Chapter 1

Introduction

1.1 Background

All across the world, bread is a popular and common choice of carbohydrate source and it is a staple food in many countries for its convenience and ease. Even in Indonesia where bread is not traditional, the consumption of bread per capita reached a total of 72.223 pieces where sweet breads and other breads experienced a small growth of 2.36% from 2018 to 2023 as seen in the 2023 statistics report by the Secretary General of the Indonesian Ministry of Agriculture. The bread can be eaten in different ways, on its own, savory with a meal, or sweet with some toppings (Pratama et al., 2024; Upayanti et al., 2024). Typically bread is made with wheat flour as a base which can produce gluten molecules such as gliadins and glutenin that give bread the viscoelastic texture it needs to trap air and create a high loaf volume (Cappelli et al., 2020).

This gluten structure is crucial to the production of wheat-based bread, however, a portion of the population in the world has an immune system that will be triggered if gluten proteins are present in the stomach, leading to dietary restrictions (Caio et al., 2019). Those people contain an array of Gluten-related diseases, one of which is known as celiac disease which is lifelong and worldwide with 1.4% of the population suffering from this disease. To accommodate these dietary restrictions, it is a priority to broaden options and improve gluten-free products to not trigger any unwanted reactions and fulfil their dietary requirements (Jnawali et al., 2016). It must be noted that gluten-free products tend to lack certain beneficial nutrients such as fiber would be typically found in gluten-containing whole grains as well as increased malabsorption of nutrients by the body due to the disease damaging the intestinal lining (Lebwhol et al., 2017; Al-Toma et al., 2019). These previous conditions should be taken into account in the formulation of gluten-free breads and will usually be accommodated with the supplementation of fiber and protein for tissue repair in the colon (Rubio-Tapia et al., 2022; MedlinePlus, 2019).

In the current market, gluten-free bread production faces significant hurdles because the ingredients used to replace gluten often cannot replicate the functionality of wheat gluten (Mir et al., 2021). This results in difficulties in achieving an elastic crumb, appropriate structure, and volume. Additionally, gluten-free doughs are less cohesive and require different technological solutions compared to wheat-based doughs, resulting in the lack of the characteristics of a normal wheat bread such as flavor and texture (Chiş et al., 2020). They often behave more like batters due to the absence of a gluten network, affecting gas retention during proofing and baking. The result is a dense bread that is incapable of expanding and holding onto the air (Hosseini et al., 2018). The rising demand for gluten-free products has spurred the exploration of alternative flours to replace wheat in bread making as current options have been lacking in organoleptic properties (Capriles et al., 2023).

One of the possible options that may be viable as a wheat flour substitute is modified cassava flour, also known as MOCAF (Putri et al., 2023). MOCAF is created by modifying cassava cells through fermentation, a process that improves its functional properties, resulting in enhanced viscosity, gelation, rehydration, and dissolving capabilities relative to native cassava flour (Andiani et al., 2023). Those characteristics bring many benefits to a MOCAF-based bread, improving its structure, giving it a soft crumb, and improving loaf volume while also extending its storage stability by delaying drying and stalling and can be mainly attributed to the cassava starches (Qi et al., 2021; Tatiana et al., 2021). However, MOCAF still has its limitations when used as the sole flour in bread production. Wheat flour contains gluten, which gives dough its elasticity and allows it to expand (Widanti et al., 2021). Unlike wheat flour, MOCAF lacks gluten, which can reduce the specific volume and affect the dough rheology affecting its final texture, flavor, and other properties (Hastati et al., 2024).

To further expand the range of Gluten-Free Bread, the addition of Okara flour, a byproduct of soymilk production, may be added. In the production of soymilk, soybeans are blended with water, and the liquid is extracted and leaves behind a residue known as Okara (Adebowale & Ajibole, 2024). This residue can be dried and ground to form a flour with fine particles, a light beige color, rich in fiber, up to 59%, and protein of up to 26.5% (Davy et al., 2022; Cao et al., 2024; Suzuki & Banna, 2020). When added to bread, okara can enhance both the nutritional value of Gluten-Free Bread as well as the physical characteristics and sensory properties thanks to the presence of proteins (Skendi et al., 2021; Zioboro et al., 2015). This fiber can help to improve the diet of celiac patients who usually lack fiber intake due the low consumption of whole grains (Caeiro et al., 2022). Okara is also rich in proteins that improve the nutritional density of the bread but also contains a specific protein which is 7S (β-conglycinin) and 11S (glycinin) globulin that can form networks that allow for gas entrapment and dough elasticity (Espinoza-Herrera et al., 2021).

Although there have been studies that have looked into rice flour and MOCAF utilization in bread individually, there has yet to be a study that attempts this with okara and bread, on its own or combined with other flours. With the introduction of a new formulation containing a novel ingredient, its physical properties, chemical properties, proximate composition, and storage stability among other characteristics need to be explored. Thus, this study would like to address a gap in the literature by investigating the effects of okara flour on gluten-free bread made with not only rice flour but also MOCAF (Modified Cassava Flour) with okara substitutions of 10%, 15%, and 20%. Furthermore, the bread will be analyzed for its proximate composition and storage stability to observe how the product will compare to regular wheat flour-based bread. A high-quality gluten-free bread should closely mimic the physical properties of wheat bread, with a soft, elastic crumb and a cohesive structure. The analyses will determine how okara addition will affect the proximate composition and physical conditions of the bread over time, observing the effects on its physical characteristics. The combination of different flours may also lead to interactions that affect the final product in terms of proximate composition or physical properties so this study will be able to observe the changes and confirm what happens to the bread.

1.2 Objective

This study aims to determine the effects of different levels of Okara substitution on the approximate composition and storage stability of a Gluten-Free Bread made from MOCAF flour and rice flour.

1.3 Hypothesis

The null hypothesis or H_0 of this research experiment is there is no significant difference in protein content, fat content, carbohydrate content, and storage stability in gluten-free bread formulated with okara and MOCAF flour. On the other hand, the alternative hypothesis is that there will be a significant difference in the protein content, fat content, carbohydrate content, and storage stability in gluten-free bread formulated with okara and MOCAF flour.