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# Carrageenan Concentration And Growth Of *Kappaphycus alvarezii* Seaweed In Liang Village

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**Abstract**

This study aimed to assess the quality of seaweed by analyzing its carrageenan content, water content, and growth rate. The research was conducted in the waters of Liang Village and Jayabakti Village for 45 days, with observation periods every 15 days. Carrageenan examination was carried out at the Pharmacy Laboratory of Sam Ratulangi University, while the water content was determined at the THP Laboratory of the same university. Growth measurements were conducted at 0, 15, 30, and 45 days in both locations. The results showed that the concentration of carrageenan in seaweed from Jayabakti Village was 39.81%, while in Liang Village it was 35.88%. The percentage of seaweed water in Liang Village was 9.3%, while in Jayabakti it was 27.0%. In addition, there was no significant difference in seaweed growth between the two water sites (P>0.05). The average difference in seaweed growth between Jayabakti Village and Liang Village on days 15, 30, and 45 was 1.5, 0.5, and 16.3, respectively. The daily weight gain rate of seaweed on day 15 was 5.55% in Jayabakti Village Waters and 5.50% in Liang Village Waters. On the 30th day, the daily weight gain of seaweed in Jayabakti Village Waters and Liang Village was 4.88% and 4.89%, respectively. On the 45th day of the rearing period, seaweed in Jayabakti Village Waters experienced a weight gain of 4.16%, while seaweed in Liang Village experienced a weight gain of 4.22%. The findings showed that the carrageenan test, conducted by assessing water content, indicated that the quality of seaweed in the waters of Liang Village was superior to that of Jayabakti Village.

*Keywords: carrageenan, growth, Jayabakti village, Liang village, water content*

## INTRODUCTION

The seaweed industry in Indonesia continues to encounter multiple challenges, including inadequate productivity, subpar seaweed standards at the cultivator level, limited bargaining power of cultivators against traders and processors, exorbitant transportation costs, insufficient processing technology, and the need to enhance domestic value-added (Nuryartono et al., 2021; Riniwati and Sahidu, 2020). The annual production of wet seaweed in Indonesia experienced a significant increase from 205,000 metric tons in 2000 to 3.9 million metric tons in 2010 and rose to 11.27 million metric tons in 2015. However, it steadily declined to 9.78 million metric tons in 2019 (van der Heijden et al., 2022).

Indonesia can generate significant economic value from its maritime resources, such as fisheries and aquaculture output. Seaweeds are a resource that has significant promise. Indonesia's coastal areas are home to approximately 782 species of seaweed, which consist of 196 green algae, 134 brown algae, and 452 red algae (Latief & Nusaly, 2023). Indonesia primarily cultivates three seaweeds (algae), Eucheuma, Kappaphycus, and Gracilaria, for commercial purposes (Basyuni et al., 2024). The productivity of seaweed farming land in South Sulawesi and Southeast Sulawesi was better than 1, whereas in Central Sulawesi it was less than 1

(Adhawati et al., 2024). It demonstrated the ineffective management of seaweed cultivation in Central Sulawesi. Nevertheless, Central Sulawesi (Sulteng) has chosen seaweed as the primary commodity for extensive development in the upcoming five years, anticipating an annual growth rate exceeding 28% in production (Ariwijaya, 2018).

Liang Village, located in the Banggai Islands Regency of Central Sulawesi Province, is a critical area for seaweed cultivation development. However, several challenges impede the progress of seaweed cultivation in this region. These challenges include a lack of knowledge and commitment to cultivation activities, limited diversity in cultivation techniques, and inadequate selection of suitable cultivation locations that can increase productivity (Tasruddin, 2015). Carrageenan levels in various Kappaphycus sp. species range from 54% to 73%, depending on the species and region. In Indonesia, the carrageenan content of seaweed ranges from 61.5% to 67.5% (Asni, 2021).

The national production of seaweed has experienced a significant surge due to the increasing commercial demand for two hydrocolloids: agar and carrageenan (Basyuni et al., 2024). The primary products derived from these seaweeds are carrageenans, which find extensive usage in various commercial applications, particularly as gelling, thickening, and stabilizing agents, especially in the food industry and sauces. Many types of seaweed or red algae (Rhodophyceae), such as carrageenan iota, kappa, and lambda, which come from distinct species of Rhodophyta, yield carrageenan, a polysaccharide. Commercial carrageenan's mass molecular weight typically ranges from 400,000 to 600,000 Da (Van de Velde et al., 2002). The carrageenan found in seaweed serves as a pliable, hydrophilic, and gelatinous framework that can adapt to different water currents and wave movements. Due to its biodegradable properties, carrageenan finds extensive use as a viscosity regulator, stabilizer, and thickening agent (Thakur and Thakur, 2016). The fields of experimental medicine, pharmaceutical formulations, cosmetics, and industrial uses also employ carrageenans (Necas & Bartosikova, 2013).

Sulawesi Province has conducted numerous studies on the carrageenan content of seaweed. However, information on the Liang Village area is still scant and requires a more in-depth study. Therefore, we conducted this study to determine the carrageenan content of the Kappaphycus alvarezii seaweed species in Liang Village, Banggai Islands Regency.

## METHOD

We conducted this research at Liang Beach Village and Jayabakti Village. The materials used in this research include a sechidisk, thermometer, refractometer, pH paper, buoy, RIS buoy, ballast, current kite, balance, seaweed, and Rafia rope.

### Procedure

#### *Preparation*

The initial phase involves gathering and organizing the necessary tools and materials for the research. We then prepare the test organisms from two different sites and measure their weight.

#### *Rearing*

During this phase, the process of observing seaweed involved measuring its weight every 15 days. We assessed the water quality biweekly, measuring temperature, salinity, pH, and current velocity in the morning and evening. We conducted measurements of brightness during daylight hours under sunny conditions.

#### *Analysis of Carrageenan*

We transported seaweed samples that had undergone sun drying to the laboratory for analysis. The Pharmacy Laboratory of the Pharmacy Study Program at the Faculty of Mathematics and Natural Sciences, Sam Ratulangi University in Manado, analyzed the samples. The THP Laboratory at the Faculty of Fisheries and Marine Sciences, Sam Ratulangi University Manado, conducted water content testing. Ainsworth and Blanshard's (1980) method forms the basis for the determination of


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seaweed carrageenan concentration, expressed as a percentage of carrageenan weight to seaweed dry weight.

The analysis approach commences with thoroughly cleansing the seaweed to eliminate any sand, dirt, or other extraneous substances. Next, we dry the seaweed in an oven at 100 °C for 2 hours. After drying, we thoroughly mixed the substance until it achieved a smooth consistency, and then filtered it to separate the larger and smaller particles. We subjected 1 gram of the obtained flour to boiling (extraction) using hot water at a temperature range of 85 to 95 degrees Celsius. The boiling process occurred in a slightly alkaline environment with a pH level of 8 to 9 and lasted for 4 hours.

We subsequently passed the seaweed extraction through a cellulose filter using pleated filter paper. We further concentrated the acquired result by heating it to a volume of 50 ml. We added approximately 15 milliliters of isopropanol and left the mixture undisturbed for one night. We subsequently strained the resulting extract through a fine white cloth and combined it with 96% isopropanol (about 15 ml). We then transferred the mixture to a tiny, pre-weighed container. Next, we dried the sample in an oven at 100 $^{0}$C for 2 hours, and then measured it using an analytical balance. We adjusted the weighing result by subtracting the weight of the empty container, which yielded the net weight of carrageenan (g).

### Data Analysis

### Parameters

### Carrageenan yield

Calculating the random of carrageenan as a result of extraction involves dividing the weight of the heated keraginan by the weight of the empty cup and the weight of the dry sample.

$$CY = \frac{Sample\ after\ heating\ -\ empty\ petridish}{Algae\ sample\ weight} \times 100$$

### Specific Growth Rate

After each culture phase of 15 days, the average daily growth rates (DGR = % day$^{-1}$) were determined and represented as the percentage increase in wet weight per day for each line, using the following formula (lignell et al., 1987):

$$DGR\ (\%) = \left[\left(\frac{W_t}{W_0}\right)^{1/t} - 1\right] \times 100$$

Let W0 represent the average wet weight at the beginning, Wt represents the average wet weight at a certain time t, and t represents the time intervals in days.

We analyzed an independent T-test to compare seaweed growth between the two locations. We analyzed carrageenan, ash, and water content using descriptive methods.

## RESULT AND DISCUSSION

### Carrageenan yield and water content

Figure 1 displays the carrageenan content of seaweed in Jayabakti Village, which is 39.61%, and Liang Village, which is 35.88%. From a visual standpoint, there is no discernible distinction in the carrageenan content between the two water locations. Nevertheless, the data on the water content of Kappaphycus alvarezii from both water locations provides compelling evidence of a significant disparity. The water content of seaweed can serve as a criterion for differentiating the quality of seaweed in two distinct areas.

According to Table 1, the seaweed from Liang Village waters has a lower moisture content of 9.3% compared to the seaweed from Jayabakti Village waters, which has a moisture content of 27%. The FAO states that the optimal moisture content guideline for maintaining seaweed quality should not exceed 12% (Joint F.A.O, 2011). The water content has a significant impact on the quality of a material. According to Hidayat (2004), the seaweed's quality improves as its water content decreases.

### Growth

Figures 2 and 3 below illustrate the average growth of seaweed in both water locations as observed in the investigation.


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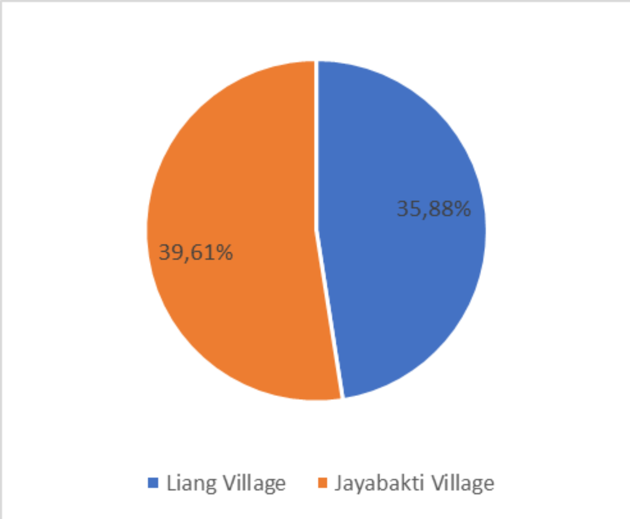


Figure 1. The Carrageenan Yield of Seaweed in Two Locations

Table 1. Carrageenan concentration and water content of seaweed in Liang dan Jayabakti village

| Parameters | Liang village | Jayabakti village |
|---|---|---|
| Carrageenan yield (%) | 35.88 | 39.61 |
| Water content (%) | 9.3 | 27.0 |

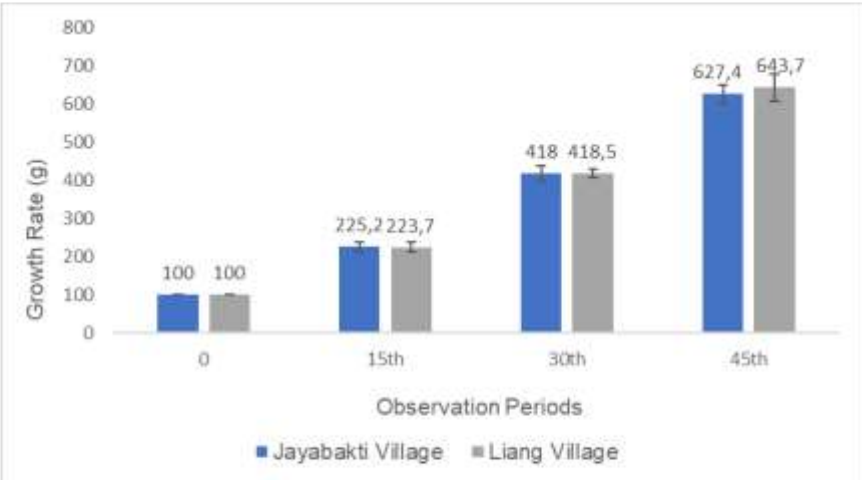


Figure 2. Growth average of seaweed in Jayabakti and Liang village

Figure 2 demonstrates that the mean proliferation of seaweed throughout each observation period exhibited an upward trend, although there was no significant disparity seen between the two rearing locations. The weight gain of seaweed in Jayabakti Village Waters varied between 100 and 627.4 g, while in Liang Village Waters it ranged from 100 to 643.7 g. The disparity in the accumulation of seaweed mass between the two sites on days 15, 30, and 45 of the cultivation period was 1.5 g, 0.5 g, and 16.3 g, respectively.

From a visual standpoint, there was a noticeable growth rise during each observation period. Statistically, the independent T-test findings revealed that there was no significant disparity in seaweed growth between the waters of Jayabakti Village and Liang Village. This was indicated by a $P>0.05$ value.



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Table 2. The result of the independent T-test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference Lower | Upper |
| Growth | Equal variances assumed | 1.388 | .254 | -.932 | 18 | .364 | -3.82500 | 4.10583 | -12.45103 | 4.80103 |
| | Equal variances not assumed | | | -.932 | 17.146 | .364 | -3.82500 | 4.10583 | -12.48194 | 4.83194 |

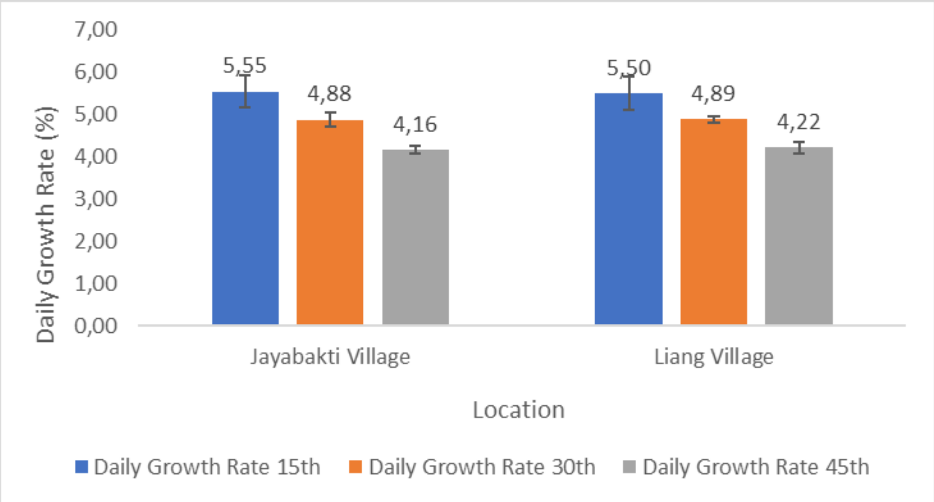


Figure 3. Daily Growth Rate of seaweed in Jayabakti and Liang village

The daily growth rate of seaweed on days 15, 30, and 45 of the raising period exhibited a rise in the proportion of active weight, which did not display any significant variation between the two rearing sites (Figure 3). On the fifteenth day, the rate of weight increase of seaweed in Jayabakti Village Waters was 5.55%, whereas in Liang Village Waters it was 5.50%. On day 30, the weight gain was 4.88% and 4.89% in Jayabakti and Liang Village Waters, respectively. On the 45th day of the rearing period, the seaweed in Jayabakti Village Waters experienced a weight rise of 4.16%, while the seaweed in Liang Village had a weight gain of 4.22%. Overall, the percentage increase in weight of seaweed did not vary much between the two locations.

From an environmental perspective, the water quality conditions meet the norms for satisfactory water quality. The disparities in temperature, depth, and salinity between the two locations are evident in Table 3. Indrayani et al. (2021) state that the optimal water quality parameters for seaweed production include a temperature range of 27-30°C, a depth of 0.60-0.80 m, and a salinity range of 28-34 ppt. The water depth in Liang Village runs from 5 to 7 meters, whereas in Jayabakti Village it ranges from 5 to 6 meters. The water depth and salinity remain within appropriate parameters. The temperature of Liang Village Waters falls within a range that is 1-2 degrees below the established quality level, whereas in Jayabakti Village Waters, it exceeds the threshold by more than 1 degree. Temperature plays a crucial role in the growth and maturation of seaweed (Zakariah et al., 2023). Fluctuations in temperature within the range of 1-2 degrees are believed to have a significant impact on the growth rate of


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grass, causing it to be rather sluggish. This is evidenced by the daily growth rate, where the proportion of weight gain is not excessively high. However, overall, the state of seaweed in both bodies of water can still be considered favorable.

Table 3. Water quality parameters in two locations of rearing

| Parameters | Liang Village | Jayabakti Village |
|---|---|---|
| Temperature (°C) | 25-26 | 29-31 |
| Brightness (%) | 100 | 100 |
| Current (cm/det) | 12-48 | 12-48 |
| Depth (cm) | 500-700 | 500-600 |
| Salinity (ppt) | 30-33 | 30-31 |
| pH | 7-8 | 7-8 |

## CONCLUSION

The carrageenan content was consistent between Liang Village and Jayabakti Village. However, the seaweed quality in Liang Village was superior to that of Jayabakti Village, as shown by a water content of 9.3%. The growth of seaweed remained consistent and satisfactory, despite the fluctuations in temperature within the range of 1-2°.

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