The function of the PssZ protein in regulation of cell processes of the symbiotic bacterium *Rhizobium leguminosarum* bv. *trifolii*

Soil bacteria belonging to the *Rhizobiaceae* family are able to establish symbiotic interactions with legumes. Due to frequent changes in environmental conditions, the presence of competitor organisms in the ecological niche, and changes in the lifestyle, symbiotic bacteria have developed a number of complex regulatory mechanisms based on post-translational modifications, in which phosphorylation/dephosphorylation of cellular proteins are the most important. These processes are carried out by bacterial protein kinases and phosphatases, which participate in transduction of various molecular signals. The aim of this dissertation was to establish the function of the PssZ protein in regulation of cellular processes in the symbiotic bacterium *Rhizobium leguminosarum* bv. *trifolii* in both *ex planta* and *in planta* conditions. The bioinformatics analyses have shown that the *pssZ* gene encodes a protein with high homology to bacterial serine-threonine phosphatases representing the metallophosphatase family. The transcriptomic analyses and determination of the phenotypic traits of the wild-type *R. leguminosarum* bv. *trifolii* and the *pssZ* mutant strains helped to establish that the PssZ protein is involved in the regulation of many cellular processes in rhizobia (e.g., cell division, synthesis of surface polysaccharides, motility). The comparative transcriptomic analyses of the wild-type and *pssZ* mutant strains indicated that the PssZ regulon contains 996 genes, with numerous genes engaged in adaptation mechanisms. It was indicated that the mutation in the *pssZ* gene is pleiotropic since it results in a prolonged generation time, changes in the amounts of produced surface polysaccharides (e.g., inhibition of the exopolysaccharide (EPS) and capsular polysaccharide (CPS) synthesis)), biofilm formation, cell motility, and surface properties. It was observed that the *pssZ* mutation negatively affects the symbiosis of this bacterium with red clover; the mutant in this gene induced formation of nodules on host plant roots, which exhibited an altered structure and were ineffective in nitrogen fixation. The results of the study presented in this work allow a conclusion that the PssZ protein plays an important role in the regulation of numerous cellular processes in both the free-living bacterium *R. leguminosarum* bv. *trifolii* and during its symbiosis with red clover.

Keywords: *Rhizobium leguminosarum* bv. *trifolii*, serine-threonine phosphatase, surface polysaccharides, transcriptome, symbiosis

Paulina Lipa