Chapter 1

Introduction

1.1 Background

The population growth of Jakarta and rapid urbanization have intensified waste management issues, thus contributing to pollution and public health concerns. It generates over 7,000 tons of solid waste per day, more than present capacities at its available landfills. The landfill in Bantargebang, Bekasi, for example, has the capacity of only 6,000-ton-a-day, where 50-60% is total organic waste. This overflow causes the accumulation of waste and environmental contamination and damage (Ali et al., 2023). Most of the waste in Jakarta consist of organic waste like food waste and plant matter. Traditional disposal methods, such as landfilling, result in the release of methane, a highly potent greenhouse gas, and the production of leachate, contaminating soil and water sources. These issues highlight the need for environmentally friendly waste management practices minimizing impact to the environmental and recycling waste into a valuable product (Gosh et al., 2023).

Black soldier fly (*Hermetia illucens*) larvae (BSFL) have been among the most promising biotechnological tools for the valorization of organic waste. This is particularly relevant as BSFL can act on the organic matter that makes up a significant proportion of municipal waste and is problematic in landfills. BSFL can reduce the amount of putrescible waste that would otherwise contribute to odor, leachate production, and methane generation in landfills by rapidly consuming food waste and vegetative matter. Their larvae are voracious feeders that can devour high amounts of organic waste within a relatively short period, converting it into two significant products: nutrient-dense larval biomass and frass (Bruno et al., 2024). The biomass of the larva is valuable due to its high protein and lipid content, which can be processed for application in aquaculture feeds, poultry feeds, and animal feeds. The frass, the residue left after black soldier fly larvae (BSFL) process organic waste from the larvae's digestion, is high in nutrients and can be utilized as an eco-friendly organic fertilizer (Martin et

al., 2024). These two products produced by BSFL rearing make BSFL a strong candidate for circular economy models, as this approach simultaneously waste reduction and resource recovery simultaneously (Nugroho et al., 2023).

One factor that most greatly affects BSFL bioconversion performance is the nutritional quality of the feed substrate. Organic household waste is abundant and widely available; however, it is heterogeneous in nature and may vary over time due to changing household consumption patterns and seasonal availability of different food items in households (Ogello et al., 2024). Such variation may affect the proportion of carbohydrates, fibre, lipids, and protein in the substrate. Because of this, the nutritional profile of waste will change in some way, which can be reflected in larval growth, efficiency in bioconversion, and quality of the resultant larval biomass. Household organic waste generally contains large amounts of starchy leftovers, peels of fruits and vegetables, and other fibrous plant materials, often providing only relatively limited protein compared to the requirements of fast-growing larvae. Due to this, it is feasible to co-feed it with other organic by-products that are usually richer in protein (Fitirina et al., 2022). Such examples include tofu dreg, which is one kind of soybean agro-industrial by-product. Tofu dreg has a relatively high composition of protein and fiber; therefore, it has the potential to supplement and improve substrate quality for BSFL. However, tofu dreg is generally underutilized and discarded, hence contributing to the inefficiencies within the food system (Lu et al., 2022; Rahman et al., 2021; Weko et al., 2023). Co-mixing tofu dreg with household organic waste can provide a more balanced substrate and, therefore, enhance waste reduction, larval growth, and nutrient recovery (Weko et al., 2023).

In this experiment, BSFL were reared on different substrates to evaluate how supplementing household organic waste with tofu dreg influences bioconversion and nutrient recovery. The only treatment substrate was a 1:1 mixture of tofu dreg and domestic organic waste. A standard commercial chicken feed was used for the control diet. The experiment was conducted over three

months to quantify the mixtures impact on the feed proximate composition , larval biomass yield, and larval proximate composition.

1.2 Objective

The objective of this study was to evaluate the yield and nutritional composition of BSFL reared on household organic waste supplemented with tofu dreg, by measuring:

- nutritional composition (protein, fat, fiber, ash, and water) of the mixture (1:1) of tofu dreg with the household organic waste collected in September, October, and November.
- The yield (mass) of BSFL reared on mixture the tofu dreg:organic waste.
- nutritional composition of BSFL reared on mixture of the tofu dreg:organic waste .

1.3 Hypothesis

H_0: There is no significant difference between BSFL reared on commercial chicken feed and those reared on a 1:1 tofu dreg–household organic waste mixture in terms of larval yield (biomass mass) and larval nutritional composition, including protein, fat, ash, moisture

H_1: There is a significant difference between BSFL reared on commercial chicken feed and BSFL reared on the tofu dreg : household organic waste (1:1) mixture in at least one of the above variables.