

Chapter 1

Introduction

1.1 Background

The human body has a protective layer that protects from the infiltration of pollutants and infectious agents which is the skin. It is subjected to sun that radiates ultraviolet (UV) light throughout the year. The skin exposure to UV radiation has become a concern since long-term exposure can cause prominent features of aging, also known as photoaging. The photoaging caused by UV radiation is characterized by the appearance of inflammation, sagging, pigmentation, and wrinkles (Juzeniene & Moan, 2012; Lin et al., 2019). The photon energy, particularly UVB radiation, causes adverse effects such as skin cancer, inflammation, oxidative stress, and protein and DNA damage. Researchers have found that the occurrences are primarily caused by reactive oxygen species (ROS) (Wang et al., 2019).

Research on the natural ingredients for preventing skin aging caused by UVB has been increasing, and out of many natural sources, Sacha inchi have been shown to have potential as a protective agent against UVB due to its bioactive compounds. The inca seeds or also known as Sacha inchi (*Plukenetia volubilis*), is classified in the family of Euphorbiaceae, located within tropical rainforests of Amazon, including Northwestern Brazil and Peru, and is cultivated in Southwest China and Southeast Asia (Kodahl & Sørensen, 2021). Sacha inchi have been shown to contain bioactive compounds including omega-6, omega-3 fatty acid, alpha-tocopherol, minerals, flavonoids, and vitamin E that contribute to its nutritional and pharmacological activities (Maya et al., 2023). Sacha inchi have also been shown to demonstrate antioxidant activity through scavenging free radicals due to vitamins and polyphenols content (Maya et al., 2023; Zakaria et al., 2023). However, the interest of most research in Sacha inchi mainly focused on the oil extraction, given its high unsaturated fatty acid (Micanquer-Carlosama et al., 2020). Consequently, the extraction of oil resulted in a significant amount of press-cake as a by-product (Torres-Sánchez et al., 2023).

The utilization of by-products from agricultural and industrial processes has become increasingly important in recent years as it enables the recovery of valuable nutrients while promoting environmental sustainability and economic benefits. By-products act as a sustainable and economical provider of bioactive substances with potential roles in the cosmetic, pharmaceutical, and food industries (Torres-Sánchez et al., 2021). Even though Sacha inchi press-cake has been known to contain a high percentage of protein (53-59%), most of Sacha inchi press-cake is wasted or only used in animal feeding (Mich et al., 2024). Furthermore, due to the extraction process, sacha inchi press cake contain lower bioactive compounds compared to the whole seeds (Lestari et al., 2024; Sánchez et al., 2021). For the purpose of increasing the value and bioactive compounds of the press cake, fermentation of the sacha inchi press-cake is done. Studies have shown that fermentation enhances the degree of bioactive substances, such as flavonoids and phenolics (Adebo & Medina-Meza, 2020; Zhao et al., 2021). In addition, an increase in bioavailability has been shown after the process of fermentation, which increases the antioxidant activity of bioactive compounds (Saritaş et al., 2024).

Studies have only investigated the nutritional characteristics and therapeutic effects of Sacha inchi in human health, such as its cardioprotective, immunomodulatory, antidyslipidemic, and antiproliferative effects (Cárdenas et al., 2021). Despite the evidence of Sacha inchi function for therapeutic application, studies have not investigated Sacha inchi ferment filtrate as a potential alternative material source to protect skin from aging induced by UVB exposure. Hence, in this study, their prospect as a photoprotective agent on UVB induced photoaging was evaluated.

This research addresses the gap by investigating the photoprotective efficacy on human keratinocytes (HaCaT cells). The overall protein, phenolic, and flavonoid content of Sacha Inchi press-cake were evaluated with BCA assay, Folin-Ciocalteu, and aluminum chloride assay, respectively. The antioxidant activity of Sacha inchi press cake was also investigated with FRAP assay. The protective effect was measured by cell viability measurement with MTS assay which quantifies the degree of damage of HaCaT cells upon UVB induction.

1.1 Objective

The primary objective of this study is to do *in vitro* investigation on the antioxidant and cytoprotective activity of Sacha inchi ferment filtrate against UVB on HaCaT cells. The objectives of this research includes:

1. To investigate the antioxidant activity of Sacha inchi ferment filtrate with FRAP assay
2. To measure the cytotoxicity range of the ferment filtrate upon treatment toward HaCaT cells
3. To measure the cytoprotective ability of the ferment filtrate towards HaCaT cells upon UVB induction

1.2 Hypothesis

Sacha inchi ferment filtrate exhibits cytoprotective activity on HaCaT cells against UVB through a significant increase in cell viability and higher antioxidant activity.