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DIRECTED BIOSYNTHESIS OF BIOLOGICALLY ACTIVE LIPIDS FROM ALGAE

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The abstracts presents the results of research on absorption and influence of the ions of metals: Mn^{2+} (0,1; 0,2; 0,5 mg/dm^3); Zn^{2+} (1,0; 2,0; 5,0 mg/dm^3); Cu^{2+} (0,001; 0,002; 0,005 mg/dm^3); Pb^{2+} (0,1; 0,2; 0,5 mg/dm^3) and diesel fuel (0,1; 0,5; 1,0 mg/dm^3) during 1-7 days on the intensity, direction and localization of lipid biosynthesis in *Chlorella vulgaris* Beij. in order to develop technologies improving the biosynthesis of lipids for biofuel (Lutsiv, Grubinko, 2012).

We investigated the unicellular green microalgae *Ch. vulgaris* Beij., which was grown in the climate chamber with illumination at a temperature 20±1°C and lighting 2500 lx, in glass flasks (250 dm^3) in the Fitzgerald mineral medium in modification by Zehnder and Gorham.

It is established that absorption of ions of Mn^{2+}, Zn^{2+}, Cu^{2+} and Pb^{2+} by cells of chlorella is fluctuating and is carried out in four stages: the stage of protective self-isolation of cells (stress-reaction), the stage of the active absorption of metals, the stage of secondary inhibition of the absorption, and the stage of restoring active absorption, that correspond with structural and functional reconstruction of cell membrane – the formation and reconstruction of «double concentric cell wall» (Grubinko, Kostiuk, Lutsiv, 2014). For the first time it is studied and analyzed the kinetic parameters of the absorption of ions in the time gradient at every stage of accumulation of metal ions.

For the first time it is showed that investigated factors contribute to the accumulation of lipids by 15-113%, including triacylglycerols – by 36-181%, dyacylglycerols – by 6-190%, phospholipids – by 1,6-10,5%, nonetherified fatty acids – by 49-257% compared to control subjects. Herewith, there are synthesized first of all polar phospholipids, also tri- and dyacylglycerols with residues of unsaturated fatty acids. Ratio of major classes of lipids (TAG:DAG:PL:FFA, %) in the control was 22:16:47:15, for the actions of: Mn^{2+} – 27:25:28:20, Zn^{2+} – 26:16:33:25, Cu^{2+} – 22:22:39:17, Pb^{2+} – 21:21:37:21, for the actions of diesel fuel during the first day – 26:22:27:25, 7th day – 29:22:25:24 (Lutsiv, Grubinko, 2012).

For the first, under the action of metal ions and diesel fuel it is established the reducing the size and increasing the number of chloroplasts in the cell, as a result there is a change of their ability to synthesize lipids. It is found that under the impact factors with decreases of number and modification of chloroplasts the content of triacylglycerols and phospholipids increases as a result of adaptive change of the localization of lipid biosynthesis from chloroplasts into cytoplasmic structures.

It is established that the formation of adaptive protection systems in cells of algae to the action of factors is performed by changing of substrate and energy support of the biosynthesis of lipids. Substrates for lipid synthesis are glycerol-3-phosphate, formed by the phosphorylation of glycerol and acyl-CoA, formed from aminoacids, and providing with energy of this process happens due to activation of the citric acid cycle, as evidenced by increased activity of 2 – oksoglutarate dehydrogenase (by 5% and 35% compared with control for actions of Zn^{2+} and Cu^{2+} respectively) and succinate dehydrogenase (in 2,8-5,6 times compared with control for actions of all investigated metal ions (Grubinko, Gorda, Bodnar et. al, 2011).

For the first time, it is established that biotechnologically effective for the intensification of the biosynthesis of lipids by *Chlorella* are triacylglycerols – by 6% is effect of Zn^{2+} (5,0 mg/dm^3, 7 days), and phospholipids – by 18-34% are effects of Cu^{2+} (0,002 mg/dm^3, 3 days), Pb^{2+} (0,5 mg/dm^3, 7 days), diesel fuel (0,1 mg/dm^3, 1 and 7 days).

There are established the regularities regarding formation of secondary concentric membranes in the algae and biosynthesis of lipids in their cell structures, changes of ratio of individual classes of lipids (phospholipids and triacylglycerols) can serve as a basis for the development of technology of industrial cultivation of algae in order to obtain industrial perspective lipid biomass.