Chapter 1

Introduction

1.1 Introduction

Soybeans (*Glycine max*) are a major classification of legume that have long been used as a source of protein in Asian countries, particularly Indonesia (Prado et al., 2022). Due to its high nutritional content and health benefits, including high protein content, soy products are becoming more and more popular worldwide. There are a variety of soy products offered globally, which can be roughly divided into two classifications: fermented products (miso, soy sauce, tempeh) and unfermented products (tofu and soy milk). The most frequently generated side streams in the soybean food industry are soy whey and okara (soybean pulp), which are mostly produced from the production of tofu (whey and okara) and soymilk (okara) (Colimoro et al., 2023; Vong & Liu, 2016). Soy whey is a liquid byproduct and has a particular quantity of nutrients, including minerals, vitamins, carbohydrates, protein, soluble sugars, and bioactive components like isoflavones. Despite its nutritional value, soy whey is often discarded without proper treatment and left untreated, which causes environmental challenges due to its high chemical oxygen demands (COD) and biochemical oxygen demands (BOD), along with its economic challenges due to its high treatment and transportation costs (Chua & Liu, 2019; Dai et al., 2023). According to Tu et al. (2019), 1 kg of soybeans may produce around 2.5 kg of tofu and release about 8.95 kg of soy whey, generating a significant amount of this byproduct. Therefore, it is necessary to utilize this soy whey waste effectively and rapidly.

To overcome these challenges, effective valorization techniques are needed to convert the soy whey waste into a beneficial product. Microbial fermentation and product formulation into a value-added

beverage are two viable methods for soy whey valorization (Karim et al., 2025). However, soy whey's natural nutrient composition is relatively low in essential nutrients and fermentable carbohydrates, which are insufficient to promote the optimum microbial development. Therefore, supplementation with glucose as an external carbon source and mineral salts is necessary to balance the carbon-to-nitrogen (C/N) ratio and increase microbial metabolism (Ferreira et al., 2016). *Aspergillus oryzae* is a type of fungus which is often employed in food fermentation such as soybean paste, soy sauce, and miso due to its Generally Recognized as Safe (GRAS) classification and its capacity to alter soluble substrates through enzymatic activity without developing harmful metabolites (Seidler et al., 2024). Additionally, previous study conducted by Pratama et al. (2025) has successfully demonstrated that *Aspergillus oryzae* is capable of growing on soy whey as a fermentation medium.

Following fermentation, soy whey is suitable for beverage formulation due to its liquid form and residual soluble components. However, as fermented soy whey is characterized by having an acidic taste and aroma, suitable ingredients must be added to balance and enhance the beverage's overall sensory profile (Arora & Mali, 2025). Fruit juices are commonly employed in soy-whey beverage production as it contain vitamins, minerals, organic acids, and bioactive substances that may enhance flavor and mask the undesirable taste (Žvirdauskienė et al., 2025). Furthermore, fruit juices naturally contain simple sugars like sucrose, fructose, and glucose, which provide sweetness and act as readily metabolized carbon sources (Pinto et al., 2022). Previous studies have successfully incorporated several fruit juices, such as mango, orange, pineapple, etc in the development of whey-based beverages, and have been shown to increase sensory acceptance of the beverage (Punoo et al., 2023; Rather et al., 2024; Tanwar et al., 2022). Mango (*Mangifera indica* L.) is one of the most popular tropical fruits, and is known to be a good source of vitamin C, carotenoids, phenolic compounds, antioxidants, and dietary fiber. Due to its pleasant flavor and sensory qualities, Arumanis is one of the most popular mango cultivars in Indonesia (Lebaka et al.,

2021; Sato et al., 2021). Moreover, According to BPS data (2020-2025), mango was the second most-produced fruit in Indonesia following banana, indicating high consumer demand (BPS, 2025). Therefore, this study aims to explore the feasibility of incorporating mango juice into a fermented soy whey beverage.

1.2 Objective

This study aims to evaluate the effect of different mango juice formulations on the physicochemical properties (color, pH, °Brix, and viscosity) and sensory evaluation of fermented soy whey beverage.

1.3 Hypothesis

H_0: There is no significant difference of mango juice-to-soy whey ratio formulations on the physicochemical properties (color, pH, °Brix, and viscosity) and sensory properties.

H_1: There is a significant difference of mango juice-to-soy whey ratio formulations on the physicochemical properties (color, pH, °Brix, and viscosity) and sensory properties.