Using Black Soldier Fly Larvae for Carbon Emissions Reduction and High-Value Extractions Towards Sustainable Waste Management

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With the recent increase of human population, food production rates have surged, resulting in one-third of all food produced worldwide to be wasted. With typical methods of waste management such as incineration, landfilling, and composting emitting heavy amounts of CO_2 equivalent (CO_2eq), an emerging greener technology is the use of black soldier fly larvae (BSFL; Hermetia illucens) as a treatment method for biodegradable waste. While using BSFL after waste management for animal feed was established, large-scale use of BSFL for chitin extraction was not performed and proved to be more economical. Furthermore, obtaining chitin also extracts lipids which can be used for biodiesel, as well as protein hydrolysate which can be sold directly as feed additives. In this study, the dry matter (DM) value of the BSFL was assessed compared with the value of the chitin, lipids and proteins obtained. BSFL chitin extraction using HCl, NaOH, and H_2O_2 provided a yield of 10% chitin, 27.7% lipids, and 28% protein. BSFL DM price averaged at 30 USD/kg, while chitin, lipids, and proteins extracted from the same weight of BSFL DM were assessed at 150% to 333% of the original value. A CO_2eq analysis showed that the daily operation for BSFL waste management until extraction would emit 88 CO_2eq kg per day compared to daily emissions of traditional techniques emitting 627 CO_2eq per ton of waste, exhibiting a reduction of 713% in daily emissions and proving that the BSFL waste management system is the most sustainable model economically and environmentally.

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