Characteristics of *Sargassum plagyophillum* Extract as An Active Compound on Non-Alcoholic Hand Sanitizer

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**Abstract.** Excessive use of non-alcoholic hand sanitizers irritate to the skin, moreover a burning effect, that alternative natural active compound is required, namely *Sargassum plagyophillum* extract. *S. plagyophillum* extract contains secondary metabolites that can act as antibacterial and can moisturize the skin. This research aimed to determine the microbiological and physical characteristics of *S. plagyophillum* of the non-alcoholic hand sanitizer. The sample used in this research was 2% *S. plagyophillum* extract obtained by maceration using methanol. The production of non-alcoholic hand sanitizers was conducted using other ingredients such as carbopol, triethanolamine, methyl paraben, propilen glycol, and distilled water. The test parameters were testing for gram-positive and gram-negative antibacterial activity, pH, and viscosity. The results showed that non-alcoholic hand sanitizer containing 2% *S. plagyophillum* extract had characteristics in the form of a gel with gram positive antibacterial activity (*Listeria monocytogenes*) with an inhibition zone of 2.50 mm, while gram negative antibacterial activity (*Pseudomonas aeruginosa*) with an inhibition zone of 4.33 mm. Subsequently, the pH value produced from the hand sanitizer containing *S. plagyophillum* was in accordance with recommended skin pH of 7.33. Meanwhile, based on the value of the viscosity, the hand sanitizer containing *S. plagyophillum* had a viscosity value according to the viscosity standard, namely 2600 cPs.

### 1. Introduction

Hand sanitizer is an antiseptic substance that contains active compounds in the form of antimicrobial agents that can inhibit the growth of gram negative and gram positive bacteria on the hands [1]. One of the active compounds contained in hand sanitizer is alcohol. Alcohol is usually used as an active compounds in hand sanitizers with a percentage of 60-95%, the alcohol has good bactericidal activity against gram-negative and gram positive bacteria with the ability to remove germs on hands in less than 30 seconds [2].

Currently, the use of hand sanitizers is increasing in line with the recommendations of the Indonesian government in implementing health protocols for activities during the COVID-19 pandemic to prevent or break the chain of the spread of COVID-19. The use of hand sanitizers is more effective and more efficient when compared to handwashing with soap and water. However, currently the most widely circulated hand sanitizer are hand sanitizers containing alcohol. Excessive of alcohol-based hand sanitizers will cause negative effects in terms of fire hazards and skin toxicity [3]. Moreover, alcohol also has a drying effect on hands which can further cause the skin to crack or peel [4].
The negative effects of hand sanitizers required another alternative as a substitute for the active compounds of alcohol in the term of natural active compounds that have the potential as antiseptic or antibacterial activities. One alternative natural active compounds for production of hand sanitizers can be found from bioactive compounds produced from aquatic resources, specifically *Sargassum* sp.

*Sargassum* sp., one species of brown seaweed, contains phenolic compounds, saponins, and flavonoids which have antibacterial activity with a diameter of inhibition against *Staphylococcus aureus* bacteria [5]. Furthermore, the antioxidant content in *Sargassum* sp. seaweed can prevent skin cells from being damaged by dryness of the skin that the skin is kept moist [6]. Based on these, the research aimed to determine the microbiological and physical characteristics of *S. plagyophillum* of the non-alcoholic hand sanitizer.

2. Methodology

2.1. Materials and Equipment

The main materials used in this research were 2% *Sargassum plagyophillum* extract obtained by maceration using methanol. The materials for production of hand sanitizers were carbopol, triethylanolamine, propylene glycol, methyl paraben, distilled water. The main tools used in this research include pH meter, viscometer, magnetic stirrer, and hot plate.

2.2. Production of non-alcoholic hand sanitizers

Some of carbops are manufactured by dispersing 0.5% carbopol with 50 mL of distilled water which has been heated to a temperature of 70 °C, allowed to expand and crushed until homogenous and left for 24 hours, then added 5 drops triethylanolamine (TEA) to form a mass of A. Methyl paraben and 2% extract of *Sargassum* sp. Dissolved in 15% propylene glycol until mass B is form. Therefore, mass B is added gradually into mass A, stirred until homogeneous, and the remaining water is added to form a hand sanitizer gel [7].

2.3. Microbiological analysis

Microbiological analysis on non-alcohol hand sanitizer was conducted based on the well diffusion method by determining the inhibition zone diameters of gram-positive bacteria (*Listeria monocytogenes*) and gram-negative bacteria (*Pseudomonas aeruginosa*) formed on Mueller Hinton Agar to which non-alcoholic hand sanitizer containing 2% *S. Plagyophillum* extract was added [8] [9].

2.4. Physical analysis

Physical analysis of non-alcoholic hand sanitizers consisted of pH test using a pH meter [10] and viscosity using a Brookfield viscometer [11].

3. Results and Discussions

3.1. Microbiological characteristics of non-alcoholic hand sanitizer

The microbiological characteristics of non-alcohol hand sanitizer containing 2% *S. plagyophillum* extract tested on gram-negative bacteria (*P. aeruginosa*) and gram-positive bacteria (*L. monocytogenes*) are presented in Table 1. The hand sanitizer containing 2% *S. plagyophillum* extract showed antibacterial activity against *P. aeruginosa* bacteria and *L. monocytogenes* (Figure 1).
Table 1. Microbiological characteristics of non-alcohol hand sanitizer containing 2% *S. plagyophyllum* extract.

| Types of bacteria       | Hand sanitizer containing 2% *S. plagyophyllum* |
|-------------------------|-------------------------------------------------|
| *Pseudomonas aeruginosa*| +                                               |
| *Listeria monocytogenes*| +                                               |

Information: (+) = inhibition zone

Figure 1. Inhibition zone diameters of pathogenic bacteria in non-alcoholic hand sanitizer

Table 1 showed that non-alcoholic hand sanitizer containing 2% *S.plagyophyllum* extract had bacterial inhibitory activity on both *P. aeruginosa* bacteria and *L. monocytogenes* bacteria which is characterized by the formation of an inhibition zone. The inhibition zone formed was presumably because the seaweed contained bioactive compounds as antibacterial, thus inhibiting the growth of the bacteria. [12] stated that the antibacterial activity could be determined from the diameter of the inhibition zone formed.

Figure 1 showed that non-alcoholic hand sanitizer containing 2% *S.plagyophyllum* extract had an inhibition zone diameters of *L. monocytogenes* of 2.50±0.50 mm and 4.33±0.76 mm of *P. aeruginosa* bacteria. This research was in line with [12] stated that *S.plagyophyllum* extract with a concentration of 2% had antibacterial activity of *L. monocytogenes* with an inhibition zone diameter of 2.67 mm, while the antibacterial activity of *P. aeruginosa* with an inhibition zone diameter of 4.00 mm. This indicated that there was no significant difference the antibacterial activity between *S.plagyophyllum* extract and *S.plagyophyllum* extract in non-alcoholic hand sanitizer.

Antibacterial activity on *Sargassum* sp. is presumably due to the presence of sulfated polysaccharides contained in the *Sargassum* picocolid group [13] [14]. The bioactive compounds in *Sargassum* sp. consisted of a terpenoid group that had the potential as antibacterial against *P. aeruginosa* bacteria [15], while the fucoxanthin group had an antibacterial effect against *L. monocytogenes* bacteria [16], then *Sargassum* sp. also contained bioactive compounds from the alginate and fucoidan groups which had biological effects as antivirals [17].
3.2. Physical characteristics of non-alcoholic hand sanitizer

Physical characteristics of non-alcoholic hand sanitizer containing 2% *S. plagyophillum* extract in the form of a gel, thick texture, and pure white color (Figure 2). Furthermore, other physical characteristics consisting of pH and viscosity was presented in Table 2.

![Figure 2. Non-alcoholic hand sanitizer containing 2% S. plagyophillum extract](image)

| Parameter     | Hand sanitizer containing 2% *S. plagyophillum* |
|---------------|-----------------------------------------------|
| Texture       | gel                                           |
| Color         | Pure white                                    |
| pH            | 7.33±0.12                                     |
| Viscosity     | 2600 cPs                                      |

pH analysis is a quality requirement in the manufacture of hand sanitizers because the pH of the hand sanitizer will affect the pH of the skin [18]. Non-alcoholic hand sanitizer containing 2% *S. plagyophillum* extract had a pH of 7.33±0.12 (Figure 2). This pH value was higher than the pH of non-alcoholic hand sanitizer containing 8% *Eucheuma spinosum* extract (5.83 mm) [18]. The pH value of the hand sanitizer gel is affected by the pH value from the active compound. However, the pH corresponds to a pH that was safe for the skin. The pH in the range of 6-7 still fulfilled the safe pH requirements for normal skin [19].

Furthermore, the viscosity test aimed to determine the viscosity value of the hand sanitizer that affected the use of drugs topically. The higher the viscosity value will have an impact on the thicker the product, making it difficult for application to the skin [20]. The viscosity obtained in non-alcoholic hand sanitizer containing 2% *S. plagyophillum* extract was 2600 cPs (according to the standard). The normal viscosity standard ranged from 2000 – 4000 cPs [11].

4. Conclusion

Non-alcoholic hand sanitizer containing 2% *S. plagyophillum* extract had characteristics in the form of a gel with gram positive antibacterial activity (*Listeria monocytogenes*) with an inhibition zone of 2.50 mm, while gram negative antibacterial activity (*Pseudomonas aeruginosa*) with an inhibition zone of 4.33 mm. Subsequently, the pH value produced from the hand sanitizer containing *S. plagyophillum* was in accordance with recommended skin pH of 7.40. Meanwhile, based on the value of the
viscosity, the hand sanitizer containing *S. plagyophillum* had a viscosity value according to the viscosity standard, namely 2600 cPs.

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