Effect of Turbidity Differences on Bleaching Condition of Sargassum sp.

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Abstract: ***The study aimed to determine effect of turbidity on the bleaching condition of Sargassum sp. The study was conducted experimentally used completely randomized design with three treatments and six replications. The turbidity used was treatment A 10 cm, treatment B 30 cm and treatment C 50cm. The main parameters observed were thallus color gradation, structure and texture, cell shape and size and chlorophyll-α content of Sargassum sp. The supported parameters observed was water quality. The result showed each turbidity treatment showed significant different effect on thallus color gradation and chlorophyll-α content of Sargassum sp. (p<0.05). Lowest thallus color gradation of Sargassum sp. was in treatment A (38.167%) and highest color gradation was in treatment C (45.0965%). Lowest chlorophyll-α content was in treatment A (0.02305 µmol) and highest chlorophyll-α content was in treatment C (0.03280 µ mol).***

I. INTRODUCTION

Seaweed is biological resource that found in Indonesia and widely used in industrial fields as agar, alginate and carrageenan. The seaweed production was up to 4.3 million tons. In 2015, Indonesia is largest marine fishery product and seaweed is among top product contributed in this industry [1]. Brown seaweeds are rich bioactive compound which their ingredient is exploited for health applications [2].Besides, seaweed are rich in minerals such as iodine, magnesium, iron, zinc and calcium and dietary fibers [3-4].

The environment has large influence on seaweed growth, development and survival. Some physical factors that influence seaweed growth such as light, brightness, turbidity, temperature, current velocity, wave and depth. In additions, chemical factors such as salinity, nitrate and phosphate which important element in seaweed growth and development.

Sargassum sp. thrives in water with temperature of 27.25 °C-29.30°C and salinity of 32-33.5%. The need for higher sunlight intensity is used in photosynthesis. Best pH conditions for seaweed cultures ranged between 7.5 and 9. In additions, water movement also needed so that nutrients continue fulfilled and seaweed is used to grow and develop. The absence of water movement caused nutrients to run out because there is no new nutrient intake. Nutrition can obtain from changing sea water [5].

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Seaweed growth is also influenced by water turbidity level. The turbidity level is needed in seaweed cultivation. The seaweed planting depth also affect seaweed growth which too depth caused difficulties on *Sargassum sp.* maintenance and too shallow cause seaweed to exposed to direct sunlight. This is related to large sunlight penetration which plays a role in photosynthesis [6]. Bleaching also caused by stress on the tissues and cytochemistry in seaweed cells.

Water turbidity is an inverse state of water brightness. Aquatic turbidity is an aquatic condition in which all solid substances in form of sand, mud and clay or particles are suspended in water and can be living component (biotic) such as phytoplankton [7]. Turbidity is related to organic and inorganic particles suspended into water which can inhibit the light penetration to enter at certain depth.

The bleaching frequently occurred in seaweed which color fade process in the seaweed. Bleaching in seaweed causes oxidized and graded pigments contained in seaweed [8]. Brown seaweed had carotenoid dye (carotene and fucoxanthin). Environmental factor influenced seaweed condition. Hence, this study was conducted to determine effect of turbidity on the bleaching condition of *Sargassum sp.*

II. METHODOLOGY

The study was conducted between period of February until May 2018 at Laboratory of faculty of Fisheries and Marine, Airlangga University. The equipment were used in this study such as aquarium 30x20x100cm^3, seaweed tanks, pumps, aerators, aerators hoses, 1000 ml measuring cups, digital balance sheets, razor blades, spectrophotometers, CCD microscopes (charge coupled device), electron microscope, pipette volume, bulb, drop pipette, object glass, glass cover, scchidisk, thermometer, pH paper, lux meter, DO meter and refractometer. Meanwhile, study material was *Sargassum sp.* obtained from Talango Island, Madura. Besides, other materials were used included chlorine, food coloring and sea water.

The study design used was Completely Randomized Design (CRD). This study was used 3 treatments with 6 replications in each treatment. The treatment used were different turbidities in *Sargassum sp.* included 10cm, 30cm and 50cm.The independent variable was water turbidity and dependent variable was bleaching condition of *Sargassum sp.* Meanwhile, control variable were water volume, aquarium, salinity, pH and temperature.

The bleaching condition of *Sargassum sp.* was observed after given different turbidity. The observation were carried out every day for two weeks. Another observation was done by observed pigment, cell shape, size and chlorophyll-α in *Sargassum sp.* The pigment observation was done by observed *Sargassum sp.* thallus colour gradation. In additions, chlorophyll-α was measured used 1200V Cole Pormer spectrophotometer.

The data was analysed used ANOVA with SPPS program. The data on *Sargassum sp.* external body changes included thallus structure and texture, cell shape and size obtained from experiment were analysed descriptively.

III. RESULT AND DISCUSSION

Sargassum sp. colour gradation was observed and measured every day for two weeks. The data on colour gradation on first day until 14th day as shown in Table 1.

Table. 1 Turbidity on *Sargassum sp.* colour gradation

Treatment	Turbidity	*Sargassum sp.* colour gradation (% ± SD)	
		1st day	**14th day**
A	10 cm	70.823	38.167^{a}±3.451
B	30 cm	61.985	43.937^{b}±1.304
C	50 cm	61.307	45.095^{b}±1.214

Note : Different ssuperscript letter on the column shows significant difference ($p<0.05$)

ANOVA showed each turbidity treatment had significantly different influence on *Sargassum sp.* colour gradation ($p<0.05$) . Duncan's multiple distance test showed treatment A was significantly different with treatment B was insignificantly different from treatment C.

Based on Figure 1, highest thallus *Sargassum sp.* colour gradation was in treatment A (70.823%), while treatment B (61.985%) did not showed different from treatment C (61.307%). The color gradations continued to decline until end study which lowest value in treatment A (38.167%) and highest value was found in treatment C (45.095%).

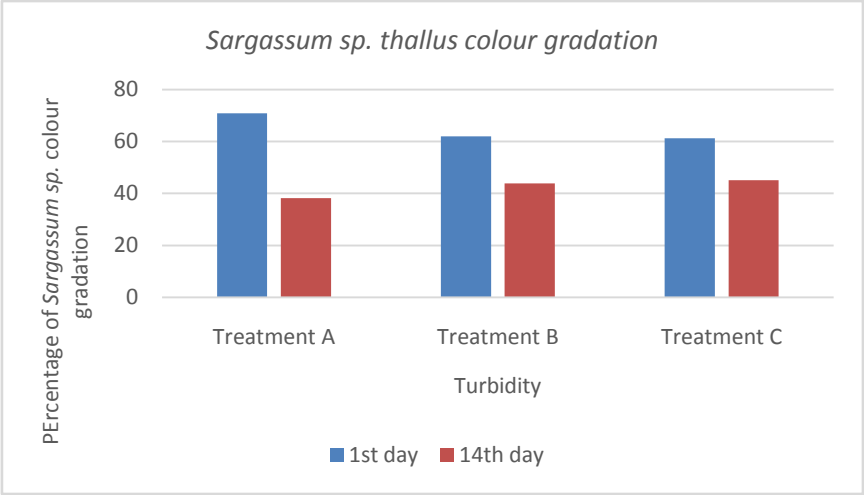

Fig. 1 Graph of *Sargassum sp.* thallus colour gradation

The chlorophyll-α content of *Sargassum sp.* was observed during first day until two weeks as shown in Table 2.ANOVA showed that each treatment had significantly different effect on the chlorophyll-α of *Sargassum sp.* ($p<0.05$). Meanwhile, Duncan multiple distance test showed treatment A had significant differences with treatment B and C.

Table. 2 Chlorophyll-α content of *Sargassum sp.*

Treatment	Turbidity	Chlorophyll-α content (μ mol ± SD)	
		1st day	**14th day**
A	10 cm	0.01447	0.02305^{a}±0.0028452
B	30 cm	0.01447	0.02823^{b}±0.0007763
C	50 cm	0.01447	0.03280^{b}±0.0003578

Note : Different ssuperscript letter on the column shows significant difference ($p<0.05$)

Based on Figure 2, the chlorophyll-α content of *Sargassum sp.* in first day were 0.01447 µmol. The chlorophyll-α content in next 14 days showed treatment A had low chlorophyll-α content and highest chlorophyll- α content in treatment C (0.03280 µmol).

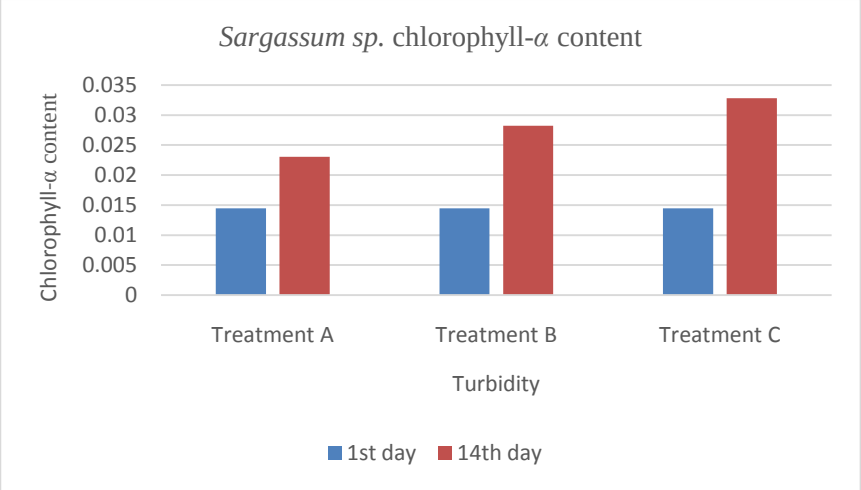

Fig. 2 Graph of *Sargassum sp.* chlorophyll-α content

The water quality was one factor influence *Sargassum sp.* growth. The water quality management is carried out by controlled water quality in 14 days. The parameter measured in the study were temperature, salinity and pH. DO measurement were carried out once a week on first day, 7th day and 14th day. The water quality range during the study as shown in Table 3.The water quality on treatment A,B and C had temperature 28°C, salinity 30ppt and pH of 7. Meanwhile, DO measurement of treatment A was 5.59 mg/l, treatment had DO of 5.73 mg/l and treatment C had DO of 5.87mg/l. The water color in treatment A was dark brown and treatment C was clear brownish.

Table 3. Water quality maintenance of *Sargassum sp.*

Turbidity	Water quality of *Sargassum sp.*				
	Temperature (°C)	**Salinity (ppt)**	**pH**	**DO (mg/l)**	**Water color**
A	28	30	7	5.59	Dark brown
B	28	30	7	5.73	Light brown
C	28	30	7	5.87	Clear brownish

IV. DISCUSSION

Bleaching was process of diminishing or loss of pigment in the thallus due to stress and unstable environmental conditions. The bleaching occurred if there were changes in the *Sargassum sp.* such as temperature, pH, salinity, turbidity, light intensity, depth and water flow. In this study, different turbidity had an effect on the bleaching condition of *Sargassum sp.*

The structure and texture of thallus was observed based on *Sargassum sp.* physical condition. The result showed there was changes in thallus structure of *Sargassum sp.* from initial until end of the study. Treatment A was observed thallus was damaged and hard texture while treatment B had thallus which easily broken but still completed texture. The thallus in treatment C still fresh and texture was completed.

In treatment A caused bleaching due to high turbidity caused *Sargassum sp.* did not absorbed light for photosynthesis. The seaweed obtained nutrients from environment diffusion through thallus wall. The water with high turbidity contained fine particles which covered plant thallus lead lack of absorption of food and light for photosynthesis.

High turbidity inhibited all metabolic processes lead to non-fulfillment of nutrient for *Sargassum sp.* The lack of energy and bad condition in *Sargassum sp.* was observed from thallus condition caused cell death. Seaweed conditions that experienced physiological and morphological disorder also caused lack of nutrition [9].

Different turbidity had different effects on the *Sargassum sp.* thallus colour gradation. The different of thallus colour gradation measurement carried out for 14 days for 18 samples in each treatment of different turbidities such as 10cm, 30cm and 50cm in 6 repetitions. In end of study, there was change and decrease in colour gradation. The statistical test showed each treatment of turbidity affected thallus colour gradation (bleaching) of *Sargassum sp.* Higher turbidity lead higher colour gradation. The result found higher turbidity caused lower colour gradation. High turbidity caused *Sargassum sp.* became stressful so thallus colour was faded. However, thallus of *Sargassum sp.* color gradation in treatment A and treatment B showed not significantly different.

The thallus colour in treatment A was observed more faded and paler compared to other treatments. The thallus color changes occurred due to environment which chromatic adaptation process that was an adjustment between proportion of pigment with various lighting qualities. The seaweed colour condition was influenced by environment changes factor included climate and oceanography. The main pigments in some macroalgae were chlorophyll, carotene, phycoerythrin and phycocyanin but different levels in each species.

In this study, treatment was observed irregular cell wall shape and not uniform. Meanwhile, treatment B and C had same shape and size as in first day. Different thallus cell number had mixed result, difference in cell numbers is thought to be related to the thallus. The main thallus diameter enlarged, and length caused fewer cells compared to new thallus.

In this study, there were increment in chlorophyll-α content which initial chlorophyll-α content was 0.01447 µmol which increased after two weeks by provided different turbidities. Increment chlorophyll-α content due to *Sargassum sp.* had been maintained for two weeks. The age also affected the chlorophyll level found in a leaf [10].

In additions, there were significant differences in each treatment. However, there was no difference in treatment B and C. Highest chlorophyll-α content was found in treatment C (0.03280 µmol) which significantly different with treatment A (0.02305µmol) and treatment B (0.02823 µmol). The statistical test showed chlorophyll-α content showed each turbidity treatment had significantly different effect on chlorophyll-α content of *Sargassum sp.* ($p<0.05$).

Turbidity level was important because correlated with photosynthesis process which naturally occurred in the waters. The turbidity level in a water was determined concentration and distribution of chlorophyll-α. The suspended substances existence in the waters caused high turbidity in the water which affected ecology in terms of decreased light penetration.

In additions, water quality maintenance of *Sargassum sp.* showed that environmental conditions of *Sargassum sp.* in optimal range and no significant changes occurred. The average temperature was constant for all treatment. *Sargassum sp.* grew up in the tropical regions with temperature range between 27°C and 30 °C which showed the optimal temperature was used in cultivated *Sargassum sp.* The temperature also influenced photosynthesis speed which increased the cultivation process. The increment in water temperature had reduced dissolved oxygen which affected photosynthesis process [11].

High turbidity was found in treatment A which water colour was dark brown and low turbidity was in treatment C that water colour was clear brownish. The result found that turbidity still tolerated in the beaching condition of *Sargassum sp.* was in treatment B and worst condition was in treatment A. Treatment B also have fairly regular cell shape and wall which not severely damaged compared to treatment A. Hence, treatment B still tolerated by *Sargassum sp.*

V. CONCLUSION

In conclusions, different in turbidity had different effect toward bleaching conditions of *Sargassum sp.* The treatment B, bleaching conditions was still tolerated by *Sargassum sp.* with color gradation value of 43.937% and chlorophyll- α content of 0.02823µmol. Furthermore, study of turbidity effect on bleaching conditions of *Sargassum sp.* in its natural habitat.

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