# UNIVERSITI TEKNOLOGI MARA

# EFFECT OF CHICKEN DUNG ON THE GROWTH PERFORMANCE, WASTE REDUCTION EFFICIENCY AND HEAVY METAL COMPOSITION IN THE BLACK SOLDIER FLY (*HERMETIA ILLUCENS*) LARVAE

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*In the name of Allah, The Most Gracious, The Most Merciful.*

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# ABSTRACT

The Black Soldier Fly (*Hermetia illucens*) or "BSF", is employed as a waste management tool in this study, similar to vermicomposting. This research was conducted to determine the effect of substrates to the black soldier fly (BSF) larvae in decomposing the waste. The growth development, waste reduction index, substrate reduction, bioconversion rate, relative growth rate, amino acid properties and accumulation of heavy metals of different substrates were evaluated. In this study, BSFL were fed with three types of substrate which was chicken dung (CD), chicken dung mixed with effective microorganism (CD+EM) and chicken feed (CF) with four replicates until 30% of the larvae reached the pre-pupae stage. During the study, larval development, waste reduction index, substrate reduction, bioconversion rate, relative growth rate, amino acid properties and heavy metal accumulation in the larvae were determined. BSFL reared with CF achieved the highest growth in size and weight of (1.94 ± 0.05 cm) and (4.80 ± 0.12 g) in average, respectively and followed by CD and CD + EM with (0.88 ± 0.07 cm), (0.49 ± 0.27 g) and (0.81 ± 0.03 cm), (0.27 ± 0.07 g) in average respectively. Waste reduction index and substrate reduction for all substrates were calculated as follows: CF (4.85 ± 0.03 g/day), (72.7 ± 0.01 %), CD (2.45 ± 0.20 g/day), (36.7 ± 0.03 %) and CD + EM (2.54 ± 0.11 g/day), (38.1 ± 0.02 %), respectively. The bioconversion rate and relative growth day for BSFL reared in different substrates were as follows: CF (1.34 ± 0.06 %), (1.92 ± 0.01 $day^{-1}$), CD (0.15 ± 0.13 %), (0.23 ± 0.03 $day^{-1}$), CD + EM (0.05 ± 0.01 %), (0.09 ± 0.02 $day^{-1}$), respectively. BSFL also seems to have accumulation of heavy metals (plumbum, zinc, iron, nickel, cadmium and copper) in their body and have different amino acid compositions if being compared to the other waste.

**Keywords:** Amino acid, bioconversion, black soldier fly larvae, growth, heavy metals, *Hermetia illucens*, substrates, substrate reduction, waste reduction

# CHAPTER 1

# INTRODUCTION

## 1.1 Background

The expansion of the human population has resulted in an increase in animal production, which is then limited by a lack of protein-rich feedstuffs that can be supplied to animals (Hua et al., 2019). Fish protein and plant protein are two of the most regularly used protein sources for livestock and aquaculture feed (Luthada-Raswiswi et al., 2021). Due to their great nutritional value, the majority of agricultural-food sector by-products are used primarily as animal feed nowadays. Utilising by-products as feed provides a lot of perks, including reduced waste output, lower competition between animals and humans for crops, and significant savings on feeding expenses (Salami et al., 2019). Malaysia has recently emphasised the energy-generating potential of five significant agricultural residual biomasses: oil palm, rubber palm, soybean, rapeseed, and animal waste (Rajoo et al., 2015). However, only a small portion of these leftover biomasses are used as fuel; the rest are burned (Wong et al., 2020). As incineration is an inexpensive method of waste disposal that contributes to air pollution, the utilisation of remaining biomasses as animal feed is a viable alternative (Wang et al., 2017). Enhancing the efficacy of solid waste treatment and recycling has significant and positive effects on environmental protection, resource conservation, economic growth, and human health protection. Numerous researchers have attempted to transform waste into commodities with additional value in an effort to reduce waste and environmental issues. The use of insects in the management of various solid organic wastes, such as food wastes, fruit wastes, poultry manures, and other forms of organic matter (Surendra et al., 2016).