CHAPTER 1 INTRODUCTION

1.1. Introduction

According to the 2021 Food Waste Index report, from 2007 to 2021, the amount of food waste generated by the commercial and industrial sectors has steadily increased by 1.74 times. Likewise, continued growth in the world's population will require the production of more food. This will require the use of more resources and land to support global population growth, leading to continued depletion of arable land and natural resources such as water and energy (Opio et al, 2012). Therefore, the current food production system is unsustainable.

The increase in food waste has had a large impact on the environment, and there are currently challenges in managing food waste. Waste disposal relies on common technologies such as landfilling, composting and incineration, which have adverse environmental consequences by producing unpleasant odors, emitting greenhouse gases (GHG) and damaging the environment around the disposal area (Tavill, 2020). Therefore, alternative solutions, such as bioconversion of waste into highprotein products, may contribute to the solution (Varelas, 2019). In return, lower emissions, reduce environmental damage and promote a circular economy (Pinotti and Ottoboni, 2021).

Insects in this case have a potential to convert the organic waste into a high value biomass better than conventional livestock (Pinotti & Ottoboni, 2021). Recently, decomposing insects such as the Diptera black soldier fly (*Hermetia illucens L.*) have received attention in the management of organic waste. Black soldier fly larvae (BSFL) has the ability to convert various organic wastes into highvalue biomass (Liu et al, 2019). Later on, the biomass can be utilized into a value-added product for various applications. Such as a source of protein in food, fish feed, livestock, and biodiesel (Barragan-

Fonseca et al, 2017; Gasco et al, 2020).

However, the nutritional composition of BSF larvae is largely dependent on the feeding medium. In general, BSFL dry matter is composed of 40% protein and 30% fat (Barragan-Fonseca et al., 2017; Liu et al, 2019). Different studies have grown BSFL on various types and concentrations of waste substrates, each yielding different results (Spranghers et al., 2016).

SFL grows best in substrates containing digestible carbohydrates and an adequate source of protein. The rate of BSF growth and biomass yield can be affected by the type of substrate it reared in (Bava et al, 2019). Balanced feed (i.e. chicken feed) or other BSF standard diets are balanced in nutrients, protein, and energy; favored because it can produce best performing BSF (Barragán-Fonseca et al, 2018). In addition to the standard diet, potential additional substrates are being continuously investigated. Such as chicken feed, industrial by-products, fruit and vegetables, straw, animal byproducts and algae (Hopkins et al, 2021; Kinasih et al, 2018; Lestari et al, 2021; Meneguz et al, 2018). Some show promising results, while others lead to limited or slower growth (Pinotti & Ottoboni, 2021). There are several factors effecting the BSFL growth performance, which include the abiotic conditions, feed nutritional composition, and the digestibility of feed (Galassi et al, 2021; Gligorescu et al, 2018; Lestari et al, 2021). Feed with high fibre (i.e. lignocellulose) slow down BSFL digestion (Galassi et al, 2021). In this study, an industrial by-product and a food waste readily available in Indonesia are proposed as the substrates for BSFL.

Both tofu dreg and bread waste are in constant supply and contribute to the bio-waste problem in Indonesia (Faisal et al, 2016). Tofu is a food consumed all over the country, valued for its high protein and beneficial vitamin content. But with it, there is on average 1,024 million tons/year of solid waste (Tofu dreg) generated (Sintawardani, 2011). Tofu dreg consists of 20.93% protein, 21.43% fiber, crude fat 10.31%, traces of calcium and phosphorus, and other compounds 36.69% (Faisal et al, 2016). On the other hand, bread is a staple food with a short expiration date. If not bought on a daily basis, bakeries often discard the older bread. In Indonesia alone, 10 million pieces of bread go to waste

weekly (Susilo et al, 2021). Composition of bread waste consists of complex carbohydrates 78.6%, fat 5.3%, proteins 13.5%, and ash 2.6% (Ewald et al, 2020).

Because starch is the most common carbohydrate in bread, BSFL can fully digest it (Muchdar et al, 2021). Therefore, combining a protein source (tofu dregs) and a good carbohydrate source (bread) as substrates may have the potential to improve BSFL growth, development time, and yield. food waste such as tofu dreg and bread waste has not been studied before.

1.2. Objectives

The objective of this study are to evaluate BSFL growth and performance in organic waste reduction using different combinations of tofu dreg and bread waste as rearing substrates.

1.3. Scope of Work

The scope of this study is as follow:

1. Utilizing different concentrations of tofu dreg and bread waste as feed for BSFL.
2. To observe BSFL yields, growth performance, and organic waste reduction performance.
3. To evaluate the best outcome from the different concentrations of substrates by statistical analysis.