CHAPTER 1: INTRODUCTION

1.1. Background

Red fruit (*Pandanus conoideus Lam*) is a plant that originates from Papua, it is often used as a natural dye, functional food, and for several medicinal purposes. The extraction of this red fruit into edible oil sources (known also as red fruit oil - RFO) imparts many culinary and pharmacological benefits, these include acting as cooking oil for food or a local medicine for the people. These benefits are mainly associated with the presence of various active compounds found within the red fruit. The fruit contains significant amounts of total carotenoid (12.000 ppm), total tocopherol (11.000 ppm), β-carotene (700 ppm), and α-tocopherol (500 ppm). Moreover, they also contain several fatty acids including oleic acid, linoleic acid, linolenic acid, and decanoic acid. In addition to the superior antioxidant properties provided by the carotenoids found in the red fruit, it may also act as a potential source for natural pigments, giving off the colors of yellow, orange, and red (Budi & Paimin, 2005).

This is in line with the current high demand of natural food colorants due to the changes in consumer's awareness and renewed food regulations. However, the current form of the RFO and the carotenoids contained in them is very volatile and easily degraded due to oxidation and when exposed to thermal environments, leading to a significant decrease in the quality of the color and its antioxidant capabilities. Hence, as a proposed solution, an encapsulation process is advised where the active ingredient is entrapped within another outer material (carrier agent/coating material/wall material), converting the previous volatile liquid oil into a more stable solid powder. One of the most widely used encapsulation processes is the spray drying method, which is used to help preserve sensitive foods such as active ingredients found in pharmaceuticals and healthy foods (I Ré, 1998).

An important parameter to be considered in the encapsulation process of the spray drying method is the properties of the feed solution for the spray drying process. The type of wall material and emulsifier that are going to be added into the feed solution will affect the final resulting powder qualities. Maltodextrin is a carbohydrate often used in many food processes due to its low price, bland flavor, high solubility, and ability to protect against oxidation. Hence, many have used it as the main

wall material in many spray drying processes. In addition to the main wall material, proteins (such as sodium caseinate and whey protein) are normally added as they are an excellent wall material for encapsulation in spray drying and have the ability to help bind to the oil compounds due to their amphiphilic characteristics (emulsifying properties). A combination of both the carbohydrate and protein wall materials has been proved to show a high encapsulation efficiency in some oils (Mohammed *et al*., 2020; Munin & Edwards-Lévy, 2011).

1.2. Objectives

The objective of this study includes:

- To investigate the effect of spray drying process towards the yield and total carotenoid content of spray-dried red fruit oil powder (RFO-P).
- To investigate the effect of different ratios of maltodextrin and whey protein isolate as carrier agents towards the total carotenoid content of spray-dried RFO-P.
- To investigate the carotenoid stability of the spray-dried RFO-P overtime during storage.
- To investigate the correlation between total carotenoid content and color of RFO-P at week 4 of storage.

1.3. Scope of the Study

To create a carotenoid-rich natural food colorant derived from RFO, this study focuses on using different concentrations of maltodextrin and whey protein isolate as a carrier agent to be used in the spray drying of RFO. This is also done to find out which ratio of maltodextrin to whey protein isolate leads to the most optimum carotenoid retention and carotenoid stability over time. This study does not focus on and conduct the extraction process of the RFO. The encapsulation process starts with the making of the emulsion with different formulas accordingly, then undergoing the spray drying process. The powders are then kept in aluminum pouches with preservatives at room temperature (±25℃) and ambient humidity (±78% RH) under dark conditions during storage until analysis. Spray-dried RFO-P

will then be examined for their total carotenoid content using a spectrophotometer at weeks 0, 1, 2, 3, 4 and their color (L*, a*, b*) by using image color analysis software at week 4. RFO and RFO-E will also be examined for their total carotenoid content at week 0. The recoverable yield of the spray-dried RFO-P will also be observed.

1.4. Problem Formulation

Problems formulations that are going to be discussed in this study include:

- What are the effects of using the encapsulation process through the spray drying method towards the total carotenoid content and yield of RFO-P?
- What are the effects of utilizing different ratios of maltodextrin and whey protein isolate towards the total carotenoid content?
- What is the effect of storage over time towards the total carotenoid and the carotenoid stability of spray-dried RFO-P?
- Is there any correlation between the total carotenoid content and color of the spray-dried RFO-P after 4 weeks of storage?

1.5. Hypothesis

The hypotheses derived here are based on the problems formulated in **Section 1.4**.

H_0 = Encapsulation process through spray drying **does not affect** the yield of the spray-dried RFO samples.

H_1 = Encapsulation process through spray drying **does affect** the yield of the spray-dried RFO samples.

H_0 = There are **no significant differences** in the total carotenoid content between the pre- and post- spray drying process of RFO samples.

H_1 = There are **significant differences** in the total carotenoid content between the pre- and post- spray drying process of RFO samples.

H_0 = There are **no significant differences** in the total carotenoid content between the different ratios of maltodextrin and whey protein isolate.

H_1 = There are **significant differences** in the total carotenoid content between the different ratios of maltodextrin and whey protein isolate.

H_0 = There are **no significant differences** in the total carotenoid content over storage time.

H_1 = There are **significant differences** in the total carotenoid content over storage time.

H_0 = There is **no significant correlation** between the total carotenoid content and color.

H_1 = There is a **significant correlation** between the total carotenoid content and color.

1.6. Expected Outcome

The outcomes expected from the hypotheses of this study include:

- There will be an affect towards the yield of the spray-dried RFO powders.
- There are no significant differences in the total carotenoid content between pre- and post-processing of spray-dried RFO-P.
- There are significant differences in the total carotenoid content between different ratios of maltodextrin and whey protein isolate.
- There are no significant changes in the total carotenoid content of spray-dried RFO-P over storage time.
- There is a significant correlation between the total carotenoid content and color of spray-dried RFO-P.