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<http://www.moderntechno.de/index.php/meit/article/view/meit43-01-119> 222

ENVIRONMENTAL PROTECTION TECHNOLOGIES IN HOTEL ENERGY SYSTEMS: PRIORITISING ENERGY EFFICIENCY IN POST-WAR RECOVERY

Chernykhivska A.

Mining engineering. Metallurgy

<http://www.moderntechno.de/index.php/meit/article/view/meit43-01-070> 236

IMPLEMENTATION OF GARNISSAGE LINING TECHNOLOGY IN FERRONICKEL REFINING CONVERTER

Akreiev V. V., Prykhodko S. V., Melnyk S. O., Ovcharuk A. M.

<http://www.moderntechno.de/index.php/meit/article/view/meit43-01-079> 249

HEAT TRANSFER MECHANISMS IN ENERGY COMPOSITES REINFORCED WITH GRAPHENE STRUCTURES

Hrytsuliak H., Liaskovska M., Kotsyubynsky A., Voloshyn Y., Hrytsuliak V., Lynnyk D., Marych T.

<http://www.moderntechno.de/index.php/meit/article/view/meit43-01-123> 263

ANALYSIS OF METHODS FOR REDUCING THE IMPACT OF STORAGE CONDITIONS ON THE DEFECTS FORMATION IN TITANIUM SPONGE

Nesterenko T.M., Nesterenko O.M., Skripnyuk V. M.

Animal products. Cereals and grain. Milling industry

<http://www.moderntechno.de/index.php/meit/article/view/meit43-01-023> 278

FORMATION OF NUTRITIVE PROPERTIES OF DESSERTS WITH PECTIN-CONTAINING RAW MATERIALS FOR HEALTH PURPOSES

Peresichna S.M., Komisarenko D.E.

<http://www.moderntechno.de/index.php/meit/article/view/meit43-01-036> 288

DISINTEGRATION PROCESSES IN FOOD TECHNOLOGIES AND MECHANIC ACTIVATION PHENOMENA

Simakhina G.O.

<http://www.moderntechno.de/index.php/meit/article/view/meit43-01-122> 298

FORMULATION DESIGN AND TECHNOLOGY DEVELOPMENT OF HEALTH SNACKS BASED ON FLAX SEEDS

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FORMULATION DESIGN AND TECHNOLOGY DEVELOPMENT OF HEALTH SNACKS BASED ON FLAX SEEDS

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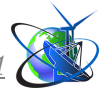
Abstract. *One of the characteristic features of the diet of the population of many countries is the choice of completely ready-to-eat products for breakfast or a snack, therefore, the development of snack technologies that have high nutritional and biological value is an urgent task. The choice of flax and sesame seeds, as well as carrot pomace for the production of snacks allows enriching the diet of people with essential amino acids, valuable ω -3 and ω -6 fatty acids, dietary fiber, a complex of vitamins, minerals and antioxidants. A snack recipe was developed, which ensures the production of a functional food product capable of preventing many non-communicable diseases, including cardiovascular and oncological diseases. The technology of flax snacks developed in the work can be implemented both at food industry enterprises and in craft production conditions.*

Key words: *flax seeds, sesame seeds, carrot pomace, snacks, recipe, technology, nutritional value, biological value, health food product.*

Introduction.

The structure of nutrition and nutritional status of the population are among the most important indicators of the socio-economic development of the country. Therefore, one of the most effective ways to improve the health of both individuals and society is to change the structure of consumed products with the exclusion or significant reduction of the share of unhealthy products and a significant increase in products with therapeutic and preventive properties [1].

The fast pace of life is becoming familiar to the majority of the population, but at the same time it worsens nutrition and health. Today, fast food products have become one of the traditional forms of nutrition and are widely used by the population of many countries as ready-made breakfasts or snacks (light snacks), that is, completely ready-to-eat products. The nutrition of the population can be improved by introducing snacks from natural plant raw materials, which are traditionally grown in our country and have



high biological value, into the production.

One of the promising sources of many useful biologically active substances is flax seeds. The nutritional value and functional properties of flaxseed are determined by the presence of many nutrients, among which it is worth highlighting ω -3 polyunsaturated fatty acids, dietary fiber, lignan, vitamins and minerals [2]. Such a biochemical composition of the raw material determines its positive effect on the functioning of the cardiovascular, antioxidant systems, gastrointestinal tract, lipid metabolism and general health of the human body.

The aim of the work is to develop a recipe and improve the method of production of health and preventive snacks made from flaxseed.

Main text

The interest in the use of flax seeds is explained by its component composition. Flax seeds are a source of nutrients and biologically active substances that have a positive effect on the human body. The most important component of oilseeds are lipids. Among the triacylglycerols of oil contained in different varieties of flax seeds, the largest share is polyunsaturated fatty acids, the total content of which can reach 50...65%. Among them, α -linolenic acid, which belongs to the ω -3 family, prevails. Next in decreasing order of content in the fatty acid composition of triacylglycerols are monounsaturated oleic acid, which belongs to the ω -9 group, and polyunsaturated linoleic acid of the ω -6 family. This composition of flax seed lipids determines the prospects for their use for the creation of health and preventive products enriched with deficient essential mono- and polyunsaturated fatty acids [3].

Flaxseed-based snacks are products with reduced moisture, which are made by soaking flaxseed in water to release mucus, which will act as a structure-forming agent when combining components and drying snacks. Various plant raw materials can be added to such a product. The production of vegetable-grain snacks is relevant. In this work, it is proposed to use flaxseed and sesame seeds as raw materials for snacks, as well as carrot pomace (a secondary product of juice production), the biochemical composition of which is presented in Table 1 [4].



Table 1 – Biochemical composition of raw materials for the production of flaxseed snacks

Nutrient	Flax seeds	Sesame seeds	Carrot pomace
Macronutrients, g			
Water	7,0	9,0	56,3
Protein	18,2	19,4	5,2
Fat	42,2	48,7	1,4
ω -3 fatty acids	9,60	0,8	0
Carbohydrates	3,8	12,2	15,3
Dietary fiber	25,1	2,6	19,8
Vitamins, mg			
β -carotene	0	40	4000
E	20,0	2,3	0,1
C	-	-	7,5
B ₁	1,6	1,27	0,04
B ₂	0,16	0,36	0,1
B ₉	87,0	96,0	-
PP	3,1	11,1	0,8
Mineral substances, mg			
Potassium	813	498	322
Calcium	255	1474	38,6
Magnesium	392	540,3	23,3
Phosphorus	642	720	89
Iron	5,73	16,0	1,3
Zinc	4,34	10,2	1,57
Selenium	0,025	0,034	0,009

Authoring

Carrot pomace has a high content of dietary fiber, carotenoids, vitamins B₁, B₂, B₅, B₆, B₉, B₁₂, C, D and PP, calcium, potassium and phosphorus. Flax and sesame



seeds are valuable sources of nutrients and essential amino acids, polyunsaturated fatty acids, in particular essential fatty acids ω -3 and ω -6, dietary fiber, antioxidants - tocopherols, zinc, selenium, etc. The high content of vitamin E in flax seeds protects the β -carotene molecules of carrot pomace from oxidative effects during the technological process and storage process. In addition, when they are consumed simultaneously, they exhibit additive effects in a higher antioxidant effect. At the same time, vitamin C, which is contained in carrot pomace, has a certain protective effect on the oxidation of vitamin E, fatty acids of the ω -3 family, which are contained in flax seeds and sesame, which explains the feasibility of their combined use in snack recipes.

The feasibility of using sesame seeds is due to the high content of alkaline elements - potassium, magnesium, calcium, important in health nutrition, which participate in many metabolic processes in the body and exhibit certain detoxifying, anti-stress and alkalizing properties, a positive effect on the cardiovascular and nervous systems.

To ensure the desired structure and quality indicators of flaxseed snacks, the functional and technological properties of all types of raw materials are important, which determine their behavior in the production of food products, the impact on the consistency, structure, technological and consumer properties. Therefore, the moisture-retaining and fat-retaining capacities of flaxseed, sesame and carrot pomace were determined (Table 2). The results obtained showed a high ability of high-molecular compounds of the raw materials to bind both water and fat, which indicates the possibility of obtaining a finished product with a homogeneous texture.

The main component of the snack recipe is flax seeds, the mass fraction of which should be 40...50%. The mass fraction of sesame seeds and carrot pomace was selected taking into account the organoleptic characteristics of the finished products, the consistency of the dough and the cost of raw materials. Taking into account the above recommendations and the results of laboratory experiments, the snack recipe was developed, which is presented in Table 3.

Calculations were made of the nutrient content in 100 g of flax snacks, as well as the level of ensuring a person's daily needs for these substances when consuming



100, 50 and 25 g of flax enriched with sesame seeds and carrot juice. When analyzing the results obtained, the following conclusions were made. The recommended daily intake of flax snacks is 75 g.

Table 2 – Functional and technological properties of raw materials

Type of raw material	Moisture holding capacity, %	Fat holding capacity, %
Flax seeds	310,5±1,8	152,6±1,0
Sesame seeds	231,4±0,9	81,5±1,2
Carrot pomace	362,6±0,4	48,4±0,2

Authoring

Table 3 – Recipe for flax snack, enriched with sesame seeds and carrot pomace

Raw materials	Consumption, kg
Flax seeds	45,0
Sesame seeds	24,0
Carrot pomace	30,0
Salt	1,0
Total	100,0

Authoring

Under these conditions, the daily needs of men aged 18-29 years of the I labor intensity group will be provided at the following level, %: protein - 13.51%, unsaturated fats - 28.8%, dietary fiber - 33.5%, vitamin E - 47.9%, B1 - 48.6%, B9 - 12.3%, potassium - 11.8%, calcium - 30.2%, magnesium - 38.7%, phosphorus - 30.5%, iron - 42.7%, zinc - 24.4%, selenium - 23.8%. Exceeding the recommended amount of product consumption of 75 g is not recommended, since when consuming 100 g of flax snacks, the level of providing daily needs in vitamins E and B1, as well as iron and magnesium will exceed 50%. The calculations confirmed that the developed recipe allows you to create a functional food product that has high nutritional and biological value.



The energy value of flax snacks with sesame and carrot juice is 1543.3 kJ (374.4 kcal) per 100 g, and the energy value of a portion weighing 75 g is 1157.5 kJ (280.8 kcal).

The organoleptic properties of finished products are extremely important, as consumer demand for the product depends on them. Table 4 presents the organoleptic properties of flax snacks enriched with carrot pomace and sesame.

Table 4 – Organoleptic characteristics of flax snacks with sesame seeds and carrot pomace

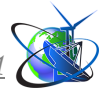
Indicator	Characteristics
Appearance	The surface of the snacks is light brown to dark brown in color, with inclusions of vegetable fiber additives, without breaks or voids. Square-shaped products of the same size
Taste	Pleasant nutty-vegetable flavor, without any off-flavors
Odor	The aroma of roasted sesame with light notes of linseed oil
Color	Yellow to light brown with inclusions
Consistency	Well-dried, brittle product
Appearance at break	Dried snack product, 2...4 mm thick, with inclusions of fiber and plant ingredients

Authoring

A method was developed for producing flax snacks enriched with sesame seed powder and carrot pomace.

Raw materials for the production of flax snack are accepted in accordance with quality control instructions. Preliminary preparation of flax seeds consists of its sieving and separation of metal impurities. Flax seeds are soaked in water at temperature 20-22°C at a hydromodule of 1:1.5. The process duration is from 40 minutes.

After soaking and swelling, flax seeds are mixed with previously prepared additives (sesame seeds, carrot pomace and salt), products are formed by rolling out the resulting dough and cutting it into squares. The resulting products are dried at a



temperature of 70...80±30C to an equilibrium humidity of 14-16%. The dried flax snack is cooled and, if necessary, additionally cut into figures of the desired size and shape.

The product is fed to automatic or semi-automatic dosing units, where it is packed in aluminum foil with a net weight of 75 g. The packed product is hermetically packaged. Packaged flax snack is stored in clean, well-ventilated rooms, protected from direct sunlight, where it is stored at a temperature not higher than 20 °C and a relative humidity of no more than 75%.

Summary and conclusions.

The modern concept of healthy eating includes the development of scientific foundations for the production, sale and consumption of health-promoting products, including snack products. Therefore, the development of a recipe and method for the production of flax snacks is an urgent task for food technologists.

The work justified the choice of raw materials, analyzed its biochemical composition, which allowed us to draw conclusions about the high nutrient density and saturation with indispensable food components. The functional and technological properties of flax seeds, sesame seeds and carrot pomace were determined, the values of which indicate the possibility of obtaining a finished product of uniform texture.

The work developed and tested in laboratory studies the recipe for flax snacks and the method of their production. The conducted studies allow us to implement the presented technology at food industry enterprises or in conditions of craft production.

The proposed product provides an expansion of the range of snack products for healthy nutrition with a high content of proteins, essential amino acids and ω -3 fatty acids; mineral elements, in particular potassium, magnesium, calcium, zinc, iodine, selenium; B vitamins, antioxidant vitamins (β -carotene, C, E), fiber, as well as biologically active substances with antioxidant, detoxification and immunomodulatory effects (polyphenolic compounds, bioflavonoids, etc.).

The proposed technology for flaxseed-based snacks using secondary raw materials, such as carrot pomace, is consistent with the concept of sustainable development and directly contributes to the implementation of its key goals, namely:



Goal 2 – End hunger, achieve food security and improved nutrition, and promote sustainable agriculture; Goal 3 – Ensure healthy lives and well-being for all ages; and Goal 12 – Ensure the transition to sustainable consumption and production patterns.

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