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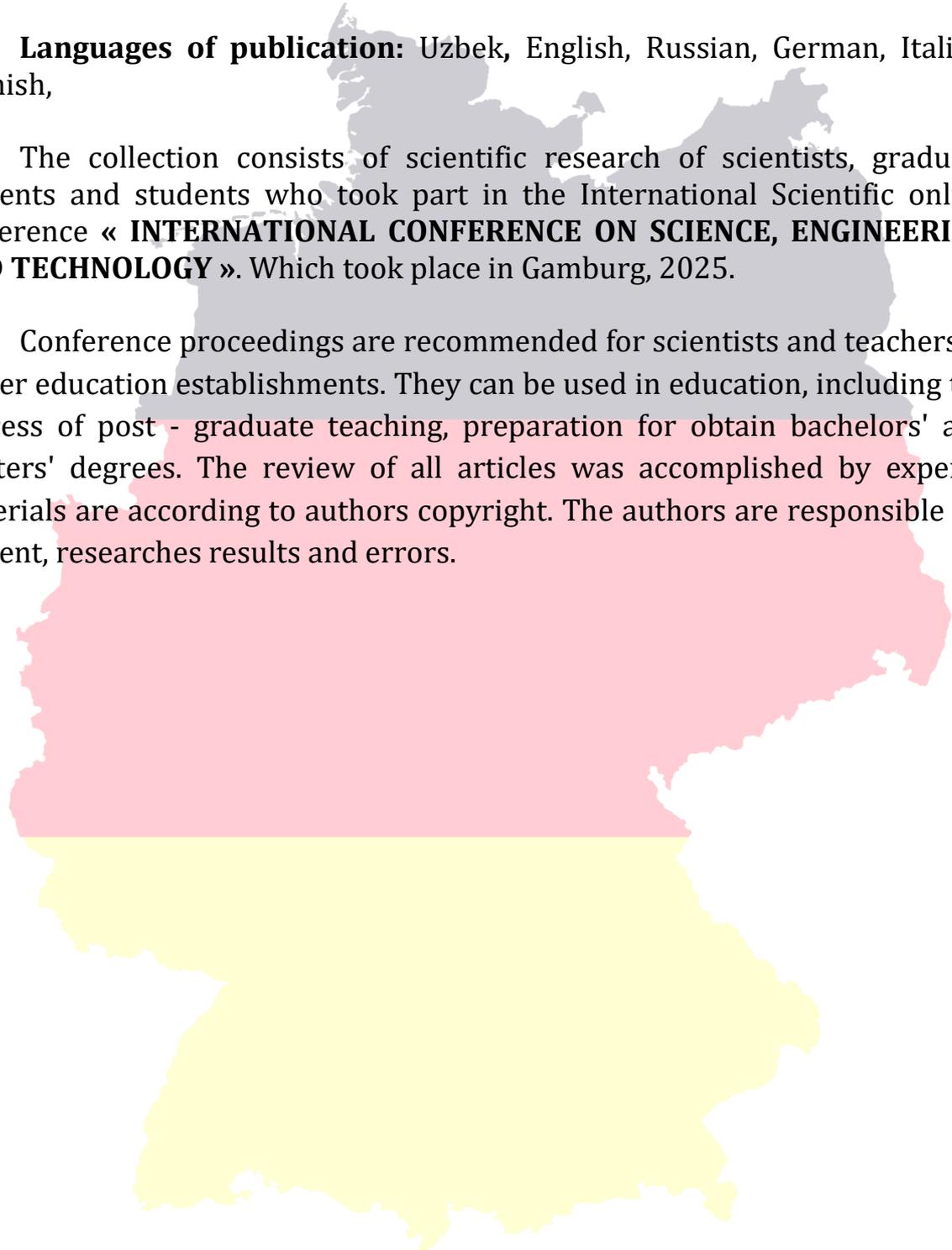


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DEVELOPMENT OF TECHNOLOGY FOR FUNCTIONAL CONFECTIONERY PRODUCTS

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Abstract: The study discusses the special role of creating fundamentally new food products that are well-balanced in composition and enriched with functional ingredients in ensuring rational nutrition for the population. Considering the chemical composition and technological properties of vegetables and vegetable pastes, their use as additives can significantly enhance the nutritional value of finished products. Therefore, vegetable-based pastes may serve as promising ingredients for improving the quality of flour-based confectionery products.

Keywords: rational nutrition, balanced composition, functional ingredients, vegetable paste, quality, nutritional value.

Introduction. A special role in ensuring rational and healthy nutrition for the population is attributed to the development of fundamentally new food products that are well-balanced in composition and enriched with functional ingredients. The concept of state policy in the field of healthy nutrition focuses on creating a wide range of natural food products intended for functional purposes.

The health and life expectancy of individuals and the nation as a whole depend on many factors, among which the quality of nutrition plays a fundamental role. Vegetables are indispensable food products and serve as a major source of essential vitamins, amino acids, macro- and microelements, carbohydrates, proteins, phytohormones, enzymes, phytoncides, aromatic compounds, spices, and other biologically active substances.

It is well known that modern society is developing under conditions of a global environmental crisis, manifested by increasing levels of pollution not only in major metropolitan areas but also in remote regions far from industrial centers. Human exposure to these unfavorable conditions intensifies the negative impacts on the body, particularly due to the formation of free radicals. Vegetable crops play an important role in preventing diseases associated with such exposure. Their effectiveness is attributed to the presence of biologically active compounds, including pectins, hemicelluloses, cellulose, and low-molecular-weight antioxidants [1, 2].



Considering the chemical composition and technological properties of vegetables, fruits, and berries, these raw materials can serve as promising enhancers for improving the quality of flour and confectionery products. Their incorporation into such products not only enhances technological

Table 1 Characteristics of Sweet Beet and Pumpkin Vegetable Pastes

Indicators	Beetpaste	Pumpkinpaste
Drymatter, notless,%	40,0±2,0	40,0±2,0
Sugar, notless,%	19,0±2,0	22,0±2,0
pH Wednesday, nomore	3,2±3,5	3,2±3,5

characteristics but also significantly increases their nutritional value. Vegetables are widely used as stabilizers of emulsion and foam structures in various food systems, including sweet dishes, and contribute to improving technology and increasing the nutritional value of flour-based confectionery products [3].

The present work demonstrates the feasibility of producing flour confectionery products made without yeast dough and supplemented with vegetable additives. Vegetables make it possible to intensify technological processes without compromising sensory quality; they also improve the balance of essential nutrients and reduce excessive caloric content. In addition, they slow down staling during storage.

In accordance with the research objective, the following task is proposed:

- to develop a recipe and production technology for a biscuit semi-finished product using sweet vegetable pastes.

The role of sweet vegetable pastes in the formation of the structure of biscuit dough and the resulting baked semi-finished products was investigated [4]. Processing vegetables into pastes and incorporating them into culinary products allowed for an expansion of the product range, improvement in the quality of finished goods, and a reduction in the amount of eggs and sugar used in biscuit semi-finished products. Table 1 presents the characteristics of sweet vegetable pastes prepared from beetroot and pumpkin.

Sweet vegetable pastes enable the intensification of the technological process in the production of flour-based products without compromising their sensory qualities. They improve the balance of essential nutrients, reduce excessive caloric content, and slow down staling during storage. Table 2 presents the quality indicators of whipped egg-sugar masses for biscuits prepared with varying amounts of vegetable pastes.

The obtained data highlight the differences between the properties of sweet vegetable pastes and those of mashed potatoes made from boiled



vegetables. Higher solids content and increased structural viscosity of the vegetable pastes positively affect the stability of the whipped mixture during storage, although they slightly reduce foaming capacity. Additionally, the acidic environment of vegetable pastes contributes positively to the performance of whipped egg-sugar masses [5].

Table 2. Quality indicators of whipped egg-sugar mass for biscuits with various amounts of vegetable pastes

Vegetable egg-sugar mass	Paste content (% by weight of flour)	Heat generating capacity (%)	Density (kg/m ³)	Stability (%)
Control (no vegetable pastes)	—	341.1 ± 5.2	389.6 ± 5.4	76.3 ± 0.62
Beet	10	364.7 ± 6.6	373.1 ± 4.3	81.9 ± 0.61
Beet	20	375.3 ± 7.3	370.5 ± 4.7	82.4 ± 0.52
Beet	30	379.8 ± 8.7	361.8 ± 3.9	83.1 ± 0.49
Pumpkin	10	349.3 ± 5.1	377.1 ± 5.4	81.4 ± 0.32
Pumpkin	20	363.7 ± 6.2	370.1 ± 4.8	82.1 ± 0.64
Pumpkin	30	379.1 ± 8.2	359.0 ± 4.6	83.2 ± 0.21

We associate the increased foaming ability of the systems with a slight rise in moisture and, consequently, a decrease in dough viscosity, which facilitates whipping during kneading. Additionally, the formation of protein-polysaccharide complexes between flour proteins and the acidic polysaccharides of vegetables—known for their high foaming capacity—further enhances this effect. These protein-polysaccharide complexes, concentrating in the interfacial adsorption layers of the foam, increase the mechanical strength of the layers and improve the overall stability of the system during storage.

Table 3 presents the quality indicators of biscuit semi-finished products containing vegetable pastes. Other quality indicators of semi-finished products with pastes are practically identical to those of the control sample, except for moisture, which is 1–2% higher in products with vegetable pastes. These results provided the basis for developing recipes for a biscuit semi-finished product with a partial reduction in sugar and melange, coupled with an increased proportion of flour, to prevent an undesirable rise in the moisture content of the baked product [6].

Table 3 Quality indicators of biscuit semi-finished product with vegetable pastes



Sample Semi-finished Product	Crumb Moisture, %	Specific Volume, 10 ⁻⁵ m ³ /kg	Porosity, %	Crumb Compressibility, units pr.AP-4/2	Organoleptic Assessment, score
Control (no vegetable pastes)	27.7 ± 0.3	349 ± 6.8	73.2 ± 2.8	175.4 ± 4.8	41
With beet paste, 10%	28.5 ± 0.2	369 ± 8.6	77.1 ± 2.1	184.4 ± 4.7	43
With beet paste, 20%	29.0 ± 0.2	358 ± 7.1	75.4 ± 3.4	180.1 ± 3.1	42
With pumpkin paste, 10%	28.3 ± 0.19	372 ± 7.3	78.3 ± 3.3	187.5 ± 4.9	43
With pumpkin paste, 20%	29.0 ± 0.2	370 ± 8.4	76.6 ± 2.9	180.2 ± 5.2	42

Based on the data obtained, it can be concluded that biscuits containing sweet vegetable pastes are not inferior in quality to the control sample. The formulation allows for the replacement of up to 10–15% of the egg-sugar mass with vegetable paste.

Analysis of the obtained data indicates that the incorporation of vegetable pastes into biscuit dough as a partial replacement for sugar and eggs does not compromise the quality of biscuits during storage. The observed slowdown in staling is primarily attributed to the water-holding capacity of polysaccharides present in the cell walls of vegetables [7].

A gelatinous structure was established in sweet vegetable pastes prepared from beets and pumpkin, characterized by a dry matter content of 30%, sugar content of 5–10%, and pH of 3.2–3.5. This structure limits moisture mobility within the system. The binding of water and its reduced mobility in these structured sweet vegetable pastes help maintain microbial stability during storage—up to 30 days at 4–6°C and 5 days at 18–20°C.

When introduced into an egg-sugar mixture for biscuits at levels of 10–20% by weight of flour, sweet vegetable pastes enhance both the foaming ability and stability of the whipped mass. Biscuit semi-finished products in which 20% of sugar and 14% of eggs were replaced with sweet vegetable pastes were found to be comparable in quality to traditional products, with no reduction in yield [8].

Formulations and technologies for producing sweet vegetable pastes have been developed and scientifically substantiated. Their use in flour-based confectionery products, such as biscuit semi-finished products, contributes to



technological improvement and better nutritional balance. The inclusion of vegetable pastes not only enables partial replacement of eggs and sugar but also enriches the final product with essential nutrients, including dietary fiber, minerals, and vitamins, thereby expanding the range of healthier bakery products.

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