

# Calorimetric investigation of the growth and product formation of lactic acid bacteria

Hassan Al-Fathi<sup>1</sup>, Claudia Heber<sup>1</sup>, Sven Paufler<sup>1</sup>, Thomas Maskow<sup>1</sup>

<sup>1</sup>UFZ – Helmholtz Centre for Environmental Research, Department of Environmental Microbiology, Permoserstrasse 15, 04318 Leipzig, Germany

*Lactobacilliales* or lactic acid bacteria (LAB) are highly interesting for the following reasons. First, these bacteria form part of the natural intestinal flora of humans and other animals. Second, they are found in decomposing plants and are therefore important for environmental technologies. Third, the fermentation products inhibit by acidification the growth of spoiling agents and provide an additional hurdle for pathogenic microorganisms. Fourth, the main product lactic acid is important as monomer for biologically degradable and biocompatible polymeric materials, in pharmacy to make ingredients water soluble, in cosmetics, as detergent and as food additive. Fifthly, lactic acid in combination with other metabolic products contributes to the organoleptic and textural profile of food items. For us, LABs as readily culturable microorganisms are well suited to develop process control techniques based on calorimetry for anaerobic processes and to test thermokinetic evaluation methods and biothermodynamic or systembiologic predictions.

Despite the great importance of lactic acid fermentation, there are relatively few thermodynamic <sup>1,2</sup> or calorimetric work <sup>3</sup>. In this study a homofermentative lactic acid bacteria was grown in a reaction calorimeter under variation of the environmental conditions (e.g. pH, temperature, salinity). The heat production rate and the carbon dioxide evolution rate (CER) were monitored in real time. Thermodynamic balances were applied to correlate the time courses of the concentration of the intermediates and microbial final products with the heat production rate. The influence of the environmental conditions on the growth rate and efficiency was evaluated in the thermodynamic context. First results will be presented.

- 1 Teusink, B., Bachmann, H. & Molenaar, D. Systems biology of lactic acid bacteria: a critical review. *Microbial Cell Factories* **10**, 11-17 (2011).
- 2 van Maris, A. J., Konings, W. N., van Dijken, J. P. & Pronk, J. T. Microbial export of lactic and 3-hydroxypropanoic acid: implications for industrial fermentation processes. *Metab Eng* **6**, 245-255, doi:10.1016/j.ymben.2004.05.001 (2004).
- 3 Fujita, T., Monk, P. R. & Wadsö, I. Calorimetric identification of several strains of lactic acid bacteria. *Journal of Dairy Research* **45**, 457-463 (1978).