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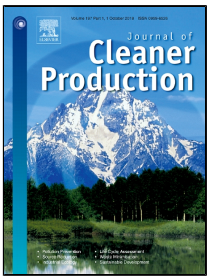

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Life-cycle Assessment on Food Waste Valorisation to Value-added Products

Chor-Man Lam[a], Iris K.M. Yu[a], Shu-Chien Hsu[b,*], Daniel C.W. Tsang[c,*]

Abstract

Food waste can serve as a potential substitute for fossil-derived feedstocks for producing value-added chemicals, such as hydroxymethylfurfural (HMF), yet their environmental performance has not yet been evaluated, thus impeding informed decision-making. This study aims to develop a life-cycle assessment (LCA) framework to guide decisions on selecting the most environmentally favourable food waste valorisation option to produce HMF. A LCA framework was developed to assess the environmental performance of eight food waste valorisation scenarios with different combinations of solvents, catalysts, and experimental conditions. The environmental impacts associated with the use of water solvent, organic co-solvents, metal catalysts, as well as the reaction temperature and time were estimated. Experimental data were analysed for building the life-cycle inventory. The conversion of bread waste using water-acetone medium with the catalyst aluminium chloride ($AlCl_3$), at 140ºC for 30 minutes, was revealed to be the most environmentally favourable food waste valorisation option, due to the utilization of less polluting co-solvent (acetone) and catalyst (aluminium chloride) as well as the relatively high yield of HMF (27.9 Cmol%). It is expected that when the development of large-scale valorisation systems become more mature and information is more readily available, the decision-supporting tool could be expanded to (1) evaluate the pilot-scale and the industrial-scale of food waste valorisation to HMF, and (2) include the economic performance of the scenarios so that more comprehensive results could be provided to assist decision-making.

Keywords: Life-cycle assessment; biomass valorisation; waste recycling; biorefinery; hydroxymethylfurfural; catalytic conversion.

[a] Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University, Hong Kong.
[b] Co-corresponding author. Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University, Hong Kong. Tel: 2766-6057. Email address: mark.hsu@polyu.edu.hk
[c] Co-corresponding author. Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University, Hong Kong. Tel: 2766-6072. Email address: dan.tsang@polyu.edu.hk