UDC 663.9:613.3
DOI https://doi.org/10.32851/tnv-tech.2021.6.14

RELEVANCE OF THE USE OF MICROALGAES IN THE CREATION OF NEW FUNCTIONAL DRINKS «DRY COCKTAIL» TYPE

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The main task of the WHO FAO is to urgently address the issue of protein-energy deficiency. Microalgae are recognized as a new platform for the production of food and feed with an increased protein component. The main task of technologists of food production and restaurant business is to increase the supply of food and dishes based on microalgae to regulate the lack of protein in the diets of various segments of the population. Existing food technologies using microalgae are highly efficient in terms of resource and energy conservation, environmentally friendly and in the long run meet the global needs of mankind related to protein and energy deficiency, cleansing the body of toxicants, improving metabolic processes, strengthening the immune system. The article describes the technology of dry drinks "dry cocktail" of high biological value with the addition of microalgae (spirulina and chlorella), the quantitative application of which depended on the content of biologically active substances – activators of metabolic processes – phycocyanin and folic acid, respectively. The dosage of spirulina and chlorella was 2.0–2.5 g and 1.0–1.25 g, respectively, per serving of beverage weighing 7.0–7.5 g. It is established that with the increase in the number of microalgae, the quality indicators of ready-made forms of dry cocktails (clumpiness, bad taste) and drinks based on them (poor dissolution and aftertaste) deteriorate. It was found that the introduction of microalgae at the final stage of homogenization of powders is optimal, because their state in the composite mixture is the smallest in dispersion, so it is better to envelop other particles with particles of microalgae and therefore the liquid phase dissolves faster and without clumping. The expediency of using microalgae in the production of beverages such as "dry cocktail" at a dose of 43,0–50,0%, which increases the nutritional value and allows us to recommend beverages such as functional products for long shelf life.

Key words: *dry drinks, spirulina, chlorella, high protein product, protein deficiency, functional product.*

Кондратюк Н.В., Чернявська А.Ю., Савченко А.М., Карпенко С.О. Актуальність використання мікроводоростей у складі нових функціональних напоїв типу «dry cocktail»

Основним завданням Продовольчої та сільськогосподарської організації ООН і Всесвітньої організації охорони здоров'я є термінове вирішення проблеми, пов'язаної з білково-енергетичною недостатністю. Мікроводорості визнані новою платформою для виробництва продуктів харчування та кормів зі збільшеним білковим складником. Головним завданням технологів харчових виробництв та ресторанного бізнесу є збільшення пропозицій харчових продуктів і страв на основі мікроводоростей для регулювання нестачі білка в раціонах різних верств населення. Наявні технології харчової продукції з використанням

мікроводоростей високоефективні у плані ресурсо- та енергозбереження, досить екологічні та дозволяють у перспективі задовольнити глобальні потреби людства, пов'язані з білково-енергетичною недостатністю, очищенням організму від токсикантів, покращенням метаболічних процесів, зміцненням імунної системи. У статті наведено опис технології сухих напоїв типу «dry cocktail» підвищеної біологічної цінності з додаванням композиції мікроводоростей (спіруліни та хлорели), кількісне внесення яких залежало від вмісту біологічно активних речовин – активаторів метаболічних процесів: фікоціаніну та фолієвої кислоти, відповідно. Дозування спіруліни та хлорели становило 2,0–2,5 г та 1,0–1,25 г, відповідно, на одну порцію напою масою 7,0–7,5 г. З'ясовано, що в разі збільшення кількості мікроводоростей погіршуються показники якості готових форм сухих коктейлів (грудкуватість, поганий присмак) та напоїв на їхній основі (погане розчинення та післясмак). Виявлено, що оптимальним є внесення мікроводоростей на заключній стадії гомогенізації порошків, адже їх стан у композиційній суміші є найдрібнішим за дисперсністю, тому відбувається краще обволікання інших частинок частинками мікроводоростей, через що суміш у рідкій фазі розчиняється швидше і без грудочок. Доведено доцільність використання мікроводоростей під час виробництва напоїв типу «dry cocktail» в дозі 43,0–50,0%, що збільшує харчову цінність і дозволяє рекомендувати такі напої як функціональні продукти тривалого терміну зберігання.

Ключові слова: *сухі напої, спіруліна, хлорела, високобілковий продукт, нестача білка, функціональний продукт.*

Introduction. One of the key problems today is the imbalance of nutrition in many countries around the world. Unfortunately, the planned and generally accepted dynamics of changes in the nutrition systems of many developed countries do not have the information base and methodological recommendations that allow to make these changes in the right direction, given the adaptation period associated with the transition to increased vegetable protein consumption. In recent years, our country has seen a decrease in the consumption of meat, dairy and fish products, which are a natural source of protein, fat and other essential nutrients. Man-made environment constantly creates physical and emotional stress on modern society, causing the development of cardiovascular disease, metabolic disorders and more. The inclusion in the diet of products with functional ingredients or functional products is of particular importance for the prevention and treatment of a number of nutritional diseases, including acute infectious, viral, immune, etc. Decreased vitality and indigestion cause a decrease in immunity in most people, so a balanced (especially protein) diet is a major factor in studying the strategy of restoring metabolic processes, and the development of new functional drinks such as "dry cocktail" with high protein content due to microalgae is relevant and promising.

Formulation of the problem. The production of beverages does not lose its relevance. The most popular among protein drinks are milk, sour milk drinks. Companies that produce milk-like beverages based on vegetable raw materials (coconut, almonds, oats, rice, buckwheat, soybeans) are beginning to develop. The shelf life of such market offers is quite short.

In the sports nutrition sector, completely different proposals are popular, which are related to the specifics of demand and are produced with the content of proteins, their hydrolysates and isolates of both plant and animal origin. Widespread amino acid-based beverages in drinking and dry form. Products are produced in composition as monoproducts (one amino acid) and "mix" or "combi" products of several amino acids. Drinks from the sports and fitness sectors help to gain and maintain muscle mass, contain whey protein, casein, soy or egg white, hemp, pumpkin, sunflower and more. An alternative to these substances may be microalgae – spirulina and chlorella, the protein content of which in dry powder reaches 60% and 50%, respectively. They also contain polyunsaturated acids Omega 3 and Omega 6, which protect against diseases of the cardiovascular and nervous systems. Currently, the state of the market of domestic specialized

sports nutrition products, including beverages based on microalgae, remains unsatisfactory. The production of dry drinks consists only in the production of mixes, which include sugar, flavors and colors, some offer vitamins and vitamin-mineral complexes. There is a great lack of items that contain natural useful components. In isolated cases, such offers, enriched with fruit and berry powders, plant extracts, useful thickeners (pectin, xanthan) still contain large amounts of sugar, no protein and products are not on the shelves in mass markets in a wide range and do not focus on distribution to increase sales.

The aim of the study is analytical research of the market, technologies and development of technology for the production of new functional drinks such as "dry cocktail" based on chlorella and spirulina.

Analysis of recent research and publications. Due to their functionality, algae and their products are of particular importance in the food industry as components of additives for animal feed and additives to functional foods. Microalgae contain high-quality proteins with a high content of essential amino acids present only in animal proteins, polyunsaturated fatty acids (PUFA), including docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), present only in fish and molecules such as phycocyanin, lutein or astaxanthin, which have a high level of protection of the human body from destructive environmental factors. Due to the high content of nutrients and healthy compounds, microalgae serve as fortifications for bakery and flour products [1; 2], sauces, [3] and even confectionery [4], and other foods [5; 6], including and ice cream [7]. Although the number of foods containing microalgae released on the market is increasing every year, microalgae products are not yet a common food ingredient, at least in Western cultures [1; 8–10]. Previous reports have suggested that the rich green color of chlorella and turquoise spirulina and their "marine" taste and odor limit their inclusion in a wide range of foods [11]. Moreover, the low production capacity of microalgae makes the biomass of microalgae inaccessible to the food industry, which operates at higher orders [12]. The third reason may be the lack/limited knowledge of consumers about the chemical composition, high nutritional and biological value of microalgae, environmental friendliness of its production and the ability to do so not in water but in specialized enterprises in hygienic conditions [1; 8]. Consumers do not have access to reliable scientific publications, and their knowledge of algae depends on Internet search results, which generally do not provide evidence for these health claims or do not link microalgae to biodiesel, aquaculture and wastewater treatment.

However, microalgae are currently the only solution as an alternative to animal protein. It is only necessary to properly conduct the adaptation period by forming a national understanding of the need and importance of the transition to alternative types of protein foods. The first steps in the restaurant industry were marked in this direction. In particular, the production of dishes containing microalgae in well-known restaurants under the brands of well-known chefs who have a high level of consumer confidence. Dishes based on microalgae have entered the most modern direction of avant-garde cuisine [13], in particular its sector – phycoastronomy [14].

Presentation of the main research material. The group of soft drinks combines a variety of raw materials, composition, properties and technologies of production of drinks that quench thirst and have a refreshing effect. These include mineral waters, fruit and berry soft drinks and kvass, dry cocktails. Sugar substances add nutritional value to soft drinks; biological – vitamins, minerals; refreshing effect – carbon dioxide and organic acids that are added or formed during the preparation of beverages. Many soft drinks have a preventive or curative effect. Dry cocktails are cocktails that, unlike all other cocktails, consist only of dry matter.

Presentation of cocktails in the form of powders is one of the modern ways of preserving beverages, designed to increase shelf life with reduced loss of quality, available for the production of soft drinks based on milk, coffee, juices and their mixes. The products do not require large production costs and a long technological process. Packaged drinks such as "dry cocktail" do not require special conditions during transportation, sale and are very convenient for consumption.

The market offers a wide range of dry drinks with different flavors, which are considered not only economical but also useful health products. However, there are a number of restrictions on the distribution of "dry cocktail" in the Ukrainian market. This is due to the limitation of raw materials for the production of such products, as well as an imperfect understanding of the importance of their consumption among the population and awareness of the technological processes of their production of enterprise technologists. The difficulty of testing technological processes is that the components of drinks such as "dry cocktail" have different degrees of dispersion, hygroscopicity and dissolution rate. Raw material components must undergo a stage of thorough preparation (drying, sieving, grinding, loosening). For the manufacture of finished products requires special equipment – homogenizers for dry matters with modules to improve the mixture at the stage of mixing and dosing. The components of the mix for dry cocktail drinks should be approximately the same in bulk density. Finished compositions, in addition to such characteristics as wettability, dispersibility and solubility, must have a short dissolution time (up to two minutes), fluidity, which affects the main organoleptic indicator – consistency, be balanced and rich in taste, aroma and color. In addition, it has a high nutritional value and gives a feeling of satiety when consuming a portion of 130–150 ml.

The development of the technology of a new drink such as "dry cocktail" "Fikosmuzi" was to model the recipe, optimize its main components for consistency, taste, speed and quality of dissolution and price. The basis of the idea of creating "Fikosmuzi" was a composition of spirulina and chlorella, the action of which is enhanced by additional vegetable powders and plant extracts, similar in properties and taste and designed for healthiness human body.

Spirulina extract is a unique complex of natural compounds that have a wide range of effects on the human body. This is primarily due to the high level of bioavailability of spirulina proteins, which are as close as possible to meat proteins. Spirulina is also a rich source of vitamins (especially beta-carotene, B vitamins), micro- and macronutrients, including magnesium, potassium, iron, copper, manganese, phosphorus, selenium, chromium and zinc. Spirulina contains a rare but vital antioxidant – phycocyanin, which acts as an inhibitor of oxidative processes that lead to aging, and prevents the formation of free radicals that stimulate the growth of cancer cells [4]. According to the content of the full spectrum of carotenoids, which synergistically interact with each other, enhancing the antioxidant effect, spirulina can be defined as the leader of "superfoods".

Chlorella, like spirulina, is high in protein, B vitamins and carotenoids, trace elements and pigments, which improve metabolic processes in the human body, aimed at the synthesis of enzymes. The most important pigment – chlorophyll – "green gold", because the structure is very similar to hemoglobin. Chlorella protein compounds have a unique feature – they produce similar structures 50 times faster than in other plants, making chlorella a promising source of protein. The chlorophyll content of chlorella has not yet surpassed any other plant in the world.

Chlorella contains such amounts of zinc, vitamin C and glycoproteins that it is recommended for use in disorders of the immune system, weak immunity. Disorders of the gastrointestinal tract are regulated by the content of polysaccharide fibers; detoxification

of the body is carried out due to the content in the cell walls of glucuronic acid and glutathione. Chlorella is recommended for consumption in the prevention and treatment of cancer, skin problems, bad breath or mouth, gum infections, stomatitis, periodontitis.

During the consumption of chlorella, brain activity and physical activity improve, the phase of active work during the working day is prolonged [15]. It is clear that spirulina and chlorella have somewhat common properties, the same nature of origin, but the chemical composition and indications for use, they are quite different, although they can harmoniously complement each other. This was the basis for the development of a new functional drink such as "dry cocktail" "Fikosmuzi". The development belongs to the restaurant industry and can be used in the food industry.

The method of preparation of the dry mixture for the production of the drink "Fikosmuzi" is to mix the dry components in the direction of increasing the weight of the ingredients. First, the components with the lowest mass are mixed by hand, then the resulting mix is added to the components with a larger mass and even greater and mixed with mechanized equipment to a homogeneous mixture. At the food industry enterprises the finished semi-finished product is packed and packed. In restaurants – prepare a dish "Fikosmuzi" ("dry cocktail"), by adding a liquid base, mixing the dry mixture to form a homogeneous system with evenly distributed insoluble particles. The beverage is consumed after a short settling (30–60 s) and repeated stirring to transfer the sedimented particles into solution. The drink can be consumed either whole at once, or prolonged, but each time before a new sip, stir with a cocktail spoon or straw.

When diluting the semi-finished product with water in a ratio of 1:10–1:15 microalgae proteins, as well as polysaccharide fibers present in the mixture of other components with their hydrophilic groups are oriented to water molecules and their swelling occurs. The result is a uniform soft texture that is pleasant to eat. The brightness of the taste and aroma was due to the addition of flavorings "Vanilla", "Coconut", "Mint", "Lemon", "Green Apple", "Kiwi", "Berry Mix", "Cactus", "Lime".

It was investigated that the addition of a hydromodule greater than a ratio of 1:15 deteriorates the taste and reduces the aroma of the finished drink, the consistency becomes more fluid and less pleasant to consume. The process of sedimentation is accelerated and stratification of the drink is observed. The drink becomes less rich in taste and aroma. There is an unpleasant aftertaste.

The addition of vegetable and berry powders, as well as plant extracts and "superfoods" to the mixture allowed to increase the nutritional value of the semi-finished product, increase the biological value by increasing the amount of essential and useful substances, improve the dry matter finished drink (more viscous and fluid enveloping consistency, improved appearance, pleasant aftertaste). When vegetable and berry powders are added, the binding of water is due to the hydration of polysaccharides, due to which the processes of swelling and dissolution take place simultaneously.

To improve the taste of the drink "Fikosmuzi" technological process involves the introduction of semi-finished sweeteners (sucralose, stevioside, erythritol). Dry drink type "dry cocktail" does not clump during storage, but requires storage conditions with moderate humidity. The humidity of the semi-finished product does not exceed 10%.

When mixing spirulina and chlorella powders with other components, the particles of these components are enveloped by microalgae particles, which improves the hydration process and accelerates the swelling and dissolution processes.

The table shows the approximate recipe of a new functional drink such as "dry cocktail" "Phytosmuzi".

Table 1

Approximate recipe for the drink "Phytosmuzi" (1 serving)

Ingredients	Mass, g
Extract of sprouted wheat seeds	0,2
Flax seed extract	0,5
Chia seed extract	0,5
Broccoli extract	0,5
Spirulina (powder)	2,0–2,5
Chlorella (powder)	1,0–1,25
Berry extract (blueberries/cranberries/sea buckthorn/blackberries/currants/raspberries)	0,1–0,4
Ascorbic acid	0,04–0,1
Powders of vegetables and fruits (carrot/beet/pumpkin/apple)	0,1–0,3
Maltodextrin	2,0–3,0
Output 1 serving	7,0–7,5 г

Table 1 clearly shows that the proposed recipe mixture contains useful components and biologically active substances that can restore and improve metabolic processes and the state of the immune system. Given the technological properties and composition of macronutrients, the development can be positioned as a quality food product for different segments of the population.

Conclusions. The article presents the key elements of functional food innovations with the use of microalgae spirulina and chlorella, which are harmoniously combined with extracts of "superfoods" and fruit, vegetable and berry powders. The role of microalgae as promising alternatives to animal protein replacement is highlighted, recommendations for the implementation of the adaptive transition to new forms of nutrition and the need to consume microalgae and food compositions based on them. The expediency of using microalgae in the technology of new functional drinks such as "dry cocktail", in particular in the product "Fikosmusi" was discussed.

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