Chapter 1

Introduction

1.1 Background

Kombucha is a functional beverage traditionally made from sweetened black tea that undergoes fermentation (Coelho et al., 2020). This fermentation process is facilitated by a symbiotic culture of bacteria and yeasts (SCOBY), which forms a gelatinous biofilm on the tea's surface during fermentation (Kim & Adhikari, 2020). The yeasts in SCOBY break down sugars to produce ethanol, which is further converted into organic acids by acetic acid bacteria. These organic acids, along with polyphenols, vitamins, and other bioactive compounds, contribute to kombucha's distinctive taste and potential health benefits (Laavanya et al., 2021). The composition of SCOBY varies depending on fermentation conditions, tea type, and microbial strains, influencing the final product's sensory and functional properties (Zailani & Adnan, 2022).

Due to its rich bioactive profile, kombucha has been widely recognized for its health-promoting properties. It contains organic acids such as acetic acid, glucuronic acid, and gluconic acid, which exhibit detoxifying and antimicrobial activities (Chou et al., 2024). Additionally, the bioactive compounds in kombucha that play an antioxidant role are primarily organic acids and polyphenols (Su et al., 2023). Phenolic compounds are typically responsible for antioxidant properties, which may contribute to mitigating oxidative stress and enhancing immune function. Kombucha also has probiotic potential since it has been significantly associated with gastrointestinal and liver effects which may affect the composition and function of the intestinal microbiome (Batista et al., 2022). Therefore, these health benefits have led to kombucha's growing popularity as a functional beverage, prompting ongoing research into improving its stability, bioactive retention, and applications in various food products.

Furthermore, although kombucha can be stored for 6 to 8 months, the fermentation process remains challenging to control (Murphy et al., 2018). The quality of liquid kombucha will begin to decrease as it ferments further, particularly in terms of its acidity, carbonation, and alcohol level. According to La Torre et al. (2021), in kombucha preservation, the beverage's phenolic content and radical-scavenging capabilities decrease over time. After 30 days of fermentation, the acetic acid bacteria and tea fungus yeasts' metabolic activity caused the pH values of black tea in kombucha to decrease. At the sixth month, the pH increases, most likely as a result of bacteria using acids as a carbon source (de Miranda et al., 2022). The study also showed that kombucha kept at refrigerator temperature could only be kept for four months at most.

The food industry is increasingly interested in high-tech food materials and focusing on bioactive ingredients like probiotics, prebiotics, omega-3-fatty acids, carotenoids, phenolic compounds, essential minerals, proteins, and extracts from herbs and spices (Piñón-Balderrama et al., 2020). Microencapsulation is a technique that encapsulates solid, gaseous, or liquid substances in a polymeric matrix or another substance, allowing for modified release (Cosa et al., 2015). It protects the substance from environmental conditions, stabilizes sensitive substances, eliminates incompatibilities, manages toxic substances safely, and develops dosages with modified release. Microencapsulation is usually used in spray drying methods. Maltodextrin is one of the carrier agents, or microencapsulation agents, that are employed to improve resistance to oxidation, controlled release, extended shelf life, and improved solubility properties (Xiao et al., 2022).

Recently, kombucha has also gained recognition for its innovative development into instant powder through spray drying technology (Rahman et al., 2024). Since spray drying technology offers several advantages, including its ability to stabilize the alcohol content, extend shelf life, and produce a fine, easily soluble powder suitable for various applications. Spray-drying is also highly efficient, allowing for large-scale production with relatively low processing costs while preserving key sensory

characteristics such as flavor and aroma (Mohammed et al., 2020). Additionally, the encapsulation of bioactive molecules during spray drying safeguards sensitive components, including polyphenols and organic acids, against degradation due to heat, light, and oxygen exposure (Zabot et al., 2022).

However, a significant challenge in this process is the spray drying technique may cause bioactive compound degradation due to elevated inlet temperatures, potentially leading to the loss of additional heat-sensitive bioactive components and adversely impacting the overall bioactive profile of the kombucha powder (Mohsin et al., 2022). The elevated intake temperatures employed in spray drying may lead to the degradation of heat-sensitive components, hence diminishing the overall antioxidant capacity and probiotic viability of the resultant powdered product (Van et al., 2024). Thus, to address this issue, the proposed research aims to develop a stable spray-dried kombucha powder by first fermenting the kombucha and then subjecting it to spray-drying to produce a stable powdered product. This study will focus on maltodextrin as the encapsulation agent, evaluating its role in preserving the functional and physicochemical qualities of the powder. By carefully controlling fermentation conditions and optimizing the encapsulation process, it may be possible to enhance beneficial metabolite levels that contribute to kombucha's functional properties.

1.2 Objective

- Evaluate/investigate the effect of different maltodextrin concentrations on the physicochemical properties of the spray-dried kombucha.

1.3 Hypothesis

Null hypothesis (H_o): different concentration of maltodetxrin does not significantly affect on the physicochemical characteristics, antioxidant activity, and functional components of kombucha.

Alternative hypothesis (H_1): different concentration of maltodextrin has a significant impact on the physicochemical characteristics, antioxidant activity, and functional components of kombucha in comparison to its liquid form.