Chapter 1

Introduction

1.1 Background

The demand for functional beverages is rapidly increasing as more consumers become aware of the risks linked to irregular diets and unhealthy lifestyles. This growing interest has shifted the beverage industry's focus toward products formulated with natural ingredients that offer added benefits (Cui et al., 2022; Majiding et al., 2023). Functional drinks often incorporate plant-based ingredients rich in antioxidants, which can effectively support the immune system (Aji & Sutiswa, 2023). One notable source of antioxidants is Red Fruit Oil, known for its high content of bioactive compounds (Saragih et al., 2020; Sirait et al., 2021). Traditionally, RFO (Red Fruit Oil) has served as a food ingredient, medicinal agent, and natural food coloring. Native to Papua, red fruit is an endemic plant with considerable potential due to its unique bioactive components (Sirait et al., 2021). Advances in science and technology have fueled extensive research to better understand RFO's nutritional and functional properties. Given its promising characteristics, efforts have been directed toward developing RFO in more versatile and consumer-friendly products. Processing RFO into powdered beverage forms offers an opportunity to optimize its benefits and expand its applications (Rohman & Windarsih, 2017).

RFO is extracted as a liquid because it contains carotene pigments that are oil-soluble but hydrophobic in water (Indriyani et al., 2024; Oubannin et al., 2024). These carotenoids are highly sensitive to heat, light, and oxygen, making them susceptible to degradation and oxidation during storage. Such deterioration can cause off-flavors, nutrient loss, and potentially harmful compounds (Ahmed et al., 2016; González-Peña et al., 2023). The liquid form of RFO, along with its poor water solubility and susceptibility to oxidation, makes encapsulation necessary to preserve its quality. Encapsulation involves dispersing RFO within a water-soluble coating agent to form an oil-in-water (O/W) emulsion, protecting the bioactive compounds (Sepeidnameh et al., 2024). Among advanced encapsulation methods, co-crystallization improves functional efficiency, stability, and bioactive compound availability (Federzoni et al., 2019). In this process, sugars serve as coformers and sweeteners, facilitating crystallization and entrapping active ingredients within a sugar matrix (Chezanoglou & Goula, 2021). Selecting appropriate types of sugar is a key step in determining the effectiveness of co-crystallization. Sucrose is widely used due to its ability to form solid, porous crystals. Dextrose, recognized as safe and readily available, can influence crystal growth kinetics, while xylitol is a sugar alcohol with sweetness comparable to sugar but fewer calories, and is valued for its solubility and ideal crystal structure. To maintain the stability of co-crystal RFO and prevent phase separation, maltodextrin is incorporated. Maltodextrin forms an amorphous glassy matrix that enhances protection, encapsulation efficiency, solubility, and powder flow characteristics (Karimi-Jafari et al., 2018).

Considering these aspects, the application of co-crystallization presents a practical strategy for producing powdered drinks that deliver functional ingredients in a stable and convenient form. The production of powdered drinks fits well with modern fast-paced lifestyles, where convenience and ease of preparation are highly valued. Instant powdered drinks are preferred when the powder consists of fine particles that dissolve quickly and effortlessly in water (Trimedona et al., 2022). To ensure the physical stability and functional quality of the resulting powdered drink, the evaluation focuses on total carotenoid content, color, and dissolution (Pattnaik et al., 2021; Zabot et al., 2022).. Total carotenoids represent the key active compounds in red fruit extract, while color reflects the visual appearance closely related to these compounds. Dissolution confirms that the powder forms a homogeneous solution without phase separation. These evaluations are carried out during storage to observe changes over time and determine the effectiveness of the co-crystallization process with the stabilizer in maintaining product quality. In this study, extracts from red fruit are combined with three types of sugars along with a stabilizer to produce functional instant powdered drinks using co-crystallization encapsulation techniques.

1.2 Objective

The objectives of this research are to evaluate the effect of different maltodextrin concentrations (5%, 10%, and 15%) on the visual appearance and TCC of co-crystal red fruit oil, to evaluate the effect of maltodextrin on the TCC and color of co-crystal RFO with different coformers during storage, and to evaluate the effect of maltodextrin on the dissolution time, TCC, and color of selected co-crystal RFO in solution during 4 weeks of storage.

1.3 Hypothesis

The hypotheses included in this experiment are as follows:

1. H0: Different concentrations of maltodextrin (5%, 10%, and 15%) will not significantly affect the visual appearance and TCC of co-crystal RFO

   H1: Different concentrations of maltodextrin (5%, 10%, and 15%) will significantly affect the visual appearance and TCC of co-crystal RFO

2. H0: Maltodextrin will not significantly affect the TCC and color of co-crystal RFO with different coformers during storage

   H1: Maltodextrin will significantly affect the TCC and color of co-crystal RFO with different coformers during storage

3. H0: Maltodextrin will not significantly affect the dissolution time, TCC, and color of selected co-crystal RFO in solution during 4 weeks of storage

   H1: MMaltodextrin will significantly affect the dissolution time, TCC, and color of selected co-crystal RFO in solution during 4 weeks of storage