CHAPTER I
INTRODUCTION

1.1 Background

In 2020, the consumption of butchered chicken in households in Indonesia reached 6.049 kg per capita and is predicted to rise further by the end of 2021 (BPS, 2021[a]). Due to the high consumption of chickens in Indonesia, chicken bones are produced as by-products and are underutilized as a food waste. The utilization of chicken bones has been limited to its usage as a fertilizer, broth, and pet food. Previous research has utilized chicken bone flour as a source of calcium in the making of cookies (Cornelia and Gozali, 2018), snack (Arinahatien, 2005), cheese sticks (Okfrianti *et al*., 2011), soy tofu (Novidahlia *et al*., 2010), and dry noodles (Agustin *et al.*, 2003). Chicken bones itself contains 69% calcium phosphate content, 21% collagen, 9% water, and 1% other components (First *et al*., 2019), thus its high calcium content makes it a potential alternative and natural calcium source. According to Sittikulwitit *et al.* (2004), calcium content is typically supplemented with calcium carbonate, tricalcium phosphate, calcium lactate, calcium citrate and calcium lactogluconate. Thus, instead of these calcium fortificants, chicken bones can be utilized as a natural source of calcium in the form of flour or powder.

Calcium is an important mineral that contributes towards the development of bones during adolescence, the retention of bone mass in older adults (Balk *et al*., 2017), and maintenance of bones and teeth health (Bardosono *et al*., 2020). Calcium

is also important as a metabolic component in biochemical and physiological processes such as for blood coagulation and hormone secretion (Sittikulwitit *et al.*, 2004). Nevertheless, calcium deficiency is still a major issue worldwide. Calcium deficiency can lead to rickets and osteomalacia amongst children, pre-eclampsia during pregnancy, as well as osteoporosis and bone fractures amongst elderly (Bardosono *et al*., 2020). A review of several studies reported that Indonesian people have calcium intake of about 254 mg/day (Bardosono *et al*., 2020) or less than 400 mg/day, which is considered as very low calcium intake (Balk *et al*., 2017). Meanwhile, according to Menteri Kesehatan Republik Indonesia (2019), the daily required intake (DRI) for calcium for adolescence aged 10-18 years old and older adults aged 50 years old and above were 1200 mg/day, whilst adults aged 19-49 years old were 1000 mg/day. The low calcium intake in Indonesia can be attributed to the low intake of calcium rich foods in people's diet.

In the recent years, snack bars have swiftly become a quick, ready to consume alternative to various snacks and meals (Constantin and Istrali, 2016). In the USA, food or snack bars have become a 20.15 billion dollars industry in 2018 and is expected to grow further by 2025 (Grand View Research, 2021). In Indonesia, the snack bar market is predicted to reach 5.88 million dollars and grow by 7.3% by 2023 (MarketWatch, 2022). The popularity of snack bars can be attributed to its convenience and nutrition, as well as the rising awareness of healthier lifestyle to eating healthier, more natural, and safe foods (Pinto *et al*., 2019). Snack bars also have a long shelf-life due to its low water activity and moisture content, thus making snack bars a nutritious, portable, and long-lasting snack (Mahendradatta *et al*., 2020).

Currently, snack bars are produced using wheat flour or soy flour (Constantin and Istrali, 2016), which are imported commodities (Frediansyah, 2018). The usage of local commodity such as mocaf flour, instead of soy or wheat flour in the making of snack bar has potential to become a more sustainable alternative or substitute in baked goods (Pontang and Wening, 2021). Mocaf flour can also be used in 50 to 100% substitution to wheat flour (Handayani, 2018) and can reduce cost of flour consumption to 20-30% (Maharani *et al*., 2021).

1.2 Research Problem

Calcium deficiency is a big problem worldwide, especially in Indonesia with about 96.63% adolescence aged 13-18 years old (Anwar *et al*., 2018) and 54.2% of adults aged 19-49 years old were suffering from calcium deficiency (Elnovriza *et al*., 2019). Similarly, about 41.8% of Indonesian men and 90% of Indonesian women were osteopenic or have lowered bone mineral density, according to PEROSI (Indonesia Osteoporosis Society) (Bardosono *et al*., 2020). The daily required intake (DRI) for calcium for adolescence aged 10-18 years old and older adults aged 50 years old and above were 1200 mg/day for both male and female, whilst adults aged 19-49 years old were 1000 mg/day (Menteri Kesehatan Republik Indonesia, 2019). Calcium is especially important for adolescence as it is necessary for bone growth. Whereas in adults, calcium deficiency can lead to reduced bone density as one ages, thus causing osteoporosis and pre-eclampsia, especially in pregnant women (Bardosono *et al*., 2020).

The high consumption of broiler and native chicken in Indonesia has led to massive amounts of by-products and waste in the form of chicken bones

(Sittikulwitit *et al*., 2004). The chicken bones can be utilized as a source of calcium in the form of flour to create snack bars. Previous research has utilized chicken bone flour as a source of calcium in cookies (Cornelia and Gozali, 2018), snack (Arinahatien, 2005), cheese sticks (Okfrianti *et al*., 2011), soy tofu (Novidahlia *et al*., 2010), and dry noodles (Agustin *et al.,* 2003). In particular, the research by Cornelia and Gozali (2018) demonstrated that the usage of chicken bone flour in cookies increased the calcium content of cookies up to 464 mg calcium/100g cookies. However, it produced a rancid aroma, foreign taste and less crunchy texture. Hence, in this study, defatting and deproteinization treatment was done to reduce fat content, rancidity and protein content, as well as to increase calcium content in chicken bone flour.

Snack bars are popular and ready to consume foods that can be seen as alternatives to meals or various less healthier snacks (Pinto *et al*., 2019). In the current market, the production of snack bar still relies on wheat and soy flour. Therefore, mocaf flour can be used as an alternative to wheat and soy flour (Constantin and Istrali, 2016) in terms of cost and dependence on imported goods (Frediansyah, 2018). In 2021, according to BPS (2021)[b] and BPS (2021)[c], Indonesia imported 3.45 million dollars and 2.49 million dollars of wheat and soy, respectively. This exhibit that there is still dependence on imported goods. Mocaf itself is a local commodity and have been utilized as an alternative or substitute to wheat flour at 50-100% due to its similar physical characteristics (Handayani, 2018).

Baking is one of the processes in snack bar processing, whereby varying baking conditions, such as its baking time and temperature may be applied. According to Ekantari *et al.* (2016), high baking temperature and longer duration of baking

time may reduce calcium content. Therefore, this research aims to substitute mocaf flour with chicken bone flour in the production of gluten free snack bar by utilizing different ratio of mocaf flour to chicken bone flour, and different baking conditions. Gluten free snack bars with an adequate calcium content may help reduce the prevalence of calcium deficiency in Indonesia in adolescence and adults.

1.3 Objective

1.3.1 General Objectives

The general objective of the research was to utilize chicken bone flour and different baking conditions in the production of gluten free snack bar.

1.3.2 Specific Objectives

The specific objectives of the research were:

1. To determine the effect of different drying time on the moisture, protein, fat, and calcium content of chicken bone flour produced.
2. To determine the effect of ratio of mocaf flour:chicken bone flour and baking conditions on the calcium content, texture, and organoleptic properties of gluten free snack bar.