Chapter 1

Introduction

This chapter provides some general information about the research project. The background, main objectives, and hypotheses of the study are explained throughout this section.

1.1 Background

Sugarcane juice is a popular beverage product made from the extraction process of fresh sugarcane plants (Arif et al., 2019). Based on data published by Mishra et al. (2022), the sugarcane juice market had experienced significant growth, with the market predicted to increase from USD 142.94 million in 2021 to USD 291.01 million in 2030. Sugarcane juice is also categorized as a sweet beverage due to its high sucrose content, which accounts for 15% of the total sugarcane juice volume (Chauhan et al., 2017). Recently, the trend of sugar consumption has become a concern for many health practitioners (Rippe and Angelopoulos, 2016). According to Ma et al. (2022), consuming a high intake of sucrose in the long term could trigger various chronic diseases including diabetes, obesity, and heart diseases. Thus, it is important to decrease the sucrose content, especially in the sugarcane juice to prevent these diseases and to maintain a healthy blood sugar condition (Stanhope, 2015).

Enzymatic treatment is believed to be used as an alternative solution to decrease the sucrose concentration by converting sucrose into FOS through transfructosylation reaction with the help of fructosyltransferase enzyme such as Pectinex® Ultra SP-L (Cywińska-Antonik et al., 2023). Based on Liu et al. (2017), FOS is regarded as a potential prebiotic that may stimulate the growth of beneficial bacteria in the human gut. Furthermore, FOS could also reduce the calorie value by up to 50% and has a sweetness intensity of 30% compared to sucrose (Cao et al., 2022). Hence, the development of FOS-rich sugarcane juice could provide beneficial effects for human health. Nonetheless, the optimization of enzymatic treatment to generate FOS is also influenced by some factors such as enzyme dosage, time, and temperature (Sánchez-Martínez et al., 2020).

Besides containing high sucrose levels, sugarcane juice is also susceptible to microbial contamination due to its high moisture content, which may lower the shelf life and degrade the nutritional value of the juice (Geremias-Andrade et al., 2019). As a consequence, thermal processing technologies are normally used to extend the shelf life of the product by killing the potential spoilage microorganisms (Murjani et al., 2023). However, this thermal processing may negatively affect the nutritional compounds, physicochemical properties, and sensorial properties of the juice (Santhirasegaram et al., 2015). Therefore, processing FOS-rich sugarcane juice with non-thermal processing like HPP could be done as a promising option to preserve the quality such as maintaining FOS content as well as enhance the microbial safety of sugarcane juice by applying high hydrostatic pressure (100 - 600 MPa) to disturb the membrane and inactivate several microorganisms including yeast, mold, and bacteria (Huang et al., 2015). According to Sehrawat et al. (2020), other than high pressure, holding time is also another important factor in HPP treatment that plays an important role in improving the efficiency of microbial inactivation to produce a safer end product. HPP holding time may vary from a few seconds to several minutes depending on the type of the product (Silva & Evelyn, 2023).

Some previous studies have been done to develop FOS-rich beverages through an enzymatic method. However, none of them have specifically focused on producing FOS-rich product in sugarcane juice and further processing it with HPP. Thus, this project aims to develop FOS-rich sugarcane juice using an optimal enzymatic processing condition, where the development of this product could potentially provide a healthier prebiotic product option for humans. Following that, this research is also carried out to evaluate the effects of HPP in improving the safety and retaining the quality of FOS-rich sugarcane juice.

1.2 Objective

The objectives of this research are:

Enzymatic treatment:

1. To optimize the enzymatic treatment conditions by varying enzyme concentrations, incubation time, and incubation temperature to produce the highest reducing sugar in sugarcane juice
2. To evaluate the effect of optimal enzymatic treatment conditions on sugar content before and after treatment.

HPP Treatment:

1. To investigate the impact of HPP holding times on microbial inactivation of FOS-rich sugarcane juice
2. To examine the impacts of optimal HPP treatment on microbial safety, physicochemical properties, sugar content, total phenolic content (TPC), and antioxidant activity of FOS-rich sugarcane juice by comparing it with untreated and pasteurized sugarcane juices.

1.3 Hypotheses

The hypotheses of the research are divided into two main parts, which are enzymatic treatment and HPP treatment. For the first part, it is hypothesized that enzymatic treatment with optimal conditions (appropriate enzyme concentration, incubation time, and incubation temperature) could significantly produce high FOS content in sugarcane juice by increasing the concentration of reducing sugar as well as altering the sugar content before and after enzymatic treatment. For the second part, it is hypothesized that holding times will significantly influence the microbial inactivation of the sugarcane juice. In addition, it is also hypothesized that optimal HPP treatment will significantly affect the microbial content, sugar content, physicochemical properties, TPC, and antioxidant activity of FOS-rich sugarcane juice compared to untreated and pasteurized sugarcane juice.