Improving the quality characteristics of flour confectionery when adding vegetable puree for the sustainable development of food production

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Abstract. The confectionery industry is an independent production sector in the food processing industry. The purpose of the work is to improve the quality of products and expand the assortment of confectionery - cupcake, which consists in adding vegetable puree (pumpkin). The object of the study is the Dutch cupcake. In the Volgograd State Agrarian University at the Department of Processing Technologies and Food Safety, test baking of a cupcake confectionery with the addition of pumpkin puree was carried out. According to organoleptic and physico-chemical parameters, the cupcakes met the requirements of State Standard 15052-2014 "Cupcakes. General technical conditions". When comparing the test samples, there are no significant differences, it differs in that the product with the addition of pumpkin puree has the smell and taste of pumpkin, and the porosity of the product decreases slightly, all this has a positive effect on the studied product. The profitability of the cupcake products with the addition of pumpkin puree is 1% higher than the control sample. A cupcake with the addition of pumpkin puree can be recommended as a preventive nutrition.

1. Introduction
Confectionery products are considered to be the most demanded and popular in the world in terms of taste and energy value among the products of the food industry [1].

Currently, this industry is one of the fastest growing industries. The annual growth in demand for confectionery products contributes to the development of industry in the Russian market. The development of confectionery industry enterprises is characterized by quick payback, high profitability and low risks [2].

Flour confectionery products occupy a leading place among confectionery products. Thirty percent of the assortment and volume of production of all flour confectionery products is given to the production of cupcakes [2, 3].

Currently, the population strives for a healthy lifestyle, proper nutrition, food industry enterprises are trying to keep up with the desires of consumers. In turn, enterprises, in order to expand the assortment and increase the demand for their products, introduce natural ingredients containing vitamins, macro- and microelements with therapeutic, preventive and functional properties into the formulation.

The use of berries, fruits, and vegetables in confectionery production is currently relevant [3].
The purpose of the work is to improve the quality of products and expand the assortment of confectionery products when adding pumpkin puree. To achieve the goal, the following tasks were solved:

- the recipe of a cupcake with pumpkin puree was studied;
- the quality of the cupcake was investigated;
- the economic efficiency of the cupcake was calculated.

The object of the study is a confectionery product - cupcake "Dutch".

2. Materials and methods

In our study, pumpkin was used in the form of puree, as a confectionery additive in the manufacture of dough for cupcakes.

In the Volgograd State Agrarian University at the Department of Processing Technologies and Food Safety in 2019-2020, test baking of cupcake confectionery with the addition of pumpkin puree was carried out.

Pumpkin is a perennial, frost-resistant herbaceous plant. For confectionery production, the following varieties are mainly interesting: nutmeg, vitamin, honey.

Pumpkin is a very fortified vegetable. Vitamins such as vitamin D, thiamine (vitamin B1), riboflavin (vitamin B2), tocopherol (vitamin E) are found in pumpkins. Vitamin D accelerates the growth of children, helps to digest coarse food well and enhances the vitality of the body. Pumpkin contains many other useful substances that are of great benefit to the body [4, 5]. Table 1 describes the chemical composition of pumpkin.

From Table 1, it can be concluded that the basis of pumpkin is water. Pumpkin is a low-calorie product. There is a small amount of protein and fat in the pumpkin.

| Indicators  | Content, per 100 g |
|-------------|-------------------|
| Fats        | 0.10              |
| Proteins    | 1.00              |
| Carbohydrates | 6.50           |
| Water       | 91.60             |
| Ash         | 0.80              |

Table 1. Chemical composition of pumpkin.

Pumpkin carbohydrates are represented by polysaccharides. This means that they are slowly absorbed and the body receives energy from them gradually, so it does not feel hungry for a long time. Since pumpkin has a composition rich in nutrients, it is easily digested and is a low-calorie product, it can be used in the confectionery industry [6].

Organoleptic and physico-chemical studies were carried out. According to organoleptic and physico-chemical parameters, the investigated product must comply with the requirements of State Standard 15052-2014 "Cupcakes. General technical conditions". Organoleptic research in the production of cupcakes studied the following indicators: structure, appearance, consistency, color, shape, smell and taste [7]. The condition of the crumb, the degree of porosity and acidity under certain baking conditions, as well as the elasticity and plasticity of the product were considered.

3. Results and discussion

The improvement of the production technology and the variety of the assortment consists in adding pumpkin puree to the investigated Dutch cupcake to improve the performance of confectionery products. Table 2 describes the recipe of the cupcake per 100 kg.

Comparing the recipes of the control and experimental samples of cupcakes, it should be concluded that the use of chicken eggs in the experimental version decreased by 14.3 kg. The use of granulated sugar decreased by 7.2 kg. The amount of wheat flour, baking powder and vegetable oil remained
unchanged. Pumpkin puree in the amount of 55.6 kg (29% of the total mass of raw materials) was added to the experimental version at the stage of kneading and knocking down the dough.

Table 2. Cake recipe per 100 kg.

| Raw material         | Control sample | Experimental sample |
|----------------------|----------------|---------------------|
| Chicken eggs, kg     | 57.1 (36.2%)   | 42.8 (22.73%)       |
| Granulated sugar, kg | 48.5 (30%)     | 41.3 (21.5%)        |
| Wheat flour, kg      | 48.5 (30%)     | 48.5 (25%)          |
| Baking powder, kg    | 0.14 (0.08%)   | 0.14 (0.07%)        |
| Vegetable oil, kg    | 3.35 (2.13%)   | 3.35 (1.7%)         |
| Pumpkin puree, kg    | 0              | 55.6 (29%)          |

A comparison of the organoleptic parameters of the product "Dutch Cupcake" and cupcake with the addition of pumpkin puree is presented in Table 3.

Comparing the control version and experimental version with the addition of pumpkin puree in Table 3, there are no significant differences, it differs in that the product with the addition of pumpkin puree has the smell and taste of pumpkin, and also the porosity of the product decreases slightly, all this has a positive effect on the studied product.

Table 3. Organoleptic indicators of the cupcake.

| Indicators         | "Dutch Cupcake"                                                                 | Cupcake with the addition of pumpkin puree                                                                 |
|--------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Taste and smell    | A product with a rich taste and characteristic aroma, without foreign tastes and odors | A product with a rich taste and with a pronounced pumpkin aroma, there is no foreign smell and taste    |
| Surface            | The upper surface is convex, without cracks, without finishing, with the presence of a pronounced lateral surface; on the lower and side surfaces there is no presence of emptiness, burnt, irregularities and breaks | The upper surface is convex, without cracks, without finishing, with the presence of a pronounced lateral surface; on the lower and side surfaces there is no presence of emptiness, burnt and r breaks |
| View in the break  | At the break, the baked product is without traces of non-kneading, there are no lumps, voids and hardening, the porosity is uniform | At the break, the baked product is without traces of non-kneading, there are no lumps, voids and hardening, the porosity is uniform |
| Structure          | Soft, bound, porous loosened, having no voids and compaction                     | Finely porous bound, soft, loosened, having no voids and compaction                                       |
| Form               | The lower and side surfaces are smooth, without voids and cavities, regular with a convexity on the surface | The lower and side surfaces are smooth and without voids and cavities, regular with a convexity on the surface |

Figure 1 shows a cupcake Dutch control sample and experimental sample with the addition of pumpkin puree in its whole form.
Figure 1. The studied Dutch cupcake in its whole form (a - control sample, b – experimental sample).

In Figure 2, you can clearly see the analyzed control and experimental samples in the section.

Figure 2. The analyzed Dutch cupcake in the section (a - control sample, b - experimental sample).

The physico-chemical parameters of the control and experimental samples are described in Table 4.

| Indicators                                      | "Dutch Cupcake" | Cupcake with the addition of pumpkin puree |
|------------------------------------------------|-----------------|------------------------------------------|
| Mass fraction of moisture, %                   | 26.2            | 28                                       |
| Mass fraction of total sugar, %                | 33.3            | 30                                       |
| Alkalinity in cupcakes prepared with chemical baking powder, in degrees, no more | 1.0             | 1.0                                      |
| Mass fraction of fat, %                        | 6.8             | 6.6                                      |

As a result of the analysis of Table 4, it can be concluded that when pumpkin puree is added to the cupcake, the indicators correspond to the standards given in State Standard 15052-2014 "Cupcakes."
General technical conditions". The addition of pumpkin puree significantly improved the quality indicators of the cupcakes studied. The mass fraction of total sugar decreased by 3.3%, as less sugar is used by 15%. The mass fraction of fat decreased slightly by 0.2%. The mass fraction of moisture increased by 1.8%, as pumpkin puree makes the product more moist, which has a positive effect on taste indicators.

Table 5 calculates the nutritional and energy value of the studied samples.

| Indicators                  | "Dutch Cupcake" | Cupcake with the addition of pumpkin puree |
|-----------------------------|-----------------|-------------------------------------------|
| Caloric content, kcal       | 324             | 243                                       |
| Proteins, g                 | 2.9             | 3.9                                       |
| Fats, g                     | 9.1             | 9.75                                      |
| Carbohydrates, g            | 61.6            | 34.83                                     |

Table 5 compares the nutritional and energy values of the studied samples. In the experimental sample, the caloric content is significantly lower than in the control sample. The protein and fat content is higher in the experimental sample, and the carbohydrate content is lower.

Thus, after conducting an organoleptic and physico-chemical assessment of the quality of the product, it was determined that the experimental sample complies with State Standards for the studied type of confectionery and is quite suitable for introducing it for a variety of assortment and for improving product quality.

Increasing the level of profitability is the main task of production [8, 9]. The calculation of the production cost of confectionery of the control and experimental samples was carried out (Table 6).

| Indicators                                | "Dutch Cupcake" | Cupcake with the addition of pumpkin puree |
|-------------------------------------------|-----------------|-------------------------------------------|
| Raw and basic materials                   | 56.8            | 52.5                                      |
| Auxiliary materials                       | 5.68            | 5.25                                      |
| Electricity                               | 3.21            | 3.21                                      |
| Salary (with deductions)                  | 19.28           | 19.28                                     |
| Depreciation                              | 0.33            | 0.33                                      |
| Maintenance and operation of equipment    | 0.68            | 0.68                                      |
| The cost of packaging                     | 0.28            | 0.26                                      |
| Transportation costs                      | 3.4             | 3.2                                       |
| Other costs                               | 1.14            | 1.05                                      |
| Total production cost                     | 90.8            | 85.73                                     |

Calculations of the production cost of the control and experimental samples of cupcakes showed that the cost of a cupcake with the addition of pumpkin puree is 5 rubles/kg less than the control sample. The difference in the production cost of the cake was influenced by the cost of raw materials and basic materials.

Table 7 shows the economic efficiency of the production of "Dutch Cupcake" and cupcake with the addition of pumpkin puree [10].

Based on calculations (Table 7), it can be seen that the cost of cupcakes with pumpkin puree is higher than for "Dutch Cupcakes". But with the help of the production of cupcakes with the addition of pumpkin puree, you can expand the assortment of confectionery products.
Table 7. Economic efficiency of the production of the studied types of cupcakes.

| Indicators                   | Units of measurement | "Dutch Cupcake" | Cupcake with the addition of pumpkin puree |
|------------------------------|----------------------|------------------|------------------------------------------|
| Volume of products sold      | kg                   | 75000            | 75000                                    |
| Cost of products sold        | rubles/kg            | 90.8             | 85.73                                    |
| Product price                | rubles/kg            | 147.12           | 138.81                                   |
| Revenue from sales           | rubles               | 9193500          | 8735250                                  |
| Profit                       | rubles               | 2383500          | 2308500                                  |
| Net profit                   | rubles               | 1906800          | 1846800                                  |
| Profitability of products    | %                    | 28               | 29                                       |

The following economic indicators also justify the cost of cupcakes with pumpkin puree: the price of products will be lower, which means that demand for the product will increase; the profitability of products sold is 1% higher, which is a good return on investment in the studied production.

4. Conclusion

Cupcake with the addition of vegetable (pumpkin) puree has a reduced nutritional and energy value. Adding pumpkin puree to a flour confection (cupcake) makes the color of the baked product yellowish and adds a pleasant pumpkin flavor. Pumpkin puree improves the taste and digestibility of confectionery. Pectin and dietary fiber contained in pumpkin in large quantities make this product low-calorie. The finished product contains vitamins, iron, magnesium, provitamin A, minerals. Minerals play an important role in the metabolism in the body.

When calculating the economic efficiency of the production of “Dutch cupcake” and cupcake with the addition of pumpkin puree, it can be concluded that the profitability of products sold with the addition of pumpkin puree will have a beneficial effect on economic efficiency.

Cupcake with the addition of pumpkin puree can be recommended as a preventive nutrition for functional disorders of the liver and kidneys, obesity, atherosclerosis, diabetes and other diseases.

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