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BIOCHEMICAL FEATURES OF THE METABOLISM OF *CHLORELLA VULGARIS* BEIJ

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Chlorella vulgaris Beijer is a specie of unicellular green algae, 2 to 10 μm in diameter, which looks like a microscopic ball. Outside, the cells are covered with a hard double-circuit shell of cellulose nature. The cytoplasm contains one parietal cup-shaped chloroplast. The pyrenoid is usually surrounded by a starch shell. The nucleus is one, but in a living cell without special treatment it is not visible. Reserve substances — starch and colorless oil. Colonies and aggregates does not form. It was first described by M. Bejerink in 1890 from a pond in Delft, Holland [11].

Chlorella uses 25-30% of solar energy, while flowering plants use only 7-13% [11].

On average, dry biomass of chlorella contains 10-20% carbohydrates. A significant part of them is starch, although in some members of the genus Chlorella, carbohydrates can be represented mainly by hemicelluloses. Lipids make up 20-30% and have a significant content of unsaturated fatty acids. The ratio of fatty acids in chlorella is similar to the ratio that is characteristic of most vegetable oils [20]. The chemical composition of chlorella is quite stable.

At the same time, the extremely high plasticity of chlorella metabolism attracts attention. its ability to radically change the direction of biosynthesis depending on cultivation conditions and under various influences. It has long been proven that under conditions of nitrogen starvation, up to 85% of lipids can accumulate in cells [19].

In most cases, microalgae are cultivated under photoautotrophic conditions. However, some species are able to grow in heterotrophic conditions. Under these conditions, microalgae are cultivated in the dark when cell growth and multiplication is supported by organic carbon. Under adverse environmental conditions, such as nutrient deficiencies, microalgae are able to significantly store energy, forming triacylglycerin (TAG). Positive regulatory enzymes, such as glucose transporter protein, fructose-1,6-bisphosphate aldolase and glycerol-3-phosphate dehydrogenase. And negative regulatory enzymes such as triose phosphate isomerase, play a crucial role in auto-accumulation of lipids under auto- and heterotrophic conditions [7].

Therefore, microalgae are a potential platform for the production of lipid-derived products such as biofuels. Understanding the links between carbon flow and lipid metabolism [18].

An increase in the concentration of heavy metals (HMs) in water leads to their excessive accumulation by aquatic organisms and causes changes in metabolism [6; 14]. On the one hand, individual metals already in small quantities can exhibit high physiological activity, stimulating effect. Some HMs are part of the enzymatic systems of algae and are biologically active, and therefore play an important role in the vital processes of aquatic organisms. And on the other hand, their excess in the environment (high concentrations) has a toxic effect on hydrobionts. Thereby leading to depression of metabolism and inhibition of vital activity [10].

Algae can accumulate trace elements against a concentration gradient thousands of times higher than their content in water, but up to a certain limit. Exceeding of this limit causes irreversible changes in metabolism and their death [6].

The amount of metals accumulated by a unit of biomass or cellular macromolecules of microalgae depends on the concentration of metal ions in the medium metal:biomass ratio, incubation duration, pH, illumination, etc [16].

For example, regarding chromium, according to the authors [15], the level of absorption of chromium ions significantly depends on its valence. It was shown that the degree of absorption of Cr(VI) ions by the alga S. platensis from the culture medium is significantly lower than that of Cr(III) ions.

Selenium is an essential trace element for all organisms, including microalgae. Selenium is directly involved in metabolic, biophysical and energy processes, and its most important action is to participate in antioxidant defense [3].

Several uses of Chlorella vulgaris have been investigated: Firstly, due to its high mineral and protein content, these algae are used as vitamin supplements and are even considered a viable food for dehydration and strongly affect human health; Secondly, many algae produce lipids. This makes these organisms a viable source of biofuels – the lipid content for biomass is approximately 42%. This is more than in soybeans, sugar beets, canes and corn; making it a viable alternative to biodiesel [5]. Recently, Chlorella vulgaris is widely used as a source of protein and lipid biomass, as well as biologically active substances [1; 8]. Due to the inclusion of exogenous trace elements in its composition, this microalgae can form biologically active complexes which are used for obtaining bioenergetic substrates and substances with potential pharmacological action [16; 13]. Selenium and metal ions (0,5 mg Se(IV)/dm^3; 5,0; 10,0; 20,0 mg Se(IV)/dm^3 separately and together with Co^{2+}(0,05 mg/dm^3), Cu^{2+}(0,002 mg/dm^3), Fe^{3+}(0,008 mg/dm^3), Mn^{2+}(0,25 mg/dm^3), Zn^{2+}(5,0 mg/dm^3)) accumulated in the lipids of Chlorella vulgaris for 7 days are synergistic under their combined action. This property is used to obtain a biologically active therapeutic and prophylactic substance [4].

Microalgae are an alternative to wastewater treatment because they provide tertiary biotreatment combined with the production of potentially valuable biomass. It can be used for several purposes. Microalgae cultures offer an elegant solution for tertiary treatment and the last stage of additional wastewater treatment due to the ability of microalgae to use inorganic nitrogen and phosphorus for their growth [2].

According to the methods of microscopy, one- and two-dimensional thin-layer chromatography for the use of mathematical methods of data interpolation and approximation it is shown that a decrease in the concentration of nitrogen, an increase in salinity and the concentration of potassium ions sharply reduce the increase in biomass. The amount of lipids under conditions of nitrogen deficiency, moderate salinity (2.5 g/l NaCl) and under the combined action of both factors increases by 10 - 15%. In this case, the content of fatty acids and the number of minor fractions increase. At a concentration of NaCl 2.5 g/l, the content of 16:0 fatty acid increases While the percentage of eicosapentaenoic acid 20:5 "Omega-3" is at a minimum level and increases as salinity decreases to optimal levels. An increase in the concentration of potassium ions is not a favorable factor for the accumulation of lipids in the biomass of microalgae Chlorella vulgaris. Increasing salinity reduces the energy costs of álgae cultivation by increasing the amount of lipids in less time [9].

Interestingly, the protein content of chlorella is four times higher than their content in wheat, and the nutritional value is comparable to meat. Thus, in the dry mass (after processing in production) in this algae can be up to 90% protein, up to 38% carbohydrates, up to 75% fat and up to 10% minerals - it all depends on the place of growth. Its protein contains more than 40 amino acids, including all essential. That is, it can be called a real concentrate of calories and vitamins.

The productivity of biomass in stationary mode is about 212.4 ± 18.1 mg of dry biomass/dm^3 and lipid content of 19.02 ± 0.4 mg of dry mass/dm^3. The content of biomass and lipids of chlorella can be changed using sunlight and stimulants of biosynthesis of individual classes of organic substances. This represents the prospect of further research. [17].

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THE BIOCHEMICAL BASIS OF THE PREFERENCES OF BIVALVE MOLLUSK *DREISSENA POLYMORPHA* IN A NEW ENVIRONMENT. UNIQUE OPPORTUNITY TO COMPARE NATIVE AND INVASIVE POPULATIONS IN THE FIELD AND EXPERIMENTAL EXPOSURES

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Since the discovery of invasive zebra mussels *Dreissena polymorpha* (Pallas, 1771), biological invasions are described as the second leading cause of extinction behind habitat destruction. Zebra mussel is one of most active filter-feeders and sedimentators in the water column [1]. Consequently, the spread of zebra mussel is crucial for the preservation of global biodiversity and ecosystem function. On the other hand, zebra mussel is valuable bioindicator species [1;3]. Therefore, the question is arisen concerning the reasons for the preferences of *D. polymorpha* in the new surrounding that provides its wide distribution. Two points of view exist to explain this phenomenon. First one proves that the reasons for these preferences can be the metabolic plasticity. Second concept explains their