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INNOVATIVE DEVELOPMENT OF PRODUCTION OF FUNCTIONAL FOOD PRODUCTS IN SOUTHERN UKRAINE

In the conditions of the modern development of the world economy, as well as under the influence of global trends towards a healthy lifestyle, the issue of creating and introducing functional food products is becoming especially relevant. One of the important directions of innovative development in the food industry is the production of products enriched with hydrocolloids obtained from Black Sea algae. Southern region of Ukraine has unique natural and climatic conditions that allow effective use of local resources to create high-quality and healthy products [1].

Hydrocolloids, as a special class of biopolymers, have the ability to form gels in solutions, which makes them indispensable in many food production processes. They can significantly affect the texture, consistency, stability and shelf life of the final products. Among the various types of hydrocolloids used in the food industry, those obtained from seaweed, such as agar, alginates, carrageenans, occupy a special place. These substances are widely used in the food industry, due to their unique properties, such as the ability to form gels, thicken, emulsify, stabilize and retain moisture.

One of the key success factors in the production of functional products based on hydrocolloids is the use of modern technologies. Today, there are many innovative methods of obtaining and processing hydrocolloids that allow to increase their quality and efficiency. For example, the methods of ultrasonic extraction, electrolysis and enzymatic hydrolysis allow to significantly increase the yield of hydrocolloids from raw materials and preserve all their useful properties. These technologies make it

possible to obtain hydrocolloids with high purity, stability and gel ability, which makes them ideal for use in the production of functional products [2].

The use of hydrocolloids in the production of baby food is of particular importance. They can be used as natural thickeners and stabilizers in the production of purees, juices, cereals and other products for children. This allows you to create products with high organoleptic properties, having a pleasant taste and consistency, while preserving all useful properties. In addition, hydrocolloids can be used to enrich children's nutrition with vitamins, minerals and other biologically active substances, which contributes to the harmonious development and health of children.

From a market perspective, functional products based on hydrocolloids have great potential. Modern consumers pay more and more attention to the health and quality of the products they consume. In this regard, functional products that have additional useful properties are in great demand. In addition, they can be used in the production of specialized products for people with special needs, such as products for people with allergies, diabetes, or those who follow certain diets [3].

Global hydrocolloids market review states that the hydrocolloids market size in 2023 was estimated to be USD 10.35 billion. The hydrocolloids industry is projected to grow from USD 10.93 billion in 2024 to USD 16.071 billion by 2032. Increasing demand for natural and healthy foods is a key market driver [4, Figure 1].

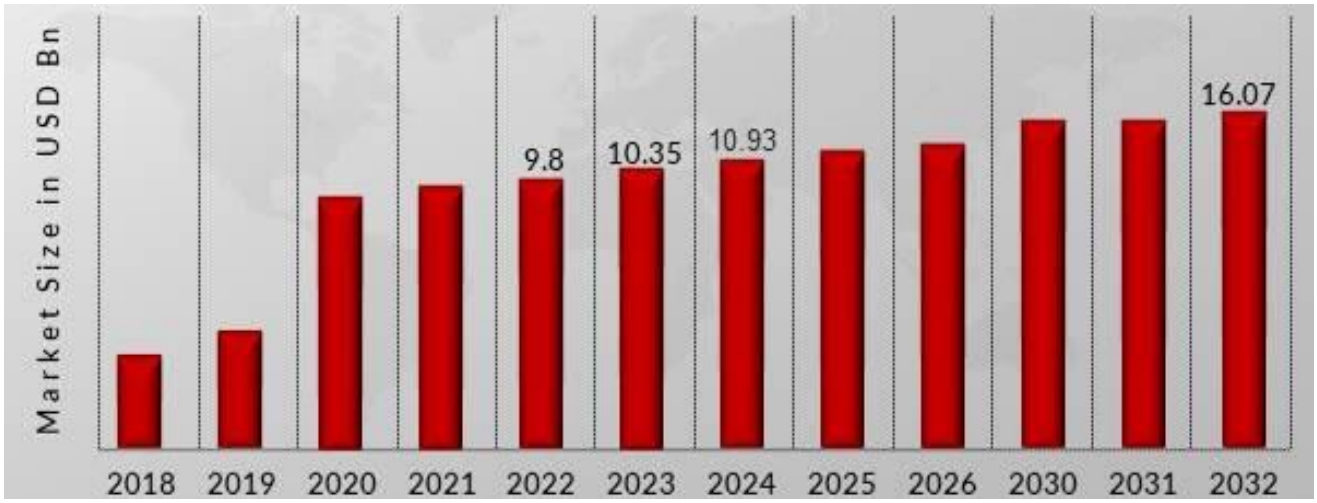

Fig. 1. Hydrocolloids Market Trends [4]

Seaweed-derived hydrocolloids have made a significant impact on the

hydrocolloid industry because they are widely available, rich in nutrients, low cost, and have no discernible taste. Seaweed hydrocolloids are used as texture enhancers in foods, such as gelling agents in jams, thickeners in dairy products, and more. Thus, driving the hydrocolloids market revenue. The food and beverage segment dominates the market with the highest revenue of 70% in 2022. Europe hydrocolloids market is expected to grow at the fastest CAGR from 2023 to 2032. This is due to the development of the food industry and the wide use of natural ingredients in food products. Additionally, the UK hydrocolloids market held the largest market share and German hydrocolloids was the fastest growing market in the European region.

The production of functional products based on hydrocolloids has significant economic potential for the southern regions of Ukraine. [5] The first accumulations of red algae on the northwestern shelf of the Black Sea were recorded in April 1909 by academician S.A. Zernov, which were named in his «Phyllophore Zernov's Field» (PZF). In the early 1990s, the area of the Field was only 500 km^2, and the biomass did not exceed 300-500 thousand tons. At the beginning of the new millennium, the restoration of phytocenoses of the ZF was noted [6].

The Black Sea, due to its ecological conditions, is home to many types of algae that can be used to obtain hydrocolloids [6, Figure 2].

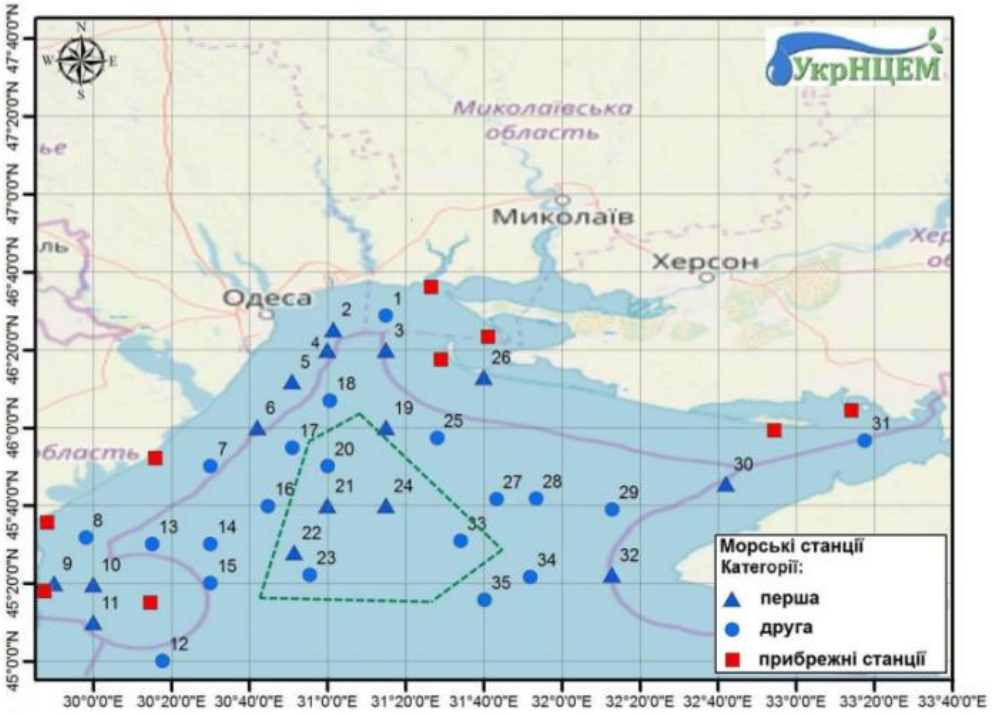

Fig. 2. The map shows the monitoring stations of the PZF [6]

The study shows that the use of this drug (carrageenan "PZF") is appropriate for expanding the range of consistency regulators of food industry products. It was found that carrageenan "PZF" extracted from the Black Sea red algae Phyllophora Brody has a 3,6-anhydrogalactose content of 21.3%; the mass fraction of sulfoether groups (in terms of SO_4) is 24.2%. The dependence of the viscosity of the "PZF" carrageenan solutions on the shear rate gradient in the interval 3-1312 s-1 was established. In the studied range of shear rates, the viscosity of solutions obeys the power law and is described by the Ostwald-Weyl equation. It was found that the reversible destruction of the structure occurs under the action of shear. The degree of thixotropic reduction of the "PZF" carrageenan solution is 87.9%. The influence of temperature and pH on the rheological properties of carrageenan solutions "PZF" was studied. It was found that at temperatures up to 45°C, carrageenan macromolecules exist in a spiral conformation, and at higher temperatures they undergo a thermoreversible transition into a coil conformation. This transition causes a decrease in viscosity and gelation of the solution. It has been found that "PZF" carrageenan solutions retain their abnormally viscous properties in a wide pH range. When the pH of the solution changes from 1 to 11, no signs of a conformational transition of macromolecules of carrageenan "PZF" were detected. In the process of storage, the viscosity of "PZF" carrageenan solutions first increased, and then decreased, regardless of the pH value. A solution with pH=4 has high stability during storage. An acidic environment prevents the development of microorganisms; however, in this case it is not strong enough to cause significant hydrolysis of the polysaccharide. The obtained data on the chemical and physic-mechanical properties of "PZF" carrageenan solutions make it possible to predict the properties of viscous solutions and gels for structured food products. [7]

The obtained data on the chemical and physical-mechanical properties of "PZF" carrageenan solutions indicate the expediency of continuing research with the aim of forming viscous solutions for structured food products with the expansion of their functional purpose.

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