The Summer Undergraduate Research Fellowship (SURF) Symposium
7 August 2014
Purdue University, West Lafayette, Indiana, USA

Optimization of Acid Production in Food Waste via Anaerobic Respiration

Charles Daniels
Department of Chemical Engineering, University of Michigan
Raymond Red Corn
Department of Agricultural & Biological Engineering, Laboratory of Renewable Resources Engineering, Environmental Sciences and Engineering Interdisciplinary Graduate Program, Purdue University
Abigail S. Engelberth
Department of Agricultural & Biological Engineering, Laboratory of Renewable Resources Engineering, Environmental & Ecological Engineering, Purdue University

ABSTRACT

According to the Food and Agriculture Organization of the United Nations, one third of all food produced in world is wasted; $1.63 * 10^9$ metric tons of nutrition is lost to transportation, contamination, or neglect every year (FAO 2013). This wasted food, however, could be repurposed as a substrate for microbial conversion into useful chemicals. This research is aimed at finding the optimal conditions for bacterial colonies to generate volatile fatty acids (VFAs): resources that are used as solvents, medicines, and chemical intermediates usually generated from petroleum based resources (Drumright et al., 2000) (Roscher 2000) (Kolt et al., 2007). An empirical approach was applied to determine the optimal conditions for VFA production from food waste. In total, five different batches of food waste were inoculated with primary sludge and incubated in continuously stirred bioreactors while pH, temperature, organic loading rate, and retention time was controlled. Lactic acid was the primary product with concentrations reaching up to 40 g / L. The optimal lactic acid production was at a pH of 5.5, a temperature of 41 °C, and a loading rate of 150 g VS / L after 16 hours. Lactic acid has value in the production of polylactic acid, a biodegradable polymer with properties similar to PTE (Yutaka et al., 2009). Currently polylactic acid-based plastics have been produced from corn and other foods, however, this research demonstrates the viability of producing lactic acid from unrefined sources, which will not compete with food supply or increase land needed for production. The outcomes of this project will help determine if food waste, which usually troublesome to dispose of, could be a viable resource for lactic acid production.

KEYWORDS

Acetogenesis, acidogenesis, fermentation, lactic acid, hydrolysis, food waste, optimization, anaerobic

REFERENCES

Yutaka Tokiwa; Buenaventurada P. Calabia; Charles U. Ugwu; Seiichi Aiba (September 2009)."Biodegradability of Plastics". International Journal of Molecular Science 9: 3722–3742.

Drumright, R. E., Gruber, P. R. and Henton, D. E. (2000), “Polylactic Acid Technology.” Adv. Mater., 12: 1841–1846.

Kolt, Gregory S.; Snyder-Mackler, Lynn (2007). “Physical Therapies in Sport and Exercise.” Elsevier Health Sciences. p. 223.

Roscher, G. (2000). “Vinyl Esters.” Ullmann’s Encyclopedia of Industrial Chemistry 38, 107-123.