Biological Hydrogen and Methane Production from Organic Waste in Two Stage Process

C. Nathao[1], N. Pisutpaisal[1, 2]

[1]Department of Agro-Industrial, Food and Environment Technology, Faculty of Applied Science, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand
[2]The Biosensor and Bioelectronics Technology Centre, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand
Keywords: Food waste, banana peel, fermentation, digestion, biomethane, biohydrogen
Presenting author email: nipon.p@sci.kmutnb.ac.th

The research investigated the total energy recovery from a two-stage fermentation process consisting of hydrogen and methane production from banana peel and food wastes. One-stage methane production from food waste at varying F/M ratios ranging from 2.5 - 10 (g VS_{fw} g^{-1} VS_s) in 0.5 L batch reactor by a mixed culture was examined under a mesophilic condition (37° C). Hydrogen fermentation was set up under the initial pH 6, whereas the methane fermentation was occurred under the initial pH 7. Optimum condition for banana peel fermentation was observed at F/M of 5. Hydrogen and methane yields were 209.9 and 284.1 mL g^{-1} VS for two-stage fermentation, while methane yield was 251.3 mL g^{-1} VS in one-stage methane fermentation of banana peel. Total energy recovery was 6.9 $x10^{-3}$ kW-h and $3.8x10^{-3}$ kW-h for the two-stage and one-stage processes, respectively. F/M of 5 g VS_{fw} g^{-1} VS_s gave the best performance for two-stage batch fermentation of food waste in 0.5 L reactor. At this condition, maximum hydrogen content, production rate, and yield were 47 %(v/v), 16.4 mL h^{-1}, and 106.2 mL g^{-1} VS, respectively. Methane content, production rate, and yield in the second stage fermentation were 64 %(v/v), 26.7 mL h^{-1} and 298.3 mL g^{-1} VS, respectively. The total energy recovery from two-stage process in 0.5 L was $1.35x10^{-2}$ kW-h. The results of the experiment of food waste substrate from two-stage fermentation process in 5 L continuous stirred tank reactor (CSTR) showed that the hydrogen yield were 292.7 mL g^{-1} VS and methane yield were 391.6 mL g^{-1} VS, and the methane yield in the one-stage from food waste fermentation were 364.3 mL g^{-1} VS. The total energy recovery from two-stage process was $6.5x10^{-2}$ kW-h, while that from one-stage process was $4.7x10^{-2}$ kW-h. The research study found that the total energy recovery from a two-stage fermentation process consisting of hydrogen and methane production potential high energy than one -stage methane production. The structure of a microbial community in process for H_2 production from food waste was investigated by a molecular biological approach. *Clostridium sp.* and *Lactobacillus* were considered to be the dominant mesophilic H_2- producing bacteria.