Metabolic response of Yersinia intermedia MASE-LG1 to osmotic stress

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Osmotic stress is one of the major limitations for cell growth. Microorganisms can evolve adaptations to abiotic stresses like high salt concentrations in the environment. Sensor and signal transduction networks provide information to the cell about the osmolarity of its surroundings leading to an immediate metabolic response to counteract the osmotic stress. Some of these adaptations can be structural, some are metabolic. Our current knowledge of microbial responses to osmotic challenges is based on studies of representative bacteria, archaea, and eukaryotic microbes that is mainly focusing on the effect of NaCl. There is still a lack of understanding whether and how different salts, for example NaCl versus MgSO4 alter the response of a microorganism to salt induced stress conditions. We chose Yersinia intermedia MASE-LG1 a strain isolated from an Icelandic lake as test organism. It is known for its abilities to adapt to a wide variety of habitats of rapidly changing environmental conditions. In order to identify which roles the different salts play in the global metabolic response, Y. intermedia was exposed sustained salt stress induced by either MgSO4 or NaCl. After metabolite extraction, metabolic profiles from three replicate cultures of Y. intermedia MASE-LG-1 grown under 3 different conditions (e.g. control salt stressed in MgSO4, and salt stressed in NaCl) were obtained. Generally, changes in numerous metabolites mainly in the amino acid metabolisms were observed in stressed samples compared to the control. To a lesser extent the carbohydrate metabolism was also affected. Looking at the effect of the different kations, the results clearly indicated significant differences in response to salt stress induced by the magnesium salt compared to sodium chloride. The results suggest that the amino acid synthesis, reflecting the general activity of translation operations, dominates the reaction to osmotic stress. These adaptations might provide necessary energy and building blocks to fuel processes conveying salt tolerance like the biosynthesis of compatible solutes. In addition we were able to identify metabolites which are linked to osmoprotective activity. The outcome of this study will have impact on our understanding of how microorganisms adapt to hostile environmental conditions.