

# CHAPTER 1

## INTRODUCTION

### 1.1. Background Research

Currently, the trend of adopting a flexitarian diet is increasing, as people are more aware of the health benefits as well as environmental impact, hence also increased the consumption of plant-based meat products (Derbyshire, 2017; Curtain & Grafenauer, 2019). This event subsequently attracts plant-based meat market trends, especially in the US, Canada, and Europe. It is also reported that the plant-based meat markets will reach 8.3 billion US dollars by 2025 (“Plant-based Nuggets Market”, 2020). Trends of plant-based meat markets are also starting in Indonesia, as foreign and local companies start to produce plant-based meat products in Indonesia (Wan, 2018; “Green Butcher: Indonesia’s First Plant-Based Meat Producer Finalises Seed Round Investment”, 2021).

The development of plant-based meat alternatives (PBMA) has come into the newest generation, which is PBMA 2.0 that aims to the creation of PBMA that not only mimic the texture, but also have the taste, appearance, nutritional value, and aroma of real meat products (He *et al.*, 2020). There are many plant-based meat products produced from PBMA 2.0, and one of them is plant-based nuggets, which are chosen due to the high popularity among consumers.

To create an acceptable quality of plant-based nuggets, several attempts have been developed to improve the nutritional and textural quality of plant-based nuggets. Based on an experiment done by Kumar *et al.* (2011), plant-based nuggets have lower fat, saturated fat, and cholesterol and higher dietary fibers, carbohydrate, and mineral contents such as potassium, zinc, copper, and iron, and lower sodium content compared to commercial chicken nuggets. However, the textural properties were still significantly lower compared to chicken nuggets (Kumar *et al.*, 2011; Bohrer, 2019). Therefore, attempts were made to improve the textural properties, which are the usage of TVP in plant-based products.

TVP is one of many meat analog products that has been widely used in plant-based meat analog applications, as it provides structural and textural properties that mimic the meat product. There are four main ingredients that can be used for TVP production, but soy-based TVP is the most chosen in the industry due to soy availability and low costs (Riaz, 2011). TVPs are produced using an extraction method, where the principle of the process begins from the food with high starch and protein contents undergoing several processes such as pressurized, heated, plasticized, and mechanically sheared to obtain the product. Compared to the other structuring methods, extrusion methods are cheaper and do not cause a high environmental impact (Kyriakopoulou *et al.*, 2019; Dekkers *et al.*, 2018). However, such methods are still not common in Indonesia, therefore leaving the price of TVPs quite expensive.

Comparing the cost production of TVP and tempeh, the cost of TVP in Indonesia is Rp 71,000 per kg (“Texturized Soy Protein”, n.d.) and Rp 192,000 per kg in the US (“TVP® (Textured Vegetable Protein)”, n.d.), whereas it costs Rp 16,000 per kg of tempeh (Widyastuti, 2021). Considering the price, tempeh is cheaper compared to TVP. Moreover, the production of TVP requires extrusion machines, as it also will induce additional costs such as electricity and machine costs. Therefore, to cover the costs of plant-based nugget formulations, tempeh is chosen as the main ingredient to substitute TVP.

Tempeh is an authentic Indonesian fermented food product that has a rich protein content that can be comparable to animal source proteins, such as chicken, beef, hamburger, and eggs (Shurtleff & Aoyagi, 1979). Besides high protein sources, many health benefits have been reported from the tempeh consumptions, such as healing digestion systems, reducing diarrhea incidence, increasing intestinal growth and proliferation, anti-oxidative properties, and reducing risk against chronic degenerative diseases (Nout & Kiers, 2005), in which those nutritional benefits are lacking in the TVP.

The utilization of tempeh towards plant-based meat products, for now, is still limited to certain products. A study by Vital *et al.* (2018) used tempeh to develop vegetarian burgers. However, the majority still dislike the burger as it still does not resemble meat texturally and sensorially. Other experiments

would be the addition of tempeh flour addition towards sausage analogs, which is reported to mimic the nutritional and textural properties of commercial meat sausages according to the regulation in Indonesia (Ambari *et al.*, 2014).

To the extent of the author's knowledge, there has been yet much research that covers the utilization of both TVP and tempeh in the development of plant-based nuggets. Therefore, the author tries to substitute and partially substitute TVPs in the formulations with tempeh. In this study, the effect of partial or full substitution of Hung TVP and ground TVP with tempeh towards nutritional value and the textural properties of plant-based nuggets will be analyzed.

## **1.2. Problem Formulation**

The problem formulations in this research would be:

1. Does the substitution and/or partial substitution of Hung TVP and ground TVP with tempeh in the formulation affect the nutritional value of the plant-based nugget?
2. Does the substitution and/or partial substitution of Hung TVP and ground TVP with tempeh in the formulation allow the nutritional and textural value to be similar to chicken nugget?

## **1.3. Objectives**

The objective of this research is to:

1. To analyze the effect of partial and/or full substitution of Hung TVP and ground TVP with tempeh on nutritional value and textural properties of plant-based nugget.
2. To compare the nutritional and textural properties of plant-based nuggets with the commercial chicken nugget.

#### 1.4. Hypothesis

**H<sub>0</sub>** = The combination of Hung TVP, ground TVP, and/or tempeh does not affect the nutritional (carbohydrate, fat, protein, ash, and moisture) content and textural (hardness) parameter compared to the negative control (plant-based nugget from control treatment).

**H<sub>1</sub>** = The combination of Hung TVP, ground TVP, and/or tempeh does affect the nutritional (carbohydrate, fat, protein, ash, and moisture) content and textural (hardness) parameter compared to the negative control (plant-based nugget from control treatment).

**H<sub>0</sub>** = The combination of Hung TVP, ground TVP, and/or tempeh does not affect the nutritional (carbohydrate, fat, protein, ash, and moisture) content and textural (hardness) parameter compared to the positive control (commercial chicken nugget).

**H<sub>1</sub>** = The combination of Hung TVP, ground TVP, and/or tempeh does affect the nutritional (carbohydrate, fat, protein, ash, and moisture) content and textural (hardness) parameter compared to the positive control (commercial chicken nugget).

#### 1.5. Scope of Research

The scope of research in this experiment are:

- Literature review of topics covering chicken nugget, tempeh, TVP, plant-based nugget, meat analog, and textural profile properties.
- Modifying the combinations of Hung TVP, ground TVP, and tempeh and their concentrations toward the plant-based nugget formulations.
- Nutritional analysis of each treatment by analyzing its carbohydrate, protein, fat, moisture, and ash content.
- Textural analysis of each treatment by analyzing the hardness parameter.

## **1.6. Importance of Research**

The importance of this research would be to improve the nutritional value of plant-based nuggets by substituting and/or partially substituting Hung TVP and ground TVP with tempeh. Textural properties are also assessed so that the hardness of plant-based nuggets with substitution and/or partial substitution of Hung TVP and ground TVP with tempeh can be comparable with the commercial chicken nuggets. This research could also widen the application of tempeh in other plant-based meat products.

## **1.7. Expected Outcome**

The expected outcomes from this study are as follows:

- There are significant differences on the effect of combination of Hung TVP, ground TVP, and/or tempeh towards the nutritional and textural properties when compared to negative control (plant-based nugget from control treatment).
- There are no significant differences on the effect of combination of Hung TVP, ground TVP, and/or tempeh towards the nutritional and textural properties when compared to positive control (commercial chicken nugget).