Chapter 1

Introduction

1.1 Background

Ensuring adequate food supply for the rapidly growing population has become one of the greatest challenges of the 21st century. The demand for food is projected to increase by 59–98% as the global population is expected to reach nearly 9.8 billion by 2050 (Durán-Sandoval et al., 2023). This rapid growth poses major challenges related to malnutrition, environmental sustainability, and food security. As a result, the need for alternative protein sources is also increasing annually due to growing awareness of sustainable food systems, leading to the exploration of novel protein sources, such as edible insects (Henry et al., 2018; Lange & Nakamura, 2021). In developing countries, protein-energy malnutrition (PEM) is one of the causes of stunted growth and death in children. It was found that 26.8 % of Indonesian children under five years old are stunted, a figure that remains far above the national target of below 20% (Maidelwita et al., 2025). Furthermore, protein consumption in Indonesia, at 62.78 grams per capita, is lower than in other ASEAN countries, such as the Philippines (93 grams), Thailand (141 grams), and Malaysia (159 grams) (Izzuddin et al., 2025). Despite the abundance of protein-rich foods in Indonesia, financial hardship remains a key barrier to adequate protein intake (Nofal et al., 2024).

To address this issue, crickets offer an affordable, high-protein alternative that could help combat PEM in Indonesia, while diversifying daily dietary protein sources. Within the order Orthoptera, crickets are the most consumed insects worldwide due to their high nutritional value and potential as meat substitutes (Magara et al., 2019). They contain essential amino acids and approximately 61% protein on a dry basis, which is one of the highest levels reported among the species identified worldwide (Liceaga, 2022; Barragán-Fonseca et al., 2025). Furthermore, their high feed conversion ratio makes them a highly sustainable protein source, as fewer resources are required compared to

traditional livestock. For instance, producing 1 kg of beef requires roughly 12 times more feed and 3,000 times more water than producing 1 kg of crickets (Omuse et al., 2024).

However, cricket consumption is uncommon due to the loss of traditional knowledge among younger generations. Indigenous communities are more likely to practice entomophagy, as they inherit knowledge of utilizing available natural resources from their elders. Although Indonesia reports a diverse insect consumption, knowledge gaps remain due to the lack of documentation and relative rarity of this insect-eating culture compared to other countries (Sabri et al., 2023). Additionally, a major constraint to edible insect consumption is food neophobia, as it tends to be at a higher level than other foods. Both neophobia and disgust drive consumer reluctance toward insect-based foods (Olum et al., 2020; Szlachciuk & Żakowska-Biemans, 2024).

One potential food product that can help mask the distinct flavor of cricket is ice cream. It is one of the most popular desserts worldwide and an appealing dairy product for consumers of all ages (Sharma, 2023; Motoki et al., 2025). Consumers in tropical countries like Indonesia highly favor this cold dessert, with the largest percentage (38%) coming from the 18–29 age group and 37% from the 30-39 age group, particularly among women (Ganis, 2023). Data from Statistics Indonesia shows that ice cream consumption increases every year, rising from 51.9% during 2013-2018 to 79% in 2022 (Mukminah & Rahayu, 2025; Khalish et al., 2020). By pairing crickets with a familiar and favored product like ice cream, food neophobia may be reduced, thus promoting wider acceptance and consumption (Romano et al., 2025).

Cricket powder has been incorporated into various food products to improve consumer acceptance. Several studies have investigated the effects of cricket powder on the proximate composition and physicochemical properties of snacks and bakery products (Cabagnols et al., 2025; Tilami et al., 2025; Jirukkakul & Phoolklang, 2025). However, research on the application of cricket powder in dairy

products remains limited, and no prior studies have explored its incorporation into ice cream. Ice cream is composed of a complex structure of partially coalesced fat, ice crystals, and air bubbles (Rolon et al., 2017). Since the physicochemical properties of ice cream are highly dependent on its composition, adding cricket powder may alter the microstructure and affect properties like color, viscosity, texture, overrun, and melting rate (Wu et al., 2025). Evaluating these physicochemical properties, together with proximate composition, is important to determine whether nutritional enhancement through cricket powder can be achieved while maintaining desirable properties and consumer acceptability. Therefore, this study aims to incorporate 9%, 12%, and 15% cricket powder into ice cream and evaluate its physicochemical properties and proximate composition.

1.2 Objective

This research aims to analyze the effect of cricket powder incorporation as an alternative protein source on the proximate content and physicochemical properties of ice cream. Physicochemical (color, overrun, melting rate, viscosity, and texture) and proximate (total solids, ash, fat, and protein) analyses will be conducted to assess the nutritional composition and quality of the ice cream.

1.3 Hypothesis

The hypotheses of this study are as follows:

1. Null hypothesis (H_0): There is no significant difference in the physicochemical properties between the different concentrations of cricket powder.

   Alternative hypothesis (H_1): There is a significant difference in the physicochemical properties between the different concentrations of cricket powder.

2. Null hypothesis (H_0): There is no significant difference in the proximate composition between the different concentrations of cricket powder.

   Alternative hypothesis (H_1): There is a significant difference in the proximate composition between the different concentrations of cricket powder.