Abstract

Molecular control of motility of Komagataeibacter strains and its influence on structure of the cellulose membranes

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Bacteria of the genus Komagataeibacter are considered to be one of the most effective producers of bacterial nanocellulose (BNC), which due to its properties, such as biocompatibility, high purity, high mechanical strength and biocompatibility is regarded as promising material for tissue engineering. Nevertheless, obtaining cellulose membranes with the desired structure and high efficiency remains a challenge for biotechnology. The main problem faced by tissue engineers is the limited porosity of BNC - densely packed BNC fibers form a network with a small space inside, which prevents the ingrowth of eukaryotic cells. One of the ways to solve this problem is to change the structure of cellulose by controlling the motility of bacteria from the genus Komagataeibacter.

The aim of this doctoral thesis was verification of the hypothesis concerning involvement of motB and motA genes in motility of bacteria of the genus Komagataeibacter and examine the effect of its disruption and overexpression on the BNC biosynthesis, especially on the membrane structure. Based on genomic sequence of K. xylinus E25, genes encoding proteins with unknown functions that are MotA/TolQ/ExbB and MotB/TolR/ExbD homologs have been selected. These proteins, specific for gram-negative bacteria, play a role in energy transfer and are involved in various motility mechanisms.

The work included the construction of the disruption and the over-expression mutants, analysis of their phenotype, which included examination of motility, cell morphology, cellulose production efficiency, and structure of BNC membrane through SEM analysis. In the next stage, the subcellular localisation of the MotA and MotB proteins was determined. Furthermore, the transcriptome of the disruption mutants was analyzed using the RNA-seq technique.

On the basis of the results obtained it can be assumed that the motA and motB genes may be involved in motility and cell division. What's more, these genes affect the production of bacterial nanocellulose. Moreover, in this study, the membranes with a porous structure were obtained for the first time through genetic modifications of K. hansenii strains. The obtained material can be used in the future as a scaffold for the growth of eukaryotic cells.