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Арутюнян М.Р., Джамеєв В.Ю.
ВПЛИВ ЦИРКАДНИХ РИТМІВ НА СТАН ЛЮДИНИ..... 39

Радловська Ю.В., Тарасова Є.В., Лілітко Д.А., Буров А.М.
РОЛЬ МІКРОБНИХ МЕТАБОЛІТІВ ТА КИШКОВОГО ДИСБІОЗУ В
ПАТОГЕНЕЗІ НЕЙРОДЕГЕНЕРАТИВНИХ ЗАХВОРЮВАНЬ..... 50

Section: Economy

Ястребний В.М.
АНАЛІЗ ПІДХОДІВ ДО КЛАСИФІКАЦІЇ РИЗИКІВ
КОРПОРАТИВНОЇ СТРАТЕГІЇ ПІДПРИЄМСТВ МОРСЬКОГО
ТРАНСПОРТУ ТА ПЕРЕДУМОВИ ЇХ УДОСКОНАЛЕННЯ..... 53

Section: Finance and Banking

Гаврилко Т., Міленко В.
КРЕДИТНА ПОЛІТИКА БАНКІВ В УМОВАХ ЕКОНОМІЧНОЇ
НЕСТАБІЛЬНОСТІ..... 56

Solianyuk L., Bylym M.
MODERN PARADIGMS FOR ASSESSING THE FINANCIAL
SUSTAINABILITY OF DOMESTIC ENTERPRISES..... 59

Solianyuk L., Chernysh T.
THE SYSTEM OF FINANCIAL INDICATORS AS A DETERMINING
TOOL FOR ENSURING EFFECTIVE CORPORATE
RESTRUCTURING AND RESTORING FINANCIAL STABILITY..... 61

Section: Food Technologies

Stetsenko N.
GLUTEN-FREE MUFFINS WITH IMPROVED BIOLOGICAL VALUE,
ENRICHED WITH SEMI-SKIMMED FLAXSEED FLOUR,
HAWTHORN POWDER AND SESAME SEEDS..... 64

Section: Information Technology, Cyber Security and Computer Engineering

Hmyria I.
COMPARATIVE ANALYSIS OF SEMANTIC SEGMENTATION
ARCHITECTURES FOR URBAN SCENE UNDERSTANDING..... 68

Section: Food Technologies

GLUTEN-FREE MUFFINS WITH IMPROVED BIOLOGICAL VALUE, ENRICHED WITH SEMI- SKIMMED FLAXSEED FLOUR, HAWTHORN POWDER AND SESAME SEEDS

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Important problems facing the food industry at the present stage are saving expensive raw materials, expanding and improving the range, creating products with health and preventive properties. There is a need to expand the range through high-quality and new products based on the use of non-traditional types of raw materials with high consumer characteristics and low cost. In recent years, the production of gluten-free products has gained great popularity in the world. Statistical data show that the number of diseases caused by the indigestibility of certain food compounds, in particular gluten, is increasing. Therefore, the development of special-purpose products for people suffering from gluten intolerance or celiac disease is currently relevant. The only method of treating the disease and preventing complications of celiac disease is a gluten-free diet. Dietary nutrition of people with gluten intolerance must meet special requirements and be provided with gluten-free food products [1].

According to the Codex Alimentarius recommendations, a food product is considered gluten-free if its gluten concentration is less than 20 ppm [2].

The main share of gluten-free products in Ukraine is made up of products of foreign production, therefore the issue of using alternative types of plant raw materials to replace traditional flour containing gluten is becoming important. As a full replacement for gluten-containing products, both traditional types of cereals can be used: (rice, buckwheat, corn, millet), and non-traditional (amaranth, sorghum, flax, quinoa, etc.) [3].

An important element of dietary therapy for patients with celiac disease is the use of foods with high nutritional and biological value in the diet. In this regard, scientists are faced with the need to develop gluten-free products that not only contain all the nutrients necessary for the human body, but also have a good taste [4]. Therefore, the development of a scientifically based technology for gluten-free flour confectionery with improved biological value due to their enrichment with natural sources of essential nutrients is an urgent task.

Rice flour can be the basic basis for the manufacture of gluten-free confectionery, therefore, a comparison of the composition of wheat and rice flour was carried out (Table 1).

Table 1 – Vitamin and mineral content in wheat and rice flour

Nutrient	Wheat flour	Rice flour
Vitamins		
B ₁ , mg	0,095	0,138
B ₂ , mg	0,045	0,021
B ₃ , mg	0,067	0,089
B ₆ , mg	0,16	0,17
B ₉ , mcg	1,4	2,6
H, mg	2,0	3,5
PP, mg	1,2	2,6
E, mg	1,4	1,1
Mineral substances		
Sodium, mg	10	16
Calcium, mg	18	44
Magnesium, mg	16	138
Potassium, mg	122	348
Phosphorus, mg	86	160
Iron, mg	1,2	2,2

When comparing the content of vitamins, it was found that rice flour is superior to wheat flour in the amount of vitamins B₁, B₃, B₆, B₉, H and PP, which indicates its higher biological value, i.e. the presence of essential nutrients. The mineral composition of rice flour is much better than wheat flour, it contains 1,6 times more sodium, 1,8 times more iron, 1,9 times more phosphorus, 2,4 times more calcium, 2,9 times more potassium and 8,6 times more magnesium.

To increase the biological value of gluten-free muffins, enrichers were selected that are characterized by a valuable biochemical composition and belong to gluten-free types of raw materials: semi-skimmed flax seed flour, hawthorn powder and sesame.

The biological value of flax seeds is determined by the presence in its composition of proteins, lignans, dietary fiber, polyunsaturated fatty acids of the ω -3 group, macro- and microelements, many vitamins. All substances have the properties of ensuring the prevention and treatment of various diseases, primarily cardiovascular, gastrointestinal, oncological, etc.

The technological scheme of flax seed processing includes the following sequence of main stages:

- cleaning of flax seeds from mineral, organic and metallomagnetic impurities;
- short-term washing of flax seeds for 5-10 min.;
- heat treatment of flax seeds by convection at a temperature of 70°C for 5 min.;
- removal of edible oil from flax seeds by the method of "cold" pressing;
- grinding of defatted flax seeds to obtain semi-skimmed flax flour.

Another fortifier was selected from the powder of the fruits of the blood-red hawthorn (*Crataegus sanguine* Pall). It contains many vitamins and minerals, antioxidants, soluble and insoluble dietary fibers, bioflavonoids. The complex of biologically active substances of the fruits of the hawthorn has a positive effect on the state of the cardiovascular system, reduces the excitability of the central nervous

system, provides prevention of hypertension and improves coronary and cerebral blood circulation.

Sesame seeds are a source of the largest amount of calcium among all plant products, due to which they have a positive effect on the condition of the bone system and teeth. It is known that the high content of vitamin E in the seeds contributes to the fight against cancer, premature aging of the human body, dietary fibers detoxify it, and polyunsaturated fats improve cholesterol metabolism, reduce its amount in the blood serum.

An evaluation of the organoleptic properties of model samples of muffins was carried out, which differed in the mass fractions of the introduction of fortifiers. When comparing them using the scoring method, the best results were obtained when using a recipe that included 8% semi-skimmed flax flour, 8% sesame seeds and 2% hawthorn fruit powder.

For the developed recipe, the change in the biochemical composition of the muffins, indicators of their nutritional and biological value were calculated. It was found that the selected sources of functional ingredients increase the nutritional value of the products, as well as the level of ensuring the daily human needs for vitamins and minerals. Gluten-free muffins are functional food products in terms of the content of many nutrients. In particular, the level of ensuring the daily needs for proteins when consuming 100 g of muffins is 15,5%, in dietary fiber – 18,5%, calcium – 17,7%, magnesium – 28,9%, iron – 21,3%, phosphorus – 15,5%, vitamin E – 19,9%; B₁ – 20,1%; B₂ – 16,5%; B₉ – 42,2%; PP – 15,4%.

Organoleptic evaluation of muffins enriched with semi-skimmed flax flour, sesame seeds and hawthorn fruit powder confirmed their high quality. Physico-chemical indicators of products containing plant-based enrichers showed that their moisture content was slightly higher due to the high moisture-holding capacity of flax flour and hawthorn fruit powder. The alkalinity of the products decreased slightly, which is due to the increase in the mass of raw materials with acidity, which is higher than in rice flour. The density of enriched muffins is higher, because they have less developed porosity.

It is important to note that in the production of gluten-free muffins, conditions must be strictly observed that exclude contamination of the equipment of technological lines, raw materials, semi-finished products and finished muffins with even the smallest parts of gluten-containing raw materials.

The proposed replacement of part of the rice flour with flaxseed, as well as the addition of hawthorn fruit powder and sesame seeds, allows you to enrich gluten-free muffins with dietary fiber, polyunsaturated fatty acids, calcium and a complex of micronutrients. Their consumption will provide a positive effect on the state of the cardiovascular, nervous systems, gastrointestinal tract, as well as the prevention of hypertension, heart attack, stroke, cancer and premature aging.

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