Chapter 1

Introduction

1.1. Background

Acne is a common dermatological condition that is considered to be one of the most widespread to people globally; in Indonesia specifically, it has a prevalence of around 68% of the population. Some common symptoms include inflammation, impaired skin barrier function, and delayed wound healing; it has also been known to negatively impact quality of life and psychological well-being (Chen et al., 2021; Riyanto et al., 2025). Current treatments often use chemical antimicrobials and anti-inflammatory agents. For example, benzoyl peroxide is a common antimicrobial agent that kills bacteria, such as *Cutibacterium acnes*, as well as salicylic acid, retinols, and antibiotics which reduces inflammation (Osmokrovic et al., 2025; Wakelin, 2025). These usually are present in cleansers, moisturizers or spot treatments and can be applied daily. However, long-term use of these solutions can lead to effects such as skin irritation, dryness, or antimicrobial resistance (Festok et al., 2024). Thus, there is increasing interest in different treatments with the use of plant-based ingredients that are safer for frequent use. Additionally, using invasive species can provide a sustainable solution while reducing environmental impact (George et al., 2026).

A plant-based and herbal-based ingredient that has potential anti-acne agent is *C. grandis*, or its common name, ivy gourd. It is an invasive plant species that primarily grows in tropical regions, including in Indonesia, and contains bioactive compounds– such as a range of flavonoids (rutin, querecetins, kaempferols), and secoiridoids (Poljuha & Sladonja, 2025). These compounds are known to show antimicrobial properties by suppressing inflammatory pathways like MAPK, as well as initiate cell proliferation pathways like PI3K/Akt signalling (Taherkhani et al., 2023). Additionally, *M. alternifolia* oil, or also known as tea tree oil, is another common treatment for acne vulgaris as it is a well-known essential oil in skincare formulations, known for its antimicrobial properties; this is mainly due to terpinen-4-ol and other antioxidant-rich monoterpenes such as α-terpinene (Rubianti et al.,

2021). It can also contribute to a fragrant smell which helps with its sensory characteristics (Ahmad et al., 2019).

Previous studies have shown that there is potential in the combination of different plant-derived compounds for wound healing. One of the many examples is that a mixture of neem leaf extract and turmeric spice has shown to reduce acne lesions by 50% in eight weeks, as well as performing better compared to benzoyl peroxide (Yogesh et al., 2021). Additionally, another study shows that the combination of propolis, *M. alternifolia* oil and aloe vera has shown to decrease lesions by 64% in thirty days, and was concluded to surpass the use of an antibiotic– erythromycin cream (Mazzarello et al., 2018).

In terms of *C. grandis* leaf extract and *M. alternifolia* oil, the antioxidant properties of *C. grandis* may reduce oxidative stress and promote cell proliferation, while the antimicrobial and anti-inflammatory environment that *M. alternifolia* oil brings can help control infection at the wound site (Namchaiw et al., 2021). By targeting different factors involved in wound healing, the combination of these compounds may enhance cell migration through combined effects. However, while both *C. grandis* leaf extract and *M. alternifoca* oil show promise for topical use individually and combined, *in vitro* wound healing effects of tea tree oil on HaCaT cells are still limited, and the combined effects of these two ingredients combined on skin cell viability and wound healing has yet to be explored. This shows a research gap in understanding whether these compounds may work complementary to enhance wound healing activity.

To investigate these effects, HaCaT cells were used, as it is a type of keratinocyte cell line, which plays a role in skin regeneration and wound closure (Piipponen et al., 2020). Cell viability test was done for different treatments of the extract to take note of any cytotoxicity that may occur, and wound healing was assessed using an *in-vitro* scratch assay by observing cell migration in a manually induced scratch.

Overall, this study aims to identify whether *C. grandis* leaf extract and *M. alternifolia* oil combined would have significant wound healing effects in HaCaT cells as well as identifying the concentrations in which this is possible.

1.2. Objective

This research aims to evaluate wound healing effects of *Cocconia grandis* leaf extract and *Melaleuca alternifolia* oil combinations through a scratch assay of visualizing of HaCaT cell migration.

1.3. Hypothesis

The null hypothesis of this study is that the combination of *C. grandis* leaf extract and *M. alternifolia* oil does not have significant wound healing effects on HaCaT cells, and the alternate hypothesis states that the combination of *C. grandis* leaf extract and *M. alternifolia* oil have significant wound healing effects on HaCaT cells.