Chapter 1

Introduction

1.1 Background

Synbiotics, a combination of prebiotics and probiotics, have gained considerable attention as a promising approach to improve gut microbiota balance, enhance nutrient absorption, and modulate the gut-brain axis (Markowiak & Śliżewska, 2017). These products exert beneficial effects on the host by promoting the survival and colonization of live microorganisms in the gastrointestinal tract. This is primarily achieved through the selective stimulation of the growth and metabolic activity of health-promoting bacteria (Pandey et al., 2015). The term “synbiotic” implies synergism, and as such, it refers to products where the prebiotic component specifically improves the growth and activity of the probiotic microorganisms (Mohanty et al., 2018).

In synbiotic food product development, certain naturally complementary food combinations, such as oat with yogurt, leeks with miso soup, and rice with kimchi, are often consumed together to achieve synergistic interactions between prebiotics and probiotics. For instance, Li et al. (2020) demonstrated improved probiotic viability in a yogurt product when supplemented with lactitol, with enhanced survival under simulated gastrointestinal conditions. Clinical research has also highlighted the potential of synbiotics in managing various health conditions, including obesity, insulin resistance syndrome, type 2 diabetes, gastrointestinal disorders, and non-alcoholic fatty liver diseases (Kim et al., 2018). However, the preparation of conventional synbiotic food products often requires time and effort, making them less suitable for individuals with fast-paced lifestyles. To address this issue, synbiotic products in powdered form offer a more convenient alternative. Powdered formulations provide extended shelf life, easier storage and transport, and greater user convenience, thus improving product accessibility (Chen et al., 2023).

Given the promising health benefits of synbiotics, the selection of an optimal prebiotic source is essential to ensure maximum efficacy. Prebiotics are responsible for selectively stimulating beneficial gut microbiota, thereby enhancing digestive health (Ruiz-Mirazo et al., 2014). These compounds are non-digestible by human enzymes, allowing them to reach the colon intact, where they serve as fermentable substrates for probiotics (Roberfroid et al., 2010). Common prebiotic sources include high-fiber foods such as fruits, vegetables, and tubers. However, tubers remain underutilized in functional food development despite their high fiber content. Among them, jicama (*Pachyrhizus erosus*), a widely cultivated tuberous legume with high carbohydrate content and a mild, sweet taste, stands out as a particularly promising potential (Cajas & Mariño, 2021). Despite its abundant availability, jicama remains underutilized in the functional food sector, even though it is a natural source of inulin, a well-known prebiotic (Subhakti et al., 2021). In addition to its prebiotic potential, jicama is low in fat and calories and is rich in micronutrients like vitamin C (Bhanja et al., 2023).

While the prebiotic component is essential in a synbiotic formulation, equal consideration must be given to the selection of an appropriate probiotic strain. Probiotics are defined as live microorganisms that confer health benefits to the host when administered in adequate amounts (Yousefi et al., 2019). Given that inulin selectively promotes the growth of *Lactobacillus* and *Bifidobacterium* species, the inclusion of a strain from one of those is ideal. In this study, *Lactobacillus acidophilus* was selected due to its well-documented probiotic potential and widespread application in functional food products. *L. acidophilus* demonstrates strong acid tolerance and the ability to adhere to intestinal epithelial cells, supporting effective colonization. Its presence supports the maintenance of a healthy microbiota by suppressing pathogenic bacteria, enhancing the production of bacteriocins (antimicrobial substances), and modulating the host's immune system (Kos et al., 2003; Gao et al., 2022). To preserve the viability of the probiotic strain, the use of protective carriers such as skim milk is essential. Skim milk serves not only as a nutritive medium that provides lactose to support bacterial growth but also functions as a protective matrix during processing (Oliveira et al., 2011). With these

considerations, this study aimed to develop a synbiotic powdered drink through the combination of jicama and *L*. *acidophilus*. To ensure the product's functionality, the chemical characteristics and prebiotic potential of jicama were analyzed, and the physicochemical and microbiological properties of the final product were evaluated.

1.2 Objective

This study aims to:

1. Evaluate the difference between the chemical characteristics of raw and processed jicama.
2. Evaluate the impact of the prebiotic potential of jicama on the growth of *L*. *acidophilus*.
3. Evaluate the impact of increasing skim milk concentrations on the probiotics' viability.
4. Evaluate the impact of increasing skim milk concentrations on the physical properties of the final synbiotic product.

1.3 Hypothesis

Corresponding to the previous objectives, the study has three separate sets of hypotheses:

- H_0.1: There is no significant difference between raw and processed jicama.
- H_1.1: There is a significant difference between raw and processed jicama.
- H_0.2: The prebiotic properties of jicama do not significantly affect the growth of *L*. *acidophilus*.
- H_1.2: The prebiotic properties of jicama significantly affect the growth of *L*. *acidophilus*.
- H_0.3: Increasing skim milk concentrations does not significantly affect the probiotics' viability.
- H_1.3: Increasing skim milk concentrations significantly affect the probiotics' viability.
- H_0.4: Increasing skim milk concentrations does not significantly affect the physical properties of the final synbiotic product.
- H_1.4: Increasing skim milk concentrations significantly affects the physical properties of the final synbiotic product.