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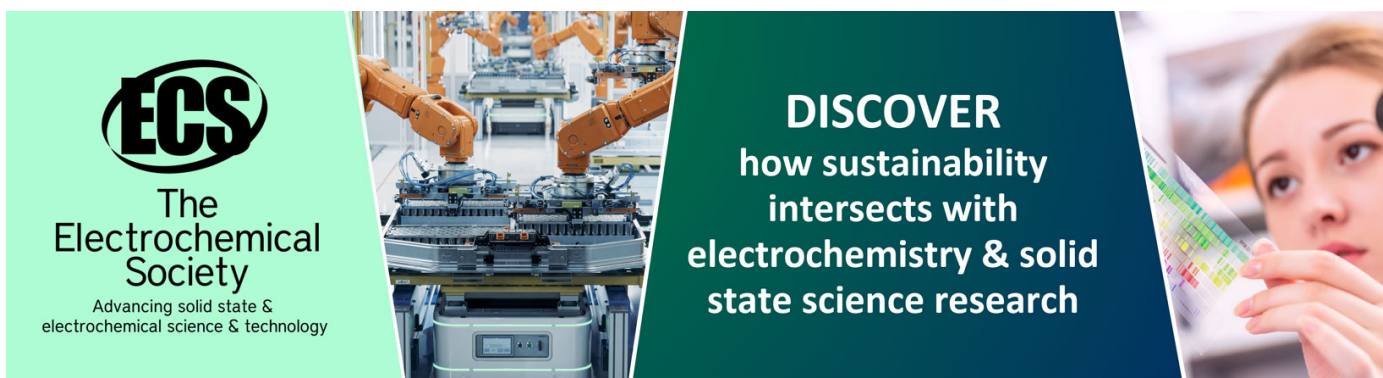
Developing a technique for obtaining powdery prefabricated turnip

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Developing a technique for obtaining powdery prefabricated turnip

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Abstract. Development of functional foods using dietary fiber is rather substantial in modern food technology. The significance of dietary fiber in functional nutrition is undeniable. The main challenge for the technologists creating new products with the application of dietary fiber is to balance meeting the needs of a human body in dietary fiber being a functional ingredient and maintaining the traditional quality of the enriched product. The article presents a technique for obtaining a powdery prefabricated turnip. The change in the mass fraction of sugars in the samples of prefabricated turnip in the drying time was studied. Analysis of changes in the mass fraction of moisture contained in the grinded turnip samples shows that within 160 minutes the degree of the product drying does not exceed 7.00%, which meets the standard requirements. The main indicators of the experimentally obtained powdery prefabricated turnip are studied. It has been established that polysaccharides, specifically, cellulose and hemicellulose, dominate in powdery prefabricated turnip. The content of harmful substances has been investigated. The content of toxic elements in turnip powder does not exceed the maximum permissible levels.

1. Introduction

The accelerating pace of modern life results in the lack of time and, consequently, lack of opportunity to eat high-quality food regularly. This leads to a deficiency in the intake of certain macro- and micronutrients. Food consumers tend to give preference to natural products with the nutritional supplements with organic nature. Therefore, one of the top-priority goals of the modern food industry is to develop the technologies and expand the range of functional foods. The growing demand of food industry enterprises for functional foods has become an urgent problem of the modern food market [1,3,4].

Modern research pays major attention to functional products that can satisfy a person's nutrient demands. These products can be obtained by combining milk protein and plant components being a source of water-soluble and fat-soluble vitamins, mineral substances and other biologically active substances as well [12].

Production of functional foods based on dietary fiber is crucial for modern food technology. The importance of dietary fiber in functional nutrition is undeniable. In the past 10 years, dietary fiber has been the subject of close attention and serious study of physiologists and technologists. The tendency to apply food fiber in diets is more clearly seen in various new food products (ranging from bread with bran to milk enriched with soluble fiber) that have recently appeared on the food market. Another aspect



of this process is food fiber technological properties, which determine their widespread use as the types of food additives that change the structure and physicochemical properties of food products [6,7,11].

The main objective of the technologists creating new products with dietary fiber is to balance the needs of the human body in dietary fiber being a functional ingredient and the traditional quality of the enriched product.

Currently, there is a lot of information on the production of dietary fiber from root crops of carrots, daikon, and various fruits. However, insufficient attention has been paid to such an old cropper as turnip [5,8,10].

Turnip is a rather valuable crop with therapeutic qualities. In addition to a relatively high nutritional value, turnip has a bactericidal, antiseptic, antisclerotic, anticancer effect and is an effective remedy for intestinal canal. Nutritionists also recommend including turnips in the diet of people suffering from obesity and diabetes.

There is an objective need to study turnips from a technological point of view, that is, to use turnips as a food fortifier of functional value, which will increase the nutritional and biological value of products and give them therapeutic and preventive properties. On the other hand, the use of turnip roots will enlarge the range of products available to all social groups, which is relevant nowadays and is of socio-economic importance [2,8].

2. Materials and methods

The studies were carried out according to standard methods in the laboratory of the Department of Technology for storage, processing of agricultural products and the laboratory of biological analyzes of the Voronezh State Agrarian University named after Emperor Peter I. The turnip breed named Petrovskaya was the object of the study.

The following methods were used for studying the general chemical composition of turnips and powdery prefabricated products based on it: mass fraction of moisture in accordance with State standard 28561-90; mass fraction of substances in the initial plant material; the fat content was determined by the method of Ruzhkovsky in the Soxhlet apparatus in accordance with the requirements of State standard 13979.2-94; crude protein in accordance with State standard 134964-93; moisture in accordance with State standard 13496.3-92 (ISO 6496-83); crude ash in accordance with State standard 26226-95; mass fraction of crude fiber in accordance with State standard 31675-2012, total sugars in accordance with State standard 32167-2013; the mass fraction of vitamin C was determined in accordance with State standard 24556-89; mass fraction of phosphorus in accordance with State standard 26657-97, calcium in accordance with State standard 26570-95 [2].

3. Results and discussions

3.1 Substantiation of drying conditions for prefabricated turnip

A powdery prefabricated product was obtained from turnip roots of the Petrovskaya breed by drying on a Feruza infrared dryer. Preliminary, the crops were crushed into 2-10 mm long shavings and placed into a drying chamber at 218-330°K. The change in the mass fraction of solids and total sugars was controlled during the entire drying process.

The research outcomes confirm that sugar losses are observed during drying (over 3.5 hours), which is caused by melanoidin formation and caramelization reactions. The highest sugar concentration of the dried turnip samples is observed after 3.5 hours of drying and is 26.5-26.7% (Figure 1).

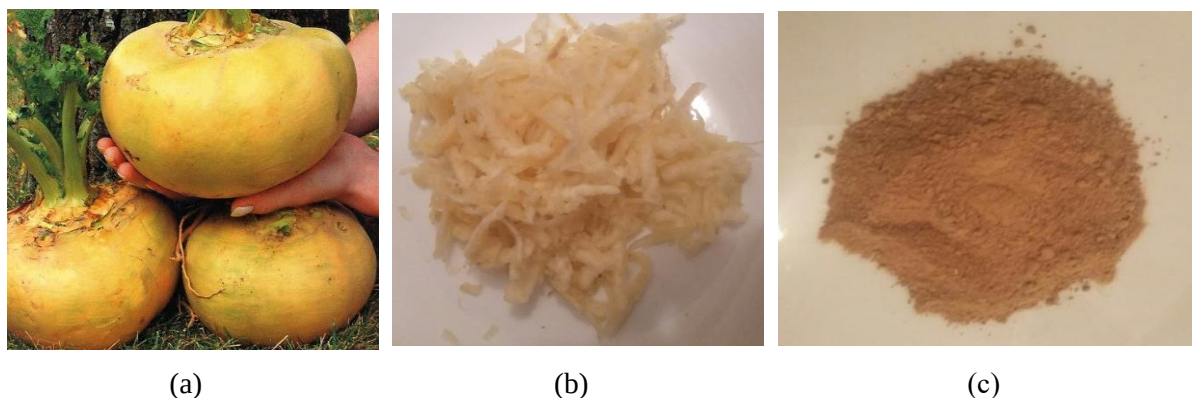


Figure 1. (a) turnip breed Petrovskaya; (b) crushed turnip; (c) powdery prefabricated turnip

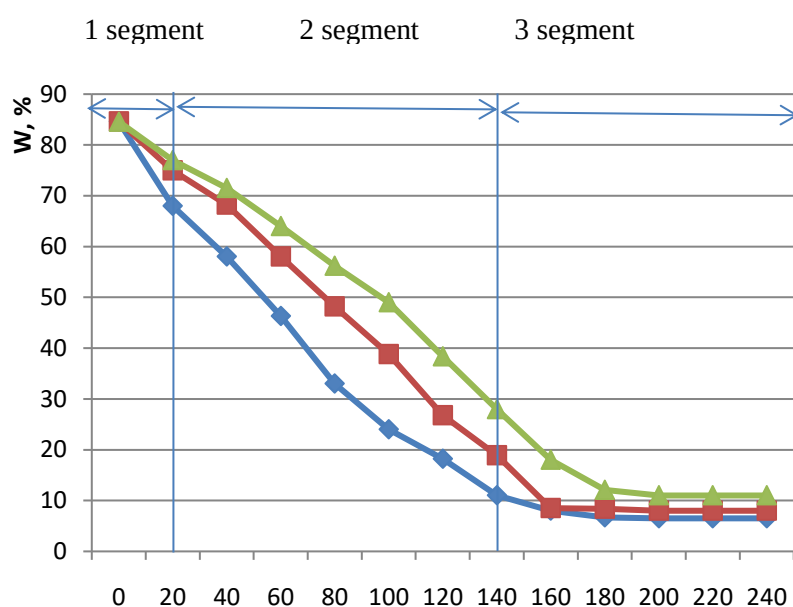


Figure 2. Change in the mass fraction of moisture in turnip shavings while drying

Three sections can be distinguished on the curves (Figure 2). The first section denotes a drying time of 0-20 minutes and is characterized by heating of the product as well as an increase in the rate of moisture removal. In the second section, the drying time is from 20 to 140 minutes, the drying speed changes with a constant dependence and the main moisture (capillary one) is removed. The third section denotes the drying time from 140 to 240 min and here a decrease in the drying rate is observed. In this case, the moisture firmly bound to the material is removed.

It is worth noting that at a drying temperature of 326°K (53°C), the drying intensity is optimal, while the drying process is sufficiently intensified and a pleasant view of powdery prefabricated turnip is maintained. As was established by previous studies, drying at a temperature of 330°K takes 1.5 hours. However, there is an excessive darkening of the dried material due to thermal decomposition of organic substances. Therefore, the temperature of 326°K can be considered the optimal drying parameter.

Analysis of changes in the mass fraction of moisture in the samples of grinded turnip shows that the product is dried within 160 minutes in order to gain the mass fraction of moisture that meets the requirements of the standard (no more than 7.00%) (Figure 3).

The obtained product is a powdery prefabricated turnip (Figure 1c) being a dark-creamy, powdery substance with a nutty sweetish flavor and with a 6.5-7.0% moisture content [2].

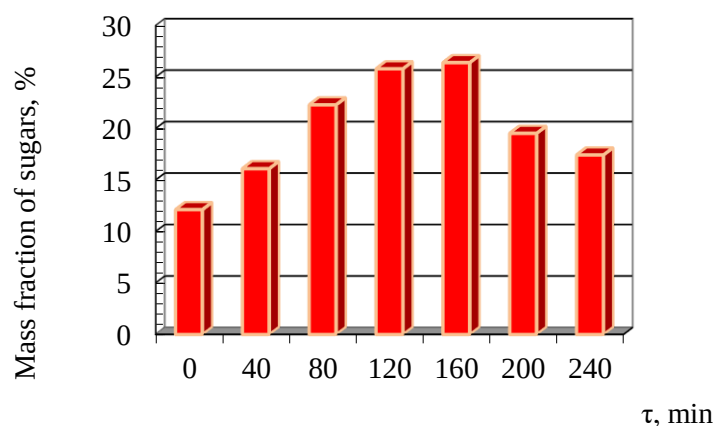


Figure 3. Change in the mass fraction of sugars in turnip prefabricated samples while drying

3.2 Study of the chemical composition and properties of powdery prefabricated turnip

Organoleptic and physico-chemical characteristics of powdery prefabricated turnip are presented in table 1.

Table 1. Organoleptic and physico-chemical characteristics of powdery prefabricated turnip

Indicators	Powdered prefabricated turnip characteristics
Consistency	Free-running and dry, free from extraneous impurity
Taste and smell	Neutral, without a turnip racy flavour and smell
Color	From cream to light brown with a yellowish tint
Dry solids weight ratio, %	93.5
Acidity, degrees	7.1
Mass fraction of food fibers, %	83.5
Particle size, microns	5000-5500
Bulk weight, kg/m ³	610

Table 2. The main indicators of the experimentally obtained powdery prefabricated product

Sample	Food fibre components, %								
	Mass fraction of food fibre moisture, %	Starch	Proteins	Soluble Pectin	Insoluble pectin	Hemicellulose	Cellulose	Lignin	Ash
Powdery prefabricated turnip	6.5	2.8	7.2	12.8	11.3	18.2	33.6	7.6	3.0

It was found that polysaccharides, specifically, cellulose and hemicellulose dominate in the powdery turnip prefabricated product (Table 2).

The outcomes of chemical and toxicological studies of powdery prefabricated turnip are presented in table 3.

Table 3. The content of harmful substances in powdery prefabricated turnip

Identifiable parameters, units of measurement	Value	Accepted level
HCCH, mg/kg	Less than 0.001	0.1
Multicide and its metabolites, mg/kg	Less than 0.006	0.1
Lead mg/kg	0.018	0.5
Cadmium mg/kg	0.014	0.03

The content of toxic elements in turnip powder does not exceed the maximum permissible levels established by hygienic requirements for the quality and safety of food staples and food products.

4. Conclusion

We recommend Petrovskaya turnip breed characterized by the most balanced composition of dietary nutrients, including dietary fiber, trace elements and antioxidants to be used for the production of powdery prefabricated turnip.

The studies have shown that a change in the mass fraction of sugars occurs during a turnip drying.

It has been established that polysaccharides being cellulose and hemicellulose dominate in turnip powder.

The content of harmful substances and toxic elements in turnip powder does not exceed the maximum permissible levels.

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