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The Effect of Salinity on the Growth of *Kappaphycus alvarezii*

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Abstract

This study aims to determine the effect of different salinities on the growth of *K. alvarezii*. This seaweed was obtained from Tumbak, Southeast Minahasa Regency—medium sea water for planting media in Malalayang water, Malalayang District, Manado City. The treatments were on salinity 25 ppt for the lower range, and 35 ppt for the higher range. The results showed that at a salinity of 25 ppt, a bacterial colony was obtained, whereas at a salinity of 35 ppt, only a stress condition was observed. The specific growth rate results for salinity levels of 25 and 35 ppt were significantly slower compared to the control treatment. The method used is algae cultivation in controlled containers, and bacterial isolation from seaweed thallus infected with ice-ice was carried out on SWC (Sea Water Complete) agar and TCBS (Thiosulphate Citrate Bile Salt) agar. This suggests that salinity is the key factor in seaweed growth. From the results, we can conclude that at salinities of 25 ppt and 35 ppt, the seaweed growth is not maximal because of bleaching. This condition could be a trigger for the growth of bacteria in lower salinity (25 ppt).

Key words: *Kappaphycus alvarezii*, salinity, bacteria, seaweed.

INTRODUCTION

Seaweed production in North Sulawesi has drastically decreased since the end of 2000 (Mudeng *et al.*, 2014). The function of seaweed is to provide food for fish and invertebrates, especially the young thallus (Rahim *et al*., 2016), and indirectly as food for humans, cosmetics, medicine, fertilizer, textile, biofilm, etc. (Soenardjo, 2011; Surni, 2014). Seaweed, as the main commodity that is cultivated in Indonesia, is *Eucheuma cottonii*, later known as *Kappaphycus alvarezii*. The key factor of seaweed cultivation besides ts cultivation method is the quality of its environment, especially the salinity (Arisandi *et al*., 2011). Salinity is assumed could contribute to bacterial disease in seaweed, which is known as the 'ice-ice' disease (Ngangi 2012). Thus, this research aims to see the effect of different salinities on the growth of *Kappaphycus alvarezii* in the laboratory.

RESEARCH OBJECTIVES

The purpose of this study is to determine the effect of different salinity levels (25 and 35 ppt) on the growth of *K. alvarezii*.

Materials and Research Methods

Culture of algae

This *K. alvarezii* was obtained from Tumbak, Southeast Minahasa Regency, North Sulawesi (Figure 1). The algae were first acclimatized with an initial weight of 100 g/L. Sea water used for culture media is taken from Malalayang Beach, Manado City. The treatment salinity tests are on 25 and 35 ppt for 15 days. This is based on Aris (2011) result. The water quality parameters measured were salinity, temperature, pH, light intensity, dissolved oxygen (DO), and carbon dioxide (CO2). The change of water is done every seven days by replacing as much as 70% (Suniti *et al*., 2012). The water salinity was controlled twice daily, and the observation of seaweed growth was also.

Bacterial Isolation Technique

Isolation of bacteria from seaweed thallus infected with ice-ice was carried out on SWC (Sea Water Complete) agar and TCBS (Thiosulphate Citrate Bile Salt) agar. The bleaching thallus was taken from the culture media, rinsed using sterile seawater. Hence, by using aseptic technique, the sample was homogenized to obtain a free colony of the bacteria. A sample dilution is performed using sterile

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seawater. Furthermore, each 150 µl of dilution sample was transferred to L-glass and incubated at 37 °C for 48 hours. A growing colony of bacteria was observed. Each bacteria-free colony that grows was characterized based on morphological characteristics (Leboffe and Pierce, 2012).

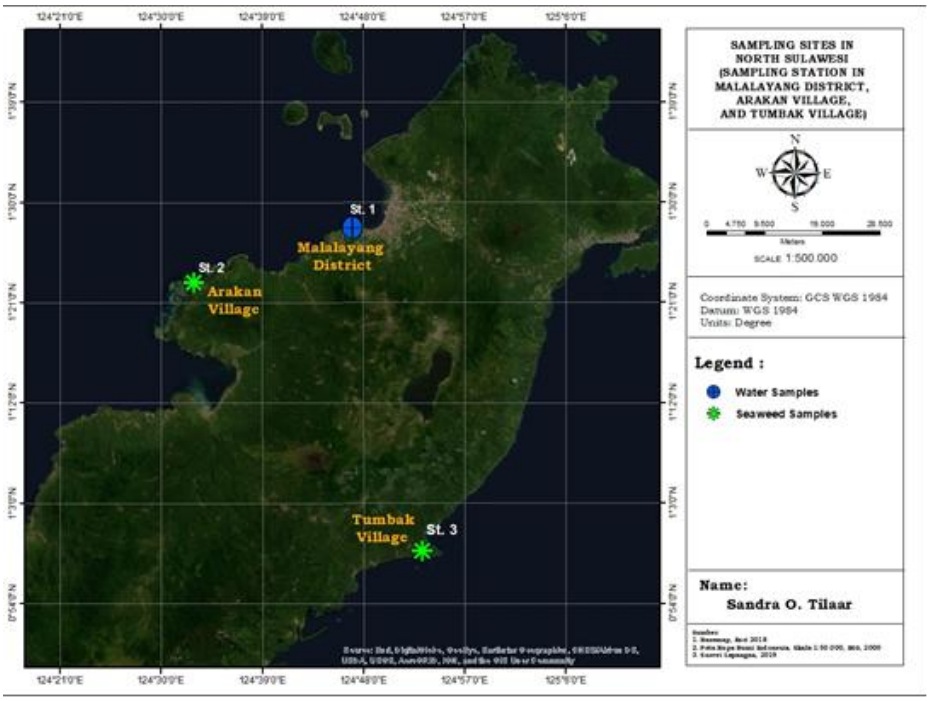

Figure 1. Sampling location of *K. alvarezii*.

Statistical analysis

Every 3 days, we observed and measured the specific growth rate of the thallus of *K. alvarezii* (Guo et al., 2014), and the effect of treatments was analyzed by ANOVA using SPSS 24.

RESULTS AND DISCUSSION

Contamination of the 'ice-ice' disease on algae

Morphological observation on *K. alvarezii* at salinity 25 ppt was 3 times, and bleaching happened on day 7 and day 9. Meanwhile, bleaching due to salinity 35ppt occurred on day 10 up to day 14. On a salinity of 25 ppt, the thallus showed white blots and faded. The fading of the thallus color at 25 and 35 ppt indicates the occurrence of the osmosis process, as a result of a more concentrated solution in the culture medium fluid. The ice-ice disease causes the growth of *K. alvarezii* to be very slow (Vairappan *et al.*, 2010, and Arisandi *et al.,* 2013). Thallus has suffered a fracture and impaired photosynthesis, and biomass weight has been reduced to 60-80% (Figure 2).

The disruption of the cell wall of plants is influenced by the role of the Golgi body in the process of cell osmoregulation. One of the functions of a Golgi body is to bring the material into the plasma membrane (Juwono and Juniarto, 2003). High salinity causes the Golgi body to be unable to balance the concentration of fluid in the cell with the fluid concentration outside the cell. In the end, fluid cells are absorbed into the environment, so that the cell shrinks from its previous size.

Choi *et al.* (2011) and Arisandi *et al*. (2011) found that water quality parameters are very responsible for the growth, the formation of thallus, and the morphogenetic development of seaweed is very strongly dependent on salinity due to osmoregulation occurring in the cell. Generally, seaweed has a low salinity tolerance to changes in salinity. It was found that *K. alvarezii* is not resistant to lower salinity (25 ppt). The stress caused

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by a sudden change in environmental conditions, especially salinity, water temperature, and light intensity, could stimulate ice-ice disease. Stress is characterized by the discoloration of thallus, which is an early symptom of seaweed that has suffered from the disturbance of ice-ice disease. Then, along with time, the tip of the thallus becomes white and finally turns out to be rotten (Musa *et al*., 2008). On the bacterial isolation result, salinity 25 ppt treatment, we found bacterial isolates (Figure 3). This bacterium will further worsen the growth rate of seaweed cultivation (Faturrahman *et. al*. 2012). At a salinity of 35 ppt, we did not find bacteria, only showing a stress condition

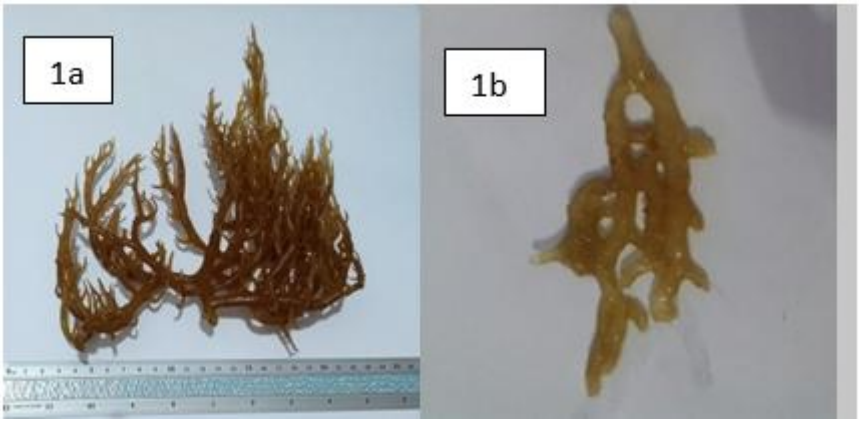

Figure 2. The appearance of thallus in the control treatment (1a) and (1b) in the salinity treatment

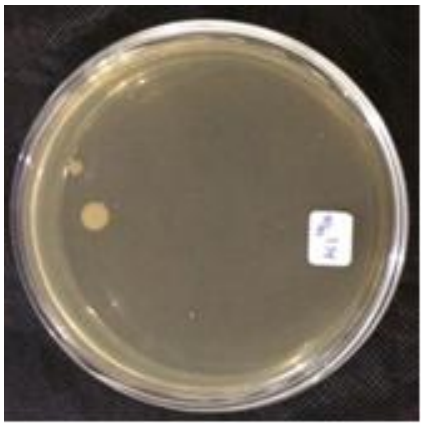

Figure 3. Bacterial isolation result

According to Arisandi *et al* (2011), seaweed will experience slow growth when salinity is below 25 ppt or higher than 35 ppt. Hurtado *et al*. (2009) studied that the slow growth of thallus can be caused by nutrient absorption is not optimal. The difference in salinity affects the physiological and biochemical mechanisms, due to the process of change in osmosis pressure, and disrupts the role of cell membranes in the nutrient transport process. This salinity disturbance often inhibits the growth of seaweed, affects the pattern of branches, and initiates the alteration of the chemical composition (Choi *et al*. 2010).

The ANOVA analysis (Table 1) of the specific growth rate showed that different salinity treatments did not affect the growth of the seaweed *K. alvarezii*. The result of specific growth on the salinity difference is very obvious. In salinity 25 and 35 ppt treatment, the alga's weight is lost. Most macroalgae or seaweed have a low tolerance to changes in salinity (Fiett, 2012).

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ANOVA

Growth

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	314.000	2	157.000	78.500	.000
Within Groups	12.000	6	2.000		
Total	326.000	8			

Growth

Duncan[a]

Treatment	N	Subset for alpha = 0.05	
		1	2
B	3	82.0000	
A	3	83.0000	
K	3		95.0000
Sig.		.420	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 3.000.

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Growth

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Means for groups in homogeneous subsets are displayed.

b. Uses Harmonic Mean Sample Size = 3.000.

CONCLUSION

From the results, we can conclude that at salinity 25 ppt and 35 ppt, the seaweed growth is not maximal, because of bleaching. This condition could be a trigger for the growth of bacteria in lower salinity (25 ppt).

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