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EFFECT OF SOAKING IN KASGOT (MAGGOT WASTE) FERTILIZER ON THE GROWTH AND CARAGENAN CONTENT OF SEAWEEDS *Kappaphycus alvarezii*

Efek Perendaman Pupuk Kasgot (Bekas Maggot) Terhadap Pertumbuhan dan Kandungan Keragenan Rumput Laut *Kappaphycus alvarezii*

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ABSTRACT

Kappaphycus alvarezii seaweed produces carrageenan; its growth and development are highly dependent on the quality of the waters and nutrients such as nitrate, phosphate, and potassium. The planting method that cultivators often carry out is to take it directly from the seaweed that is being harvested. This pattern makes the growth of seaweed less than optimal. One solution is to fertilize. One type of fertilizer that can be used is natural fertilizer, such as kasgot fertilizer. This study aims to determine the combination of soaking time and concentration of kasgot fertilizer that effectively increases the growth and carrageenan content of Kappaphycus alvarezii. This research method uses the treatment of the duration of kasgot fertilizer immersion for 2 hours, 4 hours, 6 hours and without immersion (control) and the concentration of kasgot fertilizer of 2 grams, 4 grams, 6 grams, and without kasgot fertilizer (control), repeated 3 times. The results show that the kasgot fertilizer immersion treatment can increase weight, growth rate, and carrageenan value. The higher the dose given, the higher the weight, growth rate, and carrageenan value, although in statistical tests, it was found that the immersion treatment did not significantly affect weight or growth rate. Water quality during the study (temperature, salinity, pH, and depth) was still within the standards for cultivating K. alvarezii seaweed. Further research is needed on using kasgot fertilizer in cultivating other types of seaweed or using different doses.

Keywords: Carragenan, Fertilizer, Kappaphycus alvarezii, Kasgot, Seaweed

ABSTRAK

Rumput laut *Kappaphycus alvarezii* sebagai penghasil keragenan, pertumbuhan dan perkembangannya sangat tergantung terhadap kualitas perairan dan unsur hara seperti nitrat, phospat dan kalium. Ppla penanaman yang sering dilakukan pembudiaya adalah mengambil langsung dari rumput laut yang sedang dipanen. Pola tersebut membuat pertumbuhan rumput laut menjadii kurang optimal. Salah satu solusi adalah dengan melakukan pemupukan. Salah satu jenis pupuk yang bisa digunakan adalah pupuk alami seperti pupuk kasgot. Penelitian ini

bertujuan untuk mengetahui kombinasi lama perendaman dan kadar konsentrasi pupuk kasgot yang efektif dalam meningkatkan pertumbuhan dan kandungan karagenan *Kappaphycus alvarezii.* Metode penelitian ini menggunakan perlakuan lama perendaman pupuk kasgot 2 jam, 4 jam, 6 jam dan tanpa perendaman (kontrol) serta konsentrasi pupuk kasgot 2 gram, 4 gram, 6 gram dan tanpa pupuk kasgot (kontrol), ulangan sebanyak 3 kali. Hasil yang didapatkan adalah perlakuan perendaman pupuk kasgot mampu menambah bobot, meningkatkan laju pertumbuhan serta meningkatkan nilai karagenan Makin tinggi dosis yang diberikan maka makin tinggi pula bobot, laju pertumbuhan dan nilai karagenannya walaupun dalam uji statistik diapatkan perlakuan perendaman tidak berpengaruh signifikan terhadap bobot, laju pertumbuhan. Kualitas air selama penelitian (suhu, salinitas , pH dan kedalaman) juga masih berada dalam standar untuk pembudiayaan rumput lauut *K. Alvarezii*. Perlu dilakukan penelitian lanjutan mengenai penggunaan pupuk kasgot pada pembudidayaan rumput laut jenis lain atau dengan dosis yang berbeda.

Kata Kunci: *Kappaphycus alvarezii,* Kasgot, Karagenan, Rumput Laut, Pupuk

INTRODUCTION

Kappaphycus alvarezii is a type of marine algae that has economic value because it produces a substance called carrageenan (Damayanti et al., 2019). Carrageenan has various applications in the food industry to improve texture, such as in cheese products, puddings, desserts, bread, sausages, and low-fat hamburgers, as a binder and stabilizer. The main role of carrageenan is as a viscosity-increasing agent in pharmaceutical formulations such as suspensions, emulsions, gels, creams, lotions, eye drops, tablets, and capsules (Prihastuti & Abdassah, 2019).

In 2018, seaweed production produced through cultivation in Indonesia reached 10.18 million tons, with an export value of 291.83 million USD, which continues to increase. Data shows that world imports of dried seaweed during the period 2017 to 2022 grew positively consistently (Directorate General of PDSKP, 2023).

Seaweed cultivation efforts if carried out seriously can be a solution, especially for coastal communities to be able to escape poverty which has often occurred in coastal communities (Myzarah & Gunawan, 2024; Nawari & Purnamasari, 2023). South Sulawesi Province, especially in Bone Regency, has very promising potential to develop *Kappaphycus alvarezii* seaweed cultivation. Of the total 27 sub-districts in Bone Regency, around 10 sub-districts are spread along the coast of Bone Bay, which has a length of 138 kilometers and a water surface area of 93,929 hectares. Based on 2017 data, ten coastal areas in Bone Regency have a production capacity of *Kappaphycus alvarezii* seaweed of up to 3,060 tons per year (Halimah et al., 2020).

Success in seaweed cultivation depends on several factors, including environmental conditions, seed quality, cultivation techniques applied, nutrient availability, and initial weight during maintenance. One of the main challenges in seaweed cultivation is obtaining quality and sustainable seeds. The use of low-quality seeds can inhibit seaweed growth and increase the risk of disease attacks (Arjuni et al., 2018).

Until now, seaweed production has not reached its potential due to a decrease in the genetic quality of seeds, less than optimal environmental conditions, the availability of natural seeds that are unstable and depend on the season, and disease attacks on seaweed (Mukti & Ujang, 2019). One step that can be taken to improve the quality of seaweed seeds is to apply the fertilization method.

The soaking method is one of the techniques that can be used to improve the quality of seeds in the cultivation of *Kappaphycus alvarezii* seaweed. Several studies have investigated the soaking method to improve the quality of seaweed seeds. Some soaking activities that use

natural ingredients in *Kappaphycus alvarezii* seaweed include the use of ketapang leaves (Kurniawan et al., 2020), bionic liquid fertilizer or DI Grow (Minda et al., 2024), seaweed filtrate (Akmal & Satriyono, 2016), and green natural formula fertilizer (Daud et al., 2013).

Until now, the use of kasgot fertilizer in the soaking of *Kappaphycus alvarezii* seaweed is a method that is rarely done and has not been widely studied. There are no literature references or studies that specifically discuss the use of kasgot fertilizer in the context of *Kappaphycus alvarezii* seaweed soaking. Kasgot fertilizer is produced from the digestive waste of Black Soldier Fly larvae (*Hermetia illucens*). This type of organic fertilizer has a pH level of around 7.78 and contains 3.36% nitrogen (Zhu et al., 2015). Nutritional analysis of Black Soldier Fly (BSF) feces describes it as a complex NPK fertilizer, with an average nutrient content of around 3.4% N, 2.9% P_2O_5, and 3.5% K_2O, and has a pH that is in the neutral to alkaline range (Laoli et al., 2024). With a fairly high concentration of nitrogen (N), phosphorus (P), and potassium (K), research on the use of kasgot fertilizer soaking to increase the growth of *Kappaphycus alvarezii* is an interesting topic to investigate. N, P, and K nutrients play a key role in the growth of Kappaphycus alvarezii seaweed. This prompted the author to carry out this study.

METHODS

This research was conducted in the waters of Kajuara Village, located in Bone Regency, South Sulawesi and took place from August 2023 to November 2023. Analysis of carrageenan content was carried out at the Water Productivity and Quality Laboratory at the Faculty of Marine Sciences and Fisheries, Hasanuddin University (UNHAS).

This study is a type of experimental research. Experimental research is research that aims to identify the impact of an action to be implemented on specific variables, while maintaining control of certain conditions (Payadnya & Jayantika, 2018). The research design that will be used is a Completely Randomized Design (CRD) with 4 treatment variations that will be repeated 3 times with the same soaking time of 6 hours (Rijoly et al., 2020) so that there are a total of 12 treatment units, which include:

Treatment A: Kasgot Fertilizer with a dose of 2 g/L
Treatment B: Kasgot Fertilizer with a dose of 4 g/L
Treatment C: Kasgot Fertilizer with a dose of 6 g/L
Treatment D: Control (without dosing).

After soaking, it is continued with the distribution of seeds in the sea for the maintenance or enlargement of Kappaphycus alvarezii seaweed seeds for 40 days and then continued with the measurement of research variables. The variables measured are:

1. Daily Growth Rate of Seaweed (*Kappaphycus alvarezii*)

Calculated using the daily growth rate formula (Yong et al., 2013):

$$DGR = \frac{\ln (Wt1 - Wt0)}{t} \times 100\%$$

Where:
DGR = Daily Growth Rate/Growth (g/day)
Wt0 = Initial weight of seaweed
Wt1 = Final weight of seaweed
t = Maintenance period

2. Carrageenan Yield

Carrageenan is the result of extraction calculated based on the ratio between the weight of carrageenan and the weight of dry seaweed used in each treatment (FMC Corp, 1977) Yield formula:

$$\text{Carrageenan yield} = \frac{\text{Weight of carrageenan obtained}}{\text{Weight of seaweed sample}} \text{ x } 100\%$$

The data obtained from the calculation of growth rate and carrageenan yield were analyzed using one-way ANOVA at a significance level of 0.05 to see the effect of the dose kasgot fertilizer on the growth and carrageenan of *Kappaphycus alvarezii* that has been maintained. If there is a difference, it is continued with the Tukey W test to determine which dose treatment has an effect on the growth and carrageenan of *Kappaphycus alvarezii* that has been maintained.

RESULTS

Weight and Daily Growth Rate of *Kappaphycus alvarezii* Seaweed

The average weight growth of *Kappaphycus alvarezii* seaweed can be found in Table 1 and Figure 1 to Figure 4 below.

Table 1. Weight of *Kappaphycus alvarezii* Seaweed

Treatment	Initial Weight (g)	Final Weight (g)
A	100	116 ± 3.25
B	100	119 ± 3.18
C	100	123 ± 4.21
D	100	114 ± 2.96

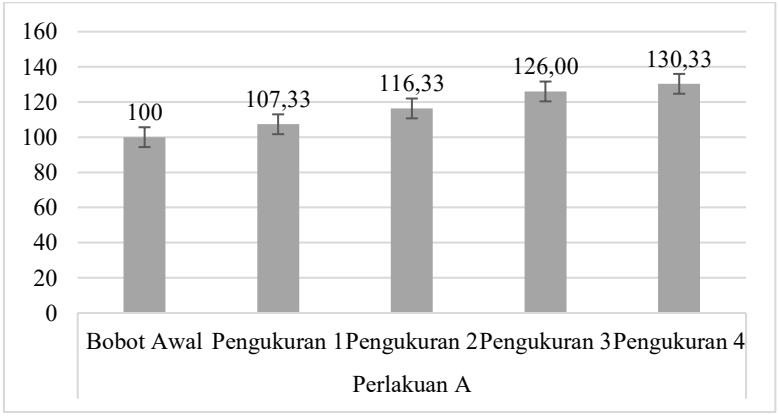

Figure 1. Growth of *Kappaphycus alvarezii* Seaweed Given Treatment A (Kasgot Fertilizer 2 g/L)

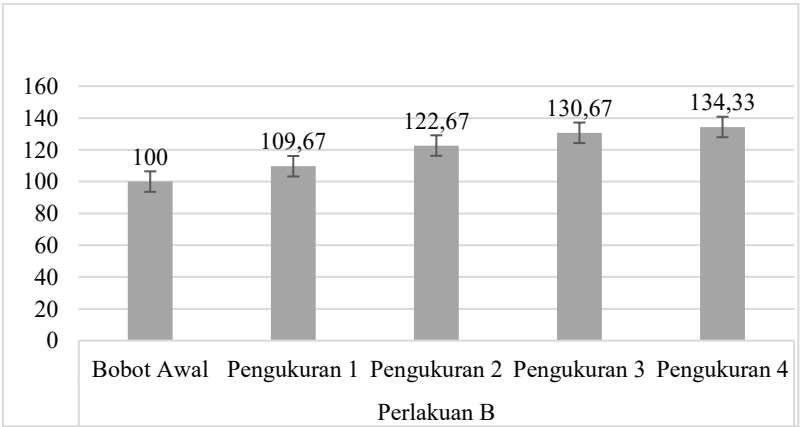

Figure 2. Growth of *Kappaphycus alvarezii* Seaweed Given Treatment B (Kasgot Fertilizer 4 g/L)

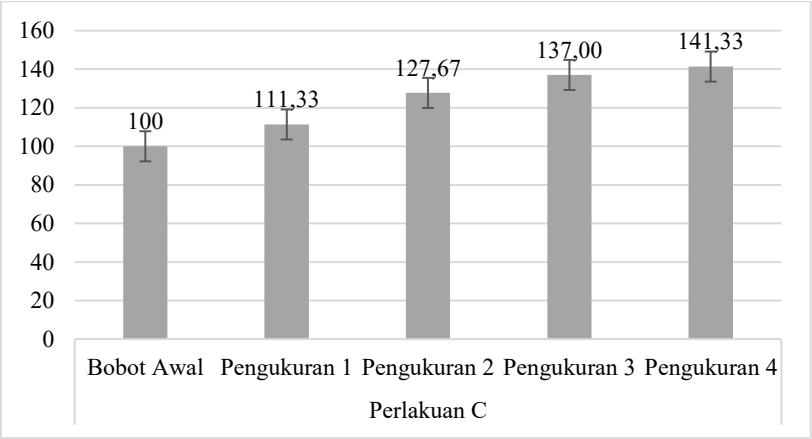

Figure 3. Growth of *Kappaphycus alvarezii* Seaweed Given Treatment C (Kasgot Fertilizer 6 g/L)

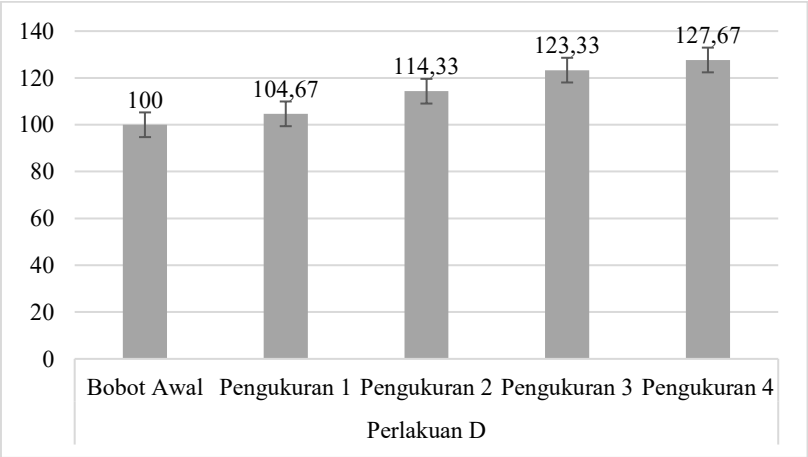

Figure 4. Growth of *Kappaphycus alvarezii* Seaweed Given Treatment D (Control)

From the data in Figure 1 to Figure 4, it can be seen that the weight of seaweed shows an increase in line with the increase in the dose of kasgot fertilizer given. From all treatments (A, B, C and D) it can be seen that the weight of seaweed from the beginning to the end of maintenance increased by around 1.1% to 1.2%. The highest growth of *Kappaphycus alvarezii* seaweed occurred in treatment C with a kasgot fertilizer dose of 6 (g/L), followed by treatment B with a kasgot fertilizer dose of 4 (g/L), then treatment A with a kasgot fertilizer dose of 2 (g/L), while the lowest growth was seen in treatment D without kasgot fertilizer immersion.

The results of the ANOVA statistical test showed that the significance value obtained was 0.436, which indicated that there was no significant difference in the weight gain of *Kappaphycus alvarezii* seaweed between each treatment of soaking in used Black Soldier Fly larvae fertilizer (kasgot).

The specific growth rate of *Kappaphycus alvarezii* seaweed can be seen in Table 2 and Figure 5 below:

Table 2. Specific Growth Rate of *Kappaphycus alvarezii* Seaweed

Treatment	SGR (g/day)
A	0.07
B	0.07
C	0.09
D	0.06

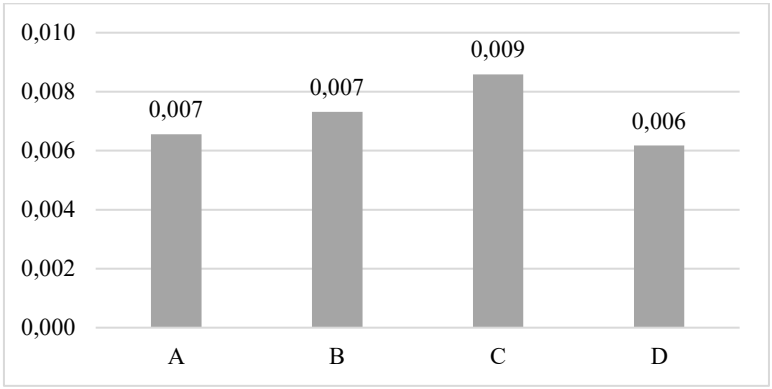

Figure 5. Comparison of Specific Growth Rate of *Kappaphycus alvarezii*

Table 2 and Figure 5 illustrate the increase in specific growth of *Kappaphycus alvarezii* seaweed along with the increase in the dose of fertilizer given. From the results of the observed treatments, it can be seen that the dose of 6 grams showed a higher specific growth rate value compared to other doses. Based on the ANOVA test, a value of 0.49 was obtained. This value means that there is no soaking treatment that has a significant effect on the specific growth rate of *Kappaphycus alvarezii*.

***Kappaphycus alvarezii* Seaweed Carrageenan**

The value of the results of the yield measurements obtained in this study can be seen in Table 3 and Figure 6 below:

Table 3. Value of the Results of the Measurement of *Kappaphycus alvarezii* Seaweed Carrageenan

Treatment	Carrageenan Value (%)
A	48.22 ± 1.07
B	50.74 ± 2.40
C	54.76 ± 6.09

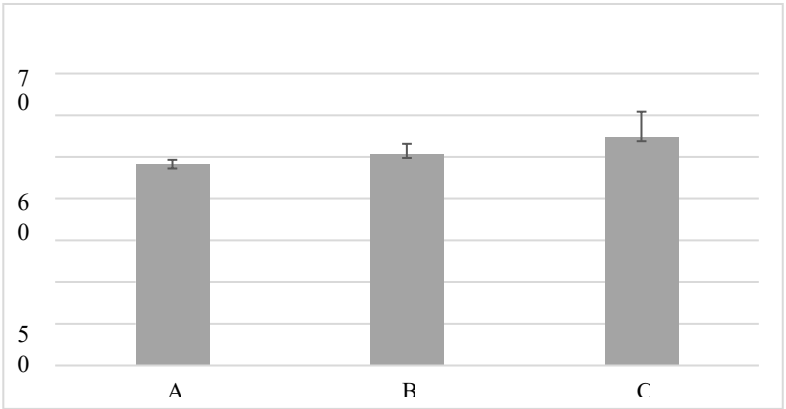

Figure 6. Carrageenan Value in *Kappaphycus alvarezii* Seaweed

Table 3 and Figure 6 show that the increase in the carrageenan value produced by *Kappaphycus alvarezii* is in line with the increase in the dose of kasgot fertilizer given. The range of carrageenan values observed was between 48.22% to 54.76%. Although there was an increase in the carrageenan value in line with the increasing dose of fertilizer, the ANOVA statistical analysis showed that the significance value was 0.205, which indicated that the treatment given did not have a significant effect on the carrageenan value produced.

Another possible reason why the effect of kasgot fertilizer is not so significant is the dosage that may not be optimal. Based on laboratory data, the N, P, and K content of this kasgot fertilizer is relatively high. Detailed information on the content value of kasgot fertilizer used for soaking *Kappaphycus alvarezii* seaweed can be found in Table 4 below:

Table 4. Content of Kasgot Fertilizer Used

Types of Fertilizers	Measured Parameters		
	N	P	K
Kasgot Fertilizer	1.83	0.97	1.35

DISCUSSION

From the data listed in Table 1 and Figure 1, it can be seen that increasing the fertilizer dose correlates with increasing seaweed weight growth. Although there was an increase in weight reaching 1.1 to 1.2% of the initial weight, this increase was relatively small. However, statistical analysis showed that the soaking treatment given did not have a significant impact on the weight gain of *Kappaphycus alvarezii* seaweed. These results are in line with other studies that applied fertilization and soaking treatments to *Kappaphycus alvarezii* seaweed, especially using natural ingredients such as soaking using the green natural formula (Daud et al., 2013), soaking ketapang leaves (Kurniawan et al., 2020), and a mixture of banana stumps and star pomfret (Yulia, 2019).

Fertilization treatments that did not show a significant impact could be caused by several possible factors. One of them is the use of seeds that have been planted repeatedly by farmers, which may result in a decrease in the quality of the seeds. Repeated planting practices can reduce genetic diversity, which can ultimately result in decreased growth, carrageenan yield, and seaweed gel strength. In addition, decreased genetic diversity also makes plants more susceptible to extreme environmental changes and disease attacks (Pong-masak & Sarira, 2018).

With the availability of fairly comprehensive N, P, and K content, the doses given to Kappaphycus alvarezii seedlings may not have reached optimal levels. The need for primary nutrients, especially Nitrate and Phosphate, for algae ranges from 40-60% of their dry body weight (Yaakob et al., 2021).

The specific growth rate is in the range of 0.61 to 0.86, this value is relatively low when compared to several previous studies involving *Kappaphycus alvarezii* cultivation. As an illustration, in Baruta Village, Southeast Sulawesi, the specific growth rate reached a range of 3.22 to 3.62% (Failu et al., 2016), while in Arakan Waters, North Sulawesi, the value ranged from 3.36 to 4% (Burdames & Ngangi, 2014).

Low growth rates in seaweed are caused by a number of factors, including seed quality, light levels, physical and chemical conditions of seawater, and the availability of nutrients in the marine environment. The possibility of low seaweed growth in these conditions is thought to occur due to several ecological conditions, both physical and chemical, as well as other significant factors that affect seaweed growth (Fikri et al., 2015).

The results of laboratory analysis showed that the average carrageenan content in each treatment varied between 47.32% and 58.89%. Carrageenan, a polysaccharide, is extracted

from red seaweed (Rhodophyceae). Its structure consists of a combination of D-galactose and 3,6-anhydrogalactose (3,6-AG) units alternately linked through α-1,3 and β-1,4 glycosilic bonds. The gel formation process of carrageenan is greatly influenced by temperature and extraction time. The quality of carrageenan is often evaluated based on its gel strength and viscosity (Erjanan et al., 2017).

The carrageenan content recorded in this study ranged from 47.32% to 58.89%. In general, these figures exceed the carrageenan content in *Kappaphycus alvarezii* in the Southeast Maluku Waters, which ranges from 37.01% to 43.25% (Kumayanjati & Dwimayasanti, 2018), and in Sangihe District, North Sulawesi which has a content of around 46.76% (Sahabati et al., 2016). However, when compared to carrageenan found in Bulu waters, Jepara Regency, which reached 87.70% (Fikri et al., 2015), the content detected in this study was still lower.

The results of the carrageenan analysis in this study showed values that were in the range, neither too high nor too low. However, to determine the appropriate carrageenan value standard, further testing is needed, especially related to the commercially applicable carrageenan standards. Based on commercial carrageenan standards, the expected minimum melting point and freezing point are 34.10°C and 50.21°C (Fathoni & Arisandi, 2020).

The carrageenan content recorded in this study, as in several other studies, often varies. Several factors influence these differences. For example, increasing the water content in carrageenan flour can increase the final weight produced. The percentage yield can also be influenced by the base concentration in the processing process and the extraction method used. In general, the higher the concentration of base used, the higher the yield produced (Djurumudi et al., 2022).

CONCLUSION

The duration of immersion of kasgot fertilizer carried out on *Kappaphycus alvarezii* seaweed with different doses of kasgot fertilizer can affect the growth rate and weight of seaweed although it does not have a significant effect. The carrageenan content of *Kappaphycus alvarezii* seaweed soaked in kasgot fertilizer increased along with the increasing dose of fertilizer given.

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