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Mathematical modelling of the ensiling process before biogas production: strengthening the links between biomass storage and anaerobic digestion

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Abstract

A stoechio-kinetic model describing the evolution of biomass through the ensiling process was developed. The model framework is based on the ADM1 in order to establish a mathematical link between ensiling and anaerobic digestion. Data from ensiling experiments with catch crop and cattle manure were used for model implementation. The model accurately describes the evolution of chemical species under most of storage conditions. Only very few adjusted parameters varied among the tested conditions, notably certain kinetic coefficients. These coefficients depend on the nature and biochemical characteristics of the feedstock. Simulations of the conservation of the biomethane potential were qualitatively consistent with the experimental results. However, additional reactions or inhibitory phenomena should be added to enhance quantitative reliability of this parameter in some cases. Simulations results show that hydrolysis reactions have low kinetic constants during ensiling (0.001-0.012 d^{-1}). Furthermore, different tolerance levels to pH and dryness among microbial populations were identified. Lactic acid bacteria can proliferate at low pH and low moisture content. The remaining fermentative microorganisms, such as clostridial bacteria, are more

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