

## **ABSTRACT**

thesis for the degree of Doctor of Philosophy (PhD) in specialty  
6D073500 – "Food Safety"

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### **"Technology development and quality assessment of chopped semi-finished horse meat using protein fortifiers"**

The concept of sustainable development of the agro-industrial complex (AIC) prioritizes a significant expansion of domestic food production and its safety. At the same time, quality and safety are the most important aspects of food industry products. Over the past few years, due to increased competition and higher consumer demands, the requirements for food safety of products have increased.

**The relevance of the topic of the dissertation** is due to the expediency of rational processing and maximum use of all types of protein-containing resources based on low-waste technologies. At the same time, the quality and safety of food raw materials are of the utmost importance to the food industry.

Due to the increase in cost and shortage of high-quality raw materials for domestic production, it is necessary to intensify scientific research on the integrated use of livestock and poultry slaughter products to create high-quality and safe products with the replacement of part of the raw materials with raw materials of a lower price segment.

One example of such raw materials is poultry by-products, namely chicken combs. Their involvement in the production process in the form of a protein concentrator in the formulation of chopped semi-finished products makes it possible to increase the degree of use of protein resources and will reduce the cost of the finished product. However, the use of chicken combs for food production in Kazakhstan has not been studied, so it is necessary to conduct a study of their biological properties.

The choice of horse meat as the main raw material is due to the dietary properties of meat and is of particular importance taking into account the national characteristics of the population of Kazakhstan as a whole.

The development and implementation of new technologies in the food industry can cause new risks associated with nutrition. In this regard, it is important to ensure the safety of food products with the identification of potential risks of contamination of the final product, guaranteeing a high level of product quality.

These circumstances made it expedient to conduct targeted research on the development and improvement of technology for the use of poultry offal for the production of meat semi-finished products.

**The goal of the study** is a comprehensive assessment of the safety of protein fortifiers from chicken combs for use in the production of meat semi-finished products from horse meat.

In accordance with the set goal, the following **tasks** were solved:

- to investigate the food safety of chicken combs and justify their use for the production of protein fortifier; to develop the technology and formulation of protein fortifier and to assess the safety of protein fortifier and a comparative assessment with horse meat;
- to develop the technology and formulation of protein fortifiers and a new meat semi-finished product using the method of qualimetric forecasting;
- to determine the CCP in the production of chopped semi-finished products using the HACCP system;
- to carry out a quality assessment, to investigate food safety and quality indicators of the developed chopped semi-finished horse meat using a protein fortifier;
- develop and approve regulatory and technical documentation for chopped semi-finished horse meat using protein fortifiers and conduct testing in production conditions.

**The object of the study:** chicken combs, a protein fortifier, chopped semi-finished products from horse meat using a protein fortifier.

**Research methods.** Experimental researches were conducted in the laboratories of the “Food production technology and Biotechnology” department, regional engineering laboratory of “Scientific Center for Radioecological Research” of the NJSC "Shakarim University of Semey", JSC "National Center for Expertise and Certification", LLP "Kazakh Research Institute of Processing and Food Industry” in Semey, in the laboratory of the Food Technology department of the Altai State Technical University named after Polzunov, Barnaul, Russia. The main part of the research and practical development was carried out in the laboratory of the "Scientific Research Institute of Food Safety" of the Almaty Technological University. The research results were processed by the methods of statistical analysis and mathematical modeling using the MS Excel, MathCAD software..

**Scientific novelty of the work.** A comprehensive assessment of the safety of chicken combs and the quality of chopped semi-finished products using the principles of HACCP was carried out.

The expediency of using a protein concentrator in the form of an emulsion of chicken combs for the production of chopped semi-finished horsemeat has been scientifically substantiated and experimentally confirmed.

The effect of protein fortifiers on the change in the structural and mechanical properties of minced meat and the finished product has been studied. The choice of the optimal mixing time of semi-finished products is investigated.

On the basis of mathematical modeling, the formulation of a new meat product has been scientifically substantiated in accordance with the principles of modern combinatorics and nutritionology.

The technology of chopped semi-finished horsemeat using a protein concentrator has been developed. An integrated management system for the safety and quality of meat products has been developed. A comprehensive assessment of

the safety and quality of the chopped semi-finished product was carried out using the principles of HACCP.

The scientific novelty is confirmed by two patents for a utility model of the Republic of Kazakhstan (No. 3374 of 12.11.2018 Method of obtaining protein-fat emulsion for minced meat pasty products, No. 3373 of 12.11.2018 Method of production of meat semi-finished products).

**The main provisions submitted for protection:**

- The possibility of using secondary raw materials of poultry processing (chicken combs) in the production of protein enrichment;
- Protein fortifiers production technology;
- Determination of control critical point in the manufacture of chopped semi-finished products;
- results of complex researches of protein fortifiers and chopped semi-finished product.

**Scientific and practical significance of the work.** The technology and formulation of protein fortifiers and chopped semi-finished horsemeat have been developed. Based on the conducted research, regulatory and technical documentation for a quality-safe chopped semi-finished product with the addition of a protein concentrator (standard) was approved.

**The author's personal contribution** includes theoretical and experimental research and processing of results, industrial testing and practical implementation of results

**Approbation of the work.** The results of the research and the materials of the dissertation work were presented and discussed at international scientific and practical conferences: The international scientific and practical conference "Problems of ensuring food security of Kazakhstan in the context of globalization", dedicated to the 60th anniversary of the Doctor of Technical Sciences, Professor Amirkhanov K.Zh. (September 15, 2017); the international scientific and practical conference "Actual problems of food production: state and prospects of development" dedicated to the 75th anniversary of a correspondent member of the Kazakh Academy of Agricultural Sciences, Doctor of Technical Sciences, Professor E.T. Tuleuov (Semey, 2017 - November 24); the international scientific and practical conference Quality of products, technologies and education: materials of the XIV International Scientific and Practical Conference (Magnitogorsk: Publishing House of State Technical University. G.I. Nosov University, 2019. – 273 p.); 7th International conference – Science and society – Methods and problems of practical application 15th February 2019 (Vancouver, Canada, 2019).

**Publications.** 14 scientific papers have been published on the topic of the dissertation, 5 of which are in journals included in the Scopus database with a non-zero impact factor, in 3 publications recommended by the Committee for Control in the Field of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, in 6 international scientific and practical conferences of the Republic of Kazakhstan, countries CIS and far abroad, including 1 article from far abroad; 2 articles in scientific publications of the Republic of Kazakhstan

and 3 articles in scientific publications of the CIS. 2 utility model patents have been obtained.

**The structure and scope of the dissertation.** The dissertation work consists of an introduction, 6 sections, and a conclusion. The list of sources used includes 159 titles. The work is presented on 161 pages of computer text, contains 48 tables, 19 figures, formulas, 4 appendices.

**Assessment of the completeness of solutions to the tasks.** The data obtained allow us to assume that the purpose of the dissertation work has been achieved and all the tasks set have been completed:

1. It has been technologically substantiated and proven that the use of chicken combs in PE to enrich chopped semi-finished products with proteins is nutritionally safe. The recipe and technology of protein fortifiers (comb - 75%, cottonseed oil - 15% and 10% of water) have been developed. A comparative assessment of the chemical composition of PE and horse meat has been carried out, where it was shown that protein content (18.8%) of PE is not inferior to horse meat

2. The technology and recipe for chopped semi-finished horse meat with a protein enrichment agent has been developed. It has been established that using the qualimetric forecasting method, the optimum dose of protein fortifiers is 20% of the mass of raw material.

3. This paper established critical control points for the production of chopped semi-finished products in accordance with the requirements of GOST R ISO 22000-2019: 1 - acceptance criteria for raw meat, 2 - acceptance criteria for auxiliary raw materials, 3 - freezing. All risks were calculated, critical limits of the monitoring system and corrective actions were defined. This allowed to reduce and eliminate the hazardous factor to an acceptable level.

4. The chemical composition of chopped semi-finished product: protein - 19.45%; fat - 14.85; moisture - 64.15%. The ratio of tryptophan : oxiprolin for semi-finished product is  $166,88/80 = 2,04$ ; higher tryptophan and lower oxiprolin signifies the higher nutritional value of a meat product. The mineral composition in the developed semi-finished product for Ca : P : Mg is 1 : 2 : 0,57, which corresponds to the requirements of a balanced diet. The estimated storage time of a newly developed minced semi-finished meat product is as follows: at  $t = -18 \pm 2^\circ\text{C}$  - 30 days (for frozen semi-finished product).

5. Production standard has been developed and approved (3992 1917 27 002-2019, TI RGP on PVC 3992 1917 27 002-2019). The technology of production of new chopped semi-finished product has been tested in real-life conditions on the basis of sausage factory "Darija", Semey city (Abay). The act of approbation for chopped semi-finished product from horse meat with the use of protein fortifiers agent was approved, the developed technology is recommended for implementation.