

## ANNOTATION

on the dissertation work of Abilova Meruyert Baurzhanovna  
on the topic: **"Development of technology for the production of confectioner products from gluten-free raw materials grown in Kazakhstan"**,  
submitted for the degree of Doctor of Philosophy (PhD)  
in the educational program 8D07201 – " Food Science "  
(6D072800 – Technology of Processing Industries)

**1. Relevance of the Study.** Providing the population with high-quality and safe food products is one of the most important tasks of the Republic of Kazakhstan's state policy in the field of healthcare and food security. In today's conditions, the development of functional and specialized food products aimed at preventing nutrition-related diseases, improving the quality of life for the population, and making rational use of domestic agricultural raw materials is of particular importance.

According to the Concept for the Development of the Agro-Industrial Complex of the Republic of Kazakhstan for 2021-2030, one of the priority areas is the development of deep processing of agricultural raw materials and the increase in the production of high-value-added products. The Address of the President of the Republic of Kazakhstan, Kassym-Jomart Tokayev, to the People of Kazakhstan emphasizes the need to improve the efficiency of the agro-industrial complex, expand the production of domestic food products, and reduce the dependence of the domestic market on imported products. These provisions determine the relevance of research aimed at creating new types of food products based on domestic raw materials.

At the same time, the National Project "High-Quality and Accessible Healthcare for Every Citizen - A Healthy Nation" prioritizes the formation of a healthy diet culture and the prevention of chronic non-communicable diseases. One of the most significant nutrition-related pathologies is celiac disease, a chronic autoimmune disorder associated with gluten intolerance. The only effective treatment for celiac disease is lifelong adherence to a gluten-free diet, which necessitates the expansion of the range of specialized gluten-free food products.

According to the Ministry of Health of the Republic of Kazakhstan, the number of patients with celiac disease is on the rise, with a significant number of children affected. However, the domestic market for gluten-free products is largely dominated by imported products, which are 5-10 times more expensive than traditional flour products. The limited availability and high cost of imported products necessitate the development of domestic technologies for the production of gluten-free products based on the use of local raw materials.

Kazakhstan has significant potential for the production of gluten-free products due to its wide range of cultivated grains, legumes, and oilseeds. Chickpeas, which are rich in protein, minerals, dietary fiber, and lack gluten, are of particular interest. Chickpea flour can be considered a promising raw material for the production of high-nutrient flour confectionery products. However, the use of legume raw

materials requires the development of technological approaches that improve their functional and technological properties.

One of the most promising methods of grain processing is ultra-high-frequency processing, which reduces grain moisture, increases its ability to be ground, partially modifies the protein-carbohydrate complex, and improves the technological properties of the resulting flour. However, the scientific literature lacks information on the specific effects of ultra-high-frequency processing on the technological properties of Miras 07 chickpeas grown in Kazakhstan, as well as its potential use in the production of gluten-free flour confectionery products.

**2. Objects of the Study.** The objects of research are gluten-free flour confectionery products and the Miras 07 variety of chickpeas, which was sectioned in the laboratory of the Kazakh Research Institute of Agriculture and Horticulture.

**3. Aim of the Study.** Scientific substantiation and development of technology for the production of gluten-free flour confectionery products of increased nutritional value based on flour from Miras 07 chickpea seeds grown in Kazakhstan. To achieve this goal, the following tasks were set:

- to analyze the gluten-free plant raw materials grown in Kazakhstan and justify the choice of Miras 07 chickpea as a promising raw material for the production of flour confectionery products;
- to study the chemical composition and technological properties of Miras 07 chickpea grain as a raw material for the production of gluten-free flour products;
- to study the effect of ultra-high-frequency treatment on the physical, chemical, and technological properties of chickpea grain;
- to develop a technology for producing chickpea flour from ultra-high-frequency-treated grain and to study its functional and technological properties;
- to develop regulatory and technical documentation for gluten-free flour confectionery products;
- to optimize the recipe composition of gluten-free flour confectionery products based on chickpea flour using mathematical modeling methods;
- to study the nutritional, biological value, and quality indicators of the developed gluten-free flour confectionery products;
- to develop a technology for producing new gluten-free flour confectionery products and conduct its experimental and industrial testing.

**4. Methods and Methodologies.** The research used a range of standard and modern research methods, including physical and chemical, biochemical, microbiological, and rheological methods, as well as mathematical methods for statistical processing of research results and building a mathematical model.

#### **5. Scientific Novelty of the Study:**

For the first time in the Republic of Kazakhstan, a comprehensive study of the technological and biochemical properties of Miras 07 chickpea grain as a raw material for the production of gluten-free flour confectionery products has been conducted.

- the effect of ultrahigh-frequency processing on the structural and functional characteristics of chickpeas has been revealed: with an optimal processing time of

180 seconds, the moisture content of raw materials is reduced by up to 4 times while maintaining the amino acid composition and minimal protein denaturation;

- It has been proven that the use of microwave processing leads to an increase in the water absorption capacity of chickpea flour by an average of 1.4 times, which improves the structural and mechanical properties of the dough and improves the quality of finished products.;

- it has been found that microwave treatment reduces the microbiological contamination of raw materials to a level of about 10<sup>3</sup> CFU/g, which increases shelf life without the use of additional preservative methods;

- recipes and technologies of gluten-free confectionery products (profiteroles "Ayzero", mini-cupcakes "Ai-Jean") have been developed, optimized using mathematical modeling methods ( $R^2$  up to 0.84), ensuring product quality improvement.

**6. Field of Application.** The results of the work are focused on use in the food industry in the production of gluten-free flour confectionery products based on domestic vegetable raw materials. The developed technological solutions can be applied at confectionery and bakery enterprises, as well as in the segment of functional and specialized nutrition for consumers suffering from celiac disease and gluten intolerance.

**7. Practical Significance of the Study.** The practical significance of the work lies in the development of technology for the production of chickpea flour using microwave processing and the creation of gluten-free flour confectionery products with increased nutritional value based on it.

The technologies and formulations developed within the framework of the dissertation have been pilot tested on the basis of the KUN BELLE Joint-Stock company.

The scientific and technical solutions presented in the dissertation work are confirmed by the patents for utility model No. 5031 "Composition of biscuit semi-finished product" and No. 6844 "Method of preparation of dietary custard semi-finished product".

**8. Author's Contribution.** The research includes theoretical substantiation and definition of tasks in accordance with the purpose, conducting experimental studies and selecting appropriate methods, selecting, analyzing and scientifically substantiating the type of raw materials for the production technology of gluten-free flour confectionery, developing and baking gluten-free profiteroles and mini-cupcakes, interpreting and processing the data obtained, preparing scientific articles, conducting production tests and development of regulatory documentation.

**9. Approbation of the Study.** All experimental data has been confirmed in accredited laboratories, and the developed technologies have been tested in production conditions. Based on the research results, articles were published and reports were presented at a number of international conferences, including: at the international scientific and practical conference "Current state, prospects for the development of agriculture and the production of specialized food products" (Omsk, Omsk State Agrarian University, 2020), at the international scientific and practical conference "Innovative development of food, light industry and the hospitality

industry", dedicated to the 30th anniversary of the Republic of Kazakhstan (Almaty, ATA, 2021), the international scientific and practical conference "Innovative development of the food industry, light industry and the hospitality industry", dedicated to the 65th anniversary of the Almaty Technological University (Almaty, Ata, 2022).

**10. Publications.** 9 scientific papers have been published on the topic of the dissertation, including: 2 articles in journals included in the SCOPUS database, with percentiles 42 and 45; 4 articles in publications 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; 3 scientific articles in materials International Scientific and Practical Conference.

**11. Scope and Structure of the Dissertation.** The dissertation contains regulatory references, definitions, designations and abbreviations, an introduction, a literature review, research materials and methods, research results and their discussions, conclusions, and a list of references.

The overall work is presented on 158 pages, with 28 tables, 42 figures, and 10 appendices.

## **12. Conclusions of the Dissertation.**

As a result of the theoretical and experimental studies aimed at scientific substantiation and development of the technology of gluten-free flour confectionery products based on chickpea flour from the Miras-07 variety, the following main scientific and practical results were obtained.

1. A comparative analysis of gluten-free plant raw materials grown in the Republic of Kazakhstan (rice, buckwheat, corn, flax, peas, beans, lentils, and chickpeas) was conducted. It was found that chickpea grain has a more balanced chemical composition and high nutritional value. The protein content ranges from 20.1% to 20.47%, the fat content ranges from 5.0% to 5.3%, the starch content ranges from 43.2% to 46.0%, the fiber content is approximately 3.7%, and the energy value reaches 328.6 kcal/100 g. In terms of mineral composition, chickpeas have a higher content of potassium (up to 968 mg/100 g) and calcium (up to 193 mg/100 g). Based on these findings, the use of Miras-07 chickpeas as a raw material for the production of gluten-free flour confectionery products is promising.

2. The chemical composition and technological properties of Miras-07 chickpea grain were studied. It was found that the protein fraction of the grain is predominantly composed of globulins and albumins and has a high content of essential amino acids, including lysine, isoleucine, threonine, and phenylalanine, which contributes to the high biological value of the raw material. The grain had a moisture content of 11.5%, which meets the requirements of regulatory documentation, and no pest infestation was detected, confirming the suitability of the raw material for industrial processing.

3. The effect of ultra-high-frequency treatment on the physical, chemical, and technological properties of chickpea grain was investigated. The optimal treatment mode was determined to be exposure to microwave radiation for 180 seconds, which resulted in partial denaturation of protein structures and starch decrystallization. As a result of the treatment, the grain's moisture content decreased to 3.45% to 3.56%,

which facilitated the grinding process and contributed to the production of flour with more stable functional and technological properties.

4. A technology for producing chickpea flour from microwave-treated grain was developed. It has been established that the use of microwave processing improves the functional and technological properties of flour, including increasing its water-absorbing capacity and improving the structure-forming properties of dough systems. The resulting chickpea flour has a uniform granulometric composition, high flowability, and is suitable for the production of gluten-free flour products.

5. The formulation of gluten-free flour confectionery products based on chickpea flour was optimized using experimental design and mathematical modeling. As a result, optimal formulations were determined for the production of gluten-free custard-based products, such as "Aizere" profiteroles and "Ai-Jean" mini-cakes, which ensure stable organoleptic and technological characteristics of the products.

6. The nutritional and biological value of the developed products was investigated. It was found that the use of chickpea flour increases the protein content in the finished products by 15-25% compared to traditional wheat flour-based flour confectionery products, as well as increases the content of minerals and dietary fiber. The developed products meet the requirements for gluten-free products (gluten content of less than 20 mg/kg).

7. Technological schemes for the production of new types of gluten-free flour confectionery products based on chickpea flour were developed. The technologies include the main stages of raw material preparation, dough preparation, shaping, and baking, which ensure the production of products with a uniform porous structure, stable shape, and high organoleptic characteristics.

8. The developed technology was tested in a pilot-scale production facility at the KUN BEL agricultural enterprise, which confirmed its technological efficiency and practical feasibility. The economic assessment showed that the implementation of the developed technologies reduces the cost of producing gluten-free products by 27% due to the use of domestic raw materials and the optimization of technological processes.

The results of the conducted research confirm the scientific validity of using the Miras-07 chickpea variety and the directed modification of its properties through microwave processing to obtain chickpea flour with improved functional and technological characteristics. The developed technologies expand the range of gluten-free flour confectionery products with enhanced nutritional value and can be recommended for implementation in food industry enterprises.