Rapeseed processing products as a component of flour-based food for gerontological purpose

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Abstract. The use of rapeseed oil and flour obtained by processing of peeled rapeseed kernels as a source of valuable nutritional and biologically active substances needed in the diet of the elderly to maintain their health and active longevity is justified. A sugar cookie formula with the use of rapeseed products has been developed. The technology of cookies which allows one to obtain a dough with the necessary properties and finished products of the required quality is proposed. The consumption of cookies will increase the level of satisfaction of the body's requirements for a complete protein, polyunsaturated fatty acids, including omega 3, dietary fiber, B vitamins and tocopherols, dietary minerals such as potassium, calcium, magnesium, phosphorus, sulfur, iron, copper, zinc, manganese, cobalt and others. The use of rapeseed flour will enrich cookies with such minor nutritional components as rape indoles, which have antioxidant and antitumor activity, stimulating the detoxification processes of the body. The introduction of rapeseed products into the composition of sugar cookies allows us to consider it as a gerontological product that slows down the aging process.

1. Introduction
The need to ensure elderly people with rational nutrition makes it urgent to develop products that can provide their body with the nutrients necessary to combat the most common pathologies, slow down biological aging processes and prolong considerable activity. There is the need to provide the diet with the following nutrients: complete protein, in which the proportion of vegetable protein should be at least 55-60%; fats containing unsaturated and irreplaceable polyunsaturated fatty acids of the omega 3; dietary fiber, especially pectin compounds; vitamins, including vitamin D, ascorbic acid (vitamin C), thiamine (B1), riboflavin (B2), niacin (B3), pyridoxine (B6), folacin (B9), cobalamin (B12), tocopherols (E), carotenoids; minor nutritional components, such as phenolic acids, bioflavonoids, including isoflavones, catechins, anthocyanins, lignans, indoles, sulfur-containing compounds and others; lipotropic substances, which include choline, methionine, lecithins; mierals, such as macronutrients potassium, magnesium, calcium, phosphorus, sulfur, etc. and micronutrients iron, iodine, copper, zinc, chromium, manganese, cobalt, selenium, and others [1, 2].

In the Russian consumer market, the range of flour products for gerontological nutrition is insignificant, while the demand for such products is quite high. When developing such products, it is necessary to take into account the traditions in nutrition and their availability for the elderly. As prescription components of gerontological products, it is advisable to use domestic food stock with...
high nutritional value, therapeutic and prophylactic orientation and low cost. Such products should be of high quality, have sensory characteristics adequate to traditional products and be used as part of a normal diet.

In Russia, traditional foods that are often consumed are flour products, including cookies, gingerbread cookies, muffins, etc. These products have good organoleptic characteristics, long shelf life, low cost, ready for direct use, do not require special storage conditions, are compact and convenient in use. All these advantages determine their popularity among all groups of Russian consumers. However, flour confectionery products made from traditional food stocks have a high calorie content and an unbalanced chemical composition. They mainly contain carbohydrates and fats with a lack of protein, vitamins, minerals and biologically active ingredients needed in the diet of older people.

In Russia, volumes of growing and processing rapeseed are constantly increasing, from the seeds of which edible oil containing essential unsaturated and polyunsaturated fatty acids, including omega 3, vitamins E, D, phospholipids, phytosterols, and other components are extracted. Rape cake obtained after oil from rapeseed is used in animal and bird feeds. However, it contains valuable nutrients, many of which are scarce and indispensable in human nutrition: 27 - 41% of a complete protein; 7 - 12% of edible oil containing unsaturated and polyunsaturated fatty acids, including the omega-3, tocopherols and carotenoids; alimentary fiber; vitamins of group B, E, D; macronutrients phosphorus, potassium, magnesium, calcium, sulfur, and others; micronutrients iron, copper, zinc, cobalt, and others [3, 4, 5, 6].

The biological feature of rapeseed, which belongs to the cruciferae oilseed family, is the presence of erucic acid in the hydrophobic part and glucosinolates in the hydrophilic part of plants. These substances are traditionally classified as anti-nutritional, their content limits the use of rapeseed products for food and feed purposes. As a result of hydrolysis, glucosinolates form glucose and aglycones, which in turn can form products such as isothiocyanates, thiocyanates, nitriles, oxazolidines and others. A large number of studies have been devoted to their impact on farm animals and birds. The most dangerous one of these compounds is progoitrin, capable of forming a cyclic nonvolatile matter 5-vinyl-2-thiooxyzolidone, which inhibits the accumulation of iodine by the thyroid gland, which reduces its activity and requires the introduction of an additional amount of iodine-containing products in the diet. The ability of thioglycosides to cause liver diseases, adversely affect the work of the gastrointestinal tract, heart, thyroid gland, and inhibit the growth of young animals is noted. In this regard, for the use of rapeseed meal and cake for feed purposes GOST 11048, a safe restrictive rate of isothiocyanates of no more than 0.8% was introduced. This justifies the direction of the selection of rape seeds to reduce or completely eliminate glucosinolates [7].

At present, only low-erucic and low-glucosinolate varieties of rapeseed of the modern breeding type “00” (two-zero), containing minimal amounts of antinutrients or completely excluding them, are approved for use in Russia. The most promising are high-yielding rapeseed varieties, adapted for different regions of cultivation, containing not more than 1% glucosinolates and not more than 2% erucic acid in the oil composition. A significant decrease in the content of glucosinolates in modern varieties of rapeseed has expanded the possibilities of using rapeseed meal for food purposes [5, 6].

In recent years, numerous studies have been conducted on the effect of thioglycosides of cruciferous plants on human health. Rapeseed glucosinolates are mainly represented by thioglycosides, which are localized in the protein-polysaccharide part of the seeds and remain in the cake after oil extraction. Cruciferous plants are attracting attention from medical researchers and pharmacists because cruciferous glucosinolates are the precursors of isothiocyanates and indole compounds used in the treatment and prevention of cancer. Derivatives of isothiocyanates are indoles, sulforaphane, ascorbigen, which are classified as minor nutritional components that have antibacterial, radiosensitizing, and antitumor effects.

Indole glucosinolates have a bactericidal and fungicidal effect on many pathogens of plants and humans. It has been established that in the low-glucosinolate varieties of rapeseed of modern selection,
mainly indole-glucosinolates, such as 4-hydroxygluco-brassicin, are mainly present. Cruciferous glucosinolates are part of the preparations for the prevention and treatment of a number of hormone-dependent oncological diseases [8, 9].

Currently, the incidence of oncological diseases in the world has increased. One of the ways to reduce their number is to use preventive means, especially among people at risk, including the elderly. The means of prevention include the use of such plant biologically active substances as flavonoids, catechins, anthocyanins, as well as natural indoles, among which indole-3-carbinol is especially distinguished.

Indole-3-carbinol strengthens the body's immune system, stimulating the body's detoxification processes, and is a promising natural compound for the prevention of aging processes and the treatment of hormone-dependent oncological diseases. Its ability to exert an antitumor effect has been proven not only in laboratory experiments, but also in the clinic. In Russia, indole-3-carbinol is included in the list of minor components and biologically active substances with an established physiological effect on the human body, the recommended norm of its consumption is 50 mg per day (methodological recommendations 2.3.1.4232-08, 2008). Rapeseed, being a potential source of glucosinolates and their derivatives, attracts the attention of health professionals and pharmaceutical companies [9].

One way to improve the quality of rapeseed seed processing products is to provide a method for separating seed cover from oilseed kernels. The exclusion of seed coatings can improve the quality and nutritional value of rapeseed processing products. The resulting oil and cake contain less coarse fiber, coloring, aromatic and anti-nutritional substances passing into them from the seed cover. The method provides for the oil seed hulling, followed by fractionation of the product and pressing purified from seed cover of oilseed kernels. After oil extraction, cake is produced, it has good organoleptic characteristics, in which high-grade protein and other valuable nutritional and biologically active substances of rape seed are concentrated [10, 11].

A promising area for the use of rape cake is its processing into flour. Rapeseed flour has a valuable component composition of food and biologically active substances. It contains from 47 to 60% of high-grade protein, residual amounts of oil with a valuable fatty acid composition, B vitamins, minerals, dietary fiber, biologically active substances, including indoles. This makes it expedient to use it as part of food products, including gerontological purposes. And explains a fairly large number of works devoted to the search for ways to use rapeseed meal for food purposes, as well as to obtain nutritional supplements based on it [3, 9, 12, 13, 14].

2. The purpose of the study

An urgent problem is the development of products for gerodietetic nutrition, containing nutrients necessary to combat the most common pathologies, slow down the processes of biological aging and prolong considerable activity. A distinctive feature of the proposed cookies is the use of rapeseed processing products as raw materials with good quality and high nutritional value - rapeseed oil and rapeseed flour from cake obtained by processing of peeled rapeseed kernels. The goal of research was to develop recipes and technologies to produce dough with the required properties and traditional-quality cookies for gerodietetic nutrition, containing physiologically functional food ingredients and biologically active substances of rapeseed processing products.

3. Materials and methods

The studies were carried out on the basis of scientific laboratories of the departments of Technology of Vegetable Food Products and Machines and Devices of Technological Systems of Kemerovo State University.

As the main objects of research we used: baking wheat flour of the first grade GOST 26574-2017; experimental product of rapeseed flour obtained by grinding rapeseed meal, formed after extracting oil from low glucosinolate rape seed in an experimental setup consisting of a centrifugal plant for rape
seed hulling by hard plate impact method, a pneumatic separator for separating the kernel from seed cover with an upward air flow, a laboratory press for oilseed crushing and a disk mill; refined deodorized rapeseed oil of the first grade GOST 31759-2012; natural nutrient additives based on macromolecular compounds (proteins and polysaccharides): Stabisol MR 63 complex stabilizer based on xanthan and guar gums Reg. No. 50.99.01.009.U.000212.07.07; wheat fiber “Vitatsel WF-200” Reg. No. 77.99.26.9. U.10529.11.09; Maysol soy protein isolate «Maisol» Reg. No. 50.99.01.009.U.000763.08.09; dough and sugar cookie prototypes.

For the preparation of experimental product of sugar cookies, we used the technology that provided for the use of liquid vegetable oils. To stabilize the structure of semi-finished products and finished products, a mixture of natural nutrient additives was used. The method involves preparing the fat phase by mixing nutrient additives with liquid vegetable oil. Then the fat phase is mixed with the rest of the recipe components, after which the dough is kneaded with the addition of a flour mixture consisting of wheat and rapeseed flour, molded and baked by traditional methods [15].

The moisture content of the dough was determined by the conventional rapid drying method. Plastic and elastic deformations of the dough were determined using a Structometer ST-1M device in 1K mode. The quality indicators of cookies were determined according to the production standards.

4. Research results
The recipe for sugar cookies with rape seed products included the following components: first-grade wheat flour, white sugar, rapeseed flour, refined deodorized rapeseed oil, invert syrup (glucose and fructose), egg powder, soy protein isolate, wheat fiber, stabilizer (guar and xanthan gums), sodium bicarbonate, sodium chloride, carbonate.

| Indicator name                  | Composition of the bake mix, weight ratio of wheat flour and rape meal |
|---------------------------------|------------------------------------------------------------------------|
| Moisture content, %             | 19.3±0.3 18.8±0.4 18.7±0.3                                            |
| Plastic deformation, mm         | 15.90±0.50 16.23±0.35 17.43±0.45                                       |
| Elastic deformation, mm         | 0.82±0.05 0.78±0.02 0.70±0.03                                          |
| Color                           | straw-colored intense yellow                                           |
| Consistency                     | soft, plastic                                                         |
| Forming capability              | do not stick to the working surfaces, hold the shape and design        |

Table 1. Quality indicators of cookie dough using rapeseed flour and oil

When developing the recipe, flour mixtures from baking wheat and rapeseed flour were used in the ratios of 90:10, 85:15, 80:20. The results of determining the organoleptic and physico-chemical quality indicators of the dough and sugar cookies from mixtures of wheat and rapeseed flour are presented in tables 1 and 2.

Table 2. Quality indicators of sugar cookie using rapeseed flour and oil
5. Results and discussion

The main structure-forming component of flour products is wheat flour, which forms gluten (gluten) due to the swelling of its proteins during kneading. Gluten gives to the dough the structural and mechanical properties necessary for molding. However, wheat flour has an unbalanced chemical composition relative to the requirements of a healthy diet, and unconventional types of flour cannot replace it in full without reducing the quality of the products. The rheological characteristics of the dough with unconventional types of flour differ from the necessary ones, which at subsequent stages of production leads to defects and deviations in the quality of the finished products. In this regard, numerous studies are being conducted on the use of non-traditional types of flour in order to increase the nutritional value of flour products while maintaining their quality. However, the assortment of such products in the Russian consumer market is insufficient [16].

To obtain a dough with plastic properties, solid fats are included in sugar biscuit formulas, which are added to the emulsion in the molten state from all types of raw materials except flour and starch. Most often, specialized confectionery fats, palm oil and margarine are added to the dough. Nevertheless, such fats contain significant amounts of saturated fatty acids and trans isomers, which reduces the nutritional value and safety of cookies. An alternative to solid fats can be liquid vegetable oils, which are more technologically advanced during storage, transportation and dosing, have high nutritional value and lower cost. However, their use in sugar cookie recipes is limited by reason that they are not sufficiently bound by the components of the dough and finished products, can leak out during the preparation and storage, which requires a change in technology and the use of stabilizing additives [15].

To stabilize the dough and cookies with liquid vegetable oil, a mixture of food additives from natural high-molecular compounds was used: wheat fiber, guar and xanthan gums, soy protein isolate. These additives have been selected based on their high water retention, fat retention and fat emulsifying abilities. The use of the above natural food additives made it possible to obtain a stable plastic dough with the introduction of rapeseed oil and rapeseed flour in the dough. The dough from a mixture of wheat and rapeseed flour in the proportions of 85:15 (Table 1) had the required rheological properties and good molding ability. Cookies made from a flour mixture in the indicated proportions had the best sensory indicators of taste and flavor, color. Physico-chemical indicators of its quality met the regulated requirements (Table 2). Rapeseed flour, obtained by processing of peeled rapeseed kernels, gives the cookie original sensory characteristics while maintaining the required quality indicators. The introduction of rapeseed oil into the cookie formula can significantly reduce the content of saturated fatty acids with an increase in the proportion of unsaturated and polyunsaturated, including essential omega 3 fatty acids, as well as enrich cookies with tocopherol (vitamin E), which are related to antioxidants. The use of natural stabilizing food additives based on plant proteins and polysaccharides allows you to increase high-grade protein and dietary fiber in cookies.

The use of rapeseed flour in sugar cookie formula makes it possible to increase its nutritional value by increasing the content of protein, dietary fiber, B vitamins, macronutrients of potassium, calcium, magnesium phosphorus, sulfur, micronutrients of iron, copper, zinc, manganese, and others. Preparation of flour mixture from wheat and rapeseed flour allows you to better balance its amino acid composition, due to the limiting amino acids of wheat flour are lysine and tryptophan, and rapeseed flour is isoleucine, methion and cystine. The addition of rapeseed flour in the formula will enrich cookies with such minor nutritional components as food indoles, which have antioxidant and antitumor activity, stimulate the body’s natural detoxification processes, and strengthen the immune system of older people. The foregoing information allows us to conclude that the produced cookies conform to the requirements of gerodietetic nutrition.
6. Conclusion
The use of rapeseed oil and flour obtained by processing of peeled rapeseed kernels as a source of valuable nutritional and biologically active substances needed in the diet of older people to maintain their health and active longevity is justified. The formula and technology of sugar cookies using rapeseed processing products, allowing to obtain dough with plastic properties and cookies of traditional quality has been developed. The consumption of this cookie will increase the level of satisfaction of the body’s requirements for a complete protein, polyunsaturated fatty acids, including omega 3, dietary fiber, vitamins, macro- and micronutrients. The use of rapeseed flour will enrich the diet with such minor nutritional components as rapeseed indoles, which have antioxidant, antitumor activity and which are detoxicants. The introduction of rapeseed products into the composition of the cookie allows us to consider it as a gerontological product containing nutrients that slow down the aging process of the body.

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