Biofilm is a compact coat that is formed on various artificial and physiologic surfaces by a population of microorganisms which in this habitat establish a tight cooperation, exploiting both the physical interactions that stabilize the community, and chemical cooperation, engaging numerous agents to modify the environment, e.g., to influence the acidity, nutrient acquisition or oxygen availability. Microorganisms can also communicate, using a special language in which each compound carries a specific message. This communication process is subjected to changes of mood, depending on the actual situation in the environment – in the case of pathogenic microbes usually the health condition of the host. Some microbes temporarily dominate, other are constantly replaced by other community members. But these cooperations or competitions have a deep sense – serve to protect the whole community against the defense system of the host to assure the survival.

Whereas the abilities of bacteria and yeast, separately, to form biofilms are well recognized, the mixed biofilms still present a challenge for researchers because of its very complicated structure. An interesting example of the formation of complex mixed biofilm is the periodontal disease, associated with a dental plaque – a biofilm that, if not removed, can lead to a chronic periodontitis during which anaerobic bacteria, primarily Porphyromonas gingivalis cause serious damages of the gingival tissue. The oral cavity is inhabited by very diverse microorganisms, including also yeast-like fungi from the genus Candida that stay under a tight control of the host as long as its immune system is not weakened – then these relatively mild commensals convert to dangerous pathogens that start the invasion, often with a collaboration with other microbes. A predominant Candida species, present in the oral cavity—Candida albicans—is detected in up to 70% of patients suffering from severe periodontitis. To colonize the host and form the biofilm, C. albicans uses its special ability to change the morphology and phenotype. Both factors are essential for biofilm formation. Elongated hyphal forms favor the biofilm type of growth, mainly because they produce effective adhesins – proteins that adhere to various surfaces. On the other hand, the phenotype switching was observed at conditions of a limited availability of oxygen, suggesting that this process can be a way to adapt to these conditions or that the forms with a new phenotype take part in the development of a specific own type of biofilm. This ability of Candida yeast can promote their co-existence with anaerobic bacteria during the periodontal disease. Perhaps, the yeast can play a role of a “hop-on hop-off taxi”, in which bacteria can hide to wait out the unfavorable changes in the environment or to follow the expansion of the biofilm. But, at any time, they can leave the taxi to continue the infection, again promoted by the phenotype plasticity of the fungus. This hypothesis is also worth considering because the severe periodontitis has been recently shown to be linked to other illnesses such as some heart and respiratory diseases, diabetes and rheumatoid arthritis. Perhaps, this is a broad cooperation within the mixed bacterial-fungal biofilm that leads to such the serious consequences.

To investigate this type of a cooperation between C. albicans and the major bacterial pathogens of the periodontal disease, we plan to carry out a study that aims to:
(1) optimize the conditions for mixed biofilm formation;
(2) investigate the tightness of the inter-microbial cooperation, through a contribution of their adhesive properties, specific for each species proteins and a modification of the production of various compounds, including signal molecules that allow the members of biofilm community to communicate;
(3) test the influence of the mixed biofilm on selected human cells;
(4) analyze the modulation of biofilm formation during the contact with the immune system of the host or the changes of the latter in a response to the biofilm presence.

Our study will improve the basic knowledge on the mixed biofilms, but can also indicate some new approaches to the therapy of periodontal disease.