THE HAPPY MARRIAGE OF METHANOGENIC ARCHAEA AND ANAEROBIC FUNGI

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Degradation of lignocellulose-rich material into biogas is an attractive strategy to face growing energy demands and moderate greenhouse gas emissions from the exploitation of fossil energy resources. Lignocellulose biomass is composed of interwoven cellulose and hemicellulose, coated by anaerobically almost undegradable lignin. This is the explanation why bacteria and archaea in the biogas reactor are not efficient in disintegration of the lignin, leaving a considerable portion of the more easily convertible sugars untouched. Anaerobic fungi (AF) from the phylum Neocallimastigomycota living in the rumen are of particular importance in the nutrition of herbivorous animals, as they are able to break down lignocellulose with high efficiency. The AF attach to the plant material and crack the fibres mechanically by growth and expansion of their rhizoids or bulbous holdfasts. To exploit this feature, we need to understand what the ideal conditions are for them and which microbes are their "favorite" partners.
During our study, we isolated anaerobic fungi and their methanogenic partners from different herbivorous animals. In our experiments, we monitored the degradation efficiency using pure anaerobic fungal culture, AF enzymes and anaerobic fungal - methanogenic co-cultures.
In this study, treatment with anaerobic fungi-methanogenic co-cultures (14-day) increased the total biomethane yield during the experimental period of 20 days. Pretreatment with anaerobic fungi significantly improved the degradability of substrates, the amount of methane produced increased by 100-300%, depending on the plant material. The results for AF biomethane yields correlated well with the organic acid concentrations measured by HPLC and with the enzyme activities. From these it can be concluded that the anaerobic fungi degraded the substrate efficiently during the 14-day long treatment.
Based on these results AF isolates were effective in enhancing cellulose degradation and successfully increased biogas production.