Abstract

Although yeasts are unicellular microorganisms, they form complex multicellular formations such as biofilms and colonies under natural conditions. Within these structures, processes such as cell differentiation, specialization by particular cell populations and cell signalling, which are typical of multicellular organisms, take place. The literature introduction to this thesis summarizes current knowledge regarding the development of biofilms and colonies, in particular those of the model organism, *Saccharomyces cerevisiae*, and some selected regulations that are important for the formation of multicellular structures. In the results section, I focus on two lines of research. The first is directed towards mechanisms, involved in the formation of multicellular structures. In studying the formation of SLI biofilms (biofilms at the solid/liquid interface), we have documented the antagonistic role of the regulators *CYC8* and *TUP1* in their formation and have also described the effect of the presence of glucose on the development and stability of SLI biofilms of strain BR-F. During this study we[D1] have developed an imaging method that allows us to prepare and observe the internal structure (vertical cross-section) of SLI biofilms, as well as the growth of unattached cells, under physiological conditions using microscopy. We have also described the principles of cell distribution during giant colony growth and introduced a "panther" distribution model for structured colonies of strain BR-F and a "zebra" distribution model for smooth colonies of strain BY4742. We also mapped cell fate during the formation and development of both types of giant colonies.

In the second part of the work, we focused on investigating the influence of mitochondria, i.e. mitochondrial retrograde regulation, and its importance for smooth colony differentiation of strain BY4742. We found that in a differentiated yeast colony we can distinguish three modes of RTG pathway regulation, depending on the regulated proteins and also on the activity of the TOR pathway. These are the Ato-branch, the Cit2-branch and the "viability" branch of RTG regulation, and each of these branches regulates specific targets in different parts of the colony. We also identified a large number of novel target proteins of the RTG pathway. In addition to classical regulation, where the RTG pathway activates the expression of selected proteins, we have described a large group of genes involved in mitochondrial translation that are negatively regulated by the RTG pathway. Our results show that the RTG pathway plays a complex and important role in the activation of selected metabolic processes and in cell adaptation and survival within the differentiated colony.

Keywords: *Saccharomyces cerevisiae*, SLI biofilm, structured colony, smooth colony, cell differentiation, FLO11, CYC8, TUP1, RTG pathway