Chapter 1

Introduction

1.1 Background

Bread is widely consumed as a convenient snack and an important source of carbohydrates. Most bread products are made from wheat flour, which contains gluten proteins that are essential for developing desirable dough structure and texture. The USDA Foreign Agricultural Service forecast a 4.3% year on year growth in Indonesian food wheat consumption for 2025/2026 (Meylinah, 2026). Moreover, there is also an increasing consumer health awareness and demand for healthier food choices which are driving the growth of the gluten free (GF) market in Indonesia. Also, the research done by Amareta et al. (2026) stated that 65% of surveyed Indonesian consumers express a direct willingness to purchase GF products despite premium pricing over conventional baked goods due to its benefits and wellness curiosity.

The gluten free bread (GFB) and confectionery segment have been identified as the largest contributor to the GF food market with projections that indicate the highest growth potential compared to other GF food categories (Masih & Sharma, 2016). However, GFB has become one of the most challenging types of food product to be formulated due to the absence of gluten which results in inelastic and incohesive dough (Bender & Schönlechner, 2020). Consequently, GFB often results in lacking rheological properties, weak crumb and crust structure, and low sensory acceptability which limit consumer appeal (Naqash et al., 2017).

Foxtail millet has gained more attention as a promising beneficial ingredient for human health and as an additional nutritious ingredient for foods, nutraceutical, and other innovative applications. Moreover, it potentially becomes an alternative GF ingredient due to the presence of bioactive compounds, low glycemic index, high dietary fiber content, and essential amino acid content (Asrani

et al., 2023; Sachdev et al., 2021). Those nutritional attributes show the potential of foxtail millet to be utilized as GF flour to develop a GFB. Other than the nutritional properties, it also has high oil and water absorption capacity which can help to improve the flavor, fat content, and reduce the dryness of GFB (Abedin et al., 2022). Foxtail millet flour also shows a good swelling capacity and hydration behavior which supports structure formation in GF products (Borah et al., 2026). However, the absence of gluten in GFB of foxtail millet flour resulted in significant technological challenges to completely mimic the viscoelastic properties of gluten (Sarabhai et al., 2021).

The quality of GF products can be improved through the incorporation of hydrocolloids, starches, emulsifiers, non-gluten proteins, or their combinations. Hydrocolloids are widely used for the formulations of GFB to enhance the texture, increase moisture retention, improve dough development and the overall quality of the GFB (Mir et al., 2016; Sarabhai et al., 2021). Among all of the hydrocolloids, Hydroxypropyl Methylcellulose (HPMC) and Xanthan gum (XG) have been widely reported by Fetriyuna et al. (2026) as one of the most commonly used hydrocolloids for GF bread due to their ability to improve the bread quality. Those hydrocolloids consistently produce a GFB with a greater bread specific volume (BSV), softer structure of the crumb, and higher sensorial acceptability compared to other hydrocolloids.

Foxtail millet is a promising ingredient for developing GFB and the incorporation with hydrocolloids such as HPMC and XG has shown its potential to improve the quality of the bread. However, most studies have evaluated foxtail millet flour or hydrocolloids separately, while information regarding the comparative effects of HPMC and XG at different concentrations on the physicochemical and sensory properties of foxtail millet based GFB remains limited. To address the research gaps, this study investigates how different hydrocolloids such as HPMC and XG under different concentrations influence the physicochemical and sensorial properties of foxtail millet based GFB.

1.2 Objective

The purpose of this study is to evaluate the effect of HPMC and XG in two concentrations (1% and 2%) towards the physicochemical properties and sensorial properties of foxtail millet based GFB

1.3 Hypothesis

H_0: HPMC and XG with different concentration not significantly affect the physicochemical properties and sensorial attributes of foxtail millet based GFB

H_1: HPMC and XG with different concentration significantly affect the physicochemical properties and sensorial attributes of foxtail millet based GFB