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Quality assurance and food safety in the production of brine cheese with
vegetable additives

ANNOTATION

for the dissertation of Imankulova Galiya
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(PhD) in the specialty 6D073500 – «Food safety»

The relevance of the work. In his 2025 Address to the People of Kazakhstan, President K. K. Tokayev emphasized the importance of developing the agro-industrial complex to ensure the production of safe and high-quality products for both domestic and foreign markets. He highlighted the need to increase the deep processing of agricultural raw materials, including meat, milk, and grain, and noted that «maximally reducing the country's dependence on food imports is a strategic task of the government. In addition, it is necessary to actively promote our traditional national products to foreign markets».

The new draft law «On Food Safety», adopted by the Mazhilis on January 23, 2025, is aimed at improving national legislation, systematizing regulatory requirements, and strengthening control and supervision mechanisms, which in turn will ensure the population's access to high-quality and safe food products.

The Government of Kazakhstan aims to achieve full self-sufficiency in basic food products by 2028, which is an important strategic measure aimed at reducing dependence on imports.

In accordance with this, the dissertation work was carried out based on these strategic directions and principles of state policy in order to develop the agro-industrial complex and ensure the population's access to safe and high-quality dairy products.

The purpose of the dissertation work ensuring the quality and safety of the production of brine cheese enriched with plant additives using the Hazard Analysis and Critical Control Points (HACCP) system program.

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

1. Determination of the quality and food safety of milk and plant raw materials used in the production of brine cheese with plant additives, selection of optimal temperature regimes for drying vegetable raw materials, and evaluation of their antioxidant properties.

2. Scientific justification of the optimal dosage of plant additives for brine cheese in order to ensure the quality and safety of the product.

3. Development of the formulation and technological scheme of brine cheese based on the use of plant additives, as well as determination of technological parameters aimed at maintaining quality and safety during the production process.

4. Evaluation of the nutritional and sanitary-hygienic safety of brine cheese, as well as its economic efficiency, through the study of physicochemical, microbiological, organoleptic, and biological indicators.

5. Identification of critical control points (CCPs) in the product manufacturing

technology, development of a monitoring system in accordance with the principles of HACCP standards, determination of corrective actions, and preparation of regulatory and technical documentation to improve the quality and safety of brine cheese based on production testing.

Objects of research:

- Raw cow's milk procured in accordance with GOST 31449-2013, obtained from milk with an acidity not exceeding 190°T and a density of not less than 1030 kg/dm³;
- White cabbage (*Brassica oleracea*) of the «Podarok» variety, belonging to the Cruciferae family, in accordance with GOST 33494-2015 «White cabbage for industrial processing»;
- Cilantro (Latin *Coriandrum sativum*), an annual herbaceous plant of the genus *Coriandrum*, family Apiaceae, variety «Prelest», in accordance with GOST 32788-2014 «Fresh coriander (cilantro) greens»;
- Brine cheese.

Research methods.

Theoretical and experimental studies were conducted comprehensively in accordance with the defined scientific objectives. Experimental research involved physicochemical, organoleptic, microbiological, biochemical, rheological, and biotechnological methods, as well as statistical and mathematical modeling.

The quality and safety indicators of milk and the final product were determined according to GOST and ST RK standards. Physicochemical analyses included the determination of fat, protein, moisture, acidity, and density. Microbiological tests assessed sanitary and hygienic safety and microbial composition, while organoleptic evaluation covered taste, smell, texture, and appearance.

Biochemical methods were used to determine the amino acid and fatty acid composition of cheese, and the antioxidant activity of plant additives was measured using DPPH, ABTS, and β -carotene/linoleic acid assays. Rheological properties and structural-mechanical stability were determined by shear strength using the ST-2 device, and water activity (a_w) was measured with a specialized instrument.

The obtained data were processed using Excel and TableCurve 3D software, and the optimal dosage of plant additives was determined through mathematical modeling.

The scientific novelty of the work. For the first time, a production technology for brine cheese with the addition of cabbage and cilantro has been developed, and approaches to improving its nutritional value and safety have been substantiated. The study determined the effect of plant additives on the microbiological, physicochemical, and organoleptic characteristics of the cheese, as well as its antioxidant activity.

To ensure product quality and safety, measures were developed based on the principles of the HACCP system, including hazard analysis and the identification of critical control points. The research results make it possible to optimize the formulation and production technology of the product while ensuring high quality

and safety.

The author's personal contribution development of a formulation for brine cheese with plant additives and creation of a technological scheme; study of the quality and food safety of milk and plant raw materials; determination of optimal drying conditions for vegetable raw materials; analysis of physicochemical, microbiological, organoleptic, and biological parameters of the product; identification of critical control points aimed at ensuring product quality and safety; implementation of monitoring in accordance with the HACCP system; as well as participation in the development of economic efficiency and regulatory-technical documentation.

The main provisions submitted for defense:

1. Justification of the quality and safety of raw milk: confirmation of the compliance of raw milk used for the production of brine cheese with plant components with international quality and safety standards.
2. Study of the food safety of vegetable crops: analysis of food safety indicators of vegetables used as components to ensure the safety of the final product.
3. Optimization of the vegetable drying process: selection of optimal temperature regimes for vegetable drying and determination of their antioxidant properties to improve product quality.
4. Identification and monitoring of CCPs: identification of critical control points in the production process, establishment of critical limits, and development of a monitoring system to ensure continuous quality control.
5. Development of measures and recommendations: creation of guidelines to enhance product safety and quality in accordance with HACCP standards, development of regulatory and technical documentation, and testing of the technology at a dairy processing enterprise.

These provisions reflect a comprehensive approach to ensuring the quality and safety of brine cheese enriched with plant components and demonstrate the importance of applying international standards and control systems at all stages of production.

The practical value of the work.

The practical significance of the work is as follows:

- Based on the obtained data, regulatory and technical documentation for the brine cheese «Ertis» was approved, ensuring the standardization of this product's production;
- Successful industrial testing of the developed technology was carried out at the «Aysha» dairy plant in Semey, confirming the feasibility of implementing new methods and approaches in brine cheese production at other enterprises;
- The measures aimed at improving product safety and quality can be applied at other dairy processing enterprises to enhance production efficiency and competitiveness.

Approbation of the work. The results of the dissertation research were presented and discussed at conferences and forums of various levels, including international scientific and practical conferences:

- International Scientific and Practical Conference «Current Problems of

Food Production: State and Development Prospects», dedicated to the 75th anniversary of Corresponding Member of KazNAAS, Doctor of Technical Sciences, Professor E. T. Tuleuov (Semey, 2017);

– II Interregional Scientific and Practical Conference «From Bioproducts to Bioeconomy» (Barnaul, April 12–13, 2018);

– XV International Scientific and Practical Conference «Food, Ecology, Quality» (Krasnoobsk, June 27–29, 2018);

– VII International Scientific and Practical Conference «International Trends in Science and Technology» (Warsaw, Poland, November 2018) and XIII International Scientific and Practical Conference “Science, Research, Development” (Berlin, January 2019);

– XX International Scientific and Practical Conference «Modern Problems of Engineering and Technology in Food Production» (Barnaul, AltSTU, March 14, 2019).

– Publication of an article in Potravinarstvo Slovak Journal of Food Sciences titled «The Study of Nutritional Value and Microbiological Characteristics of Brine Cheese with Vegetable Additive» (Slovakia, February 2023).

Publications. The results of the dissertation research are reflected in 13 scientific publications, including: 3 articles in journals recommended by the Committee for Control in the Sphere of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan; 2 articles indexed in the Scopus database with a non-zero impact factor (44th percentile); 6 papers presented at international scientific and practical conferences, including 2 articles from foreign countries; 2 articles in other scientific publications of Kazakhstan and abroad; and 1 utility model patent of the Republic of Kazakhstan, No. 2019/0413.2, dated April 30, 2019.

The volume and structure of the dissertation. The dissertation consists of an introduction, main body, conclusion, list of references, and appendices. The main text is presented on 176 pages and includes 44 tables and 22 figures.

Assessment of the completeness of the solution of the tasks.

The obtained data correspond to the aim of the dissertation and allow us to conclude that all the set objectives have been successfully achieved:

1. It was determined that the qualitative and microbiological indicators of «Steklyanka» cow milk supplied to the «Aisha» dairy plant fully comply with safety requirements (fat – 3.21%, protein – 3.88%, total mesophilic aerobic and facultative anaerobic microorganisms – 3.0×10^4 CFU/cm³, somatic cell count – 271 thousand/cm³). The nitrate content in cabbage and coriander did not exceed the established maximum permissible levels and was at a safe level for consumption (cabbage – 75–304 mg/kg, coriander – 60–258 mg/kg). However, a special treatment method was proposed to reduce the highest nitrate content in cabbage.

2. Optimal drying regimes for plant raw materials were determined (for cabbage: 55–70 °C, 3–6 hours; for coriander: 40–50 °C, 2–3 hours), under which moisture content decreased to 8–10%. It was proven that the antioxidant activity of the dried additives remains at a high level (cabbage – 99.1%, coriander – 72.5%).

These results were accepted as a scientific basis for ensuring the nutritional value and safety of the plant additives.

3. Based on the results of mathematical modeling, the optimal dosage of plant additives (cabbage and coriander) was determined to be 10%. This solution is scientifically justified by a comprehensive assessment of structural-mechanical, physicochemical, and organoleptic indicators. The addition of 10% plant components allowed for the preservation of uniform consistency, density, and plastic properties of the cheese, as well as improvement of its taste and aromatic characteristics. In addition, this dosage was recognized as optimal for ensuring microbiological stability of the product and enhancing food safety and quality.

4. A technology for producing “Ertis” brine cheese with 10% plant additives was developed, and its nutritional and sanitary-hygienic characteristics were studied. It was determined that the product is preserved at a temperature of 0–2 °C and $a_w = 0.814–0.917$ for up to 45 days. The cost of production amounted to 3,642 tenge, confirming the economic efficiency of the technology. Based on the research results, the developed technology for producing brine cheese with plant additives is confirmed by the utility model patent № 4420 «Method for producing brine cheese» (April 30, 2019) of the Republic of Kazakhstan. This patent confirms the scientific novelty of the developed technology, its industrial applicability, and practical significance.

5. Four critical control points were identified in the production process (milk reception, pasteurization, addition of plant additives, storage). In accordance with the principles of the HACCP standard, control and corrective measures were developed, and recommendations were given to improve product quality and safety. The technology was tested at the «Aisha» dairy plant, confirming its suitability and effectiveness for industrial application.