical chart of work in planning of quality*

The activities mentioned above may be formalized by stages of work as follows:

**1. Analysis of the project** is the stage of official, documented and systematic evaluation of rationality of proposed solutions carried out by personnel non-engaged in work in its development. Analysis of the project may be done in form of consultations or assisting the engaged personnel that carried out the work in development, or in form of issuing of official opinion on correctness of proposed solutions and compliance of content of the project to all requirements of its requester.

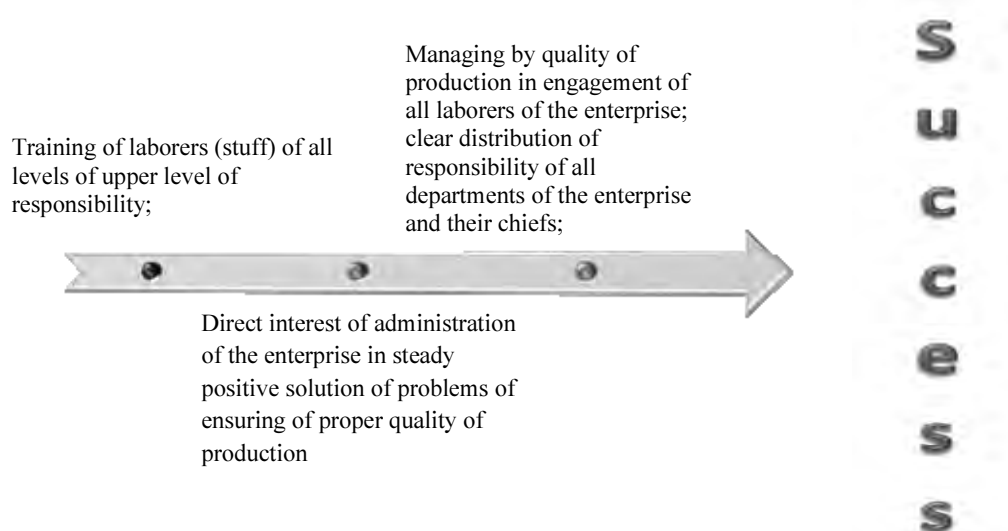
**2. Evaluation of quality of the representative sample** is the official procedure of evaluation of indices of quality of the product including the stage of its testing in operative conditions in real situations to their compliance to requirements of preliminary specifications and forecasted demands of customers.

**3. Alternative estimation** is the work in full or partial revision of critical components or systems done in purposes of checking of correctness of decisions put in the base of the project. This work may be carried out in purposes of independent

control of content of correctness of the project, what is especially important if the comprehensive testing of properties and indices of quality of projected products requires the long time or considerable expenses.

**4. Comparing with projected indices of quality** of one of items tested in practice or projected indices of competitive items.

The basic principles of forming of quality, which observance guarantees the enterprise success on the market are shown on Figure 5.13:



**Figure 5.13 Principles of forming of quality**

The notion of **level of quality** is understood here as complex of characteristics of fitness of meat product in question for satisfying of concrete demand of consumers in fixed conditions of consumption. To identify the level of quality of meat products are used some methods. The objective and organoleptic methods are used in process of identifying of level of quality of totality of products, and varied and complex ones – in identifying of level of quality of their individual kinds.

➤ *Objective method* gives the most objective results and consists in evaluation of level of quality of products in way of measuring, testing and analysis in laboratories of absolute level of quality of means of manufacturing and some properties of products of mass demand, e.g. capacity and productivity of installation, content in meat products of basic ingredients, sugar, fat etc.

➤ *Instrumental method* of finding of values of indices of quality includes chemical, physical, biochemical and technological methods of identifying of indices of quality of meat products in use of special instruments and chemicals. Its results are free of individual features of experts, therefore are character by high precision.

➤ *Calculating method* of identifying of indices of quality of meat products is carried out by means of calculation done with use of parameters found by other methods of investigation. The quantitative values of parameters of quality (for instance, caloricity of products, generalized index of its quality) are calculated on base of theoretical and empirical dependences found in earlier time.

➤ *Sociological method* of identifying of indices of quality is based on collection and analysis of opinions of real or probable consumers of products

(answers of questionnaires, conferences of consumers, mechanical counting). This method requires of development of scientifically substantiated branch-wise system of inquiry of interested persons and working of collected information. The sociological method is used mostly in process of evaluation of quality of meat products supplied to restaurants.

➤ *Expert method* of identifying of values of indices of quality is based on taking into consideration of opinions of group of 6 – 7 experts qualified in sphere of evaluation of features of products in sphere of attestation of quality.

➤ *Organoleptic method* of evaluation of quality is based on results of feelings of specific characteristics of taste of products by organs of men and need not use of technical, measuring and other methods of analysis. The criteria of quality of meat products are expressed by this method in dimensionality of points that characterize their specific characters (properties). Each mark (perfect, good, satisfactory, bad) is expressed as certain quantity of marks (for instance, 5, 4, 3 and 0). His method is used extensively in food industry because about of 80 % we obtain in tasting of products, what influences on their following choose and purchasing.

➤ *Differential method* presumes comparing of indices of quality of certain product with corresponding characteristics of etalon products or with basic indices established by normative documents. The work in evaluation of quality carried out by this method consists in calculation of values of chosen indices expressed in dimensionality of dimensionless numbers of percents and calculated by formula:

$$K_i = Q_{prod} / Q_{basic}$$

where  $K_i$  – relative index of quality,  
 $Q_{prod}$  – value of current index of quality,  
 $Q_{basic}$  – value of respective basic index of quality.

➤ *Complex method* of evaluation of quality presumes the work in calculation of totalized index of quality of the product. One of variants of such complex assessment is calculation of integral index expressed as the mean arithmetical value obtained in unifying in one of its individual indices of quality taken in consideration in observance of coefficients of their weightiness (significance):

$$K_{comp} = k_1 b_1 + k_2 b_2 + ..... + k_n b_n$$

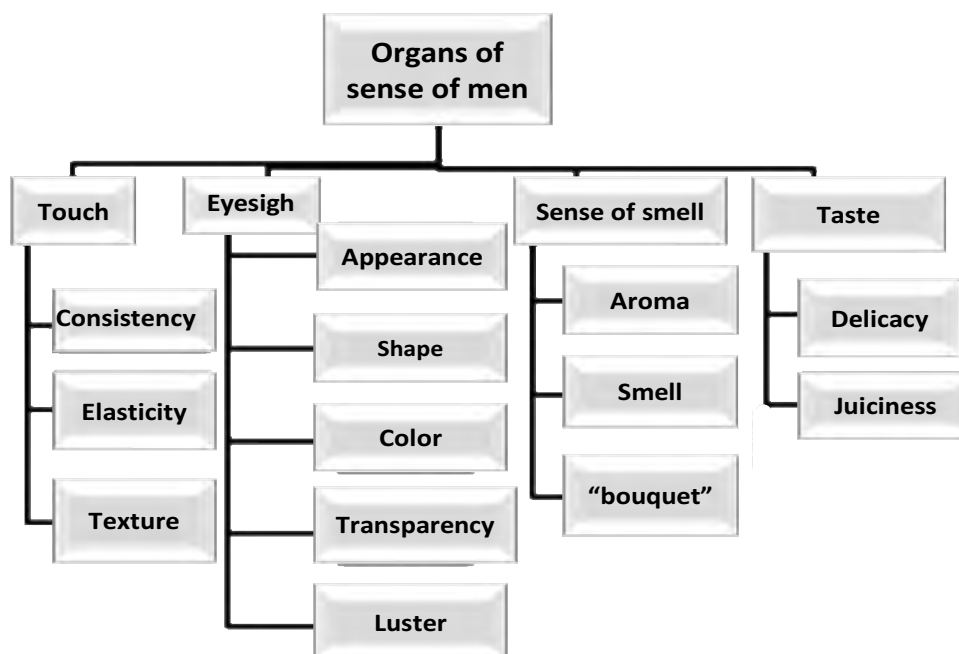
where  $K_{comp}$  – complex index of quality,  
 $n$  – quantity of indices taken into consideration,  
 $k_i$  – coefficient of ponderability of respective index of quality (individual or relative),  
 $b_i$  – normalized value of respective index of quality.

The relative indices of quality of production characterize any of its individual properties as compared with the normalized one, and the totality of such indices (complex index of quality) expresses the real level of quality of production overall.

The method used the most often of listed above is the organoleptic one known from ancient time. The term used in parallel with this one is the "*sensory analysis*". this notion is understood and analysis carried out in use of organs of sense of men (highly specified receptor organs), which assure obtaining of information on object of sensing in use of organs of sight, hearing, tasting, touching, vestibular reception and introception. The result of degustation analysis done in use of scale of numbers



permit to define such organoleptic characteristics of meat products as their appearance, color, view on place of cutting, taste, consistency, juiciness etc. Such conclusion permits to characterize the consuming properties and psychophysiological criteria of products found in use of organs of sense and other physiological capabilities of men. Moreover this work permits to assess also the aesthetic characters of the product (Fig. 5.14):



**Figure 5.14** *Indices of quality of meat products to be found organoleptically*

The absolute values of indices of quality of meat products expressed in differing units of measurement (% , N, kg, kJ, °C, K, Wt, points etc.) cannot be generalized in complex index without their transformation in units expressed uniformly (for instance in units of points). The scale of measurement used in such cases the most often is the dimensionless *scale of correspondence*. The dimensionless value of index of quality expressed in units of this scale is calculated as ratio of magnitude of tested property expressed in units of certain dimensionality to module of magnitude of value standardized in units of the same dimensionality. The basic principle put in base of conclusion on quality of tested value is use of method of comparison. The method of finding of *basic level of comparison* normalized by standard GOST 2.116-84 is based on use in this work of etalon material that complies with modern scientific and technical advances for the moment of analysis.

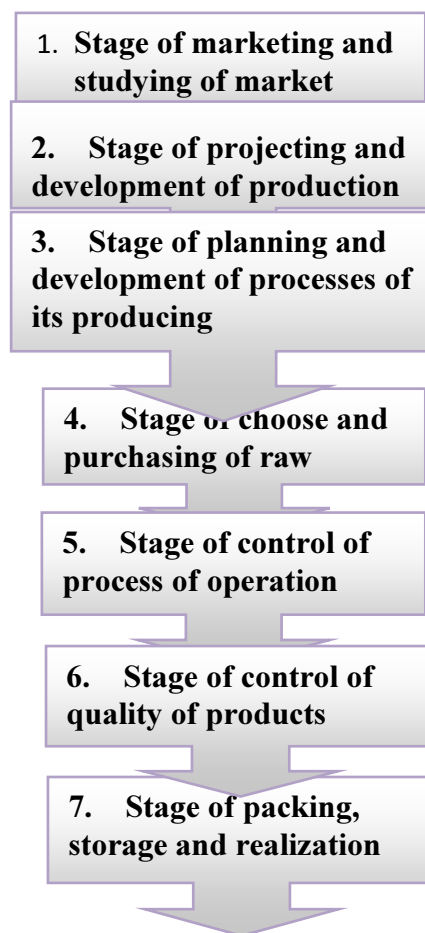
Depending of purpose of evaluation, used criteria of attestation may vary. These ones are for example indices of quality of meat products of best quality produced in Ukraine or abroad; indices of quality reached in earlier time, as well as indices of quality of experimental parties of products calculated or found experimentally. In certain time, such kind indices may be established by normative documents. in this case indices of quality of products must not be worse of those that are normalized by related documents.

The most complicated scale by quantity of indices of quality used in evaluation of level of quality (technical level) is the scale of attestation of quality of means of work. This one relates to most of individual and almost all complex indices of quality. The persons engaged in processes of manufacturing must know not only quality of certain items but also the general level of quality of totality of uniform products of the same destination.

To make this work, one uses certain system of general indices of quality, which the **basic** ones are:

- ✓ quota of fundamentally new (advanced) products in total output,
- ✓ coefficient of renovation of assortment of meat products,
- ✓ quota of certified products,
- ✓ quota of meat products intended for export,
- ✓ quota of defective products in total output,
- ✓ relative volume of seasonal consumables.

One has to understand that the proper quality of items may be reached in condition of execution of all works at all stages of their life cycle. Therefore there exist processes that must be controlled at all its stage (Fig. 5.15):



**Figure 5.15** *Stages of life cycle of meat product*

The modern processes of marketing comprise the processes of ensuring of quality. As to the norms of standards of DSTU ISO 9000 series, the basic processes to be done at stages of marketing and studying of state of market are:

- analysis of current situation on the market and evaluation of quality of own production comparable with indices of analogous products produced by competitors,
- development of program of work in projecting, development, fabrication and marketing of products,
- identification of current and prospective needs of markets of sale of produced products,
- periodical analysis of contracts,
- identification and updating of requirements of customers by technical characteristics, nomenclature, output, prices and other characteristics of contracts on supply (sale) of finished products,
- choose of analogues used in comparison of quality of proposed products in substantiation of their technical characteristics and commercial proposals,
- analysis of results of interrelation with partner organizations including evaluation of work in observance of contractual obligations and losses resulted of non-observing of requirements of contracts,
- analysis of results of work with consumers (customers).

The work in projecting and development of methods of operation may be subdivided by two categories as follows:

1. Minor projects carried out by own initiative that can be realized in a short time. Such works are executed in response on occurrence of problems in normal operation of the enterprise or in reception of complaints of customers on poor quality of sold production.
2. Major projects, e.g. development of new kinds of products, carried out by orders of customers.

The **basic data** taken in consideration by the group of developers of the project give the operative and technological departments and group of quality that operates in structure of the enterprise. This problem is solved typically by the unitized group of said services.

The responsibility for correctness and in-time execution of works in development of new products or realization of contracts on projecting is put in most cases on the structural department, which carries out R&D works. The basic data it receives from other departments of the enterprise in process of development, e.g. at the time of analysis of preliminary specifications of the project. The content of basic data used in development of the project is formed on base of claims of customers of requirements of the market. These one has to be clearly identified and documented and used as the base of work in projecting. Any deviation of content of the project has to be sanctioned by its customer.

There has to be developed the procedure of consultation of members of the group and founded channels of their intercommunication with other departments and services of the enterprise. The typical forms of basic data receives the group are described below.

**Department responsible for marketing of finished products** – explaining of technical specifications proposed by the customer or carrying out of consultations to solve the problematic questions.

**Department of supply of necessary materials and auxiliaries** – supply of necessary materials and analysis of expenditures of alternate materials and components used in manufacture.

**Technical department** consults other departments on properties and special characteristics of materials, prepares reports on their testing and informs on reliability of components and systems etc.

**Department of managing of productive work** informs on existing productive capabilities, consults on methods of overcoming of complications in producing of products, admissibility of deviating out of norms of solutions set by projects etc.

**Department of technical servicing** solves problems of storage, loading and unloading of products and materials, assists in creation of special conditions of environment necessary in process of fabrication and storage of production etc.

The norms of technical documentation must comply to all requirements of legislation in force if in cases of absence of related clauses in contracts. It is especially important in view of necessity of ensuring of safety of produced products and used technologies for life and health of men, their property and state of neighboring nature. The same requirements are valid in process of purchasing of raw and auxiliary materials. The methods and norms of operation vary dependently of type of productive work but some of the following norms of operation and properties of produced products are of universal character and used in almost all types of work:

- functional characteristics,
- outward appearance,
- safety,
- reliability,
- maintainability,
- effectiveness of processes of operation.

There exist four methods of checking of projects on their correspondence to established norms as follows:

- analysis of the project,
- qualifying or typical testing in processes of acceptance and delivering of products,
- alternate calculations,
- comparing of alternate projects.

To rise the level of quality of produced products and trustworthiness of taken decisions, one has to use at least two of listed methods.

**Analysis of the project** means the official, documented and systematical work in evaluation of taken decisions put in base of project by personnel not engaged in works in its development. The work in analysis of the project has to be repeated some times in process of development of the product. The first one carries the consultative character, which results are presented typically in form of recommendations and proposals to make some corrections of taken decisions. However, the developer carries the full responsibility for choose methods of elimination of problems found in process of analysis of the project. The principal purpose of works carried out at this stage is identification of factors that may lead to occurrence of cases of deviation of quality of finished product of the established norm.

The final stage of carrying out of work in analysis of the project may be done with involvement of specialists of departments of marketing, manufacturing and quality, which have the necessary experience in sphere in question. All proposals given at this stage have to be discussed with developers of the project. If there would be taken some alternate methods of solving of potential problems, the expanded group has to apply all proposals to administration of the enterprise for taking of final decision.

The work in evaluation of quality of the representative sample of finished product has to be done by the approved program, which would include the aspects of studying of specific elements of activities to be done. It's recommended that the person nominated for evaluation of trustworthiness of taken decisions did not take part in their development. In most cases the person responsible for auditing is the chief of department of quality. The work in evaluation of the project may clear the need of amendment of some positions of the project and after the proposed amendments would be done, the project has to be audited repeatedly to control that the found drawbacks were eliminated. The process of revision and amending of the project may continue again till its content will be free of mistakes.

The work put in progress after finished of its checking may be modified because of existence of factors as follows:

- existence of imperfections and absence of some important data (for instance of defects in made blueprints, calculations etc.),
- complexity of fabrication in process of mass production,
- impossibility of purchasing of some types of raw materials,
- proposals of customers and/or subcontractors by amendment of some of taken decisions,
- need of optimization of characteristics of finished products,
- amending of norms of safety and requirements to quality of products,
- amending of technologies of manufacturing.

There have to be registered any demands on putting of amendments in the project and documented methods of their consideration and analysis, as well as probable results of their influence of process of functioning of the enterprise. Therefore the departments of control and marketing must be the full participants of such discussions. If the proposed amendments may have the considerable influence on procedures of operation, they may be examined repeatedly. After taking of decision by the commission, the data on proposed changes have to be given for consideration and approval to administration of the enterprise. The processes of manufacturing developed in purpose of using instead of existing ones have to correspond to modern level of progress of science and technique, guarantee rising of productivity of labor, betterment of quality of production, decreasing of volumes of expenses of consumables and raw materials and have the minimal influence on state of health of men and conditions of environment. Taking these tasks into consideration, one shall take as the base the following processes that must be realized in structure of existed system of quality at this stage:

- analysis of current situation in work in ensuring of proper quality of produced products,

- development of complex of measures directed on perfection of level of organization of works in ensuring of due level of quality of production,
- development of technical documentation and acquainting of personnel with details of operation in new conditions of work,
- equipping of the manufacture by necessary equipment, technological auxiliaries and tooling, instruments of control and measurement, means of mechanization and clerical aids,
- introduction of progressive technological processes and operations,
- introduction of advanced means and methods of control and testing, specifying of status of quality of products on base of results of its control and testing,
- attestation of methods of control of quality of production,
- unconditional observance of requirements of normative and technological documentation used at all stages of process of manufacturing,
- carrying out of systematical inner and outer audits of procedures of functioning of quality system,
- organization of storage of finished products, their marking, packing and dispatch by norms of technological regulations,
- screening, isolation and utilization of products of improper quality,
- attestation of system of control and testing,
- forming and regular use of fund of normative and legal documents related to sphere of assuring of quality,
- training, raising of qualification and attestation of professional skill of personnel.

Work by technologies that may be out of sphere of regulation can result in producing of big quantity of cull products before this fact would be identified. Therefore it is critically necessary to develop the effective system of management and control capable to reveal deviations out of norms of good manufacturing practice and use the in-time corrective actions.

To be effective, the managing persons have to organize the closed cycle of operation, which will include the stages as follows:

- 1) control of process (quality of items) in purpose of in-time identification of existence of deviations,
- 2) analysis of data obtained in process of control in purposes of identification of causes of occurrence of deviations and use of necessary corrective actions,
- 3) informing of operators on need of use of necessary corrective actions,
- 4) regulation of the process.

The processes of managing of quality of processes of packing and storage of production are:

- 1) carrying out of works by preservation of proper quality of products in process of their loading/unloading, transporting and storing,
- 2) use of certified packing materials only,
- 3) control of completeness and proper state of packing materials, technical and supplementing documentation.

The norms and conditions of storage of production that is in process of fabrication and finished products have to ensure their protection against unfavorable influence of environment and guarantee preservation of their nutritional properties during the whole term of fitness for consumption. The access of laborers to storehouses must be limited, hence there have to be developed the special methodology of obtaining, storage and delivery of materials and products from places of their storing. To guarantee observance of this rule, one has take into consideration such factors as existence of ventilation and proper conditions of circulation of air, good lighting, possibility of contamination etc.

It's necessary to control dates of guaranteed validity for consumption of all kinds of products and maintain the related documentation. To prevent corruption of products in process of their storage, the responsible persons must carry periodical control of its technical state and use the necessary measures by isolation, utilization or use by other destination of spoiled products, if necessary.

The traceability of works in control of fitness for use by destination of products, materials, details, consumables at all stages of manufacture have to be assured by their identification by methods of marking, labeling, registration in route sheets etc. if laborers would use the reprocessed, aged or used packing materials, they have to ascertain that previous marking was liquidated and there was put the marking typical for materials packed presently instead. The put designation has to contain special instructions on rules of storage and use of the packed item. The ink and dye descriptions must not damage quality of packed product or wipe in process of transporting. If packing contains foodstuffs or products that may corrupt in short time, the put marking must contain information of term of packing and finishing date of fitness of its content for consumption (use).

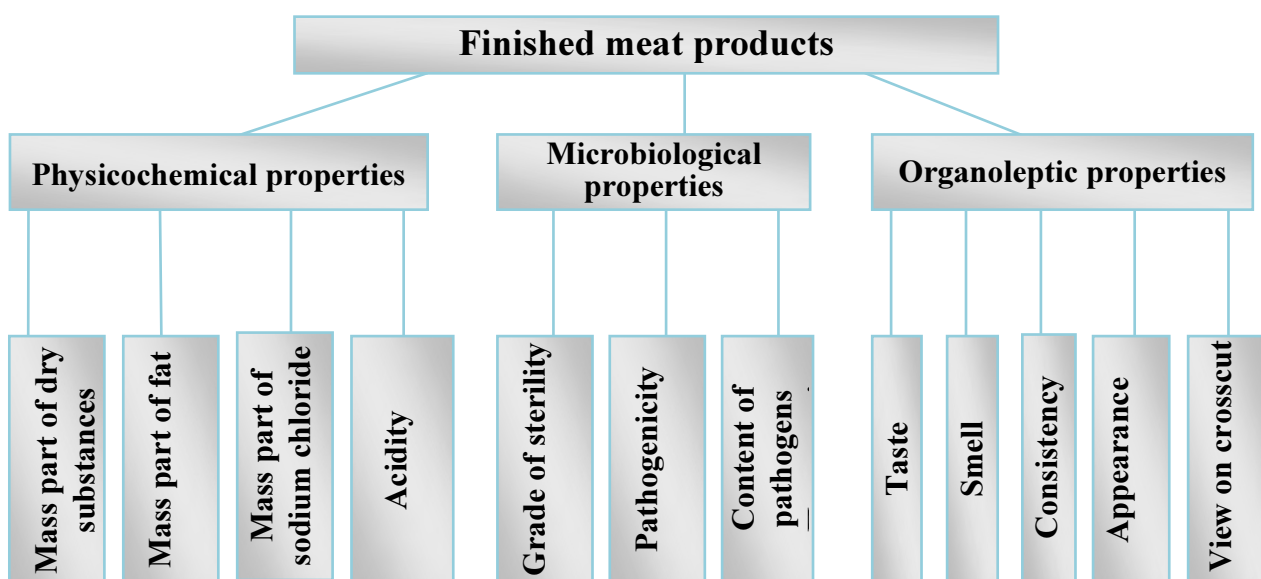
The method of complex evaluation of quality presumes carrying out of necessary actions in certain succession, which includes the basic stages as follows.

1. Development of hierarchical structure of indices of quality taken into consideration in process of evaluation of quality of the product.
2. Identification of numerical values of normalized indices of quality ( $P_{ij}$ ). Identification of permissible interval of variation of value of  $P_{ij}$  ( $P_{ij\max} \div P_{ij\min}$ ) of each of normalized indices of quality.
3. Choose of basic values of indices of quality of the product to be taken in comparison at each stage of work ( $P_{ij\delta a3}$ ).
4. Identification of type of dependence of values of  $P_{ij}$  of marks of individual indices of quality of the product  $K_{ij}$ .
5. Calculation of numerical values of individual indices of quality of tested product  $K_{ij}$ .
6. Identification of method of evaluation of grade of weightiness  $M_{ij}$  acceptable for use in calculation of complex index of quality  $K_o$ .
7. Choose of method of taking together of values of individual indices of quality of  $K_{ij}$  to evaluate quality of the product in whole.
8. Calculation of complex index of quality  $K_o$ .
9. Analysis of obtained results and taking of decision.

Any type of sausage is character by big complex of substantially own properties, which may be subdivided conditionally by two groups as follows: properties that reveal in process of reprocessing (the technological ones) and properties, which play the considerable role in process of use of finished product (the consuming properties), e.g. such that may vary in process of its storage even in cooled state.

Dependently of being of product at certain stage of cycle life, there varies the content and grade of importance of properties, which form the integral complex of indices of quality of the product. Thus, the raw materials used in production of products of alimentation purchased by the enterprise are evaluated by their natural properties. If they are at stage of reprocessing, the most valuable became technological properties that reflect interrelation of their physicochemical, structural, mechanical and thermalphysic characteristics with parameters of reprocessing and characterize the depth of their transformation. The most influential properties that act at stage of storage and transporting of products are those that characterize development of processes of chemical transformations of ingredients of the product and germination of microorganisms in it. The properties the most expressive at stage of consumption of finished products are those that characterize their organoleptic characteristics, nutritional value and appearance.

The character properties of meat products may be represented the best in view of hierarchic tree. Evaluating quality of meat products, one has take into consideration first the properties that are normalized in technical regulations on the product. The categories of quality regulated the most often are contents of dry substances, fat, sodium chloride, quantity of microorganisms in one gram of the product and its acidity and organoleptic properties. So, the hierarchic structure of properties of the product will have three levels. The properties normalized at the first level are divided conditionally by three categories: the physicochemical, organoleptic and microbiological ones (Fig. 5.16).

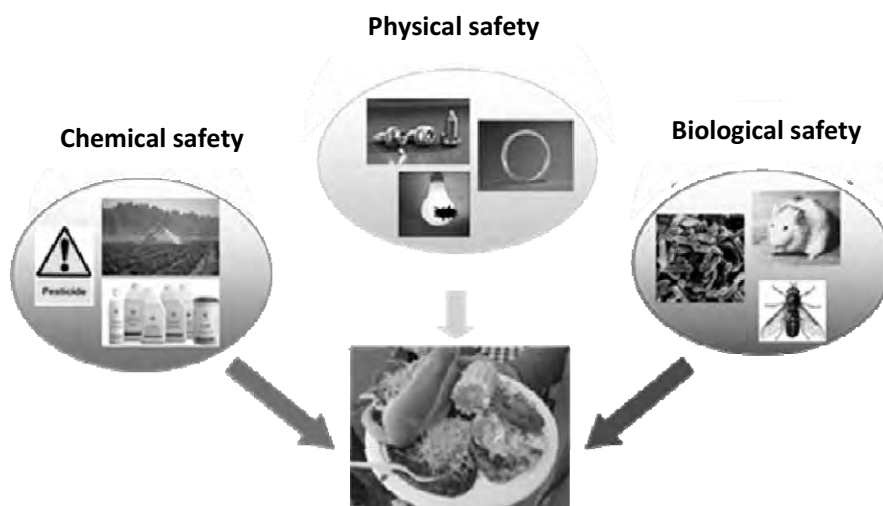


**Figure 5.16** Hierarchical structure of properties of meat products



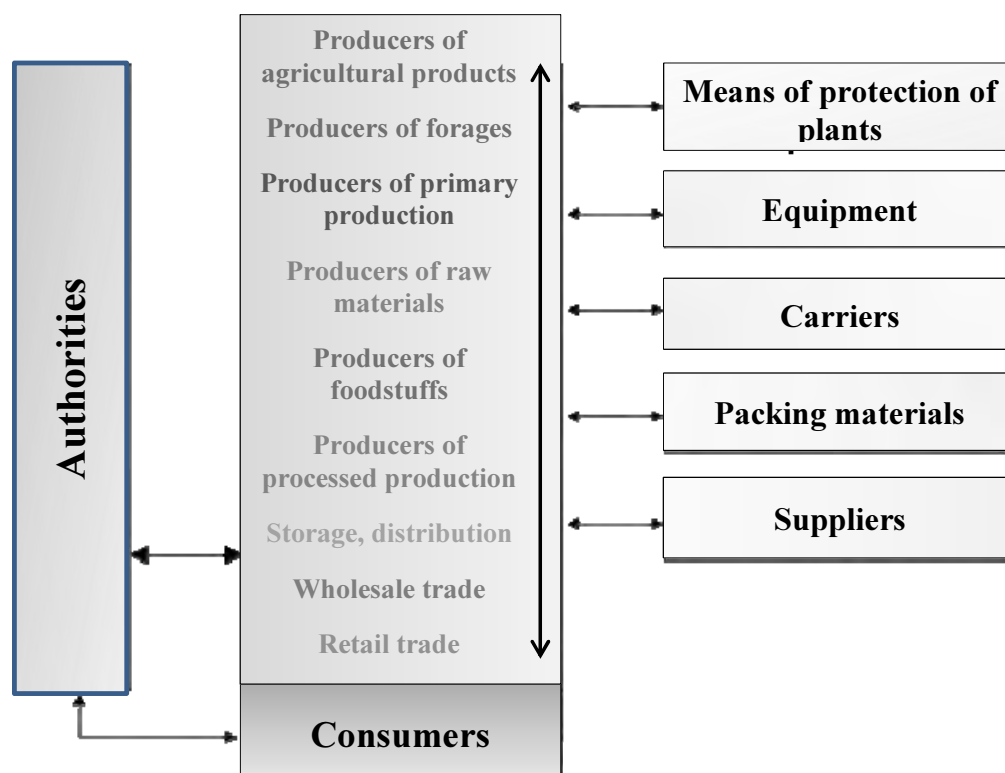
The properties used in process of evaluation of quality of products may be classified by characters as follows:

- ✓ by mode of expression, indices of quality may be expressed in natural units (for instance, in units of kg, m, m<sup>2</sup>, m<sup>3</sup>, points, %, dimensionless units) and in units of cost,
- ✓ by quantity of properties indices of quality may be single, complex (grouped, integrated, generalized),
- ✓ by sphere of use there are discriminated the absolute, basic and relative indices of quality,
- ✓ by mode of identification the indices of quality are classified as instrumental, measurable, accountable, expert and sociological,
- ✓ by stage of identification, indices of quality are discriminated as forecasted, projected, obtained in process of fabrication and those that are averaged by results of operation of the enterprise in certain period of time,
- ✓ by type of properties taken into consideration.



**Figure 5.17** *Types of safety of meat products*

There exists not the uniform method of identification of quality and safety of foodstuffs. At the same time, the work in comprehensive testing of quality of products is too expensive and non-effective method of guaranteeing of food safety. For instance, the process of identification of grade of contamination of foods by microorganisms can identify in the best case the absence of pathogens in the sample taken for analysis but not guarantees their absence in the whole party of this product. Moreover, if the pathogenic organism is really present in any batch of the product, the latter may be already sold and even consumed by destination if the guaranteed term of its storage is too short. The same arguments may be used in relation of chemical contaminants too. It's obvious that safety of all packs of foodstuffs may be guaranteed only in case of control of each one what is practically impossible. Therefore it may be asserted that testing of finished products cannot ensure the proper level of food safety expresses in terms of absence of hazard for health of consumers at all stages of nutrition raw (Fig. 5.18):



**Figure 5.18** *Schematic chart of nutritional raw expresses in terms of concept of “from afield to the meal”*

In brief, the sequence of stages of control of quality and safety of the foodstuff at all stage of nutritional raw may be expressed as follows:

**Identification of fact of correctness of use of the product by destination.**

It's necessary to identify all potential consumers of the product or group of products of the same category and point the group of persons the most sensible to its (their) probable negative influence. The manufacturer (supplier, distributor) have to give description of composition and mechanisms of influence of the product in its consumption by destination, probable variations of its properties in process of storage, as well as effects that may occur in process of its preparation and consumption. The guarantees of safety of the product in case of its consumption in non-recommended cases and use not by destination must be highlighted by related marking and described in instruction by use of the product.

**Diagram of sequence of operations** must be developed for all products and groups of products of the same category produced in structure of system of HACCP and have to include the information as follows:

- sequence of all stages of process of manufacturing,
- identification of stage(s) of use of raw materials and auxiliary materials (including stages of works carried out by subcontractors),
- stages of deviating of procedures of work of normalized operations,
- stages of producing of intermediate products and formation of by-products and wastes of manufacture.

To identify probable risks, the diagram of sequence of operation and all necessary schemes of passing by stages of manufacture of raw materials, auxiliaries, by-products and finished products must be clearly identified and described in details.

**Identification of risks.** All risks that may occur in structure of system of food safety must be identified, documented and ranked dependently of grade of their importance and probability of occurrence. The grade of essentiality of risks must be evaluated dependently of probability of their occurrence, robustness and recurrence at each stage of process of manufacturing.

**Establishing of procedures of management.** The procedures of management must be assigned for each considerable risk. Their use has to minimize or even eliminate probability of their occurrence. If it is not possible, technologists must modify composition of the product or the technology of its manufacturing.

**Critical control points (CCP).** All considerable risks must be managed in use of methods of operation developed for each CCP in observance of principles of systemic approach and properly documented. There have to be developed criteria of control in each CCP and results of continuous monitoring in these points have to witness that used measures permit to reach the desired result.

**Critical limits of each CCP.** The characteristics chosen for control in each CCP must have the established limits of variation. There have to exist the possibility of demonstration of those that observance of established conditions of work permit to decrease/prevent/eliminate probability of occurrence of risky situations. The critical limits of variation based on subjective data, such as visual control of quality of the product, must be certified by related instructions or specifications.

## **5.6 Principles of State control of quality and safety of foodstuffs**

The norms of quality of production of agriculture have to comply with certain aesthetic, physiological and technological norms, and the principal properties to be observed in their fabrication are:

- *physical* (shape, coloring, density etc.),
- *chemical* (content of fat, albumen, carbohydrates, vitamins etc.),
- *biological* (capability to be stored without sufficient loss of mass, resistivity to worsening of marketable and nutrition properties and so on).

The structure of bodies of State executive power responsible for control of procedures of work in ensuring of safety and observance by businesspersons of set norms of quality of foodstuffs includes the persons as follows:

- Council of Ministers of Ukraine,
- Central body of executive power, which forms and accounts for realization of State policy in protection of health,
- Central body of executive power, which forms and accounts for realization of State policy in ensuring of conditions of safety and correspondence to established norms of quality of foodstuffs,
- Central body of executive power, which forms and accounts for realization of State policy in assuring of the sanitary and epidemiological welfare of population.

The Central body of executive power, which forms and carries responsibility for realization of State policy in protection of health:

- establishes norms of protection of health of men,
- establishes procedures of informing of the community on cases of food poisoning,
- accomplishes the State registration and running of State registers of novel foodstuffs, food additives, flavoring additives, enzymes and mineral drinking waters,
- establishes indices of safety and quality of foodstuffs,
- approves hygienic norms of objects of sanitary measures,
- draws up the list of reference methods of analysis of foods recommended for use,
- approves documents of guiding character and presents the respective information on its official web-site.

The Central body of executive power, which forms and accounts for realization of State policy in ensuring of safety and observance of certain indices of quality of foodstuffs:

- approves the list of enterprises, which export their products abroad and puts and excludes them out of their official register,
- accomplishes continuous consultations with the specialized bodies of other countries by problems of recognition of equivalency of all or certain measures used in assuring of safety and proper quality of foods to be used in signing of intergovernmental treaties,
- organizes and accomplishes work in State control of safety and quality of foodstuffs including this work at food markets and on the State border,
- approves the long-term plan of State control and supervision and establishes forms of documents used by the State inspectors in process of carrying out of their professional activities,
- approves the procedures and criteria of accreditation of testing, measuring, calibration and reference laboratories.
- develops and validates the annual and long-term plan of State control and supervision,
- carries out inspections of animals before and after their slaughtering at enterprises specialized in this work, as well as inspects the bulks of animals killed at hunt,
- accomplishes the State control of work in introduction of procedures of operation of businesspersons based on principles of HACCP,
- authorizes testing and reference laboratories on carrying out of work in searching (testing) of objects of sanitary measures in process of the State control in spheres of their responsibility,
- carries out the epizootic search and identifies causes and conditions of marketing of hazardous and unfit foodstuffs,
- takes part in development of sanitary measures, certain norms, technical regulations and standards of quality of foodstuffs.

*Reference laboratory means the accredited laboratory authorized by the competent body by norms of Law of Ukraine of 22.07.2014 # 1602-VII "On amendment of certain legal deeds of Ukraine concerning of foodstuffs" on carrying out of works defined by this Law*

The reference laboratories are founded in accordance with norms of the Law of *"On Amendment of Certain Legal Deeds of Ukraine Concerned of Safety of Foodstuffs"*. The functions of reference laboratories execute the persons as follows:

- accredited laboratories authorized by the competent legal person,
- reference laboratories recognized in this status as such that conform to requirements of international organizations and/or European Union specialized in this job.

The reference laboratory must comply to criteria as follows:

- be accredited on right of carrying out of investigations (tests) to be done with use of reference methods,
- have the personnel, which possesses by the necessary experience in work in development of methods of investigation (testing) of quality of foodstuffs and training of personnel of other laboratories specialized in analysis of foods,
- possesses by databases of national, international and European standards on methods of control of safety of objects of sanitary measures and their investigation (testing) in sphere of their authorization.

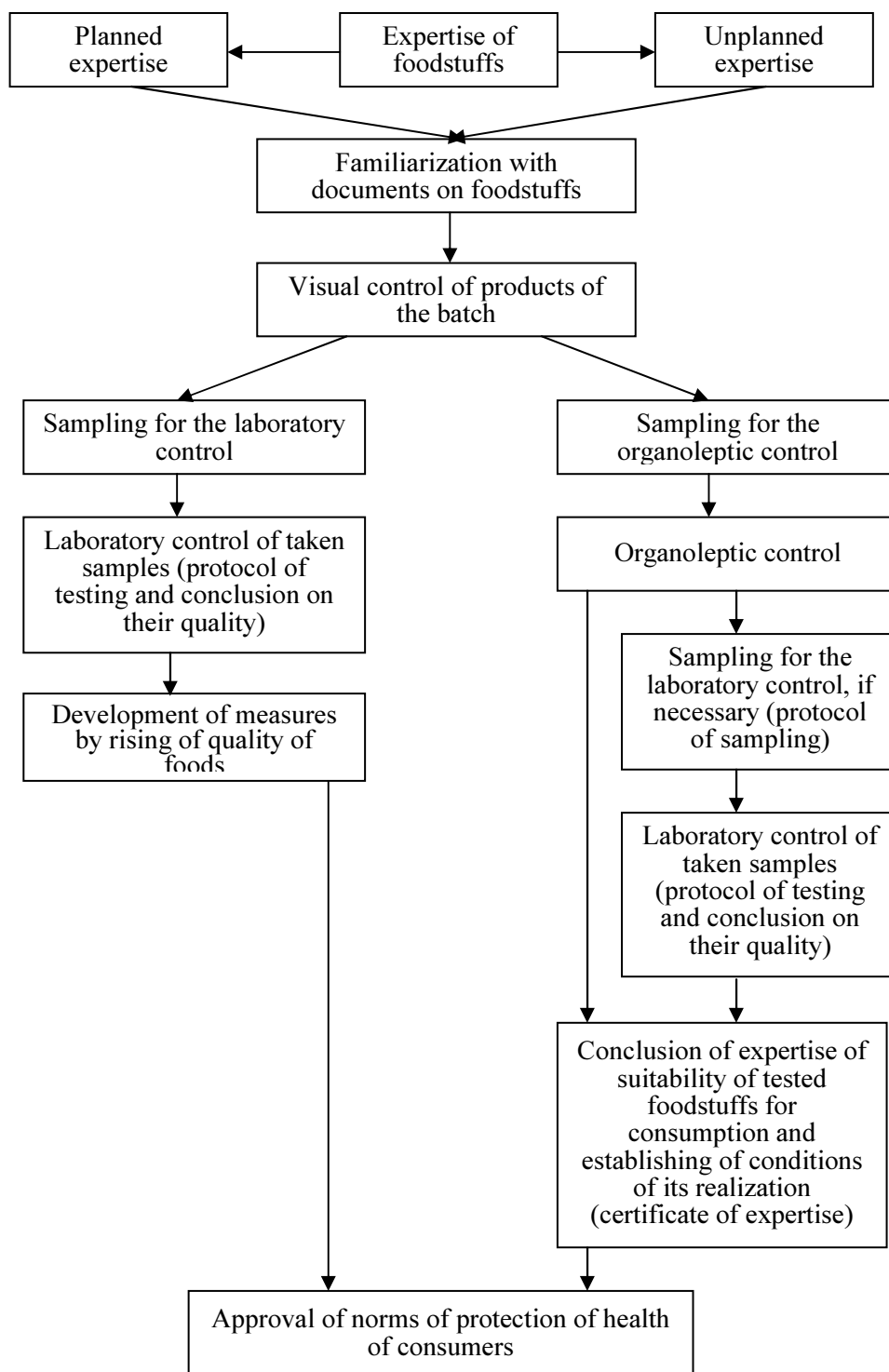
The principal functions of reference laboratories are:

- development of methods of investigation (testing),
- organization of courses of training of their personnel by profile of its authorization,
- carrying out of interlaboratory rounds of identification of professional skill of laboratories,
- participation in development of legal and normative deeds by problems of safety and control of certain indices of quality of foods,
- carrying out of R&D works to be used in work in State control and supervision,
- carrying out of arbitrary tests.

The typical procedure of expertise of quality and safety of foods shows the Figure 5.19 below.

As provide the norms of Law of Ukraine of 22.07.2014 # 1602-VII, the only body, which has the power on carrying out of work in control of state of safety of foodstuffs in Ukraine, is the *State Service by Problems of Safety of Foodstuffs* founded in way of unification of related structures of the State Veterinary Service of Ukraine, State Phytosanitary Inspection, Sanitary and Epidemiological Service of Ukraine and State Inspection by Problems of Protection of Interests of Consumers. The principal sphere of its responsibility is development and approval of norms as follows:

- procedures of introduction of principles of HACCP and/or other analogous systems of assuring of safety and quality of foodstuffs subordinated to its control,
- methods and procedures of State control of quality of foodstuffs subordinated to control of services listed above,
- maximum allowable concentrations of pesticides, veterinary preparations, inclusions, polluting substances, food additives and auxiliary materials in foods and food raw materials used in their production.



**Figure 5.19** *Typical procedure of expertise of quality of foods*

The objects of the State expertise are:

- enterprises that produce foods intended for exporting (in purposes of their registration),
- enterprises that produce and sell foodstuffs on the inner market (in purposes of issuing of permissions on their exploitation or restoration of productive activities after postponing of operation).

The State Service by Problems of Safety of Foodstuffs control conditions of operation of businesspersons in producing and distribution of products of meat- fish- and milk-processing industries, controls routine of operation of enterprises of wholesale storage of not-processes foods of animal origin, and supervises on operation of all objects of sanitary control. Besides, this Service accomplishes the functions of issuing of permissions on circulation of foods as follows:

- 1) foodstuffs and additives of special dietetic use,
- 2) functional foodstuffs,
- 3) all types of foodstuffs excluding those, that are in sphere of responsibility of the State Service of Veterinary Medicine of Ukraine.

The departments of the Service make the expertise of:

- technologies of production of foods not used in Ukraine before,
- quality of foodstuffs produced in Ukraine for the first time,
- safety of foodstuffs imported in Ukraine the first in absence of valid resolution of the State Sanitary and Epidemiological Service or the substantiated declaration on their safety issued by their producer (importer),
- foodstuffs for special dietetic consumption, functional foodstuffs, dietetic additives, food additives, flavoring substances and auxiliary materials used as their ingredients and not registered in Ukraine yet,
- projects of plants, which will produce and reprocess foodstuffs.

The terms mentioned above are used here in meanings as follows:

*Foodstuffs for special dietetic consumption mean foods, including the products to be consumed by children and aged persons, which are not the medical preparations but were specially treated in purposes of satisfying of concrete dietetic needs, which result of specific physical or physiological conditions of men and/or their specific illnesses or disorders*

*Foodstuff consumed in special medical purposes means the product developed and produced specially in purposes of curing and consumed under control of physician. Such product is assigned for partial or total substitution of ingredients of usual ration of patients, who have the limited, broken or inadequate capability to eat, digest and assimilate usual foods, or their certain nourishing ingredients, or their metabolites. The foodstuffs assigned for consumption in special medical purposes may be prescribed for the partial or full-scale alimentation of patients in impossibility of satisfying of their needs in modifying of usual ration identified by physicians*

*Functional foodstuff means the food, which contains medical preparation(s) as the constituents added in purposes of prophylaxis and/or softening of consequences of illness*

*Useless foodstuff means the foodstuff, which contains the outside inclusions and/or pieces or was damaged in result of influence of mechanical, and/or chemical, and/or microbial factors. In case of its consumption in usual conditions, the useless product is not harmful for health of men*

*Food additive – means the substance, which is not the foodstuff or its ingredient in usual conditions, but was added to the foodstuff in technological purposes in process of its production becoming so the integral component of the product (this*

*term does not includes substances, which were added into the foodstuff to improve its nutritious properties)*

*Dietetic additive means the vitaminous, mineral, or grassy component consumed with foods perorally in form of tablets, powders or mixes*

*Auxiliary material for remaking of foods means any material does not consumed as a food but used in technological purposes in process of producing or processing of foodstuffs or their ingredients*

*Flavoring substances mean all products not consumed separately of other foods but added into foodstuffs to give them the flavor and/or taste, or modify their scent. This class ingredients includes aromatic substances, aromatic preparations, aromatic substances treated thermally, smoking flavoring substances, aromatic precursors, as well as other flavoring agents and their mixtures that cannot be classified by categories listed above*

The State control and State supervision services control the grade of safety of foodstuffs by approved programs of inspection. If the inspector would have any suspicions on improper quality, and/or incorrect marking, and/or labeling of any object of sanitary control, he has to demand of its owner to do the necessary laboratory investigations by methods normalized by national standards of Ukraine. In impossibility of use or absence of such norms, there have to be used the methods established by the respective specialized international organizations. If such methods would be absent too, there have to be used the special methods of analysis developed in observance of norms of national standards of Ukraine, or documents of respective international organizations, or documents used in the European Union.

If any foreign substance must not be present in the foodstuff, the related normative and legal deeds establish the minimum level of sensitivity of methods of its identification. If result of analysis by this method would not show its presence, one may consider that this substance is absent in the analyzed food.

The persons, which produce, reprocess, transport and realize foodstuffs with violation of norms of Law of Ukraine of 22.07.2014 # 1602-VII "*On Introduction of Amendments in Certain Legal Deeds Concerned of Foodstuffs*", are subjected to fining in cases as follows:

1. admitting to processes of production and/or circulation of foodstuffs of persons, who have counterindication to this work,
2. producing and storage of foodstuffs in premises, which are not registered in accordance with norms of said Law,
3. producing and storage of foodstuffs in absence of the related permission,
4. nonobservance of obligation on introduction of principles of system HACCP at the continuously working enterprises,
5. realization of products marked improperly,
6. violation of norms of traceability at all stages of being at the enterprise of finished products and ingredients used in their producing,
7. nonobservance of obligation on returning or withdrawal of hazardous products,
8. use of non-registered auxiliary materials, which contact with foodstuffs in process of their fabrication,



9. realization of non-registered objects of sanitary measures, if such registration is specified by this Law,
10. putting in circulation of unfit foodstuffs,
11. infringement of parameters of safety of objects of sanitary measures set by legislation,
12. non-fulfillment of substantiated claims of functionaries on elimination of violations of safety and causes of non-observance of certain indices of quality of foodstuffs to be done during the term agreed with the competent body,
13. non-fulfillment of legal claims of functionaries of competent bodies on annihilation of foodstuffs and materials used in their reprocessing, which are hazardous for health of men and/or dangerous in other type uses,
14. concealment (non-presentation), refusal in giving of necessary data and giving of inauthentic information in answering on claims of competent persons,
15. refusal in admission to the enterprise of functionaries, who are authorized on carrying out of planned control actions.

*Withdrawal of the foodstuff means the measures directed on prevention of distribution, demonstration and proposing for consumers of dangerous foods*  
*Recall of the foodstuff means the measures directed on returning of the dangerous foodstuff, which was sold, or given for use, or is available for the consumer*

To start serial production of the foodstuff, the manufacturer has to receive, dependently of its type, the permission of the Chief Sanitary Doctor of Ukraine or the Chief State Inspector of Veterinary Medicine.

- compliance of characteristics of objects of expertise to sanitary norms,
- safety in carrying out of operations, which influence on state of health and conditions of life of men,
- completeness and effectiveness of sanitary, anti-epidemic and prophylactic measures to be taken by businesspersons in their work.

The content of information on medicinal properties of foodstuffs (if exist) to be put in their labels, explanatory and advertising materials, has to be agreed with the Ministry of Protection of Health of Ukraine in obligatory manner. The head body, which main subject of work is rising of level of safety of foods in Ukraine, is the National Commission by Codex Alimentarius subordinated to the Council of Ministers of Ukraine. Its principal functions are:

- establishing of parameters of safety of foodstuffs, which have to comply to international norms, as a rule,
- coordination of activities in harmonization of domestic norms of quality of foodstuffs with the international ones,
- coordination of works in harmonization of international standards, technical regulations, and sanitary norms used in producing and analysis of foodstuffs,
- development of projects of advanced sanitary measures and proposals on amending of the valid ones,

- organization of scientific and expert investigations by problems of its competence,
- informative and reference servicing in dissemination of information on activities of supreme bodies of the Commission “Codex Alimentarius”.

## **5.7 Procedures of Import of Agricultural Production in Ukraine**

The Council of Ministers of Ukraine publishes regularly the list of foods, additives, preservatives and products, which contain substances that must not be imported in Ukraine, especially the foods potentially dangerous for health, unfit for consumption, incorrectly marked and not conforming to provisions of technical regulations and/or sanitary measures of national category.

*Unfit (adulterated) foodstuff means the product useless for consumption by men in cases as follows:*

- *if it contains toxic or harmful substance(s), which presence make it dangerous for health of men (excluding substances, which are present in quantities not harmful for health),*
- *if it contains toxic or harmful substance(s) added intentionally (excluding pesticides, food additives, colorants or medical preparations for animals) in quantities, which do not exceed their maximum permissible levels,*
- *if it does not conforms to minimum specifications of quality,*
- *if it is fully or partly produced out of ill animal(s) or animal(s) slaughtered outside of supervised slaughter-house(s),*
- *if it is placed into the container or packing, which fully or partly consists of substances toxic or harmful for health,*
- *if it was specially irradiated (excluding the cases of use of irradiation done in observance of international norms of its safe use),*
- *if it contains food additives not permitted for use in foods, and/or substances that are permitted for use but present in quantities, which exceed their maximum allowable concentrations in foods,*
- *if it contains pesticides, veterinary preparations or their residues, which presence in foodstuffs is prohibited, and/or compounds, which are permitted for use but present in quantities, which exceed their maximum permissible concentrations in foods,*
- *if there were fully or partly removed and/or substituted any useful ingredient(s) of the product, or if its composition was knowingly altered in purposes of increasing of its volume or mass, or was amended in purposes of raising of its attractiveness or worth*

*Product marked incorrectly means the foodstuff, which marking is made incorrectly in use of methods as follows:*

- *its label is counterfeited or contains deceiving information,*
- *the foodstuff is sold under the trade mark of other product,*
- *information on the label is written in foreign language,*
- *the foodstuff was packed, placed in pack or prepared for realization by deceiving mode,*
- *the label placed on the product contains words and/or combinations of words read with difficulties or problematic for understanding by ordinary consumers,*

- *the foodstuff was treated or irradiated by the permitted mode but information on name and address of irradiator is not given in its label properly. The exclusion is the non-packed commodity, which was irradiated and not supplemented by the documents but supplemented by documents that inform on such treatment*

Besides, there is prohibited importing in Ukraine of products as follows:

- 1) inedible products of animal origin,
- 2) live pathogenic microorganisms *and materials, which contain pathogens of diseases of animals (excluding cases of their import in Ukrainian territory for research or other permitted use),*
- 3) veterinary preparations, premixes, forage and forage additives *not complying to norms of the Law of Ukraine “On Veterinary Medicine”.*  
*Premixes mean mixes of feed additives not intended for direct feeding of animals, which contain vitamins, amino acids, minerals and other substances mixed with water and/or forages of animal or vegetative origin used as their carriers*

The reasons of refusing in issuing of permissions on importing in Ukraine of clinically healthy animals, or cancellation of validity of resolving documents issued in earlier time, are: a) probability of bringing of pathogenic organisms, b) delivery of commodities prohibited for use in Ukraine, c) riskiness of import of commodities potentially harmful for health of men and animals.

The live animals have to be subjected before their importing in Ukraine to thermometry and inspection of State veterinary services on absence of brucellosis, paratuberculosis, leucosis, leptospirosis, as well as to prophylactic dehelminthation and treating against parasites done in terms sufficient for liberation of organism out of residues of used preparations. The transport means to be used for their delivering have to be treated and prepared by the norms used in these purposes in Ukraine.

The fact of carrying out of work in inspection and veterinary treating of animals witnessed by documents, which indicate used methods of control and witness the fact diagnostics, vaccinations and inform on their results, have to be registered in veterinary and sanitary certificates of international form written in Ukrainian and the language of the country of exportation and signed by the State Veterinary Doctor of the country of origination of the freight. If the Ukrainian State inspector will find its invalidity or discrepancy of given information, he has to inform on it the Chief State Sanitary Doctor, or the Chief State Inspector of Veterinary Medicine, or their deputies, and issue the prescription on sending of suspicious parcel on storage at specially appointed veterinary inspection post(s) on the State border.

*Control of conformity on the State border means the form of State control, which represents itself visual inspecting of the freight carried out in purpose of examination of compliance of its real content to data contained in certificates and/or documents, which supplement the parcel*

*Physical control on the State border means the control of content of objects of sanitary measures to be done in purposes of correctness of supplementing documents and identification of its safety. This work may include the control of some indices of quality of foodstuffs and state of means of transporting, correctness of packing, marking, sampling, measuring of temperature, as well as*

*other type control actions, which would be necessary in identification of conformity of content of state of freights to legal norms*

In revealing of evident discrepancies of state of the freight to be transported through the Ukrainian territory in transit to established norms, there have to be done the actions as follows:

- the inspector of veterinary medicine on the State border must inform on it the Chief State Inspector of Veterinary Medicine as soon as possible and the latter has, in turn, to inform on it the importer and/or owner of the freight and functionaries of countries of origin and destination,
- in finding of the especially dangerous illnesses, ill animals must be slaughtered and their bulks utilized by methods, which exclude expanding of found illness(es),
- the suspicious freights have to be isolated in questionable cases in quarantine stations. In existence of such necessity, the inspector has to take the representative samples of commodities and send them to the authorized accredited laboratory.

The foodstuffs recognized as dangerous, unsuitable for consumption, incorrectly marked or not complying with requirements of domestic technical regulations and sanitary norms, are not permitted for importation and must be returned to their owner. The exclusions are cases, when the importer or his authorized representative agrees on reprocessing of condemned commodities or their use by changed destination. At that, each pack of such products has to be marked by notification “*Not for consumption by men*”. In absence of packs, the problematical commodities have to be packed by method, which would permit to put such marking on the packing.

In existence in countries of origin of illnesses of animals listed by the International Epizootic Bureau as dangerous, the Chief State Inspector of Veterinary Medicine of Ukraine has the right to terminate or even prohibit importing of cattle from regions of their occurrence. This restriction is applied to all freights, including those that were sent in transit through the country (zone) of prohibition. The term of prohibition is set in observance of duration of the incubation period of the respective illness calculated since the last date of its appearance in the quarantine zone. All condemned freights of foodstuffs, which were already imported in Ukraine and reckoned as risky for health of men and animals, as well as those that are recognized as such that cannot be reprocessed, have to be annihilated by procedures established by the Council of Ministers of Ukraine.

*Annihilation of production withdrawn from circulation means the mechanical, physical, chemical, biological or other type procession and/or disposal (burial) of products or their residues in specially assigned places*

*Processing of production withdrawn from circulation means the complex of technological operations in changing of physical, chemical or biological state of production withdrawn from circulation done in purposes of its preparing for utilization or following use in another destination*

The enterprises, which reprocess, utilize and/or annihilate the dangerous and poor quality production, have to observe the following terms:

- keep the manufacturing facilities in conditions safe for health of men and state of environment,
- keep books of receipt, procession, utilization and annihilation of obtained products,
- regularly train and attest the level of proficiency of their personnel,
- inform bodies of executive power, local corporate bodies and population on accidents and extreme situations occurred in process of their operation and skillfully liquidate their consequences,
- prevent the possibility of storage of products withdrawn from circulation in unforeseen places and cases of unauthorized treating.

The products of agriculture subordinated to the State control and supervision actions, as well as the products imported, to be imported, exported or transported through the Ukrainian custom territory, have to be subjected to obligatory selective veterinary and sanitary control at the boundary quarantine stations of the State Department of Veterinary Medicine on transport. The conditions to be observed in import of objects of sanitary control in Ukraine are as follows:

- foodstuffs must be supplemented by originals of international veterinary (sanitary) certificates and/or marked by the mode, which witnesses their suitability for consumption,
- other objects of sanitary control must be supplemented by documents and/or be marked by mode that indicates the place of their fabrication.

The work of the State veterinary and sanitary frontier control bodies includes the actions as follows:

- 1) control of validity of permission on import,
- 2) phytosanitary, veterinary and sanitary control of foods subjected to custom procedures,
- 3) control of completeness and authenticity of international certificates, as well as trueness of information on content of the parcel,
- 4) control of animals on presence of symptoms of dangerous diseases,
- 5) control of existence of marking placed in country of origin onto bulks of animals, or on parts thereof, or on their packing, which witnesses their suitability for consumption,
- 6) selective control of accuracy of marking and fullness of information on quality of foodstuffs given in their labels, as well as proof of their compliance to norms of technical regulations of national category,
- 7) control of integrity of packs of foodstuffs and their opening (if necessary) in purposes of identification of their pollution by exterior substances.

The posts of the State Department of Veterinary Medicine authorized on control of production to be imported (exported) accomplish the scheduled actions as follows:

- taking of samples out of animals or other commodities for diagnostics, clinical examination and laboratory testing,
- selecting on quarantine of ill animals and animals, which show signs of illnesses,
- control of disinfecting of means used in transporting of freights.

The expanded veterinary and sanitary control of freights or their extraordinary selective sanitary inspection is carried out in the following cases:

- if the product was considered as dangerous at least once during the last five cases of its importing,
- if the product is useless, incorrectly marked or does not comply to established technical and/or sanitary norms,
- if the visual inspecting of the product carried out in earlier inspections showed evident infringements of sanitary norms,
- if the foodstuff is imported into the Ukrainian custom territory for the first time and is not supplemented by declaration of conformity of the form recognized in Ukraine,
- if the State inspector of veterinary medicine on the Ukrainian border suspects the probability of risk for health of men and animals in consumption of products, which are in the parcel.

*International sanitary certificate means the document issued by the competent authorized body of country of origin, which witnesses suitability of the product for consumption by men (excluding the products subordinated to control of the State veterinary service)*

*International veterinary certificate means the document issued by the State Doctor of Veterinary Medicine of country of origin, which witnesses that the established norms of work in protection of health of animals were observed in their fattening wholly, and/or indices of quality and safety of foodstuffs subordinated to control of the State Veterinary Service conform to the established norms*

*Inadmissible international certificate means the certificate, which contains at least one of features listed below:*

- *it was issued by the non-authorized person,*
- *it was not ratified or was issued with infringement(s) of the form approved by the competent body of country of origination,*
- *it was formalized illegibly,*
- *it contains the incomplete or inauthentic information,*
- *the term of validity of the certificate was expired,*
- *it contains the non-notarized corrections or erasures,*
- *it contains the contradictory information,*
- *it was set forth in the language not conforming to the legalized standards of registration,*
- *it was issued on products, which import and/or export (transporting in transit through the national custom territory) is prohibited*

The label on the product has to contain the additional information on its properties and may be considered as the one more instrument of control of quality of the product. The legends on the label have to be written in the official State language. The operator of the market, if wish, may double such information in other languages too. Some categories of information to be given in such kind label are given in Table 5.3:

Table 5.3

*Typical information contained in labels of foods*

Category of information	Content of label
Content	Appellation of the foodstuff and/or its ingredients
Characteristics	For example: <i>"Conforms to norms of European directive # ..."</i>
Conditions of exploitation	For example: <i>"Fill only by distilled water"</i>
Quality	For example: <i>"First grade of quality"</i>
Safety	For example: <i>"Sigh CE"</i>
Warning	For example: <i>"Safe for children"</i>
Health	For example: <i>"Allergic"</i>
Environment	For example: <i>"Environmental label"</i>
Guarantees	For example: <i>"Not rusting"</i>

The results of environmental, veterinary and sanitary operations carried out in other countries may be recognized as equivalent with the Ukrainian ones only on condition of concluding of bilateral or multilateral treaties on recognition of their equivalence. The foodstuffs and forages may be exported or re-exported in third countries only on condition of concluding with these states of special treaties and in existence of permissions issued by the competent State bodies of country of destination. The validity of certificates of conformity issued abroad may be recognized in Ukraine only on condition of absence of commercial or other interests of the authorized competent foreign body, which issued the document, and trustworthiness of results of attestation of quality of foods carried out in observance of criteria as follows:

- existence of qualified personnel and means necessary for attestation of quality of products to be exported, and
- possibility of inspection of appropriateness of equipment used in testing of said products in the country of origin.

The criteria to be observed to recognize the necessary level of competence of foreign administration in work in attestation of quality and safety of foods are:

1. Membership of country of export in the profile international organizations.
2. Observance of procedures of veterinary and sanitary control recognized internationally.
3. Transparency in making of resolves on quality and safety of objects of export.
4. Existence of independent organization, which controls observance of procedures used in international sanitary and veterinary certification.

The results of work done in assessment of conformity of foodstuffs abroad may be recognized in Ukraine in absence of respective international treaties in cases as follows:

- if Ukraine and the Party, which persons issued certificates are both members of the same international and/or regional specialized organization(s) and use the same norms of attestation of conformity,
- if this work was carried out by the specialized foreign agency accredited by the international or regional organization, which member Ukraine is.

The products of agriculture imported into the Ukrainian custom territory must be certified in obligatory manner (excluding the raw materials imported in purposes of producing in Ukraine of commodities to be certified independently) and subjected to sanitary, veterinary, epidemiological and radiological control. The enterprises, institutions, organizations and entrepreneurs can import in Ukraine raw materials, production (articles, equipment, technological lines, etc.) on condition that they are safe for life and health of men and named in the listing approved by the Chief State Sanitary Doctor of Ukraine.

The products imported in Ukraine in purposes of trade may be marketed only on condition of their origination from countries free of quarantine and in existence of: 1) certificate of origin and marking of package (boxes, packs, packaging), which informs on appellation of the product, 2) information on mass (volume) and composition of the commodity, 3) list of ingredients, additives, preservatives, colorants etc. used in process of producing of the foodstuff and/or possibly present in it, 4) information on content in products of foreign chemical substances or compounds. There also has to be given the information on energy of the product, limiting term of its use, probability of secondary effects of consumption, place of manufacturing, name and address of manufacturer, information on owner of the trade mark (if exist) written in Ukrainian (excluding the trade marks, logos or original names of companies and/or products, which may be given in original spelling). Importing in Ukraine of foodstuffs by natural persons for own consumption may be done on condition of declaring of type and quantity of all products of animal origin and fresh vegetative products.

Importing of food products is prohibited if they are potentially danger for health of men, and/or may bring in Ukrainian territory organisms and/or infections harmful for men and animals.

### **5.8 Systems of Environmental Management**

The human society understands in progress of industry the more that rising of level of culture of manufacturing and ensuring of safety of business activities are insufficient for creation of healthy state of sphere of habitat, including the bioproductive soils, water, minerals and sources of energy (oil, gas, coal, turf and uranium).

*Natural environment means the complex of natural objects minimally altered under the influence of anthropogenic factors but existing under their continuous direct or mediate pressure*

To guarantee the comfortable conditions of living, the humanity has to preserve the environmentally favorable conditions of nature, what became the constituent element of policy of ensuring of national safety. The work in solving of this problem requires of persons of economy to minimize the probability of origination of delayed effects of worsening of state of health of living and future generations. To prevent origination of risks and hazards specific to degradation of environment, the society has to operate in observance of two basic principles of management as follows:

- principle of steady development: optimization of conditions of living in process of industrial progress of the society has to guarantee satisfying of



needs of men the most, but must not threaten the capability of future generations to use natural resources because of their exhausting,

- principle of raising of purity of manufacture consists in use of complex of prophylactic measures in spheres of material production and servicing.

The constituent principle of this system should be:

- understanding of those that mankind is the integral part of nature, therefore the conditions of life of men depend greatly of state of environment,
- understanding of impossibility of existence of living beings in absence of adequate conditions of natural systems,
- understanding of finiteness of natural resources of the planet,
- voluntary limitation of amount of used resources of nature to avoid their irreversible degradation,
- limiting (if possible) of count of mankind, therefore, decreasing of its negative pressure on conditions of environment at local, regional and global levels,
- use of environmentally friendly technologies,
- recognition of norm of deliberate sufficiency in limiting of variety of goods necessary for vital activities.

It became clear soon the necessity of expanding of practice of development and certification of environmentally friendly technologies, hence introduction of principles of so-called "*environmental management*" character by minimum influence of men on conditions of nature and continuous control of hazards and risks arising in their business operation.

*Risk in use of natural resources means the probability of emerge of unfavorable changes of conditions of environment (intentional or accidental, gradual or catastrophic), which result of anthropogenic factors of influence*

Observance of norms of protection of nature in business operation is in many cases the crucial condition of contracting of persons of economy with their partners. Operating in this sphere, the EU countries legalized practices of "*ecologized*" and "*environmental*" management.

The *ecologized* type of management does not require of serious amendments in used systems of manufacture and other type business activities and presumes adaptation of norms of their operation to conditions of modern policy of rational use and saving of natural resources. This kind activity may be considered as the conservative type of management, otherwise, operation on the first level of environmental safety, which main principles are:

- economy in use of natural resources and minimization of quantity of generated wastes,
- systematical evaluation of grade of environmental risks and guaranteeing of safe conditions of living,
- regular informing of neighboring population on character of activities of the enterprise and their influence on conditions of surrounding nature.

The *environmental* management is the more advanced system, which introduction presumes participation of local businesspersons in forming by the State of territorial economical complexes character by optimum proportion of

environmental and economical interests of local persons of economy and inhabitants of neighboring region. Meantime, there exist two concepts of environmental operation, which have some different senses but used often incongruously. These are the notions of environmental administration and environmental management, which are used in meanings as follows:

- *Environmental administration* means operation of the State administration bodies and persons of economy in observance of obligatory norms of environmental legislation, development and realization of projects and programs directed on protection of natural conditions.
- *Environmental management* means the economic activities of persons of economy, which has the purpose of solving of existing problems in conditions of work in protection of environment accomplished by principle of "three P" – permanent perfecting of processes.

It is reckoned presently that activities in environmental management are the indivisible part of work of businesspersons in ensuring of proper quality of production and favorable conditions of labor, which character criterions are:

- close interrelationship of economical interests of manufacturing and ecological constituents of productive work,
- systemic revision and optimization of norms of economic policy,
- involvement of all employees in work in protection of environment,
- primacy of taking into consideration of ecological problems in everyday operation,
- charge for committing of damage for environment, which results of improper business operation.

The principal tasks to be observed in it are:

- steady decreasing of quantity of used materials and consumed energy,
- use of raw materials and auxiliaries minimally harmful for health of live beings and conditions of nature,
- stimulation of activities of the enterprise in protection of environment and creation of its "green" image,
- assuring of environmental friendliness of the enterprise,
- minimizing of negative anthropogenic influence on environment in processes of fabrication, processing and utilization of production.

Both type activities are the constituent parts of general system of management having to assist in stable progress of the enterprise in reaching of environmental parameters of its operation favorable for life. For the present, there were developed some concepts of environmental management, and the principal ones are:

- prevention of events of catastrophic character including the work in refusing of fabrication of hazardous items and/or closing of manufactures, which operation may worse conditions of surrounding nature,
- minimizing of influence of prospective effects on natural conditions of probable extraordinary situations (construction of protective erections, underground infrastructures and dams, timely evacuation of population etc.),

- alleviation of consequences of catastrophes and use of stabilizing compensative measures.

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- alleviation of consequences of catastrophes and use of stabilizing compensative measures.

The procedures used in Europe in work in protection of nature and pinning of responsibility on guilt parties for infringement of its normal conditions regulate norms of the EU Council Directive of 21.04.2004 # 2004/35/CE *"On environmental liability with regard to the prevention and remedying of environmental damage"*. Under its terms, the environmental damage is:

- direct or indirect damage to aquatic environment covered by norms of the Community water management legislation,
- direct or indirect damage to species and natural habitats protected at the Community level by the 1979 "Birds" Directive or by the 1992 "Habitats" Directive;
- direct or indirect contamination of the land, which creates the significant risk to human health.

The criterion taken into consideration in evaluation of grade of inflicted damage is also the level of blowout of wastes into the atmosphere because this event leads inevitably to pollution of waters, earth and the natural surrounding as a whole.

There exist two principal schemes of putting of liability on persons of economy for the environmental damage they cause. The first scheme to be licensed by norms of integrated pollution prevention and control is applied to the really or potentially dangerous occupational activities accomplished mainly in agricultural or industrial spheres. The hazards to be controlled are discharge of heavy metals into water and air environments, emission of wastes from installations, which produce dangerous and poisonous chemical substances, genetically modified organisms and micro-organisms, as well as the waste management activities (including landfills and incinerators). The operator may be held responsible under this scheme, even if he was not at fault.

The second liability scheme is applied to all occupational activities other than the works listed above. The punishing measures for violation of these norms may be implemented in cases as follows: 1) in existence of damage or existence of the imminent threat of damage for species and/or natural habitats protected by the Community legislation, 2) in cases of causing of damage or in existence of threat of

inflicting of damage resulting of armed conflict, natural disaster etc., 3) in accomplishing of activities covered by norms of the Treaty on establishing of the European Atomic Energy Community, 4) in realization of national defense or international security preventive measures, 5) in carrying out of works listed in related international conventions, 6) in occurrence of natural phenomenon of extraordinary, unavoidable and insuperable character. The norms of Directive of 2004/35/CE do not presume covering of losses of natural persons, which result of damage of environmental conditions because its fundamental principle is putting of financial responsibility on operators, whose activities caused or may cause the damage for environment and health of the community as a whole but not its individuals. The basic notions used in evaluation of grade of such kind risks are:

*Damage for environment:*

- a) *damage for conditions of nature and its protected beings, which threatens to the state of maintaining or the process conservation of normal conditions of their existence*
- b) *damage for waters means any perturbation, which has the considerable influence on ecological, chemical and/or other status and/or ecological potential of nature*

*Status of conservation:*

- a) *in relation of conditions of environment means minimizing of grade of sum of the long-term influences of unfavorable factors on conditions of surrounding nature,*
- b) *in relation to living beings means the sum of influences on conditions of their long-term existence and reproduction*

*Preventive actions means any activities in prevention or minimization of grade of influence carried out in response on the event or action, which cause the imminent threat of inflicting of damage to conditions of environment*

In existence of the imminent threat of environmental damage, the competent authority of each EU member-country may demand of potential polluter to take the necessary preventive actions.

*Preventive actions means any activities in prevention or minimization of grade of negative influence of unfavorable factors carried out in response on the event or action, which cause the imminent threat of inflicting of damage to conditions of environment*

In case of inflicting of environmental damage, the competent authority may demand of the guilt businessperson to take the necessary restorative actions, or organize carrying out of necessary restorative actions by other persons of economy and demand of him of recovering of spent costs, as well as assign priorities in succession of their execution. Dependently of its type, the environmental damage may be remedied in different ways:

- in damaging of state of land, the damaged soils must be decontaminated until there it would be absent any serious risk of their negative influence on human health,
- in damage for water, or protected species, or natural habitats, the damaged objects must be restored to the state, which existed before its inflicting,

otherwise replaced by identical, similar or equivalent natural resources either at the site of the incident or at an alternative place.

If the market operator causes any type damage for the environment, he has to inform on this event the competent bodies of his country immediately and take all necessary measures by control, restriction, elimination and other type works by diminishing of spreading of its consequences. In expansion of such negative influences on territories of other countries, the suffering states have to combine their efforts with the State, which inflicted the damage and organize exchange by related information, as well as inform third countries on hazards, which may influence on conditions of nature in their territories.

The enterprises, which introduced systems of environmental management, obtain the advantages in their business operation as follows:

- betterment of conditions of collaboration with suppliers of raw and auxiliary materials and consumers of their production,
- obtaining of right on concluding of cheaper insurance agreements,
- reaching of favorable taxation,
- decreasing of quantity of incidents in manufacture, which may cause their juridical responsibility.

As a result, the more organizations show their interest in refinement of systems of their operation and introduction of systems of environmental management.

The work in protection of environment and optimization of structure of use of natural resources is one of crucial tasks of global economy because atmospheric air, water of rivers and oceans, animals and birds, do not know state borders. The intense interest to this problem was initiated at 1972 UN Stockholm conference by protection of natural conditions, which accepted the document of *"The UN Program of Work by Problems of Protection of Environment"*. To harmonize the routine of mutual work in it, the Organization of United Nations gathered in Rio-de-Janeiro in June 1992 the Conference by problems of protection of environment, where representatives of 179 countries approved the document of *"Program of work in XXI century"*, which principal purpose is development of healthy economies that operate in all countries in conditions of preservation of high quality of environment. Approval of these documents progressed greatly the work in development of norms of environmental management and optimization of quantitative parameters of such activities (quantity of generated wastes, permissible concentrations of hazardous compounds etc.).

*System of environmental management is the constituent part of the system of management, which includes work of the enterprise in introduction in practice of its operation of elements of environmental policy*

The first known normative document of such kind specialization was the British standard BS 7750 *"British Standard on Environmental Management Systems"* published in 1992. The initiator of its development was not the British State, but the group of industrialists doing so in response on introduction of severe requirements of legislation to norms of protection of nature. The specialized organizations of various countries developed their own systems of environmental management as well, but their basic provisions and norms of realization differed of one other, as a rule. This event became the main cause of origination of need in development of document of

universal character, and the party responsible for this work became the ISO Technical committee TC 207 *"Environmental management"*.

The first such documents coded as the ISO standards of 14000 series validated in 1996 and did not contain any norm of "absolute character" in limiting of grade of influence of activities of the enterprise on natural conditions. However, use of their norms permitted to modernize principles of its environmental policy. The fundamental criteria taken into consideration in introduction of norms of said standards are not the permissible quantitative criteria of pollution of nature (capacity of wastes, volumes of sewage, maximum permissible concentrations of pollutants), and not criteria of ecological compatibility of existing technologies with the newly developed regulative norms, but procedures of operation in conditions of steady decreasing of pressure of results of activities of the enterprise on natural conditions. The list of the most significant of this series standards lists the Table 5.4.

The basic standard of this series documents is ISO 14001, the only normative document used in certification of systems of environmental management. The principal advantages the enterprise obtains in introduction of its norms are:

- decreasing of quantities of used energy and materials
- minimization of negative influence of results of its activities on conditions of nature,
- cutting of expenses spent on processing and utilization of wastes,
- improving of its image as the certified party among the State regulation bodies, other persons of economy and consumers,
- simplifying of procedures of contracting with foreign partners.

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The standard ISO 14001 contains many norms similar or even identical with those of standard ISO 9001. Therefore, norms of both ones may be introduced in parallel as instruments of demonstration of capability of the enterprise to operate properly in conditions of friendliness for the surrounding nature. Introduction of norms of ISO 14000 standards in EU countries permitted to legalize norms of "green" operations the constitutive instruments of tender procurements. Ukraine is the competent participant of global processes of protection of environment as well. To raise effectiveness of this work and optimize structure of national system of standardization, the Ministry of Ecology and Natural Resources of Ukraine initiated founding in 1993 of the Technical committee of Derzhstandart of Ukraine TK 82 *"Protection of conditions of nature"*.

**Table 5.4**

**International environmental standards**

<b>Standards establishing principles of environmental management</b>	
ISO 14001	Environmental management systems – Specifications with guidance for use
ISO 14004	Environmental management systems – General guidelines on principles, systems and support techniques
ISO 14014	Environmental management systems – Initial Reviews
<b>Instruments of environmental control</b>	
ISO 14010	Environmental auditing – General principles of environmental auditing
ISO 14011	Environmental auditing – Auditing of environmental management systems
ISO 14012	Environmental auditing – Qualification criteria for environmental auditors
ISO 14015	Environmental site assessments
<b>Standards oriented on environmental methods of manufacture</b>	
ISO 14020	Environmental labeling – Basic principles of environmental labeling
ISO 14021	Environmental labeling – Self-declaration – Environmental claims – Terms and definitions
ISO 14024	Environmental labeling – Practitioner programs – Guiding principles, practices and certification procedures of multiple criteria (type 1)
ISO/TR 14025	Environmental labeling and declarations – Environmental declarations of 3 <sup>rd</sup> type
<b>Evaluation of environmental effectiveness</b>	
ISO 14031	Environmental Performance Evaluation
ISO/TR 14032	Environmental management – Examples of environmental performance evaluation
<b>Environmental assessment of life cycle of production and services</b>	
ISO 14040	Life-cycle assessment – General principles and practices
ISO 14041	Life-cycle assessment – Goal and definition/scope and inventory assessment
ISO 14042	Life-cycle assessment – Impact assessment
ISO 14043	Life-cycle assessment – Improvement assessment
ISO/TR 14047	Environmental management – Life-cycle assessment – Illustrative examples on how to apply ISO 14044 to impact assessment situations
ISO 14048	Environmental management – Life-cycle assessment – Data documentation format statute
ISO/TR 14049	Environmental management – Life-cycle assessment – Management of environment – Examples of use of standard of ISO 14041 in determining of objectives, sphere of investigation, and inventory analysis
ISO 14050	Terms and definitions
ISO 14060	Guide for the inclusion of environmental aspects in product standards
ISO/TR 14062	Environmental management – Integral environmental aspects into product design and development
ISO 14063	Environmental management – Environmental communication – Guidelines and examples

The essence of standards of ISO 14000 series is normalizing of procedures of work of enterprises in sphere of environmental management and the basic doings in it are:

- establishing of norms of work in protection of environment. The interested party has to develop the special document of "Environmental policy", which should declare the basic principles of its activities in preservation and continual betterment of conditions of nature,

- development of program of environmental management and procedures of work in extreme situations. Identification of methods and terms of realization of set purposes,
- steady work in identification of actions potentially harmful for environment and development of procedures of liquidation of their consequences. Taking into consideration of interests of legal persons and individuals, whose interests fall under their influence,
- continuous monitoring or control of parameters of operations, which might influence sufficiently on the surrounding conditions. Introduction of norms of audit of used system of protection of nature,
- periodical analysis of functioning of system of environmental management by administration of the enterprise and introduction of necessary amendments in its environmental policy.

As provide norms of standard ISO 14001, the process of development and introduction of procedures of environmental management includes the work by stages as follows:

1. *Preliminary analysis of conditions of manufacture.* Identification of existing environmental conditions of operation of the enterprise and analysis of elements of its operation in spheres, which may influence on conditions of surrounding nature.

2. *Formulation of principles of environmental policy.*

3. *Establishing of duties and development of structure of responsibilities* of persons engaged in work in development of principles of environmental policy of the enterprise. Appointing of person(s) responsible for supervision on processes of realization of newly established norms.

4. *Evaluation of grade of influence of results of economical activities on environmental conditions.* Characterization of quantity of emitted gases and solid and liquid wastes. Planning of methods of their disposal, treating (if possible) and utilization.

5. *Identification of processes, which influence on environmental conditions the most, development of system of their control.*

6. *Development of system of environmental management.*

7. *Introduction of system of registration of environmental doings* and use of procedures of identification and minimization of influence of consequences of found infringements and violations of established norms of operation on conditions of nature.

8. *Betterment of environmental conditions* in observance of grade of potential influence of manufactured production on conditions of nature during the whole term of its producing and staying at the enterprise.

9. *Introduction of system of inner audit*, which foresees among others the possibility of control of third party.

*Third party means the natural person or organization, which is free of financial and organizational dependence of parties that apply for work in evaluation of conformity of objects of attestation and/or are interested in their use*



The persons of economy obtain in introduction of norms of environmental standards the number of economical benefits. For the first, they decrease the level of risks of applying of fines because they cut quantities of used consumables, hence quantity of wastes generates in their operation. For the second, enterprises may certify their environmental systems domestically and need not attest them repeatedly in any other country for the standard ISO 14001 used in formal certification is the norm of category recognized worldwide. For the third, they normalize their relations with the local natural persons, who raise the level of their consciousness continuously and may demand of introduction of environment management systems in practice of work of neighboring enterprises.

Despite voluntariness of use of provisions of this standard, almost all big foreign companies have the intention to certify their systems of environmental management by its norms and do it in 10 years. The predominant motive in it is that this became the one of obligatory norms of marketing, especially for companies that have intentions to operate in the unified European market.

The rights on carrying out of this work obtain the third-party bodies accredited by norms of the document of ISO/IEC Guide 66:2003 *"General Requirements for Bodies Operating Assessment and Certification/Registration of Environmental Management Systems"*. To attest the environmental friendliness of work of the applicant, the accrediting person appoints the specialized group of auditors, whose work includes two stages:

- works by stage 1 are centered on planning of process of auditing and analysis of documents, which describe environmental conditions at place of location of the enterprise and the business-processes it realized,
- works by stage 2 are carried out directly at the enterprise and represent in fact the certification proper.

The objects of environmental certification in Ukraine are:

- systems of environmental management,
- technologies potentially harmful for conditions of environment,
- exported and imported production harmful for environment and industrial wastes generated in their fabrication,
- procedures of treatment and reprocessing of wastes.

As to Ukraine, the three principal directions of this work in our country are:

1. In sphere of functioning of national economic complex:

- control of observance of norms of protection of environment in processes of operation of native businesspersons,
- introduction of environmentally friendly technologies,
- creation of conditions of assurance of environmental safety during the whole life cycle of production used in the country,
- observance of norms of environmental safety and prevention of pollution of nature in placing, processing, transporting, disposal and annihilation of wastes,
- prevention of importation in Ukraine of environmentally dangerous products and wastes.

2. In sphere of integration of Ukraine in the European Union:

- rising of competitiveness of “green” production of domestic origin,
- granting the certificate of environmental conformity of status of document, which indicates observance by its owner of norms of environmental legislation in force.

3. *In sphere of international collaboration in sphere of protection of nature:*

- cooperation in work with foreign associates in forming of global mechanisms of protection of environment,
- unambiguous guaranteeing of observance of provisions of international treaties, conventions and agreements of environmental profile,
- steady control of trans-boundary movement of pollutants and dangerous wastes.

The concrete criteria of environmental friendliness and rules of use of symbols of environmental purity develops the Global Ecolabelling Network (GEN) – the unprofitable association of independent specialized bodies operating certification of activities of legal persons, which work on improvement of conditions of environment. In 2013, the GEN members were Australia, Brazil, Canada, Croatia, Czechia, Denmark, Finland, Germany, Hong Kong, India, Indonesia, New Zealand, Norway, People’s Republic of China, Philippines, Republic of China, Republic of Korea, Russian Federation, Singapore, Sweden, Thailand, Ukraine, USA, Japan and European Union (as her collective member). The principal directions of GEN operation are:

- assisting in development of programs of environmental labeling to be used universally,
- informational assistance in introduction of programs of ecolabelling and harmonization of criteria of work in evaluation of conditions of environment,
- participation in programs of profile international organizations,
- conducting of international seminars and trainings of GEN members.

The Network member-countries developed for the present, about of 1,400 documents, which established the environmental criteria of quality of more of 200 types of goods used in certification of more of 120,000 kinds of products.

Ukraine joined GEN in 2004 and is represented in it by her national public organization of *"Live Planet"*, which operates under the aegis of Ministry of Ecology and Natural Resources of Ukraine. In 2011, Ukraine legalized the CEN program of confidence, which foresees recognition by the Network member-countries of results of attestation of its programs of ecolabelling by the mutually recognized norms and obtained the certificate of recognition of operation by the program of *"GENICES"*. Therefore, Ukrainian manufacturers may sell on global markets by the simplified procedures their products attested by the *"Live Planet"* functionaries.

To identify items, which quality conforms to criteria of ecological purity, Ukraine registered 8<sup>th</sup> of October 2004 at the official annual meeting of GEN member-countries in Tokyo her National Program of Ecolabelling and the national ecolabel of *"Environmentally pure and safe"* (*"Green crane"* – Figure 5.20) to be used in marking of goods attested by norms of standard of ISO 14001 *"Environmental management systems – Specifications with guidance for use"*:



**Fig. 5.20 Ukrainian national ecolabel**

Attesting the environmental purity of products, the Ukrainian business persons use the norms of the set of international standards of ISO 14000 series, especially of the standard of ISO 14020 "Environmental labeling – Basic principles of environmental labeling" and a number of normative documents, which specify norms of work in observance of criteria of environmental purity, which basic concepts are:

*Environmental declaration means the statement, which indicates the environmental characteristics of products of attested quality*

*Environmentally pure product means the certified product of uppermost quality supplemented by the respective environmental declaration*

The ISO 14000 series standards do not fix any restriction in choose of category of products, goods and services, which may be marked by ecological marks, which are of three basic types.

The norms of environmental declaring and labeling of the first type regulate the provisions of standard of ISO 14024 "Environmental labeling – Practitioner programs – Guiding principles, practices and certification procedures of multiple criteria (type 1)". This type marking witnesses the fact of minimal influence on conditions of environment of production marked by the sign of the established design placed on base of the right given by the license issued by the third party bodies specialized in environmental certification. Some of generally known signs of this category ecolabelling are (Figure 5.21):



**Figure 5.21 Signs of environmental purity of some countries**

*A – "Daisy" – sign used by EU countries, B – "Scandinavian swan" – sign used by Scandinavian countries (Sweden, Norway, Finland, Iceland), C – "Blue angel" – sign of environmental purity used in Germany, D – "Ecosign" of Japan, E – "Green seal" (USA), F – sign of environmental purity used in People's republic of China, G – sign used in Republic of Korea, H – environmental sign of Czech republic*

The conditions of placing of such kind marks are:

- proving of environmentally friendly norms of business operation,
- carrying out of environmental certification of processes of fabrication of products to be labeled.

The certifying body carries responsibility for objectivity of its work in control of observance by the certified party of criteria used in process of its attestation.

The procedures of *environmental declaring and marking of the second type* regulate the norms of standard ISO 14021 "Environmental labeling – Self-declaration – Environmental claims – Terms and definitions":

*Environmental self-declaration – means the assertion of the manufacturer, importer, distributor, retail trader or any other legal person on environmental purity of the marked product they propose issued in absence of environmental certification by the third party person of process of its fabrication*

The inscriptions normalized by the standard of ISO 14021 used the most often are: "capable to decomposition", "product of prolonged term of use", "recuperated energy", "suitable for reprocessing", "contains reprocessed materials", "decreased use of energy", "decreased use of water", "low-wasted" and some other. The declarations of type of "free of ..." the person may use only if the content of indicated harmful substance(s) is less of the threshold level of sensitivity of the attested method(s) of its (their) determination.

The Figure 5.22 below shows the graphical symbols used usually together with documents, which declare the possibility of reprocessing of the marked item or the fact of use in its fabrication of reprocessed materials:



**Figure 5.22 Signs indicating possibility of reprocessing of material of the item or presence of reprocessed components in it: A – the product may be reprocessed, B – the product contains the reprocessed materials**

The applicant carries the full responsibility for correctness of his environmental declaration and giving the interested parties of data necessary for control of its trustworthiness. The character peculiarities of this type marking are:

- voluntary use of symbols in process of environmental self-declaration,
- simplicity and intelligibility of symbols of environmental purity,
- differing of environmental symbols of other type marks.

The rules of environmental labeling of the second type restrain also the range of use of certain declarations, which have the illegible sense and indicate some criterions of environmental purity and/or environmental safety of products. The manufacturers/sellers/suppliers have to avoid of using of such formulations as "favorable for ozone", "green", "favorable for nature", "environmentally favorable", "non-polluting" etc.

Both type marking relate to processes of indication of environmental purity of products but not of processes of their fabrication, and do not witness the fact of certification of systems of environmental management by parties that propose the marked product. Moreover, some of signs of this category are sometimes illusory and may mislead consumers in their believing of reality of certification of environmental purity of marked products (Figure 5.23):



**Figure 5.23 Examples of improper use of signs of environmental marking of second type**

Such kind declarations are given usually in absence of certification of ecological purity of marked products, therefore use of expressions of type of "environmentally pure" is ungrounded in most cases. Rather they witness the wish of manufacturers to raise competitiveness of their production.

Taking into consideration the collected experience of use of environmental marking of the second type, CEN and ISO established the rules of use of such kind signs, and allotted three aspects of regulation normalized by provisions of standards of ISO 14021 (rules of use of terms of type of "may be recycled" on labels/supplementing documents), ISO 14022 (rules of use of symbols of recycling on labels and in advertising materials), and ISO 14023 (procedures of identification and verification of legitimacy of use of environmental signs).

The process of the *environmental declaring of the III type* is carried out in accordance with norms of standard of ISO 14025 and does not suppose marking of products by signs of environmental purity. Such work has the purpose of giving of environmental information on processes occurred during the whole life cycle of production, what has to give the possibility of comparing of characteristics of products of the same destination of use. This type documents may issue one or more organizations and use in this work the data obtained in process of independent evaluation of details of life cycle of production (LCA), data of inventory analysis of the life cycle of production (LCI) or the information, related to the data named above and:

- developed in use of information obtained in earlier time,
- comply to requirements set by the operator of the program, e.g. by the company or group of companies, branch of industry or the trading association, State regulation bodies of agencies, independent scientific or other type organizations.

As provided norms of standard ISO 14025, the environmental declarations of type III are issued in purposes of dissemination of information among the businesspersons but may also be used in purposes of passing of information from business structures to consumers. The developer of the environmental declaration of type III is not capable to identify users of his information in advance but he has to

take into consideration needs of various groups of buyers or groups of consumers, such as large business structures, enterprises of small and average size, State organizations specialized in purchases and individuals. The specialists who issue the environmental declarations of type III and develop programs of operation in observance of norms of standard of ISO 14025, have to notice the awareness of consumers who are the addressees of the issued information.

The businesspersons have to develop their environmental declarations in observance of legalized norms and guarantee that the given data was controlled by experts of third party or persons of their own subordination.

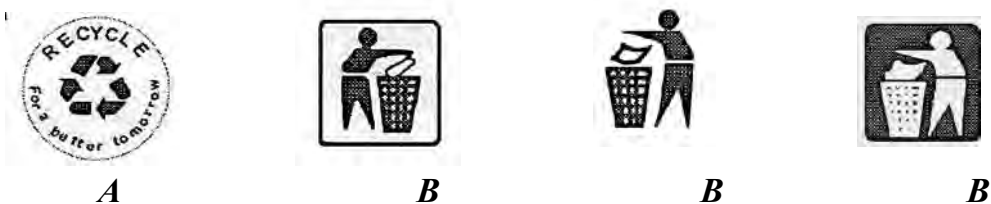
After the Chernobyl catastrophe had occurred, the domestic manufacturers began to declare extensively the medicinal properties of their products and use in it the special type marks in absence of the specialized standards that may give them right of such marking. The one of possible designs of signs, which witnesses the radioprotective properties of the product, is shown on Figure 5.24:



**Figure 5.24 Sign used for marking of products, which have the radioprotective properties**

However, the concept of ecological safety is of more general character and relates also to norms of operation in protection of environment, as well as guaranteeing of minimal negative influence on nature of marked products and their packing at all stages of their life cycle. The one more norm to observe in progress of industrial society is assuring of minimal harmless of conditions of their utilization and possibility of reprocessing of wastes of manufacture. The signs used usually in indication of recommended methods of carrying out of these works are:

Group # 1: signs, which inform on possibility of reprocessing of the product and its packing (Figure 5.25):



**Fig. 5.25 Signs indicating possibility of use of materials of the marked items as the secondary raw materials: A – “Recycle for the better tomorrow”; B – signs recommending throwing of used items into the garbage tanks differentiated by types of wastes: paper, glass, plastics, rags etc. These signs may be used together with the inscriptions of “Keep your country tidy”, “Gracias” (Thank you) etc.**

In necessity of identifying of substance used in producing of the packing material, the latter may be marked by numerical or literal symbols placed inside the recirculation loop or below it:

➤ 1 ÷ 19 plastics,

- 20 ÷ 39 paper and cardboard,
- 40 ÷ 49 metals,
- 50 ÷ 59 wood,
- 60 ÷ 69 textile,
- 70 ÷ 79 glass.

Group # 2: “*Re-treating of plastics*”. These signs are coded by numbers and used in marking of plastic items, which may be re-treated industrially. The letters put down the sign indicate the acronym of used plastic (Figure 5.26):



**Figure 5.26** *Samples of coding of plastics*

Group # 3. Signs used in EU countries in indication of possibility of repeated use of labeled materials (Figure 5.27):



**Figure 5.27** *Signs indicating possibility of the repeated use of the item (material it was made):*

**A** – the material used in fabrication of the item may be reprocessed, or the product was made of secondary raw materials partly or in whole, **B** – “Green point” – German sign, which witnesses the guarantee of acceptance of packing in places of collecting of secondary materials, **C** – packs of multiple use, **D** – packs made of secondary raw materials

*Collecting of wastes means the work in their accumulation and disposal at places or objects specially assigned for these purposes*

*Treating (reprocessing) of wastes means carrying out of any operation associated with modifying of their physical, chemical or biological state done in purposes of their preparing for environmentally safe storage, transporting, utilization or annihilation*

*Neutralization of wastes means decreasing or abolition of harmfulness of wastes done by mechanical, physical, chemical and/or biological method(s)*

*Disposal of wastes means their final placement at specially assigned places done by mode(s), which exclude their long-term harmful influence on conditions of environment and state of health of men*



The environmental marking has to inform on environmental safety of the marked item and minimum level of risk for health of men in its use (consumption). Contrary, presence of the sign shown below or the similar ones has to attract attention of consumers to probable danger of the marked product (Fig. 5.28):



**Figure 5.28** *Sign of environmental danger*

To protect consumers against risks, the State Service of Technical Regulation and Consumer Policy of Ukraine demands that the supplementing informative materials on imported commodities have to be written in Ukrainian. They may have also the additional inscriptions written in foreign languages, e.g. “*best before*”, “*a consommer de preference*”, “*avant le Mind*”, “*haeybar bis (Ende)*”, “*consumir preferemente antes de*”, which inform on terms of suitability of products for consumption. Such inscriptions as “*expiry date*”, “*term of validity*”, inform on permissible term of storage of the item before its use and “*production date*” about date of its producing.

### **Checking Questions**

1. What is the sense of term “quality” ?
2. What is quality management ?
3. What are the basic evidences of compliance of products with established norms of quality ?
4. What are the basic methods of attestation of quality of production ?
5. What are the main tasks of persons in sphere of assuring of quality ?
6. What are principles of concept of total quality control ?
7. What are principles of total quality management ?
8. What is the system of quality ?
9. What documents normalize the fundamental parameters of work in assuring of quality ?
10. What are cases of certification of quality systems ?
11. What are mechanisms of introduction of principle of refusal of total quality control ?
12. What are the principal norms of modern system of management ?
13. What sense has the concept of environmental safety ?
14. What is the system of environmental management ?
15. What are motives of environmental certification ?
16. What organizations develop the environmental criteria and norms of use of signs of environmental purity ?
17. What is the name of the Ukrainian national sign of environmental purity ?
18. What is the environmentally pure product ?
19. What is environmental marking of first type ?
20. What is environmental marking of second type ?
21. What is the sense of notion of “environmental safety” ?



### Literature

1. Баканов М.И., Шеремет А.Д. Теория экономического анализа.– М.; Финансы и статистика, 1996. – 113 с.
2. Баль-Прилипко Л.В. Стандартизація, метрологія, сертифікація та управління якістю / Баль-Прилипко Л.В., Боровиков О.Я. – К., НУБіП України, 2014 – 532 с.
3. Бичківський Р.П. Управління якістю / Бичківський Р.П. – Львів: "Львівська політехніка", 2000. – 329 с.
4. Бичківський Р.П. Метрологія, стандартизація, управління якістю і сертифікація / Бичківський Р.П., Столярчук П.Г., Гамула П.Р. – Львів: "Львівська політехніка", 2002. – 506 с.
5. Боженко І.Л. Метрологія, стандартизація, сертифікація та акредитація / Боженко І.Л. – Львів: Львівська політехніка, 2004. – 315 с.
6. Болотніков А.О. Стандартизація та сертифікація товарів і послуг / Болотніков А.О. – К.: МАУП, 2005. – 144 с.
7. Варріс Енн-Марі Наступне покоління стандарту ISO 14001: три запитання і правило “трех С” / Варріс Енн-Марі // Стандартизація, сертифікація, якість, № 2 – К., 2010. – С. 15
8. Віткін Л.М. Сучасна система технічного регулювання України: теорія та практика / Віткін Л.М., Хімічева Г.І., Зенкін А.С. - К.: МАУП, 2011. – 546 с.
9. Декрет Кабінету Міністрів України від 08.04.1993 № 113/98-ВР "Про державний нагляд за додержанням стандартів, норм і правил та відповідальність за їх порушення" /// <http://www.zakon.rada.gov.ua>
10. Декрет Кабінету Міністрів України від 10.05.1993 р. № 46-93 "Про стандартизацію та сертифікацію" /// <http://www.zakon.rada.gov.ua>
11. Джуран Д. Все о качестве: Зарубежный опыт. Выпуск 2. Высший уровень руководства и качество. М., 1993. – 250 с.
12. Загальні вимоги до компетентності випробувальних та калібрувальних лабораторій. (ISO/IEC 17025:2004). ДСТУ ISO/IEC 17025-2006. – К.: Держспоживстандарт України, 2006. – (Національний стандарт України)
13. Заклади ресторанного господарства. Класифікація. ДСТУ 4281:2004 – К.: Держспоживстандарт України, 1995. – (Національний стандарт України)
14. Закон України від 23.12.1997 № 771/97-ВР "Про безпечність та якість харчових продуктів" /// <http://www.zakon.rada.gov.ua>
15. Закон України від 05.03.1998 № 187/98-ВР "Про відходи" /// <http://www.zakon.rada.gov.ua>
16. Закон України "Про загальнообов'язкове державне соціальне страхування від нещасного випадку на виробництві та професійного захворювання, які спричинили втрату працездатності" від 23.09.1999 № 1105-XIV /// <http://www.zakon.rada.gov.ua>
17. Закон України від 14.01.2000 № 1393-XIV "Про вилучення з обігу, переробку, утилізацію, знищення або подальше використання неякісної та небезпечної продукції" /// <http://www.zakon.rada.gov.ua>
18. Закон України від 17.05.2001 № 2406-III "Про підтвердження відповідності" /// <http://www.zakon.rada.gov.ua>

19. Закон України від 24.10.2002 № 191—IV-2002 "Про внесення змін у Закон України "Про безпечність та якість харчових продуктів"///  
<http://www.zakon.rada.gov.ua>,
20. Закон України від 21.12. 2002 р. № 229-IV "Про охорону праці" ///  
<http://www.zakon.rada.gov.ua>
21. Закон України від 02.12.2010 № 2735-VI "Про державний ринковий нагляд і контроль нехарчової продукції" ///  
<http://www.zakon.rada.gov.ua>
22. Закон України від 15.05.2014 р. № 1315-VII "Про стандартизацію" ///  
<http://www.zakon.rada.gov.ua>
23. Закон України від 22.07.2014 р. № 1602-VII "Про внесення змін до деяких законодавчих актів України щодо харчових продуктів" ///  
<http://www.zakon.rada.gov.ua>
24. Зорин Ю.В., Ярыгин В.Т. Качество технологической документации при подготовке предприятий к сертификации. Стандарты и Качество. – 1996. 95с.
25. Кириченко Л.С. Основи стандартизації, метрології, управління якістю / Кириченко Л.С., Мережко Н.В. – К., Київський національний торговельно-економічний університет, 2001. – 446 с.
26. Коваленко І.І. Методи аналізу якості / Коваленко І.І., Дубовий О.М., Бідюк П.І. – Миколаїв: НУК, 2004. – 208 с.
27. Кузьміна Т.О. Міжнародна система стандартизації та сертифікації / Кузьміна Т.О. – К.: Кондор, 2011. – 426 с.
28. Наказ Мінагрополітики від 01.10.2012 № 590 "Про затвердження вимог щодо розробки, впровадження та застосування постійно діючих процедур, заснованих на принципах Системи управління безпечністю харчових продуктів (НАССР)" ///  
<http://www.zakon.rada.gov.ua>
29. Мельничук С.Д. Основи системи державного технічного регулювання / Мельничук С.Д., Боровиков О.Я., Баль-Прилипко Л.В. – К., НУБіП України, 2012 – 284 с.
30. Мухаровський М. Система безпеки харчових продуктів / Мухаровський М. // Держстандарт України, № 4 – Харків, 2001. – С. 55
31. Наказ Мінагрополітики від 01.10.2012 № 590 "Про затвердження вимог щодо розробки, впровадження та застосування постійно діючих процедур, заснованих на принципах Системи управління безпечністю харчових продуктів (НАССР)" ///  
<http://www.zakon.rada.gov.ua>
32. Настанови щодо застосування ДСТУ ISO 9001-2001 у виробництві харчових продуктів та напоїв. (ISO 15161:2000). ДСТУ ISO 15161:2004. – К.: Держспоживстандарт України, 1993. – (Національний стандарт України)
33. Оцінювання відповідності. Декларація постачальника про відповідність. Частина 1. Загальні вимоги. (ISO/IEC 17050-1:2001). ДСТУ ISO/IEC 17050-1:2006. – К.: Держспоживстандарт України, 2006. – (Національний стандарт України)
34. Оцінювання відповідності. Декларація постачальника про відповідність. Частина 2. Підтверджувальна документація. (ISO/IEC 17050-2:2001). ДСТУ ISO/IEC 17050-2:2006. – К.: Держспоживстандарт України, 2006. – (Національний стандарт України)

35. Оцінювання відповідності – Настанова щодо системи сертифікації продукції третьою стороною. (ISO/IEC Guide 28:2000). ДСТУ ISO/IEC Guide 28:2004. – К.: Держспоживстандарт України, 2004. – (Національний стандарт України)
36. Рамазанова-Стьопкіна О.А. Основи стандартизації, сертифікації та контролю якості / Рамазанова-Стьопкіна О.А. – К.: НАУ, 2004. – 112 с.
37. Ратушний А. С., Топольник В. Г. Оценка качества кулинарной продукции (Вопросы практической квалиметрии). - М.: Русская кулинария, 1991 – 182 с.
38. Система сертифікації УкрСЕПРО. Порядок проведення сертифікації продукції. ДСТУ 3413-96
39. Система сертифікації УкрСЕПРО. Атестація виробництва. Порядок здійснення. ДСТУ 3414-96. – К.: Держстандарт України, 1996. – (Національний стандарт України)
40. Система сертифікації УкрСЕПРО. Процедура визнання результатів сертифікації продукції, що імпортується. ДСТУ 3417-96. – К.: Держстандарт України, 1996. – (Національний стандарт України)
41. Система сертифікації УкрСЕПРО. Сертифікація систем якості. Порядок проведення. ДСТУ 3419-96. – К.: Держстандарт України, 1996. – (Національний стандарт України)
42. Система розроблення і поставлення продукції на виробництво. Продукція харчова. Основні положення. ДСТУ 3946-2000. К.: Держстандарт України, 2001. – (Національний стандарт України)
43. Системи управління безпечністю харчових продуктів. Вимоги. ДСТУ 4161-2003. – К.: Держспоживстандарт України, 2003. – (Національний стандарт України)
44. Системи управління якістю. Основні положення та словник термінів. (ISO 9000:2004) ДСТУ ISO 9000:2007. – К.: Держспоживстандарт України, 2007. – (Національний стандарт України)
45. Системи управління якістю. Вимоги. (ISO 9001:2004) ДСТУ ISO 9001-2008. – К.: Держспоживстандарт України, 2008. – (Національний стандарт України)
46. Системи управління якістю. Настанови щодо поліпшення діяльності. (ISO 9004-1:2000.). ДСТУ ISO 9004-2001. – К.: Держстандарт України, 2001. – (Національний стандарт України)
47. Системи екологічного керування. Вимоги та настанови щодо застосування. (ISO 14001:1994). ДСТУ ISO 14001:2006 – К.: Держспоживстандарт України, 2006. – (Національний стандарт України)
48. Система управління безпекою та гігієною праці. Вимоги. (OHSAS 18001:2002). ДСТУ-П OHSAS 18001:2006. – К.: Держспоживстандарт України, 2006. – (Національний стандарт України)
49. Система управління безпекою праці. Основні принципи виконання вимог. (OHSAS 18002:2002) ДСТУ-П OHSAS 18002:2006. – К.: Держспоживстандарт України, 2006. – (Національний стандарт України)
50. Системи управління безпечністю харчових продуктів. Вимоги до будь-яких організацій харчового ланцюга. (ISO 22000:2002). ДСТУ ISO

22000:2007. – К.: Держспоживстандарт України, 2007. – (Національний стандарт України)

51. Стандартизація, метрологія, сертифікація та управління якістю: Підручник / [Л. В. Баль-Прилипко, С. Д. Мельничук, О. Я. Боровіков, Л.М.Бутенко ] – К.: Видавничий центр НУБіП України, 2013. –532с.
52. Топольник В. Г. Комплексна оцінка процесу варіння щодо збереження харчових речовин при приготуванні страв //Вісник ДонДУЕТ. - 1999. -№4 - с. Технічні науки. - С. 68 – 73.
53. Топольник В. Г. Показник якості теплової обробки харчових продуктів //Стандартизація, сертифікація, якість. - 1999. - № 4. - С.44-46.
54. Топольник В. Г. Концепція системи властивостей технологічної обробки кулінарної продукції //Обладнання та технології харчових виробництв: Темат. зб. наук. праць. - Вип. 3. - Донецьк: ДонДУЕТ, - 1999. -С. 344-350.
55. Топольник В.Г. Комплексна оцінка якості кулінарної сировини за фізико-хімічними показниками /Вісник ДонДУЕТ. -2002. - № 1(13).-с. Технічні науки. -С. 60-66.
56. Топольник В.Г. Методика оцінки харчових продуктів за збалансованістю енергетичних речовин /Вісник ДонДУЕТ. -2003. -№ 1(17). -с. Технічні науки. -С. 63-70.
57. Топольник В.Г., Ратушний О.С. Кількісна оцінка технологічних параметрів теплової обробки страв із сільськогосподарського птаха /Вісник ДонДУЕТ. – 2001. -№9. – с. Технічні науки. – С. 31-36.
58. Топольник В.Г., Ратушний А.С. Системный анализ процессов производства кулинарной продукции -Донецк: ДонГУЭТ, 2003. - 152 с.
59. Указ Президента України "Про заходи щодо підвищення якості вітчизняної продукції" // Голос України, 24.12.2004р.
60. Управління якістю та забезпечення якості. Терміни та визначення. ДСТУ 3230-95 – К.: Держстандарт України, 1995. – (Національний стандарт України)
61. Якість продукції. Оцінка якості. Терміни та визначення ДСТУ 2925-94. – К.: Держстандарт України, 1995. – (Національний стандарт України)
62. Commission Regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labeling of organic products with regard to organic production, labeling and control
63. Directive 92/43/EEC "On the conservation of natural habitats and of wild fauna and flora"
64. Directive 2001/95/EC "On general product safety"
65. Directive 2004/95/EC "On environmental liability with regard to prevention and remedying of environmental damage"
66. EU Directive 2008/1/EC concerning integrated pollution prevention and control
67. Fundamentals of the System of State Technical Regulation: Manual / [Bal’–Prilipko L.V., Melnychuk S. D.,Borovykov O.Ya] – Kyiv , – 2013. – 253 P.

**LIST**  
**of additives permitted for use as ingredients of foodstuffs (for the state of**  
**01.11.2015)**

<b>Code of additive</b>	<b>Appellation</b>	<b>Note</b>
<b>1</b>	<b>2</b>	<b>3</b>
E 100	Curcumins	
E 101	Riboflavin	
E 102	Tartrazine	
E 104	Quineline yellow	
E 110	Sunset yellow FCF	Very harmful, carcinogen, negative influence on health of children. Forbidden for use in numerous countries
E 120	Carmines	
E 122	Azorubine	Very harmful, illnesses of gastroenteric tract, allergic reactions
E 124	Ponceau 4R	Harmful, allergic reactions
E 129	AG Allura red AG	Harmful, allergic reactions. Forbidden for use in numerous countries
E 131	Patent blue V	
E 132	Indigotine	
E 133	Brilliant blue FCF	
E 140	Chlorophylls	
E 141	Chlorophylls copper complexes	
E 142	Green S	
E 150a	Caramel I-plain	
E 150b	Caramel II - Caustic sulfite	
E 150c	Caramel III-ammonian process	
E 150d	Caramel IV-ammonia-sulphite	
E 152	Carbon black (hydro-carbon)	
E 153	Vegetable carbon	
E 160a	Carotenes: Beta carotene synthetic Natural extracts	
E 160b	Annato extracts	
E 160c	Paprika oleoresins	
E 160e	Beta-apo-8-carotenal	
E 162	Beet red	
E 163	Anthocyanins	

1	2	3
non-coded	Blackcurrant extract	
non-coded	Grape skin extract	
E 164	Saffron	
E 170	Calcium carbonate (i) Calcium dicarbonate (ii)	
E 171	Titanium dioxide	
E 172	Iron oxides and hydroxides	
E 181	Tannins (food grade	
non-coded	Metilviolet	
non-coded	Rodamin	
non-coded	Phuxin	
E 200	Sorbic acid	
E 201	Sodium sorbate	Harmful, carcinogen, negative influence on health of children
E 202	Potassium sorbate	
non-coded		
E 210	Benzoic acid	
E 211	Sodium Benzoate	Very harmful, cancerous growth, allergic reactions, negative influence on health of children
E 220	Sulphur dioxide	Very harmful, illnesses of gastroenteric tract, allergic reactions, irritates respiratory tract, negative influence on health of children
E 222	Sodium hydrogen sulphite	Harmful, illnesses of gastroenteric tract, allergic reactions, irritates respiratory tract, negative influence on health of children
E 223	Sodium metabisulphite	Harmful, illnesses of gastroenteric tract, allergic reactions, irritates respiratory tract, negative influence on health of children
E 224	Potassium metabisulfite	Harmful, illnesses of gastroenteric tract, allergic reactions, irritates respiratory tract, negative influence on health of children
E 234	Nisin	
E 235	Pimaricin (Natamycin)	
non-coded	Lactocid	
non-coded	Hydrogenium peroxydum	
E 250	Sodium nitrite	

1	2	3
E 251	Sodium nitrate	
E 252	Potassium nitrate	
E 260	Acetic acid	
E 262	Sodium acetate	
E 263	Calcium acetate	
E 270	Lactic acid	Dangerous for health of children, stress for kidneys, may contain GMO
E 285	Sodium tetraborate	
E 290	Carbon dioxide	
E 296	Malic acid	
E 300	Ascorbic acid	
E 301	Sodium ascorbate	
E 304	Ascorbyl palmitate	
E 305	Ascorbyl stearat	
E 306	Mixed tocopherols concentrate	
E 307	Alpha-tocopherol	
E 308	Gamma-tocopherol	
E 309	Delta-tocopherol	
E 316	Sodium isoascorbate	
E 320	Butylated hydroxyanisole (BHA)	Dangerous, illnesses of gastroenteric tract and liver, allergic reactions, increases content of cholesterol, may contain GMO
E 321	Butylated hydroxytoluene (BHT)	Dangerous, illnesses of gastroenteric tract and liver, allergic reactions, increases content of cholesterol, may contain GMO
E 322	Lecithines	
E 325	Sodium lactate (solution)	
E 326	Potassium lactate (solution)	
E 327	Calcium lactate	
E 330	Citric acid	
E 331	Sodium citrates	
E 332	Potassium citrates	
E 334	Tartaric acid, L (+)	
E 335	Sodium tartrates	
E 336	Potassium tartrates	
E 338	Orthophosphoric acid	
E 339	Sodium phosphates	

1	2	3
E 340	Potassium phosphates	
E 341	Calcium Phosphates	
E 342	Ammonium phosphates	
E 351	Potassium malate	
E 363	Succinic acid	
E 386	Disodium ethylene diamine-tetraacetate	
E 400	Alginic acid	Dangerous
E 401	Sodium alginate	Dangerous
E 402	Potassium alginate	Dangerous, prohibited for use in numerous countries
E 403	Ammonium alginate	Dangerous
E 404	Calcium alginate	Dangerous
E 405	Propyleneglycolalginate	
E 406	Agar	
E 407	Carrageenan and its Na, K, NH <sub>4</sub> salts	
E 410	Locust carab bean gum	
E 411	Oat gum	
E 412	Guar gum	
E 413	Tragacanth gum	
E 414	Gum arabic	
E 415	Xantan gum	
E 416	Karaya gum	
E 417	Tara gum	
E 418	Gellan gum	
E 420	Sorbitol and Sorbitol syrup	
E 421	Mannitol	
E 422	Glycerol	
E 431	Polyoxyethylene (40) stearate	
E 432	Polyoxyethylene (20) Sorbitan monolaurate	
E 433	Polyoxyethylene (20) Sorbitan monooleate	
E 434	Polyoxyethylene (20) Sorbitan monopalmitate	
E 435	Polyoxyethylene (20) Sorbitan monostearate	
E 436	Polyoxyethylene (20) Sorbitan tristearate	
E 440	Pectins	



1	2	3
non-coded	Gelatine	
E 444	Sucrose acetate isobutyrate	
E 445	Glycerol ester of wood resin	
E 450	Diphosphates	
E 451	Triphosphates: Pentasodium triphosphate (i) Pentapotassium triphosphate (ii)	
E 452	Polyphosphates	
E 460	Cellulose	
E 461	Methyl cellulose	
non-coded	Carbuloose	
E 466	Sodium carboxymethyl cellulose	
E 470	Salts of fatty acids (with base Al, Ca, Na, Mg, K and NH <sub>4</sub> )	
E 471	Mono- and Di-glycerides of fatty acids	
E 472a	Acetic and fatty acid esters of glycerol	
E 472b	Lactic and fatty acid esters of glycerol	
E 472c	Citric and fatty acid esters of glycerol	
E 472d	Tartaric acid esters of mono- and diglycerides of fatty acids	
E 472e	Diacetyltartaric and fatty acid esters of glycerol	
E 472f	Tartaric acetic and fatty acid esters of glycerol (mixed)	
E 472g	Succinylated monoglycerides	
E 473	Sucrose esters of fatty acids	
E 475	Polyglycerol esters of fatty acids	
E 476	Polyglycerol esters of interesterified ricinoleic acid	
E 477	Propylene glycol esters of fatty acids	
E 481	Sodium lactylates Sodium stearoyllactylate Sodium oleyllactylate(ii)	
E 492	Sorbitan tristearate	

1	2	3
E 500	Sodium carbonate(i) Sodium hydrocarbonate (ii) (Sodium bicarbonate)	
E 501	Potassium carbonates (i) Potassium hydrocarbonate (ii)	
E 503	Ammonium carbonate (i) Ammonium hydrocarbonate (ii)	
E 504	Magnesium carbonate (i) Magnesium hydrocarbonate (ii)	
E 507	Hydrochloric acid	
E 508	Potassium chloride	
E 509	Calcium chloride	
E 510	Ammonium chloride	Very dangerous, disorders of bowels, negative influence on liver
E 511	Magnesium chloride	
E 513	Sulphuric acid	Very dangerous, disorders of bowels, negative influence on liver
E 514	Sodium sulphates	
E 515	Potassium sulphates	
E 516	Calcium sulphates	
E 519	Copper sulphate	
E 524	Sodium hydroxide	
E 525	Potassium hydroxide	
E 526	Calcium hydroxide	
E 527	Ammonium hydroxide	Very dangerous, disorders of bowels, negative influence on liver. Prohibited for use in numerous countries
non-coded	Sodium hydroxide	
E 530	Magnesium oxide	
E 536	Potassium ferricyanide	
E 539	Sodium thiosulphate	
E 551	Silicon dioxide amorphous	
E 558	Bentonite	
E 559	Aluminium silicate	
E 570	Fatty acids	
E 575	Glucono-delta-lactone	
E 579	Ferrous gluconate	
E 585	Ferrous lactate	
E 621	Monosodium glutamate	

1	2	3
E 627	Disodium - 5 - guanilate	
E 631	Disodium 5'-inositate	
E 636	Maltol	Dangerous. Prohibited for use in most countries
E 637	Ethyl maltol	Dangerous
non-coded	Diacetyl	
non-coded		
non-coded	Smoke flavours	
non-coded	Vanillin	
non-coded	Ethylvanillin	
E 901	Bees wax white and yellow	
E 902	Candelilla wax	
E 903	Carnauba wax	
E 905a	Mineral oil, food grade	
E 905b	Petrolatum (Petroleum jelly)	
E 905c	Petroleum wax	
E 908	Rice bran wax	
E 909	Spermaceti wax	
E 910	Wax esters	
E 913	Lanolin	
E 917	Potassium jodate	
non-coded	Potassium jodide	
E 920	L-cysteine and its hydrochlorides sodium and potassium salts	
E 927b	Carbamide	
E 930	Calcium peroxide	
E 938	Argon	
E 939	Helium	
E 940	Diphtor-dichlormetane	
E 941	Nitrogen	
E 950	Acesulfame potassium	
E 951	Aspartame	Dangerous. Decomposes in heating with forming of poisonous methuyl aclohol, harmful for skin, may contain GMO. Dangerous in heating
non-coded	Cuclamic acid and Na, K, Ca salts	
E 953	Izomaly	
E 954	Saccharin (and Na, K, Ca salts)	

<b>1</b>	<b>2</b>	<b>3</b>
E 965	Maltitol and maltitol syrup	
non-coded		
E 967	Xylitol	
non-coded	Otison	
non-coded	Sacharol	
E 999	Quiliaia extracts	
E 1100	Amylases	
E 1101	Proteases	
E 1102	Glucose oxidase	
E 1103	Invertases	
E 1104	Lipases	
non-coded	Catalases	
non-coded	Zelulases	
non-coded	Pectinases	
non-coded	Beta-galactosidases	
non-coded	Glucoamylases	
E 1105	Lysozyme	
E 1400	Dextrin	
E 1404	Oxidised stach	
E 1410	Monostarch phosphate	
E 1412	Distarch phosphate	
E 1413	Phosphated distarch phosphate	
E 1414	Acetylated distarch phosphate	
E 1420	Acetyiated starch	
E 1422	Acetylated distarch adipinate	
E 1442	Hydroxypropyl distarch phosphate	
E 1450	Starch sodium octenylsuccinate	
E 1510	Ethanol	
E 1518	Triacetin	
E 1520	Propylene glycol	

## Technological functions of nutritional colorants, fixers of color and preservatives

Type of Function	Description of technological functions for:		
	nutritional colorants and their trade forms including mixes of colorants	fixers of color – nitrites, nitrates and salting mixes that contain these compounds	nutritional preservatives and their trade forms including mixes of preservatives
Basic	Dyeing of nutritional system or its separate components in wanted color	Forming of color owing to reaction of NO with myoglobin	Oppression of germination of pathogenic microflora in purposes of assuring of microbiological safety of the product during the set term of fitness
Additional	Adding of endurance of physicochemical influences (color, temperature) during the set time of color character for meat systems in process of their producing and storage	Ensuring of microbiological safety of meat products and postponing of forming of toxins Forming of aroma of ham	Decreasing of value of pH of the product Decreasing of content of water in the product
Subsidiary	Emergence of undesirable tint of color or change of color (including cases of its disappearance) in presence of other food additives (preservatives, regulators of acidity) and/or in changing of value of pH of alimentary system Heterogeneous distribution of color of meat system by its mass Coloring of fat and salted pork fat in "structured" sausages Coloring of water in second heating. Probable appearing of toxicity	Probable appearing of toxicity (exceeding of residual quantity in finished products) Forming of nitroamines Oppression of germination of useful microflora in one time with the unwholesome ones (in dry smoked and dried products) Adding of excessively salt taste (for mixes used in purposes of salting)	Probable appearing of toxicity (exceeding of residual quantity in finished products) Change of organoleptic characteristics of the product including cases of disappearing of coloration Oppression of germination of useful microflora in one time with the unwholesome ones (in dry smoked and dried products)

## Technological functions of antioxidants, regulators of acidity and nutritional phosphates

Type of function	Description of technological functions for:		
	antioxidants and their trade forms including mixes of substances	regulators of acidity and their trade forms including mixes of substances	nutritional phosphates
Basic	Inhibition of processes of deterioration because of oxidation during the set time	Change of functional technological characteristics of meat systems	Change of functional technological characteristics of meat systems
Additional	Stabilization/betterment of color	Decreasing of activity of water in the product Bacteriostatic function Antioxidative function Decreasing of losses of mass/release of water in processes of packing, transporting and storage	Change of pH of meat system of the product Decreasing of losses/release of water in processes of packing, transporting and storage Decreasing of activity of water in the product (insignificant) Bacteriostatic function (insignificant) Antioxidative function (insignificant)
Subsidiary	Oxidative function (in cases of overdosing as a rule) Deterioration of organoleptic characteristics of the product Irregularity of composition of the product by mass Probable emerging of toxicity	Excessive acidification of meat system/product Giving the product of foreign smell and taste Giving the product of unnatural tint of color Occurrence of defects of consistency	Deterioration (saponification) of taste Inhibiting of processes of forming of color Excessive content of general phosphorus in the product Change of ration of Ca:P in the product Decreasing of technological effects of the system owing to use of substances that form gels (in certain diapason of concentration of additives)

## Annex 4

### Technological functions of nutritional substances that form emulsions and gels, intensifiers of taste and aroma some additives of the same destination of use

Description of technological function for:			
Type of functions	nutritional emulsifiers, their commercial forms and mixtures of some types of starches, proteins and so on	substances that form gels, their trade forms and mixtures, as well as of modified starches	intensifiers of taste and aroma, extracts of aromatic plants
Basic	Emulsifying of fat	Improving of consistency of the finished product	Intensifying of taste and aroma of finished products
	Betterment of consistency of the product Purposeful amendment of viscosity of the mince Increasing of mass part of fixed moisture Decreasing of losses in process of heat treatment of the product	Decreasing of calorificity of the product in way of replacing of the mass part of fat Increasing of ability of the food system and minced meat to fix moisture Decreasing of losses in process of thermal treating	Increasing of durability of the aroma attributed to the product under the influence of technological factors Anti-oxidative influence (for extracts of spices) Bacteriostatic effect (for extracts of spices) Improvement of color of finished products (for extracts of spices)
Accessory	The deterioration in color of the finished product The increase in the fat content in the finished product The deterioration of the smell and taste of the finished product	Decreasing of content of proteins in finished products Liberation of moisture in process of storage of finished products Inhomogenous distribution of meat raw in bulk of the product	Increasing of negative tints of taste and aroma Biologically active action (for extracts of spices in cases of producing of products of general direction of use)

**Навчальне видання**

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# **АКТУАЛЬНІ ПРОБЛЕМИ М'ЯСОПЕРЕРОБНОЇ ГАЛУЗІ**

**Підручник**

**За редакцією доктора технічних наук,  
професора Л.В. Баль-Прилипка**

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