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Development the technology of functional meat semi-finished product using plant additive

ANNOTATION

for the dissertation work of Berik Idyryshev for the degree of Doctor of Philosophy (PhD) in the specialty 6D072700 – "Technology of food products"

The dissertation work is devoted to the development of a recipe and technology for a low-calorie semi-finished meat product with high biological value that meets the requirements of functional products made from veal with the addition of cedar cake. The work for the first time determined the results of a study of the nutritional and biological value of a product from Siberian cedar growing in the Katon-Karagai region, and gave the possibility of using it as a functional ingredient in the production of a semi-finished product. As a result of the work, the recipe and technology of the new "Arshaty" cutlet were developed in a functional direction, and its nutritional quality indicators were shown.

The relevance of scientific work. President of the Republic of Kazakhstan Kassym-Jomart Tokayev, in his message to the people of Kazakhstan, said: "Our country's strategic goal is to become one of the leading agricultural centers on the Eurasian continent. This will only be possible with a gradual transition from primary production to higher value-added products. The aim is to increase the share of processed products in the agro-industrial complex to 70% within three years. Priority should be given to sectors that are promising for us: deep processing of meat, milk, and grain, and the development of industrial greenhouse farming" he said.

In accordance with the objectives of the State Health Development Program of the Republic of Kazakhstan for 2020-2025, it is necessary to carry out disease prevention and lead a healthy lifestyle.

One of the major foodborne diseases of the 21st century is overweight and obesity. According to WHO, 1.9 billion people in the world are overweight. It has been established that every third premature death in the world is associated with diseases caused by obesity and lack of physical activity.

To solve these problems, it is recommended to use wild plant materials as a source of important and beneficial nutrients.

In the eastern region of the country, a large area is occupied by the Siberian cedar forest. In this forest, Siberian cedar nuts grow, rich in useful biologically active substances. However, despite the large reserves of this vegetable raw material, the quality indicators of the pine nut growing in the country have not been studied and there is no production for its processing. Pine nut cake is a secondary raw material. However, cedar nut cake is a source of complete protein, easily digestible carbohydrates, vitamins and minerals. Therefore, the production of semi-finished meat products with high biological value and low-calorie functional orientation is an actual and promising direction.

The purpose of the dissertation work is to develop a recipe and technology for semi-finished meat products with the addition of pine nut cake that meets the requirements for functional products.

To achieve this goal, the following tasks were set:

1. Scientific substantiation of selected meat and vegetable raw materials for the development of a semi-finished product with high biological value and low calories;
2. Study of the chemical composition, biological and nutritional value of pine nut cake obtained as a result of cold pressing and thermal extraction of oil methods;
3. Development of prototypes of semi-finished meat products with the addition of pine nut cake and study of the influence of prototypes on structural-mechanical and functional-technological indicators;
4. Development of recipes and technology, research of the nutritional and biological value of semi-finished functional products;
5. Conducting histological studies of prototypes of chilled and frozen semi-finished functional products "Arshaty";
6. Study of shelf life and safety indicators of semi-finished product of the functional direction "Arshaty";
7. Calculation of economic efficiency and preparation of regulatory and technical documentation for semi-finished functional products, testing in the meat processing industry.

The objects of the study are pine nuts growing in the Katon-Karagay region, pine nut cake, minced meat with the addition of pine nut cake, and "Arshaty" cutlet with the addition of pine nut cake.

Research methods. Theoretical and experimental research work in accordance with the tasks was carried out at the Department of Food Production Technology and Biotechnology, at the Department of Technological Equipment and Mechanics, in the engineering laboratories of the Scientific Center for Radioecological Research and the Agrotechnopark Scientific Center at Shakarim University of Semey, in the research laboratory of the Kemerovo State University (RF), in the laboratory of the Faculty of Biotechnology and Food Engineering of the Ural State Agrarian University (Yekaterinburg, RF), in the testing laboratory of "Nutritest" LLP, located on the basis of the Kazakh Academy of Nutrition, in the Semey branch of RSE on REM "National Center of Expertise" of the Committee of Public Health for East Kazakhstan region. During the experiments, modern scientific methods and tools were used – equipment, methods of mathematical statistical processing of research results using the MathCAD program.

Scientific novelty of the work. For the first time, complex qualitative and quantitative indicators and physicochemical properties of pine nut grain and cake obtained from it, growing in the Katon-Karagay district, East Kazakhstan region, were studied. The possibility of using cedar nut cake as a functional ingredient in the production of semi-finished meat products has been revealed. Thanks to the combination of veal and chicken meat and pine nut cake, a functional meat

product with high nutritional and biological value, low in fat and saturated fatty acids was obtained. It is confirmed by the utility model patent No. 5165 "Composition for the preparation of meat and vegetable cutlets used in the functional direction".

The main provisions for defense:

- technology for obtaining and the possibility of using cake from pine nut seeds growing in our country as a secondary raw material;
- results of a comprehensive study of cedar cake;
- results of studies of nutritional quality indicators of functional semi-finished meat products with the addition of cedar cake.

The practical significance of the work. Pine cake was extracted from the seeds of the Siberian pine nut growing in the Katon-Karagay region by thermal extraction and cold pressing of oil, and the nutritional and biological value was determined. In order to produce a semi-finished product of a functional orientation, the addition of the optimal amount of 10% cedar cake has been scientifically substantiated. The technology and formulation of Arshaty cutlets with the addition of a functional ingredient of cedar cake has been developed.

The author's personal contribution is the implementation of experimental studies, analysis and scientific substantiation of research results.

Approbation of work. The main content and results of the research work are presented at the following international scientific and practical conferences: "Actual issues of applied biotechnology" (Moscow, RF, 2018); "Poultry processing: an integrated approach to ensuring food safety" (Moscow, RF, 2019); "The current state, prospects for the development and modernization of the agro-industrial complex of the Republic of Kazakhstan" (Semey, 2019); "Modern problems of equipment and technology of food production" (Barnaul, RF, 2019); "Innovative technologies for competitive and preventive products of live production" (Kemerovo, RF, 2019); SCIENCE, RESEARCH, DEVELOPMENT №17, (Belgrade, Serbia, 2019); "From inertia to development: scientific and innovative research of the agro-industrial complex" (Ekaterinburg, RF, 2020); "The state and prospects of industrial and innovative development of the agro-industrial complex of the Republic of Kazakhstan" (Semey, 2022).

Publications. According to the results of scientific work 12 works were published. Including: 3 articles in journals recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan, 2 articles in a journal with a non-zero impact factor included in the Web of Science and Scopus database, 2 articles in foreign periodicals, 4 articles in the materials of the international scientific and practical conference. Received 1 patent for a utility model of the Republic of Kazakhstan.

Structure and scope of work. The dissertation consists of an introduction, reviews of scientific and technical literature and patent searches, experimental research methods, discussion of research results, conclusion, 182 bibliographic sources and 26 tables, 26 figures and appendices.

Evaluation of the completeness of the solution of the tasks. The information obtained corresponds to the purpose of the dissertation work and allows us to assume that all tasks have been completed as follows:

1. Requirements for products of a functional orientation are determined, an analysis of the results of domestic and foreign scientific works is carried out. Compared to other types of meat, veal is a dietary meat that contains less cholesterol and saturated fatty acids, but contains more biologically active substances, vitamins, macro- and microelements, amino acids. Chicken meat is soft meat with a high protein content and a fat content of not more than 10%, which is an important component of dietary nutrition in the gastrointestinal tract, diabetes, and cardiovascular diseases. It was also found that chicken meat is the most affordable among other types of meat. Pine nuts contain a large amount of amino acids that are most lacking in the human body: methionine, lysine and tryptophan.

2. As a result of studying and comparing the chemical composition and nutritional indicators of pine nut cake obtained by two different methods, pine nut cake obtained by cold pressing was selected as a functional ingredient. The amount of essential amino acids in 100 g of protein in pine nut cake was 42.44 g. Also, pine nut cake contains 6.15 mg/g of B vitamins, 5.12 mg/g of vitamin E, P – 1665.0 mg/g, Mg – 568.0 mg/g, Ca – 32.2 mg/g, Fe – 13.76 mg./g, Zn – 9.66 mg/g, I – 0.58 mg/g.

3. The influence of pine nut cake on the chemical composition, structural-mechanical and functional-technological indicators of semi-finished meat products was studied. As pine nut cake is added to the semi-finished product, the amount of protein increases (from 17.21% to 18.57%), the amount of carbohydrates (from 3.48% to 7.69%), and the amount of ash (1, from 35% to 2.14%), on the contrary, the amount of fat (from 16.84% to 7.01%) decreased. The introduction of cedar cake in an amount of 10% into semi-finished meat products improves its chemical composition, structural-mechanical and functional-technological indicators.

4. On the basis of research work and mathematical modeling, a recipe and technology for cutlets of the Arshaty functional direction was developed. The main raw materials for cutlets "Arshaty": veal – 50%, chicken – 25%, cedar cake – 10%. It has been established that the Arshaty cutlet is close to the reference protein scale approved by WHO in terms of amino acid score. In accordance with the requirements of TR TU 022/2011, it has been established that the Arshaty cutlet is a functional meat product with a high protein content and a low content of saturated fatty acids, which is a source of vitamins and minerals. That is, 44% of the energy value of the new product is provided by protein. The mineral substances of groups E and B and Ca, Fe contained in the product satisfy more than 15% of the daily requirement of the body. Also, in 100 g of the product, the content of saturated fatty acids does not exceed 1.5 g.

5. As a result of histological studies, images were obtained, images of histological sections of samples of semi-finished meat products, chilled and frozen, with and without the addition of cedar cake, and an analysis of microstructures was carried out. As a result of the analysis, it was found that cedar cake added to the

Arshaty cutlets is evenly distributed throughout the meat and forms a compact mass. This is clearly shown on histological sections .

6. It has been established that the food safety indicators of Arshaty meatballs do not exceed the standards approved by the Customs Union Technical Regulation 034/2013 "On the safety of meat and meat products". Cutlet "Arshaty" is stored for 90 days at a temperature of -18 °C .

7. Compared to the control product, the Arshaty cutlet is rated as economically advantageous at 4580 tenge per 100 kg. Normative and technical documentation for products was developed and approved. Production approbation was carried out at the enterprise of the sausage shop "Dariya".