Prospects for the Use of *Arctium Lappa L* Extract in the Production of Candy Caramel for Diabetic Nutrition

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Abstract

Expanding the range of specialized products is a new stage in the development of modern food industry. More than 4 million people suffer from diabetes in the Russian Federation. People with such a diagnosis need to exclude products containing sucrose from their diet, since it has a high glycemic index - 1. It should be noted that it is necessary not only to create a product without sucrose, but also able to improve the quality of life and work of the human body. Food enrichment is a trend in the modern food industry. The creation of such products allows not only expanding the range of food products, but also filling in the deficiencies of macro and micronutrients in the body. The aim of the work was to study the possibility of creating isomalt caramel with the addition of *Arctium Lappa L* extract and eucalyptus oil for diabetic nutrition. The studies were conducted according to organoleptic and physico-chemical quality indicators established by GOST 6477-88. Organoleptic quality indicators were evaluated by a tasting method; humidity and acidity were accepted as criteria of physical and chemical indicators. It is noted that the introduction of 2g of the

additive does not affect the quality indicators, and 5g exceeds the critical values established by regulatory documents. The optimal dosages of fortifying additives are 4% extract of burdock and 0.01ml of eucalyptus oil. Such dosages can increase the nutritional value of caramel.

Keywords: diabetic nutrition; isomalt; candy caramel; *Arctium Lappa* L; functional product.

Introduction

A feature of the current stage of the food industry development is the development of functional products necessary for proper human nutrition. This approach allows creating a product that meets the individual needs of a person, i.e. personal needs (Nikitina, Chernukha, 2020). The consumption of functional foods let balance the diet and prevents a shortage of macro, micronutrients and vitamins (Roberfroid, 2002).

To develop the functional food market in Russia, a new settlement system was created in 2015 based on the Food Supplements and Education Act (DSHEA) system, which has been effectively operating in the United States since 1994. Since the introduction of this system, many new functional products have been developed in comparison with FOSHU, thanks to the simplification of state accreditation. As a result of the expansion of production in 2018, sales of functional products increased to 1.8 billion and the level is growing every year. So the total market (FOSHU and New Functional Foods) is about \$ 8 billion (Iwatani, Yamamoto, 2019).

The development and popularization of a sports lifestyle and active pastime creates the need to develop proper nutrition, which can reduce human fatigue, as well as reduce the recovery time of the body, due to the BAS contained in the product. Today, every person, regardless of lifestyle and physical activity, realizes the need for proper nutrition and is more and more familiar with this branch of nutrition. Consumption of fortified foods creates an opportunity to improve the tone of the body and improve the standard of living (Miškulin et al., 2019).

Sugar products, in particular candy caramel, are one of the most popular consumer goods. To improve the nutritional properties of caramel, it is necessary to search for new components to add to the recipe, which can contribute to the proper functioning of the body. Since the addition of inulin to the diet, which is necessary for the normal functioning of the gastrointestinal tract, brain and other organs, the polysaccharide is also necessary for people suffering from diabetes. Inulin is a water-soluble storage polysaccharide and belongs to a group of non-digestible carbohydrates called fructans. Inulin has received GRAS status and is widely available in approximately 36,000 plant species, including burdock roots. Inulin is commonly used as a prebiotic, fat substitute, sugar substitute, texture modifier and to develop functional foods to improve health through its beneficial role in stomach health. Inulin is used as a functional ingredient in the development of new food

products (Shoaib et al., 2016). Due to the high content of carbohydrates in the composition, sugar candy is contraindicated for patients with diabetes mellitus, due to a possible dramatical increase of glycemic index. Diabetes mellitus is a panacea of the XXI century, which is much younger, 83% of people with a diagnosis are children and adolescents (Shestakova et al., 2019). This disease is characterized by high blood glucose levels and relative insulin deficiency. Since 2010, about 6% of the adult population has been diagnosed with diabetes mellitus (about 285 million people), the second type of diabetes accounts for 90% of all cases (Evert et al., 2019). Research scientists predict an increase in the number of cases due to increased economic welfare of countries and citizens, so by 2030 the number of cases will reach 0.5 billion people (Guariguata et al., 2014). With an increase in the population, the diagnosis will lead to an increase in costs in the health care system up to 16.9 billion rubles (Asaad et al., 2016). Studies by the Canadian Diabetes Association (CDA) scientists have proven the effectiveness of a diet that includes the necessary nutrients. Such therapy will help reduce the level of glycated hemoglobin (A1c) by 1-2%, which means improve cholesterol levels and alleviate the body's condition (Dworatzek et al., 2013). In this regard, the development of confectionery products diabetic is relevant (Kolbina, Kurbanova, 2020).

Methods

The studies were conducted on the basis of the Department of Agrobiotechnology of the Kuzbass State Agricultural Academy. Control samples were made according to the classic recipe of candy caramel. In the experimental samples, granulated sugar was replaced with isomalt, Arctium Lappa L extract (1% -5%) and eucalyptus oil in an amount of 0.01ml were introduced for enrichment. The indicated concentrations are justified by the daily intake and taste preferences of the added additives, presented in Table 1.

Table 1. Scheme of the experiment on the influence of biologically active substances on the candy caramel qualitative properties

Sample	Characteristics
Control	Traditional recipe, no additives
Experiment 1	Isomalt caramel, no additives
Experiment 2	Isomalt caramel, 2 % Burdock extract, 0.01 ml of Eucalyptus extract
Experiment 3	Isomalt caramel, 3 % Burdock extract, 0.01 ml of Eucalyptus extract
Experiment 4	Isomalt caramel, 4 % Burdock extract, 0.01 ml of Eucalyptus extract
Experiment 5	Isomalt caramel, 5 % Burdock extract, 0.01 ml of Eucalyptus extract

When studying the effect of the introduced additives, the samples were investigated by physicochemical and organoleptic quality indicators. The objects of study were isomalt-based candy caramel with the addition of enriching additives of Arctium Lappa L. root extract and eucalyptus oil.

Results

Candy caramel is a low-recipe confectionery product, due to which it is available to all segments of the population. The main ingredients are granulated sugar, which is prohibited in the consumption of diabetes mellitus; in connection with this it is necessary to replace the product. The choice is made on isomalt, also known as palatinose, a natural component derived from sugar beets. Compared to sucrose, isomalt has a high stability, favorable for teeth, slow digestibility and a 40-50% reduction in sweetness, compared to sucrose. Isomaltulose has a low glycemic index, an increased source of energy, and also does not have a negative effect on the human body. It is successfully used in the production of chocolate, breakfast cereals, chewing gums, dairy products, ice cream and yogurt (Sawale et al., 2017). The main advantage of isomalt is that its hydrolysis process is 4-5 times slower than the sucrose one. Dentists also prefer isomalt, due to the fact that it does not harm tooth enamel and does not cause tooth decay (Shishkina et al., 2015). In the process of the study, isomalt caramel was developed with a large Burdock extract with a concentration of 2 to 5g per 100 g of caramel mass. Tasting evaluation showed that the addition of 2g does not change the taste compared with the control sample. In accordance with GOST R 53904-2010, the isomalt sweetness coefficient is 2 times less than the sucrose coefficient, which is 0.5 and 1 respectively, as a result of which experimental sample 2 did not differ in degree of sweetness from the control. Appearance of the control sample and the experimental isomalt sample without additives and with additives in the amount of 2g is shown in Figure 1.

Control

Experiment 1

Experiment 2

Figure 1. Organoleptic evaluation of samples

With an increase in the burdock extract concentration, there was noted an increase in herbal taste, the appearance of bitterness and darkening in the coloring. With the introduction of 5g of an enriching additive, there was noted a decrease in the score according to organoleptic indicators (taste, color, smell): pronounced bitterness, astringency of the herbal taste. Good taste was noted in samples No. 3-6, which are presented in Figure 2.

Experiment 3

Experiment 4

Experiment 5

Figure 2. Organoleptic evaluation of samples

During the tasting assessment, a color change from light beige to dark yellow was noted. The increase in color is associated with a change in the concentration of the extract of *Arctium Lappa L.*, which has a dark brown color.

A study of physico-chemical quality indicators, such as humidity and solids content, showed that with addition of additives, the moisture content decreases in average by 0.5% compared to isomalt caramel without additives, thereby observing a trend: with an increase in the concentration of *Arctium Lappa L.* extract in isomalt caramel samples, the moisture content is proportionally reduced. In this case, the humidity of the control sample and experiment 1 is equal to within the error. Accordingly, the solids content in the samples with an increase in the content of *Arctium Lappa L.* is proportionally increased. Data on determination of the samples' moisture content are presented in Figure 3.

Figure 3. Humidity of candy caramel samples

An important indicator of assessing the quality of candy caramel is the acidity of the caramel mass. In the course of the work, it was determined that the acidity of test samples 2, 3, 4, and 5 increases by an average of 2.1 degrees with respect to sample 1; thus, the following tendency is observed: with an increase in the *Arctium Lappa L* extract concentration, the acidity proportionally increases. Acidity data are presented in Figure 4.

Figure 4. Acidity of candy caramel samples

The indicator of the experiment 1 sample in comparison with the control has not changed, within the margin of error. The acidity of the caramel mass is regulated by the values of GOST 6477-88 (not more than 7 degrees), the performance of the experiment 5 sample exceeds the values established by the regulatory document.

Discussion

The technological scheme for the production of isomalt caramel consists of the following operations: preparation of raw materials, preparation of syrup, filtering, boiling (5 minutes), introduction of Burdock extract and Eucalyptus oil, homogenization, molding and packaging (Tarabanova, Gaptar, 2018).

When processing the results of the experiments, it was found that the optimal dosage of making the *Arctium Lappa L* extract is 4g per 100g of caramel mass.

Determining the energy value, there was noted a significant decrease in the product calorie content. So, the control sample was 386, 73 kCall, caramel from isomalt with the addition of 4% - 232 kCall.

The calculation of the nutritional adequacy of isomalt caramel shows the possibility of caramel consumption for all segments of the population, including patients with diabetes mellitus, both children and adults. There are no restrictions on the consumption of sweetener. The addition of large burdock extract to the formulation can improve the nutritional value of the product: the content of inulin, potassium, calcium, magnesium, folic acid. Eucalyptus oil also contains macro and micronutrients that the body needs, it also gives a light illuminating aroma and taste, relieves sore throat. The supplement contains substances such as iron, boron, cobalt, silicon, manganese, nickel and other substances and vitamins (B, C, E, PP) for the normal functioning of the body. Conducted scientific studies indicate that it is impossible to provide the body's need for nutrients without the use of functional enriched foods.

Conclusion

The use of *Arctium Lappa* L extract and Eucalyptus oil in isomalt caramel has been theoretically justified and practically confirmed. The technology was developed and the optimal dosage of additives in the formulations was determined - 4g per 100g of caramel mass.

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