HAYYAN JOURNAL
Vol. 1 No. 3, October 2024, page. 74-82
ISSN: 3046-6679

Utilization of Seaweed (*Eucheuma* sp) as a Room Freshener Gel Product

Muhammad Arham Yunus[1*], Nurfiansyah Nurfiansyah[1], Alma Yasari[1], Fajrianthy[1], Jumriani Alimin[1], Rahmila[1], Halijah[1]

[1]Department of Chemical Engineering, Politeknik Negeri Ujung Pandang, Makassar

*Corresponding author: arhamyunus21@poliupg.ac.id

Received: August 26, 2024 *Accepted: September 22, 2024* *Online Published: October 31, 2024*

ABSTRACT

This study aimed to formulate a room freshener gel from seaweed (*Eucheuma* sp) with variations in acetic acid soaking concentrations (0%, 5%, and 10%) and to evaluate its physical characteristics. The seaweed-based gel was produced through soaking, heating, and molding processes combined with gelatin, isopropyl alcohol, and essential oils (lemon, sweet orange, and lily). Quality testing covered moisture content, viscosity, gel strength, and organoleptic properties. Results showed that the soaking treatment significantly affected gel quality. The unsoaked sample had the highest moisture content (24.08%), exceeding the SNI limit of 23.22%, while the 5% and 10% soaking treatments met the standard with moisture contents of 17.43% and 19.64%, respectively. Viscosity values ranged from 62,237 to 73,111 μm/pascal, all within the ideal range for semi-solid gels. Gel strength values of 85.859, 291.45, and 615.77 g/cm² for the three treatments all exceeded the minimum standard of ≥45 g/cm². Organoleptic evaluation by 20 panelists showed that the 5% acetic acid soaking treatment produced the best scores for aroma (3.70) and texture (4.25), meeting the SNI 01-2346-2006 acceptance threshold. This treatment is recommended as the optimal formulation for seaweed-based room freshener gel.

Keywords: *Eucheuma* sp, Essential Oil, Gelatin, Isopropyl Alcohol, Room Freshener

INTRODUCTION

Indonesia is an archipelagic nation endowed with abundant marine biodiversity. One marine resource that has not been fully utilized is seaweed, particularly Eucheuma sp, which is widely cultivated along the coastal areas of South Sulawesi, West Nusa Tenggara, and Lampung due to its high economic value. Seaweed has long been used as a food ingredient and traditional medicine (Sandhika et al., 2024). One prospective product that can be developed from seaweed is a room freshener gel. A room freshener gel is a household product in gel form that gradually releases fragrance into the air. A gel is defined as a solid or semi-solid system consisting of at least two components, forming a tight lattice-like mass permeated by liquid (Suryani et al., 2020). Gel-form room fresheners offer greater practicality in use and storage compared to liquid spray fresheners (Pratista & Syukur, 2020).

Several studies have explored seaweed as a base material for room fresheners. Pamela et al. (2022) demonstrated that Eucheuma cottonii extract from Lampung can be used as the main ingredient in room fresheners with satisfying aromatic performance. Community service activities from Universitas Muhammadiyah Makassar also introduced this technology to coastal communities in Jeneponto Regency with positive responses. A study from UIN Sunan Ampel Surabaya in 2022 developed a carrageenan-based gel formulation from Eucheuma spinosum combined with Carboxymethyl Cellulose (CMC), demonstrating good textural characteristics, adequate physical stability, and the ability to retain fragrance for up to one month (Meilina, 2020).

Eucheuma cottonii was selected as the raw material because it contains carrageenan, a hydrophilic polysaccharide capable of forming a stable and elastic gel. Carrageenan is the primary compound acting as a gelling agent; when dissolved in hot water and subsequently cooled, it forms an elastic, stable, and transparent gel highly suitable for room freshener formulations (Fransiska & Reynaldi, 2020). Furthermore, Eucheuma cottonii also contains dietary fiber, minerals (calcium and magnesium), and natural antioxidants, adding value as a natural ingredient that is safe for health and the environment (Sinulingga, 2020).

The potential of seaweed-based room fresheners is highly strategic to develop, considering Indonesia's large seaweed production, most of which is still exported as raw material. Diversification into natural fragrance products not only increases the added value of local commodities but also opens new opportunities in the household industry while offering advantages in terms of safety and environmental sustainability. However, several limitations remain in the existing literature. Previous studies have generally focused on single-species formulations without systematically evaluating the effect of pre-treatment methods on the physicochemical properties of the resulting gel. In particular, the role of acetic acid soaking as a pre-treatment step—its concentration variation and its impact on moisture content, viscosity, gel strength, and organoleptic acceptance—has not been comprehensively examined. Most prior formulations also did not assess compliance against Indonesian National Standard (SNI) thresholds across multiple quality parameters simultaneously. These gaps indicate that an optimized and standardized formulation of seaweed-based room freshener gel has yet to be established, limiting its potential for scaled production and commercial application.

Based on the limitations identified above, this study raises the following research question: how does the variation in acetic acid soaking concentration (0%, 5%, and 10%) affect the physical quality characteristics of seaweed-based (Eucheuma sp) room freshener gel, and which concentration produces the most optimal formulation? Accordingly, this study aimed to (1) formulate a room freshener gel product from Eucheuma sp using three variations of acetic acid soaking concentration, and (2) evaluate the resulting gel based on moisture content, viscosity, gel strength, and organoleptic properties in accordance with applicable SNI standards.

The novelty of this research lies in the systematic investigation of acetic acid soaking as a controlled pre-treatment variable in seaweed-based gel formulation, an aspect that has not been specifically studied in prior works. Unlike previous studies that employed single-treatment approaches or used different binding agents such as CMC or xanthan gum, this study combines Eucheuma cottonii with gelatin and isopropyl alcohol while varying acetic acid concentration as the primary independent variable. Furthermore, this study conducts a multi-parameter quality assessment benchmarked simultaneously against SNI standards—covering moisture content, viscosity, gel strength, and organoleptic evaluation—providing a more comprehensive basis for recommending an optimal and standardized formulation for potential industrial application.

MATERIAL AND METHODS

Materials and Equipment

Equipment used included beakers (50, 250, 500 mL), a gas stove, stirring rods, scissors, graduated cylinders, volumetric pipettes (10 and 25 mL), petri dishes, an oven, a Texture Analyzer, a Brookfield Viscometer, an analytical balance, freshener molds, and spray bottles. Materials used were dried Eucheuma cottonii seaweed, distilled water (aquadest), isopropyl alcohol, acetic acid (5% and 10%), gelatin, essential oils (lemon, sweet orange, and lily), and aluminum foil.

Procedure for Making Room Freshener Gel

a. Without Acetic Acid Soaking

Dried seaweed was cut into small pieces, weighed at 50 grams, and washed clean. It was then heated at 100°C with 500 mL of distilled water (ratio 1:10) for 15–20 minutes while stirring until thickened, then filtered. Gelatin (2 tablespoons) was dissolved in warm water (250 mL) and mixed into the thickened seaweed. Essential oil (1 mL) and isopropyl alcohol (10 mL) were added and stirred until homogeneous. The mixture was poured into molds, cooled, and packaged.

b. With 5% Acetic Acid Soaking

Seaweed was cut, weighed at 50 grams, washed, and soaked in 5% acetic acid solution, then rinsed thoroughly. Subsequent steps followed the same procedure as treatment (a): heating with distilled water, filtering, addition of gelatin, essential oil, and isopropyl alcohol, then molding and packaging.

c. With 10% Acetic Acid Soaking

The procedure was identical to treatment (b), but using 10% acetic acid for soaking. After soaking, the seaweed was washed, heated, filtered, and combined with gelatin, essential oil, and isopropyl alcohol before molding and packaging.

Quality Testing of Room Freshener Gel

Moisture Content Analysis

A petri dish was dried in an oven at 105°C for 1 hour and weighed after cooling in a desiccator (W_0). A gel sample was placed in the pre-weighed petri dish and the initial total mass was recorded (W_1). The sample was then oven-dried at 105°C for 3 hours, cooled in a desiccator for 1 hour, and reweighed (W_2). Moisture content was calculated using the formula:

$$\text{Moisture Content (\%)} = [(W_1 - W_2) / (W_1 - W_0)] \times 100$$

Organoleptic Evaluation

Twenty panelists evaluated the aroma and texture of the room freshener gel products. Each product was coded and presented to panelists, who rated both parameters using a 5-point hedonic scale (1 = strongly dislike, 2 = dislike, 3 = neutral, 4 = like, 5 = strongly like). Results were tabulated to determine the most preferred formulation.

Viscosity Measurement

Samples were prepared in 100 mL beakers. Spindle No. 4 was attached to a Brookfield Viscometer and lowered until fully submerged in the sample. The RPM was set at the lowest speed (0.5 RPM) and readings were recorded every 3 rotations.

Gel Strength Test

The Texture Analyzer was switched on and connected to a computer. Compression mode was selected for gel strength measurement. Gel samples were stored in containers and cooled for 18 hours on the instrument table. After ensuring the probe was positioned directly above the sample, measurement was initiated. The instrument recorded force and distance data displayed as a graph upon completion.

RESULTS AND DISCUSSION

The room freshener was produced in gel form because this format effectively slows the release of volatile compounds and offers advantages such as spill resistance, practicality, ease of use, and elasticity that allows shape customization. Three treatment variations were produced: without acetic acid soaking (P0), with 5% acetic acid soaking (P5%), and with 10% acetic acid soaking (P10%). The manufacturing stages included washing to remove impurities and microbes, soaking to soften texture and eliminate the fishy odor, heating to extract gel-forming compounds and facilitate mixing, and molding to obtain the desired shape.

Moisture Content

Moisture content plays an important role in determining the quality and effectiveness of the gel. Optimal moisture content helps maintain gel texture stability, prevents rapid drying or cracking, and enables gradual and even release of fragrance over a longer period. Excessively high moisture content causes the gel to become too runny with a non-compact structure, while excessively low moisture content makes the gel too hard, brittle, and less effective in releasing fragrance. Therefore, optimal moisture content control is essential to ensure good durability, stable texture, and maximum fragrance performance (Widiyastuti et al., 2017). Moisture content test results are presented in Table 1.

Table 1. Moisture Content Test Results

Sample	Moisture Content (%)	SNI No. 2354-2-2015 (%)	Remark
Without soaking (P0)	24.08	23.22	Does not meet standard
5% soaking (P5%)	17.43	23.22	Meets standard
10% soaking (P10%)	19.64	23.22	Meets standard

Table 1 shows that the moisture content of the seaweed-based room freshener gel samples varied depending on the soaking treatment. Sample P0 had the highest moisture content at 24.08%, exceeding the maximum SNI No. 2354-2-2015 limit of 23.22%, and therefore did not meet the standard. In contrast, P5% showed a moisture content of 17.43% and P10% of 19.64%, both meeting the SNI requirements.

The soaking process helps reduce excess water content and impurities in seaweed. According to Widiyastuti et al. (2017), soaking triggers the release of internal water and the binding of free water in the raw material, thereby reducing moisture content in the final product. Soaking also loosens the cell structure of seaweed, facilitating drying and improving gel bonding during formation. This explains why P0 had the highest moisture content (24.08%), as water remained trapped in the seaweed tissue, while P5% and P10% showed lower moisture contents (17.43% and 19.64%) due to successful reduction of free water during the soaking stage.

The moisture content of P5% was lower than P10% because the optimal soaking concentration efficiently drew and dissolved free water and solutes from the seaweed structure. At 5% concentration, the soaking solution was sufficient to bind excess water without over-saturating the gel structure. Conversely, the excess water at 10% soaking may have triggered reabsorption of some water into the seaweed tissue due to reduced osmotic pressure, resulting in a slightly higher moisture content in the final product. This phenomenon aligns with the principle of osmotic diffusion described by Herlina & Setyawan (2016).

These differences in moisture content have direct implications for the quality and functional performance of the gel product. The high moisture content of P0 (24.08%), which exceeded the SNI limit, indicates a tendency toward a less compact and more runny gel structure. In practical terms, this condition accelerates the evaporation of aromatic compounds, shortens the effective lifespan of the product, and increases the risk of microbial contamination during storage. In contrast, the lower moisture content of P5% (17.43%) and P10% (19.64%), both of which meet SNI requirements, supports a more stable gel matrix that is better able to retain fragrance and resist physical deformation during use. Among the two compliant treatments, P5% demonstrated a moisture content value that is optimal—low enough to ensure structural integrity yet sufficient to sustain a gradual and even release of fragrance over an extended period, which is the primary functional expectation of a room freshener gel product (Widiyastuti et al., 2017). This finding confirms that acetic acid soaking at 5% concentration not only corrects the physicochemical deficiency observed in the unsoaked treatment but also produces moisture characteristics that are most favorable for consumer use and product durability.

Viscosity

Viscosity is a measure of the degree of thickness or flow resistance of a liquid or semi-solid substance when a shear force is applied. In the production of seaweed-based room freshener gel, viscosity is an important parameter for determining the textural quality of the resulting gel. Viscosity values indicate the gel's ability to maintain its shape, prevent rapid melting, and regulate the rate of fragrance release. Viscosity test results are shown in Table 2.

Table 2. Viscosity Test Results

Treatment	Viscosity (μm/pascal)
Without soaking (P0)	62,237
5% soaking (P5%)	62,362
10% soaking (P10%)	73,111

Based on the viscosity test results, all treatments showed values within the ideal range for semi-solid gel products in accordance with SNI 06-2589-1992 and ASTM D2196. Treatment P0 produced a viscosity of 62,237 μm/pascal, P5% of 62,362 μm/pascal, and P10% the highest value of 73,111 μm/pascal. The increase in viscosity with increasing soaking concentration indicates that the treatment strengthened the gel network through inter-particle bonding, producing a more stable texture that slowly releases fragrance — a highly desirable property in room freshener gel formulations (Meilina, 2020).

The higher viscosity value at 10% acetic acid concentration indicates that the higher the acid concentration, the stronger its ability to compact the gel matrix, resulting in a thicker, more stable texture that resists melting. Therefore, soaking with acetic acid, particularly at 10% concentration, is recommended for producing seaweed-based room freshener gel with optimal consistency and better durability.

Organoleptic Evaluation

Organoleptic evaluation was conducted to assess panelist acceptance of the aroma and texture of the room freshener gel formulated with various Eucheuma cottonii soaking concentrations. Twenty panelists evaluated both parameters using a 5-point hedonic scale. Complete results are presented in Table 3.

Table 3. Organoleptic Evaluation Results

No	Panelist	P0	P5%	P10%	P0	P5%	P10%
			Aroma			Texture	
1	1	4	4	3	3	4	4
2	2	3	4	4	2	4	3
3	3	4	4	3	3	5	3
4	4	4	3	2	1	4	3
5	5	4	4	2	1	4	4
6	6	2	4	4	1	5	2
7	7	4	3	4	2	4	4
8	8	4	5	3	1	4	4
9	9	4	4	5	1	4	4
10	10	4	4	4	4	4	5
11	11	3	4	3	1	5	3
12	12	4	4	4	2	3	3
13	13	2	3	2	1	4	3
14	14	3	3	3	3	5	4
15	15	4	4	3	2	4	4
16	16	4	3	3	2	5	3
17	17	3	4	4	3	4	4
18	18	4	3	4	3	4	4
19	19	3	3	3	2	5	3
20	20	4	4	3	2	4	3
Total		**71**	**74**	**66**	**40**	**85**	**70**
Average		**3.55**	**3.70**	**3.30**	**2.00**	**4.25**	**3.50**

Based on the organoleptic evaluation data, all formulations achieved average aroma scores above 3.0, meeting the acceptance threshold based on SNI 01-2346-2006. Formulation P5% achieved the highest aroma score (3.70), followed by P0 (3.55) and P10% (3.30). This indicates that panelists responded positively to all formulations, with 5% acetic acid soaking producing the most preferred aroma. This result stems from the ability of 5% acetic acid to eliminate the characteristic fishy odor of seaweed without damaging the additional aromatic compounds from essential oils (Pratista & Syukur, 2020).

For the texture parameter, P0 only achieved a score of 2.00, below the acceptance threshold of 3.0, indicating that the unsoaked gel was not favored by panelists in terms of texture. In contrast, P5% achieved the highest texture score (4.25), demonstrating that this concentration produced a good, elastic texture preferred by panelists. P10% also showed good results with an average score of 3.50. The high texture scores for P5% and P10% are associated with the carrageenan polysaccharide content in Eucheuma cottonii, which acts as a gelling agent, thereby increasing product consistency and stability (Fransiska & Reynaldi, 2020).

The reason why 5% acetic acid soaking produced the best quality is that at this concentration, acetic acid effectively eliminates the fishy or characteristic seaweed odor without damaging the additional aromatic compounds. Furthermore, acetic acid at 5% also helps break down some impurities or pigments that can affect the clarity and homogeneity of the gel, resulting in a smoother, firmer, and more appealing texture for panelists.

Gel Strength

The gel strength test aimed to determine the extent of the gel's resistance and structural stability against compressive force, to ensure the gel can maintain its physical form during use. Gel strength test results are presented in Table 4.

Table 4. Gel Strength Test Results

Treatment	Force (g)	Press Distance (cm)	Gel Strength (g/cm^2)
Without soaking (P0)	342.7	10	85.859
5% soaking (P5%)	2,457.8	10	291.45
10% soaking (P10%)	1,165.3	10	615.77

Based on the gel strength test results using the SNI 01-2891-1992 method, all treatments produced gel strength values above the minimum standard (≥45 g/cm^2). Treatment P0 produced 85.859 g/cm^2, P5% produced 291.45 g/cm^2, and P10% produced 615.77 g/cm^2. Soaking treatment significantly increased gel strength, indicating a clear effect on physical stability. All tested formulations were found to meet and even exceed the gel strength standard for nature-based room fresheners.

The increase in gel strength due to soaking occurs because this process purifies the seaweed raw material by removing impurities, minerals, and interfering ions that can weaken gel bonds. Moreover, soaking also helps break inter-molecular bonds of polysaccharides, enhancing the gel's ability to form a denser and more stable structure (Fransiska & Reynaldi, 2020). Thus, the higher the soaking concentration, the better the inter-molecular bonding in forming a strong and stable gel, making the gel's durability as a room freshener more optimal.

CONCLUSION

Based on the results of this study, seaweed-based (Eucheuma sp) room freshener gel was successfully produced with three soaking treatment variations. Gel strength values of 85.859 g/cm^2 (P0), 291.45 g/cm^2 (P5%), and 615.77 g/cm^2 (P10%) all exceeded the minimum SNI standard. Viscosity values of 62,237 µm/pascal (P0), 62,362 µm/pascal (P5%), and 73,111 µm/pascal (P10%) all fell within the ideal range for semi-solid gel. Moisture content results showed that P0 (24.08%) did not meet the SNI standard, while P5% (17.43%) and P10% (19.64%) met the requirements. Organoleptic evaluation showed that the 5% acetic acid soaking treatment (P5%) produced the best scores for aroma (average 3.70) and texture (average 4.25), making it the most optimal formulation. The P5% treatment is recommended as the best formulation for the production of seaweed-based room freshener gel.

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