Formulation And Physical Quality Evaluation Of Body Scrub Preparations From Coffee Grounds And Brown Seaweed Extract (Sargassum polycystum)

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Abstract.
Brown seaweed (Sargassum polycystum) is a natural ingredient rich in secondary metabolite compounds with high potential as antioxidants, antibacterials, and anti-inflammatory agents. This study aims to extract this seaweed, identify the metabolite content, and evaluate the effect of variations in stearic acid concentrations (15%, 16%, and 17%) on body scrub preparations. Extraction was carried out using the maceration method using 70% ethanol for 3 days. Phytochemical results showed bioactive compounds such as flavonoids and phenols. Physical quality tests showed a homogeneous preparation with a distinctive aroma and light brown color. Statistical analysis using One-Way ANOVA showed that variations in stearic acid significantly affected pH and viscosity. Formulation 1 (15% stearic acid) had the best pH and spreadability, while Formulation 3 (17% stearic acid) had optimal viscosity.ormulation 3 (17% stearic acid) is considered the best because it produces the most optimal viscosity.
Keywords: Sargassum polycystum, Maceration, Body Scrub, Stearic Acid, Physical Quality

INTRODUCTION

Indonesia is a country that receives high levels of sunlight. UV (ultraviolet) rays from the sun have an oxidative effect on free radicals, and if continuously exposed to the skin, they will cause inflammation and damage (Jannah 2021). Skin aging is a natural process. Skin cells, such as keratinocytes, fibroblasts, and melanocytes, decrease in number with age. Skin aging is characterized by skin pigmentation, dullness, and dryness. Therefore, antioxidants are essential for the skin (Marsha and Rosalina 2022).

Seaweed is a marine biota that is very abundant, especially in Indonesian waters. However, only a few types of seaweed have economic value, so their management is not optimal (Langford et al., 2021). Seaweed is one of the marine organisms that has antioxidant activity. Brown seaweed (Sargassum sp.) contains active compounds such as flavonoids, triterpenoids, polyphenols, carotenoids, and alkaloids that have antioxidant activity (Hidayati et al., 2019). Based on research conducted by Sami et al., (2021), a seaweed extract concentration of 0.02% - 0.1% can absorb UV radiation, thereby reducing erythema and pigmentation on the skin (Syamsiah 2022).

Body scrubs contain coarse granules that act as an abrasive to remove dead skin cells from the epidermis (Imron et al. 2025). Body scrubs help accelerate the turnover of new skin cells, leaving them healthier, smoother, softer, and less dry. Coffee grounds are one of the ingredients used to make scrubs, as they offer beneficial properties for the skin due to their natural scrubbing properties. The 1-1.5% caffeine contained in coffee grounds can act as a vasorestrictor, meaning it tightens and shrinks blood vessels (Sari, 2020).

Coffee grounds from various coffee shops or cafes are still considered useless waste or trash. In fact, coffee grounds can still be used as an ingredient in body scrubs, as a mask for the face or skin (smoothing the skin), coffee grounds can provide a soft skin effect so that they have good nutrients to protect the skin from sun damage and prevent damage to collagen or elastin substances that cause wrinkles on the skin. Coffee grounds also contain antioxidant compounds in sufficient quantities, namely polyphenols, flavonoids, proanthocyanidins, coumarins, chlorogenic acid, and tocopherols (Sari, 2020).

METHODS

This type of research is an experimental laboratory study that includes the manufacture of brown

seaweed extract (Sargassum polycystum) using the maceration method. The formulation of a body scrub preparation using brown seaweed extract (Sargassum polycystum) and coffee grounds with stearic acid concentrations of F1 (15%), F2 (16%), F3 (17%) with three repetitions each. The parameters tested are phytochemical screening, evaluation of the physical quality of the preparation, namely organoleptic tests, pH tests, homogeneity tests, and adhesiveness tests..

The populations used in this study were seaweed plants obtained from a beach in Pacitan and coffee beans. The samples taken in this study were brown seaweed obtained from Pacitan that met the inclusion criteria and coffee grounds obtained from a coffee shop in Madiun City.

Table 1. Formulation *body scrub*

No	Nama	Concentration (%)		
		F1	**F2**	**F3**
1	Brown seaweed extract	5%	5%	5%
2	Coffee grounds	15	15	15
3	Setil Alkohol	5	5	5
4	Propilen Glikol	15	15	15
5	Asam Stearat	15	16	17
6	Trietanolamin	2	2	2
7	Gliserin	5	5	5
8	Metil Paraben	O,12	0,12	0,12
9	Aquadest	Add)ml	Add 100ml	Add 100ml

The tools used in this study were stirring rods, porcelain cups, beakers, measuring cups, hot plates, watch glasses, analytical balances, dropper pipes, pH meters, object glasses, water baths, rotary evaporation, sieve no. 60, cream containers, mortars and pestles. The materials used in this study were Brown Seaweed Extract (Sargassum polycystum), Coffee grounds (Coffea Robusta), Cetyl alcohol, Stearic acid, Triethanolamine, Propylene glycol, Glycerin, Propyl paraben, Methyl paraben, Aquadest and 70% Ethanol.

The data analysis used in this study was descriptive and quantitative. Descriptive analysis was conducted on the results of organoleptic tests (shape, color, odor) and homogeneity tests on body scrub preparations. Meanwhile, quantitative data analysis was conducted on the results of physical quality tests of body scrub preparations, namely pH tests, spreadability tests, and viscosity tests. Data analysis with Analysis of Variance (ANOVA) on pharmaceutical formulations is an important statistical method used to compare the averages of three or more sample groups to determine whether there are statistically significant differences between different formulas (Febrianti et al., 2024) and a further Post Hoc test was carried out.

RESULTS AND DISCUSSION

Extraction

The extraction process in this study was carried out by wet extraction, namely maceration of brown seaweed (Sargassum polycystum). The extraction process was carried out by soaking 500 g of brown seaweed powder (Sargassum polycystum) using 2500 mL of 70% ethanol solvent for maceration for 3 days. The yield of seaweed extract using the maceration method using 2.5 liters of 70% ethanol solvent: 500 g of seaweed powder, produced a yield of 6.1%.

The ideal standard is >10%, from this yield result there are several factors that cause low yield, low yield value can be influenced by environmental factors where it grows, plant age, the structure of brown seaweed cell walls is very dense and hard so that it can affect the release of secondary metabolite compounds (such as fucoxanthin, phenolics, or terpenoids) from within the cell, as well as the effectiveness of solvent evaporation during the process of concentrating thick extracts using a water bath. The yield result is related to the active compound of a sample, if the yield value is higher then the number of active compounds contained in the sample is also higher (Mutmainnah et al., 2024).

Phytochemical screening

Phytochemical screening was carried out to prove the secondary metabolite compounds contained in brown seaweed extract (*Sargassum polycystum*) using qualitative analysis, namely visual analysis to analyze the secondary metabolite compounds contained in the sample in the form of phytochemical tests using color tests with various chemical reagents (Handayani et al., 2020).

Table 2. Phytochemical screening of *Sargassum polycystum*

Bioactive compounds	Color or changes observed	Test Results
Flavonoid	Red/Yellow/Orange	+
Alkaloid	Orange	+
Saponin	Stable foam up to ± 7 minutes	+
Tanin	Green/brownish red/blue/dark black	+
Triterpenoid	Red/purple	+

Based on phytochemical test results, brown seaweed extract showed positive results for all bioactive compounds tested, including flavonoids, phenols, alkaloids, saponins, tannins, and triterpenoids. These results indicate that brown seaweed (Saragsassum polycystum) is rich in secondary metabolites with the potential to exhibit high biological activity, such as antioxidant, antibacterial, and anti-inflammatory properties (Aini et al., 2022).

Organoleptic Evaluation

Organoleptic testing aims to determine the physical properties of the preparation and serves as a quality control measure for body scrub preparations (Hikma et al., 2022). The results of the organoleptic evaluation showed that the use of seaweed extract and coffee grounds affected the color of the body scrub preparation. The organoleptic test of the three creams showed no color differences because the concentrations of seaweed extract and coffee grounds were the same. All three preparations had the same aroma, namely the distinctive aroma of coffee and seaweed. The cream produced by the organoleptic test had a light brown color, a distinctive coffee aroma, and an appearance similar to body scrub.

Table 3. Organoleptic Evaluation

Organoleptic test	Replication		
	Form	Color	Aroma
F1	Cream	Light brown	The distinctive aroma of coffee and seaweed
F2	Cream	Light brown	The distinctive aroma of coffee and seaweed
F3	Cream	Light brown	The distinctive aroma of coffee and seaweed

pH Test

A pH test was conducted to ensure that the scrub containing brown seaweed extract and coffee grounds would not irritate the skin. According to SNI 16-4399-1996, the pH for skincare products is between 4.5 and 8.0.

Table 4. pH Test

pH test			
Replication	**F1**	**F2**	**F3**
Replication 1	6.2	6,3	6,4
Replication 2	6.2	6,3	6,4
Replication 3	6,2	6,3	6,4
Average ± SD	6.21 ± 0.1	6.31 ± 0.1	6.42 ± 0.2

The results of the significance value (Sig.) generated from the ANOVA test showed a figure of 0.000. Then a Post Hoc Test statistical test was carried out. The Mean Difference (I-J) value between F1 and F2 was negative (-0.10000), which indicated that the pH value of F1 was significantly lower than F2. A similar pattern was seen in the comparison of F1 and F3 (-0.20000), and F2 and F3 (-0.10000). Thus, the average order of pH values of the three preparations was pH F1 < pH F2 < pH F3. Through this Bonferroni statistical test, a significance value of 0.000 ($p < 0.05$) was obtained for all comparison groups. This proves that variations in stearic acid concentration have a significantly different effect on the pH value of the body scrub preparation.

The results of pH measurements on each preparation show that the higher the concentration of stearic acid, the higher the pH. This can be caused by the concentration of stearic acid which can affect the pH of the preparation. Increasing the stearic acid content from 15% to 17% automatically increases the concentration of stearate salts formed due to reactions with alkaline components in the formula. F1 has the lowest pH value (closest to the weak acid/physiological area of the skin) compared to F2 and F3. Increasing the concentration in F2 and F3 triggers the preparation to become more alkaline, which risks reducing the comfort of long-term use on the skin.

Homogeneity Test

All formulas showed good homogeneity, with no coarse particles or clumping detected

Table 5. Homogeneity Test

Concentration	Homogeneity	Information
F1 (15%)	√	There are no particles and lumps.
F2 (16%)	√	There are no particles and lumps.
F3 (17 %)	√	There are no particles and lumps..

Good homogeneity in body scrub preparations is influenced by optimal mixing during formulation. Constant stirring at the appropriate temperature helps the oil and water phases mix perfectly, resulting in a stable emulsion. Furthermore, the use of ingredients such as stearic acid, triethanolamine, and cetyl alcohol plays a role in forming a good emulsion system, allowing all components to be evenly dispersed (Iqbal Abdul Raup et al., 2023).

Viscosity Test

The viscosity test was conducted to determine the thickness of the body scrub cream preparation. The higher the viscosity value, the thicker the preparation. In this study, viscosity was read using a Brookfield viscometer with a spindle and a predetermined rpm rotation speed (Thomas et al., 2016). Variations of stearic acid emulsifiers were made with concentrations of 15%, 16%, and 17%.

Table 6. Viscosity Test

Viscositas Cps			
Replication	**F1**	**F2**	**F3**
Replication 1	19.750	23.250	26.500
Replication 2	20.000	23.000	27.500
Replication 3	20.500	22.500	27.250
Average ± SD	20.083,33 cp± 381,88 cp)	22.916,67 cp ± 381,88 cp	27.083,33 cp ± 520,42cp

The results of the ANOVA test obtained a very high F-count value of 198.370 with a significance number (Sig.) of 0.000. Because the significance value is much smaller than 0.05 ($p < 0.001$). It can be concluded that there is a very significant difference in viscosity values between the three body scrub preparation formulas. Then, the Post Hoc test continued with a negative Mean Difference (I-J) value when F1 was compared with F2 (-2.83333) and F3 (-7.00000) indicating that F1 has the lowest viscosity value. Conversely, F3 shows a positive Mean Difference value against F1 (7.00000) and F2 (4.16667), indicating that F3 has the highest viscosity.

This linear increase in viscosity is directly proportional to the increase in the concentration of stearic acid added to the preparation. Stearic acid functions as a thickening agent as well as an oil phase emulsion base that forms the internal network structure of the preparation. When the stearic acid concentration increases from 15% (F1) to 16% (F2) to 17% (F3), the higher concentration is able to bind the liquid phase more strongly, resulting in a thicker preparation and significantly increasing its viscosity value. Formulation 3 (F3) with a stearic acid concentration of 17% produces the highest viscosity and is the most structurally stable to prevent scrub particles from experiencing phase separation during storage.

Spread Power

A spreadability test is performed to evaluate how well a product spreads evenly over the skin surface when applied. The more evenly distributed the product is, the better it absorbs into the skin (Latifah, Pudjono, and Rosmi, 2022).

Table 7. Spread power

Spread power			
Replication	**F1**	**F2**	**F3**
Replication 1	4.77	4.67	4.62
Replication 2	4.90	4.62	4.57
Replication 3	4.75	4.70	4.70
Average ± SD	4.80 ± 0.81	4.66 ± 0.40	4.63 ± 0.65

In the results of the spreadability test for the body scrub preparations, the results of the F1-F3 spreadability test approached the specified range of 4.5 cm - 7 cm, the spreadability according to the SNI 16-4399-1996 standard, which is 4.5 cm - 7 cm. The ANOVA test results obtained a significance value (Sig.) of 0.033. Because the significance value is smaller than the critical limit of 0.05 ($p < 0.05$), it can be concluded that there is a statistically significant difference in the average spreadability between the three body scrub preparation formulas (Ghozali, 2021).

After the ANOVA test, a Post Hoc Test statistical analysis was performed. F1 and F2 have a p value = 0.105 ($p > 0.05$), which means that increasing the concentration from 15% to 16% has not provided a statistically significant decrease in spreadability. The comparison between F2 and F3 has a p value = 1.000 ($p > 0.05$), indicating there is no significant difference between the 16% and 17% levels. The comparison between F1 and F3 has a p value = 0.047 ($p < 0.05$). This proves that a fairly wide difference

in concentration (a 2% difference between F1 and F3) has a real and significant impact on reducing spreadability.

The low value can be influenced by high viscosity. When the stearic acid concentration is increased from 15% (F1) to 17% (F3), the amount of solid fraction of fatty acids in the emulsion phase becomes increasingly dense and saturated. This increase strengthens the hydrophobic gel matrix in the cream preparation, the high resistance of the preparation to external shear forces when tested, so that the spreadability value experiences a linear decrease as shown by the statistical results.

CONCLUSION

The low value can be influenced by high viscosity. When the stearic acid concentration is increased from 15% (F1) to 17% (F3), the amount of solid fraction of fatty acids in the emulsion phase becomes increasingly dense and saturated. This increase strengthens the hydrophobic gel matrix in the cream preparation, the high resistance of the preparation to external shear forces when tested, so that the spreadability value experiences a linear decrease as shown by the statistical results.

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