

Developmental stage-specific variations in the physicochemical and nutritional profiles of oil extracted from *Hermetia illucens* larvae

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The growing need for sustainable, nutritionally valuable lipid sources has led to interest in exploring non-conventional oils. In the present study, oil extracted from three developmental stages of black soldier fly (*Hermetia illucens*) larvae (BSFL), namely 4th instar, 5th instar, and prepupa, was analysed for its physicochemical properties and fatty acid composition. The BSFL collected from the controlled biocomposting system was used in the experiment. Collected BSFL were sorted, dried, powdered, and subjected to Soxhlet extraction followed by solvent recovery using a rotary evaporator. Oil yield varied from 25.66 to 30.80%, depending on the developmental stage. Progressive larval development resulted in improved oxidative stability, while acid values remained within acceptable limits. The oil obtained from the 5th instar exhibited a high saponification value (196.35 mg KOH/g), showing its potential for various industrial and feed applications. Fatty acid analysis revealed stage-dependent variation in lipid composition. The 5th instar oil was dominated by omega-9 oleic acid (52.48%) and contained a moderate level of omega-3 docosahexaenoic acid (4.03%), highlighting its nutritional potential. In contrast, prepupa oil had more medium-chain fatty acids, decanoic acid (78.72%), indicating its suitability for industrial use. Oil from the 4th instar stage contained comparatively lower levels of oleic acid (1.16%) and linoleic acid (1.16%). Thus, these findings highlight that BSFL oil is a promising and suitable lipid source, especially the oil from the 5th instar stage, which shows considerable potential for animal feed, industrial applications, and as a dietary supplement.

Keywords: Alternative protein, Food security, Life on land, Stage-specific distinctions, Sustainability

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