

## I. INTRODUCTION

### 1.1. Background

*Staphylococcus aureus* (SA) is an opportunistic human pathogen that can cause a wide range of clinical infections. They are gram-positive bacteria that come in cocci shape and tend to cluster altogether becoming a “grape-like” structure and can survive in high salt environments at up to 10% concentrations (Taylor & Unakal, 2022). As a pathogen, SA does not directly cause infection if it resides on human skin unless it successfully enters the human bloodstream or internal tissues. Moreover, up to half of the adults are a reservoir for these microbes, exhibits that a healthy individual can also be colonized by SA, however, they will not be infected as healthy skin have various way to protect from infection such as skin microflora, lipid, salt, enzymes, and surface ph (Burian et al., 2021).

As an opportunistic bacteria, the infection of *S. aureus* such as bacteremia, infective endocarditis, impetigo, folliculitis, pneumonia, urinary tract infection, etc. is mostly treated using antibiotics, and ever since methicillin was found in the 1960s, the treatment has mainly revolved around it. However, a crisis emerged in the 1980s in public health settings, as *methicillin-resistant staphylococcus aureus* (MRSA) started to rapidly spread from one country to another globally, and all types of beta-lactam antibiotics became resistant to MRSA. Additionally, MRSA is recognized as a polyphyletic, meaning that the current MRSA epidemic does not share a common ancestry with the current MRSA epidemic. This poses a challenge to studying MRSA because different lineages retain different genotypic and phenotypic tractors hence its fitness, virulence, and resistance spectrum are also different (Jean-Philippe Rasigade & François Vandenesch, 2014).

Other than the aforementioned *S. aureus* infection disease, one skin disease named atopic dermatitis (AD) or eczema shows a phenomenon where the skin is highly colonized by *S. aureus*. Eczema has been recognized as a multifactorial skin condition up until now (Magnifico et al., 2020). The development of AD is considered a result of the interaction between skin barrier defect and genetics, as well as immunological and environmental factors such as dust, mite, soap, hygiene, and stress.

Although regarded as a multifactorial skin condition, *S. aureus* colonization is believed to act as an aggravating factor causing the exacerbating inflammation, and increasing the risk of invasive infection causing other diseases such as septic shock, septic arthritis, bacteremia, or osteomyelitis (Patrycja Ogonowska et al., 2021), additionally cases of MRSA infection on eczema patient had also been previously reported where it also increase the severity and reduce the sensitivity of topical anti-inflammatory agents (Ong, 2014).

*Houttuynia cordata*, commonly known as the chameleon plant, is a perennial herbaceous plant found across Asia. This plant possesses a wide variety of chemical components, including alkaloids, phenolic acids, and flavonoids. *H. cordata* has been used extensively in several Asian countries, including China, Korea, and India as food or medicinal herbs. In China, this medicinal plant has a long history of usage to cure a variety of illnesses, including fever, cough, and colds. It also has anti-inflammatory, anti-bacterial, anti-viral, and anti-tumor properties. According to Rafiq et al.

(2022), the flavonoid component of *H. cordata* is the key component for disease treatment. Generally, the whole plant can be used as medicine as Chinese traditional medicine allows it to treat pneumonia and viral infection. Aside from *H. cordata*, a native plant from Asia, *Rhodomyrtus tomentosa* is also a notable plant used in traditional medicine (Wu et al., 2021).

*Rhodomyrtus tomentosa*, a flowering plant from the *Myrtaceae* family, is also widely used as a medicine to treat illnesses like myelopathy, stomachaches, dysentery, and diarrhea. On its leaves, roots, or fruits, phenolic and terpenoids are significant biological compounds with antibacterial, anti-inflammatory, and anticancer properties (Vo & Ngo, 2019). Other than being used in traditional settings, the extraction from *R. tomentosa* leaf had been used previously to treat SA infection that invades the bovine udder epidermal tissue model in an ex vivo setting and shows a strong inhibitory effect that is comparable to vancomycin. However, the antimicrobial activity assay had been done mainly towards MRSA isolates other than eczema in humans (Auemphon Mordmuang et al., 2019). Besides, the end goal of this project is to develop a skincare product to treat atopic dermatitis, the extraction solvent for the plants' extract is limited to ethanol and water because both are deemed safe for human consumption as food and natural medicinal purposes (Ni et al., 2021).

Based on the issue of MRSA emergence as well as its polyphyletic traits, this study will be conducted to confirm the presence of MRSA in eczema skin patients and test two kinds of plants; *Houttuynia cordata* and *Rhodomyrtus tomentosa* as a part of the screening project of potential plants that have antimicrobial activity against MRSA isolated from eczema in human.

## 1.2. Research Question

Based on the background, the research question are formulated:

1. Can methicillin-resistant *Staphylococcus aureus* be isolated from eczema skin patients?
2. Does *Rhodomyrtus tomentosa* extract inhibit the growth of MRSA?
3. Does *Houttuynia cordata* extract inhibit the growth of MRSA?

## 1.3. Hypothesis

The hypothesis related to the research question:

1.  $H_0$ : Methicillin-resistant *Staphylococcus aureus* can not be isolated from eczema skin patients.  
 $H_1$ : Methicillin-resistant *Staphylococcus aureus* can be isolated from eczema skin patients.
2.  $H_0$ : *Rhodomyrtus tomentosa* extract does not inhibit the growth of MRSA.  
 $H_1$ : *Rhodomyrtus tomentosa* extract does inhibit the growth of MRSA.
3.  $H_0$ : *Houttuynia cordata* extract does not inhibit the growth of MRSA.  
 $H_1$ : *Houttuynia cordata* extract does inhibit the growth of MRSA.

## 1.4. Research Scope

The research scope of this research includes

1. Bacteria isolation from eczema patient skin swab specimens.
2. Bacteria identification.
3. Characterization of *Staphylococcus aureus* isolate (mecA gene).
4. Water and ethanol extraction of *Rhodomyrtus tomentosa* and *Houttuynia cordata*.
5. Susceptibility test.