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## DEVELOPMENT OF DIETARY CHOCOLATE PRODUCTS USING NATURAL SWEETENERS

**Abstract.** Chocolate is a popular confectionery among children and adults. However, excessive consumption of chocolate adversely affects human health due to the high content of simple carbohydrates, in particular sucrose. The Department of "Technology of bread products and processing industries" of Almaty Technological University has developed a recipe for chocolate with natural sweeteners (stevioside and erythritol). The resulting sample is characterized by the maximum approximation to the traditional taste, there is no side effect of the used sweeteners – bitterness and a specific aftertaste.

In terms of organoleptic and physico-chemical parameters, it is close to the classic dark chocolate, and also exceeds by more than two times the average value of the antioxidant capacity for the lipophilic fraction in the chocolate line of the traditional recipe using sugar and without additives (control sample). This may be a consequence of the increased content of cocoa products in the formulation of the prototype chocolate compared to the control sample due to the exclusion of sugar from its formulation and its replacement with natural sweeteners.

**Keywords:** sweeteners, stevia, erythritol, chocolate.



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**Introduction.** The accumulated domestic and foreign experience indicates that the most effective way to correct nutrition and prevent carbohydrate metabolism disorders is to follow an appropriate diet, including products that do not contain sugar. Modern specialized confectionery products of diabetic nutrition for people with impaired carbohydrate metabolism suggest the inclusion of sweeteners or sweeteners in the recipe instead of sugar.

Chocolate is a popular confectionery among children and adults. However, excessive consumption of chocolate adversely affects human health due to the high content of simple carbohydrates, in particular sucrose [1-2].

Chocolate, which does not contain sucrose in its composition, is perfect for athletes, people suffering from diabetes. At the same time, such chocolate does not contribute to excessive fat deposition in the body, does not destroy tooth enamel, has a low glycemic index (does not increase blood sugar levels) [3-5]. Patients with diabetes mellitus deny themselves the use of sweets, including chocolate because of the sugar content in it. This is especially contraindicated for those with type I

diabetes. Eating foods containing sugar increases the risk of complications. But the ban on chocolate is conditional for patients with type 2 diabetes. A diabetic who keeps the sugar level at a properly stable level may well be treated to a piece of chocolate without much harm to the body. Only chocolate needs to be purchased bitter black or special diabetic.

Therefore, the development of a chocolate recipe based on natural sweeteners with a low glycemic index and calorie content contributes to expanding the range of products for people with diabetes, as well as those who want to lose weight and maintain the desired weight, for supporters of a healthy lifestyle and proper nutrition.

Reducing the sugar content in chocolate is not an easy task. The amount of sugar can be regulated by reducing its content in the recipe by introducing sweeteners that do not have calories. It is possible to use so-called "bulk" sweeteners, the level of sweetness of which is close to sucrose (xylitol, sorbitol, manitol, etc.), or intensive, which are many times sweeter than sucrose (cyclamate, aspartame, etc.) [4-7].

The purpose of the work is to analyze and generalize international and domestic experience in the use of sweeteners and sweeteners in the technology of chocolate products, as well as systematization of their properties. Research objectives: to analyze the advantages and disadvantages of sweeteners and sweeteners; to systematize data on the practical use of sweeteners and sweeteners in confectionery technology for further research on the development of specialized confectionery products.

**Conditions and methods of research.** The Department of "Technology of bread products and processing industries" of Almaty Technological University has developed a recipe for chocolate with natural sweeteners (stevioside and erythritol).

In some countries of the world, the use of stevia has become habitual. Sweet honey grass can be consumed without restrictions, focusing only on the body's need for sweet foods, while long-term use of steviosides causes a cardiotoxic effect, having a positive effect on the function of the cardiovascular system. Stevia is an indispensable food product for overweight people, as it is calorie-free and has a complex of biologically active substances that normalize carbohydrate metabolism in the body [6-8].

Erythritol (erythritol) is a polyatomic sugar alcohol produced on a production scale from corn. In its natural form, it is found in melons, pears, grapes and other fruits and vegetables [7]. The sweetness coefficient of erythritol is 0.7. Its energy value is only 0.02 kcal/gr. whereas sucrose has 4 kcal/gr.

The main difficulty in the manufacture of chocolate with sugar substitutes in the traditional way is that when replacing sucrose with stevia and erythritol, a specific bitterness appeared in the finished chocolate, the elimination of which became the main task at the initial stage of development [8-9]. Erythritol partially helps to reduce the bitterness of stevioside by increasing its dosage. In addition to it, inulin, vanilla, cinnamon and coconut flour were introduced into the chocolate recipe. These supplements can increase the amount of dietary fiber.

To eliminate bitterness, the optimal quantitative ratio of all the ingredients contained in chocolate was selected. The test samples were prepared as follows: chocolate mass was poured into stone melangers, prepared according to recipes differing in the mass ratio of the above ingredients. Conching and melanging processes were carried out within 48 hours from the end of loading.

During this time, the size of the volume fraction of particles reached 30 microns, and the degree of grinding of the chocolate mass was 97%, which made it possible to make its taste advantages more complete and subtle. After the end of the

melange, the chocolate was tempered on a granite table, then dosed into molds and placed in a cooling chamber for 30 minutes. In order to evaluate the resulting chocolate and achieve the best taste indicators, a "blind" tasting was carried out. A group of tasters, including a person suffering from type II diabetes, was presented with chocolate with a different ratio of ingredients.

Figure 1 shows a diagram of chocolate ratings by taste parameters. The composition of sample 1 included cocoa mass and cocoa butter in a ratio of 1:3, erythritol, stevioside, coconut flour and inulin. Sample 2 differed from sample 1 by adding cinnamon and vanilla. In the 3rd variant, the ratio of grated cocoa and cocoa butter changed and amounted to 1:2, erythritol and stevia were added without additives. Samples 4 and 1 were similar in composition, but different in the ratio of grated cocoa to cocoa butter (1:2). In its composition, sample 5 is identical to 2, but contains less grated cocoa. The last chocolate sample uses all the ingredients.

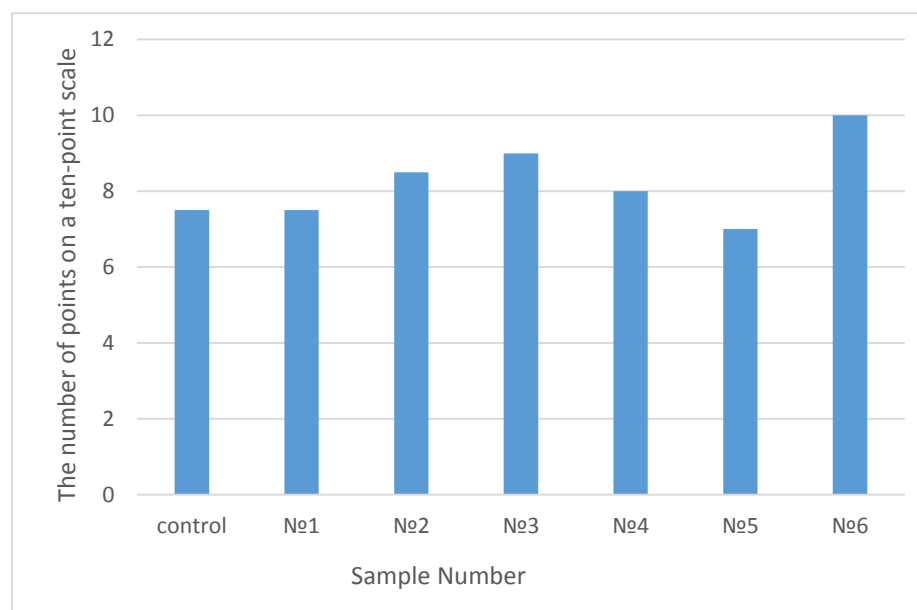


Figure 1. The results of chocolate evaluation on a ten-point scale

As a result of the tasting evaluation, a sample was selected with an optimal ratio of prescription components: cocoa mass, cocoa butter, cinnamon, erythritol, stevioside, vanilla and coconut flour – 60:20:0, 6:10:0, 01:6, 39:3. With this ratio of ingredients, the test sample is characterized by the maximum approximation to the traditional taste of classic dark chocolate. Chocolate was also prepared according to the traditional recipe using sugar and without additives.

**Research results.** The resulting chocolate was examined according to organoleptic and physico-chemical quality indicators compared with the control sample (Figure 2 and Table 1).

Based on the analyses of the developed chocolate and the control sample, analyses of the finished results were made. Results and their discussion. According to the results of the organoleptic evaluation shown in the figure, it was found that

there were no differences between the experience and the control, with the exception of taste. This is due to the slight cooling effect of erythritol in the test sample.

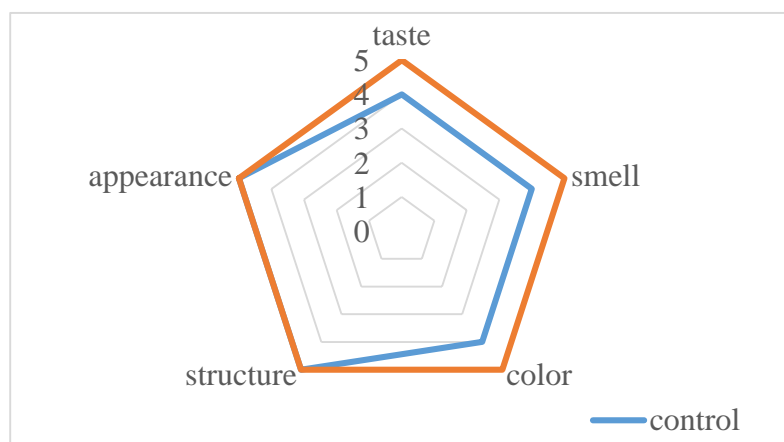


Figure 2. Organoleptic quality indicators of the developed chocolate

Table 1

Physico-chemical quality indicators of the developed chocolate

Indicator	Characteristics of chocolate samples	
	Control	Developed sample
Mass fraction of cocoa butter in terms of on dry sub-stance, %	50	20
Mass fraction of total solids in the pen- account for dry substance, %	70	80
Fineness, %	95	95
The total content of fat-soluble (SSA) antioxidants, mg/100 g	63	115
Water soluble (PAS) antioxidants, mg/100 g	-	-

The glycemic index of bitter chocolate with a cocoa product content of 72% and sugar has a rather low value - 25-30 units, however, with the exclusion of sugar and the addition of inulin, the glycemic index decreased to 20 units.

The degree of chocolate grinding was the same in both cases (at least 95%).

The energy value of the prototype is 425 kcal / 100 gr., and the control one is 508 kcal / 100 gr.

Improving the technology of chocolate production with the replacement of sugar with steverite and inulin made it possible to obtain bitter chocolate with a functional value, a reduced glycemic index and energy value, acceptable organoleptic parameters and the degree of grinding compared to the control. At the same time, the cost of such chocolate was 100-200 tenge / 100 gr. above the control. Diabetics recommend this chocolate for use.

To meet the physiological needs of dietary fiber, it is necessary to eat at least 2 servings of chocolate per day (1 serving is 10 grams).

From the obtained data presented in Table 2, it can be seen that the prototype chocolate has the value of the antioxidant capacity index for the lipophilic fraction of 115 mmol TE / g of weight, which is more than twice the average value of AOE in the chocolate line of well-known Russian manufacturers. This may be a

consequence of the increased content of cocoa products in the formulation of the prototype chocolate compared to the traditional chocolate of the control sample due to the exclusion of sugar from its formulation and its replacement with natural sweeteners.

The value of the indicator of the antioxidant capacity of the prototype chocolate by the hydrophilic fraction was also negligible, as in the chocolate of the control sample, which is due to the lack of moisture in the chocolate and, accordingly, water-soluble substances.

**Discussion of scientific results.** Thus, in order to implement the basic consumer requirement "people should not get fat from chocolate" and the technical characteristic "calorie content", sucrose can be replaced with sweet substances of vegetable origin, cocoa beans variety can be used for the production of chocolate with a reduced calorie content and dietary fiber can be introduced into the chocolate recipe.

At the same time, the new product will have advantages that distinguish it from other similar products from this product line: thanks to the replacement of sugar with other sweet substances of plant origin (glycyrrhizin, stevioside, citrus flavonoids), chocolate acquires the following useful properties: reducing calories, preventing caries, anti-inflammatory effect, anti-allergic properties, etc.

**Conclusion.** As a result of the conducted research, a recipe for dietary chocolate based on erythritol, stevia extract and a number of natural ingredients that do not contain sucrose in its composition was developed. In the resulting product, there was no side effect of the used sweeteners – bitterness and a specific aftertaste. In addition, the content of antioxidants in the developed chocolate was higher than in the chocolate of classical manufacture.

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### **ТАБИҒИ ТӘТТІЛЕРДІ ҚОЛДАНАТЫН ДИЕТАЛЫҚ ШОКОЛАД ӨНІМДЕРІН ӘЗІРЛЕУ**

**Аңдатпа.** Шоколад - балалар мен ересектер арасында танымал кондитерлік өнім. Дегенмен, шоколадты шамадан тыс тұтыну қарапайым көмірсулардың, атап айтқанда сахарозаның көп болуына байланысты адам денсаулығына теріс әсер етеді. Алматы технологиялық университетінің «Нан-тоқаш өнімдері және өңдеу өнеркәсібі технологиясы» кафедрасында табиғи тәттілендіргіштері (стевиозид және эритритол) бар шоколадтың рецепті жасалды. Алынған үлгі дәстүрлі дәмге максималды жақындаумен сипатталады, ол қолданылған тәттілендіргіштердің жанама әсері жоқ - ащы және ерекше дәм.

Органолептикалық және физика-химиялық көрсеткіштері бойынша ол классикалық қара шоколадқа жақын, сонымен қатар қант қосылған және қоспасыз (бақылау үлгісі) дәстүрлі рецепт бойынша шоколадтың липофильді фракциясы үшін антиоксиданттық қабілетінің орташа мәнін екі еседен астам жоғарылатады. Бұл оның рецептінен қантты алып тастауға және оны табиғи тәттілендіргіштермен ауыстыруға байланысты бақылау үлгісімен салыстырғанда тәжірибелік шоколад рецептісінде какао өнімдерінің жоғарылауымен байланысты болуы мүмкін.

**Тірек сөздер:** тәттілендіргіштер, стевия, эритритол, шоколад.

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### **РАЗРАБОТКА ДИЕТИЧЕСКИХ ШОКОЛАДНЫХ ПРОДУКТОВ С ИСПОЛЬЗОВАНИЕМ НАТУРАЛЬНЫХ ПОДСЛАСТИТЕЛЕЙ**

**Аннотация.** Шоколад является популярным кондитерским изделием среди детей и взрослых. Однако чрезмерное потребление шоколада неблагоприятно отражается на здоровье человека из-за высокого содержания простых углеводов, в частности сахарозы. На кафедре «Технология хлебопродуктов и перерабатывающих производств» Алматинского технологического университета разработана рецептура шоколада с природными сахарозаменителями (стевиозид и эритритол). Полученный образец характеризуется максимальным приближением к традиционному вкусу, в нем отсутствует побочный эффект применяемых сахарозаменителей – горечь и специфичное послевкусие.

По органолептическим и физико-химическим показателям он приближен к классическому темному шоколаду, а также превосходит более чем в два раза среднее значение антиоксидантной емкости по липофильной фракции в линейке шоколада традиционной рецептуры с использованием сахара и без добавок (контрольный образец). Это может быть следствием увеличенного содержания какао продуктов в рецептуре опытного образца шоколада по сравнению с контрольным образцом в связи с исключением сахара из его рецептуры и заменой его на натуральные сахарозаменители.

**Ключевые слова:** подсластители, стевия, эритрит, шоколад.