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The Effect of Harvesting on The Production and Antioxidant Activity of Sea Grape (*Caulerpa racemosa*) by Rigid Quadrant Nets Planting Method

Pengaruh Umur Panen Terhadap Produksi Dan Aktivitas Antioksidan Anggur Laut (*Caulerpa racemosa*) Dengan Metode Tanam Rigid Quadrant Nets

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ABSTRACT

Caulerpa racemosa sea grape is one type of seaweed that has bright prospects to be produced and developed, because it has the advantage of being able to produce secondary metabolites and advantages in the pharmaceutical field such as antioxidant activity, anti-coagulant, anti-mutagenic, anti-bacterial, anti-cancer and anti-cancer activity and tumor. However, the quality of production and the content of active ingredients in plants are influenced by the age of harvest, so that there is no decrease in quality and the content of active ingredients is maintained, efforts are needed to be able to inhibit the damage. The purpose of this study was to determine at what harvest age sea grape can produce high production quality and antioxidant activity. The method used in this study is an experimental method with a completely randomized design (CRD). There were 5 treatments, P1 sea grapewas harvested at 20 days old, P2 sea grapewas harvested at 25 days old, P3 sea grapewas harvested at 30 days old, P4 sea grapewas harvested at 35 days old and P5 sea grapewas harvested at 40 days. 3 repetitions. The results showed that the harvest age of *Caulerpa racemossa* sea grape which were different and cultivated using rigid quadrant nets planting media had a significant effect on absolute growth, but had no significant effect on specific growth rate and had no significant effect on antioxidant levels, to obtain antioxidant levels, absolute weight growth and the optimal specific growth rate in the cultivation of *Caulerpa racemossa* sea grape, 30-40 days of harvest were used.

ABSTRAK

Anggur laut *Caulerpa racemosa* merupakan salah satu jenis rumput laut yang memiliki prospek cerah untuk diproduksi dan dikembangkan, karena memiliki keunggulan dapat menghasilkan metabolit sekunder, memiliki keunggulan di bidang farmasi seperti aktivitas antioksidan, anti koagulan, anti mutagenik, anti bakteri, anti kanker, dan aktivitas anti tumor. Namun, mutu produksi dan kandungan bahan aktif pada tanaman salah satunya dipengaruhi oleh umur panen, agar tidak terjadi penurunan mutu dan kandungan bahan aktif tetap terjaga, diperlukan upaya untuk dapat menghambat kerusakannya. Tujuan dari penelitian ini untuk mengetahui pada umur panen berapakah anggur laut dapat menghasilkan mutu produksi yang tinggi dan aktivitas antioksidan.

Metode yang digunakan pada penelitian ini adalah metode eksperimental dengan Rancangan Acak Lengkap (RAL). Terdapat 5 perlakuan, P1 anggur laut dipanen pada umur 20 hari, P2 anggur laut dipanen pada umur 25 hari, P3 anggur laut dipanen pada umur 30 hari, P4 anggur laut dipanen pada umur 35 hari dan P5 anggur laut dipanen pada umur 40 hari dilakukan 3 kali ulangan. Hasil penelitian menunjukkan bahwa umur panen anggur laut *Caulerpa racemossa* yang berbeda dan dibudidayakan menggunakan media tanam *rigid quadrant nets* berpengaruh nyata terhadap pertumbuhan mutlak, namun tidak berpengaruh nyata terhadap laju pertumbuhan spesifik dan tidak berpengaruh nyata terhadap kadar antioksidan, untuk memperoleh kadar antioksidan, pertumbuhan bobot mutlak dan laju pertumbuhan spesifik yang optimal dalam budidaya anggur laut *Caulerpa racemossa*, digunakan umur panen 30-40 hari.

Kata Kunci	*Anggur Laut, Antioksidan, Rigid Quadrant Nets, Produksi, Umur Panen*
Keywords	*Sea Grape, , Production, Antioxidant, Rigid Quadrant Nets, Harvest Age*
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INTRODUCTION

Caulerpa racemosa sea grape is a type of seaweed that has bright prospects for development (Cahyanurani et al., 2020). Sea grapes are usually consumed as vegetables or fresh vegetables by people in Indonesia. Based on several studies that have been conducted, sea grapes are a species of green algae that produces secondary metabolites that function as antioxidants. Tanna et al. (2018) stated that Caulerpa sp. has advantages in the pharmaceutical field as antioxidant, anti-coagulant, anti-mutagenic, anti-bacterial, anti-cancer and anti-tumor activity.

Sea grape production needs to be developed because foreign market demand, especially Japan, requires sea grape exports of at least 500 kg per month in fresh form with demand tending to increase (Simorangkir, 2017). Japan uses sea grapes as animal feed and medicine to reduce high blood pressure and to cure rheumatism (Fithriyani, 2009).

Sea grapes can grow well because they have the ability to produce secondary metabolites (organic compounds produced by plants that can be used as a source of medicine) so that they can protect them from structural damage (Tanna et al., 2018). It is thought that antioxidant activity and other ingredients contained in a plant are also influenced by the age of harvest, according to Hariani et al. (2012) in Zuhdi et al. (2018) that harvesting is closely related to the growth stage of the plant, because it can describe the level of physiological maturity of the plant, production and content contained in the plant, apart from that the age of harvest can also influence changes in color, texture, size and shape of plant parts.

There are several efforts made to achieve maximum sea grape production results, namely choosing the right location. The location is far from factory waste dumps, fresh water sources, household waste, the water quality parameters at the cultivation location meet the criteria for growing sea grapes, and are free from aquatic animals that are herbivores. Use of seeds according to the criteria of not being infected by disease, fresh, lush ramuli, elastic thallus and so on. The planting techniques and cultivation technology applied, handling during the production process, harvest handling and post-harvest also have an influence on achieving maximum harvest results (Soegiarto et al., 1989 in Iskandar et al., 2015).

One of the appropriate technologies for overcoming sea grape production problems is rigid quadrant nets planting media made from bamboo. Rigid quadrant nets made from bamboo are known as Ancak (Sumbawa and Lombok languages), made from pieces of bamboo woven using a single woven technique in a square shape with sides measuring the same length, namely 50cm x 50cm. This planting medium is cheap in terms of production costs, environmentally friendly because the main raw material used is bamboo, so it is quite easy to apply. Bamboo plants are considered good if used as a planting medium for cultivating sea grapes, their rough and stiff surface makes it easier for the rhizoids to attach and develop, because in their natural habitat Caulerpa racemosa grows attached to rocks or slightly rough substrates to live (Yudasmara, 2015).

Sea grapes can generally be harvested when they are 30 days old or even less or more than 30 days, depending on the intensity of sunlight to support the photosynthesis process for growth (Yudasmara, 2015). In sea grapes, according to Iskandar et al. (2017) can be harvested when they are 20 days old, whereas according to Ismianti et al. (2018) sea grapes can also be harvested at 40 days of age. Based on this description, it is suspected that different harvest ages will affect production results, antioxidant activity and quality in sea grape plants, because according to Dewi et al. (2016), the quality and content of active ingredients in plants is influenced by the age of harvest.

Caulerpa sp. It is very easily damaged if it has reached its maximum growth limit and has a very short shelf life during the post-harvest process. So that the quality is maintained during production and there is no decrease in the active ingredient content, efforts are needed to prevent damage. Research on "The Effect of Harvest Age on the Production and Antioxidant Activity of Sea Grapes (*Caulerpa racemosa*) using the Bamboo Nets Rigid Quadrant Method" to determine the harvest age of sea grapes to produce high production quality and antioxidant levels.

METHODS

This research was carried out from December 2020 to February 2021, taking place in the waters of Teluk Saleh, Labuhan Teluk Santong Village, Pelampang District, Sumbawa Regency, West Nusa Tenggara Province. Analysis of antioxidant levels was carried out at the Analytical Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, Mataram University. The method used in this research was an experimental method using a Completely Randomized Design (CRD) with 5 additional treatments and 3 replications, so that 15 experimental units were obtained.:

P1= Sea grapes were harvested after being kept for 20 days
P2= Sea grapes were harvested after being kept for 25 days
P3= Sea grapes were harvested after being kept for 30 days
P4= Sea grapes were harvested after being kept for 35 days
P5= Sea grapes were harvested after being kept for 40 days

Procedure

The planting medium used in this research is bamboo rigid quadrant nets which have been made using bamboo that has been split and cut to a size of 50 cm and a width of 2 cm then woven with a size of 50 x 50 cm, length 50 cm and width for 15 units. Next, the planting medium is filled with 1,000 gr/unit of sea grapes, then the planting medium is marked according to the treatment and placed according to the specified position. The sea grape seeds used are seeds originating from nature, the Caluerpa racemosa (Forsskal)

J. Agardh type. Maintenance is carried out for 40 days, during sea grape cultivation cleaning is carried out every 7 days, along with checking water quality parameters. Sea grapes that have been preserved are then harvested on the 20th day, 25th day, 30th day, 35th day and 40th day.

The activity of harvested sea grapes was carried out using a UV-Vis Spectrophotometer, DPPH method, at the Analytical Chemistry Laboratory, Mataram University. The DPPH method is a method that can measure antioxidant activity well, is simple, easy, fast, and only requires a small sample. Perwata et al (2009) in Ulfa (2016) explain that an ingredient can be said to be antioxidant active if the percentage of antioxidant activity is more than or equal to 50%. If the value is 100%, it means that antioxidant testing needs to be continued by diluting the sample to determine the activity concentration limit, while a value of 0% means that it has no antioxidant activity.

Research Parameters

Absolute weight growth

Absolute weight growth is calculated using the formula Effendy (2003) in Cokrowati et al. (2018) as follows:

$$G = Wt - W0$$

Information:

G : Absolute Weight Growth (gram)
Wt : Weight of sea grapes at the end of the study (gram)
W0 : Weight of sea grapes at the start of the study (gram)

Specific Growth Rate

Calculation of specific growth rate is calculated using the formula Dawes (1994) in Cokrowati et al. (2018) as follows:

$$LPS = \frac{\ln Wt - \ln W0}{t} \times 100\%$$

Measurement of Antioxidant Activity

The antioxidant activity of sea grapes was tested using a UV-Vis Spectrophotometer using the DPPH method. Then, the antioxidant activity of each sample was determined using the % DPPH antioxidant activity calculation formula of Amin et al. (2013) as follows:

$$\text{Antioxidant Activity (\%)} = \frac{(\text{A Blank} - \text{A Sample})}{\text{A Blank}} \times 100\ \%$$

Information :

A Blangk = Uptake of DPPH radicals
A Sample = Absorption of DPPH radicals after sample treatment

Water Quality

The supporting parameters measured in this research are water quality which includes temperature, pH, salinity, brightness, nitrate and phosphate.

Data Analysis

The research data were analyzed using Data Analysis in Microsoft Excel Software and Unvariate One Way Analysis of Variance statistical analysis with SPSS at a significance level of 5% to determine the effect of the treatment in the research. If the data shows a real effect, then further analysis is carried out using Duncan's test.

RESULT AND DISCUSSION

Absolute Weight Growth

Based on One-Way Anova statistical analysis, it shows that different treatments of harvest age for Caulerpa racemosa sea grapes have a significantly different effect (p

<0.05%) on the absolute weight growth of cultivated sea grapes. The results of data analysis of absolute weight growth of sea grapes on harvest age are presented in Figure 1.

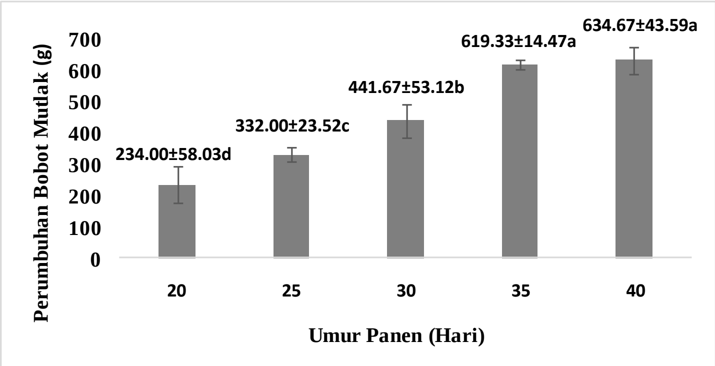

Figure 1. Absolute Weight Growth Chart

The absolute weight growth of sea grapes at harvest aged 20 days (P1) tends to be lower with a value of 234.00 grams compared to other absolute growths. The treatment with a harvest age of 20 days (P1) showed a significantly different effect to the treatment with a harvest age of 25 days (P2), a harvest age of 30 days (P3), an age of 35 days (P4) and a harvest age of 40 days (P5).

The results of data analysis in the 25 day harvest age treatment (P2) showed a value of 332.00 grams. The treatment of sea grape harvest age at 25 days (P2) also showed a significantly different effect to the treatment at 20 days harvest age (P1), 30 day harvest age (P3), 35 day harvest age (P4) and 40 day harvest age treatment (P5). In the 30 day harvest age treatment (P3), the value was 441.67 grams. The treatment of sea grape harvest age at 30 days (P3) showed a significantly different effect to the treatment at 20 days harvest age (P1), 25 day harvest age (P2), 35 day harvest age (P4) and 40 day harvest age treatment (P5).

Meanwhile, in the 35 day harvest treatment (P4), the value was 619.33 grams. Treatment of sea grape harvest age at 35 days (P4) gave a significantly different effect to harvest age of 20 days (P1), harvest age of 25 days (P2), harvest age of 30 days (P3) but did not provide a significant difference to treatment at age 40 days (P5). The 40 day harvest age treatment (P5) obtained a value of 634.67 grams. The treatment of sea grape harvest age at 40 days (P5) showed a significantly different effect to the treatment at 20 days harvest age (P1), 25 day harvest age (P2), 35 day harvest age but did not show a significantly different effect to the treatment. Harvest age 35 days (P4).

Absolute weight growth is the result of the final weight being reduced by the initial weight of a sample. The best absolute weight growth data for sea grapes was obtained at P4 and P5, while at P1 the absolute weight growth data for sea grapes obtained during the study showed lower growth compared to other treatments. In the first week of cultivation until harvesting at 20 days of age, it was observed with the naked eye that the growth of each treatment was almost the same, this indicates that the grapes were sea grapes. still in the process of adapting to the new environment.

Based on the treatments that have been carried out, the absolute growth of sea grapes is significantly influenced by differences in harvest age, the longer the harvest age, the higher the absolute growth of sea grapes. This result is proven by the results of the analysis of the average absolute growth in each treatment. According to Utama et al. (2013) in Susilo (2015) that harvest age can also influence the absolute weight, changes in color, texture, size and shape of plants and determining the right and appropriate harvest period can also maintain quality.

The best absolute weight growth values were found in treatments P4 and P5, namely harvest age of 35 days and 40 days. According to Darmawati (2017), the absolute weight of sea grapes continues to increase as they approach 35 days of age, because at that age the cell tissue of sea grapes has developed optimally. Time is an important parameter that must be considered in seaweed maintenance, harvesting sea grapes prematurely will reduce the quality of seaweed. According to Hurtado et al. (2008) in Darmawati (2017), harvesting time influences growth quantity, quality and economic costs. Apart from that, the age of seaweed also affects the nutritional content.

Specific Growth Rate

Based on One-Way Anova statistical analysis, it shows that the different treatments at harvest age for Caulerpa racemosa sea grapes did not have a significantly different effect (p > 0.05%) on the specific growth rate of cultivated sea grapes. The results of data analysis of the specific growth rate of sea grapes on harvest age are presented in Figure 2.

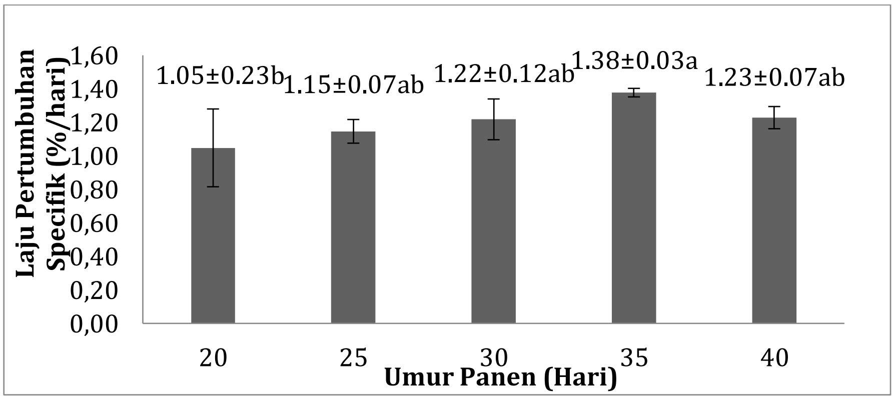

Figure 2. Specific Growth Rate Chart

The specific growth rate value of sea grapes at harvest age when maintained at 20 days (P1) was found to be 1.05%/day. The 20 day harvest age treatment (P1) showed results that were not significantly different from the 25 day harvest age treatment (P2), 30 day harvest age (P3), 35 day harvest age and 40 day harvest age treatment (P5) but showed significantly different effects. against the 35 day harvest age treatment (P4).

When treated with a harvest age of 25 days (P2), a value of 1.15%/day was obtained. The 25 day harvest age treatment (P2) showed no significantly different effect on the 20 day harvest age treatment (P1), 30 day harvest age (P3), 35 day harvest age (P4) and 40 day harvest age treatment (P5).

In the sea grape harvest age treatment at 30 days (P3), a value of 1.22%/day was obtained. Then the 30 day harvest age treatment showed no significantly different effect on the 20 day harvest age treatment (P1), 25 day harvest age (P2), 35 day harvest age (P4) and 40 day harvest age treatment (P5).

The 35 day harvest age treatment (P4) obtained a value of 1.38%/day. The 35 day harvest age treatment showed no significantly different effect to the 25 day harvest age treatment (P2), 30 day harvest age treatment (P3), and 40 day harvest age treatment (P5) but showed a significantly different effect to the 20 day harvest age treatment. (P1) and in the 40 day harvest age treatment (P5), a value of 1.23%/day was obtained.

The 40 day harvest age treatment (P5) obtained a value of 1.23%/day indicating that there was no significantly different effect on the 20 day harvest age treatment (P1), 25 day harvest age (P2), 30 day harvest age treatment (P3) and Harvest age 35 days (P4).

Specific growth rate describes the ability of sea grapes to grow specifically within a certain period of time. The specific growth rate of sea grapes at the 35th day of harvest (P4) tends to be faster with an average value of 1.38%/day compared to other harvest ages, namely P1 (1.05%/day), P2 (1.15 %/day), P3 (1.22%/day), and P5 (1.23%/day). According to Darmawati (2017) that sea grapes should be harvested at the appropriate age so that they can provide optimal growth and development results because a harvest time that is too short can cause the development and growth of sea grapes to be disrupted.

Other factors that can influence the specific growth rate of sea grapes are external and internal factors. According to Fikri et al. (2015) in Gultom et al. (2019) that there are several external factors and several internal factors that influence the specific growth rate of seaweed. One of the internal factors is the species, there are several species of seaweed that have a fast specific growth rate (Eucheuma cottonii, Gracilaria, Sargassum sp.) The use of seeds in accordance with the criteria of not being infected by disease, thick ramuli not broken and not slimy, thallus elastic and so on. The seedlings are not too old (around 20-35 days). Seedlings that are too old will result in sea grapes experiencing little growth and development because the sea grape cell tissue has previously developed optimally. Meanwhile, external factors are an environment that is suitable to its natural habitat, far from factory waste dumps, fresh water sources, household waste. Plant spacing 30 cm -100 cm per plant, initial seed weight 100-1000 grams, planting techniques and cultivation methods. Apart from that, Akib et al. (2015) in Gultom et al. (2019) also stated that the biological, physical and chemical factors of a body of water determine the growth rate of seaweed.

Antioxidant Activity

Based on One-Way Anova statistical analysis, it shows that differences in the harvest age of Caulerpa racemosa sea grapes do not have a significantly different effect ($p > 0.05\%$) on the antioxidant activity of cultivated sea grapes. The results of data analysis of sea grape antioxidant activity on harvest age are presented in Figure 3.

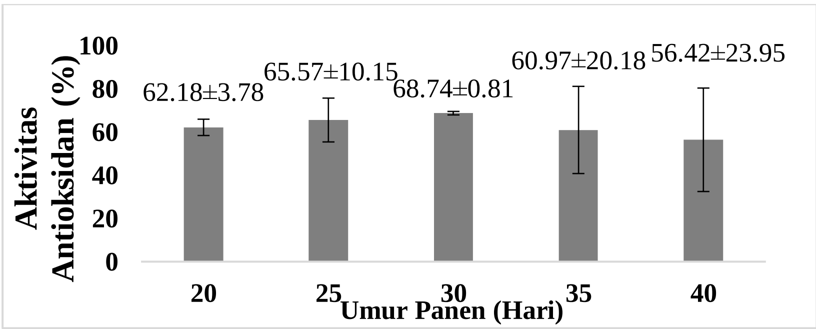

Figure 3. Antioxidant Activity Graph

The effect of antioxidant activity of sea grapes on harvest age which was maintained at 20 days (P1) with a value of 62.18%, the 25 day harvest age treatment (P2) obtained an antioxidant activity value of 65.57%, the 30 day harvest age treatment (P3).) obtained an antioxidant activity value of 68.74%, the 35 day harvest age treatment (P4) obtained an antioxidant activity value of 60.97% and the 40 day harvest age treatment (P5) obtained a value of 56.42%. The data shows that there is no significantly different effect on the treatment of 20 day harvest age (P1) with 25 day harvest age (P2), 30 day harvest age (P3), 35 day harvest age (P4) and 40 day harvest age (P5).

Caulerpa racemosa sea grapes have the ability to produce antioxidant activity. The nature of *Caulerpa racemosa* being safe for consumption is utilized by the public as a fresh vegetable and consumed raw, this allows *Caulerpa racemosa* sea grapes to be used as a source of natural antioxidants. Zuhdi et al. (2018) explained that antioxidants are compounds that can inhibit oxidation reactions, by binding free radicals. Meanwhile, the choice and availability of natural antioxidants is still very limited.

Based on antioxidant activity data, it can be seen that harvest age does not have a significant effect on the antioxidant activity of sea grapes, but the antioxidant activity obtained in each treatment is quite high. Perwata et al. (2009) in Ulfa (2016) explains that an ingredient can be said to be antioxidant active if the percentage of antioxidant activity is more than or equal to 50%. If the value is 100%, it means that antioxidant testing needs to be continued by diluting the sample to determine the activity concentration limit, while a value of 0% means that it has no antioxidant activity. Apart from that (Saefudin et al., 2013) also explained that if the percentage of immersion using the DPPH method is more than 90%, this indicates very high antioxidant activity (>90% Very high), (50%-90% high antioxidant activity) (20%-50% moderate antioxidant) (<20% low antioxidant activity) (0% indicates no antioxidant activity). In research by Saefudin et al, (2013) it was shown that the antioxidant activity test using the DPPH method on the bark of the Bayur tree (*Pteruspermum javanicum*) produced an antioxidant activity of 92.02%, this value was in the very high category.

The difference in antioxidant activity obtained in each treatment is thought to be caused by external and internal factors, one of which is external factors, namely, errors in the work procedures used when macerating sea grape extract. In the research, only 24 hours were used to macerate sea grape samples, this time was not optimal to obtain complete antioxidant compound activity. In the opinion of Sami et al, (2015) another factor that can influence the content of antioxidant compounds in a material when using the DPPH method is the short maceration period, which is only 1 day, when compared with the theoretical maceration period, which is usually carried out for 3 -5 days (Ansel, 1989 in Sami et al, 2015) so that compounds that are efficacious as antioxidants can be obtained optimally.

One of the internal factors that influences the antioxidant activity of a plant is that differences in the concentration of secondary metabolites contained in sea grapes can influence antioxidant activity. According to Arianti et al. (2007) in Bahriul et al. (2014) that differences in concentrations of secondary metabolites in plants can produce different levels of antioxidants. The more secondary metabolites it contains, the stronger its antioxidant activity.

There were differences in secondary metabolite concentrations which caused different antioxidant levels during the research because there were pests attacking sea grape plants. In sea grape harvesting P1.1, P2.1, P2.2. P3.1, P3.2, P3.3, P4.1, and P4.3 show that the sea grape planting medium is being gnawed on by barking clams (*Strombus canurium*), the clams are sticking to the cultivation medium and you can even see sea grape grains being eaten by barking clams. According to the opinion of Setyorini et al. (2017) that secondary metabolite compounds are produced in excess amounts if the plant is threatened with survival. Mariska (2013) in Setyoriniet al. (2017) also stated that secondary metabolite compounds in plants have a function, to protect themselves from environmental stress, protect against pest/disease attacks, protect against ultra violet rays, as growth regulators and to compete with other plants. Apart from that, Cavas et al (2005) also explained that antioxidants in Caulerpa racemosa are not completely influenced by high solar radiation and poor water quality, but the presence of epiphytes and pests around sea grape plants can change antioxidant levels. Meanwhile, Farasat et al. (2014) in Hidayat et al. (2020) explains that, if there is an excessive heating process when extracting sea grapes, it can cause the loss of some bioactive compounds and damage to the structure of compounds that function as antioxidants.

Water Quality

The water quality values obtained during the research were measured every 7 days to control the growth of sea urchins. Water quality measurements were carried out at 07.00 WITA. The measurement results can be seen in Table 1.

Table 1. Water Quality Measurement Results.

No	Parameter	Range Value of Research Results	Average Value of Research Results	Appropriateness	References
1	Temperature (°C)	30-32,8	30,96	25°C–31°C.	Piazzi *et al.* (2002) *dalam* Ismianti *et al.* (2018)
2	Salinity (ppt)	30-34	31,43	25 – 35 ppt.	Carrutes *et al.* (1993) *dalam* Burhanuddin (2014)
3	Brightness (m)	1,25-1,30	1,26	> 1 m	Satam (2003) *dalam* Ismianti *et al.* (2018)
4	pH	8,30-8,60	8,41	8,0 - 8,7	Burhanuddin (2014)
5	Phosfat (mg/L)	0,01	0,01	0,10–1,68	Darmawati (2017)
6	Nitrate (mg/L)	1,16-1,64	1,40	0,9-3,5	Yuliastuti *et al.* (2018)

Measuring water quality parameters is important in sea grape cultivation activities, but in this case water quality parameters are not the main thing that is observed. Water quality measurements are carried out once a week at 07.00 WITA. The water qualities that have been observed in this research include temperature, salinity, pH, brightness, nitrates and phosphates.

The results of temperature measurements at the research location are an average value of around 30.96 oC, this shows that the location has a good range of temperature values for cultivating sea grapes. According to Piazzi et al. (2002) in Ismianti et al. (2018) that the optimal temperature range to support the growth of sea grapes is between 25oC–31oC.

The results of salinity measurements carried out at the research location ranged from 30-35 ppt. From the results of salinity measurements obtained in these waters, it is very good for the growth of sea grapes, this is in accordance with the statement from Carruters et al. (1993) in Burhanuddin, (2014) stated that Caulerpa racemosa can grow well in calm waters with a salinity range of 25 – 35 ppt. The salinity value in the waters of Santong Bay is relatively high, this shows that the area is a fairly hot area.

The brightness at the research location is greatly influenced by the intensity of sunlight entering the waters. The brightness value found at the research location was 1.25 - 1.30 m. This value is still within the tolerance limits suitable for sea grape growth. According to Satam, (2003) in Ismianti et al. (2018) that good brightness for sea grape growth is > 1 m. The better the brightness, the better the light that enters the water. The intensity of sunlight that penetrates into the water really depends on the brightness of the water. The brighter the water, the deeper the light can penetrate. Sunlight is very necessary for seaweed in the process of photosynthesis.

The pH value of water plays an important role in the growth of sea grapes. The pH value in waters can be used as an indicator of the balance of chemical elements and nutrients which are very beneficial for the life of aquatic vegetation. The results of pH measurements carried out at the research location ranged from 8.30 to 8.60. This value shows that the location has good Ph levels for cultivating sea grapes. Setiaji et al. (2012) in Burhanuddin, (2014) that seawater pH in the range of around 8.0 - 8.7 is very suitable for the growth of Caulerpa racemosa.

Phosphate and nitrate are nutrients that determine fertility in waters. The phosphate level obtained in water samples in Santong Bay waters was 0.01 mg/L, while the nitrate level obtained was in the range of 1.16-1.64 mg/L. The phosphate content obtained is relatively low, this causes sea grapes to grow less optimally, but Caulerpa racemosa sea grapes can still grow. According to Darmawati (2017), the elements N and P are nutrients that are needed by algae for their growth. Fertile waters have a range of phosphate nutrients in normal sea waters between 0.10–1.68 mg/l which can provide good results. for the growth of *Caulerpa racemosa*. Meanwhile, according to Dahlia et al. (2015) in Yuliastuti et al. (2018) nitrate is not toxic to aquatic organisms, but if the levels are too high, it can cause excessive algae growth or what is usually called algae bloom. The nitrate range for optimal seaweed growth is 0.9-3.5 mg/l.

CONCLUSSION

Based on the results of research data analysis, it was found that different harvest ages of Caulerpa racemossa sea grapes and cultivated using rigid quadrant nets planting media had a significant effect on the absolute growth of sea grapes, but had no real effect on the specific growth rate and had no real effect on antioxidant activity, to obtain Antioxidant content, absolute weight growth and optimal specific growth rate in the cultivation of *Caulerpa racemossa* sea grapes, a harvest age of 30-40 days is used.

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