Genome-scale reconstruction and analysis of the metabolic network in the hyperthermophilic Archaeon *Sulfolobus solfataricus*

Thomas Ulas and Dietmar Schomburg

Department of Bioinformatics and Biochemistry ,

Technische Universität Carolo-Wilhelmina zu Braunschweig

t.ulas@tu-bs.de

We reconstructed a model of the crenarchaeon *Sulfolobus solfataricus*, a hyperthermophilic microorganism which grows in terrestrial volcanic hot springs with optimum growth occurring at pH 2-4 and a temperature of 75-80°C. The genome of the *Sulfolobus solfataricus P2* contains 2992245 bp on a single chromosome and encodes 2977 proteins and many RNAs [1]. *S. solfataricus* is of high interest for environmental and biotechnological applications because of its thermophilic and acidophilic properties. The established network comprised a total of about 858 reactions, 60 transport reactions and about 770 metabolites representing the overall metabolism of this Archaeon, based on the annotated genome and available biochemical information. Experimental data [2] was used to fit the model to phenotypic observations. Using the model in conjunction with constraint-based methods, it was able to identify the main characteristics such as growth yield, network robustness, and simulate the utilization of different carbon sources including phenol, HCO_3^-, and others. Altogether, it was possible to add 37 different carbon sources from literature and simulate autotrophic growth. Comparing the growth on these different carbon sources revealed that glycerol is the carbon source with the highest growth yield per imported carbon atom (143% of glucose). In addition to the commonly known heterotrophic growth of S. solfataricus, the crenarchaeon is also able to grow autotrophically using the hydroxypropionate-hydroxybutyrate cycle for bicarbonate fixation [3]**.** We successfully integrated this pathway into our model and compared both growth conditions. Furthermore, the ability to degrade phenol is of special interest, because phenol is a pollutant that often arises in the industry. The thermoacidophilic properties of *S. solfataricus* and its ability to degrade phenol makes this microorganism a potential candidate for extreme environments.

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