Chapter 1

Introduction

1.1 Background

Jakarta, being a host of economic opportunities and focus of urbanization and infrastructure development, has become an attractive destination for migration in Indonesia. This has resulted in the broader metropolitan area of Jakarta to receive an average increase of 1.61% in population through 2021-2024 (Macrotrends, 2024). The population growth has also caused numerous issues in the city, including nutritional demands and waste management.

The increase in nutritional demand will also result in increasing animal-based protein production. However, maintaining sufficient production in Indonesia is difficult due to production cost and limited economic viability (Lonnie et al., 2018). To substitute, Indonesia consumes plant-based proteins such as tahu and tempeh, resulting in 72.94g daily protein intake for the average person living in Jakarta, surpassing the recommended 57g (Nugraheni et al., 2020). However, plant-based protein is less digestible, contains less complete amino acid profile and micronutrient. As such, it is critical to improve the accessibility of animal-based protein. In the production of animal-based protein, feed often accounts for more than half of the cost of production, up to 60-80% for most animals (Sumner et al., 2018; Tacon & Metian, 2015). The quality of the feed heavily impacts the cost of production but also the quality and quantity of protein produced. Indonesian farmers, due to lack of resources, rely on materials such as cassava by-products and low-quality maize, which are high in fiber and lacking in fat and protein content, limiting the potential animal growth (Horne et al., 2019). In order to improve the quantity and quality of animal-based protein, adequate feeding is required.

Following the food demands, a huge amount of solid waste is also produced, Jakarta produces 8.77 kilotons of waste everyday with the majority of the mass being organic waste (Ardiatma et al., 2024).

If left to fester, the buildup of organic waste could result in the production of methane gas, a greenhouse gas, which poses a risk towards the environment and respiratory health (Yulianto et al., 2024). Moreover, the buildup of methane gas within a pile of organic waste could pose fire hazards due to methane being flammable. To process waste, waste banks are integrated within several household areas in Indonesia (Budiyarto et al., 2025). However, being a community-driven effort, the amount of waste recycling within waste banks is limited, contributing to only 7% to recyclable waste management.

Black soldier fly (BSF), or *Hermetia illucens*, is a cosmopolitan species which originated from south american regions. Capable of valorizing organic waste into high quality animal feed and possible biodiesel feed, it has raised interest as it is accessible due to its cosmopolitan nature (Wang & Shelomi, 2017). The consumption of organic waste by BSFL results in two functional byproducts: larval biomass, which is a rich source of fats and proteins, and frass, the excrements mixed with organic leftovers that function well as fertilizer (Martin et al., 2024). Both as animal feed and fertilizer, BSFL cultivation can support the agricultural industry with supplying higher quality harvest while reducing the cost of consumables used to grow them. Moreover, adult BSF does not have a functional mouth and does not often interact with humans naturally, this results in disease-transmission from BSF to humans unlikely, whether it is by bites, stings or contaminating food surfaces (Joosten et al., 2020).The ability to consume organic waste to reduce landfill whilst producing high quality animal feed and fertilizer lends itself to be a potent, multi-functional process which benefits a multitude of industries within Indonesia.

This study aims to investigate the viability of tofu dreg (TD) and spent coffee ground (SCG) as potential feed towards BSFL. The two types of waste are selected due to the nutrient profile within and the abundance of both within Indonesia, resulting in both being potential valorization targets.

1.2 Objective

This study aims to investigate TD and SCG as BSFL feed and the effect towards biomass yield and nutritional content of BSFL. To achieve this objective, the study conducted:

- Measure BSFL biomass yield and the proximate nutritional composition (moisture, ash and fat) after 10 days of feeding on the substrates: CF (control), SCG and TD.
- Measure the correlation between feed nutrition and dry biomass yield of BSFL cultivation after 10 days of feeding.

1.3 Hypothesis

For the biomass yield:

- Null Hypothesis (H_0) = No significant difference were observed between the biomass yield of CF and the formulations of TD and SCG as BSFL feeding substrates.
- Alternative Hypothesis = A significant difference was observed between the biomass yield of CF and one or more of the formulations of TD and SCG as BSFL feeding substrates.

For nutritional content:

- Null Hypothesis (H_0) = No significant difference were observed between the proximate composition of CF and the formulations of TD and SCG as BSFL feeding substrates.
- Alternative Hypothesis (Ha) = A significant difference was observed between the proximate composition of CF and one or more of the formulations of TD and SCG as BSFL feeding substrates.

For correlation analysis:

- Null Hypothesis (H_0) = No significant correlation was observed between all nutrition composition and dry biomass yield
- Alternative Hypothesis (Ha) = A significant difference was observed between the nutrition composition and dry biomass yield