

Kametsel Frumentarious Dietary Fibers as a Functional Ingredient to Prevent Obesity

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Abstract.

Obesity is a serious problem that causes considerable economic and social losses, the level of which constantly grows. Over the recent years the science has started developing the production of food with low energy caloric content thanks to substitutes. Some requirements are set to them: the substituted products must be a demanded food ingredient due to their multi-functionality. The results of the research allowed referring them to the required components of the diet that have health-promoting properties. The authors made a review of food that is economically advantageous for the producer and does not have any impact on the organoleptic properties of the product and contains constitutional substances. Kametsel frumentarious dietary fibers comply with such requirements. The article studies physical and chemical indicators of the Kametsel dietary fibers quality, and water and fat binding capability. The degree of dietary fibers imbibition depending on the temperature was defined. To develop new functional products, moisture absorption for frumentarious dietary fibers was studied. The review of food products containing Kametsel dietary fibers was made. The authors researched the possibility to use Kametsel FW 200 dietary fibers preliminarily dissolved in water in the receipt of the shortbread biscuits instead of the fat component. However, the enrichment of the food product with dietary fibers assumes their use in the amount of not less than 3-6 g per 100 g of the ready product which is associated with possible changes of its quality. That is why when developing functional products with dietary fibers, every case requires experimental research focused on solving technological tasks.

Key words: dietary fibers, obesity, prevention, Kametsel, nutrition, biscuits.

INTRODUCTION.

The modern world has a problem of safe and correct nutrition because a lot of low quality and falsified food is regularly revealed, which causes poisoning and diseases.

Nutrition plays an important role in physiological needs of the person's body - from his formation to protection from negative impact of external factors. The nutrition can be called sensible or balanced if it contains enough proper and quality substances. It has an impact not only on the individual development of the person, but also predetermines the development and life activity of many generations [1].

Obesity is a multi-factorial disease that appears as excess accumulation of fat tissue in the organism (not less than 20% of the body weight with men, and 25% with women). One of the main reasons of this disease is the incompletion of the calories that get into the organism and their metabolic cost. It is followed then by other dangerous diseases [2].

The risk of obesity occurs in case of excess consumption of products with a high content of calories. Diabetes, heart and oncological diseases happen on this background. Healthy life style and sensible nutrition can prevent these undesirable consequences [3-6]. In this context, it is urgent to develop pastry with the low content of fat.

Obesity is a serious problem that causes considerable economic and social losses, the level of which constantly grows [3, 4].

The social and economic effect of the obesity problem is as important. It is defined by the threat of the employable population's disability and decrease in the life duration as a result of associated diseases.

Researchers defined that in Finland adults with obesity suffered from unemployment more often than their companions with the normal weight. Besides, it was defined that in Sweden the percentage of the labor efficiency losses as a result of temporary unemployment or invalidity was 10% [2-4, 7].

The body overweight causes economic consequences, for example, additional expenses. There are direct expenses like medicinal drugs, weight loss products, and special clothes. Indirect expenses include loss of labor efficiency as a result of missing working days because of the disease [2]. Thus, it is urgent to develop medical and preventive food products meant for people who are apt to and suffer from obesity.

Over the recent years the science has started developing the production of food with low energy caloric content thanks to producing substitutes. Some requirements are set to them: the substitution must be economically profitable for the producer; it must not have an impact on organoleptic properties of the product and should contain useful substances.

Dietary fibers that are the most demanded ingredient due to their multifunctionality comply with these requirements. The results of the research allowed referring dietary fibers to the required components of the diet that have health-promoting properties.

Dietary fibers are referred to the required food components whose physiological need is 20 g/day. Monitoring of the Russians' nutrition structure says that now the level of these nutrients consumption is 30-40% of the day norm. In this context, it is undoubtedly urgent to develop technologies of products that are rich in dietary fibers [8].

Dietary fibers are a complex of routings that form cell walls of plants and consist of cellulose, hemicellulose, lignin and pectin substances and a number of other water-soluble polysaccharides. Dissolvable dietary fibers absorb moisture and form gels [9, 10].

Dissolvable dietary fibers (containing cellulose, hemicellulose, etc.) are most often added into pastries. They are applied to decrease the caloric value, glycemic index, and enrich the product. In the pastry emulsion, dough and other semi-finished products substances of dietary fibers, especially solvable, show certain technological effects:

- They increase the content of moisture in dough and ready products due to moisture holding properties, and thereby maintain the freshness of baked products during a longer period of time;
- They have an impact on the rheological properties of dough and ready product. For example, adding dietary fibers in the emulsion for the sugar dough stabilizes it, makes it more homogeneous and fills with air bubbles which are allocated more smoothly; adhesiveness of dough pieces also improves. Ready products are characterized by the increased solidity, absorptivity and increased void content;
- They provide texture characteristics of pastry that in case of correctly chosen dietary fibers and optimal concentration acquire air texture characterized as “melting in the mouth”; and
- They improve structural characteristics of products, prevent abruptions on the top of biscuits, improve the solidity of waffle products, decrease the flowability of fancy pastry, decrease the rupture when storing the frozen dough and semi-finished dough, etc. [11].

Various types of vegetable fibers are an alternative to plant components. Fibers are a vegan product the human body cannot digest. Fibers are found in any uncrushed grain, kidney beans, and peas, as well as in all fruits and vegetables. Dietary fibers, namely frumentarious, are perfectly combined in receipts of pastry with other functional additives and strengthens their affect.

In this context, frumentarious fibers are of practical interest not only as moisture and fat holding component, but also as fillings in receipts of pastries that have an impact on organoleptic and structurally mechanical properties of products [12].

The goal of the work was to research Kametsel FW 200 frumentarious dietary fibers as a functional ingredient to prevent obesity.

Table 1. Physical and Chemical Indicators of the Kametsel FW 200 Dietary Fibers

Indicator	Value
Moisture content, %	5.50
Active acidity, pH	6.28
Water activity, Aw	0.21
Density, kg/m ³	260
Adsorption capacity, mec/mpv	16.80
Granulometric texture, %	66 ≤ 71 μm
Bulk weight, g/l	200 ± 14.0%

METHODS.

During the first stage of the research the peculiarities of chemical composition and properties of Kametsel FW 200 were studied to stipulate the possibility to use them for developing pastries for preventive purposes with the increased consumer features.

The weight fraction of protein was defined by using the system of quantitative identification of N₂/protein DKL8 made by VELD SCIENTIFICA, Italy. The biological value of sainfoin seeds powder was studied by experimental defining the amino acids composition through the use of the system of capillary electrophoresis KAPEL-105M made by the Lumex Company, Russia [13].

The weight fraction of fibers was defined by using the special equipment FIBRE THERM FT12 made by Gerhardt, Germany, in accordance with GOST 10846-91. The weight fraction of fat was defined by using the automatic equipment for solid and liquid extraction SOXTHERM SOX414a made by Gerhardt, Germany [14].

The weight fraction of carbohydrates including mono- and disaccharides was defined by using the chromatographic methods by using the high-pressure liquid chromatograph in the mixture of acetonitrile and water (77:23). The quantity of diterpene glycosides was defined by using the densitometers made in Germany by the calculation method according to the insensitivity of marks coloring.

Water and fat binding capabilities were defined by the method of centrifugation according to the standard methodology.

RESULTS.

The Kametsel FW 200 dietary fibers are made of wheat bran shelled according to the special technology. They are hollow dietary frumentarious fibers with different length and diameter. Due to its unique natural structure, the three-dimensional sheath frame is formed in the product [9, 15]. They are used as a food filling in food production. Fibers can quickly and stably bind water in the ratio of 1:5-6, they form fat emulsions - 1:5:5, and have a high speed of swelling. These features allow using them for producing various types of food [5].

The natural frumentarious fibers are a white powder with no odor, unleavened by taste. Table 1 shows physical and chemical indicators of the Kametsel FW 200 dietary fibers quality [15].

Due to their three-dimensional and capillary structure, the dietary fibers under research can bind water and fat much better than in ballast substances with the superficial allocation of particles. In order to define the conditions of preparing dietary fibers in production of pastries, the water and fat binding capabilities were studied (Table 2) [12].

Table 2. Technological Properties of Dietary Fibers

Indicator	Value
Water binding capability, %	270
Fat binding capability, %	120

The authors [15] revealed that the degree of dietary fibers swelling decreased when the temperature increased. The maximum degree of swelling for the Kametsel FW 200 dietary fibers is 414 % under the temperature 29.5 °C.

The capillary mechanism of binding depends on the fiber length. Particles with the fiber length being 30-70 µm (water binding 4-5:1, and fat 2.5-3.5-1) have the minimum degree of binding water and fat. Fibers with the length of about 400-500 µm (water 9-10:1, fat 5:1) have the maximum features [16].

Water absorption is expressed by the maximum humidity, i.e. the amount of water absorbed by dietary fibers stored for not less than 30 days [11]. To develop new functional products, these features (Figure 1) were studied for the Kametsel FW 200 frumentarious dietary fibers.

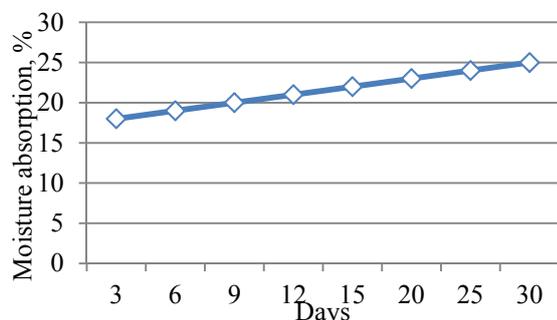


Figure 1. Dependence of Moisture Absorption on Time

Kametsel FW 200 is the most demanded neutral food filling in food production. The efficiency of using it is defined by the functional properties that allow extending the range and improving the quality of the ready products, decreasing the healthy food production cost. Kametsel FW 200 is characterized by the ability to quickly and stably bind water in the ratio of 1:5-6, to form cold and hot emulsions stabilizing these systems in the wide range of pH and temperatures, which allows using it when producing various types of food products.

It is known [9] that the use of the Kametsel FW 200 frumentarious dietary fibers has a positive impact on the rheological features of the gingerbread dough: the resistance of samples to the deforming loading decreases proportionally to the additive dose.

The authors [17] defined good emulsifying capabilities of Kametsel. It forms a good structure and increases the form stability of products, enriches food with ballast substances, and decreases the caloric value of ready products.

The content to make the fat filling is known [18]. It contains the Kametsel FW 200 frumentarious fibers as a dry mixture. It prolongs the freshness term and microbiological stability of filling by decreasing the indicator of water activity.

The researchers [19] developed the production of curd desert with the plant filling as Kametsel functioning as an adsorbent binding heavy metals, nitrites, nitrates, and cancerigenics.

The authors developed preventive shortbread biscuits [20], including test-form basis that uses wheat flour, wheat middling, flavoring agent, fat component, and soda, salt. It contains a mixture of margarine and the Kametsel FW 200 dietary fibers in the ratio of 6:1 as a fat component, and a mixture of sugar and cola nut as a flavoring agent. At the same time, the Kametsel FW 200 dietary fibers are preliminarily filled with water warmed to 40°C in the steam boiler, and then kept for 2-3 minutes for swelling in the water and fibers ratio of 7:1.

Table 3 shows qualitative indicators of the obtained preventive shortbread biscuits as compared to the control sample made according to the standard receipt.

Table 3. Organoleptic and Physical and Chemical Indicators of the Shortbread Biscuits

Indicator	Characteristics	
	Prototype	Sample
Form	With no marks and deformations, the biscuits edgings are ornamentally shaped	
Top	Smooth with an accurate image on the front part, well-burnt, without swelling	
Color	Light golden	Dark golden, smooth
Flavor and aroma	Fresh, odorless	There is light smack and cola nutty fragrance
Moisture weight, %	9.3	8.1
Fat weight as calculated to the dry substance, %	24.3	19.5
Alcali content, grad	1.6	1.3
Water absorption, %	157	176
Dietary fibers content, g	2.13	7.6
Caloric value, kilocalories	448	380

As a whole, the conducted researches have shown that the Kametsel frumentarious dietary fibers with water at the ratio of 1:7 perfectly form a gel that can partially substitute fat agents in pastries, which makes them a perspective ingredient to use in food technologies including pastry production.

DISCUSSION.

Asmaeva Z.I. researched the possibility of using the Kametsel FW 200 frumentarious dietary fibers in the functional bread and flour products with the advanced nutrition value and increased content of digestible carbohydrates [21]. The authors [15] studied the possibility to use dietary fibers in the gingerbread production. It caused positive changes of rheological properties of dough. It is expressed in decreasing the value of samples resistance to the deforming loading proportionally to the dozed additive. However, the Kametsel frumentarious dietary fibers are not sufficiently used in the food production.

CONCLUSION.

This composition of shortbread biscuits considerably reduces the time for baking pastry. Convenience, simplicity of production and functional content make shortbread biscuits not only a delicious pastry but also an optimal preventive food with a decreased fat content. However, the enrichment of the food product with dietary fibers assumes their introduction in the amount of not less than 3-6 g per 100 g of the ready product which is related to possible changes of its quality. That is why when developing functional products with dietary fibers, every case requires experimental research focused on solving technological tasks.

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