Potential of Fucoxanthin Content in Sargassum sp. on Sunscreen Cream Preparation

Devi Suryani Permata Sari, Eka Saputra, Mochammad Amin Alamsjah

***Abstract**: Brown seaweed contains a source of economic value metabolites, one of which is carotenoids. Carotenoids are a group of important pigments produced by marine biota. One of the pigments from the carotenoid class that is produced by brown seaweed is fucoxanthin. Fucoxanthin from Sargassum sp. has bioactivity content as an anti-ultraviolet ray, making it compatible as a natural cosmetic ingredient in sunscreen creams. This study was aimed to observe the potential of Sargassum sp. contained fucoxanthin for sunscreen cream preparation. The result showed that each treatment had a significant difference effect on the SPF value ($p<0.05$). The highest SPF value was found in cream preparations with 2% fucoxanthin extract addition with 3.36. pH value generated in each treatment was 6-8 at 15 days storage. Cream was included in an O/W homogeneous type. Based on the hedonic test, there were significant differences ($p<0.05$) on appearance and cream colorbut there was no significant difference ($p>0.05$) in texture and odor. The highest level of panelist preference was found in cream preparations with 2% fucoxanthin extract addition.*

I. INTRODUCTION

Brown seaweed is a source of economic value metabolites such as carotenoids, alginate and fucoidan. Carotenoid pigment is an important group generated by marine biota. One of the carotenoid pigments that are widely produced by brown seaweed is fucoxanthin[1]. Fucoxanthin was found on a type of brown algae, such as *Sargassum cristaefolium* (0.080±0.017%),*S. aquifolium* (0.097±0.01%), and *S. polycystum* (0.090 ± 0.003%) [2]. Fucoxanthin had very good bioactivity compound as an anticancer, antioxidant and anti-ultraviolet light. Fucoxanthin had an anti-pigmentation activity on skin that was caused by ultraviolet-B radiation [3].

Sunscreencreamproduct generally comes from chemical compoundsthat are easily obtained and selected based on the needs. Chemical material which was often used in sunscreen cream product was titanium dioxide, 4-MBC (4-Methylbenzylidene Camphor), oxybenzone, and octinoxate. Thesunscreen cream usage from the chemical compound could cause a contact allergy on some skin types that were sensitive to these compounds [4]. Sunscreen is a substance that contains a protective skincare to sunlight, making the UV rays would not be able to enter the skin. Sunscreen could effectively absorb at least 85% of 290 to 320 nm sun wavelength and beam the light at more than 320 nm wavelength.

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The ability of preventing the ultraviolet rays on the sunscreen cream was based on the sun protecting factor [5].

The study aimed was to observe the potential of fucoxanthin extracted from brown seaweed Sargassum sp. for the production of sunscreen cream. This research also had another objective which was to determine the best fucoxanthin concentration added on the sunscreen cream through the SPF value range existed.

II. METHODOLOGY

This study was conducted in Faculty of Fisheries and Marine Chemical Analysis Laboratory AirlanggaUniversity on February until July 2018.Equipment were Erlenmeyer tube, rotary evaporator, chromatograph column, KLT plate, magneticstirrer,UV/Vis spectrophotometer and pH meter.Materials were *Sargassum sp.* seaweed obtained from Talango Island, Sumenep, Madura, ethanol, silica gel, n-hexane, acetone, emulgade, stearic acid, methylparaben, centile alcohol, liquid paraffin, butylhydroxidetoluene (BHT), glycerin, tri ethanol amine (TEA), and fragrance.

This study was used Complete Randomized Design (CRD) experimental method with 4 treatments and 5 replications. Fucoxanthin concentration extracts added in the sunscreen cream were 0.5%, 1%, 1.5%, and 2%. 500 g of *Sargassum sp.* were soaked in 2.5 L of ethanol solvent at 18°C for 3 days. Solution was distilled using Whatman paper to separate solid and liquid component. Distilled solution was evaporated using the rotary evaporator maximumly at 35°C until paste extract was obtained during the process.

Chromatograph column preparation was begun by putting silica gel inside the column 15 cm height. Crude extract of *Sargassum sp.* was also put inside the chromatograph column. Purification process was done by adding n-hexane and acetone (6:4 v/v).

Plate was heated in the oven for 2 hours and formed 2 cm bottom line and 1 cm top line. Crude extract was solute in ethanol and put on the plate with 0.5 cm space each. Plate was put inside the chamber that had been saturated for 3 hours using n-hexane : acetone solution (6:4 v/v). Plate was taken from the chamber as the solution movement reached the top limit of the plate. Fucoxanthin content was identified by determining the retardation factor value (Rf).

Oil solution materials, such as emulgade, centile alcohol, liquid paraffin, and stearic acid were dissolved until all were homogenously mixed at ± 75°C, which was called as oil phase (supply 1).

Water soluted materials, such as glycerin, TEA, and aqueous, were homogenously solution at ±75°C, which was called as water phase (supply 2). Supply 1 and 2 were mixed to produce supply 3 at ±75°C, appeared as a homogenous cream. BHT, methylparaben, and fragrance were added on supply 3 at ±40°C. Fucoxanthin extract was also added based on the treatment concentrations, such as 0.5%, 1%, 1.5% and 2%.

Each sample was taken as much as 1 g and soluted in 100 mL of ethanol 96%. Sample was homogenized. Sample was taken 5 mL of each sample solution into the Erlenmeyer tube and added ethanol until reaching 25 mL. UV-Vis spectrophotometer was calibrated using ethanol 96% by taking 1 mL of ethanol and putting it in the cuvet before taking the cuvet into the UV-Vis Spectrophotometer.

Data obtained from the research result was analyzed using Kruskal Wallis method for non-parametrical data and ANOVA (Analysis of Variance) for parametrical data. Analysis was continued using Duncan's Multiple Range Test (DMRT) as the data showed significant difference to determine the best treatment given during the study.

III. RESULT AND DISCUSSION

15 kg of fresh macroalgae Sargassum sp. produced 1,600 g of simplicia. S Simplisia that had been macerated with ethanol produced 12 g of crude extract. Crude extract yield produced was 0.75% (bb/bk). This crude extract produced 3.95 g of fucoxanthin after purification process with the yield produced was 0.24% (bb/bk).Fucoxanthin compound movement distance value was 2.8 cm. Conversion of compound movement distance and solvent movement distance was 7.5 cm, taken from the Rf value with 0.37.SPF value on sunscreen samples added with fucoxanthin from Sargassum sp. is presented on Table 1.

Table. 1 SPF value of sunscreen cream

Treatment	SPF(±SD)
Cream + Fucoxanthine Extract of *Sargassum* sp. 0.5%	2.80^{b}±0.07
Cream + Fucoxanthine Extract of *Sargassum* sp. 1%	2.92^{b} ±0.14
Cream + Fucoxanthine Extract of *Sargassum* sp. 1.5%	2.96^{b}±0.18
Cream + Fucoxanthine Extract of *Sargassum* sp. 2%	3.36^{a}±0.27

Note: Different superscript letters shows significant difference ($p<0.05$)

ANOVA result analysis showed that the SPF value of sunscreen cream produced in this studyshowed significant difference ($p<0.05$) between treatments. Based on Table 1, highest SPF value was presented on the sunscreen cream added with 2% fucoxanthin extract of *Sargassum sp*.pH value on the sunscreen cream added with fucoxanthin extract of *Sargassum sp.* canbe seen on Table 2.

Table. 2 pH value on sunscreen cream sample

Fucoxanthine Extract (%)	Observation Duration(Day)				
	3rd	6th	9th	12th	15th
0.5	7.34^{a}±0.26	8.13^{a}±0.21	8.11^{a}±0.13	8.10^{a}±0.11	8.11^{a}±0.30
1	7.08^{a}±0.08	8.06^{ab}±0.10	7.90^{a}±0.14	7.99^{a}±0.07	7.87^{a}±0.46
1.5	6.94^{bc}±0.15	7.91^{b}±0.09	7.66^{b}±0.18	7.87^{ab}±0.05	7.94^{a}±0.26
2	6.77^{c}±0.08	7.64^{c}±0.22	7.57^{b}±0.18	7.59^{b}±0.38	7.83^{a}±0.19

Note: Data was the average value from five replications ± Standard Deviation; Different superscript letters showed significant difference ($p<0.05$)

Lowest pH value was found at sunscreen cream added with 2% fucoxanthin extract, while the highest was found sunscreen cream added with 0.5% fucoxanthin extract. DMRT analysis result showed no significant difference ($p>0.05$) on 15th days of treatment, while the other days showed significant difference on all treatments ($p<0.05$) against pH value of the sunscreen cream. Homogeneity result on the sunscreen cream added with fucoxanthin extract from Sargassum sp. by 30 panelists showed that all creams were homogenous on all treatments with no crude particles presented.

Cream type on fucoxanthin sunscreen cream samples are presented on Fig. 1.

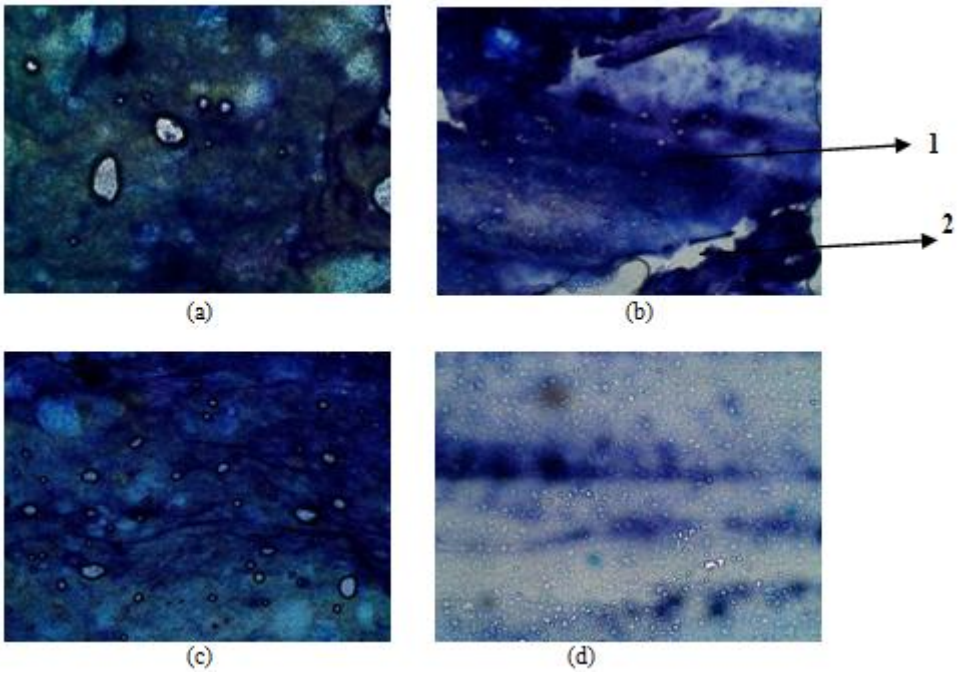

Fig. 1 Sunscreen cream type

Note: (a) Cream with 0.5% fucoxanthine extract from *Sargassum* sp.
(b) Cream with 1% fucoxanthine extract from *Sargassum*sp.
(c) Cream with 1.5% fucoxanthine extract from *Sargassum*sp.
(d) Cream with 2% fucoxanthine extract from *Sargassum*sp.
(1) Oil phasedroplet
(2) Water phasedroplet

DueCream type test was done to observe the emulsion type produced. The emulsion type produced in this research was oil in the water emulsion (O/W).Hedonic test graphic result on the fucoxanthin sunscreen cream is presented Fig. 2.

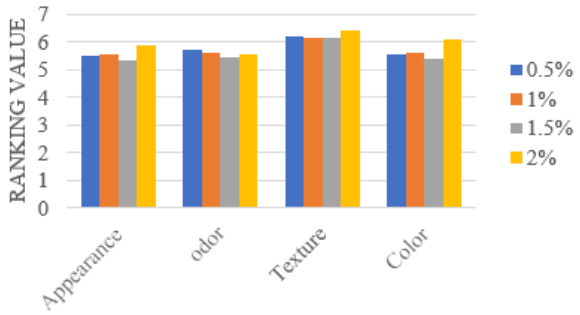

Fig. 2 Hedonic test result

Based on the Kruskal-Wallis analysis method, it showed that hedonic test on odor and texture aspect showed no significant difference between all treatments ($p>0.05$), making the panelist preferred cream formulation with fucoxanthin addition on those aspects were no different. This was contradictive with appearance and color aspect that showed significant difference ($p<0.05$). The highest preferred hedonic result of sunscreen cream by female panelists based on the appearance and color aspect was shown on the sunscreen cream added with 2% fucoxanthin extract treatment.

IV. DISCUSSION

Sunscreen cream sample was one of the cosmetic types used to reflect sunlight effectively, especially in the area of ultraviolet and infrared wave emissions for preventing the occurrence of skin disorders because of the sunlight exposed. SPF value indicated the effectiveness of sunscreen cream in protecting the skin from UV rays from the sunlight. The different value of SPF on each sunscreen cream sample was caused by different concentration of fucoxanthin extract from Sargassum sp. added at each treatment formulations. Fucoxanthin extract of *Sargassum sp.* had SPF value of 8.56, so the higher concentration of fucoxanthin extract from *Sargassum sp.* added on the sunscreen cream, higher SPF value would get. SPF value on sunscreen cream sample with the addition of fucoxanthinextract from Sargassum sp. was included in the minimum standard of sunscreen cream capability (2-4).

pH of sunscreen cream samples observed for 15 days showed a significant difference. Sunscreen cream pH value in this study was ranged from 6-8. This pH value was in accordance with National Product Standard (SNI) (1996), mentioning the recommended cream product should be at 4-8 of pH level. Low pH level on the cream against pH skin would cause irritation reaction, whereas high pH level would cause dry and scaly skin [6]. pH sample changes in the storage indicated less stabilized sample material during the storage condition.

Homogeneity showed smoothness and uniformity texture of the sunscreen cream produced [4]. Homogeneity also affects the effectiveness of skin therapy related to the same medication levels on each usage. When the sample had been homogeneous, the active substances level at the time of usage would always be the same. Emulgade on cream served as an emulgator, which could make a stable and homogeneous cream sample [7].

Sunscreen cream with the addition of fucoxanthin extract had oil in water (M/A) emulsion type. This was due to methylene blue distributed in the water soluble external phase. Factor influencing M/A emulsion type was the oil volume used in the cream phase which was smaller than the water phase [8].

Hedonic test on odor had no significant difference between all treatments. This happened because addition of fragrance on the sunscreen cream had same concentration, i.e. 0.1 mL. Texture aspect on the test result also had no significant difference between all treatments because each treatment used the same cream formulation. Appearance and color aspect showed significant difference observed on all treatments. Appearance and color aspect on sunscreen cream added with fucoxanthin extract of *Sargassum sp.*showed different appearance and color, thus making the higher fucoxanthin extract concentration added, the more increased the color density made.

V. CONCLUSION

Fucoxanthin extract from *Sargassum sp.* had a potential as a bioactive material for sunscreen cream with the minimum category for SPF index (2-4). The highest SPF value was observed on the sunscreen cream added with 2% fucoxanthin extract of Sargassum sp.

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