Characterization of the physical properties and sensory acceptability of *Caulerpa racemosa* grain beverage

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**Abstract.** *Caulerpa racemosa* grain was a healthy product and high nutrition. This study applied study was applied *Caulerpa racemosa* grain in the beverage with the addition of alginate powder. Thus, the present work was aimed to determine the properties of beverage *C. racemosa* grain formulated with the alginate concentration was varied (0; 0.025; 0.05; 0.075; 0.10 and 0.125 %). The testing of quality beverage *C. racemosa* viscosity was analyzed using viscometer methods. The colorimeter investigated the colour. The sensory acceptability hedonic and score method (colour, appearance, aroma, taste, texture, and overall acceptance) used a 5-point. Results showed that alginate used alginate 0.025%, the highest preference, aroma, and appearance scores. The addition of alginate increased alginate was increased the viscosity of beverage *C. racemosa* grain. The colour of *C. racemosa* grain progressively became light as the level of alginate grew. However, the increased alginate is not significant enough to change the redness and greenness value of *C. racemosa* grain beverage. The panelists have preferred to drink the selected *Caulerpa* grain beverage (concentration sodium alginate 0.025%), with slightly viscous.

1. **Introduction**

The utilization of *Caulerpa* spp is still minimal. Asian people have long made seaweed as a vegetable that is directly eaten. Seaweed is used as fodder for feed and poultry, besides food besides to food as a source of nutrition [1]. *Caulerpa* spp is a green Chlorophyta seaweed that grows on rocks or living in association with other seaweeds. Therefore caused ecological problems in the Canary Islands and invaded the Mediterranean Sea [2]. *Caulerpa* is characterized by a soft thallus resembling cartilage, generally green and light yellow, growing between stones, attached to the substrate with retaining fibers. *Caulerpa* produces and is widespread in the tropics the area tropics [3].

Alginate is a homopolysaccharide of α-L-Guluronic acid (G), β-D-Manuronic acid (M), or heteropolysaccharide consisting of both acids, which are arranged which arranged in crosslink (MG). The ratio of M blocks, G blocks, and MG blocks of aliphatic extracted is determined by species of extracted brown seaweeds; and will affect the gel strength of the alginate solution. The general formula of alginate molecules is \((\text{C}_6\text{H}_{11}\text{O}_{6}\text{Na})_n\) [4]. A few studies few numbers of studies on *C. racemosa* have been reported, especially on general morphology, abundance, distribution, standing stock [5], and micronutrients and trace elements [6]. *Caulerpa* is very easily damage by microbial activity, enzymes, or environmental influences. Fresh seaweed will be damaged within a short short time after the harvesting process. It is a critical process essential to use a suitable handling
method [7]. One way to extend the shelf life of *C. racemosa*, its derivative products are made, one of which is making *Caulerpa* grains. This grain-making technique is known as the spherification technique using sodium alginate and calcium lactate. The combination of these materials to protect the core material from environmental influences and hold volatile materials from chemical damage during processing, storage, and handling must release the coated material when consumed. Furthermore, *Caulerpa* grains are made in the form of drink *Caulerpa* grain ready to be served. The present work aimed to determine drink *C. racemosa* beverage properties formulated with the alginate concentration (0; 0.025; 0.05; 0.075; 0.10 and 0.125 %).

2. Materials and Methods

2.1. Material

*Caulerpa racemosa* fresh was collected from Binuangeun, Banten, Indonesia. The ingredients of *C. racemosa* beverage were sodium alginate, flavour, sugar, and colouring food purchased from the local market.

2.2. Methods of making Caulerpa grain beverage

The making of *Caulerpa* grains refers to Basmal and Nurhayati [8] with the treatment of 0.8% sodium alginate and 0.8% calcium lactate. The procedure for making *Caulerpa* grain beverage, as follows in Figure 1.

![Figure 1](image)

*Figure 1.* The flow chart of *Caulerpa* grain beverage.

The formulation of *Caulerpa* grain beverage such as sugar 10%, colouring 0.01%, flavour 0.3%, and sodium alginate varied adding to make 100 % of total weight. *Caulerpa* grains beverage was packaged in bottles with 250 mL packaging.

2.3. Characterization of the physical properties (viscosity and colour) Caulerpa grain beverage

The characterization of the physical properties of *Caulerpa* grain beverage as such viscosity of beverage solution using a method referred in Sinurat et al. [9]. The solution was stirred gradually at room temperature. The viscosity of the solution was measured using a *Brookfield* viscometer in units centipoise (cP). The *Caulerpa* grain colour of were determined according to lightness (*L* = 100; white and *L* = 0; black), Chroma *a* [green chromaticity (-60) to red (+60)], and Chroma *b* [blue...
chromaticity (-60) to yellow (+60)] space value using a colorimeter (Konica Minolta, Chroma Meter CR-400, Tokyo, Japan).

2.4. Sensory Evaluation of Caulerpa grain beverage

Sensory evaluation of Caulerpa grain beverage was conducted by score test and hedonic test. The parameter for the score test such appearance, colour, aroma, texture, and taste. Then for the hedonic test with parameters as such: appearance, colour, aroma, texture, and taste, and overall acceptability. Caulerpa grain beverage (50 mL) was poured into 100 mL glass for quality assessment. A trained panel of 100 judges was employed for the sensory evaluation of the Caulerpa grain beverage. Somebody conducted the panelist training session of 15 minutes before the start of the evaluation. Afterward, one sample at a time was offered to each member. The sensory testing was made in the panel room with controlled temperature and relative humidity. The panel room was completely free of food/chemical odors, unnecessary sound, and daylight mixing. It was provided with a prescribed questionnaire to record their sensory observations. The information contained on the sensory performance was indicated as 5 = Like; 4 = Like slightly; 3 = Dislike moderately; 1 = Dislike [9].

Data obtained from each parameter was analyzed statistically by Analysis of variance and Duncan’s Multiple Range test (p<0.05) by using the SPSS 17.0 software package (LEAD Technologies Inc, Chicago, USA) as described by Steel et al. (1997) [11].

3. Results and Discussion

3.1. Characterization of the physical properties (viscosity and colour) Caulerpa grain beverage

The viscosity of Caulerpa grain beverage with varied sodium alginate (0; 0.025%; 0.05%; 0.075%; 0.10%; 0.125%) as shown in Figure 2. The variations in sodium alginate concentration were directly proportional to the results of Analysis the viscosity analysis of drink Caulerpa grain. The higher concentration of sodium alginate results in a higher viscosity of drink Caulerpa grain. The viscosity of alginate is affected by gel strength, temperature, alginate concentration, alginate molecular weight, and the ratio of units M and G from alginate molecules [12]. An increase in the proportion of G units produces a more viscous alginate solution.

![Figure 2. The viscosity of Caulerpa grain beverage.](image-url)

Notes: F1 = Sodium alginate 0%; F2 = Sodium alginate 0.025%; F3 = Sodium alginate 0.05%; F4 = Sodium alginate 0.075%; F5 = Sodium alginate 0.1%; F6 = Sodium alginate 0.125%
The Caulerpa grain beverage containing Caulerpa grain, alginate solution, sugar, and the flavour had significantly (p < 0.05).

The colour of the drink Caulerpa tends to be dark to dark, probably because the cause dye used was a green change to past tense. According to Gonzalez et al. [12], The colour of the product is usually the product of effect traditionally imparted by the colour of the ingredients used.

Table 1. Colour of solution Caulerpa grain beverage.

| Formulation of Caulerpa grain beverage | Lightness (L*) | Redness (a*)  | Yellowness (b*) |
|---------------------------------------|----------------|---------------|-----------------|
| F1                                    | 4.03±0.00 a    | -3.15±0.02 a  | 1.71±0.03 a     |
| F2                                    | 4.21±0.00 a    | -3.16±0.01 a  | 1.62±0.05 a     |
| F3                                    | 3.84±0.01 b    | -3.62±0.06 a  | 1.99±0.09 b     |
| F4                                    | 3.47±0.06 a    | -3.27±0.06 a  | 1.85±0.03 b     |
| F5                                    | 4.11±0.04 b    | -3.39±0.00 b  | 1.73±0.00 c     |
| F6                                    | 3.88±0.02 b    | -3.42±0.00 b  | 1.66±0.04 d     |

Data are mean ± standard deviation (n = 3). Values with different superscript letters within a column are significantly different (p < 0.05).

It was the redness (a*) of Caulerpa grain beverage part formulations that showed an insignificant difference (p > 0.05) from each other (Table 1). The * for all formulations was negative, which indicates the colour of the drink Caulerpa grain was green—the yellowness (b*) of drink Caulerpa grain trend to yellow. However, the all-formulations part was significantly different (p > 0.05) from each other (Table 1). The formulation F1 and F2 had quite different (p > 0.05) from the other formulations. Formulation F1 and F2 are the same for lightness (L*), redness (a*), and yellowness (b*).

3.2. Sensory evaluation of Caulerpa grain beverage

3.2.1 Score Test. The colour scores of Caulerpa grain beverages were presented in Fig. 3, revealing significant variation (p<0.05).

![Figure 3. Score Test of Caulerpa grain beverage.](image-url)
The panelists rated all the *Caulerpa* grain beverage in the present work between 3-4 shown strong aroma. The panelist gave the value that F2 was the most potent aroma compared to each other. The variation of concentration alginate for texture showed significant improvement (p<0.05). A sensory test score of panelists for texture could be a preferred beverage with high concentration alginate. However, in taste, the panelists for taste could have selected with low concentration alginate is F1.

3.2.2 *Hedonic Test*. A sensory test score of panelists about appearance for all formulations as ‘like slightly.’ The panelist's hedonic score gave value for colour that variation concentration alginate to all formulations as dislike moderately. The panelist gave the same aroma and texture almost the same for all formulations. However, for parameters, taste, and overall acceptability, the panelists have significantly different opinions. The formula F1 had the highest score for taste and overall acceptability compared to other formations. The results of sensory show that panelists prefer slightly viscous *Caulerpa* beverages to be thick or watery ones. In another study using alginate as a thickener in functional drinks, the optimum concentration of the most preferred alginate is 1% [14].

![Figure 4](image.png)

Notes: F1 = Sodium alginate 0%; F2 = Sodium alginate 0.025%; F3 = Sodium alginate 0.05%; F4 = Sodium alginate 0.075%; F5 = Sodium alginate 0.1%; F6 = Sodium alginate 0.125%

**Figure 4.** The hedonic score of *Caulerpa* grain beverage.

4. **Conclusion**
The variation in concentration of alginate affects the viscosity *Caulerpa* grain beverage solution. A sensory test score of panelists about appearance for all formulation as like slightly: according to panelists, the best formula result based on the score and hedonic tests was F2 (sodium alginate 0.025%) based on taste and overall acceptability.

**Author contributorship**
E Sinurat as main contributor; Nurhayati, D Fransiska, and J Basmal as supporting contributor

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