Application of food supplement in production in order to promote health and prophylactic properties

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Abstract. The article is devoted to the issue of the growth of bakeries, their competitiveness, the possibility of introducing new progressive equipment into production and the ability to enter new consumer markets. The study is conducted on the basis of the Volgograd State Agrarian University in the department “Processing technologies and food security”. The aim of the study is to study the use of natural raw materials used to improve the quality, nutritional value and increase the competitive raw materials. As an additive, water is replaced with carrot juice, in the proportion of 50:50 and 100 %. Then there is the definition of organoleptic and physico-chemical properties. The use of carrot juice improves the quality characteristics of bread, the physico-chemical indicators correspond to State Standard 27842-88. In addition the economic efficiency of production of wheat bread is calculated. The level of profitability of wheat bread production with the replacement of water with carrot juice in the proportion of 100 % is 15.25 %, which is 5 % higher than the control sample.

1. Introduction
The problem of healthy nutrition of the population is one of the most pressing problems today. A balanced diet and high consumer properties of products are necessary to maintain human health. The state policy in the field of healthy nutrition is aimed at improving the nutritional structure of the population by increasing the number of mass-consumption products with high nutritional and biological value.

Foods that have a special recipe, which includes special additives that have health and preventive properties, are increasingly attracting the attention of Russians. In recent years, in the baking industry, food additives of various activities are widely used, the need for which is due to the spread of accelerated dough preparation methods, the quality of flour, the variety of properties of processed raw materials, the expansion of the product range, the extension of freshness to products and much more [1].

In everyday life, we live side by side with such a science as «chemistry». All areas of life are very closely associated with it, including food industry. All products on the market now, one way or another, are made with the help of all-possible chemical additives, in particular, with the help of food additives [2].

Non-traditional raw materials can be used as additives: various fruits, vegetables and their processed products. Their use is promising, since these raw materials are rich in dietary fiber, mono- and disaccharides, fructose, vitamins, minerals, etc.
Fruit and vegetable semi-finished products are recommended for use in the manufacture of products from wheat flour. Such additives improve the nutritional value and perform an aesthetic function, giving the products a characteristic color and aroma.

Relevance: Today, it is not enough to produce only mass sorts of bread and bakery products in order to survive and be successful, it is necessary to use natural unconventional raw materials as a food additive, which will lead to improved quality and increase the range of products enriched with vitamins and therapeutic and prophylactic properties, attention to which increases with each passing year. This in turn will lead to a great demand among the population and, as a result, to the financial growth of the enterprise.

Knowledge of the problem: The quality of bread can be improved in different ways, using functional additives and non-traditional types of raw materials in the following areas: improving the nutritional value of bread through the use of high-protein products, the use of functional additives in the processing of flour; increasing the nutritional value of bread through the use of non-traditional types of raw materials; the use of new types of grain raw materials [3].

The feasibility of the development of the theme: Bread and bakery products are among the most common food products of the population, which contain almost all the substances necessary for life and the normal development of a living organism. A promising raw material for the production of bakery products is natural carrot juice obtained from table carrots.

The most promising, in terms of functional properties and uses in food production, are semi-finished products based on fruits and vegetables. They are concentrates of raw materials and contain a significant amount of useful for humans, including biologically active substances - vitamins, carotene, trace elements, pectin, dietary fiber and coloring agents, mono - disaccharides, etc. [4].

2. Materials and methods

The purpose of the study is to study the use of natural non-traditional raw materials in order to improve the quality, nutritional value and increase the competitive raw materials.

To achieve this purpose it is necessary to solve the following tasks:
- to determine organoleptic and physico-chemical indicators of the quality of raw materials and finished products;
- to justify economically the production of wheat bread with carrot juice.
- to analyze the results of research.

The object of study was a sample (type) of bread, selected according to State Standard 27669-88. An organoleptic assessment of the quality of bread and an examination of the physico-chemical indicators of the quality of selected samples of bread from the experimental batches were carried out: the moisture content of the crumb of the selected sample; the acidity of the crumbs of the selected sample; the porosity of the crumbs of the selected sample. Organoleptic quality assessment of bakery products was carried out during the inspection and tasting. Usually, the quality of bakery products is determined by the shape, appearance of the crumb and crust, freshness, absence of defects, diseases, foreign inclusions and crunching during chewing, taste and smell [5].

The study was conducted on the basis of the Volgograd State Agrarian University of the Department «Processing Technologies and Food Security».

3. The technology of bakery products and the results obtained

Carrot juice is rich in vitamins, if you follow simple rules for its use. It is important to assess the impact of this unconventional raw material on the functional properties of baked semi-finished products both at the stage of their production and in finished products.

For the baking industry, natural carrot juice is an unconventional raw material and is of interest, first of all, because it has a high nutritional value. It has a high content of vitamins B, PP, C, E and K, it also contains carotene - a substance that in the human body turns into vitamin A, which improves lung function, cardiovascular system, liver, gastrointestinal tract, and strengthens the retina, maintains skin and mucous membranes in good condition. The energy value of carrots is 33 kcal / 100 g of the edible
part. The recommended consumption rate of fresh carrots is 11 kg per year. Carrot juice is saturated with plenty of proteins, carbohydrates and minerals.

Carrot juice is a source of ballast substances that reduce the calorie content of the product, promote the excretion of harmful substances from the body (cholesterol, carcinogenic substances, heavy metal salts), and improve intestinal motility.

The technological process of making bread consists of the following stages: preparation of raw materials, kneading dough and other ingredients, fermentation, dividing the dough into pieces of a certain mass, molding and proofing dough pieces, baking, cooling and storing bread products [6].

In the production of bread, flour, water, and salt were used as the main raw material.

Trial laboratory baking of bread was carried out by the straight-line method in accordance with State Standard 27669-88 “Baking wheat flour. Method test laboratory baking bread. This standard extends to wheat baking flour and establishes a method for determining its quality by conducting laboratory test baking and bread evaluation based on organoleptic characteristics, as well as tin bread by volume yield.

Research methods involved the use of natural carrot juice for baking bread (Figure 1).

![Figure 1. Natural carrot juice.](image)

Before kneading dough 1 sample (control - bread made from wheat flour), salt-sugar solution and yeast suspension were prepared per 100 g flour: water in an amount of 60 % by weight of flour; yeast 2 g; sugar 1 g; salt 1.3 g.

Before kneading dough 2 sample (bread made from wheat flour of the highest grade with 50 % water replaced by carrot juice), a salt-sugar solution was prepared and a yeast suspension per 100 g flour: water in an amount of 30 % by weight of flour; carrot juice – 30 % by weight of flour; yeast 2 g; sugar 1 g; salt 1.3 g.

Before kneading dough 3 sample (bread made from wheat flour of the highest grade with full replacement of water for 100 % carrot juice), a salt-sugar solution and yeast suspension were prepared per 100 g flour: carrot juice – 60 % by weight of flour; yeast 2 g; sugar 1 g; salt 1.3 g.

The dough was kneaded manually until a homogeneous mass was obtained. The dough was placed in a dish that was placed in a thermostat with a temperature of 35°C and relative humidity of 75 %. The total time of fermentation of the dough was 150 minutes. During the period of fermentation of the dough, two interceptions were made. The first battering was done 90 minutes after the start of fermentation. 60 minutes after the first knockout, the second one was done. Simultaneously with the second interrupting the dough, it was molded. In the process of forming, the dough was interrupted and divided into four equal pieces of the mass, which were formed into containers and placed in molds oiled with vegetable oil. The molds were placed in a thermostat for proofing, which lasted until the test was ready for planting in the oven.

Bread was baked for 20 minutes at a temperature of 180-220°C and relative humidity of air in the oven – 75 %.
Two hours after baking the bread, its quality characteristics were determined: organoleptic and physico-chemical properties. The size of bread, its form (shape, surface and color of the crust), as well as the porosity, the color of the crumb, the taste and smell of the bread (Table 1) were determined.

| Quality indicators                              | Sample No. 1 (control version) | Sample No. 2 (50% carrot juice) | Sample No. 3 (100% carrot juice) |
|------------------------------------------------|--------------------------------|---------------------------------|---------------------------------|
| Shape and surface                              | correct, corresponding to the bread form | correct, corresponding to the bread form | correct, corresponding to the bread form |
| The color of the crust of bread                 | light brown                    | brown                           | brown                           |
| The shape of the surface of the crust of bread  | oval                           | convex, smooth, oval            | smooth, level, oval             |
| The color of the bread crumb                   | white                          | light-yellow                    | yellow                          |
| Cookiness                                       | baked, soft, hemming           | baked, soft, crumpled           | baked, mild, crumpled           |
| Porosity                                        | small, evenly distributed      | small, not evenly distributed   | small, evenly distributed with dense pulp |
| Elasticity                                      | good                           | average                         | good                            |
| Kneading                                        | no lumps                       | no lumps                        | no lumps                        |
| Taste                                           | norm                           | norm, with a pleasant carrot flavor | norm, with a pleasant carrot taste |
| Smell                                           | norm                           | norm with the presence of weak flavor | norm with the presence of a pleasant aroma of baked carrots |

Based on the data in Table 1, the addition of carrot juice to the recipe significantly increased the presentation of bread in all respects. The color of the crumb on the version with the addition of 100% carrot juice was distinguished by a brighter color, which is associated with the content of special pigment components (carotene) in the juice composition (Figure 2).

**Figure 2.** Carrot bread with the addition of 100% juice (sectional view).

12 hours after baking, the shrinkage of the bread was determined (Table 2). The use of carrot juice significantly increased the mass of the dough and lowered the pack and shrinkage. So with the introduction of 50% - and 100% - carrot juice in flour of the highest grade allowed to reduce the mass of dough compared with the control sample by 12.2 and 4.07%, respectively, reduce packs by 2 and 6
grams, respectively, and shrinkage by 7 grams. Despite the smaller mass of dough, the mass of bread 12 hours after baking with the addition of 100% carrot juice was 141 g, which is 6 g more than in the control variant. The most significant increase in the volume of bread was noted in the control variant. In this case, the volume of bread reached 386 cm³, which is 50 cm³ more than the volume of bread using 50% carrot juice and 35 cm³ more using 100% carrot juice. Volumetric bread yield when using 100% carrot juice was 351 cm³.

### Table 2. Effect of carrot juice on the baking properties of wheat bread

| Indicators                        | Sample No. 1 (control version) | Sample No. 2 (50% carrot juice) | Sample No. 3 (100% carrot juice) |
|-----------------------------------|-------------------------------|---------------------------------|----------------------------------|
| Mass of dough before baking, g    | 172                           | 151                             | 165                              |
| Mass of hot bread, g              | 147                           | 128                             | 146                              |
| Upeck, g                          | 25                            | 23                              | 19                               |
| %                                 | 14.53                         | 15.23                           | 11.51                            |
| The mass of bread in 12 hours after baking, g | 135                     | 119                             | 141                              |
| Shrinkage, g %                    | 12                            | 9                               | 5                                |
| Volumetric bread yield, cm³       | 386                           | 336                             | 351                              |

The use of carrot juice allowed significantly increasing the baking properties of flour, thereby improving the quality characteristics of bread. Also the introduction of carrot juice has increased the volume of bread. The results of physico-chemical studies are presented in table 3.

In assessing the physicochemical parameters, the crumb moisture, acidity and porosity were determined. High humidity reduces the nutritional value of bread, impairs its taste and reduces the shelf life. As a rule, it was found that the higher the grade of flour, the lower the rate of moisture of the bread. Acidity affects the taste properties of bread. Insufficiently or excessively sour bread has an unpleasant taste. It is judged by this indicator that the process is conducted correctly. The higher the porosity of the product, the longer they retain their freshness and are better absorbed by the body. Well-loosened bread with uniform fine thin-walled porosity is better impregnated with digestive juices and therefore more fully digested.

### Table 3. Results of physico-chemical indicators of wheat bread

| Indicators | Sample No.1 (control version) | Sample No.2 (50% carrot juice) | Sample No.3 (100% carrot juice) | Requirements according to State Standard 27842-88 | Conclusions about compliance |
|------------|-------------------------------|--------------------------------|---------------------------------|--------------------------------------------------|-----------------------------|
| Humidity, %| 36.0                          | 39.0                           | 42.0                            | no more than 45.0                                | accordance                  |
| Porosity, %| 76.0                          | 70.0                           | 74.0                            | not less than 68.0                               | accordance                  |
| Acidity, hail | 1.9                          | 2.3                            | 2.6                             | no more than 3.0                                 | accordance                  |

With a deeper analysis of the physico-chemical indicators of bread and processing all the data obtained, it can be said that all samples comply with the requirements of State Standard 27842-88. It should be noted that when adding 100% carrot juice, the acidity of the bread was slightly increased, but it met the requirements of State Standard.

To determine the absolute efficiency of production, generalizing and differentiated indicators are used. The formation of generalizing indicators is based on two conditions: consideration of the final result and reflection of the aggregate value of costs or resources (Table 4) [7].
Table 4. Calculation of production of 100 kg of wheat bread

| Items of expenditure       | Sample No. 1 (control version) | Sample No. 2 (50 % carrot juice) | Sample No. 3 (100 % carrot juice) |
|----------------------------|-------------------------------|----------------------------------|-----------------------------------|
| 1. Wheat flour baking top grade, kg | 100                           | 100                              | 100                               |
| 2. Yeast, kg               | 2                             | 2                                | 2                                 |
| 3. Food salt, kg           | 1.3                           | 1.3                              | 1.3                               |
| 4. Sugar, kg               | 1                             | 1                                | 1                                 |
| 5. Water, liter            | 60                            | 30                               | -                                 |
| 6. Carrot juice            | -                             | 30                               | 60                                |

| Price, RUB / kg            |                               |                                  |                                   |
|----------------------------|-------------------------------|----------------------------------|-----------------------------------|
| 1. Wheat Flour Extra Class | 21                            | 21                               | 21                                |
| 2. Yeast                   | 61                            | 61                               | 61                                |
| 3. Food table salt         | 7                             | 7                                | 7                                 |
| 4. Granulated sugar        | 31                            | 31                               | 31                                |
| 5. Water                   | 13                            | 13                               | -                                 |
| 6. Carrot juice            | -                             | 46                               | 46                                |

| Cost, RUB.                 |                               |                                  |                                   |
|----------------------------|-------------------------------|----------------------------------|-----------------------------------|
| 1. Wheat Flour Extra Class | 2100                          | 2100                             | 2100                              |
| 2. Dry baker's yeast       | 122                           | 122                              | 122                               |
| 3. Food table salt         | 9.1                           | 9.1                              | 9.1                               |
| 4. Granulated sugar        | 31                            | 31                               | 31                                |
| 5. Water                   | 780                           | 390                              | -                                 |
| 6. Carrot juice            | -                             | 1380                             | 2760                              |

The cost of raw materials, RUB.

- Sample No. 1: 3042.1
- Sample No. 2: 4032.1
- Sample No. 3: 5022.1

Costs, RUB.

- Sample No. 1: 1021.3
- Sample No. 2: 1021.3
- Sample No. 3: 1021.3

Production cost, RUB.

- Sample No. 1: 4063.4
- Sample No. 2: 5053.4
- Sample No. 3: 6043.4

Selling expenses, RUB.

- Sample No. 1: 31
- Sample No. 2: 31
- Sample No. 3: 31

Total cost, RUB.

- Sample No. 1: 4094.4
- Sample No. 2: 5084.4
- Sample No. 3: 6074.4

The organoleptic characteristics of sample No. 2 and No. 3 are better than sample No. 1. When adding carrot juice, wheat bread had a pleasant taste and aroma. In addition, the addition of juice makes samples No. 2 and No. 3 more nutritious than sample No. 1. Replacing water with juice made it possible to speak of bread as a healthy food product. All this made it possible to increase the selling price of samples No. 2 and No. 3.

Table 5. Economic efficiency of the production of wheat bread

| Indicator                          | Sample No. 1 (control version) | Sample No. 2 (50 % carrot juice) | Sample No. 3 (100 % carrot juice) |
|-----------------------------------|--------------------------------|----------------------------------|-----------------------------------|
| The total cost of 1 kg of products, RUB. | 40.94                          | 50.84                            | 60.74                             |
| Selling price of 1 kg of products, RUB. | 45                             | 57                               | 70                                |
| Profit, RUB, per 1 kg of product  | 4.06                           | 6.16                             | 9.26                              |
| Profitability level, %            | 9.92                           | 12.12                            | 15.25                             |

Comparing the data of table 5, namely, the cost of 1 kg of products, it is clear that the production of white bread from wheat flour of the highest grade of samples No. 2 and No. 3 is more expensive compared to the basic recipe. Increasing the selling price affects the quality of the product. The sales
price of new bread (sample number 3) increased, but only slightly. The quality of bread in all respects is higher, and the bread is more nutritious. Thus, the level of profitability of sample No. 2 increased on average by 2%, and sample No. 3 - by 5%, compared with the control.

4. Conclusion
The feasibility of using carrot juice in the production of bakery products to improve the nutritional value has been theoretically substantiated and experimentally confirmed. A bakery recipe with the addition of carrot juice in a volume of 50% and 100% by weight of flour was developed. To stabilize the baking properties of flour, to form the required properties of semi-finished products, to regulate the fermentation process, to improve the quality of bread, including and to slow down the process of staling and to reduce the crumb crumb, are sugary products obtained by hydrolysis of starch. One of these products is carrot juice, the juice contains mono- and disaccharides (sugar) in the amount of 12.4 g/100 g.

The calculation of the economic efficiency of the production of bakery products using carrot juice was performed. An economic calculation showed that the total cost of wheat bread is higher than the cost of bread with carrot juice of sample No. 2 and No. 3 by 1 and 2 thousand rubles respectively. The quality of bread in all respects is higher, and the bread is more nutritious.

Thus, the profitability of bread with the addition of carrot juice in the amount of 100% by weight of flour, more than in the control sample by 5% and amounted to 15.25%. The introduction of bakery products to the market with the addition of carrot juice will allow us to produce competitive products and take our place in the niche of the functional group of food. Adding carrot juice in bakery production strengthens the gluten of dough, increases its water-absorbing ability, speeds up the fermentation process of dough, improves its plasticity, taste and aroma of finished products, increases their volume, increases the elasticity of crumb and rind, gives the crust a rich blush and gloss, makes it bright crumb increases shelf life of finished products.

As a result, the addition of carrot juice products are obtained with a low fat content, but to the taste, flavor and color of the peel, not inferior to more high-prescription varieties.

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References
[1] Conte P, Fadda C, Piga A et al. 2016 Techno-functional and nutritional performance of commercial breads available in Europe. Food Sci. and Technol. Int. 22(7) 621–633 DOI:https://doi.org/10.1177/1082013216637724
[2] Prosekov A Yu and Ivanova S A 2016 Providing food security in the existing tendencies of population growth and political and economic instability in the world. Foods and Raw Materials. 4(2) 201–211 DOI:https://doi.org/10.21179/2308-4057-2016-2-201-211
[3] Dorn G A, Savenkova T V, Sidorova O S, and Golub O V 2015 Confectionery goods for healthy diet. Food and Raw Materials. 3(1) 70–76 DOI:10.12737/11240
[4] Timotijevic L, Khan S S, Raats M, Braun S 2019 Research priority setting in food and health domain: European stakeholder beliefs about legitimacy criteria and processes. Food Policy. 83 116–124 DOI:https://doi.org/10.1016/j.foodpol.2018.12.005
[5] Laukemper R, Jekle M, Becker T 2019 Time-dependent adhesion behavior between dough and contact surfaces in bakeries. J. of Food Eng. 255 24–31 DOI:https://doi.org/10.1016/j.jfoodeng.2019.03.006
[6] Efremova E N 2015 Improving the formulation of wheat bread with additives that have functional and technological properties. News of the Nizhnevolzhsky agrouniversity complex: Science and higher professional education. 4(40) 207–213

[7] Lobanov V G, Slepokurova Yu I, Zharkova I M et al. 2018 Economic effect of innovative flourbased functional foods production. Foods and Raw Materials. 6(2) 474–482 DOI:http://doi.org/10.21603/2308-4057-2018-2-474-482