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Impact of TiO₂ on the energy charge of *Azotobacter vinelandii*

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About 99% of microorganisms function in contact with solid particles in the soil. The interaction of bacteria and such materials leads to the change in their physiological and biochemical activity. It was previously demonstrated by us that titanium dioxide particles (0.1–1.0 μm) stimulate the growth of *A. vinelandii*. However, the mechanisms of the stimulating effect of solid materials of inorganic nature on the biochemical activity, in particular, on energy metabolism of microorganisms are yet to be elucidated in fine detail. The functioning of microorganisms is closely related to the energy generation in cells in the form of highly energetic compounds (ATP, ADP, AMP) and is in close interaction with growth characteristics of the crop.

It was established that after 24 h of cultivating with titanium dioxide, the energy charge of the cells of *A. vinelandii* IMV V-7076 was increased by 11 %, compared to the control. This effect may be conditioned by the contact interaction of bacteria and solid particles, which has been assumed by Mary Fletcher. It was demonstrated by us that the introduction of Tween-80 into the medium, containing titanium dioxide particles, influenced the interaction of cells and these particles. The electrophoresis method was used to demonstrate that the increase in the content of Tween-80 in the dispersion medium resulted in the decrease in the negative charge of particles and bacteria. The results obtained allow for the statement that this effect was the consequence of the sorption of non-charged molecules of Tween-80 on the surface of titanium dioxide particles and bacteria, which limited the contact between the cells and solid particles. It was demonstrated that the introduction of Tween-80 into the medium, containing titanium dioxide, led to the decrease in the growth activity of *A. vinelandii*. This fact triggered the interest to the impact of titanium dioxide on a possible change in the energy charge of the cells in the medium with Tween-80. It was determined that the introduction of titanium dioxide into the medium, containing 0.01 mM Tween-80, resulted in a considerable decrease in the level of the energy charge of the cells (by 7.5%).

Therefore, it was demonstrated that one of the possible mechanisms of the stimulating impact of disperse materials on the growth of bacteria is the contact interaction of the cells and solid particles, which leads to a considerable increase in the energy charge of the bacteria under study.