

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Overripe tempeh is tempeh that has been fermented over the normal time period wherein the mold fermentation ceases and is taken over by bacterial fermentation. The resulting overripe tempeh has a pungent odor, brown-greyish coloration and a wetter softer texture than normal tempeh. Overripe tempeh is produced by fermenting for 2 - 5 days longer than normal tempeh (Djunaidi et al., 2017). It is commonly used for traditional Javanese cuisines and condiments, it is normally mixed with chili and/or coconut milk as a basic flavor to create foods such as: *sambel tumpeng, gudeg, lodeh, botok, oseng-oseng* and many more (Hassanein et al., 2015; Puteri et al., 2015). Overripe tempeh can be classified into two types which are *tempe semangit*, and *tempe bosok*. The fermentation period of *tempe semangit* is produced by further fermentation in normal tempe for 48 hours longer after it is ripe, while *tempe bosok* is further fermented 72 hours after ripe (Wijaya & Puteri, 2015). In contrast, normal tempeh has a further fermentation period of 48-72 hours after inoculation.

The process of traditional tempeh production involves soaking dry soybean for 24 hours, followed by boiling and mechanical dehulling of the beans, in this stage the beans are laid out, shaped into thick beds. The next stage involves the inoculation of microorganisms which are one of the primary factors that drives the changes within the tempe, variation in this process differentiates the modern and the traditional counterpart as one uses controlled inoculum and the other the wild type variant. Through the inoculation of lactic acid bacteria (LAB) and the mold starter culture *Rhizopus oligosporus* and packaging specifically made to restrict air supply. The fermentation process will slowly change the soybean into tempeh, key organisms such as lactic acid bacteria (LAB) introduced in the soaking stage creates a favorable environment for the inoculated *Rhizopus* to germinate and create white mycelium structures binding the beans together (Nurdini et al., 2015). This process inhibits

undesirable microorganisms and gradually changes the yellow color soybean into a paler white color while also creating a firm texture.

Continuous fermentation of tempeh over the period after ripening is defined as over fermentation. This process will produce a type of tempeh that has a different set of physicochemical characteristics than normal tempe. During this process the activity of the *Rhizopus* inoculum slowly ceases as its mold cannot survive and the solid state fermentation is overtaken by the bacterial fermentation. The dominant microorganisms left the overripe tempeh lead to secondary changes affecting physicochemical, texture, and water soluble protein content.

Most of the recent studies regarding tempeh range from microbiology, chemical and nutritional changes, functionality and its sensorial aspect (Utami et al., 2016). There are a lot of studies of tempe made using other ingredients and to some degree products derived from other beans. Despite that, studies involving physicochemical analysis and pattern changes that have a high degree of importance in characterizing the stage of fermentation of tempe products are rare. Studies on the subject of the overripe state of tempe are few and far between, covering only fermentation up to 72 hours with very limited information in terms of proteolytic activities and physicochemical analysis. The most recent study about physicochemical property was from Erkan et al. (2020) which is considered the most up to date literature covered the physicochemical features of tempeh (24-48 hour) produced from different sources of legumes and beans which includes analysis such as bulk density, texture, pH, moisture, color difference and protein content analysis.

The aim of the study is to evaluate individual changes in both tempe type in all parameter which include physicochemical changes, textural and water soluble protein changes during overripening. The second objective of the study aims to evaluate the changes in all parameters over each day of overripening between both tempe types and also to correlate changes in selected parameters.

## **1.2 Statement of the Problem**

Based on the background of the study, several problems were formulated:

1. How are the physicochemical changes, textural and water soluble protein changes during tempeh overripening process (0, 24, 48, 72, 96, and 120 hours)?
2. Is there a difference between the physicochemical changes, textural and water soluble protein changes of modern and traditional produce tempeh during overripening process (0, 24, 48, 72, 96, and 120 hours)?
3. How is the correlation between:
  - a. Moisture content with textural changes?
  - b. pH value with moisture content?
  - c. pH value with textural changes?
  - d. pH value with water soluble protein content?

## **1.3 Research Objective**

The general objective of this research is:

1. To evaluate the individual changes in modern and traditionally produce tempeh in all parameters which includes physicochemical, texture and water soluble protein content during overripening process (0, 24, 48, 72 and 120 hours).
2. To evaluate the comparison between modern and traditionally produced tempeh daily changes in all parameters including physicochemical, texture and water soluble protein content during overripening (0, 24, 48, 72 and 120 hours).

3. To correlate changes in selected parameters from all samples during overripening of tempeh.

The third objective will be analyzed using a correlational test

- a. The selected parameters were made based on the assumption that the fermentation process directly affects pH and moisture. This is based on previous studies from several journals discussing the correlation between these parameters, hence below were chosen paired parameter for the correlational analysis which includes
  - Moisture content and textural changes.
  - pH value and moisture content.
  - pH value and textural changes.
  - pH value and water soluble protein content.

#### **1.4 Hypotheses**

There are two hypotheses on this research, which were:

1. Null hypotheses (Ho)
  - a. There is no significant difference in physicochemical properties, textural and water soluble protein changes within individual changes in both tempe types during overripening process
  - b. There is no significant difference in the comparison between both tempe types daily changes in physicochemical properties, textural and water soluble protein changes between both tempe types during the overripening process.
  - c. There is no significant correlation between all parameters during the tempeh overripening process.
2. Alternative hypotheses (Ha)
  - a. There is significant difference in physicochemical properties, textural and water soluble protein changes within individual changes in both tempe types during overripening process.

- b. There is significant difference in the comparison between both tempe types daily changes in physicochemical properties, textural and water soluble protein changes between both tempe types during the overripening process.
- c. There is significant correlation between all parameters during the tempeh overripening process.

### **1.5 Importance**

The significance of this study can provide several benefits in:

1. The knowledge regarding the physicochemical studies and water soluble protein analysis of overripe tempeh could be used for future studies as a supplementary literature.
2. Academia through new findings of physicochemical studies and water soluble protein analysis of overripe tempeh could be used to stimulate new research on the topic.
3. Society in which the information of the physicochemical studies on overripe tempeh could be used better understand and characterize the tempeh along with increasing the quality of overripe tempeh.

### **1.6 Research Scope**

The scope of the research is limited to the physicochemical analysis which includes pH, moisture along with analysis of textural and water soluble protein changes in overripe tempe samples from modern facilities sourced from Rumah Tempe Indonesia and traditional facilities source from Sunter Market.