

Abstract

Organic matter processing through *Hermetia illucens* (black soldier fly) technology offers promising fecal sludge management (FSM) and sustainable sanitation option. Fecal matter has been valorized using black soldier fly (BSF) technology; however, there is insufficient knowledge in substrate co-treatment rationing rates to scale up the extant BSFL systems for optimum waste conversion. In this study, an evaluation of BSF process performance during co-treatment of fecal matter and kitchen waste was carried out under laboratory-scale conditions. BSF larvae feeding substrates were formulated using fresh fecal matter and kitchen waste (FM: KW) in the ratios; 1:0, 4:1, 2:1, 1:1, and 0:1. The experiments were set out in rectangular plastic containers (26*13*11 cm). Under each mixing ratio, 1000g of the feed substrate was treated utilizing 5g of 5-day old BSF larvae. One hundred larvae were randomly picked at three-day intervals from each treatment (in triplicate) to monitor the larval weight gain across the treatment process. Larval days to 50% pupation, mean pupal yield, waste reduction rate (WR), bioconversion rates (BR), and feed conversion rates (FCR) were monitored for the process performance. The results showed that substrate mixed 1:1 attained the best measures; WR (90.56%), a high weight reduction index (WRI) (5.66), high BR (14.56), and a high overall prepupal yield (72.78g) within a shorter development time (16 days). This study affirms the performance efficacy of BSFL to sufficiently convert fecal substrates when co-treated with kitchen waste, promoting a circular economy. It, therefore, illustrates that a co-treatment strategy has the potential to boost and enhance sustainable fecal waste management for future applications.