Chapter 1:

Introduction

1.1 Background

The bread and bakery industry in Indonesia revenue was US$ 4,254 million in 2019 which US$ 1,829 million (43% of bread and bakery market) comes from pastry and cakes (Statista, 2019). The bread and bakery industry is expected to grow by 5.6% annually from 2020-2023 (Statista, 2019). The Indonesian cake industry includes *bolu kukus* (BK) which is a traditional Indonesian steamed cake which is usually consumed as breakfast.

BK is normally made of wheat flour and recognized for its vibrant colours, bowl shape, moist, sweet, and soft texture (Anggraini, M., et al., 2014). BK shares similarities in ingredients and process with sponge cakes and Chinese steamed cakes/buns. BK undergoes steaming for its cooking process unlike sponge cakes which undergo baking. Furthermore, in BK, the egg and sugar are beaten prior to addition of the rest of the ingredients to allow incorporation of air into the batter for initial leavening. In comparison to Chinese steamed cakes/buns, BK batter does not use yeast and therefore does not undergo the fermentation process.

Current studies on BK are limited to partial substitution of wheat flour with banana flour, sweet potato flour, and squash flour (Ramadhani, Z. O., et al., 2019), (Noer, S. W. M., et al., 2017), (Anggraini, M., et al., 2014). There is no research regarding the shelf life specifically on BK. The shelf life of existing commercial BK claims to reach a maximum of 4 days without any scientific support. According to Axel, C., et al. (2017), spoilage of bakery products are usually caused by microbial spoilage. Main microbial growth observed in bakery products are from molds from the post-baking/post-steaming processes. Airborne mold from the atmosphere can contaminate the surfaces of equipment or packaging or directly contaminate the bakery product's surfaces (Galić, K., et al., 2009). A chinese steamed bun called MiGao observed post-process contamination of mold spores from

the atmosphere which are unavoidable during its production (Ji, Y., et al., 2007). Main molds observed in MiGao are of *Penicillium*, *Aspergillus*, *Cladosporium*, and *Eurotium* species (Ji, Y., et al., 2007). These spoilage molds are also observed in baked bread which causes 1-5% in product losses (Saranaj, P. & Geetha, M., 2011). Therefore, commercial BK will be analyzed in this study to determine the mold contamination in BK produced in a factory environment.

Mold growth in bakery products can be controlled by reducing pH, water activity (a_w), and/or adding antimicrobials (Axel, C., et al., 2017). The use of weak organic acids such as propionic, benzoic, and sorbic acids have been the center of attention of inhibiting mold growth in the bakery industry due to their natural source or origin (Degirmencioglu, N., et al., 2010). However, additions of such ingredients alter the product characteristics and for its effects to be effective, requires additional hurdles (Lombard, G., 2000). Mold inhibitors are more effective in inhibiting mold growth compared to organic acid due to their antimicrobial action. Antimicrobials disrupt the cell membrane or cellular process which results in inhibition of growth (Albers-Nelson, R., n.d.). The effects of mold inhibitors such as potassium sorbate (PS), sodium benzoate, and calcium propionate have been studied on bread (Degirmencioglu, N., et al., 2010), (Katsinis, G., et al., 2008), (Hongqin, H., et al., 2012).

Sodium benzoate is well known for its powerful antimicrobial activity in foods; however, it is not considered as a preservative for baked goods (includes steamed bread and cake) by *Badan Pengawas Obat dan Makanan* (BPOM) (BPOM, 2019). Antimicrobials such as natamycin are of natural sources but chemical preservatives such as benzoates and sorbates are more effective in inhibiting mold growth (Albers-Nelson, R., n.d.), (Chuan, X., et al., 2006). According to Katsinis, G., et al. (2008), PS was observed to extend the shelf life by 173% while calcium propionate by 141% on the same concentration (0.1-0.3% flour weight). Therefore, PS was selected as mold inhibitor for BK due to its better effect and regulation fulfilment.

1.2 Research Objective

The objective of this study was to observe the effects of PS on extending the shelf life of BK by inhibiting mold growth over 9 days. Furthermore, company BK was also analyzed to determine the viability of utilizing PS on extending the microbial shelf life of BK up to 9 days in a factory environment. The outcome of this research will provide information on the viability of 0.1% (w/w) PS as a mold inhibitor to extend the shelf life on BK up to 9 days.

1.3 Problem Formulation

Based on the research background, the problem can be formulated to:

- What is the level of yeast and mold contamination of BK in a 9-day storage duration?
- What is the maximum microbial shelf life of BK made in the factory and lab environment?
- What is the effect of PS treatment on the microbial shelf life of BK in a 9-day storage duration?

To measure the yeast and mold contamination in BK, total yeast and mold count (TYMC) tests were conducted based on FDA laboratory methods (food), Bacteriological Analytical Manual Chapter 18 Yeasts, Molds and Mycotoxins, April 2001. TYMC tests were conducted over 9 days to determine yeast and mold growth. Maximum microbial shelf life was achieved when surface mold growth was observed on the BK samples or the TYMC exceeds the SNI 7998-2009 standards of $1x10^4$ CFU/g, whichever comes first. In effort to extend the shelf life of BK, 0.1% PS (w/w) was utilized to inhibit the mold growth problem. The concentration chosen was based on the desired effectiveness in literature of similar products (bakery products) and maximum permitted limit by BPOM.

1.4 Scope of Study

This study's field of research is food preservation focusing on extending the shelf life of BK by adding food preservative (mold inhibitor). The research is limited to (1) the standard production process and formulation of BK by **company A**, (2) shelf life testing was conducted for 9 days, (3) only TYMC test was conducted in the shelf life testing, (4) parameters such as pH, a_w, texture, colour, and

sensorial properties were not analyzed in this study, (5) mold inhibitor used was only PS, (6) single PS concentration was used, 0.1% (w/w) and the concentration was determined by existing literature of bakery products and maximum permitted limit by BPOM.