Journal of Adaptive Learning Technologies
ISSN **2997-3902** (Online)
Vol. 2, No. 10, Oct 2025,
Available online at: https://scientificbulletin.com/index.php/JALT

STUDY OF THE INFLUENCE OF VEGETABLE PASTES ON THE PROPERTIES OF SPONGE DOUGH

Ashurova M. Z., Ganieva N. Kh. Khalikova N., Khairullaev A.
Bukhara State Technical University

Article information:
Manuscript received: 15 Aug 2025; **Accepted:** 20 Sep 2025; **Published:** 31 Oct 2025

To study the effect of vegetable pastes on the properties of sponge cake dough, sugar, mélange, and vegetable paste were whipped for 15 minutes, followed by kneading the dough.

The quality of sponge cake dough is primarily determined by the properties of the whipped egg-sugar mixture, so its quality was first analyzed using the following parameters:

- foaming capacity of the system;
- density and resistance of the whipped mixture to separation. Samples were analyzed immediately after whipping. The experimental data are presented in Table 1.

As shown in Table 4.1, the addition of vegetable pastes to the egg-sugar mixture promotes better aeration of the mixture during whipping, as evidenced by a decrease in the density of the whipped mixture and an increase in the foaming capacity of the system.

Compared to the control sample without additives, the density of the whipped mass with 20% vegetable paste decreased by 48% for beetroot paste and 51% for pumpkin paste, while foaming capacity increased by 9.3% and 6.0%. The stability of the whipped mass after 3 hours of preparation was higher for the samples with additives by 5.2% and 4.8%, respectively.

These data reflect the difference in the properties of vegetable pastes from those of boiled, mashed vegetables (127). The higher dry matter content and increased structural viscosity of vegetable pastes have a positive effect on the stability of the whipped mixture during storage and, at the same time, contribute less to foaming. The acidic environment of vegetable pastes has a positive effect on the quality of whipped egg-sugar masses with pastes. Increasing the paste concentration from 10% to 20% strengthens the dough structure and has virtually no effect on foaming.

The increase in foaming capacity is due to an increase in dough moisture.

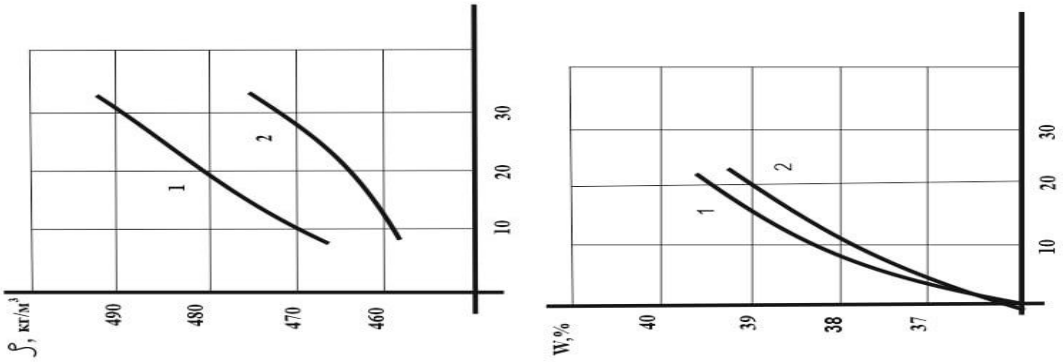
We attribute the increase in foaming capacity of the system to a certain increase in moisture content and, consequently, a decrease in viscosity, which promotes dough whipping during mixing, as well as the formation of protein-polysaccharide complexes between flour proteins and acidic vegetable polysaccharides, which have high foaming capacity.

At the same time, protein-polysaccharide complexes, concentrating in the interfacial adsorption layers of the foam system, increase their mechanical strength and the stability of the entire system during storage.

Table 1. Quality indicators of whipped egg-sugar mixture with various amounts of vegetable pastes.

Samples	Quality indicators		
	Foaming capacity	**Density, кг/м³**	**Stability After 3 hours %**
Control without vegetable pastes	343,1±5.2	389,6±5,4	78,3±0,62
With added pastes, % of flour weight:			
Beetroot 10	364,7±6,6	373,1±4,3	81,9±0,61
20	375,3±7,3	373,7±4,3	82,4±0,52
30	379,8±6,7	361,8±3,9	83,1±0,49
Pumpkin 10	349,3±5,1	377,1±5,4	81,4±0,32
20	363,3±5,1	377,1±5,4	81,4±0,32
30	397,1±8,2	359±4,6	83,2±0,21

Data on determining the moisture content and density of biscuit dough depending on the type and amount of added pastes is presented in Fig. 1.



Data on determining the moisture content and density of biscuit dough depending on the type and amount of added pastes is presented in Fig. 2....

As can be seen in Figure 4.1, the moisture content of the sponge cake dough increases to 39.5% with the addition of additives at a rate of 30% of the flour weight, compared to 36.4% for the dough without additives. It can be assumed that excessive dough moisture, when vegetable pastes are added at a rate of more than 20% of the flour weight, leads to an increase in the proportion of moisture absorbed by the proteins and starch in the flour. This contributes to the crumb tightening during baking, resulting in a deterioration in the sponge cake quality.

While the pastes had a positive effect on the properties of the whipped egg-sugar mixture, the latter acquired an undesirable flavor from the added vegetables. Therefore, in further studies, the pastes were used at a concentration of 10-20%.

Table 2. Structural and mechanical characteristics of sponge cake dough with different amounts of vegetable pastes.

Samples	Coefficients of the Ostwald-da Viele equation		Values at =0,9c^{-1}	
	Consistency coefficient Па, С	Current index	Shear stress Па	Effective viscosity, Па.С
No additives With the addition of pastes, % к mass of flour	50,1±1,46	0,32±0,05	48,5±1,64	50,2±2,08
beetroot 10	49,3±1,28	0,317±0,02	46,8±1,29	49,2±1,74
20	48,4±1,14	0,311±0,02	45,3±1,09	47,5±1,17
Pumpkin 10	48,9±1,17	0,312±0,01	46,9±1,18	48,4±1,72
20	47,8±1,13	0,209±0,03	45,2±1,07	46,9±1,19

An important technological characteristic is the structural and mechanical properties of the dough, in connection with this, it was considered necessary to consider the degree of influence of vegetable additives on the structural and mechanical level of the characteristics of the biscuit dough.

The structural and mechanical properties of the sponge cake dough were determined by its resistance to loading in the working cylinder of a Reotest-2 viscometer at shear rates of j = 0.1667 ± 2.7 s-1.

The resulting values for the consistency coefficient K, flow index n, shear stress τ, and effective viscosity ηeff of the dough at a shear rate of j = 0.9 s-1 are presented in Table 2.

An analysis of the obtained data shows that adding vegetable pastes at a rate of 10% to the flour mass results in a decrease in the dough consistency coefficient by 2.0% and 2.4%, while the effective viscosity decreased by 2.0% and 3.6% for beetroot and pumpkin pastes, respectively. A decrease in viscosity within these limits clearly indicates an improvement in efficiency. It can be assumed that, due to the lower dough viscosity, the dispersed phase particles (air bubbles) expand more during baking. Therefore, the somewhat stronger film framework of eggs, sugar, vegetable paste components, and flour, compared to dough without additives, prevents gas from escaping from the bubbles. The sponge cake shrinks less during baking and is characterized by a higher specific volume, porosity, and crumb compressibility.

To determine the optimal dosage of vegetable pastes, it was considered necessary to study the effect of varying amounts on the quality of baked sponge cakes. Vegetable pastes were added to the egg-sugar mixture at a rate of 10-30% of the flour weight before whipping, as adding the paste at the end of the egg-sugar whipping process causes the foam structure to collapse under its weight, causing the mixture to settle. A control sample without added vegetable pastes, prepared according to a traditional recipe, served as a control.

Laboratory-baked sponge cakes were kept at room temperature for 8 hours to strengthen the crumb structure, after which quality parameters were determined. The results are presented in Table 3.

The data obtained demonstrate a positive effect of vegetable pastes on the organoleptic properties of the baked semi-finished product, manifested in a more uniform porosity, a tender and elastic crumb, and an enhanced aroma, especially for the semi-finished product with pumpkin paste. Regarding other quality indicators of semi-finished products with pastes, they are virtually identical to those of the control semi-finished product, with the exception of moisture, which is 1-2% higher in the semi-finished product with vegetable

pastes.

These results, combined with literature data, served as the basis for developing biscuit semi-finished product recipes with a partial reduction in the proportion of sugar and mélange and an increase in the proportion of flour, in order to prevent an undesirable increase in the moisture content of the baked semi-finished product.

The data obtained revealed a positive effect of vegetable pastes on the organoleptic properties of baked semi-finished products, manifested in more uniform porosity, a tender and elastic crumb, and aroma, especially for the semi-finished product with pumpkin paste.

As for other quality indicators of semi-finished products with pastes, they are virtually identical to those of the control semi-finished product, with the exception of moisture, which is 1-2% higher in the semi-finished product with vegetable pastes.

The obtained results, taking into account the literature data, served as the basis for developing recipes for biscuit semi-finished products with a partial reduction in the proportion of sugar and melange and an increase in the proportion of flour, in order to prevent an undesirable increase in the moisture content of the baked semi-finished product.

Table 3. Quality indicators of semi-finished sponge cake with vegetable pastes

Sample semi-finished product	Quality indicators of semi-finished products				
	Humidity of the crumb, %	Specific volume 10-5 m3/kg	Porosity, %	Compressibility of crumb, units, AP-4/2	Organoleptic assessment
Control (without vegetable pastes)	28,2±0,3	349±6,8	73,2±2,8	175,4±4,8	41
With beetroot paste, 10%	29,0±0,2	36,9±8,6	77,1±2,1	184,4±4,7	43
With beetroot paste, 20%	29,6±0,02	35,8±7,2	75,4±3,4	180,1±5,1	42
With pumpkin paste, 10%	29,6±0,19	37,2±7,3	78,5±3,3	187,5±4,9	43
With pumpkin paste, 20%	29,6±0,2	370±8,4	76,6±2,9	180,2±5,2	42

REFERENS:

1. Alekseev A. M. On the molecular structure of intracellular water and its possible physical significance // The state of water and water exchange in cultivated plants. - Moscow: 1971. -pp. 11-12.

2. Baranov V. S., Vasilenko Z. V. Modern concepts of the structure and composition of carbohydrates in the cell walls of plant products. - Moscow: Plekhanov Mining and Metallurgical Institute, 1979. -32 p.

3. Beyul E. A., Enisenina N. P., Paramonova E. G. Nutritional value of vegetables and fruits. - Moscow: Food industry, 1972. -pp. 16-21.

4. Vasilenko Z. V., Baranov V. S. The mechanism of softening of vegetables during heat

treatment. - Abstracts of the All-Union Scientific Conference. – Kharkov, 1981. Pp. 67-69.

5. Vasilenko Z. V., Baranov V. S. Fruit and vegetable puree in food production. - Moscow: Agropromizdat. 1987. -. 125.
6. M. Z. Ashurova, G. X. Sulaymanova, N. Kh. Ganieva. Improvement of the Functional Properties of Bread and Bake Products. Eurasian Journal of Physics, Chemistry and Mathematics www. geniusjournals. org Volume 17| April 2023 ISSN: 2795-7667 P. . 22-25.
7. M. Z. Ashurova, G. X. Sulaymanova, N. Kh. Ganieva. CURRENT TRENDS IN FUNCTIONAL FOOD DEVELOPMENT. Innovative Texnologica: Methodical Research journal. ISSN: 2776-0987 Volume 4, Issue 2 Feb. 2023. R. 49-61.
8. M. Z. Ashurova, G. X. Sulaymanova, N. H. Ganieva. Technology Improvement and Expansion Range of Bread and Bakery Products. International Journal of Formal Education Volume: 2 Issue: 2 | Feb – 2023 ISSN: 2720-6874 http://journals. academiczone. net/index. php/ijfe P 48-54.
9. M. Z. Ashurova, G. X. Sulaymanova, N. H. Ganieva. THE STUDY OF THE TECHNOLOGICAL PROPERTIES OF SPICY GREENS DURING THERMAL COOKING. JMEA Journal of Modern Educational Achievements 2023, Volume 5 https://scopusacademia.org/ P 458-464.
10. M. Z. Ashurova, G. X. Sulaymanova, N. H. Ganieva. Bolalar ovkatlanish maҳsulotlarining functional hususiyatlarini oshirish tendenlari. Magazine “Fan va technologylar tarakkiyoti” 2023. No. 6. 240-246 b.