Chapter 1

Introduction

1.1 Background

Ultraviolet (UV) radiation is one of the factors that contribute to skin damage (Khalil & Shebaby, 2017). Prolonged exposure to UV radiation can lead to skin cancer in humans. Hence, Ultraviolet (UV) radiation is one of the factors contributing to the skin damage, which can lead to skin cancer upon exposure to human skin. The exposure of UV, especially UVB with wavelength ranging from 280-320 nm can initiate cancer which contributes to the main cause of human's death. UVB rays have the ability to reach the dermis through the epidermis' outermost layers and damage the primary groups of skin cells including fibroblasts and keratinocytes, resulting in skin cell loss and/or apoptosis (Fernandez et al., 2014). UVB radiation accelerates skin aging through multiple interconnected biological mechanisms, which primarily involve DNA damage (Tanveer et al., 2023). UVB rays penetrate the epidermis and directly harm DNA in keratinocytes through the formation of cyclobutane pyrimidine dimers and other mutagenic lesions.

In order to reduce the effect of these damages, the usage of natural sources as a preventive action become important due to their rich content of protective bioactive compounds as well as their ability to enhance antioxidant defenses to repair the DNA damage (Adinortey et al., 2018; Lagunas-Rangel & Bermúdez-Cruz, 2020). Among many that have been studied to prevent skin damage that is caused by UVB, *Physalis angulata* and *Vitex trifolia* exhibited great potential to be utilized as a potential source of materials to prevent DNA damage.

Cutleaf Groundcherry (*Physalis angulata*), or often called daun ciplukan by Indonesia people, is a plant belonging to the solanaceae family that is rarely cultivated by farmers because its grows wildly close to farmed crops (Firdaus et al., 2022). It is often used holistically due to its antioxidant

properties that are found in the stems, leaves and flowers. The strong antioxidant effect from flavonoid, vitamin A and vitamin E compounds on this leaf is believed to be able to prevent anti-aging on human skin (Bjørklund et al., 2022). Simple-Leaf Chaste-Tree (*Vitex trifolia*) or Legundi is a plant belonging to the Lamiaceae family which has a shape like shrub or small tree and is characterized by its adaptability, thriving in diverse environments (Rojaz-Sandoval, 2022). It has been investigated for its potential medicinal properties, in which the potential of preventing aging on human skin by its antioxidant properties of the plant. Antioxidants, for both enzymatic and non-enzymatic ways, have an ability to reduce oxidative damage and neutralize ROS to preserve cellular homeostasis especially from plant sources (Rusu et al., 2022). Numerous studies have demonstrated that dietary antioxidants derived from plants lower the risk of aging, including age-related illnesses and syndromes. Since there is correlation between both antioxidant compounds and aging reduction, these two natural sources are expected to exert an effect that assists the prevention of aging on human skin.

To date, there has not been a study comparing the anti-aging activity of both plants. Hence, this study is going to investigate and compare the photoprotective effect on cell culture keratinocyte (HaCat) using *in-vitro* methods to assess their potential as alternative sources for active agents that could protect from UVB-induced aging and DNA damage. Both plants are high in bioactive substances that strengthen the body's defenses against free radicals, including flavonoids and phenolics (Jalab et al., 2023). Since oxidative stress is a primary cause of age-related illnesses and cellular aging, evaluating these plants' antioxidant capacities aids in identifying which may be more useful in slowing down the aging process.

This study will analyze total phenolic and flavonoid content, DPPH antioxidant activity, cytotoxicity, cytoprotective effects, and DNA damage (comet assay) using both extracts. These analyses aim to

evaluate biological potential while optimizing efficiency, cost-effectiveness, and mechanistic insights into cellular processes (Tirumala et al., 2021).

1.2 Objective

The main objective of this study is to compare the protective activity from UVB through antioxidant effect of extracts (*Physalis angulata* and *Vitex trifolia*) on HaCaT cells, including:

1. To characterize the bioactive compound and compare the antioxidant activity of *Physalis angulata* and *Vitex trifolia* extracts
2. To measure the cytotoxicity range of the extracts upon treatment towards HaCaT cell with MTS assay
3. To measure the cytoprotective ability of the extracts towards HaCaT cells upon UVB induction

1.3 Hypothesis

- One of the extracts exhibit a stronger cytoprotective activity on HaCaT cells against UVB-induced DNA damage through an increase in cell viability.