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The development of technology for functional food products on based on combination of raw materials of vegetable and meat origin

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Abstract. The most rational and promising way to solve the problem of healthy nutrition, according to most scientists and specialists, is to combine raw materials of meat and vegetable origin. To obtain functional products, an important factor is not only the enrichment of food products with vegetable raw materials, but also the stabilization of the quality of meat systems. The use of vegetable components in addition to raw meat makes it possible to obtain combined products that are diverse in composition, which significantly expands the range of high-quality products and creates the possibility of designing products of a given composition. Also, it was found that the content of only meat or vegetable protein in food has less biological value than their mixture. The combination of vegetable and meat protein is well achieved in paste products. The article highlights the development of technology for the production of functional foods using meat and vegetable raw materials. The study objective was the development of combined food products for medical, prophylactic and functional purposes. An improved recipe for meat paste with the addition of vegetable ingredients is proposed. Quality assessment by organoleptic and physico-chemical indicators of the end-product was carried out according to generally accepted methods.

1. Introduction

Recently, much attention has been paid to the organization of healthy nutrition for Russians. According to one of the basic principles of the concept of healthy nutrition, products should not only satisfy the needs of the human body for nutrients and energy, but also perform medical and preventive goals. More and more attention is being paid to the development of functional products. Research in this area is ongoing, so the list of functional ingredients is constantly updated.

The problem of micronutrient deficiency in the population is noted in all countries, including economically developed ones. The elimination of micronutrient deficiencies is an extremely acute problem for all countries. It is indicated in the Concept of the state policy in the field of healthy nutrition of the population of the Russian Federation, approved by the decree of the Government of the Russian Federation, as a priority task, since the optimization of the vitamin status of the population refers to technologies for reducing losses from nutritional-dependent, socially significant diseases.



A significant contribution to the development of the problem under consideration was made by domestic scientists: academician of the RAMS **V A Tutelyan**, Academician of the Russian Agricultural Academy **I A Rogov**, professors **V B Spirichev**, **B P Sukhanov**, **A P Nechaev**, **V M Poznyakovsky** and others [1].

In the works of **V V Tolstoguzov**, **I A Rogov**, **E S Tokaev**, **L G Vinnikova**, **N V Gurova**, **V G Vysotsky**, **V T Dianova**, **E I Titov**, **A I Zharinov**, **N K Zhuravskaya**, **N N Lipatov**, **L F Mitaseva**, **N G Kroha**, **I V Bobreneva** conducted researches in multicomponent meat systems of compatibility of biopolymers (protein – polysaccharide), taking into account their influence on physicochemical and technological properties [2].

The scientific novelty of the presented researches consists in the development of a new recipe for the production of functional products from raw materials of vegetable and meat origin; obtaining a product with high biological value; expanding the range of functional foods.

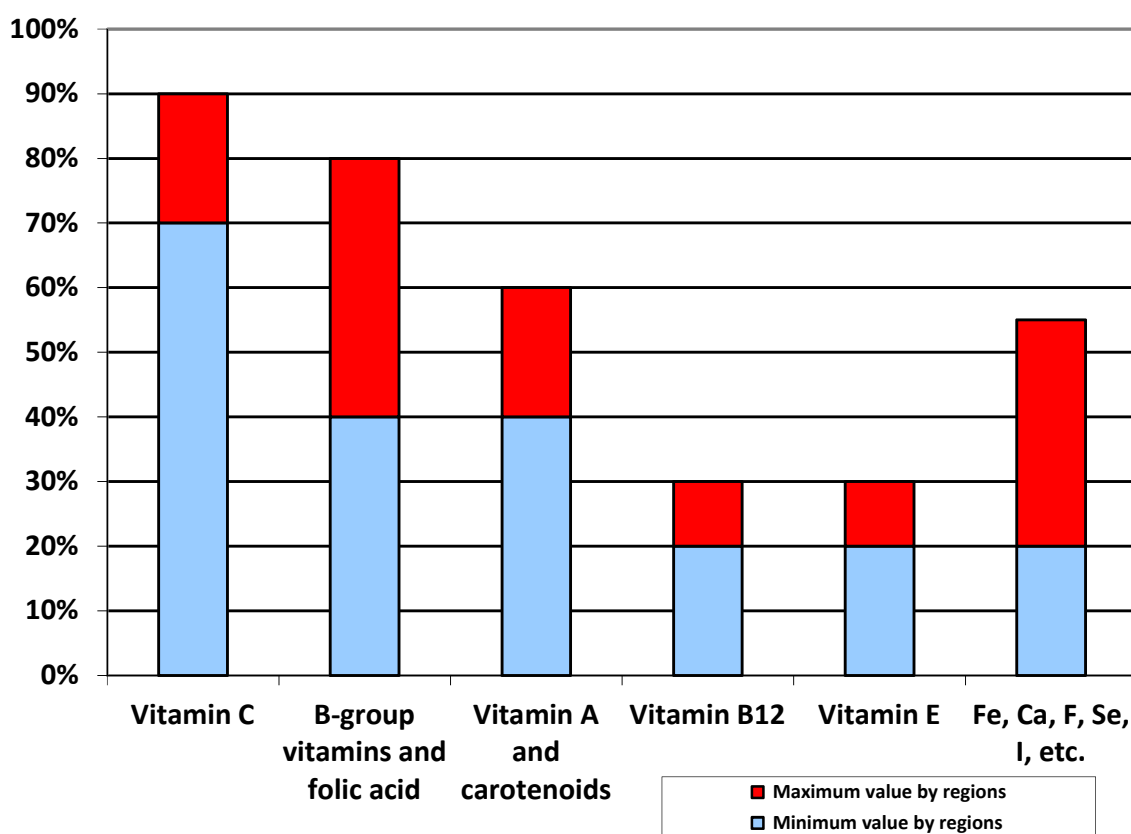


Figure 1. Lack of basic micronutrients in the nutrition of the population of the Russian Federation

The results of regular mass examinations of various population groups of the Russian Federation confirm the widespread micronutrient deficiency in most children and adults, the most important of which are: vitamins A, C, B₁, B₂, B₆, folic acid, calcium, sodium, potassium, iodine, fluorine, selenium, zinc, iron and dietary fiber. The situation is aggravated by an imbalance in the diet of the population, a decrease in the consumption of meat and meat products, as well as vegetables and fruits. The lack of basic micronutrients in the nutrition of the population is presented in Figure (1).

2. Materials and methods

The object of study is meat paste. The raw ingredients used were beef, flax flour, pine nuts, water chestnuts and fenugreek seeds.

Pastes are homogenized products with a predominant content of meat. Delicate consistency is achieved by special methods of processing raw materials and the selection of recipe ingredients. The characteristic feature of the paste is the lack of a strong colloidal chemical bond between the particles, which boiled sausage is distinguished by. As a result, the paste in water breaks up into tiny particles.

Paste packaged in optimally convenient packaging is in great demand among the population and is considered a gourmet product.

Quality assessment by organoleptic and physico-chemical indicators of the finished product was carried out according to generally accepted methods.

3. Analysis of raw material

3.1. Analysis of animal raw material

The chemical composition and nutritional value of meat is widely and fully considered in many works. Such scientists as **I A Rogov, L V Antipova, N I Dunchenko, N A Zhrebtsov** described in details proteins, protein sources, their role in nutrition and aminoacid composition. Researchers note that in human nutrition, meat is the main source of complete protein, easily digestible by the organism. Among protein sources, meat occupies a special place, since it is closest to the proteins of the human organism in chemical composition, structure and properties. The mass fraction of protein in meat is 14–23%. Meat proteins are the most valuable components, accounting for 95% of all nitrogenous substances in the organism.

The meat raw materials used for the production of foods contain predominantly high-grade proteins, which contain all the essential aminoacids - leucine, phenylalanine, lysine, isoleucine, valine, methionine, threonine, tryptophan - in quantities and ratios that are close to optimal.

The aminoacid composition of blood plasma or egg protein is taken as a standard for the optimal content of essential aminoacids. The ratio of the three most important essential aminoacids - tryptophan, methionine and lysine in meat products corresponds to the balanced nutrition formula [3].

To maximize the preservation of nutritional value in the production of culinary products from meat, the development of more gentle heat treatment regimes is required to minimize the destruction of nutrients and provide a higher value of the finished product.

There are many options for the heat treatment of meat products in connection with this is of undoubted interest changes in nutrients that occur during the main types of cooking. The authors show that protein loss during cooking is 10%, when frying in small pieces – about 5%, in large pieces - 10%, and when stewing and roasting - only 5%. The chemical composition, energy value, digestibility and taste of meat depend on the ratio of these tissues in it and on the qualitative and quantitative composition of their constituents [4].

In human nutrition, meat products are one of the main sources of phosphorus. Trace elements and vitamins enter the human organism with meat. Extractive substances of meat improve the taste of food, stimulate appetite and increase the secretion of digestive glands.

In technological practice, the tissues of which meat is made are classified not according to functional attribute but according to industrial value. In this regard, they are conditionally divided into muscle, fat, connective, cartilage, bone and blood. Meat products provide the human body with complete, easily digestible animal proteins used to build tissues, and are also a source of fat and additional nutritional factors - vital polyunsaturated fatty acids, vitamins and minerals. These nutrients are concentrated mainly in muscle tissue, to a lesser extent in adipose tissue and very slightly in connective tissue. Therefore, the less connective tissue in meat the higher its nutritional value. Excessively high fat content in meat, causing its high calorie content, at the same time reduces the taste, protein value and digestibility of meat.

The optimal ratio between protein and fat is 1: 2.5. **A S Ratushny, V I Khlebnikov, B A Baranov** in the works revealed the question of the influence of the method and mode of heat treatment of meat on the change in its physico-chemical parameters and biological value. It is noted that a protein molecule undergoes complex physical and chemical changes during heating, primarily denaturation

and coagulation, the depth of which depends on temperature, the duration of the heat treatment, and some other factors. In addition, **L F Pavlotskaya, N V Dudenko, M M Adelman** noted that prolonged heat treatment worsens the effects of proteolytic enzymes.

Considering that the production of functional products can be carried out using standard technical equipment for meat production, to solve these problems it is advisable to create specialized workshops and sites for the production of such products at existing enterprises.

Beef takes the first places in the protein content among all types of meat, and the fat content in it is less than in pork or lamb. It is recommended to use it in diets, during sports training, as well as during recovery from illness, when you can't eat fatty foods. The product is rich in magnesium, calcium, potassium, sodium, phosphorus, iron, aminoacids. There are many B-group vitamins: B₁, B₂, B₃, B₅, B₆, B₉, B₁₂, K, as well as elastin and collagen. 100 g of meat provide a daily need for vitamins B₁ by 30 - 40%, B₂ - by 8 - 10%, B₃ - by 3%.

Among the nutraceuticals of meat raw materials that give it functional properties include vitamins, minerals, polyunsaturated fatty acids, bioactive peptides, etc.

The macro- and microelements contained in meat (iron, zinc, selenium, etc.) along with vitamins are also indispensable nutritional factors.

Meat and meat products are the main source of iron for the human organism. The digestibility of iron from animal raw materials is 5-8 times higher than from vegetable products, which necessitates the consumption of meat products with anemia. Iron deficiency is still a widespread pathology that affects every fifth inhabitant of our planet. The activity of iron-containing enzymes decreases with iron deficiency. The cause of the disease is an insufficiently balanced diet [5].

3.2. Analysis of vegetable raw material

As a source of vegetable protein, it is of interest to use water hazelnuts, flax seeds, fenugreek seeds, pine nuts, chicory, and fenugreek berries.

The kernel of a water nut (chilim) (lat. *Trápa nátans*) contains a very small amount of fatty oil, which sometimes happens in it tenths of a percent.

Thus, in terms of fat content, water nuts are inferior even to the fruits of edible chestnut. However, the fruits of water walnuts are rich in carbohydrates and nitrogenous substances, which determine their high nutritional benefits.

From the organic substances that make up a water nut, carbohydrates (starch and sugar) are one of most important. Starch is represented by grains of various shapes. Sugars are contained in the form of monosaccharaides, mainly glucose and disaccharide - sucrose. Water nuts contain significant amounts of nitrogenous substances, flavonoids (strengthen the walls of blood vessels, stimulate the body's defenses, stop inflammatory processes, remove toxins from the liver), phenolic compounds (accelerate metabolic processes, have an antispasmodic effect), triterpenoids (prevent malignancy, increase hemoglobin production), tannins (prevent the development of dysbiosis, inhibit the activity of pathogenic microorganisms, increase blood coagulation) [6].

The content of the main substances that make up the water nut depends on a number of external factors and the degree of maturity of the fetus. The kernel of an immature water nut contains significantly less carbohydrates and nitrogenous substances than in the mature kernel. Iron, calcium, potassium, sodium, magnesium, phosphorus, etc. are among the minerals in the ash of water-fruit.

Flax seeds (lat. *Linum usitatissimum*) have a unique composition and contain many useful substances that are necessary for the normal development of the organism. The special composition of flax seed, namely the increased content of omega-3 fatty acids and lignans in it - natural hormones that block the action of bad estrogens that cause breast cancer, has long identified this nutritional supplement as necessary for the organism.

Flax seeds are enriched with selenium, which is often not enough for the inhabitants of large cities. Due to this, they are taken for the prevention of cancer.

Flax seeds contain calcium, phosphorus, potassium, sodium, magnesium, manganese, zinc, copper, iron, etc. Seeds are rich in vitamins B₁, B₂, B₃, B₆, B₉, which improve metabolism and promote the

formation of red blood cells, as well as vitamins A, C, E, beneficial effect on the condition of the skin, hair, etc [7].

Pine nuts (lat. *Pinus sibirica*) contain a rich complex of nutrients, including vitamins B₁-B₉, K, E, copper, manganese, phosphorus, iron, sodium, etc.

Vitamin E is one of the strongest antioxidants needed by the body to effectively fight cancer. It also strengthens the nervous, cardiovascular, reproductive systems and helps improve brain function. 200 grams of pine nuts make up the body's daily need for phyloquinone (vitamin K), which helps to normalize blood coagulation and stimulates the production of other vitamins in the body.

The body needs copper to maintain normal hemoglobin and to synthesize collagen, which affects the condition of joints and skin.

Manganese is necessary for the absorption of thiamine, which is involved in the formation of the bone structure, stabilizes the functions of the central nervous system and has an antioxidant effect. To strengthen and maintain the health of nails allows phosphorus, which in 100 grams of nuts contains 71% of the daily norm.

Fenugreek (lat. *Trigonélla foénium-graecum*) is an annual plant of the legume family. The use of fenugreek seeds is widespread in the national cuisines of the peoples of southern Europe and India. They also contain a lot of galactomannan ("fenugreek gum"), which is widely used in the food industry as a thickener, gelling agent and stabilizer.

The composition of the seeds includes a large amount of essential oil, which includes more than 50 different components, such as sesquiterpenes, n-alkanes, alkanols and lactoses.

Seeds are rich in macro-, microelements and vitamins such as iron, potassium, calcium, selenium, copper, zinc, manganese, magnesium, thiamine, folic acid, riboflavin, pyridoxine, niacin, as well as vitamins A and C. It also contains polysaccharides: saponins, hemicellulose, tannins, pectin, alkaloids, lysine and L-tryptophan, as well as steroid saponins (diosgenin).

Fenugreek contains a lot of soluble fiber, which improves heart performance, and the potassium content stabilizes and normalizes blood pressure. Fenugreek also restores the intestinal microflora, helps cleanse the intestines of helminthes.

4. Results and discussion of studies

According to the developed recipe, experimental development of an experimental sample was carried out. The meat undergoing blanching is cut into plates with a thickness of 8-12 mm. Blanching is carried out for 15 minutes at a temperature of 80-90 °C. After that, the meat raw materials are cooled to 8-10 °C, crushed on a spinning top with grill holes with a diameter of 2-3 mm, processed on a cutter or a cutter-mixer. Nuts and seeds are minced and added to the minced meat, along with the broth and linseed flour.

Prepared minced meat is placed in metal molds and baked for 3 hours in rotary or conveyor ovens or ovens. Roasting takes place at a temperature of 90-145 °C, the temperature is gradually increased from 90 °C in the first hour of roasting, to 120 °C in the second and 145 °C in the third. The roasting process is considered completed when the temperature in the thickness of the paste reaches 72 °C [8].

The introduction of fenugreek, flax flour, water and pine nuts in meat raw materials allowed increasing and diversifying the content of useful substances necessary for the organism in the finished product. It was experimentally established that the introduction of plant components in the formulation allowed to reduce the mass fraction of fat in the finished product and made it possible to enrich the product with dietary fiber, vegetable protein, vitamins A, C, E and such biologically significant elements as iron, calcium, potassium, sodium, magnesium, phosphorus, manganese, zinc, iodine, etc. Thus, the combination of raw materials of vegetable and animal origin allows a wide range to regulate the composition of nutrients and is an actual direction in the production of functional foods.

Physico-chemical characteristics of the finished product are presented in table (1).

Table 1. Physico-chemical characteristics of the finished product

Indicators	Sample
Mass fraction of protein, %	22.6 ± 0.2
Mass fraction of fat, %	16 ± 0.2
Moisture content, %	44.4 ± 0.2
Mass fraction of salt, %	2.5 ± 0.05
Mass fraction of sodium nitrite, %	0.004 ± 0.0001
Potassium, mg / 100 g	597.0
Calcium mg / 100 g	156.0
Magnesium, mg / 100 g	172.0
Sodium, mg / 100 g	65.0
Sulfur, mg / 100 g	230.0
Phosphorus, mg / 100 g	348.0
Chlorine, mg / 100 g	49.0
Iron, mg / 100 g	4.5
Iodine, mg / 100 g	7.0
Zinc, mg / 100 g	6.5

5. Conclusion

Improved recipes made it possible to obtain an original meat product enriched with vegetable ingredients such as fenugreek, flax flour, water and pine nuts. The product has excellent organoleptic characteristics and high quality properties, which will make it popular among consumers. In addition to the above advantages, it is also a functional food product due to its high content of vitamins, protein, dietary fiber and minerals.

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