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ADDITION OF SEAWEED FLOUR (*Eucheuma cottonii*) AS FIBER SOURCE AGAINST CENDOL LEVEL OF FLAVOR

Penambahan Tepung Rumput Laut (*Eucheuma cottonii*) Sebagai Sumber Serat Terhadap Tingkat Kesukaan Cendol

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ABSTRACT

Eucheuma cottonii seaweed flour is rich in cargo, minerals, and fiber. The fiber content of cape seaweed can be used in various food or beverage applications, one of which is cendol product. This study was conducted to evaluate the waste of *Eucheuma cottonii* seaweed flour on chemical and organoleptic properties in cendol products. This research was conducted at the Fisheries Results Processing Laboratory, Faculty of Fisheries and Science of Padjadjaran University, and at the PT Laboratory (SIG). Saraswanti Indo Genetech Bogor. The study used experimental methods with four treatments, namely the addition of 0%, 5%, 10%, and 15% to cendol. Organoleptic testing conducted by 25 panelists is semi-trained and serves as a recitation in the language of recitation. The parameters analyzed include hedonic tests of appearance, aroma, taste, and texture as well as chemical analysts such as air, protein, fat, ash, dietary fiber. Organoleptic test results are analyzed with Friedman and Bayes tests, while chemical analysis results are descriptively comparative. Studies have shown that the addition of 5% of Eucheuma cottonii seaweed to dough is the preferred treatment of organoleptic test beds with an average likelihood score of visibility (6.8); taste (7.0); and texture (6.0). This treatment also produces a chemical composition of air (91.55%); air content (0.16%); protein content (0.59%); fat content (0.02%); carbohydrates (7.70%) and dietary fiber content (1.94%).

Keywords: Cendol, Eucheuma cottonii, Organoleptic, Dietary Fiber, Chemical Composition

ABSTRAK

Tepung rumput laut *Eucheuma cottonii* kaya akan kandungan karaginan, mineral, dan serat. Kandungan serat tepung rumput laut dapat digunakan dalam berbagai aplikasi makanan ataupun minuman, salah satunya produk cendol. Penelitian ini dilakukan untuk mengevaluasi dampak penambahan tepung rumput laut *Eucheuma cottonii* terhadap sifat kimia dan organoleptik pada produk cendol. Penelitian ini dilaksanakan di Laboratorium Pengolahan Hasil Perikanan, Fakultas Perikanan dan Ilmu Kelautan Universitas Padjadjaran, serta di

Laboratorium (SIG) PT. Saraswanti Indo Genetech Bogor. Penelitian ini menggunakan metode eksperimen dengan empat perlakuan, yaitu penambahan tepung rumput laut sebanyak 0%, 5%, 10%, dan 15% pada cendol. Uji organoleptik dilakukan oleh 25 panelis semi terlatih dan dijadikan sebagai ulangan dalam pengujian. Parameter yang dianalisis mencakup uji hedonik terhadap kenampakan, aroma, rasa, dan tekstur serta analisis kimia seperti kadar air, protein, lemak, abu, serat pangan. Data hasil uji organoleptik dianalisis dengan uji Friedman dan Bayes, sedangkan hasil uji kimia dianalisis secara deskriptif komparatif. Hasil penelitian menunjukkan bahwa penambahan 5% tepung rumput laut *Eucheuma cottonii* pada cendol merupakan perlakuan yang paling disukai berdasarkan uji organoleptik dengan rata-rata skor tingkat kesukaan terhadap kenampakan (7,3); aroma (6,8); rasa (7,0); dan tekstur (6,8). Perlakuan ini juga menghasilkan komposisi kimia yaitu kadar air (91,55%); kadar abu (0,16%); kadar protein (0,59%); kadar lemak (0,02%); karbohidrat (7,70%) dan kadar serat pangan menjadi (1,94%).

Kata Kunci: Cendol, Eucheuma cottonii, Komposisi Kimia, Organoleptik, Serat Pangan

INTRODUCTION

Indonesia is known as one of the world's leading producers of seaweed, particularly Eucheuma cottonii, which contributes approximately 84% of total global production (FAO, 2021). This seaweed is commonly processed into flour due to its high nutritional content, particularly carrageenan, minerals, and dietary fiber. Eucheuma cottonii flour has a very high fiber content, at 57.2% per 100 grams (Supriadi, 2004), thus offering significant potential as an additive to enhance the nutritional value of various food products, particularly in terms of fiber content.

Dietary fiber plays a crucial role in maintaining good health, including aiding digestion, lowering cholesterol, and regulating blood glucose levels (Rana et al., 2019). However, Indonesians' dietary fiber consumption remains below the recommended daily intake. The average daily fiber intake is only around 10.5 grams, well below the recommended daily allowance of 29-37 grams (Ministry of Health, 2019). This situation highlights the need to develop fiber-rich food products to increase overall fiber intake.

One traditional food product with the potential to be developed into a functional beverage is cendol. Cendol is a traditional Indonesian drink enjoyed by all levels of society.

The addition of Eucheuma cottonii seaweed flour to cendol products has the potential to be an alternative way to increase the fiber content of the beverage. In addition to increasing nutritional value, the addition of seaweed flour can also affect organoleptic properties, such as color, texture, and flavor. This is related to the physical and chemical characteristics of the fiber, food, and carrageenan in seaweed flour. Based on this, this study aims to evaluate the effect of seaweed flour addition on the organoleptic and chemical characteristics of cendol, as an effort to support increased fiber intake in community consumption patterns.

RESEARCH METHODS

Place and Time

This research was conducted from February to March 2025. Cendol production and hedonic testing were conducted at the Fisheries Product Processing Laboratory, Padjadjaran University. Proximate testing and dietary fiber content testing were conducted at the GIS Laboratory, PT. Saraswanti Indo Genetech, Bogor City.

Tools and materials

The tools used in the process of making cendol include bowls, basins, pans, gas stoves, ladles, spatulas, spoons, knives, digital scales, blenders, piping bags, jars, coolboxes, and plastic cups. The ingredients used in making cendol are rice flour, tapioca flour, Eucheuma cottonii seaweed flour, plain agar powder, granulated sugar, mineral water, ice cubes, and pandan leaves. The ingredients used in making cendol sauce are coconut milk, pandan leaves, brown sugar, granulated sugar, and mineral water.

Research Procedures

Cendol was made from a mixture of rice flour, tapioca flour, and Eucheuma cottonii seaweed flour at concentrations of 0%, 5%, 10%, and 15%. Organoleptic tests were conducted, including hedonic tests, fiber tests, and proximate analysis, including moisture, ash, fat, protein, and carbohydrate content. Data were statistically analyzed using the Friedman and Bayesian tests to determine the best treatment.

Research methods

This method used an experimental approach with four treatments and 25 semi-trained panelists as replicates. Observed parameters included hedonic testing, proximate analysis, and dietary fiber content testing. The percentage of Eucheuma cottonii seaweed flour added for each treatment was as follows:
Treatment A: Addition of 0% seaweed flour (control)
Treatment B: Addition of 5% seaweed flour
Treatment C: Addition of 10% seaweed flour
Treatment D: Addition of 15% seaweed flour

Chemical test data, including fiber content and proximate analysis, were analyzed descriptively and comparatively, breaking down the laboratory results into a scientific narrative. The nutritional content of each sample was described and compared to identify differences between treatments (Sugiyono 2018).

Hypothesis

Based on the framework of thought, the addition of 10% Eucheuma cottonii seaweed flour in the manufacture of cendol can increase the fiber content and produce the most preferred product.

RESULTS

Cendol Preference Level Results

Appearance

Appearance is one of the main parameters in assessing food quality and is also an initial factor influencing panelists' interest in a product (Sari et al., 2022). Product appearance in organoleptic testing is assessed based on color, brightness, uniformity of shape, and the presence or absence of appearance defects, which can influence panelists' initial perceptions of the product being tested (Hidayat et al., 2020). The average appearance score for cendol supplemented with Eucheuma cottonii seaweed flour is shown in Table 1.

Table 1. Analysis Value of the Level of Preference for the Appearance of Cendol with the Addition of Seaweed Flour (Eucheuma cottonii).

Treatment	Median Value	Average value
A (0%)	7	7,5 b
B (5%)	7	7,3 b
C (10%)	7	6,8 ab
D (15%)	5	5,9 a

Description: The average value followed by same lowercase letter in the column direction indicates significantly different results according to the multipe comparison test at a 95% confidence level.

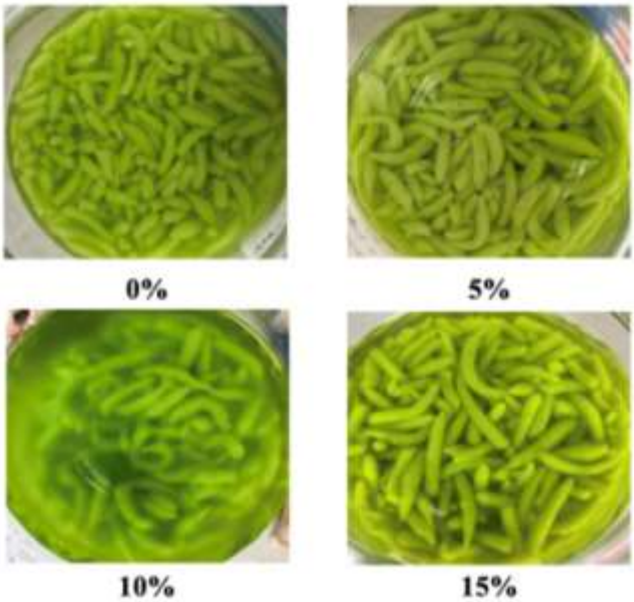

Figure 1. Cendol

Aroma

Aroma plays a crucial role in food because it contributes to consumer acceptance (Trisyanai and Syahlan, 2022). Aroma testing was performed using the sense of smell, using the characteristic odor of seaweed cendol (Eucheuma cottonii) as a parameter. The average aroma of cendol with the addition of Eucheuma cottonii seaweed flour is shown in Table 2.

Table 2. Analysis Value of the Level of Preference for Cendol Aroma with the Addition of Seaweed Flour (Eucheuma cottonii).

Treatment	Median Value	Average Value
A (0%)	7	7,0 a
B (5%)	7	6,8 a
C (10%)	7	6,8 a
D (15%)	7	6,9 a

Description: The average value followed by the same lowercase letter in the column direction indicates significantly different results according to the multiple comparison test at a 95% confidence level.

Flavor

Taste is the response perceived by the taste buds to stimulation from chemical compounds in food and is mostly assessed using the taste buds or tongue (Bahmid et al., 2019). The average taste of cendol with the addition of Eucheuma cottonii seaweed flour is shown in Table 3.

Table 3. Analysis Value of Taste Preference Level of Cendol with the Addition of Seaweed Flour (Eucheuma cottonii).

Treatment	Median Value	Average Value
A (0%)	7	6,9 a
B (5%)	7	7,0 a
C (10%)	5	6,1 a
D (15%)	5	5,8 a

Description: The average value followed by the same lowercase letter in the column direction indicates significantly different results according to the multiple comparison test at a 95% confidence level.

Texture

Texture is the perception of pressure felt when a product is bitten, chewed, swallowed, or touched with fingers, and reflects the physical properties of the food ingredient (Pitunani et al., 2016). The average texture of cendol with the addition of Eucheuma cottonii seaweed flour is shown in Table 4.

Table 4. Analysis Value of the Level of Preference for the Texture of Cendol with the Addition of Seaweed Flour (Eucheuma cottonii).

Treatment	Median Value	Average Value
A (0%)	7	7,5 b
B (5%)	7	7,3 b
C (10%)	7	6,8 ab
D (15%)	5	5,9 a

Description: The average value followed by the same lowercase letter in the column direction indicates significantly different results according to the multiple comparison test at a 95% confidence level.

Cendol Proximate Test Results

Proximate testing is a chemical analysis used to determine the primary nutritional composition of a food. Proximate analysis of cendol products was performed on the control treatment (0%) and the predetermined best treatment (5%). The results of the proximate analysis included moisture content, ash content, protein content, fat content, and carbohydrate content.

The results of the moisture content test showed differences between treatments, indicating that the addition of seaweed flour affected the product's moisture level. Meanwhile, the ash content reflects the mineral content of the cendol. Protein and fat content each reflect the potential nutritional value in terms of macronutrients. Carbohydrate content reflects the total energy content of a food product. The results of the proximate test for the 0% and 5% treatments are shown in Table 5.

Table 5. Results of Proximate Test Analysis of Cendol with the Addition of Seaweed Flour (Eucheuma cottonii).

Treatment	Cendol Products	
	Treatment (0%)	Treatment (5%)
Water	92,56%	91,55%
Ash	0,07%	0,16%
Protein	0,46%	0,59%
Fat	<0,02%	<0,02%
Carbohydrate	6,91%	7,70%

Cendol Fiber Content Test Results

The dietary fiber content test is an analytical method to determine the total amount of fiber contained in food, both soluble and insoluble in water (Winarno, 2004). The results of the fiber content test for the treatment (0%) and the best treatment (5%) can be seen in Table 6.

Table 6. Results of Analysis of Dietary Fiber of Cendol with the Addition of Seaweed Flour (Eucheuma cottonii).

Treatment	Cendol Products	
	Treatment (0%)	Treatment (5%)
Serat	1,92%	1,94%

DISCUSSION

Based on the analysis results, the panelists' preference for the appearance of cendol ranged from 6.9 to 7.5, indicating that it was generally still preferred by the panelists. The Friedman test showed that the addition of seaweed flour significantly affected the appearance of cendol. The treatment with the addition of 15% seaweed flour did not show a significant difference compared to the 10% treatment, but was significantly different compared to the 0%, 5%, and 10% treatments. This visual difference was related to changes in color and the appearance of spots on the surface of the cendol. Increasing the concentration of seaweed flour in the cendol formulation tended to cause the color to become paler and faint spots to appear on the surface of the cendol. These spots are thought to originate from coarse particles in the seaweed flour that did not dissolve completely due to the less than homogeneous mixing process. The high crude fiber and polysaccharide content in seaweed flour can cause incompatibility with the cendol-forming ingredients, thus affecting the product's visual appearance. In addition, the green color of pandan leaves also tends to decrease in intensity because it is mixed with the yellowish gray color of seaweed flour at high concentrations (Prastyawan et al., 2014).

The analysis results showed that the panelists' preference for the aroma of cendol ranged from 6.8 to 7.0, which was still considered acceptable. The Friedman test results showed no significant differences between treatments, thus concluding that the addition of seaweed flour (Eucheuma cottonii) did not significantly impact the aroma characteristics of cendol. The control treatment (0%) obtained the highest score, 7.0, due to the purer aroma produced and meeting the panelists' expectations for traditional cendol. Conversely, the lowest scores were found in the 5% and 15% treatments, each with a score of 6.8, due to the emergence of a distinctive seaweed aroma that differed from the original aroma of cendol. This aroma originates from natural volatile compounds in seaweed, such as sulfur compounds, aldehydes, ketones, and alcohols, which create a marine or fishy aroma (Herawati, 2018). However, all treatments were still in the preferred category on the hedonic scale 5-9 (Soekarto, 1985) indicating that the aroma of seaweed was still acceptable to the panelists within certain limits.

The analysis results showed that panelists gave varying levels of preference for the cendol flavor, ranging from 5.8 to 7.0, with the aroma of the product still being considered favorable by the panelists. The Friedman test results showed no significant differences between all treatments. However, the treatment with the addition of 5% seaweed flour obtained the highest score of 7.0, indicating that this concentration was able to maintain the distinctive flavor of cendol. The complex flavor of cendol is influenced by non-volatile compounds in pandan leaves such as polyphenols, saponins, and carbohydrates (Cheng et al., 2017), as well as the contribution of compounds from seaweed such as amino acids and polysaccharides that support the umami and sweet flavors (Yuan et al., 2021). The addition of 15% seaweed flour to cendol received the lowest score of 5.8, this was due to the appearance of a bitter aftertaste according to the panelists. This flavor comes from sulfuric compounds such as methionine and cysteine, as well as minerals like magnesium and potassium, which in high amounts can suppress sweetness and increase the perception of bitterness (Peacock & Wong, 2012). Furthermore, the Maillard reaction during the heating process can produce melanoidin compounds, which contribute to the additional bitterness (Nursten, 2005). Adding large amounts also tends to mask the natural flavor of pandan, disrupting the overall flavor balance.

The analysis results showed that the panelists' acceptance of the cendol texture ranged from 5.7 to 6.8, indicating that the cendol texture was preferred by the panelists. The Friedman test results showed that all treatments did not produce significant differences. The 5% cendol treatment obtained the highest score of 6.8, which is associated with a chewy cendol texture, not too hard, and not too soft, thus providing a pleasant chewing sensation. This chewiness comes from the interaction between carrageenan and starch in the dough, where carrageenan plays a role in forming a gel structure with amylose molecules when heated (Suryaningrum et al., 2022; Herawati, 2018). The 15% cendol treatment obtained the lowest score of 5.7, due to the cendol texture becoming denser and somewhat harder. This is caused by increased interparticle bonds due to the gelatinization of fiber and polysaccharides in seaweed flour. Research by Prastyawan et al., (2014) also shows that high concentrations of carrageenan can increase chewiness, but risks reducing the level of liking.

Moisture content is an important quality parameter in describing the amount of water in a food product, which can affect texture, appearance, and taste (Riansyah et al., 2013). The results of the water content analysis showed that cendol with the addition of 5% seaweed flour (Eucheuma cottonii) had a water content of 91.55%, showing a lower value compared to the control cendol of 92.56%. This decrease indicates that the fiber in seaweed flour is able to bind water effectively, thereby reducing product moisture (Lukito et al., 2017). This condition contributes to increased stability and shelf life potential, considering that high water content can accelerate microbial growth, while lower water content can accelerate shelf life (Dewita et al., 2013).

Ash content describes the inorganic mineral content in food ingredients and is obtained from the residue of complete combustion of the sample (Smith et al., 2023). The analysis results showed that the ash content of cendol with 5% seaweed flour (Eucheuma cottonii) produced a value of 0.16%, which was higher than the control cendol at 0.07%. This increase is related to the contribution of minerals from seaweed such as calcium, magnesium, potassium, and phosphorus (Yuliarti, 2015). However, high mineral content can also affect sensory characteristics. Calcium and magnesium ions can cause a bitter aftertaste and form a denser gel texture due to their interaction with carrageenan (Herawati, 2018). Furthermore, mineral particles that are not completely dissolved have the potential to cause spots that interfere with the appearance of the product (Dewita et al., 2013).

Protein is an essential nutrient that plays a role in structural and metabolic functions, and can serve as an energy source (Winarno et al., 2007). Analysis results showed that cendol with the addition of 5% grass flour (Eucheuma cottonii) had a protein content of 0.59%, higher than the control cendol at 0.46%. This increase indicates that seaweed contributes to the nutritional value of the product, as it contains a moderate amount of vegetable protein, around 1.5%-3.5% (Wiratmaja et al., 2011). Protein in seaweed contains nitrogen compounds such as amino acids and peptides that contribute to the umami taste, although in high concentrations it can cause a bitter or salty aftertaste (Wijayanti & Rachmawati, 2018). A similar study by Sipahutar et al. (2021) showed that the addition of seaweed flour increased the protein content in tilapia sausage products.

Fat is an important component in food, serving as an energy source and influencing the sensory characteristics of the product (Siti et al., 2013). The analysis results showed that the fat content in cendol, both control cendol and cendol with the addition of 5% seaweed flour (Eucheuma cottonii), was very low, at less than 0.02%. This low level indicates that the addition of seaweed flour at this concentration did not significantly affect the fat content or organoleptic characteristics.

Carbohydrates are the body's primary energy source (Utomo & Qomariyah, 2017). Analysis showed that the carbohydrate content of control cendol increased from 6.91% to 7.70% in cendol with the addition of 5% seaweed flour (Eucheuma cottonii). This increase is related to the complex polysaccharide content, particularly carrageenan, which has a high ability to absorb water and form a gel (Mulyani et al., 2020). Furthermore, carrageenan is also classified as a soluble dietary fiber that contributes to the total carbohydrate content of the product (Santoso et al., 2004).

Dietary fiber is a part of plants that cannot be digested by the human digestive system, consisting of non-starch polysaccharides such as cellulose, hemicellulose, and lignin (Purwaningsih et al., 2023). Based on the analysis results, the fiber content in the control cendol increased from 1.92% to 1.94% in the treatment with the addition of 5% seaweed flour (Eucheuma cottonii). Although this increase is relatively small, it indicates a contribution of fiber from seaweed. The limited increase is due to the low concentration of seaweed flour used in this study. Adding high amounts has the potential to increase fiber content, but it needs to be balanced with attention to the sensory characteristics of cendol. Overall, the addition of seaweed flour (Eucheuma cottonii) to cendol has the potential to increase fiber content, thus supporting the development of cendol as a functional food product (Herawati, 2018).

CONCLUSION

Based on the research results, the treatment with the addition of 5% seaweed flour (Eucheuma cottonii) was the treatment most preferred by the panelists, with an average score of appearance of (7.3); aroma (6.8); taste (7.0); and texture (6.8) and a total alternative value of 6.99. The results of the proximate test on this treatment showed an ash content of (0.16%); fat (<0.02%); water (0.91%); carbohydrate (7.70%), and protein (0.59%) and dietary fiber content of (1.94%).

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