The effect of paper waste and food waste on biohydrogen production at mesophilic temperatures in batch reactors

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Hydrogen appears to be an ideal candidate as an alternative to fossil fuels. It has the highest energy content per unit of weight for any known fuel and it can be used to generate electricity by fuel cell technology. Hydrogen can be obtained biologically via fermentation via anaerobic bacteria and photolysis via algae and cyanobactera. However, hydrogen is produced at higher rates with fermentation compared to photolysis and has the potential to combine organic waste management with simultaneous hydrogen production. Dark fermentation of hexoses has been extensively studied using a variety of anaerobic inocula under different growth and operational conditions. Few reports have demonstrated biohydrogen production directly from food waste or paper waste. In addition, the effect of different amounts of paper waste and food waste on biohydrogen production has not been studied. The objective of this work was to examine the effect of different amounts of paper waste and food waste on biohydrogen production in batch reactors.

Batch experiments were conducted in 125-mL serum bottles containing 20 mL total of inoculum and media. Food waste and paper waste were used as substrates for biohydrogen production. The amount of each substrate used in the batch reactors were blends of both substrates with 100% food waste and 100% paper waste serving as controls. Food waste and paper waste were obtained from the cafeteria at the University of Minho and a local paper manufacturer, respectively. The inoculum used in the batch experiments was obtained from an anaerobic digester from a municipal wastewater treatment plant. Methanogenesis was inhibited by the addition of bromoethanesulfonate (25 mM). The initial pH of the batch experiments was adjusted to 6.5 by flushing the headspace of each batch reactor with 100% CO_2 for several minutes. Batch cultures were incubated at 37 ºC (± 2 ºC). Hydrogen production was monitored using GC-TCD with nitrogen as the carrier gas. Soluble microbial products (formate, acetate, propionate, *n*- and *i*-butyrate, valerate, and ethanol) were determined using HPLC. VFA and hydrogen production were observed with both paper waste and food waste although the amount varied depending on the amount of food and paper initially fed to the batch reactors. The results of this work will help to optimize the amount of hydrogen that can be produced using a real world waste stream. In addition, this work will also assist in the development of optimal hydrogen production and yields from organic wastes in a continuous system.

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