FUNDAMENTAL BASIS OF PRODUCTION AND APPLICATION OF BIODEGRADABLE POLYHYDROXYALKANOATESs

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Microbial polyhydroxyalkanoates (PHAs) have long been studied due to their potential for replacement of petroleum-based plastic. The study addresses the effect of different conditions of carbon nutrition on synthesis of polyhydroxyalkanoates by the bacterium *Ralstonia eutropha*. First and foremost, PHAs are carbon storage compounds for many organisms. There are still many aspects of the physiology of PHA accumulation and degradation that are still not understood.

Measurements of key P3HB-related enzyme activities throughout cell growth reveals correlations of acetoacetyl-CoA reductase and synthase enzyme activity maxima with P3HB biosynthesis. The investigation addressed kinetic parameters of growth and accumulation of polyhydroxyalkanoates and gas exchange parameters of the culture of the CO-resistant strain of the hydrogen bacteria *Ralstonia eutropha* B 5786 cultivated on synthesis gas – a product of gasification of brown coals.

The results were compared with those obtained by growing the bacteria on electrolytic hydrogen and it was concluded that synthesis gas can be successfully used to produce PHAs. In experiments with wild-type strain it has been first found that under mixotrophic growth conditions – CO_2 + co-substrate (alcanoic acids) – bacteria can synthesize multi-component PHAs, consisting of short- and medium-chain-length monomers with carbon chains containing 4 to 8 atoms. It has been shown that PHA composition is determined by the type of the co-substrate. Fatty acids with odd number of carbons induce bacteria to synthesize multi-component PHAs with 3-hydroxybutyrate, 3-hydroxyvalerate, and 3-hydroxyhexanoate as major monomers and 3-hydroxyheptanoate and 3-hydroxyoctanoate as minor, occasionally occurring, ones. Fatty acids with even number of carbons induce synthesis of not only their respective monomers (3-hydroxyhexanoate and 3-hydroxyoctanoate) but also 3-hydroxyvalerate, making possible synthesis of four-component PHAs, containing 3-hydroxybutyrate and 3-hydroxyhexanoate as major components. A family of short- and medium-chain-length four- and five-component PHAs has been synthesized and their physicochemical and biomedical-properties examined.

NANOPARTICLES AS TOOLS FOR HIGH-SENSITIVE IMMUNOASSAYS

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Modern medical diagnostics, ecological monitoring, and safety control need in simultaneous assays of wide row of analytes in extremely low concentrations. In this connection the solutions combining fast not-labour (including out-of-lab) testing and low detection limits are of high demands for immunoassays. The report presents the results of our development of new sensitive immunoanalytical systems and characterization of the current level of the investigations in this field.

Different nanodispersed particles provide various novel possibilities as markers for the detection of immune complexes. The application of fluorescent semiconductor nanoparticles, quantum dots, as an alternative label for rapid immunochemical tests is a subject of specific interest. Their detection in lower concentrations as compared with the commonly used colloidal gold has been confirmed for membrane assays, and the given effect has been transformed into a lower limit of the analyte detection. The quantum dots demonstrate high stability of the fluorescence, which provides reliable documentation and quantification of the assay results. Other nanodispersed carriers, magnetic iron oxide nanoparticles, are characterized as tools for pseudo-homogeneous immunoassays combining diffusion-independent interactions in the volume of the reaction mixture with the following rapid concentration and separation of the formed immune complexes and their simple heterogeneous detection.

The applications of nanoparticles in different approaches to amplify analytical signals in the course of immunoassays are characterized, including cascade aggregation of nanoparticles via ligand-receptor interactions. The potential of multiparametric optimization of nanoparticles size, content and composition of labelled immunoreactants is discussed as way to reach maximal sensitivity of immunoassays. It was shown that such variation may change the threshold level between positive and negative results of immunochromatographic tests in 10-50 times (depending on target antigen and antibody affinity) without loss of the assay accuracy. Video digital registration of the bound label coloration was characterized as an additional tool to quantify sub-threshold concentrations of target analytes. Experimental evaluation of the effectiveness of the proposed approaches has been carried out on the examples of immunochemical test-systems for the control of low- and high molecular weight compounds (mycotoxins, cardiac markers, etc.).

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