SECTION 5. FOOD TECHNOLOGY

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5.1 Improving food adequacy low-value collagen-containing raw materials in the technology of semi-finished products

The modern development of technologies at meat processing enterprises is aimed at finding ways to rationally use low-value meat protein-containing raw materials and create innovative technologies for the production of organic food.

In the scientific and technological aspect, the issues of improving the efficiency of natural resources are reduced to the development and implementation of low- and zero-waste resources and energy-saving technologies, which provide the most complete, efficient use of resources and principles of a waste-free, environment.

Solving the problem of waste-free production should be borne in mind two sides of the same process. The first is the most efficient extraction and full use of resources and, as a result, the reduction of waste generation. The second is to expand the use of generated waste. These paths do not exclude but complement each other.

Waste-free is the technology of manufacturing products in which raw materials and energy resources are spent rationally. At the same time, the concept of waste-free production assumes that the impact on the environment does not lead to disruption of its functioning.

The main provisions of the concept of waste-free technologies include:

- creating the most closed systems by analogy with the natural ecosystem;
- rational use of all components of raw materials;
- achieving minimal harmful effects on the environment.

Resource-saving at the enterprises of the meat processing industry of Ukraine is a modern direction of increase of efficiency of production and cost-effective implementation, which not only saves raw materials but also affects the growth of production for the same quantities of raw meat.

Meat and products of its processing are renewable raw materials, which are relatively expensive, and the process of their production is labor-intensive. Therefore, in terms of full economic calculation, it is necessary to direct funds and efforts to preserve raw materials, to the more complete and rational use of all its components in the processing process.

Secondary raw materials, which belong to the renewable resources of meat production, are used irrationally, in most enterprises such raw materials are sold cheaply or disposed of. Using such raw materials can solve a number of problems.

The problem of greening food production has two interrelated aspects. The first of them is the organization of rational production, which ensures the production of high quality, environmentally friendly products with minimized costs, the second - in resource-efficient production, environmental protection, reduction of man-made load, implementation of efficient waste treatment systems. [321-323]

Secondary raw materials include by-products obtained from the slaughter of farm animals, such raw materials are sometimes used irrationally due to the peculiarities of their composition and properties.

The total yield of offal to live weight is 12-16% for cattle, 12-18% for pigs, 10-14% for small cattle, 5-6% for poultry.

Significant resources of animal protein contain by-products of the second category: spleen, lungs, etc. With the exception of the spleen and meat of beef heads, by-products of the second category contain a complete set of essential amino acids. Indicators of the content of essential amino acids of proteins selected for the experiment by-products are shown in table. 1.

Table 1

The content of essential amino acids of proteins of beef offal of I and II category

By-products	Essential amino acids, g / 100 g of protein								
	Tryptophan	Lysine	Threonine	Valine	Isoleucine	Leucine	Phenylalani	Methionine	Together
Lungs	0,88	6,30	2,84	4,15	4,16	8,23	4,20	1,0	31,76
Meat trimmings	0,92	8,41	4,94	6,05	4,22	8,02	3,46	3,80	39,82

Most by-products has a low-fat content, which allows them to be used in the production of meat products as protein raw materials. The use of animal proteins from collagen-containing raw materials allows enriching meat products with dietary fiber, significantly improving the rheological parameters of food products, and, above all, the consistency. [324]

For more complete and rational use of available unclaimed animal raw materials, active use of biotechnologies is proposed, which allow obtaining high-value food, food supplements, medicines, and other useful products from non-edible raw materials while significantly reducing energy costs.

The use of biotechnology is one of the important areas of rapidly evolving scientific and technological progress. The technology is based on the industrial application of natural living systems (primarily microorganisms). Industrial cultivation of microorganisms, plant and animal cells is used to obtain many valuable compounds - enzymes, hormones, amino acids, vitamins, antibiotics, methanol, organic acids (acetic, citric, lactic), and more.

Enzymes - biological catalysts of protein nature, which are synthesized in the cells of living organisms, accelerate and coordinate biochemical reactions that regulate metabolism.

The use of enzyme preparations in the technology of production of meat products allows to intensify the technological process and involve in the process of non-

traditional, lower-grade raw materials. The use of enzyme preparations has a positive effect on the tenderness, juiciness, nutritional value of raw materials, the formation of the required level of moisture-binding and adhesive ability, improves organoleptic characteristics. The advantages of this approach in relation to the technology of meat products are presented in Fig. 1. [325-326]

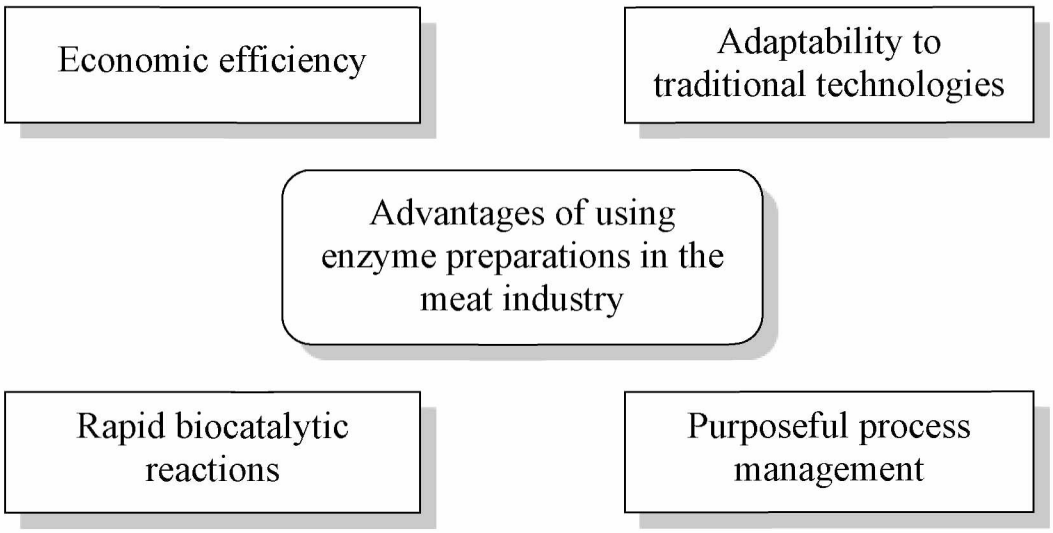


Figure 1. Justification of the feasibility of using enzyme preparations

According to the set tasks, the by-products of cattle of the I and II categories - lungs and meat trim, which are characterized by unsatisfactory organoleptic and functional-technological properties, were selected as objects of experiments. The choice is justified by the fact that the raw material contains a large number of connective tissue proteins, and especially collagen. The presented research can serve as a further basis for the development of rational use of such raw materials, as well as the possibility of its use in the food industry. [327]

The choice of enzyme preparation for the cleavage of connective tissue was guided by the following principles: ease of use, availability, the possibility of use at a pH close to the raw material, activity against collagen.

To improve the quality characteristics of low-grade raw materials, their biotechnological treatment with the enzyme preparation STABICOL SKIN (PRIORITY INTERNATIONAL LLC) was carried out. Protein enrichers were obtained in this way. The prepared raw material was ground in a meat grinder with a

lattice hole diameter of 6-8 mm and formed a collagen-containing composition. To obtain a protein enrichment used collagen-containing raw materials of the meat industry - meat trimmings with a large inclusion of connective tissue and by-products of the second category - lungs in a ratio of 1: 1.

In the prepared mass was made 2.5% aqua of STABICOL SKIN in a ratio of 1: 1.5 to the mass of raw materials, stirred, and kept in production conditions for 12 hours. The biomodified mass was freed from the remains of the solution and subjected to fine grinding on a cutter.

Enzymatic treatment was performed with the following concentration of STABICOL SKIN aqua: 0.01; 0.025 and 0.05%, within 6 and 12 hours.

It should be noted that the largest changes in the structure, which are observed visually, occurred with samples, treated with enzyme aqua STABICOL SKIN, a concentration of 0.25% for both 6 and 12 hours of treatment.

Indicators of protein and moisture obtained in the study of enzymatic processing products are shown in table. 2.

Table 2

The effect of enzymatic treatment on changes in the amount of protein and moisture in the studied systems

Indexes	Control	Options for enzymatic treatment					
		0,01/6	0,025/6	0,05/6	0,01/12	0,025/12	0,05/12
Protein content	16,76 ±0,5	13,86 ±0,43	13,91 ±0,43	13,95 ±0,43	13,64 ±0,45	13,75 ±0,45	13,86 ±0,45
Protein loss	-	2,89 ±0,07	2,85 ±0,07	2,81 ±0,07	2,99 ±0,05	3,01 ±0,05	2,89 ±0,05
Moisture content	69,27 ±2,04	69,55 ±2,05	71,19 ±2,1	72,84 ±2,14	73,29 ±2,16	74,13 ±2,2	74,96 ±2,24

For the product of enzymatic treatment of the lung an increase in the mass fraction of moisture can be explained by an increase interchain distance and rupture of

bridges between collagen subunits. In the product of enzymatic processing of meat trimmings, in addition to muscle proteins there is loose connective tissue (adipose), exposed to swelling and hydrolysis. It should be noted that minimal protein losses were characteristic, regardless of the processing parameters.

As the results of studying the effect of the parameters of enzymatic treatment on the moisture content and loss of protein substances in the samples show, dynamics of changes in the studied parameters is of a non-linear nature, which is possibly related to the peculiarity of the structure and the amount of collagen in each type of raw material.

Loss of protein substances for all samples at a preparation concentration of 0.01%, regardless of the duration of treatment, were small and amounted to, 0.01 / 6 - 2.89%, and 0.01 / 12 - 2.99%. An increase in the concentration of an enzyme preparation led to an intensification of destructive changes in collagen fibers and muscle proteins and reached a maximum at a collagenase concentration of 0.025 and 0.05%, due to penetration deep into the protein and additional hydrolysis of collagen. As a result, the protein breakdown occurred, it passed into a liquid fraction and was washed out of the spatial grid.

The results of changes in the functional and technological properties of the prototypes are presented in Fig. 2.

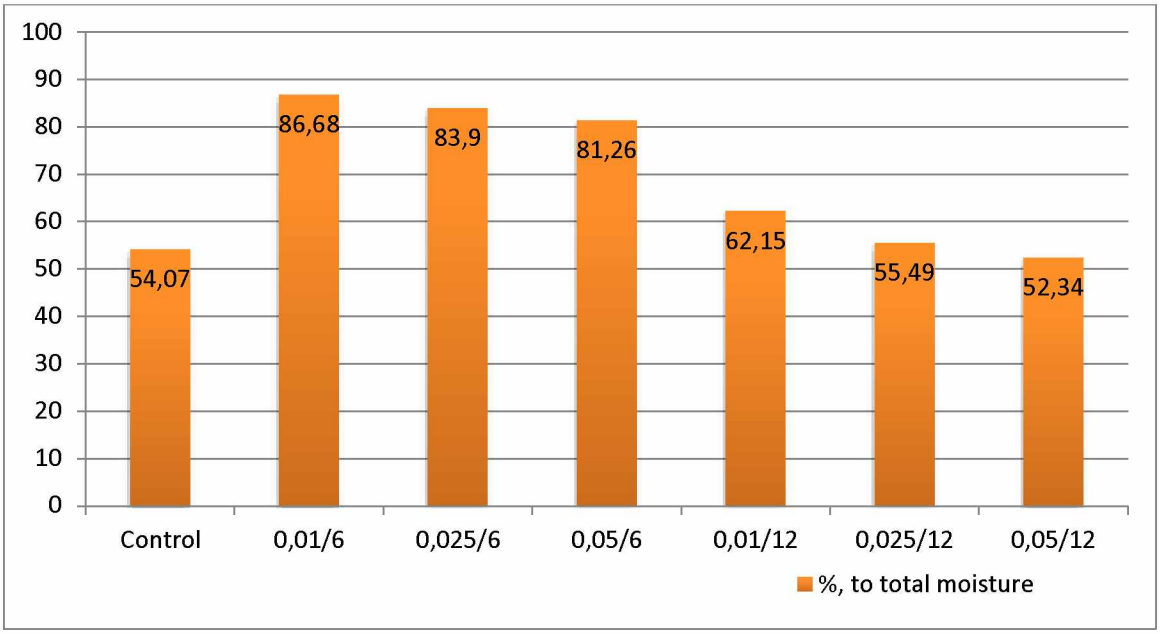
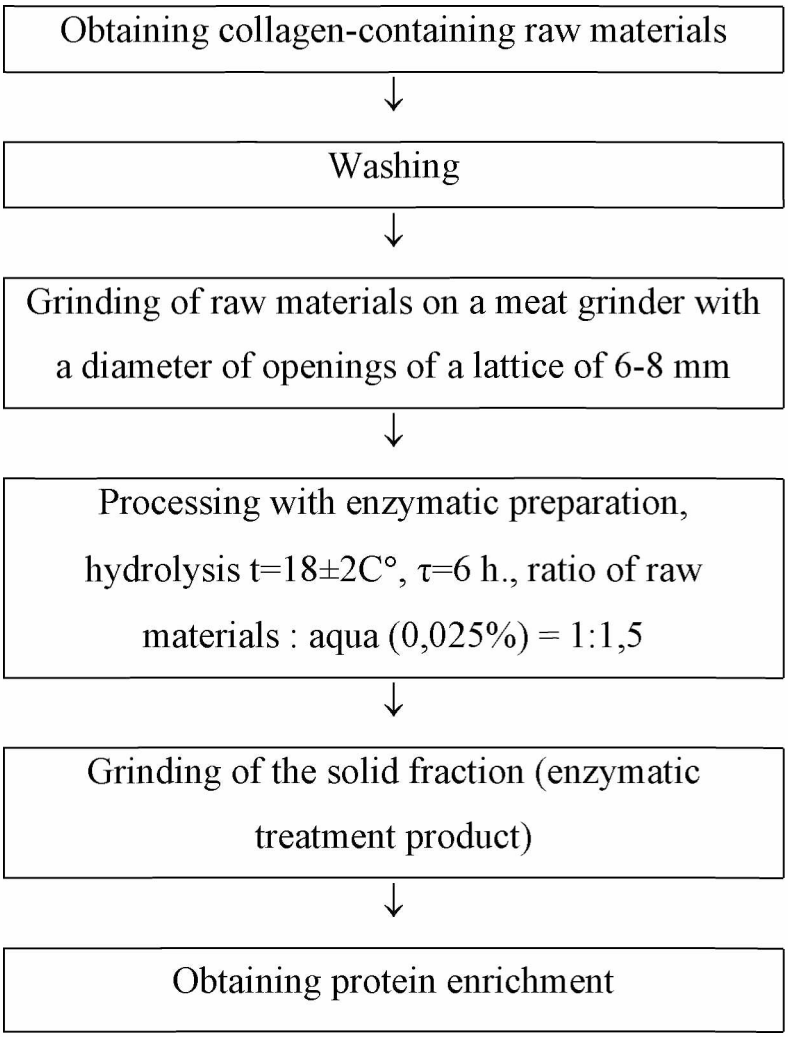


Figure 2 Moisture-binding capacity of enzymatic treatment products

In the presented samples with 6-hour treatment, the value of moisture-binding capacity was higher than at twelve-hour, which can be explained by the degree of collagen hydrolysis.

Based on the presented results of the study, the optimal modes of processing of the composition were selected, taking into account protein losses and changes in the moisture-binding capacity of raw materials - 6 hours with a concentration of enzyme preparation of 0.025%.

Technological scheme of biomodified composition production:



Protein enrichment on the basis of by-products that have undergone biotechnological processing, are introduced into the stuffing of semi-finished products in the form of a protein-fat emulsion. [328]

After obtaining a modified protein enrichment was prepared protein-fat emulsion by adding to it the following components: ice water in a ratio of 1: 1 to the weight of the protein enrichment, sesame oil, in the amount of 25% by weight of protein enrichment and crushed for another 4 minutes

Minced meat for the manufacture of chopped semi-finished products was made according to the recipe specified in table. 3. A sample made without the use of protein-fat emulsion according to the traditional recipe is accepted as a control.

The level of substitution of raw meat for protein-fat emulsion was determined by the optimal organoleptic parameters of the experimental samples with the introduction of a substitute from 10 to 20%.

Table 3

Formulations of the studied products

Type of raw material	Application rate per 100 kg,%			
	Control	6.1	6.2	6.3
Semi-fat pork	50	45	40	40
Chicken	15	25	25	20
Emulsion	-	10	15	20
Nontreated by-products	15	-	-	-
Eggs	3	3	3	3
Onion	5	5	5	5
Bread	7	7	7	7
Breadcrumbs	3	3	3	3
Table salt	1,7	1,7	1,7	1,7
Spices	0,3	0,3	0,3	0,3

According to the set of organoleptic parameters, the most acceptable was the sample with the replacement of raw meat with protein enrichment in the amount of 20%. The test samples were more juicy, tender and had a better consistency compared to the control sample.

Prepared samples of cutlets were evaluated by organoleptic parameters. The advantage of organoleptic evaluation as a method of product quality analysis is the ability to quickly and simultaneously identify a set of product properties such as appearance, color in the cut, aroma, taste, texture.

Analyzing the data of Fig. 3, we can say that the prototype of the prepared cutlets on organoleptic parameters were not inferior to the control product.

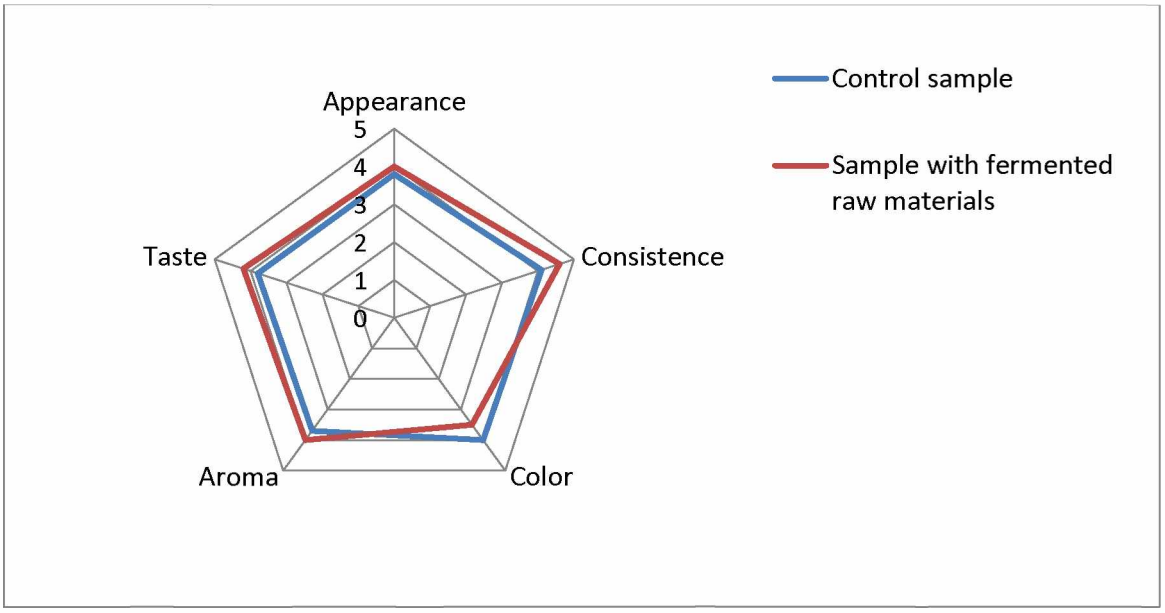


Figure 3. Profilogram of the dependence of the score of organoleptic parameters of the product that has undergone heat treatment

Thus, based on the results of research, we can draw the following conclusions: first, biotechnological processing can improve the structure of raw materials containing collagen, collagen fibers swell, there is their defibering; secondly, the microstructure of the control sample and the experimental sample with protein-fat emulsion do not differ significantly.

Based on the results of organoleptic studies, it can be concluded that the developed cutlets are not inferior to the control sample in terms of nutritional value and also meet the requirements of DSTU 4437: 2005. The sample of cutlets with the introduction of protein-fat emulsion has a juicier texture, pleasant smell and taste.

Thus, the results of research indicate a positive effect of the use of the enzyme preparation "STABICOL SKIN" for processing the composition - improves the functional and technological properties of low-value meat protein-containing raw

materials. The technological effect of the drug can be expected in increasing the tenderness, juiciness, yield and improving the organoleptic evaluation of meat products. The results allow us to positively assess the prospects for the use of the drug "STABICOL SKIN" in the technology of meat products and the possibility of creating effective biotechnology in the industry.