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Dark fermentation of liquid after hydrothermal treatment of kitchen waste

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Dark fermentation (DF) is a promising biological process for the conversion of wet organic waste into hydrogen-rich gas. This study investigates the potential of liquid fractions derived from thermally pretreated kitchen waste as substrates for DF. Two thermal pretreatment strategies – thermal hydrolysis and hydrothermal carbonization – were applied over a wide temperature range, with a fixed treatment time. For one specific temperature, an extended treatment time was also tested to evaluate the impact of prolonged hydrolysis.

Fermentation experiments were conducted under mesophilic conditions using inoculum sourced from fermented sludge (Group Wastewater Treatment Plant in Lodz), heat-treated at 70°C to suppress methanogenic activity. Process performance was evaluated through hydrogen production yield (mL H_2/g_{TVSKW}), pH and dissolved organic carbon (DOC) pre- and post-fermentation, and also by volatile fatty acid (VFA) composition after fermentation.

The results clearly show that pretreatment temperature has a significant effect on the efficiency of hydrogen production. Certain conditions resulted in significantly higher yields, while both insufficient and excessive pretreatment hindered the process. In one case, extending the treatment time significantly improved substrate availability, resulting in enhanced hydrogen production.

Overall, the results emphasize the importance of optimizing thermal pretreatment parameters. When properly adjusted, thermal pretreatment can effectively balance substrate solubilization with the preservation of hydrogen-producing microbial activity. Conversely, non-optimal conditions can severely limit DF performance, probably due to incomplete hydrolysis or the formation of inhibitory compounds.

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