Bioanalytical insight into life of bacterial populations - an alternative approach to monitoring of microbial growth

Insight into life of bacterial populations, monitoring their cultures is of fundamental importance in many areas of human activity, like medicine, clinical diagnostics, environmental research, biotechnology, etc. Monitoring of microbial cultures makes possible to identify factors that inhibit their growth, allowing examination of resistance to drugs as well as the development of effective antibiotics. In ecology, the biocatalytic microbiological activity is one of the basic parameters determining the quality of waters and soils. Selected bacteria are bioindicators of both fertility and the degree of environmental contamination. Some bacterial strains are culturing on a mass scale (biotechnology) and used, among others, as biocatalysts in various areas of modern ecoengineering. For example, betagalactosidase active bacteria are used in the food industry for the production of lactose-free food, while ureolytic bacteria in environmental engineering (biomineralization and bioremediation).

In the microbiological practice, for the examination of bacterial cultures, manual off-line methods based on the determination of physical parameters of culture, proportional to the population size (like counting methods, determination of optical density, biomass, etc.) are most commonly applied. The aim of the project is a completely different approach to the study of microbial populations. In the proposed project the insight into microbial culture will be based on the direct and quantitative determination of its biocatalytic activity. For such purposes the development and examination of biochemical monitors (i.e. systems operating in real-time and on-line mode) is proposed. The operation of these biomonitors will be based on the principles of flow analysis. Modern electronic devices for controlling microfluidics and flow-through optoelectronic detectors will be used to develop prototypes of such systems. The main goal of the project is to recognize whether biochemical monitoring of microbial cultures provide more information than routine microbiological methods. In the course of the project, the biomonitors enabling tracking changes in the activity of four selected hydrolases will be used to monitor and modeling of full life cycle of microbial population (not only the growth phase) of selected bacterial strains. Moreover, the expected effect of the proposed research will be the evaluation of concepts and development of prototypes of such type bioanalytical systems, which in the future would be able to find applications in advanced environmental and biotechnological research.

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