

CHAPTER I

INTRODUCTION

1.1 Background

Food is a must for sustenance and adequate protein consumption is important to maintain normal bodily functions. Proteins as energy source generate 4 kcal/g. Proteins consumed are deconstructed into amino acids or peptides. Amino acids are required for protein synthesis in the body. Some of these AAs cannot be synthesized in the body and must be obtained from food sources. According to FAO/WHO/UNU (2002), a healthy adult requires 0.66/kg of protein per day (Nadathur *et al.*, 2017).

Diet among middle-lower income people in Indonesia scored low in terms of dietary diversity score (DDS). Low DDS is caused by low intake in vegetables, fruits, animal food and soybeans. Among ASEAN countries, Indonesians consumed the least amount of protein sources. Lacking in protein energy intake coupled with heavy rice consumption resulted in a double burden of malnutrition, undernutrition, and obesity. Protein-energy malnutrition could result in greater risk of infection and illness in children as skin and immune system can be affected by lacking the proteins needed. In adults, protein-energy malnutrition may result in muscle and blood loss (McGuire and Beerman, 2011).

Food security exists when dietary needs of people can be met year-round with safe and nutritious food. As of 2019, the population in Indonesia is about 273 million with growth rate of 1.14% (UN, 2019). More than one-third of children below 5 years old are stunted, which indicates undernutrition. Malnutrition in

children may be caused by lack of protein energy, vitamin A and obesity (Kemenkes RI, 2015). The current baseline diet in Indonesia provides 2607 kcal of energy, with rice providing about 70% of the dietary energy needs. Disproportionate energy intake from rice could result in obesity and nutrient deficiencies. To adjust the baseline diet to lower energy intake while raising protein intake, along with the need to increase food production would result in increased greenhouse gas emissions from bovine, aquatic, and poultry sources (WHO, 2020).

Entomophagy is the practice of eating insects. About 2037 kinds of insects are consumed globally and contribute to 2 billion people's diet worldwide. Insects are potential candidates to becoming alternate protein sources due to high protein conversion rate, fast growth rate and high breeding rate. The ability to recycle agricultural wastes with much lesser space and water requirements mean that insects are more environmentally friendly. Insect proteins are generally comparable to that of animal protein with good amino acid profiles. Methionine is the exception, however. Nevertheless, this makes insects good in tandem with maize and wheat diets (van Huis *et al.*, 2013 and Paoletti, 2005).

Black Soldier Fly Larvae is the larval stage of Black Soldier Fly (*Hermetia illucens*). BSFL remain as larvae for about 3 weeks which makes a good protein converter with more time to process organic matter such as kitchen scraps. BSFL has a protein content of 38.9% (Nyakeri *et al.*, 2017). Although protein content may be lower than other known insects among entomophagist such as crickets and mealworm, feed conversion ratios are superior, which makes a good protein converter with more time to process organic matter such as kitchen scraps. Pre-

pupae stage following the larval stage exhibits "self-harvesting" behaviour, which prompts them to climb to higher places before pupating into adult Black Soldier Fly. This behaviour allows system design to separate larvae from other stages in its life cycle. In Sabah, Malaysia, BSFL has been consumed by Kadazan-Dusun people. Important note is that the BSFL are grown in tapioca, which would also be used in making *tapai* beverage. For human consumption, substrates for rearing must be food-grade (Lam *et al.*, 2020; Wang and Shalomi, 2017).

According to the BSN (2011), cookies have a protein content minimum of 5% in weight. Often, cookies are considered as 'empty calories' with high sugar and fat content by nutritionist. Despite the negative label, cookies are enjoyed by many. Cookies can be modified with special formulations to carry dietetic and functional benefits. Hidden insect preparation has been attempted by researchers, such as mealworm in beef patty preparations (Megido *et al.*, 2016) and BSFL in Vienna-style sausage preparation (Bessa *et al.*, 2019). Cookies are potential candidate for hidden insect preparation, as the low water activity may help extend shelf life, and help in increasing protein intake from snacking in between meals

1.2 Research Problem

Entomophagy, despite being not a new practice, is uncommon. As a case in point, among the rural Kadazan-Dusun people consuming BSFL, this practice is slowly fading. Younger people of Kadazan-Dusun found eating them to be repulsive. Entomophagy is also associated with words such as "disgusting", "primitive," and "weird". A possible solution to reduce insect food neophobic is through invisible preparation in known and familiar foods. Megido *et al.* (2016)

has attempted inclusion of mealworm in patty preparations. Cookies are relatively cheap to purchase, have good shelf life and are enjoyed throughout the world. Partial substitution of wheat flour with BSFL flour is hoped to increase protein content and reduce insect food neophobia as a newer alternative to protein.

1.3 Objectives

1.3.1 General Objective

The general objective of this research is to utilize black soldier fly (*Hermetia illucens*) larva in meal form in preparation of cookies.

1.3.2 Specific Objectives

The specific objectives of this research are:

1. To obtain the BSFL meal and evaluate the physical and chemical characteristics
2. To determine the effect of different ratio of BSFL meal to wheat flour in producing cookies based on their physical, chemical, and sensory characteristics
3. To evaluate and compare the chemical characteristics of the best formulation of cookies and control cookies using proximate analyses.