High pressure effects on microbial cell biology

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Research on the effect of high hydrostatic pressure (HHP) on cells and microorganisms has initially been driven to understand life in deep sea organisms or microbial inactivation in food processes. HHP exerts manifold effects on cells and microorganisms, leading to adaptation, stress response or cell death. It affects all levels of cellular physiology targeting cellular organization, transcription, translation, protein conformation, enzyme activity and membrane function. These effects result from the general thermodynamic property of high pressure to influence macromolecular interaction. Therefore, HHP can be used as a powerful tool to study these basic cellular functions and possibly tailor them to understand e. g. cellular regulation or signal transduction or use cells as factories apart from any food or deep sea related system.

To get insight in the mechanisms of the complex bacterial response to high pressure we have analysed *Lactobacillus sanfranciscensis* which is used in food biotechnology. HHP sensitive targets were identified in the (i) membrane physiology with fluorescence techniques, (ii) proteome with 2-D electrophoresis (iii) transcriptome with microarrays and real time PCR and (iiii) regulation with the development of a reporter system. More than 25 proteins were identified to be differentially expressed upon high pressure stress. In a transcriptome analysis about 8% of the investigated genes were affected in their expression. Most of them appeared to be up-regulated by 2-4 fold. These results were verified by real time PCR. For some genes up-regulated at proteome level, gene induction was shown (*clp*L/*gua*A/*gro*EL/*rbs*K), for others their response to high hydrostatic pressure at the transcriptome level seems to differ from proteome. The up-regulation of certain genes corroborates the hypothesis that the cell tries to compensate for pressure induced impairing of membrane transport and translation. The latter appears as a highly pressure sensitive process initiating changes in cellular physiology and stress response to maintain vital functions and repair.