Abstract

The yeast *Saccharomyces cerevisiae* when growing on solid medium forms structured colonies. During its development, two subpopulations of cells are formed, termed as U cells ("upper cells") and L cells ("lower cells"). This nomenclature derives from their position within the colony. These cells differ from each other considering their morphology, metabolism, physiology and are characterized by varying degrees of resistance to stress. This diploma thesis deals with new methodological approaches that can be used in further research of yeast differentiation.

The first part deals with yeast differentiation and de-differentiation. In the experimental part, the development of mechanically mixed yeast colonies was monitored. The development was monitored in situ in the colony section using fluorescence and "wide-field" microscopy. The ability to de-differentiate of already specialized cells was evaluated mainly according to the nature of the expression of the fluorescently labeled protein Ato1p, which serves as a protein marker of U cells.

The second part deals with the optogenetic system EL222 and its possible use in yeast. Many optogenetic tools have been described to control various cellular processes using light. One of these optogenetic tools is the EL222 system, which allows the induction of expression in cells by blue light. One of the goals of this diploma thesis was to test the activity of the EL222 system in yeast with regard to its further use for the research of yeast colonies. For this purpose, vectors carrying EL222 system genes adapted for yeast function were created. Furthermore, an optogenetic yeast strain BY-EL222 was prepared, which was subsequently used to pilot test the ability of the system to induce reporter gene expression by light in yeast colonies.

Key words: *Saccharomyces cerevisiae*, cololy differentiation, de-differentiation, Ato1p, optogenetics, mixed collony, EL222, blue light