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INTRODUCTION OF FOOD ENCAPSULATED EMULSIONS WITH RUTIN TO PREVENT ALIMENTARY DISEASES

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Abstract. The last years, in Ukraine and around the world there is a tendency to introduce into the consumption of special foods. The problem remains the practical lack of affordable, easy-to-use foods on the market that take into account the needs of patients due to metabolic disorders. The products presented on the domestic market do not always promote bioconversion and assimilation of physiologically functional ingredients, are available in a limited range and do not take into account all the specific needs of human metabolism.

Approaches to nutrition of people with certain diseases of alimentary character are analyzed. The mechanism of action on the human body of food products with physiologically functional ingredients in the form of encapsulated rutin emulsions, which can be used as components of special products for nutrition of people with certain diseases, is shown. It is also important to use inexpensive domestic raw materials, which will provide products with social and economic effects. Promising for use as a physiologically active component is rutin, which can be introduced into food as an encapsulated emulsion. The benefits of such products on the human body and the possibility of expanding the range of special purpose food are shown. It is important to use routine for nutritional support of people when creating special food based on encapsulated emulsions. Using for food such emulsions for introduction into the diets of people with non-communicable diseases are proposed.

Key words: encapsulated emulsions, rutin, physiologically functional ingredients, engineering of special food products, alimentary diseases, restaurant technology.

ВПРОВАДЖЕННЯ ЕМУЛЬСІЙ З РУТИНОМ У ХАРЧОВИХ КАПСУЛІНАХ ДЛЯ ПРОФІЛАКТИКИ ХАРЧОВИХ ЗАХВОРЮВАНЬ

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Анотація. В останні роки в Україні і світі спостерігається тенденція до впровадження у споживання харчових продуктів спеціального призначення. Проблемою залишається практична відсутність на ринку доступних за ціною, зручних для використання харчових продуктів, що враховують потреби хворих через порушення обміну речовин. Представлені на вітчизняному ринку продукти не завжди сприяють біоконверсії і засвоєнню фізіологічно функціональних інгредієнтів, наявних в обмеженому асортименті і не враховують всіх специфічних потреб метаболізму людей.

Проаналізовано підходи до харчування людей з певними захворюваннями аліментарного характеру. Показано механізм дії на організм людини харчових продуктів з фізіологічно функціональними інгредієнтами у виді капсульованих емульсій рутину, які можна використовувати як компоненти спеціальних продуктів для харчування людей з певними захворюваннями. Важливим при цьому також є використання недорогої вітчизняної сировини, що дозволить отримати продукти з соціальним економічним ефектом. Перспективним для використання в якості фізіологічно активного компонента є рутин, який може бути уведений у харчові продукти як капсульована емульсія. Показано переваги дії таких продуктів на організм людини, та можливість розширення асортименту харчової продукції спеціального призначення. Актуальним є використання рутину для нутритивної підтримки людей при створенні спеціальних харчових продуктів на основі капсульованих емульсій. Запропоновано харчові продукти з використанням таких емульсій для введення у раціони людей з неінфекційними захворюваннями

Ключові слова: капсульовані емульсії, рутин, фізіологічно функціональні інгредієнти, інжиніринг спеціальних продуктів харчування, захворювання аліментарного характеру, технології продукції ресторанного господарства.

The article has research nature and reveals problems in such fields of science as nutrition, nutrition, innovative nutrition. Today, according to the World Health Organization (WHO), the most common diseases are alimentary. According to the WHO, having a safe and balanced diet is an important factor in promoting good health.

Meals are useful when they are balanced in macronutrient and micronutrient composition, contain the necessary functional physiological ingredients and have certain structural properties. This is especially important for systems that are two-phase. There are macro- and microemulsions that differ significantly from each other. Innovative technologies of production of food products of mass consumption of new generation on technology of structured products with capsule structure are also introduced.

Emulsions are thermodynamically or kinetically stable liquid dispersions of oil and aqueous phases in combination with a surfactant. The dispersed phase usually contains small particles or droplets of 5–200 nm (microemulsion) and more than 300 nm (macroemulsion). Encapsulation of biologically active substances in emulsions occurs spontaneously: fat-soluble components are concentrated in the fat phase, water-soluble – in the aqueous phase. The formation of microemulsions requires in many cases in addition to the surfactant, oil and aqueous phases to use a secondary surfactant or co-solvent. In such systems, not only are the physiological functional ingredients well dispersed, but because of the lamillary structure, the emulsions are much better absorbed by the human body.

Extraction is traditionally used to in the food industry to extract biologically active substances from raw materials. Ultrasonic extraction allows to minimize the duration of extraction by accelerating the diffusion process and increasing the permeability of the extractant. Ultrasonic extraction allows to obtain a more significant amount of native biologically active substances in a short time [15; 16; 17].

Rutin is a biologically active substance, a natural flavonoid that increases the strength of capillaries, reduces the permeability of blood vessel walls, participates in redox processes, improves the condition of connective tissues and their oxygen saturation, prevents premature aging and protects against allergic reactions, improves absorption of ascorrhiza, lowers cholesterol, prevents thrombosis and varicose veins, optimizes heart function, lowers blood pressure, eliminates edema. Insufficient amount of routine in the daily diet should be supplemented with extracts.

There fore, understanding the relationship between the structure of food, the presence of physiologically functional ingredients that are better suited to the cells of the body due to the formation of structured emulsions, and the prevalence of food-borne diseases and related risk factors is important. preventive measures and treatment of people in general [1; 12; 20]. The formation of the structure of special purpose products will prevent a significant number of diseases, and research in this direction is necessary, which determines the relevance of this work.

Literary review. World experience in combating diseases and maintaining normal metabolism of the human body indicates the feasibility of reviewing the main points of bioconversion of nutrients in the human body. New theoretical principles become the basis for solving important technological problems in the development of new diets and certain food for sick people, taking into account the special needs of their body and the specifics of each disease of an alimentary nature.

Various domestic and foreign scientists [1–4] and other researchers have paid attention to the issues of engineering of special purpose products. Scientists have substantiated scientific approaches to optimizing the nutrition of patients, developed medical and biological requirements for special food, analyzed the features of the use of dietary supplements, as well as developed a range of special food for people with certain diseases.

Previous studies on the creation of new food for people with non-communicable diseases have solved a number of problems [1; 5–7]. For example, issues such as the development of effective approaches to the introduction of fat-soluble components into the aqueous phase to increase their bioconversion in the human body remained unresolved. The technology of manufacturing such products and the evidence base of the effectiveness of such components in the food system.

It is obvious that in complex food systems there is an interaction between the ingredients, which leads to the formation of complexes, the reactivity of which may increase or decrease. In the work of Telezhenko L.M. [11]. It is shown that complexation with the participation of phenolic substances, in which the properties of the π -acceptor are revealed, contribute to the increase of the ORP of the system. Accordingly, an increase in Δ (the energy required to excite the electron) leads to an increase in the reactivity of the system. With the same central ion and the same configuration of complexes, the value of Δ is greater the stronger the field formed by the ligands.

The study of the absorption spectra of complexes allows us to determine Δ from the equation: $\Delta = h\nu = hc / \lambda$,

Where h is the Planck constant, ν is the frequency of the quantum of light, c is the speed of light, λ is the wavelength.

The density of the formation of complex compounds can also be estimated by their dissociation constant, which is also not simply due to the multicomponent mixtures.

We have proved a simpler and more effective assessment of the behavior of inverse systems in complex formation through the analysis of the values of their potentials. In a number of redox systems, each of them with a higher potential is an oxidant relative to a system with a lower potential. The potential difference characterizes the intensity of processes.

It is established that the efficiency of stabilization of pigments by complexation is due to the density of the complex, which is characterized by the magnitude of the decrease in ORP in excess of the complexing agent. For example, the introduction of phenolic substances (such as quercetin or rutin) and organic acids (such as ascorbic or citric) to betalains causes a shift in the value of ORP by 2–10 times.

Therefore, the creation of two-phase systems in the form of encapsulated emulsions will regulate their oxidative activity and stability, provided that they have physiologically active components, rutin and organic acids [14].

The introduction of encapsulated rutin emulsions in the food line will increase their antioxidant properties and will create a laminar cluster structure that will provide better bioconversion of physiologically functional ingredients in the human body.

The purpose and objectives of the study. The purpose of the study is developing the formulation of encapsulated emulsions with rutin, the technology of their manufacture, introduction to dishes and determine the safety of the cluster structure in the finished product.

To achieve this goal is necessary to perform the following tasks [10]:

- analyze the possibility of engineering special purpose products in restaurants;
- to investigate the processes of extraction of rutin from onion peel and determine the activity of the extract;
- develop a formulation of encapsulated emulsions with rutin;
- to investigate the mechanisms of interaction of active components in the presence of clusters;
- formulate priority physiological and hygienic requirements that must be met by developed special purpose products;
- show the economic and social effect of the developed encapsulated emulsions with rutin.

Material and methods of research. Methods of polarographic microscopy, spectrophotometric [12], system analysis, chemical, microbiological and organoleptic research methods are used.

Onion peel extract and oil-in-water food emulsion were used as study objects. Extraction of onion peel was performed using an ultrasonic bath Codyson CDS-100.

Research results. Today, the enrichment of food with biologically active components is becoming relevant. As a result of technological processing of raw materials at the enterprises of the food industry the considerable part of functionally significant components of food is lost, the human organism does not receive necessary quantity of them in a native kind. The physiological properties of rutin are recognized as a capillary-strengthening effect. It helps to increase the strength of the smallest vessels – capillaries, reducing their fragility and reducing permeability. Rutin is important for maintaining normal vascular status in the prevention of hemorrhage, especially in critical areas of the human organism such as the brain and heart muscle.

Pure rutin is naturally yellow or yellow-green color, tasteless and odorless, and when viewed under a microscope, it looks like needle-like crystals. Rutin consists of quercetin and a disaccharide (rhamnose and glucose). The daily norm of a rutin is from 25 to 50 mg a day, for women on the average from 20 mg, and for men from 28 mg.

For flavonoids (which include rutin), as for other substances, there is no method of isolation, universal for all raw materials. In each case, resort to the most successful method or combination of methods, taking into account mainly the properties of substances and characteristics of raw material. Methyl or ethyl alcohols, or mixtures of them with water, are most often used as an extractant to extract flavonoids from plant raw materials. The resulting alcoholic extract is evaporated and diluted with hot water.

Looking rutin under a microscope, it looks like needle crystals.

Rutin is found in onion and garlic peels, so it was decided to use onion peels as a raw material to obtain an extract with rutin.

First, we conducted research to detect the presence of rutin in the onion peels, as it is known that in the spring the rutin in the peels becomes less, because it has already fulfilled its protective antioxidant properties.

Microscopic examination revealed rutin in the husk. In Fig. 1 shows photomicrographs of onion peel in polarized light (magnification 40 times). The micrographs show small streaks that light in polarized light. This is a rutin.

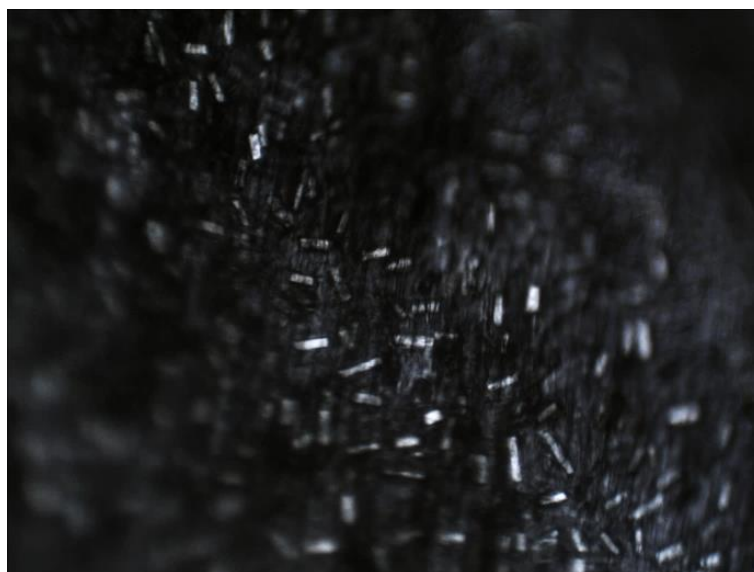


Figure 1 – The micrograph show small streaks that light in polarized light (×40). This is a rutin.

Considering that we plan to use the extract for the preparation of food emulsions, water with a pH of 8.20 was chosen as the extractant. Extraction was performed with using an ultrasonic bath Codyson CDS-100 for 30 minutes, hydromodule 1:10, temperature 40 °C.

The resulting onion peel extract was filtered, concentrated 10 times and microscopically examined. Studies have shown that rutin crystals are present in the extract (Fig. 2) and they are not present in the peels that were extracted.



Figure 2 – Rutin crystals are present in the extract

The dry matter content in the onion peel extract is 2.4%.

The pH of the extract is 6.2, redox potential 130 mV.

Microbiological researches have shown that the number of microorganisms in the extract after storage in the refrigerator for 1 week does not exceed the norm (1.0×10^3 CFU / g of product) and is 0.1×10^2 CFU / g. This small microbiological contamination is due to the fact that ultrasonic treatment has a sterilizing effect.

Organoleptic characteristics of onion peel extract are shown in table 1.

Table 1 – Organoleptic characteristics of onion peel extract

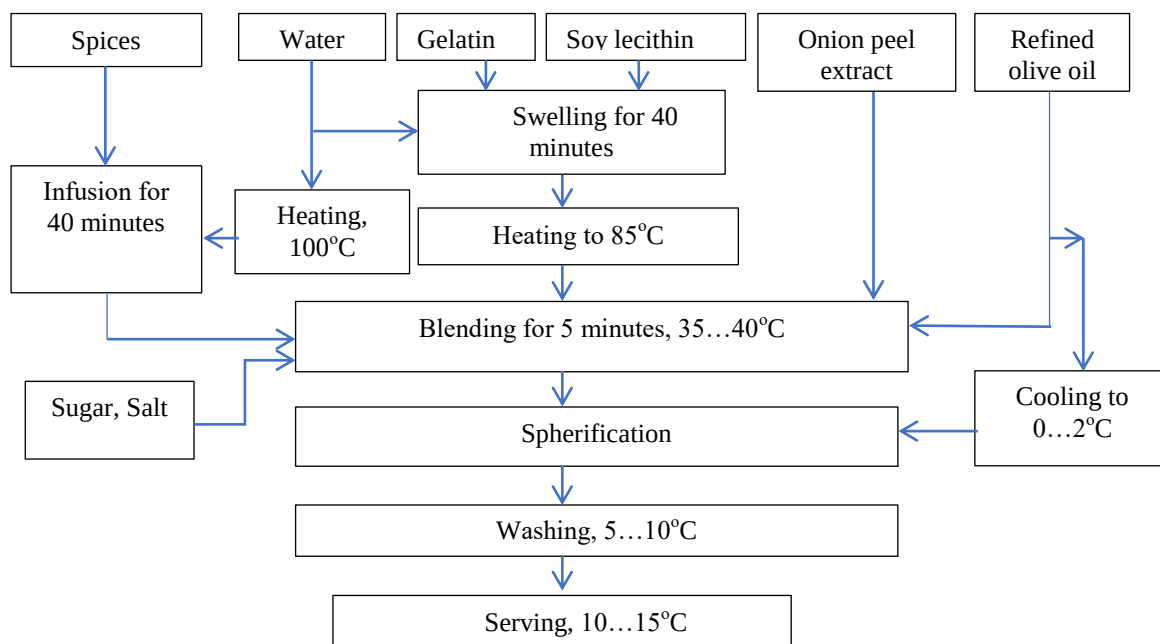
Name	Characteristic
Color	Orange-brown
Transparency	not permeable
Scent	Light, onion peel
Taste	Sour-tart

Emulsion-type sauces occupy a leading place among the variety of sauces used in restaurants. They improve the taste and aroma of food, as well as easily absorbed by the body. Recently, in the restaurant industry, special attention is paid to the development of sauces with the inclusion of biologically active ingredients and innovative serving. The recipe of the sauce for encapsulation with rutin extract is given in table 2, the flow chart – in Fig. 3.

Table 2 – Sauce recipe for encapsulation

Name	Weight, gram
Refined olive oil	30
Water	60
Soy lecithin	5
Gelatin	5
Sugar	2
Salt	0,5
Onion peel extract	10
Spices:	
Fresh lemongrass	3
Cayenne pepper	0,1
Ginger	3
TOTAL:	100

Plant lecithin is an emulsifier and at the same time a physiological functional nutrient with high efficiency of physiological effect, a natural antioxidant and antioxidant for therapeutic and prophylactic dishes. Gelatin enriches the sauce with protein and acts as a structuring agent during spherification. The prescription amount of onion peel extract was determined taking into account the organoleptic characteristics. Spices give the sauce a sour-spicy taste and at the same time enrich it with biologically active components.

**Figure 3 – The flow chart of the sauce for encapsulation with rutin extract**

Technology of prepare: Pour spices over boiling water and infuse 40 forks. Granulated soy lecithin and gelatin are filled with water for swelling, then heated to 85 °C. 30 gr. olive oil, 10 gr. extract with rutin, lecithin-gelatin gel and infusion of spices beat with a blender, bring to taste, pour the mixture into a pastry bag and carry out spherification in oil (0–2 °C). The resulting spheres are filtered and washed with cold water. We recommend serving the encapsulated emulsion sauce with cold meat and fish dishes as a recipe component of vegetable salads.

Data of organoleptic analysis of the obtained sauce after spherification are given in table 3.

Table 3 – Data of organoleptic analysis of the obtained sauce after spherification

Name	Characteristic
Appearance	Light orange spheres with a diameter of 3–5 mm
Taste	The taste is pleasant, sour-spicy, with a hint of lemongrass
Scent	Lemongrass
Color	Pleasant light orange

Conducted microbiological studies showed that the number of microorganisms after 72 hours of storage in the refrigerator, the amount of MAFANM was within normal limits – 1.5×10^2 CFU / g.

Conclusions:

As a result of the conducted researches the compounding and technology of preparation of the encapsulated emulsion sauce with an extract of rutin from an onion peel are developed.

Soy lecithin granular and gelatin are used as emulsifying substance and structuring agent.

Organoleptic analysis showed high taste characteristics of the developed product. The microbiological safety of encapsulated sauce has been proven.

It is important to use routine for nutritional support of people when creating special food based on encapsulated emulsions. Using for food such emulsions for introduction into the diets of people with non-communicable diseases are proposed

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