ANNOTATION

to the PhD dissertation of Nurzat Urgazievna Konkubaeva for the degree of Doctor of Philosophy (PhD) in the field of 741000 – Food Product Technology on the topic "Development of Technology and Recipes for Fortified Breakfast Cereals Based on Puffed Wheat Grains"

1. The dissertation was carried out at the Department of Food Science and Technology of the Kyrgyz State Technical University named after I. Razzakov.

2. The topic and the scientific supervisor were approved by the Academic Council of the Kyrgyz State Technical University named after I. Razzakov (November 24, 2021, protocol №3).

3. Scientific Supervisors:

Asylbek Kulmyrzaev, Doctor of Technical Sciences, Professor of the Kyrgyz-Turkish Manas University (Kyrgyz Republic);

Ruta Galoburda, Doctor of Engineering Sciences, Professor at the Food Institute, Faculty of Agriculture and Food Technology, Latvia University of Life Sciences and Technologies (Latvia).

4. Relevance of the Research Topic: Micronutrient deficiency often leads to metabolic disorders, decreased work capacity, and rapid fatigue, which is a serious public health problem, especially in developing countries. This can result in various diseases, including infectious and chronic ones, and negatively impact the quality of life. Food fortification is considered one of the most effective ways to prevent micronutrient deficiencies. Currently, the food industry is very interested in introducing new products that can improve health and overall well-being. Ready-to-eat breakfast cereals are becoming increasingly popular among consumers due to their convenience, transportation and storage stability, and consumer appeal factors such as cost, attractive appearance, and texture. Among such food products, puffed grains ready for consumption can be an excellent choice for developing new breakfast cereals. In the context of the green economy, there is an urgent need to use by-products of the food industry as valuable ingredients for food. For example, fruit and vegetable pomace, brewers' spent grain, cereal bran, and whey can become excellent sources of nutritious and environmentally friendly ingredients. Using whey in the production of new food products not only contributes to the creation of beneficial products but also reduces the negative impact on the environment, as in many countries, a large proportion of whey is discarded untreated into the soil or water bodies. Whey is widely used as an ingredient in the production of beverages, sauces, chips, bread, pasta, cakes, soufflés, and other products. Thus, research in the field of developing fortified breakfast cereals using whey is relevant. This will allow the creation of products based on waste-free technology, contributing to improving

the population's nutrition, in line with the requirements of the Kyrgyz Republic's Food Security and Nutrition Program for 2019-2023 and the WHO Global Action Plan for Noncommunicable Diseases (NCDs) to reduce premature mortality from NCDs by 25% by 2025 by providing key nutritional recommendations.

5. **Research Objective:** development of technology and recipes for ready-to-eat fortified breakfast cereals made from puffed wheat grains.

6. **Research Tasks:**

- to study and analyse scientific, technical, and patent literature on the research topic;
- to study the effect of technological processes for obtaining puffed grains on the physicochemical properties and safety indicators of wheat;
- to optimize the recipe for breakfast cereals based on puffed wheat grains by introducing vanillin and dry whey into their composition;
- to develop a technology for new types of breakfast cereals;
- to determine quality indicators of target products and the content of some biologically active substances in them;
- to study the effect of added ingredients on the textural, physicochemical properties, safety indicators of finished products, and shelf life;
- to develop and approve regulatory and technical documentation, industrial testing of the production technology of the proposed products, industrial production of new types of breakfast cereals.

7. **Scientific Novelty of the Research:**

- justification and experimental confirmation of the feasibility of using whey powder to enrich puffed wheat grains;
- identification of the impact of technological processes for obtaining puffed grains (husking, moistening, thermal processing "puffing") on the physicochemical, textural, properties, and safety indicators of wheat;
- development of a mathematical model for optimizing the content of biologically active substances in the recipe for breakfast cereals based on puffed wheat;
- experimental confirmation of the increased content of B vitamins, amino acids, and minerals due to the addition of whey powder to the recipe for puffed wheat. It has been proven that the addition of dry whey provides the daily requirement of pyridoxine by 515%, thiamine by 442%, riboflavin by 438%, potassium by 6%, calcium by 14%, magnesium by 20%, iron by 15%, manganese by 50%, and zinc by 66% when consuming 100 g of the product;
- identification of the impact of added food ingredients (sugar, vegetable oil, vanillin, whey powder) on the physicochemical and textural, properties, as well as on the safety indicators of the finished products;

- study of the effect of storage conditions on the physicochemical, textural, and sensory attributes of finished products, which allowed determining their shelf life.

8. Practical Significance

Developed a technology for the production of puffed wheat with vanillin and puffed wheat with whey.

Developed and approved a technical document for breakfast cereals - puffed wheat with vanillin and puffed wheat with whey TU 10.61.33-001-24446338-2022.

Obtained patent KR for invention № 1469 "Badyrak Vanilla" (2012).

Conducted industrial testing of puffed wheat with vanillin and puffed wheat with whey technologies at the Kyrgyz Republic's enterprise LLC "Makyi-Dan." After that, the serial production was launched, and the sale of puffed wheat with vanillin under the name "Badyrak Vanilla" was organized.

The results of the study of the composition of puffed wheat grains and puffed wheat with additives are recommended to be included in the relevant reference books on the chemical composition of food raw materials and finished products.

Analytical and experimental research data were used in the development of lecture courses and methodological manuals for practical work on the discipline "Technology of Preservation and Food Concentrates" for students of food-related universities.

9. Main Provisions for Defense

- Research results on changes in textural, properties, physicochemical indicators, and safety indicators during the production of puffed wheat.
- Scientific justification for the use of whey powder and vanillin to increase the nutritional value and improve the organoleptic properties of puffed wheat.
- Research results on determining changes in textural, properties, organoleptic, and physicochemical indicators when using added ingredients and during storage.
- Industrial testing of the developed products under industrial production conditions showed the feasibility of producing the developed products on an industrial scale, which is confirmed by acts.

10. Research Results Approval: The main provisions and research results were presented at 8 scientific publications, the 2 following publications were indexed in SCOPUS: N. Konkubaeva, K. Juhnevica-Radenkova, V. Radenkovs, R. Galoburda, Effect of Coating on Physico-Chemical Characteristics of Puffed Wheat Grains, Rural Sustainability Research. – 2023. – Vol. 49. – № 344. – P. 19-26; N. Konkubaeva, A. Kulmyrzaev, A. Deydiev, V. Radenkovs, R. Galoburda, Effect of Storage Period on Acid Value and Sensory Attributes of Puffed Wheat

Grains «Badyrak Vanilla» and «Badyrak with Whey», Rural Sustainability Research. – 2023. – Vol. 49. – № 344. – P. 40-47.

Reports with the research results were also presented at: Scientific-practical conference: "Innovative Technologies in the Field of Nutrition, Service, and Trade" (Russia, Yekaterinburg, 2014); The 16th Baltic Conference on Food Science and Technology FOODBALT 2023 "Traditional and Non-Traditional in Future Nutrition" (Latvia, Jelgava, 2023); The Annual 29th International Scientific Conference "Research for Agriculture 2023" (Latvia, Jelgava, 2023); The 22nd World Congress of Food Science and Technology (IUFoST 2024) The future of food is now: Development, Functionality & Sustainability (Italy, Rimini, 2024).

10. Keywords: wheat, breakfast cereals, puffed grains, whey, recipe optimization, organoleptic analysis, hardness, crispness, microstructure, color, water activity, acrylamide, 5-HMF, antioxidants, vitamins, amino acids, total phenolic content, total flavonoid content, DPPH, fatty acids, volatile compounds.