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Inorganic Phosphate Solubilization by Rhizosphere Bacterium *Paenibacillus sonchi*: Gene Expression and Physiological Functions

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Due to the importance of phosphorus (P) in agriculture, crop inoculation with phosphate-solubilizing bacteria is a relevant subject of study. *Paenibacillus sonchi* genomovar Riograndensis SBR5 is a promising candidate for crop inoculation, as it can fix nitrogen and excrete ammonium at a remarkably high rate. However, its trait of phosphate solubilization (PS) has not yet been studied in detail. Here, differential gene expression and functional analyses were performed to characterize PS in this bacterium. SBR5 was cultivated with two distinct P sources: NaH_2PO_4 as soluble phosphate source (SPi) and hydroxyapatite as insoluble phosphate source (IPi). Total RNA of SBR5 cultivated in those two conditions was isolated and sequenced, and bacterial growth and product formation were monitored. In the IPi medium, the expression of 68 genes was upregulated, whereas 100 genes were downregulated. Among those, genes involved in carbon metabolism, including those coding for subunits of 2-oxoglutarate dehydrogenase, were identified. Quantitation of organic acids showed that the production of tricarboxylic acid cycle-derived organic acids was reduced in IPi condition, whereas acetate and gluconate were overproduced. Increased concentrations of proline, trehalose, and glycine betaine revealed active osmoprotection during growth in IPi. The cultivation with hydroxyapatite also caused the reduction in the motility of SBR5 cells as a response to Pi depletion at the beginning of its growth. SBR5 was able to solubilize hydroxyapatite, which suggests that this organism is a promising phosphate-solubilizing bacterium. Our findings are the initial step in the elucidation of the PS process in *P. sonchi* SBR5 and will be a valuable groundwork for further studies of this organism as a plant growth-promoting rhizobacterium.

Keywords: *Paenibacillus sonchi*, phosphate solubilization, PGPR – plant growth-promoting rhizobacteria, organic acids, osmoprotection, RNAseq

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