The Potential and Application of *Eucheuma* sp. for Solid Soap: A Review

T Wahyuni*  
1 Research Centre for Marine Fisheries Product Processing and Biotechnology, Ministry of Marine Affairs and Fisheries of Indonesia, Jakarta, Indonesia  
Email: twahyuni@gmail.com

Abstract. Soap is a daily necessity for cleaning the body and face. There are many types of soap products on the market that soap is containing Sodium Lauryl Sulphate (SLS) / Sodium Laureth Sulphate (SLES) and SLS / SLES free soap. Mostly, mass-produced soap (cosmetic industry) and home industry use additives by utilizing the potential of natural resources from terrestrial and marine. This paper is a review on the potential of marine resource that is *Eucheuma* sp. for solid soap, especially SLS / SLES free solid soap. The results of several research of soap formulation using seaweed as raw materials have been done that were extraction of *Eucheuma* sp. using maceration method by alcohol compounds solvent and water solvent. This review article is expected to be a reference for researcher and algae soap entrepreneurs in determining their formulation by paying attention to methods that are environmentally friendly and easy to adopt.

1. Introduction

Soap is a skin care cosmetic that functions as a body and face cleanser. Bath soap or cleansing soap is generally in solid soap and liquid soap, while facial cleansing soap is usually in solid soap and gel soap. Today, the society’s trending to use soap is not only about cleansing the body and face but is also based on the health benefits for the skin and is safe for the body. Soaps made from natural, environmentally friendly, and affordable extracts are increasingly in demand. The cosmetic industry is trying to meet market demand and attract consumers’ attention by using soap raw materials from terrestrial and marine resources. Terrestrial resources such as various types of plants (alo vera, moringa, green tea, peppermint, clove, dandelion, etc.), various types of fruits (strawberries, oranges, papaya, etc.), various types of vegetable oils (olive oil, coconut oil, sunflower oil, avocado oil, etc.) and many other types have been developed as raw materials for soap. Similarly, the community are starting to be interested a soap product that based on marine resources, such as soap made from fish collagen, chitosan, and seaweed as raw material.

Seaweed (algae) is a resource with abundant biomass in the oceans and has been known as a source of good nutrition for the health of the human body [1]. Seaweed extract has been developed as an additive for liquid soap [2,3] and solid soap [4,5,6] products so that produce quality soap to maintain skin health and beauty. In demand of consumer, some cosmetic manufacturers use seaweed as raw material for soap, especially facial soap. The Body Shop® uses algae extract from Laminaria saccharina. Famous brands in Indonesia such as Martha Tilaar® uses Undaria pinnatifida and Wardah® uses Ulva lactuca. The local brand Ocean Fresh®, which is also gaining popularity in the marketplace, has used seaweed as a natural raw material from red algae extract that carrageenan is composed with other marine ingredients such as chitosan (shrimp, crab, and small crab shells), marine collagen and mango.

This paper studies the potential of *Eucheuma* sp. as a raw material for solid soap products. The results of this study are expected to become a reference for researchers to carry out further research on solid soap using *Eucheuma cottonii* as raw material to produce quality soap and as a reference for soap entrepreneurs in the production of seaweed solid soap with a technology that is easy to adopt and environmentally friendly.
2. *Eucheuma* sp. and its use as a solid soap raw material

Indonesia's marine is known to be very rich in diversity, both genetic and biological compounds. It is not enough to be proud of the wealth of marine resources that we have, but it is necessary an effort to utilize these sources and biodiversity optimally. According to [7], the use of natural materials from tropical marine is still classified as very low, which is about <50 types of compounds per year rather than subtropical marine which are classified as very high, which can reach >200 types of compounds per year. Research on exploration of marine resources in Indonesia has been done to take advantage of marine natural materials and to find natural ingredients that are needed by the global market [8].

Seaweed is the algae of macro-sized with biomass that is mostly found in intertidal areas and sufficient sunlight. Seaweed has been shown to produce active metabolic compounds that are beneficial to human health [9]. Indonesia has relatively clear waters and a tropical climate so that it supports seaweed agriculture throughout the year, the cultivation area for seaweed is estimated to reach 1,110,900 ha spread from Maluku, Gorontalo, Central Sulawesi, South Sulawesi, Southeast Sulawesi, East Nusa Tenggara, Nusa Tenggara West Southeast, Bali, East Java, West Java, to Sumatra. However, around 222,180 ha or about 20% of the cultivation area is only used as a seaweed producer [10]. In 2005, Indonesia became the largest producer of seaweed *Eucheuma* sp. and *Gracilaria* sp. [10].

The exploration and utilization of *Eucheuma* sp. which a type of red seaweed, as a raw material for cosmetic has be of interest to the industry and it is being developed. Today, cosmetic users are selective to choose a soap that not only functions to clean but also choose a soap that functions to treat skin health safely without side effects. Generally, soap products that function as body cleansers and facial cleansers use synthetic commercial raw materials as a source of moisturizers such as Propylene Glycol. However, for sensitive skin, Propylene Glycol has allergen properties that have a negative impact on skin tissue such as irritation and inflammation [11,12]. Thus, an alternative source of natural moisturizer is needed as a raw material for solid soap to produce soap products that are safe for consumers.

Soap is the sodium or potassium compound with fatty acids from vegetable oils and / or animal fats that is a solid, soft, liquid or foaming form which is used as a cleanser, by adding fragrance, and other ingredients and do not hazard health [13]. According to [14], solid bath soap is a solid cosmetic preparation that is used when bathing to clean the skin. Generally, solid soap functions as a bath soap and facial cleanser.

According to [15] that along with the development of the soap industry and aiming to reduce production costs, soap raw materials derived from vegetable oils and animal fats are substituted with synthetic surfactants, namely Sodium Laureth Sulfate / Sodium Lauryl Sulfate (SLES / SLS) and sodium palmitate is derived from byproducts / waste of vegetable oil industry. The use of SLES / SLS raw materials in soap making produces soap that erodes the fat layer on the skin so that the skin becomes dry, bearish and irritates for the sensitive skin, this happens because SLES / SLS is a surfactant material that has a high concentration of clean power. Meanwhile, The SLES / SLS-free soap does not cause dryness or skin irritation because SLES / SLS-free soap is made from the reaction of vegetable oils and/or animal oils with alkaline compounds. Currently, some people are starting to become aware and change to using SLES / SLS free soap with the aim of maintaining healthy skin.

This paper studies the potential and application of *Eucheuma* sp. as a moisturizing ingredient in SLES/SLS free solid soap making. According to [16,17] *Eucheuma* sp contains carrageenan as a polymer compound that can be used for moisturizing and antioxidants in cosmetics [18] so that the addition of seaweed extract to soap will produce a soap containing antioxidants to prevent premature aging and according to [19] soap which is added with seaweed gives a moist effect on the skin so that the skin does not desiccate.

Usually, the use of seaweed, especially *Eucheuma* sp. as a cosmetic raw material uses the maceration method with solvent alcohol compounds so that it becomes the active ingredient of carrageenan in antiseptic solid soap products [20], hand washing liquid soap [21] and skin lotion

---

2
In addition to using the maceration method, a heating extraction method has also been carried out using water solvents to produce seaweed porridge as raw material for cosmetics such as SLES / SLS-free soap products [24] and seaweed porridge without heating on mask products [25], sunscreen [26], skin lightening cream [27] and lip balm [28]. This paper will inform about the application of *Eucheuma* sp. as a cosmetic raw material for SLES / SLS free solid soap products.

2.1 Application of *Eucheuma* sp. Extract as a Solid Soap Raw Material

*Eucheuma* sp. contains marine active ingredient that has the potential to produce carrageenan. Carrageenan is a generic name for a family of hydrophilic polysaccharides with extremely effective thickening and gelling properties. It is used in numerous health and beauty products to provide texture and consistency because carrageenan has hygroscopic properties that give it a moist and soft effect on the skin [29]. *Eucheuma* sp seaweed extract produces carrageenan, one of which is used for non-food that is as an additive for solid soap. The research of *Eucheuma cottonii* extract to solid soap products has been done [30].

| Parameters       | Solid soap with extract of *Eucheuma cottonii* 0% | Solid soap with extract of *Eucheuma cottonii* 3.5% |
|------------------|--------------------------------------------------|--------------------------------------------------|
| Antioxidant      | -3.053 ± 2.63%                                   | 10.296 ± 0.54%                                   |
| Water content    | 11.125 ± 0.195%                                  | 8.54 ± 0.192%                                    |
| Free fatty acid  | 3.752 ± 0.69%                                    | 2.595 ± 0.67%                                    |
| pH               | 11.612 ± 0.167                                   | 9.463 ± 0.189                                    |
| Hardness         | 686.5 gf                                         | 1134.42 gf                                       |
| Stability of foam| 79.63 ± 0.63%                                    | 84.48 ± 1.22%                                    |

Table 1 showed that the addition of *Eucheuma cottonii* extract 3.5% in making solid soap will affect its antioxidant activity. Soap with the addition of *Eucheuma cottonii* extract 3.5% will have higher antioxidant activity than without the addition of *Eucheuma cottonii* extract. The physicochemical characters of soap by adding *Eucheuma cottonii* 3.5% is in accordance with soap SNI 2016 requirements.

The antioxidant activity is the effect of phenolic compounds extracted *Eucheuma cottonii*. The results of sany's research [30] reported that solid soap with *Eucheuma cottonii* extract contained phenolic compounds that are 86.540 ppm, 18.289 ppm, 513.750 ppm, and 809.000 ppm for alkaloids, flavonoids, phenols, and saponins, respectively. Phenolic compounds were obtained from *Eucheuma cottonii* extract using the maceration method with 60% methanol as a solvent, which is a ratio of 1: 1 (w / v) for 3x24 hours. The solvent was changed every 24 hours. After then filtering was carried out using filter paper and evaporated with a rotary evaporator at the temperature of 40°C. The dry extract of *Eucheuma cottonii* obtained were the oven managed at 40°C [30]. *Eucheuma cottonii* extraction by maceration method using alcohol compound solvent produces a byproduct that is solvent residue (alcohol compound). In this case, it needs to be used as a thought and further research in making solid soap using *Eucheuma cottonii* extract without a by-product, so it is more environmentally friendly.

2.2 Application of *Eucheuma* sp. Porridge as a Solid Soap Raw Material

Algae is developed in cosmetic products by utilizing its physico-chemical characteristics, specially forming a gel, viscosity, binding to water, and binding to ions so that it functions to resist moisture [31]. Research on Algae of *Eucheuma cottonii* porridge has been widely developed in the field of cosmetics such as masks [25], sunscreens [26], lip balms [28], and solid soaps [24].
Dolorosa [27] conducted a study on the qualitative content of *Eucheuma cottonii* porridge bioactive compounds. *Eucheuma cottonii* porridge contains bioactive components that are alkaloids and terpenoids [27]. Alkaloids and terpenoids are phenolic compounds that function as antioxidants. The addition of *Eucheuma cottonii* porridge has the potential to improve the quality of soap products. Making SLS / SLES free of solid soap using additional ingredients of *Eucheuma cottonii* porridge produces a softer and more moist quality soap on the skin with a pH of 9-10 [24].

The process of making *Eucheuma cottonii* porridge uses the homogenization method with demineralization solvent then heated at the temperature of 40-60 C for 1 hour with the aim of softening the texture [24]. Furthermore, the process of making *Eucheuma cottonii* porridge can be produced by homogenizing it using deionized water and then crushing by a blender [27]. Thus, *Eucheuma cottonii* has the potential to become a solid soap product by applying *Eucheuma cottonii* porridge in the process of making solid soap. *Eucheuma cottonii* porridge application is certainly easier to adopt and environmentally friendly than the application of seaweed extract which produces solvent by-products (residual alcohol compounds). However, it still needs further research to produce quality solid soap using additives of *Eucheuma cottonii* porridge, specially research on the addition of seaweed porridge with various methods and comparing the quality of soap products in physico-chemistry characteristics.

3. Methods

During performing this review, it was explored from some databases such as Scopus, ResearchGate, and Google Scholar to identify and to download the abstracts, reports, review articles, research papers, and patents related to the potential of *Eucheuma* sp for solid soap. The keywords used during searching of information were seaweed cosmetics (or algae cosmetics) + solid soap + seaweed soap (or algae soap) + *Eucheuma* sp. for solid soap.

4. Conclusions

Generally, seaweed extract as a raw material for soap uses chemical solvents. The extraction process is long and uses a lot of imported solvents, making seaweed extract expensive and producing residual solvent by-products so it is not environmentally friendly. Meanwhile, when viewed of the target consumers, soap users tend to like soap products that use natural ingredients. Thus, it is necessary to explore research on the use of *Eucheuma* sp. as a raw material for solid soap so as to produce quality soap with technology that is easily adopted by coastal communities in Indonesia and environmentally friendly.

References

[1] Xu S Y, Huang X and Cheong K L 2017 Recent advances in marine algae polysaccharides: isolation, structure, and activities Marine Drugs, 15:12, 388.
[2] Shanggang C 2017 A kind of Sargassum handwashing liquid Patent (China:CN106265185A).
[3] Yeucun W 2015 Seaweed moisturizing shower gel Patent (China: CN CN105106055A).
[4] Nishi K 2011 Soap Patent (Japan: JP2012255087A).
[5] Akizuki S 2009 Soap Patent (Japan: JP2009263644A).
[6] Hong-Tae K 2010 Soap made from seaweed and manufacture method thereof Patent (Korea: KR20100037484A).
[7] Blunt J W, Copp B R, Hu W P, Munro M H G, Northcote P and Prinsep M R 2009 Marine natural products Nat Prod Rep 26: 170-244.
[8] Chasanah E 2008 Marine Biodiscovery Research in Indonesia: Challenges and Reward Journal of Coastal Development 12: 1-12.
[9] Pereira and Costa-Lotufa. 2012 Bioprospecting for bioactives from seaweeds: potential, obstacles, and alternatives Rev. bras. farmacogn 22 (4):894-905.
[10] Zamroni A and Yamao M 2011 Coastal Resource Management: Fishermen’s Perceptions of Seaweed Farming in Indonesia World Academy of Science, Engineering and Technology 60: 32-38.
[11] Lessmann H, Schnuch A, Geier J, and Uter W 2005 Contact Dermatitis (Singapore: Blackwell Munksgaard) 53:247-259.
[12] LaKind J S, McKenna E A, Hubner R P, and Tardiff R G 1999 A Review of the Comparative Mammalian Toxicity of Ethylene Glycol and Propylene Glycol Critical Reviews in Toxicology 29(4): 331-365.
[13] [BSN] Badan Standarisasi Nasional Indonesia 2016 Sabun Mandi Padat SNI 3532-2016 (Jakarta: BSN).
[14] [BPOM] Badan Pengawas Obat dan Makanan 2013 Peraturan Kepala Badan Pengawas Obat dan Makanan Republik Indonesia Nomor 34 Tahun 2013 Tentang Kriteria dan Tata Cara Pengajuan Notifikasi Kosmetika (Jakarta: BPOM).
[15] Showell M S 2006 Handbook of Detergents (Boca Rato: Taylor & Francis Group CRC Press).
[16] De Souza M C R, Marques C T, Dore C M G. da Silva F R F, Rocha H A O. Leite E L 2007 Antioxidant activities of sulfated polysaccharides from brown and red seaweeds J. Appl. Phycol 19: 153–160.
[17] Pereira L, Amado A M, Critchley A T. van de Velde F, Ribeiro-Claro P J A 2009 Identification of selected seaweed polysaccharides (Phycocolloids) by vibrational spectroscopy (FTIR-ATR and FT-Raman) Food Hydrocoll. 23: 1903–1909
[18] Goddard E D and Gruber J V 1999 Principles of Polymer Science and Technology in Cosmetics and Personal Care 1st Edition (New York: CRC press).
[19] Wahyuni T 2014 Sabun Natural Rumput Laut Sebagai Peluang Usaha Perempuan di Desa Sangrawayang-Sukabumi Proiding Seminar Nasional Perikanan Indonesia Hasil Penelitian Perikanan dan Kelautan Tahun 2013 (Jakarta: Sekolah Tinggi Perikanan) 154-157.
[20] Baehaki A, Lestari S D, Hildianti D F 2019 Pemanfaatan Rumput Laut Eucheuma Cottonii Dalam Pembuatan Sabun Antiseptik Masyarakat Pengolahan Hasil Perikanan Indonesia 22:143–54.
[21] Akiib N I, Triwatami M, Putri A E P 2019 Aktivitas Antibakteri Sabun Cuci Tangan yang Mengandung Ekstrak Metanol Rumput Laut Eucheuma spinosum Medula 7(1):50–61.
[22] Purwaningsih S, Salamah E, Budiarti T A 2014 Formulation of Skin Lotion with Addition of Carrageenan and Natural Antioxidant from Rhizophora mucronata Lamk Jurnal Akuatika 5(1): 55-62.
[23] Putri R R, Herpandi, Nopianti R 2015 Karakteristik Fisiko-Kimia dan Mutu Sensoris Skin lotion Rumput Laut (Eucheuma cottonii) dengan Penambahan Kolagen Ikan Komersil FishtecH – Jurnal Teknologi Hasil Laut Indonesia 4(1): 75-78.
[24] Wahyuni T 2016 Pengaruh Superfatting terhadap Kualitas Sabun Rumput Laut Natural Seminar Nasional Hasil Litbang Pengolahan Produk dan Bioteknologi Kelautan dan Perikanan 2016 (Jakarta: Pusat Penelitian dan Pengembangan Daya Saing Produk dan Bioteknologi Kelaatan dan Perikanan) 13-16.
[25] Nurjanah, Fauziyah S, Abdullah A 2019 Karakteristik bubur rumput laut Eucheuma cottonii dan Turbinaria conoides sebagai bahan baku masker peel off Jurnal Pengolahan Hasil Perikanan Indonesia 22(2): 391-402.
[26] Luthfiyana N, Nurjanah, Nurilmala M, Anwar E, Hidayat T 2016 Rasio bubur rumput laut Euchena cottonii dan Sargassum sp. sebagai formula krim tubir surya Jurnal Pengolahan Hasil Perikanan Indonesia 19(3): 183-195.
[27] Dolorosa M T, Nurjanah, Purwaningsih S, Anwar E, Hidayat T 2017 Kandungan senyawa bioaktif bubur rumput laut Sargassum plagyophyllum dan Eucheuma cottonii sebagai bahan baku krim pencerah kulit. Jurnal Pengolahan Hasil Perikanan Indonesia 20(3): 633-644.
[28] Nurjanah, Abdullah A, Fachrozan R, Hidayat T 2018 Characteristics of seaweed porridge
Sargassum sp. and Eucheuma cottonii as raw materials for lip balm *Forum IPIMA IOP Conference Series: Earth and Environmental Science* **196**: 1-6.

[29] Jahan A, Ahmad I Z, Fatima N, Ansari V A 2017 Algal bioactive compounds in the cosmeceutical industry: a review *Phycologia* **56** (4):410–422.

[30] Sany I P, Romadhon, Fahmi A S 2019 Physicochemical Characteristics and Antioxidant Activity of Solid Soap Enriched With Crude Eucheuma cottoni Extract *International Conference on Tropical and Coastal Region Eco Development IOP Conference Series: Earth and Environmental Science* **246**:1-12.

[31] Yunizal 2004 *Teknologi Pengolahan Alginit* Jakarta: Pusat Riset Pengolahan Produk dan Sosial Ekonomi Kelautan dan Perikanan.