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MICROSTRUCTURAL STUDIES OF IMPROVED MEAT CHOPPED SEMI-FINISHED PRODUCTS

Розглянуто удосконалені фарші яловичі з заміною 5 %, 10 %, 15 % м'ясної частки на люпинове борошно з додаванням 0,5 % порошку кореня дивосилу, як пряно-ароматичної сировини та контрольний зразок яловичого фаршу. Гістологічні дослідження показали за ШИК реакцією вміст у м'ясних розроблених напівфабрикатах м'ясної та рослинної частин. За гематоксиліном та еозином визначили відсотковий склад фаршів.

Ключові слова: *м'ясні січені напівфабрикати, порошок кореня дивосилу, борошно люпину харчового білого.*

1. Introduction

It is well-known that nutrition of all population groups in Ukraine is an important factor that largely determines the health of the nation. The problem of environmentally friendly, rational, balanced nutrition is very acute. To date, the production of meat products requires the use of a variety of meat raw materials. Since the concept of modern food is not just a fashionable trend, and the imperative of time, the introduction of new functional products with prescribed health-prophylactic properties to the market is entirely appropriate.

The urgency of the direction is determined by the need to search for new sources of high-grade protein and the introduction of new types of products with high nutritional value. Among a significant amount of vegetable raw materials containing protein, a special place belongs to lupine [1]. The production of meat chopped semi-finished products, which combine recipe meat raw materials and proteins of vegetable origin, containing high-grade proteins, acquires special urgency [2]. To ensure the control of the prescription bookmarks of meat chopped semi-finished products in accordance with the requirements of regulatory documents, it is important to identify the raw components on the basis of the histological (microstructural) characteristics of the combined minced meat.

The histological method is a direct method for determining the composition of raw materials and products. Microstructural studies can identify components and differentiate the properties of various tissue and cellular structures [3].

Lupine was described at the World Congress in the United States as an important reserve of protein substances of high quality [4]. The elecampane root contains up to 44 % of inulin. It has also been proven that elecampane facilitates the restoration of metabolic processes, the surge of energy, vigor, the return of youth and health [1, 4].

Quality control of meat and meat products is a topical issue of our time. This is due to the global changes that have occurred recently in all branches of the meat and meat processing industry [5]. Functional chopped meat semi-finished products harmoniously combine high taste qualities, nutritional value with good functional properties and provide a positive impact on human health. At the same time, they are intended for a wide audience of consumers and can be used regularly as part of a normal diet without any special recommendations.

2. The object of research and its technological audit

The object of research is meat chopped semi-finished products with 5 %, 10 %, 15 % lupine flour content and 0.5 % elecampane root. Lupine, along with soy, is high in protein in seeds. In addition to protein in the grain of lupine contains 25–40 % without nitrogen extractives, up to 9 % or more fat, 3–4 % of ash. The average protein content in lupine flour is 36.6 % of dry matter (DM), which is 3 times higher than that for wheat flour of grade I and 2.2 % in DM for soy flour. About 90 % of the protein substances from the total content in the seeds of lupine are readily assimilated fractions – albumins and globulins, while in soybean flour – only 67 %.

The protein of lupine seeds is characterized by a significant content of essential amino acids. The limiting amino acids of the lupine protein are sulfur-containing. The lupine protein, in particular, differs from soy, wheat and other leguminous proteins with a higher content of such amino acids as:

– lysine;
– threonine (an indispensable amino acid, especially necessary for a young organism);
– leucine (an indispensable amino acid, which plays an important role in the treatment of liver diseases, anemia, etc.). This confirms the high quality of the lupine protein.

Unsaturated fatty acids (oleic, linoleic, linolenic, palmitic) and saturated (stearic) predominate in triglycerides of lupine seeds. Among the unsaturated lipid acids in the seeds of all varieties of lupine is a relatively high palmitic acid content.

The content of vitamins is one of the main physicochemical indicators of food raw materials, which determines its nutritional value. Lupine seeds also contain water-soluble vitamins – thiamin, riboflavin, pyridoxine, biotin, folic acid, ascorbic acid, etc. In terms of the B vitamins, the seeds of lupine are close to the seeds of other

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leguminous plants (peas, soybeans) and far exceed the grain (rye, wheat).

All the above-mentioned food preferences of lupine seeds, as well as the lack of specific taste, smell and pleasant color of lupine flour meet the necessary requirements. This makes it possible to use grain of food varieties of white lupine in the production of high-protein children's products, dietary and therapeutic and prophylactic purposes.

Elecampane is a perennial herbaceous plant. In medicine, rhizomes with roots are used, which in dry form has a strong peculiar aroma and a spicy, slightly bitter taste. In the rhizomes and roots of elecampane contains essential oil of a complex composition (lactones, alantol and proazulen). In addition to essential oil, inulin is found (up to 44 %), inulinen, pseudoinulin, acetic and benzoic acids.

The addition of lupine flour provides an increase in food and biological value made from meat chopped semi-finished products without impairing consumer properties and enriches the diet with vegetable protein.

However, an increase in the vegetable fraction in meat chopped semi-finished products may affect the organoleptic and taste properties, which requires the selection of a formulation with the optimal content of vegetable fraction.

3. The aim and objectives of research

The aim of research is investigation of the microstructural characteristics of the improved meat chopped semi-finished products enriched with lupine flour and elecampane in comparison with the control one by histological method.

To achieve this aim, it is necessary to solve such problems:

1. Find by the histological method the content of components in chopped meat, as well as vegetable and meat particles.

2. Investigation of the influence of vegetable fraction on the organoleptic and taste properties of the product in the improved meat chopped semi-finished products.

4. Research of existing solutions of the problem

The method of microstructural analysis of meat raw materials, semi-finished products and finished products made from meat raw materials is used in European countries [6]. However, in the vast majority of countries, this method has no legal basis [7]. A sufficiently powerful regulatory and legal framework has been developed by specialists of the microstructural research laboratory of meat of the V. Gorbatov All-Russian Research Institute of Meat Industry [5]. Employees analyzed the possibility of using an enzyme immunoassay, which has high sensitivity and specificity. This method is most suitable for determining the type of meat, the qualitative and quantitative composition of plant proteins, such as, for example, soy.

The works [8–14] are devoted to the introduction of protein components, mainly soya concentrates, bran, whey, etc., into meat chopped masses. In Japan, for more than twenty years, various methods of preparing meat products with high calcium content have been used. When making cutlets, schnitzels, sausages minced meat, crushed animal bones are added in the minced meat [9]. In the United States, extensive research is being conducted on the production of a protein-mineral food supplement made from bones and bone residues [10]. In the UK, the bone is processed according to Johnson-Fowdler's method for the production of edible fat, soluble protein and food phosphate [11].

There are known methods for making meat chopped semi-finished products (RU 2039466, 2228118, 2275131, 2352161, 2377931, 2542516, 2562533, and the patent of Ukraine 94146, 111296, 111506) include adding to minced meat:

– meat extracts and powders;
– by-products or products of their processing;
– hydrated soy protein;
– plant and biologically active additives;
– dietary fiber;
– oils and the like.

In [3, 5], nutritional value and perspectives of using lupine flour in food are noted.

Thus, the results of the analysis lead to the conclusion that enrichment of meat products with vegetable protein is an actual issue for today. A large number of scientists are working to solve the problem of protein deficiency in people's nutrition.

5. Methods of research

For microscopic examination, the selected material of the developed mince was labeled and fixed in a 10 % neutral formalin solution. After that, the fixed material was dehydrated in a series of alcohol solutions, with ascending concentrations (70, 80, 90, 96°), compacted in two portions of chloroform and poured into paraffin. On the sledge microtome, sections 0.5–1 cm thick were made which were dyed with hematoxylin and eosin – periodic acid Schiff reaction. Light microscopy and microphotography of histopreparations were performed using a Leica DM 2500 microscope and a Leica DFC 450C camera (Germany), as well as the Leica Aplitation Suite 4.4 software.

In the work, ground beef was studied replacing 5 %, 10 %, 15 % of the meat portion with lupine flour and adding 0.5 % of the elecampane root powder, as a spicy aromatic raw material. And also a control sample of ground beef is developed in accordance with GOST R 52675-2006. Lupine flour of the «Pishchevoi» grade was used, which was grown at the Institute of Agriculture of the National Academy of Agrarian Sciences (Chabany, Kyiv, Ukraine). Lupine flour is a homogeneous, fine-colored powder of light yellow color, neutral to taste and smell. Elecampane is a dried and crushed root. Smell is strong, fragrant, taste is bitter-spicy.

Four samples of research minced meat were elected.

№ 1 «Control», GOST R 52675-2006. Ingredients: beef (cutlet meat), raw fat, wheat bread, onion, water, black pepper, salt, food salt.

№ 2 «5 %». Ingredients: beef (cutlet meat), raw fat, lupine flour, wheat bread, onion, water, black pepper, elecampane root, salt.

№ 3 «10 %». Ingredients: beef (cutlet meat), raw fat, lupine flour, wheat bread, onion, water, black pepper, elecampane root, salt.

№ 4 «15 %». Ingredients: beef (cutlet meat), raw fat, lupine flour, wheat bread, onion, water, black pepper, elecampane root, salt.

6. Research results

The research was carried out on the basis of the Department of Normal and Pathological Morphology and

Judicial Veterinary of the National University of Veterinary Medicine and Biotechnology named after S. Z. Gzhitsky (Lviv, Ukraine).

In the microstructural study of samples in minced meat, it is found:

1 – muscular fibers of polygonal and round shape, the cytoplasm of which is uniformly colored reddish-pink, and their dark blue nuclei were clearly visible under the sarcolemma. This indicates that fresh meat was used for minced meat;

2 – fatty tissue, which is histologically characterized by a network structure. Vacuoles of various shapes and sizes appeared in the locations of the fat pieces, which gave the cut a net appearance;

3 – onion is represented by wavy fibers of violet color;

4 – bread mass is represented by crumbly fibers of brown color;

5 – lupine flour is represented by assembled groups of round cytoplasm of violet color with cores of dark purple color, placed in the center of polygonal cells;

6 – elecampane is represented by the dark brown single points.

Fig. 1–8 show histological sections of samples of minced dyed with:

A. Hematoxylin and eosin.

B. Periodic acid Schiff reaction (which paints cytoplasm of plant origin in bright red-pink color).

On the sections of the control sample (Fig. 1), by hematoxylin and eosin with glasses 10 and lens 10, the following are determined:

1 – muscular fibers of polygonal shape have a clear contour;

2 – fatty tissue is large cells of mesh and oval form;

3 – onion is represented by fibrous, loose fibers, as it has been grinding;

4 – bread is represented by single crumbly parts.

The structure of the mince is uniformly homogeneous, the loosening of the fibers is observed, as the mince was subjected to mixing.

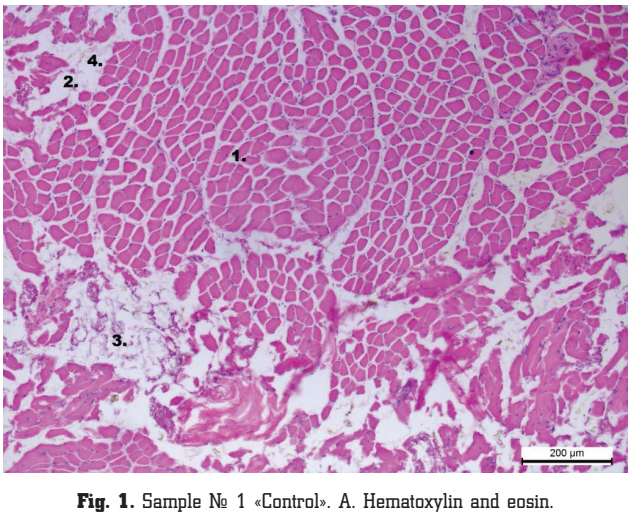

Fig. 1. Sample № 1 «Control». A. Hematoxylin and eosin. Glasses 10 and the lens 10: 1 – muscle fibers; 2 – fatty tissue; 3 – onion; 4 – bread

During the periodic acid Schiff reaction on the cut of the control sample (Fig. 2), the vegetable (1) and meat (2) parts are clearly identified on the glasses 10 and the lens 20, according to which the compliance of the components of the minced meat components is established. It can be noted that in a significant weight fraction is the meat part of the minced meat.

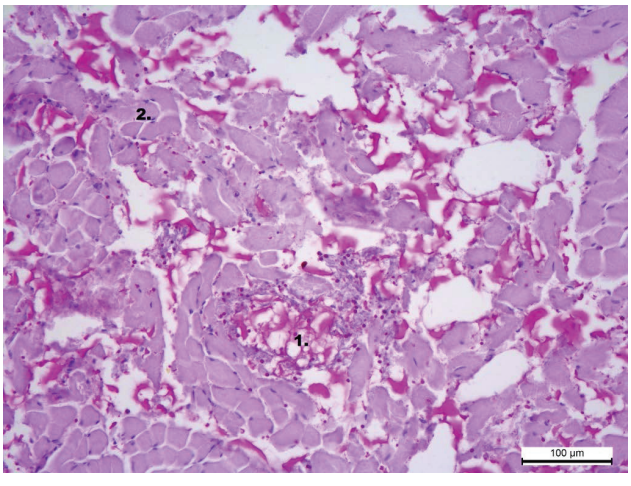

Fig. 2. Sample № 1 «Control». B. Periodic acid Schiff reaction. Glasses 10 and the lens 20: 1 – vegetable part; 2 – meat part

Fig. 3 shows a cut of minced meat with 5 % content of lupine flour and 0.5 % of the elecampane root. By hematoxylin and eosin with glasses 10 and the lens 10 it is established:

1 – muscular fibers of polygonal shape with a clear contour;

2 – large cells of mesh and oval form – fatty tissue;

3 – fibers with fibrous loosened form – onion;

4 – single loosened fibers – bread;

5 – spherical polygonal vacuoles with nuclei in the center of cells – lupine flour;

6 – single fibers of a clear form – elecampane.

The structure of the minced meat is uniformly homogeneous.

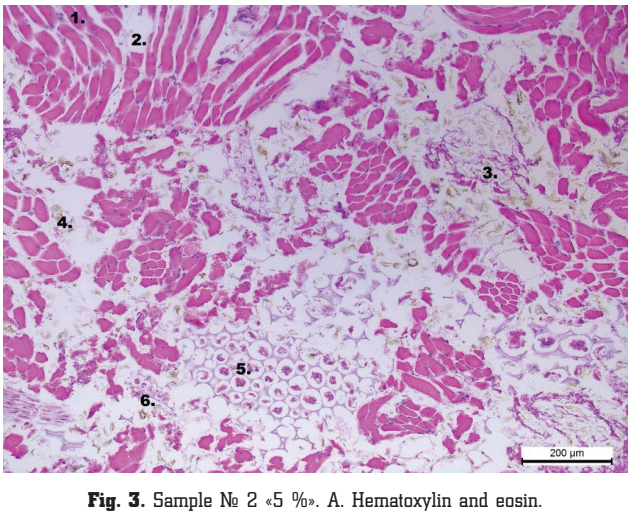

Fig. 3. Sample № 2 «5 %». A. Hematoxylin and eosin. Glasses 10 and the lens 10: 1 – muscle fibers; 2 – fatty tissue; 3 – onion; 4 – bread; 5 – lupine flour; 6 – elecampane

Vegetable (1) and meat (2) parts are clearly defined in Fig. 4 for the periodic acid Schiff reaction with glasses 10 and the lens 20.

The content of vegetable components is increased by 5 % according to the developed recipe, but the meat

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content is close to the control and remains significantly high.

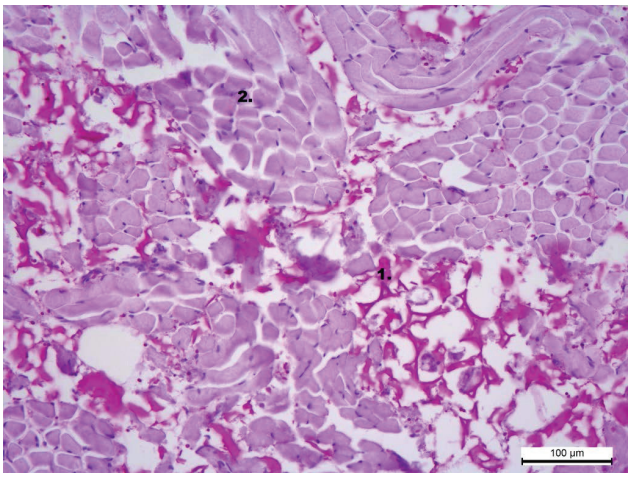

Fig. 4. Sample № 2 «5 %». B. Periodic acid Schiff reaction. Glasses 10 and the lens 20: 1 – vegetable part; 2 – meat part

Fig. 5 shows a cut of minced meat with 10 % content of lupine flour and 0.5 % of the elecampane root. By hematoxylin and eosin with glasses 10 and the lens 10 it is established:

1 – muscular fibers of polygonal shape with a clear contour;

2 – large cells of mesh and oval form – fatty tissue;

3 – fiber with fibrous loosened form – onion;

4 – single loosened fibers – bread;

5 – spherical polygonal vacuoles with nuclei in the center of cells with large accumulation – lupine flour;

6 – single fibers of a clear form – elecampane.

In the structure of minced meat there are insignificant stratifications and there is no uniform mixing of the ingredients included in minced meat, as lupine flour absorbs moisture.

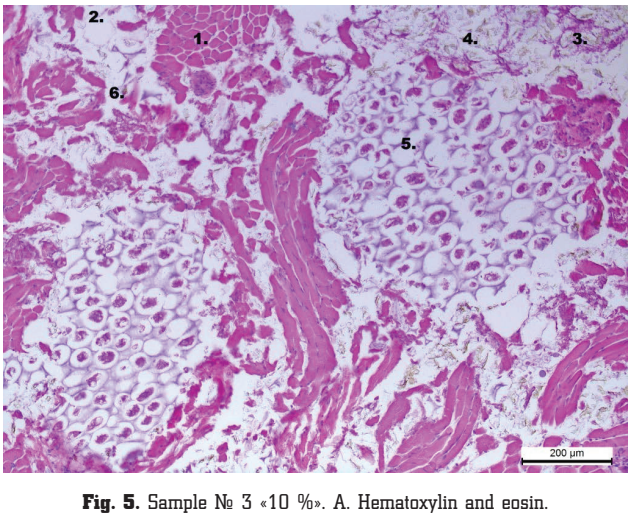

Fig. 5. Sample № 3 «10 %». A. Hematoxylin and eosin. Glasses 10 and the lens 10: 1 – muscle fibers; 2 – fatty tissue; 3 – onion; 4 – bread; 5 – lupine flour; 6 – elecampane

Fig. 6, in accordance with Periodic acid Schiff reaction with glasses 10 and the lens 10, determines vegetable (1) and meat (2) parts. Vegetable part is increased by 10 % according to the developed formulation, without worsening organoleptic and taste properties.

Fig. 7 shows a cut of minced meat with 15 % content of lupine flour and 0.5 % of the elecampane root. By hematoxylin and eosin with glasses 10 and the lens 10 it is established:

1 – muscular fibers of polygonal shape with a clear contour;

2 – large cells of mesh and oval form – fatty tissue;

3 – fiber with fibrous loosened form – onion;

4 – single loosened fibers – bread;

5 – spherical polygonal vacuoles with nuclei in the center of cells with large accumulation, absorb moisture – lupine flour;

6 – single fibers of a clear form – elecampane.

The structure of the minced meat is broken, non-uniform, crumbly. There is an uneven placement of the muscle and vegetable parts.

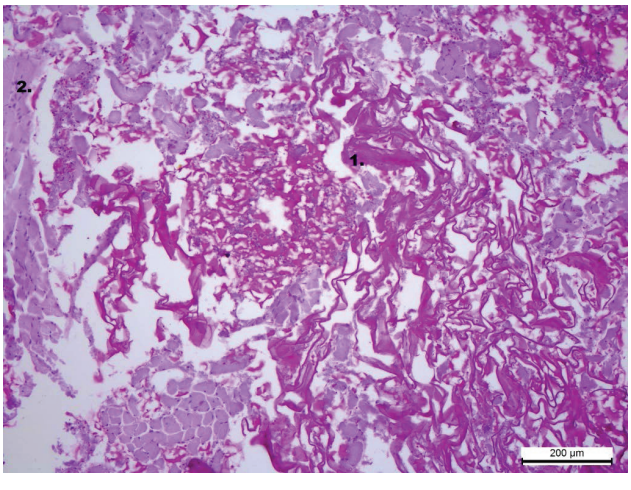

Fig. 6. Sample № 3 «10 %». B. Periodic acid Schiff reaction. Glasses 10 and the lens 10: 1 – vegetable part; 2 – meat part

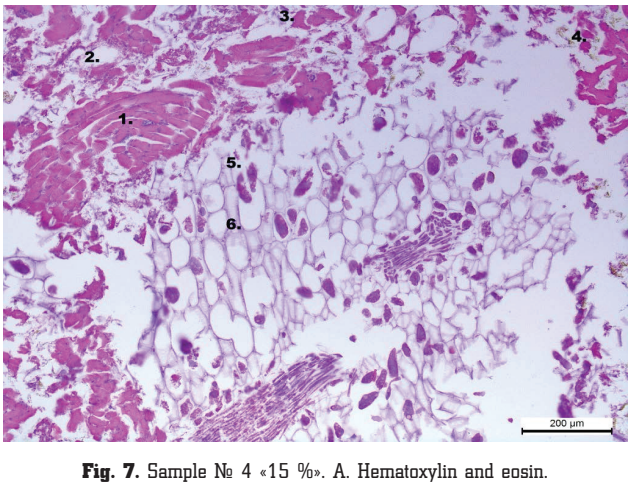

Fig. 7. Sample № 4 «15 %». A. Hematoxylin and eosin. Glasses 10 and the lens 10: 1 – muscle fibers; 2 – fatty tissue; 3 – onion; 4 – bread; 5 – lupine flour; 6 – elecampane

Fig. 8, in accordance with periodic acid Schiff reaction with glasses 10 and the lens 10, determines vegetable (1) and meat (2) parts.

According to the developed recipe, the vegetable part increases by 15 % that significantly increases its content in minced meat, while negatively affecting taste.

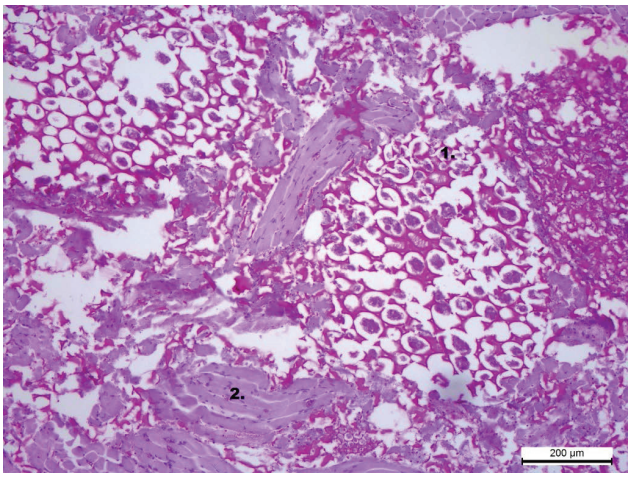

Fig. 8. Sample № 4 «15 %». B. Periodic acid Schiff reaction. Glasses 10 and the lens 10: 1 – vegetable part; 2 – meat part

7. SWOT analysis of research results

Strengths. The developed beef cutlets are enriched with the content of vegetable full-grown protein (5 %, 10 %, 15 %). These cutlets are economically profitable, as the meat portion is replaced by a cheaper vegetable grows.

Weaknesses. The disadvantage is the excessive introduction of components (more than 15 %) is deterioration of organoleptic and taste properties. Products become crumbly with a bitter taste.

Opportunities. The introduction of meat and vegetable cutlets into food will solve the problem of protein deficiency, which is about 25 % today. This product provides high-quality meat semi-finished products of functional purpose, safe for consumers' health, balanced by amino acid and mineral compositions, with good nutritional and taste properties.

Further research will be aimed at determining the toxicity of this product by feeding to white mice.

This product can be competitive in the market, as it can be used in medical and preventive and rational nutrition. It would be advisable to use beef-vegetable cutlets in fast food, thereby changing the stereotypes about the benefits and harm of street food.

Threats. The production of the developed cutlets requires additional expenses, since lupine in Ukraine has a wide application for feed purposes and additional cultivation and production are required for the production of lupine flour of the «Pishchevoi» grade.

8. Conclusions

1. The content of components in minced meat, as well as vegetable and meat particles is determined by the histological method, and quality control of the developed products is carried out. Studies have shown that the application of lupine flour:

– 5 % – minced meat uniformly homogeneous;

– 10 % – slight stratification of minced meat is allowed;

– 15 % – uneven placement of muscle and vegetable parts, minced meat is broken, non-uniform and loose.

2. It is established that with the help of microstructural research it is possible to establish a qualitative model of a useful product without impairing organoleptic and taste properties. Investigation of the microstructure of minced meat according to the simulated recipes has shown that the introduction of more than 15 % of lupine flour into the composition of the semi-finished product causes a loosening of the structure of the products. An increase in the vegetable fraction by 15 % also has a negative effect on taste properties.

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МИКРОСТРУКТУРНЫЕ ИССЛЕДОВАНИЯ УСОВЕРШЕНСТВОВАННЫХ МЯСНЫХ РУБЛЕНЫХ ПОЛУФАБРИКАТОВ

Рассмотрены усовершенствованные говяжьи фарши с заменой 5 %, 10 %, 15 % мясной доли на люпиновую муку с добавлением 0,5 % порошка корня девясила, как пряно-ароматического сырья и контрольный образец говяжьего фарша. Гистологические исследования показали за ШИК реакцией содержание в мясных разработанных полуфабрикатах мясной и растительной части. По гематоксилину и эозину определили процентный состав фарша.

Ключевые слова: мясные рубленые полуфабрикаты, порошок корня девясила, мука люпина пищевого белого.

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SUBSTANTIATION OF THE CHOICE OF OPTIMAL CONCENTRATIONS OF ACTIVE INGREDIENTS OF THE ANTIOXIDANT COMPOSITION FOR FRUIT TREATMENT BEFORE STORAGE

Розроблена антиоксидантна композиція на основі іонолу, диметилсульфоксиду та лецитину, застосування якої сприятиме подовженню терміну зберігання плодів з мінімальним рівнем щодобових втрат. Проведеною оптимізацією встановлено, що при зберіганні плодів яблуні та груші концентрація дистинолу повинна бути на рівні 0,041...0,042 %, концентрація лецитину – 2,9 %, при зберіганні плодів сливи відповідно: дистинолу – 0,022 %, лецитину – 3,4 %.

Ключові слова: *обробка плодів антиоксидантною композицією, подовження терміну зберігання, щодобові втрати при зберіганні.*

1. Introduction

Fruit products due to their high biological value and functional properties should be an obligatory component of the human diet throughout the year. According to some authors, the proportion of fruits in the diet is considered an indicator of the growth of the well-being of the population [1, 2].

According to the recommendations of the Food and Agriculture Organization of the United Nations (FAO) to ensure the food security of the population, the total capacity of refrigerated storage facilities in the country must correspond to the population and the balance sheet conditions of the export-import turnover. At the same time, part of the fruit and vegetable products stored should be 90...125 kg per person per year. Unfortunately, this value in Ukraine today is on the average 10.5...17.5 kg per person, and in large industrial centers does not reach the required level [3].

Among the main factors contributing to this situation in the field of fruit storage are the lack of modern production facilities for storing and use of too expensive, and sometimes very complex and unsustainable storage technologies [4–6].

In this regard, studies devoted to the search for ways to improve existing storage technologies, with the aim of providing the population with fresh and quality fruit products throughout the year, are relevant.

2. The object of research and its technological audit

The object of research is the technological process of refrigerated storage of fruit products.

The biggest problem with storage for this technology is a high level of losses (20–30 %) from microbiological diseases and physiological disorders. In addition, low positive temperatures only inhibit, but do not stop the redox processes. Therefore, when storing fruits in conventional cold rooms, a high rate of post-harvest ripening processes is noted. At the same time there is a rapid deterioration of non-quantitative indicators and biological value.

To find ways to eliminate these problems, a technological audit is conducted, which aimed to investigate the possibility of using antioxidant compositions for fruit treatment before further storage.

