Utilization of agar *Gracilaria* sp. as a natural thickener on liquid bath soap formulation

L R Dita¹, Sudarno¹, J Triastuti¹,²

¹Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Airlangga University, 60286 Surabaya, East Java, Indonesia.
²Corresponding author: juni.triastuti@fpk.unair.ac.id

Abstract. Agar *Gracilaria* sp. is potential seaweed in Indonesia with largely opportunity to be used as raw material for cosmetics, especially skincare creams, lotions, powder, lipstick, facial makeup, and soap. Liquid bath soap is one of the cosmetics that require thickener in the composition, which often generally uses carcinogenic cocamide DEA. On the other hand, agar *Gracilaria* sp. has a gelling agent capable of having a thickening effect on certain products such as liquid bath soap. This study aimed to determine the potential of agar *Gracilaria* sp. as a thickener agent in liquid bath soap as a cocamide DEA substitute. This study used agar *Gracilaria* sp. with a percentage of 0, 1, 2% and 1% cocamide DEA. Parameters determined were the viscosity, pH, specific gravity, microbial contamination, and organoleptic. Data were analyzed using analysis of variance (ANOVA) and Duncan test, while organoleptic data analysis used the Kruskal Wallis test. The study results showed that the addition of 1% *Gracilaria* sp. agar had 762.22 cPs viscosity, pH 9.06, 1.05 g/ml specific gravity, and <1x10¹ colonies/ml microbial contamination.

1. Introduction

The enormous potential of seaweed in Indonesia has the opportunity to be utilized in industries, such as pharmaceuticals, cosmetics, textiles, food, and others. One derivative result of seaweed that has been widely used in the industrial field is agar [1]. Agar is a linear polysaccharide and galactan molecule extracted from the red seaweed. Indonesia has utilized agar producing seaweed, one of which is good prospect is *Gracilaria* sp. seaweed [2]. Agar has been widely utilized in various fields as thickener, emulsifier, stabilizer, and other functions in food [3].

The utilization of cocamide DEA or cocamide diethanolamine in liquid bath soap nowadays will cause cancer disease, if used for a long period. The Office of Environmental Health Hazard Assessment [4] in California established cocamide DEA in the list of chemicals that can cause cancer. Cocamide DEA was also assigned as 2B carcinogenic group by The International Agency Research on Cancer [5]. 2B carcinogenic group is “Possibly carcinogenic to humans”.

Considering the problem above, this study was conducted with the aim to determine the influence of *Gracilaria* sp. agar as a potential natural thickener in the formulation of liquid bath soap based on the standard quality and consumer acceptance rate. This study is expected to provide information on natural thickening material that can substitute the harmful cocamide DEA on the composition of liquid
bath soap. The utilization of agar *Gracilaria* sp. as a natural thickener makes the liquid bath soap produced safely for consumers.

2. Material and methods

This study was conducted on February - June 2018 in the laboratory of Chemistry and Microbiology, Faculty of Fisheries and Marine, Universitas Airlangga. Agar *Gracilaria* sp. samples were obtained from PT. Surya Indoalgas. The study model used a completely randomized design method with four liquid bath soap formulations, namely P0 (blank), P1 (1% cocamide DEA), P2 (1% agar *Gracilaria* sp.), and P3 (2% agar *Gracilaria* sp.). Viscosity, pH, specific gravity, microbial contamination and organoleptic test were performed in this study.

3. Result and discussion

The study results of agar *Gracilaria* sp. as natural thickener on liquid bath soap formulation comprised viscosity, pH, specific gravity, and microbial contamination test are presented on Table 1.

| Test                        | Formulation | SNI 06-4085-1996 |
|-----------------------------|-------------|------------------|
|                             | P0  | P1  | P2  | P3  |               |
| Viscosity (cPs)             | 417.91±190.29 | 685.86±224.36 | 762.22b | 1.355,4a | -               |
| pH                          | 9.18±0.08  | 9.37±0.09       | ±135.96 | ±212.73 | 6-11             |
| Specific gravity (g/ml)     | 1.09±0.01  | 1.07±0.01       | 9.06±0.14 | 1.06±0.01 | 1.01-1.10        |
| Microbial contamination     | <1x10³    | <1x10³         | <1x10³  | <1x10³  | Maks. 1 x 10³   |
| (colony/ml)                 |             |               |               |               |                   |

Note: Notation presented as different superscript letters on the table indicate a significant difference (P<0.005) from the formulation treatment against viscosity, pH, and specific gravity value.

The viscosity data of P0, P1, P2, and P3 were within the range of 400-4000 cPs [6]. P2 formulation of liquid bath soap with the addition of 1% agar *Gracilaria* sp. has the same notation with P1 formulation. Cocamide DEA content in P1 formulation is composed of fatty acids and amine is carcinogenic. Cocamide DEA is utilized as a thickener component for shampoo, hand soap, and other cosmetic preparations thus should be replaced with natural ingredients such as agar. This is because agar is useful to turn the liquid into elastic solid or sol shape into gel [7]. According to [8], this gel formation occurs as a result of agarose molecules merging formed as randomized scrolls into a double helix, then jointly forming several chain parts. The organoleptic test indicated no significant difference in the viscosity aspect (P<0.05). This means that the viscosity of liquid bath soap looks the same in front of the consumer's eyes. According to [9], the viscosity of liquid soap affects consumer acceptance and appropriate container determination.

Data on Table 1 shows the study result required SNI 06-4085-1996. Liquid bath soap products had base pH because the basic ingredients is detergent and citric acid. Citric acid in the solution can form H⁺, thus causing more number of dissociated acids. More number of dissociated acids results in increased H⁺ ion and decreased pH content [10]. Meanwhile, specific gravity value is the relative comparison between the substance and pure water density at the same volume and temperature [11]. The measurement of specific gravity aims to determine the quality and purity of the compound, especially the liquid bath soap produced. In addition, ingredients dissolved into the water will further form a solution with altered specific gravity [12].

This study showed that there was no microbial contamination found in the liquid bath soap as this product is not for the microbial growth. According to [13], microbes can develop
optimum with pH ranging from 3.8-5.6 and 22-37°C temperature. One ingredient of liquid bath soap is sodium chloride with microorganism killing capability [14].

| Test               | Formulation |
|--------------------|-------------|
| Appearance         | P0          | P1          | P2          | P3          |
|                    | 7.17±0.99   | 7.10±1      | 6.30±1.12   | 5.63±1.5    |
| Aroma              | 6.87±1.2    | 6.70±1.26   | 6.53±1.48   | 6.87±1.05   |
| Thickness          | 5.83±1.6    | 6.23±1.39   | 6.00±1.7    | 6.17±1.49   |
| Foam               | 6.03±1.75   | 5.87±1.33   | 6.03±1.54   | 5.73±1.87   |
| Slippery effect    | 6.03±1.22   | 6.00±1.15   | 6.57±1.22   | 6.40±1.25   |
| Soft impression    | 6.23±0.9    | 6.20±1.06   | 6.77±1.14   | 6.30±1.18   |

Note: Notation presented as different superscript letters on the table indicate a significant difference (P<0.05) from the formulation treatment against organoleptic value.

The organoleptic value of liquid bath soap comprised appearance, aroma, viscosity, foam, slippery effect, and the soft impression has the same notation for all formulations in Table 2. Nonetheless, the aroma of all liquid bath soap products was covered by the perfume ingredient in the formulation. This was in line with [6], who explained that perfume is an ingredient added in a cosmetic product to cover the unpleasant aroma of other ingredients and give a refreshing fragrance for the user. Foam, slippery effect, and soft impression were not influenced by the addition of agar Gracilaria sp. and cocamide DEA. The study result for appearance was conducted by visual observation using human visual sense. The appearance result indicated no murky characteristic as all materials used were dissolved perfectly. Meanwhile, the addition of agar Gracilaria sp. in the formulation tends to be murky as this material contains fiber content which is insoluble. However, the murky characteristic is not negative value, instead of giving a positive value for the soap product with dye addition to creating better and attractive color gradation.

4. Conclusion
Agar Gracilaria sp. is potentially utilized as a natural thickener on liquid bath soap formulation.

5. References
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