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FROZEN PRE-COOKED SEMI-PRODUCTS WITH IODINE-CONTAINING STUFFING

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Abstract. The article shows the necessity of healthy foods development and introduction into population's food ration, which are enriched with scarce micronutrients, especially with iodine, to strengthen health and prevent diseases. There is a review of Laminarium chemical composition and proved the possibility of using these algae as iodine-containing ingredient to produce foodstuffs aimed to prevent iodine deficient disorders. The correlation of iodine and selenium in Laminarium algae is unique and is (1.0 : 0.7). This is that correlation what is necessary for human's thyroid gland to provide normal functioning and optimal producing of the most important hormones – Thyroxine (T6) and Triiodothyronin (T3). While the development of pancakes with Laminarium stuffing, it was made a number of physical and chemical indicators of the stuffings compositions: humidity, active and titrated acidity. The important criteria for the stuffing formulation development was the product organoleptic estimation. It was found the optimal correlation of the formulation's components of the Laminarium stuffing with the degree of homogenization considering. The application of modern research methods and experimental design, the study of organoleptic, physical, and chemical indicators of Laminarium and stuffing for pancakes with it allowed us to determine the optimum additive content in the stuffing and to optimize technological parameters of pancakes production. The Laminarium algae introduction in the recipe will enrich pancakes with a large number of macro- and microelements, vitamins and organic compounds. It has been found that the new product – pancakes with Laminarium stuffing characterized by high iodine content, has a high nutritional value and good consumer's indicators. This allows to recommend it for using in preventive nutrition.

Keywords: pancakes, stuffing, iodine deficiency, pre-cooked semi-product, Laminarium, seaweed, biological activity.

ЗАМОРОЖЕНІ КУЛІНАРНІ НАПІВФАБРИКАТИ З ЙОДОВМІСНИМИ ФАРШАМИ

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Анотація. У статті зазначено необхідність розробки й впровадження у раціон харчування населення страв здорового харчування, збагачених дефіцитними мікронутрієнтами, в тому числі йодом, для зміцнення здоров'я й профілактики захворювань. Розглянуто хімічний склад ламінарії і обґрунтовано можливість використання її в якості йодовмісного інгредієнту для створення борошняних кулінарних напівфабрикатів – млинців для профілактики йододефіцитних захворювань. Показано, що співвідношення йоду і селену в ламінарії унікальне і становить (1,0:0,7), саме це співвідношення необхідно щитовидній залозі людини для забезпечення нормальної функції і оптимального вироблення найважливіших її гормонів – тироксину (Т6) і трийодтироніну (Т3). При розробці технології млинців з фаршем із ламінарії був проведений ряд досліджень фізико-хімічних показників рецептурних композицій фаршів, а саме вологості, активної та титрованої кислотності. Важливим критерієм для розробки рецептури фаршу з ламінарії була органолептична оцінка продукту. Встановлено оптимальне співвідношення рецептурних компонентів фаршу з ламінарією з урахуванням ступеня їхньої гомогенізації. Введення добавки ламінарії в рецептуру фаршу дозволить збагатити млинці макро- та мікроелементами, вітамінами та цінними органічними сполуками.

Ключові слова: млинці, фарш, йододефіцит, кулінарний напівфабрикат, ламінарія, морська капуста, біологічна активність.



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Introduction. Formulation of the problem

According to the concept of healthy eating, which aim is to form and preserve health, reduce the risk of alimentary-dependent diseases, the extremely important direction is to include in a specialized food rations the dishes that have a beneficial effect on the functional systems of the human body.

A significant interest and prospect for the production of a number of specialized food products are presented by brown algae of the Laminarium family. Those beneficial properties are because they are sources of a number of micronutrients, lipotropic substances, food fibers, B vitamins, iodine and some other essences. The dish with a seaweed, as a natural source of iodine, can be recommended for the group preven-

tion of the iodine deficiency. The products enrichment with *Laminarium* with such essential elements as selenium in an organically bound form, allows to create a product with increased iodine resistance. They can provide prophylactic and therapeutic effects on the health of persons who are suffering from various kinds of socially significant diseases, especially non-infectious.

The increase of diseases of the Ukrainian population in recent decades, experts are attributing with the ecological situation deterioration, the food products quality and an unbalanced nutrition. High-quality and safe products are one of the most important factors influencing the human health.

Nowadays, food products have become an effective remedy for improving physical and psychic health, which reduces the risk of many diseases. That's why there is a growing need for the use of food products with a balanced chemical composition containing biologically active substances of a different action spectrum.

According to the manufacturer's experience, the make of products a high nutritional value in recent years has increased significantly, due to the expansion of the assortment, the emergence of new products types in this market sector, and rather high interest, confidence and understanding of buyers of the functional foods importance to keep them healthy and reduce the risk of diseases [1-3].

For the food products enrichment with various functional properties, while their creation it is necessary to use those micronutrients, the lack of which is actually appear.

Analysis of Literature

These days, one of the important medical and social problems for many world countries is the presence of endemic iodine deficiency – a condition when the minimum physiologically necessary amount of iodine for the human body (100 – 250 µg per day) is not reached with food and water.

The problem of iodine deficiency, according to the WHO experts, is the most common cause of a mental retardation that can be prevented by an effective iodine prophylaxis [4,5].

The best way to prevent the iodine deficiency is to use products that contain the organically bound iodine.

Iodine is currently the only known microelement involved in the hormones biosynthesis. The biological role of iodine is associated with its involvement in the thyroid gland hormones formation – triiodothyronine and thyroxine.

Unique raw materials with those composition and properties are brown algae, which are used to prepare as independent food products (salads, canned food, soups, other dishes, snacks, etc.), as well as their

modified derivatives, which are used as the structure-forming components.

The most promising for this are brown algae, including *Laminarium* – *Laminariales*.

Laminarium can be confidently called the most famous representative of brown algae. There is known more than 20 species of a *Laminarium* algae family, also known as sea cabbage.

Seaweeds have a unique biochemical composition that can fully cover the human body needs in exogenous biologically active substances. These are microelements, amino acids, polysaccharides, non-saturated fatty acids, chlorophyll, carotenoids, water soluble vitamins, as well as iodine, a significant amount of which is found in brown algae in the form of organic compounds [6,7].

Laminarium is a ready, natural, perfectly balanced complex, which contains about 40 micro and macro elements, which are connected with organic substances. Specific content in iodine is 110 – 800 µg per 100 g of dry substance [8]. Mineral substances, including alkaline and ground metals, can accumulate in quantities, many times exceeding the concentration of these elements in water. Most of these elements are biogenic, that is, they are part of the vitamins, enzymes, and are necessary for the normal human body functioning. The most important of the biogenic micro elements are selenium and iodine. Selenium is a major antioxidant agent, which increases the body resistance to negative environmental effects. In the sea algae it is contained in organic form. Iodine in seaweed is also in connection with amino acids of proteins (tyrosine), that explains its high bioavailability, in contrast to inorganic iodine. However, the biggest interest is that the correlation of iodine and selenium in *Laminarium* is unique and is equal to 1,0 : 0,7. It is this correlation which is necessary for the human thyroid gland to ensure normal function and optimal development of the most important of its hormones – thyroxine (T₄) and triiodothyronine (T₃) [9-14].

Excellent curative qualities of seaweed are due to the fact that its protein, fat and carbohydrate composition in its biological characteristics is favorably different from other food plants (Table 1).

Laminarium stimulates the general metabolism processes, corrects the work of the endocrine glands (particularly in thyroid gland), is used in the nerve disorders treatment, normalizes the mineral balance, provides a powerful anti-sclerotic effect, prevents the occurrence of diseases such as angina pectoris, myocardial infarction.

Laminarium contains alginates, fucoidan, manitol and laminarans. Fucoidan is a biologically active sulfated polysaccharide having antitumor and anticoagulant activity and inhibits the growth of a number of microorganisms. Laminarans are low molecular weight β-1,3-1,6-glucans, have a wide range of biological effects: increase the organism resistivity to bacterial, vi-

ral, fungal, parasitic infections, they are used as stimulants while secondary immunodeficiencies.

It is known that Laminarium reduces the absorption and accumulation of radionuclides of cesium and strontium in the human body [15]. More than 40 years ago, the search for safe and effective substances that could bind and remove radionuclides and heavy metals from the human body began. Studies conducted in more than 10 countries have shown that alginates (from the Latin *Alga* – sea grass) have the highest efficiency - the alginic acid salts, which are the product of seaweed processing and contain the valuable biologically active substances.

Table 1 – Chemical composition of Laminarium [9-11]

Index	Contents
Protein, g/100g	0.9
Fat, g/100g	0.2
Carbohydrates, g/100g	3.0
Food fibers, g/100g	0,6
Organic acids, g/100g	2.5
Water, g/100g	88.0
Ash, g/100g	4.1
Calories, k/Cal	24.9
Minerals, mg/100g	
Calcium	40
Magnesium	170
Sodium	520
Potassium	970
Phosphorus	56
Sulfur	9
Iron	16
Iodine	0.3
Selenium	0.0007
Vitamins, mg/100g	
Vitamin A,	0,15
Vitamin B ₁	2,5
Vitamin B ₂	0,04
Vitamin B ₆	0,06
Vitamin B ₉	0,0023
Vitamin B ₁₂	0,001
Vitamin C	2,0
Vitamin D	0,0024
Vitamin PP	0,55
Vitamin E	0,87

The seaweed alginates and in the isolated state have the properties of food fibers and enterosorbents. They remove heavy metals, radionuclides and toxins from the body.

Soluble alginates are highly effective thickeners and formers, and now they are important nutritional supplements that improve the rheological properties of food products.

Alginates and laminarin (derived from Laminarium) inhibit the mutagenic effect of xenobiotics on the genetic apparatus of cells, blocking the enzymatic ac-

tivity of intestinal flora, which reduces the metabolic activity of carcinogens [16-22].

Sea cabbage is the carrier of many biologically active substances: chlorophyll and fikoxanthine. carotenoids, mitosis-static substances, vitamins B₁, B₂, B₁₂, C, D, PP, E, F, traces of vegetable oils, unsaturated fatty acids.

It is known that the positive influence of biologically active substances from Laminarium is manifested in the antioxidant activity due to the presence of mineral and organic substances suppressing peroxide lipid oxidation (LPO).

The system of antioxidant protection includes vitamins and provitamins, which are contained in algae in harmonized correlations: tocopherols, ascorbic acid (vitamin C), β-carotene (provitamin A).

As apart of the Laminarium, there is a complex of amino acids required for the synthesis of the major antioxidant enzymes (superoxide dismutase, catalase, glutathione peroxidase). The seaweed contains minerals that are involved in the LPO process.

So, for the glutathione peroxidase construction, a microelement Selenium (Se) is required. The phyto-maintenance provides the normal structure of membrane formations, protein structures, which leads to delayed processes of apoptosis, stimulates regenerative and repair processes, slows down the effects of aging. Algae are an indispensable raw material for the natural degreasers, thickeners, stabilizers production, which are widely used in the food products preparation. Low caloric content, high nutrients content, which create a feeling of satiety for a long time, make the seaweed an indispensable component of dietary nutrition for people suffering from overweight. Also, it is the best way to prevent thyroid diseases, including an endemic goiter.

At present, when the pharmacological properties of many biochemicals of algae have become well-known, scientists are paying a lot of attention to the functional food products development with additives from them.

The purpose of experimental research is the scientific substantiation and development the technology of frozen culinary semi-finished products, namely pancakes with Laminarium stuffing for the iodine deficiency prevention and its unpredictable consequences.

In order to develop the Laminarium stuffing pancakes technology, it was necessary to establish the optimal correlation between the prescription components of the product, taking into account the degree of homogenization, to optimize organoleptic parameters, to improve the freezing conditions of semi-finished products, and to research the physical and chemical parameters of the Laminarium additives and stuffing with it.

Research Materials and Methods

In this work, have been used standard methods for researching the organoleptic and physical-chemical

properties of the product and the method for determining the biological activity of natural origin objects [24].

Based on the analysis of iodine-based raw materials, it was decided to use Laminarium as a stuffing ingredient for pancakes. Pancakes are so versatile that they can serve as a high-grade breakfast and dinner, remaining one of the most popular and traditional dishes. However, a modern life pace does not leave any time for the preparation of these delicacies. One of the promising and profitable destinations in the field of expanding the range of this group of culinary products is the production of frozen pancakes. Frozen pancakes are made with different stuffings and are one of the most

popular semi-products for fast cooking. By introducing modern lines of pancakes production, it is possible to produce the most qualitative products in large quantities, but with different stuffings, including Laminarium.

For the research were chosen four samples: a control sample of pancakes stuffed with green-stuff and egg with the recipe No. 1044 [25]; stuffed pancakes with different content of Laminarium, namely: 18%; 36%; 54% to the mass of the product.

The best formulation for stuffing with Laminarium is presented in the percentage correlation in Figure 1.

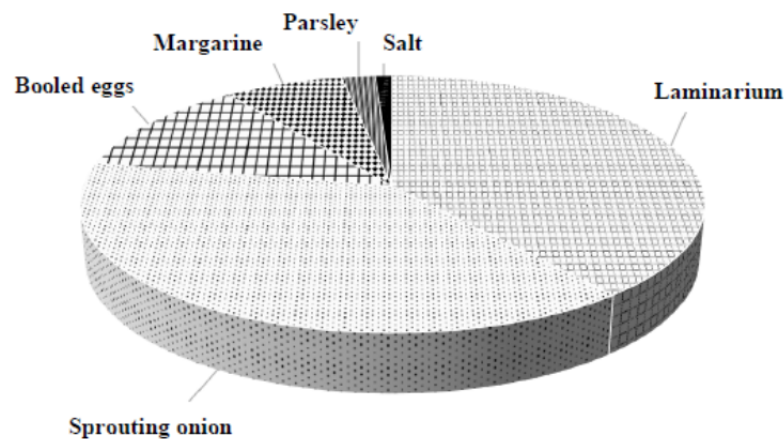


Fig. 1. The percentage correlation of stuffing ingredients for pancakes diagram

The results of the research and their discussion

An important criterion for the preparation of stuffing from Laminarium was the product organoleptic

evaluation. As we see from Figure 2, a pancake sample with 36% of Laminarium supplementation turned out to be the best by its organoleptic indicators.

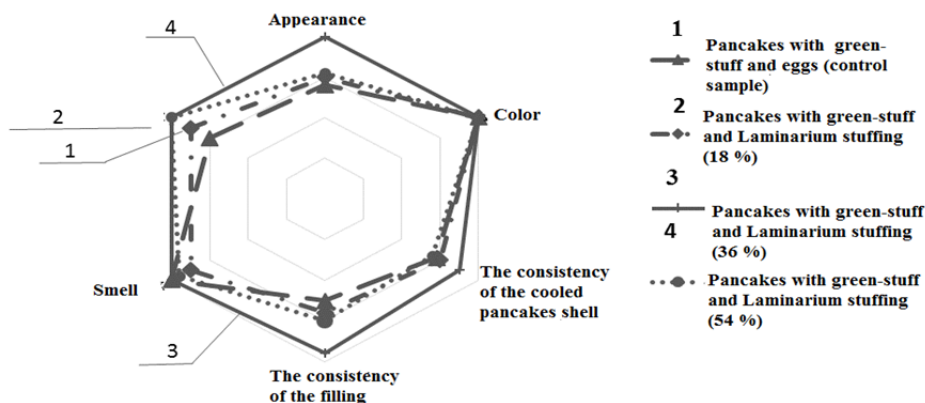


Fig. 2. The organoleptic indicators of pancakes with Laminarium stuffing and green-stuff

It was made a number of studies of physical and chemical parameters, namely, the moisture content of stuffing, the stuffing active and titrated acidity and the biological activity (Fig. 3-6), while the technology development of Laminarium stuffing supplement for pancakes.

It is known that with the increase of the Laminarium admixture content, the stuffing moisture content increases, due to the fact that after its recov-

ery, Laminarium absorbs a large amount of moisture (up to 93%).

The increased acidity of stuffings with the increase of the Laminarium additive content is expected. It happens due to the fact that sautéed onion in the stuffing is replaced with Laminarium additive. In turn, the sautéed onion is characterized by increased acidity than the Laminarium. Laminarium contains alginic acid, which affects on the stuffing general acidity.

The healing power of Laminarium can't be related to the biological activity of any one component. It is due to the harmonic synergistic effect of all biologically active substances that are part of the Laminarium. According to this, a particular interest has the definition of such an indicator as a biological activity, the

magnitude of which takes into account two main factors: the intermolecular interaction of the ingredients that are part of the pancake stuff and the cooperative contribution of the biologically active components to the intensity of electronic transport simulating the energy homeostasis of the organism [23].

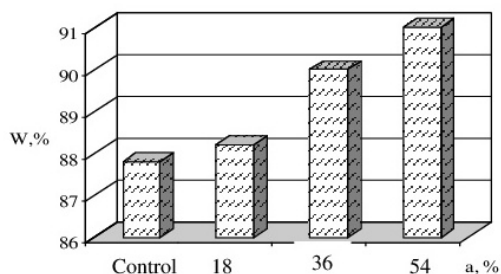


Fig. 3. Dependence on humidity, W, % stuffing on the Laminarium content a, %

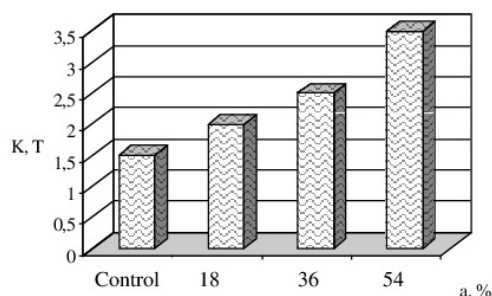


Fig. 4. Dependence of titrated acidity of stuffings K, °T on the content of Laminarium additions a, %

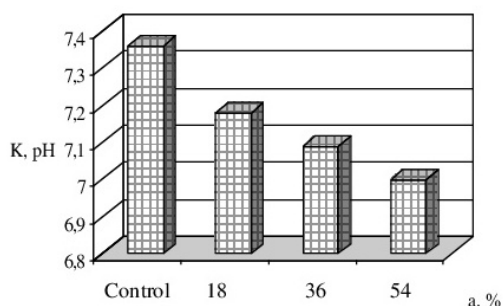


Fig. 5. Dependence of active acidity of stuffings k, pH on the Laminarium additive, a, %

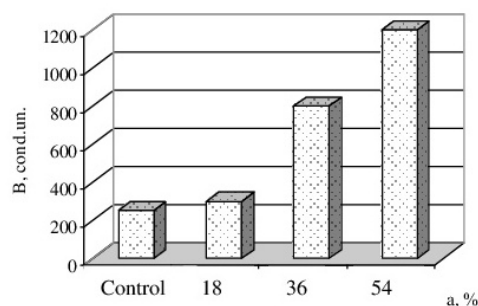


Fig. 6. Dependence of biological activity in cond. un. of stuffings on the content of Laminarium additions, a, %.

The criterion for assessing the biological activity of vegetable origin products is based on the catalysis of the electron transport by the product in the system of "reduced nicotinamide adenine dinucleotide /NAD·H₂/ – potassium ferriyanide K₃[Fe(CN)₆]. The ability of various biologically active components included in stuffing, can cause a non-oxidation of oxidation NAD·H₂ to NAD and to simultaneously restore Fe⁺³ до Fe⁺² shows that these substances can increase the general non-specific resistance of the organism [24].

This criterion is widely used for the food products analysis that have therapeutic and prophylactic properties (dairy products, juices, drinks, etc.) [26,27].

We made a series of experimental studies to determine the biological activity of the stuffing control sample with herbs and eggs, and stuffing with Laminarium. Experimental data of the stuffing biological activity study are presented in Fig. 6.

As can be seen from the experimental data presented in Figure 6, all prototypes are biologically ac-

tive, since the transfer velocity in the system increases by their presence almost once. It should be noted that the ability of the test samples to oxidize H NAD₂ to NAD is different, therefore the value of biological activity has a rather wide range and there is an increase in the biological activity of stuffing with the Laminarium addition.

Conclusions

Thus, on the basis of the received physical and chemical data, organoleptic parameters and biological activity of pancakes, it can be concluded that the introduction of an additive from the Laminarium in the formulation is expedient. The new food product - frozen half-finished pancakes with stuffing from Laminarium, is characterized by high iodine content, high nutritional value and good consumer characteristics, which allows it to be recommended for consumption in prophylactic nutrition.

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ЗАМОРОЖЕННЫЕ КУЛИНАРНЫЕ ПОЛУФАБРИКАТЫ С ЙОДОСОДЕРЖАЩИМИ ФАРШАМИ

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Аннотация. В статье показана необходимость разработки и внедрения в рацион питания населения блюд здорового питания, обогащенных дефицитными микронутриентами, в том числе йодом, для укрепления здоровья и профилактики заболеваний. Рассмотрены химический состав ламинарии и обоснована возможность использования ее в качестве йодосодержащего ингредиента для создания мучных кулинарных полуфабрикатов блинчиков для профилактики йододефицитных заболеваний. Показано, что соотношение йода и селена в ламинарии уникально и составляет (1,0 :0,7), именно это соотношение необходимо щитовидной железе человека для обеспечения нормальной функции и оптимальной выработки важнейших ее гормонов – тироксина (Т₄) и трийодтиронина (Т₃). При разработке технологии блинчиков с фаршем с ламинарией был проведен ряд исследований физико-химических показателей рецептурных композиций фаршей, а именно влажности, активной и титруемой кислотности. Важным критерием для разработки рецептуры фарша из ламинарии была органолептическая оценка продукта. Установлено оптимальное соотношение рецептурных компонентов фарша с ламинарией с учетом степени их гомогенизации. Установлено, что новый продукт – блинчики с фаршем с ламинарией, характеризуется повышенным содержанием йода, обладает высокой пищевой ценностью и хорошими потребительскими показателями, что позволяет рекомендовать его к употреблению в профилактическом питании.

Ключевые слова: блинчики, фарш, йододефицит, кулинарный полуфабрикат, ламинария, морская капуста, биологическая активность.

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