

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Meat has been considered as an essential part of a human's diet. It is an excellent energy source and nutrients, including protein and several micro-nutrients such as zinc, iron, and vitamin B12. At the global level, meat consumption is rising due to increased population growth and average individual incomes (FAO, 2018). However, the rise of meat consumption and its production process are often found to have several adverse effects, especially toward environmental sustainability (Godfray et al., 2018), as more land is required to be used to feed the animals. Livestock production is also a significant source of greenhouse gases (carbon dioxide, nitrous oxide, and methane) which contribute to global warming events (Gerber et al., 2013). Shreds of evidence showed that high consumption of red and processed meat also increases the risk of some types of chronic diseases (Forouzanfar et al., 2015), such as colorectal cancer (Bouvard et al., 2015).

Moreover, animal welfare became a severe problem as the well-being of animals cannot be neglected in some societies. The global challenge that is currently faced by food sector is to provide food with sufficient nutrition for the growing population without damaging the ecosystem. Concerns toward the environment, health, and animal welfare led to changes in eating behavior by developing meat substitutes (Nadathur et al., 2017). Besides providing more ethical, sustainable, and healthful alternative meat products, the development of meat substitution also aims to give the product meat-like properties, including texture, taste, and overall sensory experience (Sexton, 2016).

Chicken nugget is a popular dish or snack worldwide. Nugget made from chicken meat is the only nugget accepted compared to pork and beef which has not gained enough consumer acceptance. The demand for a healthier diet and various concerns led to the changes in chicken nugget formulation to use alternative meat ingredients. However, the utilization of new formulation to develop plant-based nugget (PBN) is complex as

the changes in the formulation will affect texture, flavor, and overall sensory attributes of the nugget (Grumbles, 2008). Plant-based nuggets available in the market are low in fat as defatted ingredients are primarily used in product making. The author's previous trials on PBN making showed that the overall texture of PBN was not juicy, less dense, and crumbly as the ingredients did not completely bind each other. Texture, tenderness, juiciness, flavor, and aroma are the essential quality parameters of a meat-based product influenced by the percentage of fat content (Kyriakopoulou et al., 2019). To produce plant-based meat products that could obtain equal consumer acceptance as meat-based products, the addition of fat is one of the approaches to improve the juiciness and mouthfeel. In addition, fats in meat products are reported to have an extensive role in reducing cooking loss, stabilizing meat emulsion, enhancing water holding capacity, and affecting structural and rheological properties (Hughes et al., 1997).

Unlike other meat analogues, studies regarding plant-based nuggets, mainly targeted to incorporate fat, are still extremely limited. For meat products, emulsified fats are usually used to prevent the separation and stabilize fat during cooking (Kyriakopoulou, 2021). The combination of solid fats extracted from the fruit and liquid fats has the potential to resemble animal fat (Sha and Xiong, 2020). Plant-based food manufacturers, such as Impossible Burger and Beyond Meat use a combination of these two different types of fats to achieve the appropriate fat balance in their products. For plant-based food products, oils and fats originated from canola, sunflower, rapeseed, palm, corn, and coconut are mostly used (Kyriakopoulou, 2021). Recently, fats derived from the cocoa plant were used to develop plant-based meat products to achieve a marbling-like appearance and give juicier flavor ("Our Ingredients - Beyond Meat", n.d.).

Thus, this study aimed to improve the quality characteristics of low-fat plant-based nuggets by incorporating emulsified fats consisting of two different types of lipids (solid and liquid) and to evaluate their effects on the physicochemical properties of the plant-based nugget.

## **1.2 Objective**

The objectives for this study were as follows:

1. To investigate the changes of physicochemical properties of plant-based nugget with addition of solid and liquid lipids mixture with various ratios in the form of emulsion.
2. To investigate the effect of solid and liquid lipids with various ratios on the emulsion properties.
3. To evaluate the correlation between emulsion and physicochemical properties of treated samples.
4. To compare the physicochemical properties of treated samples with commercial chicken nugget.

## **1.3 Hypotheses**

The hypotheses for this study were as follows:

- The physicochemical properties of the plant-based nugget prepared with emulsified solid and liquid fats will be significantly affected by the type of fats used.
- Various solid and liquid lipids ratios will affect emulsion properties.
- Emulsion and physicochemical properties of plant-based nugget are correlated due to the treatment applied.
- There will be significant difference in physicochemical properties between plant-based nugget with commercial chicken nugget

## **1.4 Research Scope of Work**

In this study, the combination of fats in the emulsion form was incorporated into PBN samples. The processes include formulation of PBN recipe, PBN development, physicochemical analysis, and statistical analysis. Emulsion stability and water-absorbing capacity (WAC) of the emulsion were measured. After the samples were cooked, physicochemical properties of the samples such as cooking loss, moisture content,

texture profile were investigated. Statistical analysis was conducted using IBM SPSS Statistics 25.0 to ensure the validity of the results.

### **1.5 Research Significance**

The findings of this study will contribute to the improvement of plant-based nugget formula since the study on plant-based nuggets is still limited. Moreover, the potential PBN formulation could be used for preliminary reference in the future study of plant-based food development.