

CHAPTER 1 - INTRODUCTION

1.1. Background

Tempe is one of Indonesia's most widely consumed traditional fermented foods, produced through the solid-state fermentation of soybeans by *Rhizopus* species (Astuti *et al.*, 2000). Overripe tempe, or *tempe semangit*, refers to tempe with 72 to 96 hours of extended fermentation (Adriani *et al.*, 2014). Overripe tempe has a characteristic of darkened brown color, softer texture compared to normal tempe, and pungent aroma (Hassanein *et al.*, 2015). Overripe tempe is traditionally used in various regional dishes in Indonesia, specifically in Javanese cuisine (Gunawan-Puteri *et al.*, 2015). The extended fermentation period on tempe enhances protein digestibility, which is caused by the breakdown of complex protein into free amino acids, improving its nutritional value (Witono *et al.*, 2015). Overripe tempe contains elevated levels of free amino acids such as glutamate and aspartate that contribute to the umami flavor that has the potential for usage as a natural flavor enhancer (Gunawan-Puteri *et al.*, 2019).

Studies have shown in attempts to utilize the overripe tempe as the source of protein and umami ingredients in several food products, such as overripe tempe powder cubes (Setiadharmas, 2015), plant-based pastes (Mursito, 2015), overripe tempe addition in weaning foods (Fortunata, 2017), and overripe tempe addition in rice porridge for infants (Gunawan-Puteri, Laurensia Christli, et al., 2018). In 2019, a plant-based broth product called Rhisoya, made from overripe tempe powder, was launched and commercialized by PT. Pangan Bijak Indonesia. The product held a brand image of healthy and clean, as being free from *monosodium glutamate* (MSG), artificial colorants, and preservatives. PT. Pangan Bijak Indonesia demonstrates the potential of overripe tempe not only as a traditional food but also as a functional ingredient for plant-based product applications.

In recent years, PT. Pangan Bijak Indonesia, in collaboration with partner Swiss German University, has the opportunity to address one of the national issues, which is the high rate of stunting. Indonesia is a very large country with a population of 282,477,584 people in 2024; of that total population in Indonesia, 10.91% are toddlers. With a large population, this can provide opportunities for the Indonesian economy. This opportunity, however, has not been realized due to the unfavorable health conditions of the Indonesian people. One of the problems that are found in Indonesia is the high stunting rate. The stunting rate in Indonesia in children under 5 years of age reached 24.4% in 2021 (Martony, 2023). The target set by the government to reduce the stunting rate is 14% by 2024, which makes this an urgent problem to be resolved, plus the prevalence of stunting is still high at 21.5% in 2023. Some of the government's efforts to overcome stunting cases include monitoring pregnant women and children at risk of stunting, subsidy programs or assistance to underprivileged families, and recently, the government implemented a free meal program, which is implemented in schools throughout Indonesia.

The use of overripe tempe as one of the ingredients for the formulation of such food may increase protein content and enhance flavor. However, overripe tempe has limitations, particularly its limited solubility in water due to the high content of insoluble dietary fibers and interactions between macromolecules, such as amylose-lipid and protein-starch complexes, which hinder water absorption (Mahdi *et al.*, 2022). This is why the study was conducted

This study aims to investigate the use of overripe tempe as an addition in the seasoning of instant noodles to increase protein content and enhance flavor, in order to get an instant noodle seasoning that is nutritious and meets the protein intake requirement, so that it can help overcome the stunting rate in Indonesia.

1.2. Research Problems

Problem #1: The incorporation of overripe tempe powder into instant noodles seasoning formulation remains unexplored, and its effect on consumer acceptance hasn't been studied.

Problem #2: Overripe tempe powder alone may not meet protein requirements for high-protein food due to its high proportion of fibrous material and distinct taste.

Problem #3: Optimization of a seasoning formulation that is acceptable from a sensory standpoint and regulatory compliance

1.3. Research Objectives

1. To evaluate the impact of overripe tempe application as seasoning or toppings in the sensory acceptance of instant noodles.
2. To evaluate the seasoning formula with overripe tempe application and determine the supporting ingredients needed in the seasoning formulation.
3. To optimize the seasoning formulation that is acceptable from a sensory standpoint and regulatory compliance.

1.4. Significance of Study

The availability of instant noodles that meet the requirements for protein and salt, while remaining delicious, can play a significant role in helping children meet their daily nutritional needs and reducing the risk of stunting. Moreover, such nutritionally enhanced instant noodles can serve as an affordable alternative, ensuring their benefits are accessible to a broader segment of the Indonesian population.

1.5. Research Questions

Question #1: What is the impact of overripe tempe powder on the sensory attributes of the final product?

Question #2: What is the optimal amount of overripe tempe application and supporting ingredients needed to achieve the protein and salt requirements?

Question #3: How can the seasoning formulation be optimized to meet the acceptability from a sensory standpoint and regulatory compliance?

1.6. Hypothesis

Hypothesis #1: The insolubility of overripe tempe produces a gritty texture; however, overripe tempe can enhance flavor.

Hypothesis #2: The optimal amount of overripe tempe application, combined with supporting ingredients, can be formulated to meet the target protein and salt requirements.

Hypothesis #3: The optimization of the seasoning formula can be accepted from a sensory standpoint and regulatory compliance

