

ABSTRACT

The dissertation by Gulzhan Maksutovna Tokysheva on the topic "Improving the technology of herodietic sausage products with the use of vegetable raw materials" for the degree of Doctor of Philosophy PhD in the specialty 8D07201 - "Food Product Technology"

Relevance of the dissertation work. Currently, the world is experiencing progressive aging of the population. In 2000, the global population aged over 60 was estimated at around 600 million; according to WHO forecasts, by 2025, this number is expected to increase to 1.2 billion people, and by 2050, to an anticipated 2 billion people [1].

In the Republic of Kazakhstan, there is an observed increase in the proportion of elderly individuals within the country's population age structure, and in 2023, individuals aged over 60 years accounted for 13.2%, and those aged over 65 years comprised 8.2% of the total population [2]. According to the UN classification, a society in which the proportion of people aged over 65 years constitutes 7% or more of the total population is considered aging. Thus, it can be asserted that our country is at the initial stage of demographic aging. Between 2010 and 2022, the expected life expectancy in our country increased from 68.3 years to 74.44 years.

According to statistics, proper and rational nutrition increases life expectancy by 15-20%. Experts from ESPEN (European Society for Clinical Nutrition and Metabolism), in their scientific article on nutritional support for patients with SARS-COV-2 infection, confirm the relevance of herodietic food products, noting that the COVID-19 pandemic has created an unprecedented health threat and challenges for the global healthcare system. They concluded that patients with the worst outcomes and higher mortality have compromised immunity, often older individuals with polymorbidity and inadequate nutrition. In this context, experts believe it is necessary to conduct prevention and diagnosis of proper nutrition for people [3].

In light of the COVID-19 pandemic circumstances, considering the UN principles regarding the elderly (adopted by the General Assembly Resolution 46/91 on December 16, 1991) urging countries to provide older people access to food products meeting their needs, the Resolution of the Government of the Republic of Kazakhstan from April 6, 2011, No. 380 "On the Concept of a Healthy Lifestyle and Healthy Eating" and "The Concept of the State Health Development Program of the Republic of Kazakhstan for 2020-2025 in the Field of Healthy Eating" for the period up to 2025, the development of gerodietic products is crucial [4-6].

Significant contributions to the development of gerodietic nutrition principles were made by scientists such as N.S. Mashanova, A.K. Igenbayev, E.Zh. Zhaksybayeva, and other international researchers M.M. Arafah, M. Subathra, S. Shila, M.A. Devi, T. Ramesh, S.W. Kim, A.A. Korish, A.G. Khramtsov, S.B. Yudina, A.V. Ustinova, among others. Importantly, virtually all developed product

types are focused on nutritional balance, increased consumption of essential components, and the additional introduction of plant-based ingredients that beneficially affect the functions of the elderly.

Currently, in many countries, including Kazakhstan, the list and physiological daily norms of essential nutrients needed by the elderly for balanced healthy nutrition have been scientifically established, along with the main functional ingredients prioritized for gerodietic nutrition. For example, the FAO and WHO recommended daily protein intake norms for men aged 60-74 years are 85 grams, and for women, 78 grams [7].

However, the practice of elderly people consuming complete protein products enriched with the necessary biologically active substances diverges from physiological norms. There is a particularly felt shortage in the diet of specific amino acids, calcium, phosphorus, hyaluronic acid, vitamins that support the functions and regenerate the tissues of the musculoskeletal system. These functional substances are rich in secondary meat raw materials, as evidenced by the works of domestic scientists E.T. Tuleuov, B.K. Asenova, A.K. Kakimov, N.A. Kuderinova [8-10].

Secondary meat raw materials are a valuable source of natural biologically active substances of a gerodietic profile, thanks to the high content of connective-tissue proteins and mineral components (primarily calcium, phosphorus, and magnesium) in their composition [11].

However, the range of available gerodietic products on the market, especially those of domestic production, is quite limited. It is important that virtually all developed product types are aimed at incorporating plant-based ingredients, which beneficially affect the functions of the elderly. Increasing the production of domestic products aligns with the objectives of the state program for the development of the agro-industrial complex of the Republic of Kazakhstan for 2017-2021 [12].

The issues of preventing premature aging through the inclusion of plant-based components in the human diet were explored in the research of K.Zh. Amirhanov, B.K. Asenova, Baliga, M.S., Meera, S., P.G. Xiao, S.T. Xing, L.W. Wang, E. Ntchapda, A. Djedouboum, M.D. Kamal-Uddin, A.S. Juraimi. The main directions of these studies were the examination of antioxidant effects that prevent or inhibit lipid peroxidation, exploring methods to increase resistance to atherosclerotic changes, and supporting the repair and maintenance of the human musculoskeletal system. It has been proven that these processes are most effectively facilitated by the intake of vitamins, bioflavonoids, tannins, organic acids, and other biologically active substances from plant materials [13-16].

Given the information presented above, the development of gerodietic nutrition products through the use of biologically active components from underutilized secondary meat resources, combined with plant materials possessing geroprotective properties, appears both relevant and practical. This approach would allow for the expansion of the gerodietic product range, the creation of a new specialized group of functional items balanced in chemical composition and meeting the needs of the elderly organism. By incorporating plant materials, it

would also reduce the use of synthetic antioxidants and address the issue of waste-free, comprehensive processing of meat raw materials in meat processing industries.

The aim of the dissertation work is to improve the technology of herodietic sausage with the addition of vegetable raw materials and protein hydrolysate.

To achieve this goal, the following tasks were defined:

- determination of the purpose, tasks, and objects of the dissertation research based on conducting an analytical review of literary sources;
- justification of the use of plant raw materials for the production of gerodietic sausage products and investigation of their influence on sausage products;
- justification of the possibility of using protein hydrolysate in the production of gerodietic sausage and obtaining protein hydrolysate through enzymatic treatment;
- experimental research on improving the technology of gerodietic sausage products using plant raw materials and protein hydrolysate, and mathematical processing of results;
- testing of research results, calculation of economic justification, conducting industrial trials, development of regulatory documents, and obtaining a patent of the Republic of Kazakhstan.

Research objects: plant materials – purslane; wool-bearing by-products of the second category (beef, horse, and lamb legs with the hoof joint); protease enzyme preparation BLT 7; protein hydrolysate obtained through enzymatic hydrolysis; control and experimental samples of gerodietic sausage.

Research methods. In conducting the research, scientific concepts, principles, and integrative approaches to the development of food products with specified properties were applied, based on standard and specialized methods of collecting and analyzing information, and systematizing results. In conducting a comprehensive assessment of the quality of raw materials and finished products, generally accepted, standard, and special methods for researching organoleptic and physico-chemical indicators, indicators of nutritional value and safety were used.

Scientific novelty. The optimal specific amounts of enzyme preparations for obtaining protein hydrolysate from beef, horse, and sheep wool-bearing by-products were investigated, and effective hydrolysis regimes were determined. A recipe was developed, and the technology for producing gerodietic sausage products was improved through the use of plant raw materials with high antioxidant activity and dry protein hydrolysate obtained from wool-bearing by-products.

Practical significance of the work. Based on the analysis and synthesis of the obtained data, the recipe and technology for gerodietic sausage products using plant raw materials were substantiated and improved.

Technological regimes for obtaining protein hydrolysate through enzymatic hydrolysis were established. Technical documentation was developed and approved – the organization standard ST LLP 200240008529-001-2023

"Bayanaul" cooked sausage product of increased biological value.

The effectiveness of the developed technology was confirmed by its positive testing in the production conditions of LLP "MPK Rahmet". The economic feasibility of implementing the gerodietetic sausage product using plant raw materials into production was calculated.

The research results have been incorporated into the educational process for the training of bachelor's degrees in engineering and technology.

Author's personal contribution. The author was responsible for setting the necessary tasks, planning and implementing experiments, statistical processing of the results and their publication, industrial testing of the developed technology for producing gerodietetic sausage products using plant raw materials, and developing regulatory documentation.

Main positions to be defended:

- justification for the use of plant raw materials, specifically purslane (*Portulaca oleracea*), and protein hydrolysate from category II by-products in the technology of gerodietetic sausage products;
- technology for obtaining protein hydrolysate through enzymatic hydrolysis, possessing high biological value for enriching gerodietetic sausage products;
- technology and recipe for gerodietetic sausage products using plant raw materials and dry protein hydrolysate.

Approbation of the work. The technology for gerodietetic sausage products using plant raw materials and dry protein hydrolysate was tested at the production facilities of LLP "MPK Rahmet" as part of the project "Development of meat gerodietetic product technology, enriched with biologically active ingredients from secondary meat raw materials" under the program "Development of technologies using new strains of beneficial microorganisms, enzymes, nutrients, and other sets in the production of special dietary food products" (BR10764998) of the targeted program funding for scientific research by the Ministry of Agriculture of the Republic of Kazakhstan for the years 2021-2023.

The results of the dissertation research were presented at the international scientific-practical conference "Innovative development of the food, light industry and hospitality industry" (Almaty, October 21-22, 2021), and at the International Scientific-Practical Conference "Modern trends in the development of chemical technology and engineering in the food and light industry" (Almaty, February 23, 2023).

Research results. On the topic of the dissertation, 10 scientific works have been published, including 2 articles (percentiles 44% and 75%) in foreign journals with a non-zero impact factor included in the Scopus database, 3 articles in scientific publications recommended by the Committee for Quality Assurance in Science and Higher Education of the Ministry of Education and Science of the Republic of Kazakhstan, 4 articles in the proceedings of domestic international scientific conferences, 1 patent of the Republic of Kazakhstan for a utility model No. 8767 "Method of producing gerodietetic boiled sausage" and 1 recommendation for the production of new products at the S. Seifullin Kazakh

Agrotechnical University, 1 organizational standard ST LLP 200240008529-001-2023 "Bayanaul" cooked sausage product of increased biological value.

The research of the dissertation work led to the following conclusions:

1. An analytical review of literary sources was conducted, identifying the potential for using plant raw materials and protein hydrolysate for the production of new gerodietic sausage products, and setting the objects, goals, and tasks of the research.

2. The choice of plant raw materials with antioxidant properties for use in the recipes of gerodietic sausage was scientifically substantiated. It was established that purslane has high antioxidant activity: the ability to reduce iron ions by the FRAP method - 43.5 ± 1.0 mg GAE/g of dry matter, radical scavenging ability by the DPPH method - 83%, which, in turn, contributes to enhancing the geroprotective effect of the final product. The content of phenolic compounds in purslane was 16.88 mg GAE/g, flavonoids - 26.33 mg rutin/g, carotenoids - 4.33 mg/g. The influence of purslane on the physico-chemical properties of gerodietic sausage was studied. The increase in vitamin E concentration up to 0.72 mg / 100 g was noted.

3. The chemical composition analysis of wool-bearing by-products showed that the protein content in sheep legs with the hoof joint was 27.10-27.30%, in horse and beef at the same level 26.56-26.84%. The effectiveness of using the enzyme preparation BLT 7 in the amount of 1% based on the total mass for hydrolysis of proteins from beef, horse, and sheep legs with the hoof joint was determined and justified. Optimal regimes with a high degree of hydrolysis of 80.4-80.8% were selected: temperature - 45°C, pH – 7.5, time set at 24 hours. The protein content in the hydrolysate from horse legs with the hoof joint was 80.76%, in hydrolysates from sheep and beef - 85.60%.

4. Physico-chemical indicators of experimental samples manufactured with the addition of 1% purslane and protein hydrolysate of 3%, 5%, 7% were studied. Mineral composition research results showed that the calcium content in experimental samples with the addition of 3% and 5% protein hydrolysate increased by 2.4% and 4%, phosphorus by 1.4% and 4% respectively. Adding dry purslane powder to the experimental samples affected the amount of tocopherol, amounting to 0.48 ± 0.05 (Experiment 1) and 0.47 ± 0.03 mg/100 g (Experiment 2). Mathematical processing suggested an optimal content of plant raw materials and protein hydrolysate in gerodietic sausage at 1% and 7% respectively, but as a result of comprehensive research of the finished product, purslane - 1% and protein hydrolysate - 5% were chosen. According to the research on the amino acid score, the limiting essential amino acids contained in the finished product include leucine 85.7%, phenylalanine+tyrosine 89.4%, and valine 90.5%. The study of rheological properties showed that compared to the control, the shear stress and viscosity of the sausage farce, with the addition of protein hydrolysate in the amount of 3%, increased by 8.53% and 18.74% respectively, and in the amount of 5% - by 12.23% and 18.29% respectively. The research on functional-technological properties proved an increase in water-binding capacity - by 8.2%, fat-retaining capacity - by 5%, color stability - by 89.96%.

5. The economic efficiency assessment showed that improving the recipe and technology of new gerodietic sausage products increases the yield of finished products and reduces the cost of production by partially replacing meat raw materials, which allowed reducing the costs for the production of 1 ton of finished products by 5.28%. The technology of gerodietic sausage "Bayanaul" was tested in production conditions at LLP "MPK Rahmet", normative technical documents were developed and approved - the organizational standard LLP ST 200240008529-001-2023 "Bayanaul" cooked sausage product of high biological value. A patent of the Republic of Kazakhstan No. 8767 for the utility model "Method of producing gerodietic boiled sausage" was obtained.

The volume and structure of the dissertation. The dissertation is structured into sections such as the table of contents, introduction, literature review, research methods, research results, analysis of research results, conclusion, and supplementary materials. The work comprises a computer-generated text presented across 107 pages, including 42 tables and 25 figures. The bibliography consists of 185 literature sources.