

PRODUCTION OF PRODUCTS USING SECONDARY FOOD RAW MATERIALS

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**ABSTRACT.** The relevance of conducting research in the field of developing snack products with specified quality characteristics that can meet the physiological needs of different population groups with an accelerated pace of life is confirmed by the order. Analysis of the research showed that the technologies currently being developed for the joint processing of starch-containing and secondary food raw materials by thermoplastic extrusion make it possible to produce safe, biologically valuable, high-quality snack products.

**KEY WORDS:** extrusion, secondary raw materials, snacks, resource conservation, product quality, nutritional value.

The main goal of the food policy of our country is to ensure the quality of food products as the most important component of strengthening the health of the population.

Thus, the development of new generation products, such as snacks, with specified quality characteristics that ensure the prevention of the most common non-communicable diseases is a priority task [1,2,3,4]. In recent years, due to the complex processing of raw materials and the development of modern processing methods, food products of a complete composition have been obtained, which have increased nutritional value, improved organoleptic and physicochemical indicators, which are achieved by enriching the recipes with valuable substances from by-products of processing industries [5,6,7]. As a result of technological processes in the food and processing industries, a wide range of by-products is formed in the amount of 138 thousand tons per year. However, more than 70% of the volume of secondary raw materials is used in animal husbandry for feed goals. Such irrational use of secondary raw materials leads to the exclusion of biologically valuable and cheap raw materials from the field of view of food producers. Recycling of such waste for the needs of the food industry ensures the expansion of the raw material base of the agro-industrial complex while reducing production costs [8,9,10]. In terms of chemical composition, by-products of processing contain a small amount of fats and sugars and consist almost entirely of proteins and dietary fiber. Thus, by-products of processing are advisable to use in the development of functional products, the priority development of which is noted in the plan [11,12,13,14] until 2030. Disposal of food production waste requires solving a set of technological problems, among which the defining task is the creation of an energy-efficient and environmentally friendly technology for the comprehensive processing of waste from food and processing enterprises, the quality of the final product of which will not be inferior to the quality of a similar product from primary raw materials. One of the most technologically advanced and in-demand combined methods of processing secondary raw materials in recent years is extrusion. Extrusion technology allows processing starch-containing and protein-containing food raw materials, as well as their mixture, to create a large number of products with different sizes, shapes, textures and tastes [15,16,17,18]. Over the past ten years, there has been a steady increase in demand for fast food products, including snacks. Thus, in the conditions of a snack "on the go", it is possible to replenish

the physiological needs of the body for nutrients with snack products of a balanced composition. In modern industrial production of snacks, extrusion plays a particularly important role. During the extrusion process, thermal and shear energies are applied to the raw material, causing structural and chemical changes, changes in the biological value of the product, such as gelatinization and destruction of starch, denaturation of proteins, oxidation of fats, destruction vitamins, antioxidants, phytochemicals, formation of flavors, increase in mineral bioavailability and solubility of dietary fiber. Extruded snack products, as new generation products, are today one of the most promising options for improving their composition due to by-products of processing industries. Currently, a number of studies have already been conducted [19,20,21,22] aimed at developing snack extrudates, the composition of which was improved by adding by-products of processing industries to the recipes, confirming the prospects and relevance of this direction. Thus, V. Stojceska, P. Ainsworth and others enriched a mixture based on rice flour with dietary fiber and proteins using by-products from cauliflower to obtain ready-made expanded snacks. The researchers found that the addition of cauliflower cake significantly increases the levels of dietary fiber and protein [23,24]. The extrusion of a mixture of rice flour with cake of vegetable processing industries is also devoted to a study [25,26]. K. Navneet, B.C. Sarkar, and H.K. Sharma developed rice flour-based snacks fortified with dehydrated carrot cake and a powdered legume mixture. In a study by V.V. Vanshin et al., expanded corn grits extrudates were enriched with dietary fiber using carrot and pumpkin pulp. It was found that dough moisture content of 16% and pulp mass fraction of 15% allow obtaining snack products with a high degree of swelling, crispy consistency, developed porosity with a pronounced taste and aroma. The sticks were characterized by a regular shape and bright yellow color [27,28,29]. S. Yagci and F. Gogus developed an extruded snack product based on partially defatted hazelnut flour, fruit waste, and wholemeal flour in combination with rice grain. Increasing the content of partially defatted hazelnut flour resulted in an increase in bulk density and water solubility index, but a decrease in porosity and water absorption index of extruded snacks [30,31,32]. Z.D. Shoar, A.K. Hardacre and C.S. Brennan substantiated the improvement of the nutritional properties of starch extruded snack products by adding tomato pulp to the recipe by increasing the level of lycopene and dietary fiber in the finished product. The authors found that lycopene retention was higher in products containing tomato skin powder [33,34]. The possibility of producing an extruded product based on corn mixed with apple pulp was studied by E.L. Karkle et al. They found that hydration up to 17.2% by adding water to the extruder preconditioner was a key factor in determining the microstructure of the extruded snack, its texture and increasing digestibility [35,36]. The study noted that the use of by-products of fish processing and sugar production as a source of protein and dietary fiber can significantly increase the biological value of extruded potato snacks without a significant increase in the cost of the finished product. In the course of the study [37,38], V.I. Stepanov et al. developed snacks from the "Grain Assortment" mixture containing 25% carrot pulp. The authors modernized a standard extruder, which allowed them to obtain a finished food concentrate enriched with dietary fiber and vitamins, with a standard moisture content of 8%, when processing a high-moisture recipe mixture. A. Paul, P. Andrew et al. studied the effect of adding spent brewing malt to ready-to-eat extruded snacks. They found that adding spent malt significantly increases the content of protein, phytic acid and bulk density of snacks, while reducing the expansion index, individual and total cell area [39,40]. In a study by F. Robin, C. Dubois and others, wheat was supplemented with wheat bran

to achieve dietary fiber levels of 12.6% and 22.4%. Increasing the bran concentration decreased sectional and volumetric expansions and increased longitudinal expansion [41,42]. Recently, there has been increased interest in the processing of substandard bread by thermoplastic extrusion. Thus, in the study by V.V. Vashin, E.A. Vashina and A.V. Erkaev, the possibility of processing by-products of bakery and cereal production (substandard bread and millet flour) into breadsticks by means of extrusion was proven. The scientists established that the optimal ratio of bread crumbs and millet flour in the recipe mixture is considered to be 70:30 [43].

In the work by V.P. Popov and S.P. Vasilevskaya, a method for the joint processing of substandard bread and wine pomace for the production of semi-finished dry breakfast products and crackers that require further frying in oil was proposed. The authors established that with a content of 0-6% wine pomace to the weight of the recipe mixture, an intensification of the extrusion process and an improvement in the quality of the manufactured products are observed [45]. As a result of the study [44], a technology was developed for the production of air crackers with increased nutritional and biological value obtained by the method of warm extrusion based on flour and cereal grains, bread and wafer crumbs with the addition of baker's yeast. O.V. Abramov developed bread sticks with high nutritional value. The composition of the crispy sticks included crumbs from stale and deformed "Darnitsky" bread and beetroot-molasses powder semi-finished product in the amount of 3-5%, which is distinguished by a high content of pectin and potassium. The obtained extrudates had high energy and nutritional value, were distinguished by good consumer properties and were recommended for everyday nutrition of school-age children [46]. Analysis of the conducted studies [3,7,27] showed that the technologies currently being developed for the joint utilization of waste from the food and processing industries make it possible to produce safe, biologically valuable, high-quality snack products. The technologies tested on the example of the obtained snack products can be further applied to the production of special-purpose products, the distinctive feature of which is maximum adaptation to the physiological needs of certain population groups.

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