

Preparation of dietary fiber from oats

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Abstract. Today, there is a trend of increasing demand for products made from plant materials, especially the demand for plant-based drinks. Many enterprises adhere to the technology of producing these drinks from whole grain raw materials. In this regard, at the enterprises, producing these products, the volumes of secondary plant raw materials, meal, have increased, the issue of processing of which has not yet been fully resolved. Sensory and physicochemical characteristics of whole grain oats were determined, and the results showed that this raw material is suitable for subsequent processing. Based on the results of the research, it was established that the prepared dietary fiber preparation from oats has high functional and technological indicators and a degree of hydration, as well as low moisture content, which increase the yield and improve the quality of the finished product. These results allow us to conclude that the obtained dietary fiber preparation can be used in the future for food production.

1 Introduction

Plant-based beverages are commonly consumed [1]. The growth in consumption of products made from cereals is associated with the trend in the consumer food market. Due to the absence of lactose and being a substitute for traditional cow's milk, this product is becoming an increasingly popular product for people on diets, concerned about their health, and those with lactose intolerance [2].

Currently, a new direction in the field of environmental protection is developing in the world – recycling industrial and agricultural waste and, as a result, reducing pollution of natural and waste waters. Of particular interest is cellulose-containing wastes from the processing of cereal crops [3]. One example of the processing of such raw materials is food additives, among which dietary fiber plays an important role.

Dietary fiber is becoming increasingly in demand in the production of various food products. A lack of dietary fiber in a person's diet leads to decreased immunity and an increased risk of diseases such as diabetes, atherosclerosis, coronary heart disease, intestinal diseases and obesity. Modern research shows that with a daily physiological need for dietary fiber of 30 g, their actual consumption usually does not exceed 10 g. It has been

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recorded that increasing the consumption of insoluble dietary fiber by at least 10 g per day can significantly reduce the risk of the occurrence and development of multiple diseases, including cardiovascular problems [4].

During the production of herbal drinks from oats, large quantities of waste are generated in the form of a meal rich in functional ingredients. In most cases, oatmeal is used for the production of animal feed, and much less often for human nutrition [2].

When extracting cereals, the remaining cereal meal contains a significant amount of protein, usually about 15-20%. The fat composition of the meal usually includes a small amount of fat, including saturated and unsaturated fatty acids. The meal contains phosphorus, magnesium, iron, zinc and other microelements that can be beneficial for health, as well as vitamin E and B vitamins [5].

An excellent source of insoluble dietary fiber is oatmeal. Insoluble dietary fiber plays an important role in maintaining gut health because it does not dissolve in water. The chemical composition of oatmeal includes dietary fiber, which is represented by soluble and insoluble fiber. Dietary fiber is an important component of recycled plant materials, and can be used as a functional ingredient for the production of products enriched with dietary fiber or products with a reduced fat content [6].

The rich chemical composition makes oatmeal useful and promising as a raw material for the production of various products. Based on the above, the relevance of the work lies in a rational approach to the processing of secondary plant materials to produce dietary fiber, which can be used to enrich food products.

The purpose of the research is investigating a dietary fiber preparation obtained by processing oats into plant milk.

2. Materials and Methods

2.1. Preparation of dietary fiber from oats

The objects of the research are whole grain oats and a dietary fiber (DF) preparation obtained from the oats. The technological scheme for obtaining a dietary fiber preparation is presented in Figure 1.

2.2. Qualitative analysis

Before starting work with the dietary fiber preparation from oats, the quality indicators of whole grain oats were determined in the laboratory. Sensory indicators were investigated in accordance with the requirements of GOST 28673-2019. Acidity was determined by titration and humidity by drying the sample at a temperature of 105 °C.

The enzyme used in the work was glucavamorin, an enzyme preparation that is obtained by cultivating a selected strain of the fungus *Aspergillus awamori*. It is used for saccharification of raw materials containing starch.

The oil-holding capacity, water-holding capacity, emulsifying capacity, and degree of hydration were determined in the obtained samples of the DF preparation; physico-chemical indicators were also determined – humidity, fiber content.

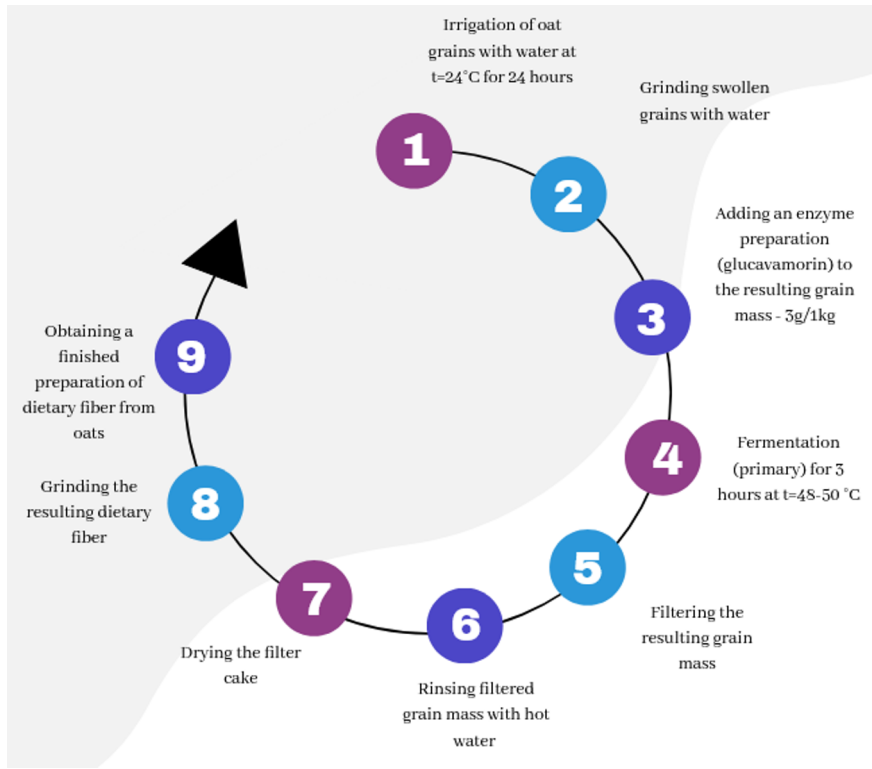


Fig. 1 Technological scheme for the production of dietary fiber preparation from oats

3 Results and Discussions

When assessing the quality of raw materials, it was found that, in accordance with GOST 28673-2019, the oat sample belongs to type 1, subtype 2, since the grain is large, smooth, and yellow. The results of the research assessing the quality of grain indicators are shown in Table 1.

Table 1. Sensory and physico-chemical indicators of oats

Indicators	Characteristics for oats	
	accordance with GOST 28673-2019	test sample
Colour	Characteristic of a healthy oat grain	Characteristic of a healthy oat grain
Smell	Characteristic of healthy oat grain, without mold, malt, musty and other foreign odors	Characteristic of healthy oat grain, without mold, malt, musty and other foreign odors
Mass fraction of moisture, %, no more	13,5±0,68	10,25±0,51
Weed impurity, %, no more	2,0±0,1	1,0±0,05
Grain impurity, %, no more	4,0±0,2	1,5±0,075
Acidity, degrees, no	6,0±0,3	3,9±0,195

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The studied oat sample meets the requirements of GOST 28673-2019 in terms of sensory and physicochemical parameters and can be used to obtain plant milk and a dietary fiber preparation from oatmeal.

The finished preparation of dietary fiber from oats, obtained by fermenting the meal with a microbial enzyme, had functional and technological indicators studied, the quantitative content of fiber was determined and the degree of hydration was detected, and a comparative analysis was carried out with the indicators of a sample of the preparation of dietary fiber from barley [7]. The results are shown in Table 2.

Table 2. Results of functional and technological indicators of the finished dietary fiber preparation

Indicator	Test sample of dietary fiber preparation from oats	Sample of dietary fiber preparation from barley [7]
Degree of hydration, %	1:3	–
Oil-holding capacity, g/g	3.95±1.97	3.8
Water-holding capacity, g/g	3.42±1.27	6.0
Emulsifying capacity, %	32.10±1.61	48.2
Mass fraction of fiber, %	72.00±3.60	–
Moisture content, %	6.67±0.34	–

The dietary fiber preparation obtained by fermentation from oats showed higher values of the oil-holding capacity, and the water-holding capacity, and emulsifying capacity of the studied dietary fiber preparation were slightly lower than that of the dietary fiber sample from barley.

Figure 2 shows whole grain oats, dried crushed dietary fiber, and a finished preparation of dietary fiber from oats.

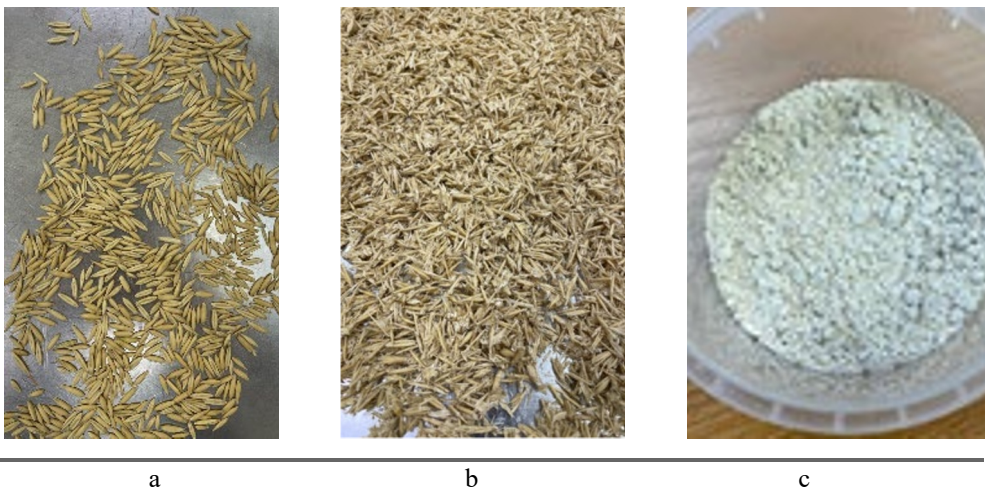


Fig.2. The raw materials and the resulting oat products: a – whole grain oats; b – oat meal after receiving plant milk; c – dietary fiber preparation from oats.

High water-holding capacity and swelling ability are due to the chemical structure of dietary fiber. They contain a large number of hydrophilic groups and a small number of lipophilic groups [8].

The results of determining the functional and technological properties of dietary fiber from brown rice also showed high values of water-holding and oil-holding capacities: from 3.18 to 4.6, and from 1.22 to 1.81, respectively, for different types of preparations [9].

Other studies have found that the highest water-holding capacity is found in dietary fiber preparations obtained from quinoa – 5.35 g/g, and the highest capacity for fat absorption in dietary fiber preparations from mung beans – 4.73 g/g [10].

Many scientists note in their studies that the technology for obtaining dietary fiber significantly affects the properties of the resulting preparations. Fermentation and germination increase the specific surface area of the fibers and, as a consequence, increase the area of contact with water and oil. Heating and extrusion also affect the structural characteristics of fibers [11, 12].

Thus, we can conclude that the properties of dietary fiber are influenced by the source of raw materials and the technology for obtaining the drug. The resulting preparation by fermentation of oats showed high functional and technological indicators, comparable to other fiber preparations, and can be used in the manufacture of food products to improve their nutritional value and technological properties.

4 Conclusion

As a result of an analytical review of the literature, the problem of processing secondary plant raw materials in the form of oatmeal was identified, and existing areas of its use were considered.

The sense and physico-chemical indicators of whole grain oats were determined, and the results showed that this raw material is suitable for subsequent processing.

A technological scheme for obtaining a dietary fiber preparation from oatmeal has been compiled. The experimental data obtained to evaluate the functional and technological indicators of the resulting dietary fiber preparation from oats in comparison with the literature data for the dietary fiber preparation from barley showed that the oil-holding capacity of the DF preparation from oats is higher, and the water-holding capacity is lower than from barley. However, the emulsifying capacity of the DF preparation from barley is 10% higher than from oats. The degree of hydration of the resulting DF preparation was 1:3.

Based on the above, we can conclude that the resulting preparation of dietary fiber from oats can be used as a technological additive in various sectors of the food industry: in the bakery industry, in the production of fermented milk products, in the production of meat products to increase the fiber content and improve their nutritional value.

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