Quality improvement and shelf life of sweets of the Assorty type

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Abstract. The current stage of development of the confectionery industry is characterized by a high degree of market saturation with a variety of products. In this regard, perfection of the assortment of products and improving their consumer properties are very relevant and timely. The purpose of the study is the development of the formula composition of sweets of the Assorty type, providing an increase of the nutritional qualities and flavor properties of products. The work is performed at the scientific research institute of «Food security» and the department of commodity science and commodity expertise of Plekhanov Russian University of Economics. Based on the laboratory tests, the composition of the components in the formula of sweets of the Assorty type of increased nutritional qualities was selected. High-protein flour from sunflower shrot was used to provide a high protein content in the product. The possibility of using a valuable food ingredient - powder from carob beans (carob) - as a substitute for cocoa solids has been shown. The nutritional qualities of the developed sweets was calculated, the obtained results confirmed the efficiency of the selected formula composition: the developed products exceed the control sample 1.5 times in protein content, while reducing the fraction of fat, carbohydrates and caloric content. The analysis of the complex of organoleptic indicators points to the high flavor and aroma properties of the developed sweets. The quality control of the developed products was conducted by organoleptic and physico-chemical indicators during storage. It is established that the developed composition provides the quality safety of sweets for 12 months.

1. Introduction

Confectionery products are an important component in the dietary of Russians and belonging to the favorite products that are ever-increasing demand of general population.

In the market economy conditions, the quality specifications, production and realization of products are focused on consumer needs. The main objective of the functioning of the confectionery industry in Russia is to satisfy the needs of general population in high-quality confectionery.

The current stage of development of the confectionery industry is characterized by a high degree of market saturation with a variety of products. In this regard, perfection of the assortment of products and improving their consumer properties are very relevant and timely.
The problem of increasing the shelf life of confectionery products is also one of the priorities in the confectionery industry, that leads to a rethinking of a set of factors affecting on the mechanism of the food spoilage.

Sweets are a complex, multicomponent product and stand out among all the confectionery products by the variety of composition, technology and assortment of finished products.

Today it is impossible to imagine a confectionery market without body sweets with filling. Fat, cream and fruit and berry fillings, jams, confitures, jelly, chocolate and creamy fillings are widely used for the production of sweets of the Assorty type. Due to these fillings, they become not only tasty, but also more economically effective, that is extremely important in modern market conditions.

Market research on the sweets market shows that the level of consumption of chocolate products in Russia is dynamically growing. However, not only the volume of current consumption of chocolates is growing, but also the requirements that Russian customers are making to them. The traditional criteria of consumer choice (price, flavor and quality) today are inseparable from a new group of criteria: health and a healthy lifestyle, safety and transparence (consumers want to know what they consume).

Specialists in the confectionery industry feel like doing to increase their protein content as the most valuable and deficiency component of food and reduce the amount of carbohydrates when creating new products.

The perspective source of protein substances can serve secondary resources of plant raw materials such as shrot [1] and meal [2], formed during the production of sunflower oil. It was established that the amino acid composition of high-protein flour from sunflower shrot is characterized by the presence of all the essential amino acids, high content of glutamic and asparagine acids, arginine, glycine, alanine, proline, serine and tyrosine [3].

Carob or carob beans, in crushed into powder can be used in a wide variety of food products. Carob is a source of fibrous, sugar, as well as a set of biologically active compounds, such as polyphenols and pinitol [4], the last of which has an insulin-like effect [5]. Polyphenols, which contain a significant amount of powder from carob seed, especially tannins, have antioxidant activity [6-8].

The work is done on carob powder was added to fermented-milk ice cream in combination with probiotic cultures [9], carob enriches it with dietary fiber and can serve as a substitute for lactose for people with a lack of appropriate food enzymes when adding into yogurt [10]. However, research of such kind are not conducted in Russia enough.

The usage of rosemary extract provides to keep the original quality of food products by stabilizing the processes underlying the development of rancidifying and salting of fats, against the background of the findings of antioxidant properties, so providing to increase shelf life [11].

In rosemary are identified 25 elements, some of which prevailing macros - kalium, calcium, magnesium, natrium, phosphorus and microelements - aluminium, silicium and ferrum. This emphasizes the therapeutic relevance and the possibility of creating medicines preparations to treat and prevention of a number of illnesses associated with disorder of mineral metabolism based on rosemary. Rosemary also contains tannins, flavonoids, rosemary, coffee, nicotinic, ursolic acids and amino acids [12].

The use of these ingredients in sweets composition provide to increase their competitiveness in order to prevent the displacement of products by analogues.

The purpose of the study is the development of the formula composition of sweets of the Assorty type, providing an increase of the nutritional qualities and flavor properties of products.

The following tasks were solved to achieve this goal:

- to develop a formula for sweets of the Assorty type of high biological value with use of vegetable protein;
- to conduct the quality control of the developed products by organoleptic and physico-chemical indicators during storage and define its shelf life.
2. Materials and methods

2.1 Materials
High-protein food flour from sunflower shrot («OZRKD Biotech-pro» LLC) is a functional product of deep biotechnological processing of sunflower shrot, has a delectable flavor and aroma, neutral colour, produced in accordance with TC 10.41.42-001-10152018-2019 «High-protein food flour from sunflower shrot «Bioproten». Technical conditions.

The plant extract «Rosemary extract NovaSOL Rosemary (EW0110C45/1)» is a solubilizate of a 15.0% rosemary extract (carnosine acid content no less than 6.0%) - a viscous, dark brown with an olive tint, oily liquid with a tangy.

Powder from carob beans Caruma 60 (strong roasting) («TransCarob_Rus» LLC). Made by TC 01 13-23-004-2993295-2017.

The control sample is sweets of the Assorty type produced at the confectionery company «SlaSti» in Tolyatti (table 1).

Table 1. Composition of confectionery glaze, filling and sweets of the Assorty type

| Product     | Composition                                      |
|-------------|--------------------------------------------------|
| Confectionery glaze | sugar, laurin fat, cocoa solids, coconut oil, edible salt, lecithin, «Vanillin» flavouring |
| Filling     | sugar, coconut oil, nonfat milk solids, lecithin, salt |
| Sweet       | sugar, coconut oil, laurin fat, nonfat milk solids, cocoa solids, edible salt, lecithin, «Vanillin» flavouring |

2.2 Determination of the peroxide number
The lipids of the studied products were realized by chlorophorm extraction at room temperature for 4-6 hours with periodic shaking of the containing of the flask. Then, the obtained extract was filtered and the solvent was distilled at atmosphere pressure and a temperature of (60 - 78)°C in a boiling water bath. The method for measuring the peroxide number is based on the interaction of peroxides contained in fat with potassium iodide in the presence of glacial acetic acid with the release of iodine and subsequent titration with solution of sodium thiosulfate. The peroxide number (X) in millimoles of active oxygen (1/2 О) per kilogram of sample (mmol/kg) was calculated by the formula:

\[ X = \frac{(V_1 - V_0) \cdot C \cdot 1000}{m}, \]

when: \( V_0 \) - the solution volume of sodium thiosulphate used in the control measurement, cube cm; \( V_1 \) - the solution volume of sodium thiosulphate used in the determination of fat peroxide number in a sample with lipids, cube cm; \( C \) - concentration of used solution of sodium thiosulphate, moles/cube dm; \( m \) - sample weight of studied fat, g; 1000 - a coefficient for conversion of the measurement result in millimoles per kilogram.

2.3 Determination of water activity
Water activity (Aw) was measured by the apparatus «AquaLab Pre» (Decagon Devices, Inc., Pullman, Washington, USA). AquaLab Pre uses the cooled mirror method to determine water activity. Aw was calculated by the formula:

\[ Aw = \frac{P}{P_0} = \frac{Rh}{100}, \]
when $P$ - water vapor pressure in the system of food product; $P_o$ - vapor pressure of pure water; $R_h$ - moisture relative in a state of equilibrium (in which the product does not imbibe moisture and does not release it into the environment), %.

2.4 Sensory analysis

The verbal scale was used to assess the intensity of the characteristic feature of flavor and aroma of the product using the profile method: 0 - no feature; 1 - only recognizable or felt; 2 - low intensity; 3 - middle intensity; 4 - strong; 5 - very strong intensity.

3. Results and discussion

During the research, degustation of control samples of sweets, fillings and confectionery glaze provided by the manufacturer was conducted. According to the results of the degustation, semi-finished products and finished products were found to be too sugary, without a signified characteristic chocolate flavor in the mass for molding the body and lactic flavor in the filling. Both masses were characterized by a bad taste of fat.

The data obtained allowed one to determine the direction of further research. Considering a given the task, raw materials were selected which could presumably improve the flavor profile of semi-finished products and the finished product, and with their use samples of confectionery glaze, filling and sweets were made (table 2).

Table 2. Composition of the developed confectionery glaze, filling and sweets of the Assorty type

| Product      | Composition                                                                 |
|--------------|-----------------------------------------------------------------------------|
| Confectionary glaze | sugar, laurin fat, coconut oil, carob, cocoa solids, lecithin, edible salt, «Swiss chocolate» flavouring, «Orange» flavouring, «Vanillin» flavouring, rosemary extract |
| Filling      | sugar, coconut oil, sunflower flour, nonfat milk solids, lecithin, edible salt, «Almond» flavouring, «Caramel» flavouring, rosemary extract |
| Sweet        | sugar, coconut oil, laurin fat, sunflower flour, nonfat milk solids, carob, cocoa solids, lecithin, edible salt, «Swiss chocolate» flavouring, «Almond» flavouring, rosemary extract, «Orange» flavouring, «Vanillin» flavouring, «Caramel» flavouring |

The nutritional qualities of the developed sweets of the Assorty type was calculated, the obtained results confirmed the efficiency of the selected composition of the raw materials: high protein content in the finished product 6.0% (table 2). A comparative analysis of the nutritional qualities of the control and experimental sweet samples showed that the developed products exceed the control sample 1.5 times in protein content, while reducing the fraction of fat, carbohydrates and caloric content (table 3).

Table 3. Composition of the main nutrients in sweets of the Assorty type

| Composition, g per 100 g | Sweets         |
|-------------------------|----------------|
| control                 | experiment    |
| protein                 | 4.0           | 6.0          |
| fats                    | 35.0          | 31.0         |
| carbohydrates           | 57.0          | 55.0         |
| Caloric content, kcal/kJ| 540/2263      | 530/2221     |

The analysis of the complex of organoleptic indicators points to the high flavor and aroma properties of the developed sweets of the Assorty type. It is noted that the added of high-protein flour from sunflower shrot in the filling influenced the organoleptic characteristics of sweets, a delectable
halva flavor appeared. The control sample was differed by excessive sweetness, as well as a bad melting body, the filling melted is faster than the glaze.

Objects were researched for 12 months of storage. The declared shelf life of the control sample is 6 months. However, after 4 months of storage, the control sample had a foreign and unclean flavor, characteristics of rancidity. The experimental samples had high flavor properties during the whole shelf life.

The resistance of sweets to long shelf life was studied by analyzing changes in the values of peroxide number. It was noted that oxidative processes during storage of experimental sweets proceeded more slowly compared with control samples (table 4).

| Sample                  | Peroxide number, mmol ½O/kg |
|-------------------------|-----------------------------|
|                         | Storage duration, months    |
|                         | Start of storage | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Control                 | 0.28 | 0.31 | 0.40 | 1.01 | 1.30 | 2.10 | 1.91 | 2.30 | 2.10 | 2.40 | 2.80 | 2.50 | 2.90 |
| Confectionery glaze     | 0.17 | 0.21 | 0.28 | 0.44 | 0.57 | 0.51 | 0.55 | 0.52 | 0.59 | 0.90 | 1.01 | 1.50 | 1.70 |
| (control)               | 0.13 | 0.25 | 0.19 | 0.56 | 0.52 | 0.56 | 0.61 | 0.55 | 0.80 | 1.02 | 1.30 | 1.50 |
| Filling (control)       | 0.18 | 0.28 | 0.37 | 0.28 | 0.63 | 0.54 | 0.48 | 0.57 | 0.66 | 1.50 | 1.30 | 1.70 | 1.90 |
| Experiment              | 0.08 | 0.11 | 0.16 | 0.30 | 0.37 | 0.38 | 0.44 | 0.40 | 0.43 | 0.80 | 0.90 | 1.30 | 1.40 |
| Confectionery glaze     | 0.07 | 0.13 | 0.18 | 0.26 | 0.33 | 0.38 | 0.39 | 0.47 | 0.52 | 1.08 | 0.80 | 1.20 | 1.40 |
| (experiment)            | 0.07 | 0.13 | 0.18 | 0.26 | 0.33 | 0.38 | 0.39 | 0.47 | 0.52 | 1.08 | 0.80 | 1.20 | 1.40 |

The results show that at the end of storage of experimental sweets, the values of peroxide number did not exceed the established parameters. The dynamics of organoleptic indicators also confirmed the resistance of this sample to oxidation. Thus, it is an obvious fact that the content in sweets of a complex of natural antioxidants (included in the composition of powder from carob beans and rosemary extract) has an inhibition on the accumulation of oxidation products.

The storage duration of food products is determined by the content and condition of moisture in them. Recently, the water activity indicator (Aw) has been widely used to characterize food products which characterizes the association energy of moisture in a wet material. In the USA and EEC countries, activity water is a mandatory value of safety and quality for most foods. The kinetics of microbiological and biochemical processes, including those responsible for spoilage of food, depends on the value of the water activity. As a rule, their intensity decreases with reduction of the water activity. This indicator determines the course and direction of mass exchanging processes between the product and the environment, affects the structural-mechanical properties of finished products [13].

The water activity in the confectionery glaze, fillings and sweets of the Assorty type of experimental and test samples was determined (figure 1).
Figure 1. The change of Aw in sweets samples during storage

As can be seen from the data presented, sweets belong to products with low moisture according to the water activity $\text{Aw}<0.6$. The higher the $\text{Aw}$ in the product, the more likely some types of microflora have vital action. Microbiological processes do not proceed in products with low moisture, they retain their qualities for a long time, which confirms the reality of increasing the shelf life of the experimental product.

4. Conclusion
Based on the research, a formula composition of sweets of the Assorty type was developed, which contributes to increasing the nutritional qualities of the product due to additional enrichment with vegetable protein, improving organoleptic characteristics and increasing the shelf life of sweets.

The quality control of the developed products was conducted by organoleptic and physico-chemical indicators during storage and fix their shelf life. The developed composition provides the quality safety of sweets for 12 months.

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