Use of continuous lactose fermentation for ethanol production by Kluyveromyces marxianus for verification and extension of a biochemically structured model

A biochemically structured model has been developed to describe the continuous fermentation of lactose to ethanol by Kluyveromyces marxianus and allowed metabolic coefficients to be determined. Anaerobic lactose-limited chemostat fermentations at different dilution rates (0.02 – 0.35 h⁻¹) were performed. Species specific rates of consumption/formation, as well as yield coefficients were determined. Ethanol yield (0.655 C-mol ethanol/C-mol lactose⁻¹) was as high as 98 % of theoretical. The modeling procedure allowed calculation of maintenance coefficients for lactose consumption and ethanol production of $m_s = 0.6029$ and $m_e = 0.4218$ (C-mol)*(C-mol*h⁻¹), respectively. True yield coefficients for biomass, ethanol and glycerol production were calculated to be $Y_{true}^{sx} = 0.114$, $Y_{true}^{ex} = 0.192$ and $Y_{true}^{gly} = 2.250$ (C-mol)*(C-mol⁻¹), respectively. Model calculated maintenance and true yield coefficients agreed very closely with those determined by regressions of the experimental data. The model developed provides a solid basis for the rational design of optimised fermentation of cheese whey.