Physics and Chemical Characteristics of Sargassum Sp. Seaweed with Addition of Sodium Alginate Stabilizer to Different Concentrations

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Abstract. One of the most effective ways to increase the use of the Sargassum seaweed resources in Indonesia is by processing them into syrup products. Syrup is a fast-food beverage product and is easily dissolved in water which makes it practically easy to serve. It could also be saved relatively long. Additional ingredients that could stabilize or bind the processed products can be developed using Sargassum seaweed. Sargassum seaweed contains phenol compounds and polysaccharides in the form of alginate which functions as a thickening and gelling agent. . This study aims to determine the physical and chemical characteristics of Sargassum sp. Which was given different concentration level of sodium alginate as stabilizer. The results of the Analysis of Variance (ANOVA) showed that the administration of alginate and CMC type stabilizers gave significant differences ($p < 0.05$) on the viscosity parameters, total plate numbers, and organoleptic parameters in the form of taste and texture. Meanwhile the color parameters and the aroma did not show any effect. Statistical test results showed that the CMC type or control treatment was able to maintain the sweetness level with an average score of 4.8. The viscosity test showed that the treatment with the administration of 1% sodium alginate stabilizer or P3 resulted in the highest average viscosity value which was 139.60 Cps.
Key Words. Stabilizer, Sodium Alginate, Sargassum sp.

1. Introduction

There has not been many people utilize *Sargassum seaweed* although the benefits to its processed products is well known to people. *Sargassum* sp. is one of the brown algae species *(Phaeophyceae)* which produces alginic acid. Said alginic acid is widely used in the food, textile, cosmetics and pharmaceutical industries. The characteristics possessed by the alginates include their ability to form gels, increase viscosity, and stay stable at various pHs levels (Bertagnolli *et al.,* 2014).

Syrup has been one of the known Indonesian product to ever utilize *Sargassum* seaweed. Syrup is a fast-food beverage product and is easily dissolved in water which makes it practically easy to serve. It could also be saved relatively long. It is not only to satisfy one's' thirsty feeling or to meet the need of one's body fluid. Some types of syrup can be an antioxidants needed by the body as an antidote to free radicals (Hadiwijaya, 2013).

Utilizing basic ingredients out of the nature to produce syrup which is available to the community as natural antioxidants is very much needed. *Sargassum* sp. is known to contain active compounds such as teroida, alkaloids, phenols, and triterpenoids to function as antibacterial, antiviral, and antifungal (Pakidi and Suwoyo, 2017). Koivikko (2008) states that the brown algae plants (Phaeophyceae) has phenolic substances in the form of fluorotanine which acts as a source of antioxidants.

Additives that function as stabilizers or binders in syrup processed products can be developed using *Sargassum seaweed.* group *Sargassumseaweed* contains phenol compounds and polysaccharides in the form of alginates which function as thickening agents and gelling agents (Balboa *et al.,* 2013).

2. Methodology

2.1. Research place and time

This research was conducted on April 1 - July 31, 2018. The Syrup Making Process was undergone at the Food Laboratory and Dry Laboratory of the Faculty of Fisheries and Marine, Universitas Airlangga. The viscosity test was conducted using a digital *viscometer* from the Physical Chemistry Education Laboratory, Faculty of Science and Technology, Universitas Airlangga Surabaya. The total plate number (ALT) test was conducted in the Microbiology Laboratory of the Faculty of Fisheries and Marine Affairs, Airlangga University Surabaya.

2.2. Tools and materials

The tools used in making pedada syrup are analytical balance, beaker glass, spatula, aluminum foil, spoon, pH paper, *food processor,* Philips HR 7627 brand, measuring cup, blender, pan, stirring rod, stove, and glass bottle. The equipment used for testing the physical and chemical characteristics of seaweed syrup includes pH meters, *viscometer,* petri dish, erlenmeyer, *hot plate,* bunsen, micropipette, and incubator. The fresh *Sargassum* sp. Seaweed was obtained from the Talango Island was located in Sumenep Regency, water, salt, citric acid, granulated sugar, 20 ml of pandan leaf extract, Sodium Carbonate (Na_2CO_3 1%), and sodium alginate powder *(food grade)* from *CV. Nurajaya* Surabaya. The material used for the research procedure for the total syrup number testing is by creating *Buffered Peptone Water* as a diluent solution and the *Count Agar* (PCA) media used as a growth medium for standard microorganisms or all types of bacteria.

2.3. Methode

This research was an experimental research and used a completely randomized design (CRD) with one factor, namely the type of stabilizer material (Sodium Alginate and CMC). This study used 4 treatments and 5 replications so there were a total of 20 experimental units.

2.4. Work procedure

2.4.1. The process of producing seaweed syrup sargassum *sp.*

Prepare 200 grams of fresh *seaweed Sargassum* sp. and remove its stem first leaving only its leaves and fruit. The seaweed was then soaked within Nasolution$_2$CO$_3$ with a ratio of 1: 1000 (v/v) to clean and soften its tissues and also absorb the sea salt minerals left (Cundari et al., 2014). The next process was to break the leaves and fruit by using a *food processor* with a little water. The resulting porridge of seaweed was then mixed into 37% sucrose sugar and 5% fructose which previously had been heated. The natural flavored extract of 0.5% pandan leaves and 0.5% citric acid were then added in 4 liters of water. The seaweed syrup that was produced was then stirred.

The next step was to do the treatment of stabilizers addition. The seaweed syrup preparations were then divided into four treatments with each of five replications, so that there were 20 bottles of syrup samples containing 200 ml of syrup preparation per bottle. The control treatment uses 0.3% CMC stabilizers. The first treatment contained 0.5% sodium alginate stabilizer. The second treatment contained 0.75% sodium alginate stabilizer. The third treatment contained 1% sodium alginate simultaneously while stirring.

2.4.2. The organoleptic test

The Sensory Test or the organoleptic test is assessed through a sensing process using the five human senses. This sensory or organoleptic tests in the food industry can be used for quality control, shelf life determination, product development, product reform, product profile, product mapping, and product acceptance. The organoleptic analysis on seaweed syrup preparations was done by using a *preference* test (test/hedonic test) on 30 non-trained panelists including students of the Faculty of Fisheries and Marine Universitas Airlangga Surabaya.

2.4.3. Viscosity test

The viscosity test were done by placing the sample in a *viscometer* until 100 ml of the spindle was submerged in the vial. Spindle was set to 30 rpm speed. The *Viscometer was then* run and the viscosity of syrup would be read.

2.4.4. The total plate number test

The method to determine the total plate number is used to determine the total number of aerobic and anaerobic microorganisms (psychrophilic, mesophilic, and thermophilic) in fishery products (SNI, 2006). The analysis of total microbial was done by taking 1 ml of each dilution sample which was then put into a sterile petri dish and was performed in duplo for each of the dilution. 15-20 ml liquid PCA media was then poured into the petri dish. The petri dishes were carefully rotated and moved horizontally or parallel (or form the number eight) until the sample was evenly mixed (Atma, 2016)..

2.5. Data analysis

The data obtained from the results of this study were then analyzed using *ANOVA* to determine the differences in the results of each treatment. The Duncan test was done at the latter if the treatment took effect (Kusriningrum, 2008). The hedonic test results and protein content of blueberry juice would be analyzed descriptively.

3. Result and discussion

3.1. Result

3.1.1. VIscosity

The result of Viscosity Measurement from Syrup products made from seaweed Sargassum sp. can be seen in Annex 6. The following table shows the results of the average syrup viscosity values produced while stored

Tabel 1. Average value data Viscosity (Cps).

Treatment	Viscosity Value (Cps) ± SD
P0	$139.60^{a} \pm 13.240$
P1	$175.40^{b} \pm 5.079$
P2	$202.00^{b} \pm 22.804$
P3	$246.00^{c} \pm 43.932$

Description: P0 (Addition CMC 0.3% or control), P1 (0.5% of Sodium Alginate Addition), P2 (0.75% of Sodium Alginate Addition), and P3 (1% of Sodium Alginate Addition). Letter notations in different *superscript* within the same column show a comparison between treatments with significant differences ($p < 0.05$).

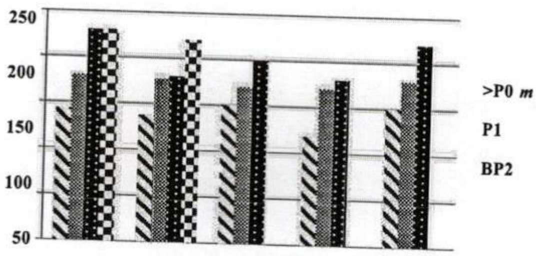

Figure 1. Graph of viscosity test results

3.1.2. Organoleptic

Table 2. Color.

Treatment	Value of Color ± SD
P0	3.93 ± 0.36515
P1	4.00 ± 0.37139
P2	4.00 ± 0.45486
P3	4.03 ± 0.31984

Description: P0 (Addition CMC 0.3% or control), P1 (0.5% of Sodium Alginate Addition), P2 (0.75% of Sodium Alginate Addition), and P3 (1% of Sodium Alginate Addition). Letter notations in different *superscript* within the same column show a comparison between treatments with significant differences (p <0.05).

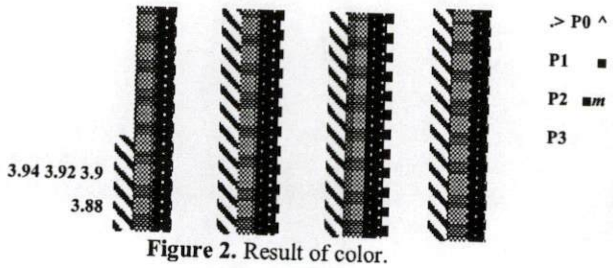

Figure 2. Result of color.

Table 3. Taste.

Treatment	Score of Taste ± SD
P0	4.80[b] ± 0.40684
P1	4.40[a] ± 0.67466
P2	4.13[a] ± 0.81931
P3	4.30[a] ± 0.60648

Description: P0 (Addition CMC 0.3% or control), P1 (0.5% of Sodium Alginate Addition), P2 (0.75% of Sodium Alginate Addition), and P3 (1% of Sodium Alginate Addition). Letter notations in different *superscript* within the same column show a comparison between treatments with significant differences (p <0.05).

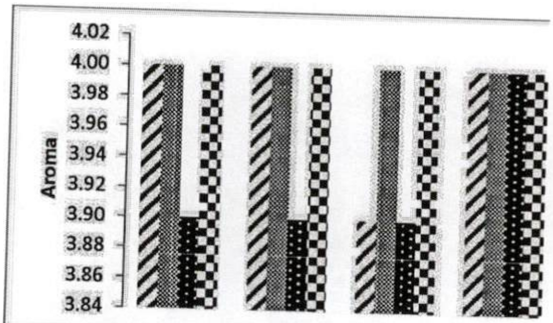

Figure 3. Graph of favourite taste.

Table 4. Smell.

Treatment	Score of Smell ± SD
P0	4.03 ± 0.55605
P1	4.03 ± 0.41384
P2	3.90 ± 0.40258
P3	4.03 ± 0.55605

Description: P0 (Addition CMC 0.3% or control), P1 (0.5% of Sodium Alginate Addition), P2 (0.75% of Sodium Alginate Addition), and P3 (1% of Sodium Alginate Addition). Letter notations in different *superscript* within the same column show a comparison between treatments with significant differences ($p < 0.05$).

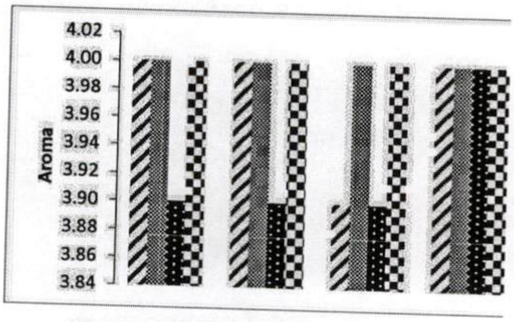

Figure 4. Graph of favourite smell.

Table 5. Viscosity

Treatment	Score of Viscosity ± SD
P0	2.33^{a} ± 0.92227
P1	3.00^{b} ± 0.58722
P2	3.33^{b} ± 0.60648
P3	4.20^{c} ± 0.48423

Description: P0 (Addition CMC 0.3% or control), P1 (0.5% of Sodium Alginate Addition), P2 (0.75% of Sodium Alginate Addition), and P3 (1% of Sodium Alginate Addition). Letter notations in different *superscript* within the same column show a comparison between treatments with significant differences ($p < 0.05$).

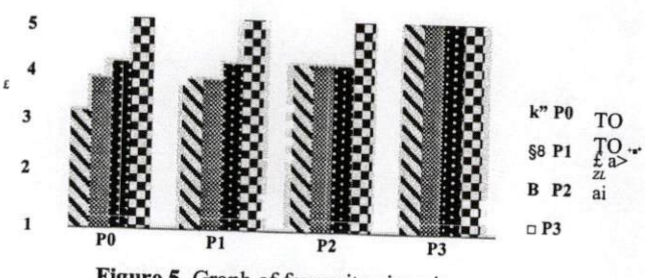

Figure 5. Graph of fovourite viscosity.

Table 6. Total plate number test.

Treatment	*JN* ± SD
P0	$389.800^{b} \pm 0.08375$
P1	$283.200^{ab} \pm 0.088877$
P2	$235.600^{a} \pm 0.026159$
P3	$196.800^{a} \pm 0.0100358$

Description: P0 (Addition CMC 0.3% or control), P1 (0.5% of Sodium Alginate Addition), P2 (0.75% of Sodium Alginate Addition), and P3 (1% of Sodium Alginate Addition). Letter notations in different *superscript* within the same column show a comparison between treatments with significant differences (p <0.05).

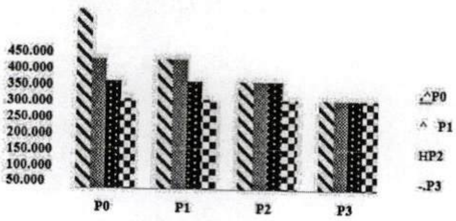

Figure 6. Graph of total plate number test.

4. Discussion

The Viscosity parameter produced by Seaweed Syrup *Sargassum* sp. states that the more concentration of stabilizer added to the syrup preparation, the greater the viscosity level is. The P3 treatment with 1% concentration of Sodium Alginate could produce the highest viscosity value of 310 cP.as which resulted in a very thick syrup texture and less favored by panelists. The increase in viscosity was characterized by gel formation because it binded to larger water firming the texture of the food (DeMan, 1989).

The physical parameters the syrup produced found that the product tended to produce acidic pH ranging from 3.8 to 5. The pH value indicates hydrogen ion concentration which describes the level of acidity. The higher the pH value means lower acidity level. Vice versa, the lower the pH value means higher acidity level. Winarno (1997) states that the type of CMC stabilizer is optimum at pH 5 in a dispersing medium. Alginate stays stable at pH 3.5 and would cause a tendency to settle when the pH around is lower than 3.5 (Rasyid, 2005).

The acidity level of a product is also caused by the addition of citric acid. The use of citric acid in this study served as a controller that stabilize the pH of ± 4 so that the syrup color stayed stable in high a temperature storage. Lower acid concentration in syrup causes the syrup to be brownish yellow in color (Sayuti and Winarso, 2015).

The organoleptic parameters of the color aspect observed in Seaweed syrup *Sargassum* sp. states that the color produced in all treatments tends to be the same, namely colored brown. This is because the color of *seaweed Sargassum* sp. As the basic material is brown. Therefore, the natural flavor of the pandan leaves did not dominate the color of the syrup produced. A common feature of seaweed species *Sargassum crassifolium* is brown because of the dominance of the fico cantine pigment which covers the chlorophyll pigment so that the algae looks brown. Chocolate algae are good food ingredients as iodine producers (Anonim, 1997).

The Observation of the organoleptic parameters in the form of flavors on 20 syrup samples produced proved that the CMC type stabilizer *(Carboxymethyl Cellulose)* used was able to improve the taste by maintaining the sweetness of the juice. The research conducted by Fernisa (2016) stated that CMC is a colloidal solution that can reduce the sour taste of citric acid and increase the sweetness of sucrose. In addition to the administration of sucrose and fructose sugar, the sweet taste produced by Seaweed Syrup *Sargassum* sp. is also caused by young tissue in the leaf part of the seaweed (Zailanie et al., 2001).

Research conducted by Kusbiantoro et al. (2005) stated that the treatment of stabilizing ingredients does not affect color and aroma, but affects the taste and texture. Hydrocolloids generally do not contain volatile ingredients that can cause aroma and color in food, but it can have a synergistic effect on adding flavor to the emulsion.

The reduced level of sweetness of syrup along with the increase in concentration of stabilizers can be caused by the binding of water in the organic components in the larger syrup resulting in a less stable consistency of flavor and requiring a greater stirring frequency after the addition of water. P1, P2, and P3 treatment with the addition of Sodium Alginate stabilizer produced a taste parameter that was almost close to sweetness when compared to the Control Treatment using 0.3% of CMC type stabilizers (b/v).

Fructose has relatively grated sweetness compared to sucrose. Fructose has a relative sweetness of 114, while sucrose has a relative sweetness of 100 (Buckle *et al,* 1987). Fructose or fruit sugar added to beverage products containing fiber does not get absorbed directly in the intestine. Fructose metabolism is different from glucose metabolism (Teff *et al,* 2009). The more concentration of stabilizer is given, a more neutral and not fishy aroma is produced by the syrup. In addition, the aroma produced by syrup is dominated by the addition of sucrose which produces the reducing agent of sugars.

Handayani (1994) stated that a heated sugar will experience caramelization in both acidic and alkaline environments. The caramel that is formed will affect the aroma of the product produced. The addition of alginate concentrations greater than 5% (b/v) accompanied by 50-70 ° C heating can trap volatile compounds produced by food raw materials (Koesoemawardani and Ali, 2016).

Parameters of the Total Plate Number (ALT) calculated while sotraging the Seaweed Syrup *Sargassum* sp. for 1 month showed that the total microorganisms contained was not suitable as recommended by SNI 3544-2013 concerning Syrup Quality Requirements. Based on the calculation of the Total Plate Number (ALT), the maximum requirement is 5x10 with a colony / mL unit.

5. Conclusion and suggestion

5.1. Conclusion

The results of the study showed that the addition of CMC and Sodium Alginate stabilizers could affect the organoleptic parameters of syrup produced in terms of taste and texture. There was not any effect found in terms of color and aroma. Based on the Parameters of Total Plate Numbers (ALT) in this study, Seaweed Syrup *Sargassum* sp. did not meet the SNI 35442013 concerning Syrup Quality Requirements.

5.2. Suggestion

Suggestion from this study is to add a small concentration of synthetic preservatives when producing Seaweed syrup in order to prolong the shelf life of syrup.

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