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PROGRAMMVORSCHAU

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Mag. Mag. Dr. Simon K.-M. R. Rittmann, Bakk.

University of Vienna
Archaea Biology and Ecogenomics Division, Department of Ecogenomics and Systems Biology

"Novel insights into the physiology and biotechnology of CO2 to CH4 conversion"

Johannes Kepler Universität Linz
17.15 Uhr, HS 13 (TNF-Turm)

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Novel insights into the physiology and biotechnology of CO_2 to CH_4 conversion

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Due to the negative impact of fossil fuel utilization and issues related to global warming the utilization of carbon dioxide (CO_2) is becoming a topic of industrial relevance. Autotrophic and hydrogenotrophic methanogens can be employed for CO_2 conversion through biological methane (CH_4) production (CO_2-BMP). During CO_2-BMP, CO_2 and molecular hydrogen can be converted to CH_4 at high volumetric CH_4 evolution rates (MERs) in continuous culture. The application of fed-batch bioprocessing and high pressure (up to $9 \cdot 10^6$ Pa) were not yet considered for CO_2-BMP.

First, various process parameters from continuous culture experiments of pure culture CO_2-BMP were examined *in silico*. Invariant and multivariate effects of process parameters have been unscrambled applying multivariate analyses and modelling. The limitations of the models will be discussed.

Thereafter, the role of trace elements (TE) in affecting the performance of *Methanothermobacter marburgensis* and *Methanothermococcus okinawensis* were investigated *in silico*, in closed batch and fed-batch cultivation mode. TE transport systems of the two methanogens were also examined *in silico* to reveal the importance of TE utilization in methanogen physiology.

M. okinawensis responded to rising concentrations of TE by increasing CO_2 conversion during closed batch, and can grow and produce CH_4 in during fed-batch fermentation. CO_2 conversion of *M. okinawensis* was also investigated at pressures up to $9 \cdot 10^6$ Pa with H_2/CO_2 (4:1) and/or $H_2/CO/N_2$. *M. okinawensis* converted CO_2 for each of the pressures tested, except for the H_2/CO_2 experiment at $9 \cdot 10^6$ Pa.

Multiple parameter-based process optimizations employing *M. marburgensis* were performed in exponential fed-batch fermentations at various TE dilution rates, sulphide dilution rates and H_2/CO_2 inflow rates. Here, we present the highest ever reported MER of 476 mmol L^{-1} h^{-1} and the highest reported specific growth rate of 0.69 h^{-1} from fed-batch fermentation of *M. marburgensis* at isobaric pressure.