Chapter 1: Introduction

1.1. Introduction

Nowadays, cosmetics are deemed important on a daily basis. Throughout history, several usages of cosmetics have been traced back to ancient Egyptian civilization where cosmetics had been used as a way to mask body odors and retain skin softness. Moreover, cosmetics are also considered sacred as only certain people and rituals require the use of cosmetics (Chaudhri and Jain, 2014). As time went by, cosmetic usage increased significantly and became conventionally used in all strata. This aspect leads to an increased demand for cosmetics each year (Galetić and Požega, 2019). Various studies have explored several promising new inventions in cosmetics. One of the areas where cosmetics research has been focusing on recently is anti-aging activity. Aging is an inevitable process that occurs in every living thing. In the case of the human skin, aging mainly results in a form of wrinkles due to the decrease in extracellular matrix (ECM) dermo-epidermal junction caused by free radicals (Matsumoto, 2010). Antioxidants were considered as a measure to overcome free radicals. Thus it can interfere with the aging process. Several research for antiaging properties has been focused on antioxidant content due to its promising ability in renewing ECM including collagen and elastin production (Działo et al., 2016). Many bioactive compounds have antioxidant properties that can be used as anti-aging. One of which is the phenolic and flavonoid compounds. These compounds can be obtained synthetically or naturally from plant extract. In this case, the demand for plant extract-based cosmetics was higher and had been the goal for several developments in cosmetics.

Theobroma cacao L. (cocoa tree) pod husk is a byproduct of cocoa bean which is conventionally used in food and beverage industries. As a byproduct of the cocoa bean, cocoa pod husk is often treated as waste and disposed of. However several studies suggested cocoa pods which are commonly used in various food and beverage products might have several beneficial effects. Several studies suggested the cocoa pod extract still has an abundance of

phenolic and flavonoid content. The study by Rojo-Poveda *et al.* (2020), studied the content of cocoa pod husk and found the presence of catechin and epicatechin which belong to the flavonoid family of compounds. Moreover, a study by Abdul et al. (2016) suggested a gel formulation of cocoa pod extract to have some properties of anti-wrinkle due to the flavonoid and phenolic compound. Despite the inability to successfully penetrate the skin, cocoa pod extract was found to have a promising effect on wrinkles prevention. Hence, it is suggested to enhance the penetration of extract to the skin in order to fully assess the anti-aging promising activity.

To increase the penetration of the extract, many researchers have suggested the potential of a liposome as a drug carrier. The structure of liposomes resembles a living cell membrane that forms a phospholipid bilayer (Choi & Maibach, 2005). Thus, papers have stated liposomes can ease the transdermal penetration of drugs (Blueschke et al., 2018; Kim et al., 2020; Pierre & Costa 2011). Liposomes also can increase the stability of drug formulations. Moreover, liposomes are also considered to be biodegradable and non-toxic as a topical formulation of drugs. However, several drawbacks are also present in liposome formulation. Liposomes can lower the half-life of the drug and have a low solubility due to their components of lipid (Akbarzadeh *et al.,* 2013). In addition, liposome production was considered costly compared to other drug formulations due to its materials. Thus it is needed to find another measure to overcome the drawbacks of liposomes.

Another counterpart of the liposome, the niosome, resembles the liposome characteristic. According to Bartelds *et al* (2018), niosome are considered to have more consistency, stability, and elasticity than liposomes. Moreover, niosome are also stable physically and chemically, enabling drugs to be encapsulated inside the niosome. The materials of niosomes consist of non-ionic surfactant and cholesterol which are considered cheaper than liposome materials. This aspect enables both lipophilic and hydrophilic drugs to be entrapped inside niosome

formulations (Gharbavi *et al.,* 2018). Hence, the formulation of niosome to encapsulate the extract was considered to be a promising idea and investigated in this study.

1.2. Objectives

The objective of this thesis is to extract and characterize *Theobroma cacao* L. pod husk extract as well as formulate and evaluate a niosome system that could encapsulate *Theobroma cacao* L. bean husk extract. The formulated niosome was expected to increase the penetration of the extracts for anti-aging purposes and the penetration enhancing capability will be measured. The characterization performed in this study will include niosome characterization and extract characterization. Niosome characterization includes encapsulation efficiency, morphology (pH), and particle size while extract characterization includes total phenolic content, total flavonoid content, and antioxidant study using DPPH, FRAP, and ABTS.

1.3. Scope of work

The scope of work of this thesis was the characterization of Cocoa Pod Husk ethanolic extract antioxidant potential including total phenolic and flavonoid content, antioxidant test (DPPH, ABTS, FRAP), formulation of niosomes, encapsulation efficiency, stability studies (entrapment efficiency, pH, particle size, and zeta potential), and penetration study of niosomes using Franz cell diffusion method.

1.4. Hypothesis

The hypothesis of this study are:

1. *Theobroma cacao* L. possessed antioxidant properties
2. *Theobroma cacao* L. pod husks are able to be formulated into niosomes and the niosomes will exhibit good physicochemical properties and stability.
3. Formulation of *Theobroma cacao* L. pod husk extracts in niosomes increases penetration of the extract.