Potential of *Rumex crispus* Root Infusion Against the Growth of *Staphylococcus epidermidis*

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Abstract *-Acne vulgaris (AV) is a chronic inflammatory disorder of pilosebaceous units that is commonly seen in young adults. The main factors involving AV are increased sebum production and bacterial inflammation. One of the bacteria commonly associated AV is Staphylococcus epidermidis (SE). Antibiotics for treating AV may lead to side effects such as skin irritation or rashes, and in certain cases, can trigger severe allergic reactions. Medicinal plants are considered safer than antibiotics. Biological activities and effectiveness of medicinal plants have been evaluated both in traditional medicine and across various scientific disciplines. The studies conducted so far show that medicinal plants represent a significant source of antioxidants and compounds with antibacterial effect. Rumex crispus (RC) has a long history of use in herbal medicine and is traditionally regarded as beneficial for individuals with persistent skin conditions across various medical traditions. This study purpose is to find out the anti-bacterial potential of RC infusion to treat acne problem at concentrations of 5%, 10%, and 15% against SE with four replications. The result of the study shows that the zone of inhibition diameters was categorized moderate and there was no significant difference between each concentration (p value = 0.375). The result of the study concluded that RC infusion might slow SE growth enough to help, but may not be sufficient as a sole treatment for AV at the tested concentrations.*

Keywords: *Acne vulgaris, Staphylococcus epidermidis, Rumex crispus*.

I. INTRODUCTION

Acne is not a life-threatening skin condition, however, its presence can negatively impact psychological well-being, reducing self-confidence and affecting overall quality of life (Nandy and Srivastava (2024). According to Luthfiana et al. (2022), *Acne vulgaris* (AV) affects nearly 85% of the global population, typically occurring between the ages of 11 and 30. In Indonesia, the prevalence of AV is 72.5%, with the majority of cases occurring among adolescents aged 18–25 years, followed by 27.5% in adults aged 26–35 years. The main factors involving AV are increased sebum production, sloughing of keratinocytes, inflammation, and bacterial growth (Sutaria et al., 2023). One of the bacteria commonly associated AV is *Staphylococcus epidermidis* (SE), parts of the normal skin flora that can evade antibiotic effects and suppress the body's immune defenses, enabling it to act as an opportunistic pathogen (Anjum, 2023). One approach to treating AV involves the use of antibiotics such as erythromycin, doxycycline, and clindamycin. However, prolonged or continuous use of these antibiotics can lead to irritation, the development of resistance, and immune hypersensitivity (Dessinioti and Katsambas, 2022; Dilley and Geng, 2022). However, the use of antibiotics may rise bacterial

resistance, largely driven by the inappropriate use of these drugs in excessive doses or for prolonged durations (Guzman, 2023). Research on the use of natural ingredients that have antibacterial potential is becoming increasingly relevant (Zouine et al., 2024). *Rumex crispus* (RC), commonly known as yellow dock or curly sorrel, is a medicinal herb traditionally used to address various health conditions (Qian et al., 2024). Its roots contain bioactive compounds, including anthraquinones, flavonoids, tannins, and saponins, all of which are recognized for their antibacterial properties (Hussain et al., 2016). An infusion—prepared by steeping plant material in hot water—is a simple and effective method for extracting these active constituents (Verica et al., 2020). This study aimed to found out the antibacterial activity of RC root at concentrations of 5%, 10%, and 15% against *Staphylococcus epidermidis* (SE). The infusion method was employed to assess the diameter of the bacterial growth inhibition zone. This study purposed to present information on RS infusion as a safe and effective antibacterial agent, offering a potential alternative treatment for acne caused by *Staphylococcus epidermidis* (SE).

II. LITERATURE REVIEW

Globally, AV is a common chronic inflammatory disorder affecting the pilosebaceous follicles. While not life-threatening, its severity can lead to scarring, skin irritation, and considerable psychological impacts, including depression (Vasam et al., 2023). One of acnecausing bacteria is SE. It can lead to opportunistic acne infections, particularly during puberty. This is largely due to elevated androgen activity, which stimulates sebaceous gland growth and increases sebum production (Luthfiana et al., 2022). SE is a gram-positive, spherical bacterium with a diameter of approximately 0.5–1.5 µm, typically forming irregular grape-like clusters. It is facultatively anaerobic, non-spore-forming, and non-motile, with an optimal growth temperature of 30–37ºC. On solid media, its colonies appear white to cream-colored, round or slightly convex, and may develop a stellate (star-shaped) morphology on specialized media (UK Standards for Microbiology Investigations, 2020). Antibacterials are substances that kill or inhibit the growth of bacteria. They are used to treat bacterial infections in humans and animals, either in the form of medication or by direct injection into the body (Kéllou, 2024). Their mechanisms of action include damaging bacterial cell walls, blocking protein synthesis, or interfering with bacterial metabolism. However, the emergence of antibacterial-resistant bacteria has made treatment increasingly challenging. RS, commonly referred to as yellow dock or curly sorrel, is a member of the *Polygonaceae* family found in many parts of the world, including Europe, Asia, and North America. The plant is characterized by its wavy-edged leaves and brownish-yellow roots. For centuries, it has been utilized in traditional medicine to address various health issues, including digestive problems, skin conditions, and infections (Saoudi et al., 2021). The roots of RS are rich in bioactive compounds, including anthraquinones, flavonoids, tannins, and saponins, which are recognized for their antioxidant, anti-inflammatory, and antibacterial effects (Gonfa et al., 2021). The extraction of natural products is one of the oldest human practices, with the use of plant extracts and isolated compounds for dietary supplements, medicine, cosmetics, and agricultural purposes dating back many centuries. RS has active constituents, the plant is commonly prepared as infusions or extracts and is frequently incorporated into various herbal medicine formulations (Eom et al., 2020).

III. MATERIALS AND METHODS

The Materials and Methods in this study include:

1. **Research Design**: This study employed a laboratory experimental approach. Antibacterial activity was assessed using the agar diffusion method with blank discs to measure the inhibition zone diameters. The experiment was designed using a Completely Randomized Design (CRD) with extract concentrations of 5%, 10%, and 15%. The resulting data were analyzed through Analysis of Variance (ANOVA).

2. **Tools and Instruments**: The tools used to conduct this research include: Petri dishes, dropper pipettes, micropipettes, funnels, analytical balances, tweezers, 250 mL *Erlenmeyer flasks*, 100 mL, stirring rods, filter paper, loop needles, sterile cotton swabs, label paper, disk paper, aluminum foil, plastic wrap, autoclaves, water baths, *Bunsen* burners, grinders, and calipers. The materials used in this study included RS roots powder, ethanol 70% (technical grade), and distilled water. *Nutrient Agar* (NA) served as the growth medium and SE cultures. The bacterial suspension was adjusted to match the 0.5 McFarland standard, equivalent to approximately 1.5×10^8 bacterial cells/ml.

3. **Procedures**: RS root samples were collected and sorted to remove any damaged portions, with 3 kg of roots prepared for processing. The selected roots were washed under running water and dried for four days under indirect sunlight to prevent ultraviolet light from degrading their bioactive compounds. Once dried, the roots were ground into a fine powder using a blender. Reducing the particle size increased the powder's surface area in contact with the solvent during infusion, thereby enhancing the extraction of active biocompounds. Water was brought to a boil in a pan, after which the finely ground dried RC root added at concentrations: 5% (*5 g dried herb + 100 ml distilled water*), 10% (*10 g dried herb + 100 ml distilled water*), and 15% (*15 g dried herb + 100 ml distilled water*). Once the infusion cools to room temperature, it is transferred to a sealed container for temporary storage. A total of 20 mL of sterilized Nutrient Agar (NA) was poured into Petri dishes. SE bacteria, adjusted to the McFarland standard of 10^8 CFU/mL, was spread evenly across the surface of the solidified NA medium using a sterile cotton swab. Paper discs containing RC infusion extract at the designated concentrations were then placed onto the medium surface with a micropipette, positioned on the middle of the Petri dish. The plates were incubated at 24°C for 24 hours, after which the inhibition zones were observed and their diameters measured with a vernier caliper and categorized using zone inhibition category table (Davis and Stout, 1971; Pratiwi et al., 2024):

Table 1. The Zone of Inhibition.

Inhibition Zone	Category
0	Resistant
<5 mm	Week
5 – 10 mm	Moderate
10 – 20 mm	Strong
	(Sensitive)

	>20 mm	Very Strong (Very Sensitive)

4. **Analysis Techniques**: The differences in the mean inhibition zone diameters of SE for each treatment (RC root infusions at 5%, 10%, and 15% concentrations) were analyzed using a one-way Analysis of Variance (ANOVA) to assess whether the treatments produced statistically significant variations in inhibition zone diameter.

IV. RESULTS AND DISCUSSION

The observed inhibition zones for *S. epidermidis* are summarized in the table below:

Table 2. Zone of Inhibition Category

Infusion/Antibiotics Concentration (%)	Average	Category
5	9.20±1.20	Moderate
10	8.13±1.39	Moderate
15	9.10±0.59	Moderate
Clindamycin	22.65±0.86	Very Strong

Table 2 shows that the zone of inhibition diameter of *5%, 10%,* and *15%* categorized as moderate or intermediate on the average of *9.2±1.20*, *8.1±1.39* and *9.1±0.59* millimeter in diameter for the four replications average. Zone of inhibitions for antibiotic is *22.65±0.86* which was very strong or very sensitive or susceptible. The moderate inhibition category indicates that the infusion has only partial inhibition; the bacteria are sensitive, but not highly so. The killing or growth-preventing effect is noticeable, but not maximal. If it were a medicine, it might slow bacterial growth enough to help, but may not be sufficient as a sole treatment at that concentration. For instance, in evaluating the antibacterial activity of RS root extracts against SE, a moderate inhibition zone would imply that the extract has some antibacterial properties, but further optimization of concentration or formulation may be necessary to enhance its efficacy. According to Rodloff et al. (2008) and Niels et al. (2019), a moderate inhibition zone in antibiotic susceptibility testing does not automatically mean the antibiotic is ineffective. While a larger zone typically indicates stronger antimicrobial activity, a moderate zone still reflects a certain degree of bacterial inhibition, and the antibiotic can remain clinically relevant

Table 3. Statistical Analysis of One Way ANOVA for Infusion Concentrations

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2.821667	2	1.410833	1.095793	0.375041	4.256495
Within Groups	11.5875	9	1.2875			
Total	14.40917	11				

Table 3 shows the statistical analysis to assess whether the treatments produced statistically significant variations in inhibition zone diameter. The *F critical* (*4.256495*) was greater than the *F statistic* (*1.095793*) and the *p value* (*0.375*) was greater than *0.05* indicates that there was no significant difference among the zone of inhibition diameter between group of different concentrations. The lack of significant differences in the zone of inhibition diameters suggests that all tested treatments exhibited similar antimicrobial effects against the bacterial strain. This may indicate limited potency of the agents under the experimental conditions or intrinsic resistance of the bacteria. Future studies with higher concentrations, or higher gap between each concentration tested or alternative microbial strains, or more sensitive assays are recommended to clarify these findings.

V. CONCLUSION

The result of the study concluded that the *Rumex crispus* (RC) infusion might slow bacterial growth enough to help, but may not be sufficient as a sole treatment of *Acne vulgaris* (AV) at the tested concentrations. Further study is needed using high concentration or higher gap concentration or using ethyl alcohol (ethanol) solid extraction instead of water infusion.

AUTHORS' CONTRIBUTIONS

This study was formulated by both first and second author and both involved in all laboratory activities and the paper works.

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