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FORMULATION AND TESTING OF SOLID SOAP CONTAINING 96% ETHANOL EXTRACT OF PURSLANE (*Portulaca oleracea* L.) COMBINED WITH VIRGIN COCONUT OIL (VCO) AGAINST *Staphylococcus aureus*

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ABSTRACT

Staphylococcus aureus is a pathogenic bacterium commonly associated with various infections. An initial step in preventing and addressing infections is the use of antibacterial soaps. The purslane extract can serve as an antibacterial agent that inhibits the growth of S*taphylococcus aureus*, while VCO offers additional protection through its antimicrobial properties and ability to maintain skin moisture. This study aimed to formulate a solid soap using 96% ethanol extract of purslane combined with VCO. Purslane powder was extracted using a maceration method. The physical properties of the soap were evaluated, including organoleptic evaluation, PH, homogeneity, foaming capacity, foam stability, and antibacterial activity against *Staphylococcus aureus*. Based on the results of the physical property evaluations, the solid soap met the required standards. The antibacterial effectiveness test showed inhibition zones for F1 at 3.21 ± 0,023 (weak category), F2 at 4,26 ± 0,102 (weak category), and F3 at 5,2 ± 0,070 (weak category). The results indicate that the purslane extract, in combination with varying amounts of VCO, can be formulated into solid soap that meets the physical property evaluation criteria and possesses antibacterial activity against the growth of S*taphylococcus aureus.*

Keywords: Solid Soap; Antibacterial; Purslane Plant; VCO; *Staphylococcus aureus*

INTRODUCTION

Staphylococcus aureus is a pathogenic bacterium commonly found in skin infections, including acne, boils, and wounds. This bacterium can form biofilms, making it more difficult to treat with conventional antibiotics (Chambers and DeLeo, 2009). Therefore, the use of personal care products with antibacterial effects is an important step in preventing and addressing S. aureus infections. One of the initial steps in preventing and managing infections caused by *Staphylococcus aureus* is the use of an antibacterial soap.

Solid soap is a cleaning product commonly used for personal hygiene and can be used daily or specifically for skin care. Currently, solid soap is popular among middle-type consumers because of its affordable price and economic nature. The primacy of using solid soap rather than liquid soap is that it is easy to store, has a longer shelf life, and tends to be more eco-friendly as it uses minimalized packaging. Solid soap can be formulated with a plethora of natural ingredients to improve health and beauty (Ramayanti *et al*., 2022).

One of the plants that has antibacterial activity is the extract of pusrlane (*Portulaca oleracea L*), which contains secondary metabolite compounds such as flavonoids, alkaloids, tannins, and saponins, which are Rich in omega 3 fatty acid, antioxidants, and bioactive compounds, which have anti-inflammatory and antibacterial effects (Liu *et al.*, 2023). Research has shown that purslane extract has the potential to slow the growth of many bacterial types, including skin pathogens (Okuda *et al.*, 2021). Virgin coconut oil (VCO) comes from the meat of fresh coconut and is commonly known to contain lauric acid, which has an antimicrobial nature. Lauric acid can kill or slow down the growth of bacterial pathogens, including *Staphylococcus aureus*, which frequently causes skin infections and other health problems (Mena Sutrisno and Marfu'ah, 2020). VCO also has the ability to humidify and repair the skin barrier. VCO constitutes oil or natural fat that is used in the production of the soap itself and is easily saponified, which is why it is used as the material for making solid soap.

Combining purslane extract with VCO in the formulation of solid soap can provide synergistic benefits. Purslane extract acts as an antibacterial agent that slows down the growth of *Staphylococcus aureus*, while VCO provides layered protection through its antimicrobial properties (Okuda *et al.*, 2021). Humidify the skin while repairing the skin barrier. This formulation not only aims to clean, but can also emanate therapeutic effects that are useful for skin health.

Based on this narrative, the author is interested in making solid soap made from 96% ethanol extract of pusrlane combined with VCO. The solid soap that is made will be evaluated for its physical and antibacterial activity against *Staphylococcus aureus* bacteria.

RESEARCH METHODS

Equipment and Materials

The ingredients used in this study were purslane plants (*Portulaca oleracea,L)* harvested from Muara Rungga village, Empat Lawang Regency, South Sumatra Province. 96% Ethanol (merck, Germany), VCO (virgin coconut oil), olive oil, Natrium Hidroxide, Cocamide DEA (Bratachem, Indonesia), *staphylococcus aureus* bacteria, *Tryptic Soy Agar* (TSA), *Tryptic Soy Broth* (TSB) *(*Bratachem, Indonesia*)*.

The tools used in this study were Analytical Scales (Ohaus PAJI003), pH meter (Ohaus STARTER 300), hot plate (AKEBONNO MSP-3101®), mess 40 sieve, rotary evaporator (R-300), blender, Autoclave (American 75X), Petri dish (Pyrex), Incubator, Laminar Air Flow (LAF*)*, Bunsen, Ose Needle, and tweezers.

Research Procedure

1. Fabrication of Purslane Simplicia

The simplicia is processed by separating the impure part of the purslane plant, then the purslane plants are sliced into small pieces and dried in air for 1-5 days. Next, it was ground with a blender until it became simplicia powder and then sifted using mesh 60 sifter (Artini, 2022).

2. Produciton if purslane extract

Purslane simplicia powder was extracted using the maceration method, where 500 g of Purslane Plant simplicia powder was macerated using 96% ethanol (1:10) for 3 days and remacerated again for 2 days. Then, the resulting liquid extract was concentrated using *a rotary evaporator* until a thick extract was obtained (Artini, 2022).

3. Manufacturization of Purslane Extract Solid Soap

The Purslane extract Solid Soap is produced by weighing all the ingredients used for the formula, then NaOH is dissolved with Aquadest bit by bit and let the solution cool down to 30-40°C, while VCO and Olive Oil are mixed and then heated to 70 C. Liquid NaOH is subsequently blended into the mixture of VCO and Olive Oil while simultaneously stirring using a hand blander until the homogen becomes trace, and Cocamid DEA, purslane extract, and Fragrance are mixed until it becomes homogen; finally, the formulation is poured into the mould and left for 24 hours (Junita and Runggamusi, 2023).

Table I. Purslane Plant Extract Solid Soap Formulation

Component	Concentratio (%)		
	F1	F2	F3
Purslane Plant Extract	6,25	6,25	6,25
VCO	25	30	35
Olive Oil	15	15	15
NaOH	9	9	9
Cocamid Dea	10	10	10
Olium Rosae	0,5	0,5	0,5
Aquadest ad	100	100	100
Purslane Plant Extract	6,25	6,25	6,25

4. Evaluation of Purslane Plant Extract Solid Soap

Organoleptis evaluation

Organoleptik testing is performed by visually observing the texture, scent, and color of the solid (Sari *et al.*, 2024).

Homogeneity evaluation

After preparing approximately 0,5 gram of soap, the soap was rubbed against the glass surface to observe its homogeneity. This test was designed to assess the physical uniformity of the object. If there are no lumps or large chunks in any of the soap mixture components, the mixture is assumed to be a homogen (Febriani *et al.*, 2020).

pH Evaluation

The pH was determined using a pH meter. The calibrated electrode was dipped into a solution prepared for evaluation, which was made from 1 gram of soap that was liquidified with 10mL of distilled water (Febriani *et al.*, 2020).

Foam Power and Foam Stability Evaluation

Foam power and foam stability are determined by the cylinder shaker method. The sample was then weighed to 1 g, placed in a reaction tube, and distilled water was added until it reached 10 mL, shaken by rotating the reaction tube 10 times, and the height of the foam formed was measured. The tube was then allowed to sit for 5 minute, and the foam was gauged again after 5 minute (Sari *et al.*, 2024).

$$\% \text{ Foam lost} = \frac{nitial\ foam\ height - final\ foam\ heigh}{Initial\ foam\ heigh} \text{ x } 100\%$$

$$\text{Foam stability} = 100\% - \% \text{ foam lost}$$

5. Anti-bacterial Activity Evaluation

Antibacterial Soap was tested by disc diffusion onto *Staphylococcus aureus* bacteria, and a bacterial culture was prepared by inoculating one test colony of an organism in *Tryptic Soy Agar* (TSA). The soap solution was pipetted onto a sterile disc paper 6 mm in size. The paper disc was then dried with laminar airflow before being moved to a bacterial inoculum containing TSA. Dettol® bar soap was used as a positive control, and distilled water was used as a negative control. The mixture was then incubated at 37°C for 24 Hour. Testing was done for 3 times. Zones of inhibition were observed during the incubation period (Sari *et al.*, 2024).

RESULTS AND DISCUSSION

The ingredients used in this study were purslane plants (*Portulaca oleracea*) taken from Muara Rungga Village, Empat Lawang Regency, South Sumatera Province. The

purslane plant was verified by the Laboratory of Mathematics and Science, Faculty of Bengkulu University. The species of the purslane plant (*Portulaca oleracea) belong to* the caryophyllales and Portulacaceae families. Out of 500 g extracted, macerated with 96% ethanol and concentrated using *a rotary evaporator* from the simplicia of a purslane plant obtained the results of 10,23% yield with a brownish green color and a distinctive aroma of purslane plant.

Figure 1. Purslane plant extract

The extraction purslane plant using 96% ethanol attracts more metabolite compounds than using chloroform solvent, so that the solvent used in this research is 96% ethanol (Londonkar and Nayaka, 2011). Fitochemical screening results showed that purslane plants contain phenolic compounds, alkaloids, saponins, steroids, tanin, and glicocide compounds (Iranshahy *et al.*, 2017). Tanin-containing inpurslane acts as an anti-inflammatory and antibacterial agent (Liu *et al.*, 2023). Based on these results, the ingredients of bar soap made of purslane plant can be used as an antibacterial bar soap. In this study, 3 formulas of solid soap purslane plant extract concentrat were prepared each with 6,25% formulation dan variation of VCO, which is F1 (25%), F2 (30%), and F3 (35%). Solid soap was prepared using the *Hot Process* method, a method of soap production that heats up until it rechs around 60°-70°C. In a previous study, purslane plant extract at 6,25% concentration already had an anti-bacterial effect (Artini, 2022). VCO is rich in saturated fatty acids, similar to lauric acid, which could improve the stability of foam and provide effective cleaning properties, as well as repair foam texture, which makes creamy and soft foam. VCO also contains lauric acid, which exhibits antibacterial properties. It can help fight bacteria and viruses on the skin (Mena *et al.*, 2020). Evaluations performed on solid soap made from purslane plants include organoleptis, pH, homogeneity, foam power, foam stability, and antibacterial activity of *Staphylococcus aureus* bacteria.

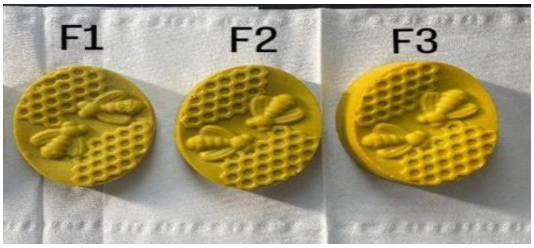

Figure 2. Solid Soap Made from Purslane Plant Extract

Solid Soap made of Purslane Plant Extract Evaluation

Organoleptic testing of solid soap purslane extract was performed through physical observation of the soap by looking at the aroma, shape, and color of the soap. The soap was scented, and the addition of aroma was done because of the unpleasant smell of the purslane extract. The consistency is difficult because VCO contains a large amount of lauric acid and myristate acid that results in a rigid soap consistency (Ataya and Rohman, 2022). The color

of the solid soap purslane extract was yellow, as indicated by the purslane plant extract content.

Homogeneity testing of ingredients extracted from the purslane plant resulted in F1, F2, and F3, indicating that all of them were homogenic because there was no lump, and coarse grains were found while the soap had a great color spread. The results of homogeneity testing indicated that the ingredients of the purslane plant extract were qualified.

pH testing is needed for the sake of the condition by SNI 3532:2021; soap can cause skin irritation if the soap pH is too high, pH, which is relatively based on soap, can improve cleaning, causing pores on the skin so that foams can bind more dirt (Sari *et al.*, 2010). The average results of pH testing from the three formulas are 10,56 which means that it is still suitable for SNI 3532:2021 (6,00-11,00) requirement bases that come from the soap is influenced by the curing process, and it is affected by the length of time during the curing process; the longer the curing process, the smaller the pH (Widyasanti *et al.*, 2018). This was also caused by the amount of NaOH, which has strong bases that affect the base pH of the soap.

Table II. Results of Evaluation of Purslane Plant Extract Solid Fiber

Evaluation	Concentration			Syarat (SNI 3532:2021)
	F1	F2	F3	
Organoleptic	Rose scented, hard consistency, yellow coloured	Rose scented, hard consistency, yellow coloured	Rose scented, hard consistency, yellow coloured	-
Homogeneity	Homogen	Homogen	Homogen	-
pH	10,76 ± 0,025	10,57 ± 0,005	10,44 ± 0,011	6,00-11,00

Testing was performed on the foam because the amount of foam is an important factor affecting consumer acceptance. On average, the foam on solid soap purslane extract was 13,89 cm. Foam power and foam stability do not have any parameters, so its gauge is tested by testing the acceptance of the consumer. The lauric acid contained in the soap can provide good and thick foaming, even though it does not have a long lifespan. In addition, lauric acid miristate acid contained in VCO provides high Foam Power for soap (Ataya and Rohman, 2022).

There is no minimum or maximum requirement for foam stability. The foam stability result is obtained from the percentage of foam loss averaged from three formulas between 31,46%-34,12%, with an average foam stability of 65,88-68,53%, the lower the foam loss, the better the foam stability.

Table III. Results of Evaluation Foam Height and Foam Stability of Purslane plant Solid Soap

Concentration	Repetition						Average (%)	Stabilitas (%)
	Initial	Initial	Initial	Final	Final	Final		
F1	13	14	13	9	9	9	31,46 ± 1,21	68,53± 1,21
F2	14	13	14	9	9	9	32,16 ± 1,21	67,87± 1,21
F3	15	14	15	10	9	10	34,12 ± 1,37	65,88± 1,37

Soap antibacterial activity was tested using a disc diffusion test on *Staphylococcus aureus* bacteria. Aquadest was used as the negative control, and dettol solid soap was used as

the positive control. The effective antibacterial activity can be determined based on the largest clear zone diameter with the smallest concentration. The diameter of the inhibition zone is affected by many different factors, such as the method of spreading bacterial suspensions grown in media, less even distribution, substance concentration on the disc, and bacterial sensitivity to the substance. The inhibition of bacterial growth was classified into 4 groups: weak response (0–3 mm), medium (3-6), and strong (>6 mm) (Oktavia and Pujiyanto, 2018). Based on these classifications, the purslane plant solid soap solution has inhibitory effects against Staphylococcus aureus bacteria. Based on the antibacterial activity test on purslane plant bar soap, there was inhibitory power from the soap itself, as shown in **Table IV**.

Table IV. Antibacterial Activity Evaluation Results of Purslane Plant Extract Solid Soap

Formula	Inhibitory Zone Diameter			Average	Category
	I	II	III		
F1	3,2	3,2	3,25	3,21 ± 0,023	Weak
F2	4,25	4,4	4,15	4,26 ± 0,102	Weak
F3	5,25	5,25	5,1	5,2 ± 0,070	Weak
K-	0	0	0	0	-
K+	0	0	0	0	-

Based on antibacterial activity test gathered inhibitory power of F1 3,21 ± 0,023 weak category, F2 4,26 ± 0,102 weak category, F3 5,2 ± 0,070 weak category. valuation report resulted in variations in each formula for inhibitory power. Besides Purslane Plant extract, which has an anti-bacterial effect, VCO contains fatty acids, such as medium-chain fatty acids (MCFA) and medium-chain triglycerides (MCT), which affect the test results. MCFA containing lauric acid have antiviral, antibacterial, and antiprotozoal properties (Zuniarto *et al.*, 2024). These issues were caused by imperfections while dissolving the positive control soap so that the substance was still left out in the solution, which requires a long time to dissolve soap.

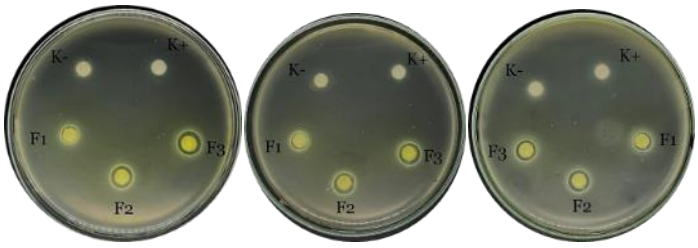

Figure 3. Inhibitory Zone on The Evaluation Anti-Bacterial Activity on Purslane Plant Extract Soap.

CONCLUSION

Based on the research it shows that purslane plant extract combined with VCO Variation can be formulated into solid soap that qualifies based on organoleptic, homogeneity, foam power, and foam stability evaluation. Researched ingredients sample have the antibacterial activity to *staphylococcus aureus* bacteria. Minimum inhibitory concentration of solid soap towards *Staphylococcus aureus* concentated at F1 3,21 ± 0,023 weak category, F2 4,26 ± 0,102 weak category, F3 5,2 ± 0,070 weak category.

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