

The progress of biotechnology and biological sciences has led to the development of a rich set of methods enabling the analysis of biochemical processes in living cells. Even though we are still far from understanding the systems "designed" by nature at the level of an individual microorganism, more and more attention is being focused on investigating the interactions between different species. Metabolic dependencies are of fundamental importance for microbial communities. Importantly, the exchange of metabolites between species in a given ecosystem allows to establish and strengthen the cooperation that ensures survival and evolutionary success.

So far, no detailed description of the course and effects of bioreactor cocultivation of microorganisms producing secondary metabolites, molecules of high industrial and pharmaceutical importance, has been published. Examples of compounds in this group are penicillin (an antibiotic), lovastatin (a medicine that lowers the level of endogenous cholesterol), oxytetracycline (an antibiotic often used in dermatological treatments) and nystatin (an antifungal drug from the group of polyenes), substances produced on an industrial scale using the filamentous microorganisms, which include actinomycetes and filamentous fungi.

The main goal of the project will be to characterize the cocultures of filamentous fungi (*Aspergillus terreus* ATCC 20542, *Penicillium rubens* ATCC 28089) and actinomycetes (*Streptomyces rimosus* ATCC 10970, *Streptomyces noursei* ATCC 11455) with respect to the biosynthesis of their major secondary metabolites (lovastatin, penicillin, oxytetracycline, nystatin) and to describe the morphological changes occurring during the simultaneous growth of two species in a stirred tank bioreactor. In the course of the project a number of bioprocess-related strategies of coculture initiation will be evaluated, i.e. confrontation of two species at the stage of seed material preparation (preculture), simultaneous inoculation of the bioreactor with the use of individual cultures of the two species (monocultures) or delaying the confrontation until one of the tested species enters the idiophase (the production stage of the culture). The scope of the work will include bioreactor cultivation, qualitative and quantitative analysis of secondary metabolites, microscopic observations, digital image analysis and bioinformatic analysis of genomes.

The most important questions that will be addressed in the current project are as follows: Are there any secondary metabolites produced by the tested species exclusively under coculture conditions? What differences in terms of secondary metabolites production profiles can be observed between cocultures and monocultures? Does the coculture lead to the enhanced production of secondary metabolites compared to monocultures? What similarities and differences in terms of morphology can be observed between mono- and cocultures? What is the relationship between the chosen method of coculture initiation, the observed morphological forms and the concentration profiles of secondary metabolites?