Sustainable Bioenergy Carriers from Wastes

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The development of new technologies for renewable energy production is crucial for decreasing the reliance in fossil fuels and improving global sustainability. Waste materials are valuable resources that can be used for the production of energy carriers. Organic wastes can be anaerobically digested to ultimately produce methane. Hydrogen can be recovered from this process, if methanogenesis is inhibited. These energy carriers can also be derived from recalcitrant materials in a two step-process combining waste gasification and subsequent syngas bioconversion. Research carried out at our group focuses on the study of anaerobic processes for the production of energy-carriers using a multidisciplinary approach that combines both microbiological and technological aspects. Important achievements have been made within the anaerobic digestion of lipid-rich wastes. From our research, it became clear that lipids and LCFA-rich wastewater anaerobic treatment can be feasible with efficient methane recovery. Additionally, wastes containing fats and proteins, such as wastes from poultry industry, slaughterhouse and meat-processing industry have been assessed for methane production. Hydrolysis of cellulolytic and proteinaceous materials in solid wastes was enhanced using physicochemical pre-treatments and bioaugmentation, which is auspicious for optimal methane production. Sugar-rich wastes were used for assessing biohydrogen production and allowed the identification of critical aspects for methanogenesis inhibition. Immobilization of hydrogen-producing microorganisms in high rate continuous reactors was performed with good hydrogen recovery. Currently, we are studying the utilization of latex bionanocoatings for the entrapment of hydrogen-producing microorganisms as a means to improve cell immobilization. Another research area of expansion in our group is syngas fermentation to methane. Studies have been conducted on gas-liquid mass transfer for evaluating the potential of bioprocesses for syngas conversion. Concurrently, the physiology and microbiology of syngas-converting mixed cultures is also being assessed.