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# Analysis of *Caulerpa* sp Quality Cultivated with Different Harvesting Age

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**Abstract :** A high variability of seaweed quality might be influenced by duration of rearing (harvesting age). This study aimed to investigate the appropriate harvesting age for the best quality, that be conducted on Lagurudav illage's waters, Takalar regency(05º26'07.9"S and 119º22'29.9"W) by using floating monoline method. A 50 grams of each seed's initial weight was set with 30 cm space each seed, kept submerged at the depth of 50cm above seawater surface. The quality of *Caulerpa* sp measured at different harvesting age includes: moisture, protein, fat, crude fiber, carbohydrate and ash content. The quality *Caulerpa* sp and water quality were analyzed descriptively. The quality of *Caulerpa* sp (protein, crude fiber, carbohydrate, ash content) was observed increase in line with the increase of harvesting age. Several observed nutrient contents, such as protein (13.80%), crude fiber (15.72%), NFE (10.75%), and ash content (29.01%), were quite high. The moisture was monitored in the range of 42.98%-48.77%. the fat content was fluctuated in the range of 0.17%-0.29%. Water quality parameters, such as light intensity, temperature, pH, salinity, turbidity, nitrate and phosphate, were observed in the ideal condition for the growth of *Caulerpa* sp.
**Keywords :** seaweed *Caulerpa* sp, quality, harvesting age.

## Introduction

*Caulerpa* sp, one of green seaweed species with many potential benefits for human, begins to be utilized as a food ingredient, being freshly raw-consumed or as a vegetable. It has been proven to have high nutritional contents –plant-based protein, carbohydrates, minerals, vitamins[5,19] and polyphenols[21].Besides, the edible alga contains Insoluble Dietary Fiber or IDF[12],generally composed of cellulose and hemicellulose, pharmaceutical, and cosmetic industries[23,26].

Many benefits of *Caulerpa* sp make it begins to be exploited, generally obtained from nature that depends on natural conditions and seasons. Therefore, the effort to increase production is important to fulfill the ever-increasing requirement. Aquaculture is expected to fulfill the requirement, obtain maximum and continuous production, and well-organized supply, either quantity or quality.

The explained condition, nowa days, trigs to the production-based study which tend to the importance for good quality through aquaculture. The quality produced by seaweed is greatly environment-influenced,

might be geared by location and duration of rearing which is associated with the availability of nutrients. Seaweed growth is entirely dependent on the availability of nutrients and environmental conditions as aquaculture. In addition, the duration of rearing could affect to the nutrient content, both quantity and quality[13]. It can be understood that the nutritional content of seaweed is a product of photosynthesis that is very dependent on the duration, direct on the nutrient accumulation in thallus. Therefore, the nutrient content is highly depended by the duration of rearing. The harvesting age should be well-noted to ensure the quality seaweed cultivated for resulting the maximum quality.

Based on the above, it is necessary to measure the quality of the different harvest time so it can be determined when *Caulerpa* must be harvested with the best quality.

## Materials and Methods

### Seed of *Caulerpa* sp.

The fresh seeds, identified by characteristic green color, fresh appearance of branch and stolon, were obtained from the waters around the Spermonde islands, Makassar. The young seed, characterized by white/clear color, was avoided[18].

### Preparation

The study took a place on the waters of village Laguruda, Takalar, considering of lots of seaweed farming activities. The initial stages were preparation of aquaculture floating raft sized 3x2m$^2$ which consist of beams, bamboos, PE plastic rope (Ǿ 2.7 and 10mm), icestrap, net, and anchor.

### Cultivation of *Caulerpa* sp.

The study employed the floating monoline method, performing to adjust the sea level change. The floating method made it fixed on the sea surface. Seeds of seaweed, initially weighted 50 grams each, were set 30cm every clump of treatments, planted at 50cm depth-from-sea surface. Seaweed were reared for 42 days, and sampled with an interval of 14 days (0, 14, 28, and 42 days after planting). Samples were weighed and performed for proximate analysis to determine nutrient levels (seaweed quality).

### Quality Analysis of *Caulerpa* sp.

Quality analysis of *Caulerpa* sp was performed by using proximate analysis, which include: content of protein, moisture, ash, fat, crude fiber and carbohydrate.

**Protein content**[2,24] :

$$Protein\ content\ (\%) = \frac{(a-b)xNx0{,}014x6{,}25}{W}\ x\ 100\%$$

where: a = ml NaOH for the blank titration, b = ml titration NaOH for sample titration, N = normality of NaOH, W = weight of sample (g)

**Moisture content**[1] **:**

$$Moisture\ content\ (\%) = \frac{W1-W2}{W1}\ x\ 100\%$$

Description: W1 = initial sample weight, W2 = final sample weight

**Ash content**[2]:

$$Ash\ content\ (\%) = \frac{A-B}{C}\ x\ 100\%$$

Description: A = cup + dry sample (g), B = empty cup (g), C = sample's cup (g)

**Fat content**[2] :

$$Fat\ content\ (\%) = \frac{fat\ weight}{sample\ weight} x\ 100\%$$

**Crude fiber content**[2] :

$$Crude\ fiber\ content\ (\%) = \frac{a-b}{c}\ x\ 100\%$$

Where: a = weight of fiber residue in the filter paper (grams), b = weight of dry filter paper (grams), c = initial weight of the sample (gram)

**Carbohydrate content**[2] :

*Carbohydrate content (%dw) = 100% - (A+B+C+D+E)*

Where: A = moisture content, B = ash content, C = fat content, D = protein content, E = crude fiber content.

**Water Quality Analysis**

Water quality parameter measurements were conducted every week until the end of rearing period, include: light intensity, temperature, pH, salinity, turbidity, nitrates and phosphates.

**Data Analysis**

Data of *Caulerpa* sp quality were analyzed descriptively, while water quality data were analyzed descriptively according to the ideal condition for the growth of *Caulerpa* sp.

## Results and Discussion

**Quality of *Caulerpa* sp**

Data of *Caulerpa* sp quality during the study were presented by the proximate analysis result, showed in Table 1 below.

**Table 1. Quality of *Caulerpa* sp during the study**

| Proximate Analysis | Age of harvesting | | | |
|---|---|---|---|---|
| | 0DAP | 14DAP | 28DAP | 42DAP |
| Moisture (%) | 46.09 | 48.77 | 43.65 | 42.98 |
| Protein (%) | 6.30 | 6.63 | 9.60 | 13.80 |
| Crude fiber (%) | 8.75 | 9.00 | 10.83 | 15.72 |
| Fat (%) | 0.17 | 0.29 | 0.13 | 0.17 |
| NFE (%) | 6.20 | 6.29 | 7.58 | 10.75 |
| Ash (%) | 27.86 | 28.01 | 28.56 | 29.01 |

*) DAP: Day(s) After Planting

The result (indicated in Table 1) shows that harvesting age affects the quality of *Caulerpa* sp. Quality of *Caulerpa* sp, described by protein, crude fiber, fat, carbohydrate and ash content, increased in line with the increase of the harvesting age. This finding is consistent with[8,16], stated that the chemical content of seaweed is very varied, whose influence are species and harvesting age.

Moisture content of *Caulerpa* sp.was observed in the range of 42.98%-48.77%. The highest value was obtained at 14 days of harvesting age, 48.77%. At 28 days of harvesting age, it began to decline, then got the lowest at 42 days of harvesting age, to 42.98%. The low moisture at 42 days might be caused by the late-harvesting, makes polysaccharide in cells growing up and reduce the moisture. The high moisture of seaweed makes the soften-texture, resulting in the ease-to-consume as a fresh vegetable.

An increase of protein content of *Caulerpa* sp was found linearly with an increase of harvesting age with a range of 6.30%-13.80%. The highest was observed at 28 days and 42 days of harvesting age, respectively 9.60% and 13.80%. This finding is in accordance with[6], stated that the wet weight of green seaweed contains 6-20% protein.While[17]the protein content of *Caulerpa*spranged10-13%. The protein content of green seaweed is higher than red seaweed and brown seaweed[4]. Protein content of seaweed is also influenced by the availability of nitrogen in water[8].The algal cell walls are also rich in proteins, which are embedded in the matrix polysaccharide phase[26].

Crude fiber content was observed to increase with an increase of harvesting age. Started at 8.75% in the beginning, it then increased to 15.72% after 42 days. This might be due to high polysaccharide content of seaweed when the harvesting age increased. Polysaccharides of seaweed are hardly digestedby human's digestion system, make it suitable as a fiber source, which means it can stimulate the fiber intake. Total crude fiber is an amount of dietary fiber and functional fiber[6,17].

Fat content of this study was observed to be fluctuated, ranged 0.17-0.29%. This is in accordance with[6,20], that seaweed contains a low fat content, ranged 1-5%. Furthermore[6,22],stated that the seaweed is poor in fat, generally less than 4%.. Fat content of seaweed are mostly composed by poly unsaturated fatty acids, generally essential for humans and animals1[6,16,27].

Nitrogen-Free Extract (NFE) content also increased with the increase of harvesting age, dramatically at 42 days, overall ranged 6.20%-10.75%. Seaweeds are generally storing food in the form of carbohydrates, especially polysaccharides[19]. The building compound of carbohydrates is the further product of photosynthesis, the content depends on the photosynthesis rate and accumulation time of assimilate in thallus cells. It is mostly in the form of fiber, an undigested by human digestive enzymes, that plays a small role of calories intake and makes it suitable for a diet food[20].Furthermore, [6]stated that xylan and ulvan are easy-to-find polysaccharides of green algae and easy-to-digest by intestinal bacteria. The cell wall of *Caulerpa* is described as a branched polymer containing 3-linked galactose, terminal-and 4-linked xylose, as well as 4-and 3,4-linked arabinose residues. Sulfate groups, when present, are linked to C-3 of 4-linked arabinose and C-6 of 3-linked galactose units. No pyruvic acid has been reported[3].

Ash content in this study increased with the increase of harvesting age but not significant. This is due to the increase of nutrients level in line with the harvesting age. Ash is an essential component in a dietary, determining the mineral level. Ash content in seaweed consists of macro-minerals and trace elements[6].Absorption of minerals in seaweed was carried through whole surface of thallus, making it more effective. The amount of mineral absorbed influences of ash content in seaweed tissues.

Photosynthesis affects the quality of seaweed, the longer the harvesting age the longer it lasts, consequently affected on the high nutritional content of seaweed that becomes higher when harvested at 42 days. Quality of *Caulerpa* sp obtained in this study is higher than[25]from ManokwariArowicoastlineand[7]from Tongkeina waters, Manado.

This study indicates the increase on quality of *Caulerpa* sp until42 days of harvesting age. However, [5]argued that the growth rate for various rearing methods of *Caulerpa* sp began to decline when the rearing age reach 5 weeks (35 days). Quality of *Caulerpa* sp at harvesting age of 6 weeks (42 days) was higher than 42 days. It could be used as a basis for determining the harvesting age of *Caulerpa* sp. to obtain the best quality.

Several water quality parameters, such as temperature, salinity, pH, and $CO_2$ were observed in the ideal condition for *Caulerpa* sp. The nitrate level was relatively low, ranged 0.01-2.6 ppm, but still within the limits of seaweedviability[10,14]that ranged 0.9-3.5 ppm. The phosphate level was also low (0,16-0.62 ppm) but still possible to support the survival of *Caulerpa*. Nitrogen and phosphorus are two essential nutrients for the growth of algae. Nutrients are needed for the growth of seaweed so that nutrients must be in accordance with the needs of seaweed. Nutrient deficiencies will inhibit the growth of seaweed while the excess nutrients will affect the growth of seaweed[11].

## Conclusion

Harvesting age affects the quality of *Caulerpa* sp. Quality of *Caulerpa* sp. (contains the content of protein, crude fiber, carbohydrate, and ash) increases in line with the increase of harvesting age. The highest

water content was obtained at the harvesting age of 14 days, while the lowest at 42 days. Fat content was fluctuated. Water quality parameters (light intensity, temperature, pH, salinity, turbidity, nitrate and phosphate) were still in the ideal condition for *Caulerpa* sp.

We would like to suggest that the *Caulerpa* sp. harvesting should be done after 42 days of rearing. Research on the exploration and processing needs to be developed considering the high potential of *Caulerpa* sp. as an food ingredient and nutrient source.

## References


1. [AOAC] Association of Official Analytical Chemist. 1995. Official Analysis of the Association of Official Analytical Chemist. Virginia: The Association of Official Analytical Chemist, Inc.
2. Apriyantono A, Fardiaz D, Puspitasari NL, Sedarnawati, Budiyanto S. 1989. Petunjuk Laboratorium Analisis Pangan. Bogor: Pusat Antar Universitas Pangandan Gizi, IPB.
3. Arata, P.X., Quintana, I., Canelón, D.J., Vera, B.E., Compagnone, R.S., Ciancia, M., 2015. Chemical structure and anticoagulant activity of highly pyruvylated sulfated galactans from tropical green seaweeds of the order Bryopsidales. Carbohydr. Polym. 22, 376–386.
4. Astorga-Espana, M Soledad., Galdo´n, Beatriz Rodr´ıguez., Rodr´ıguez-Rodr´ıguez, Elena M., & Romero, Carlos D´ıaz., 2016. Amino acid content in seaweeds from the Magellan Straits (Chile). Journal of Food Composition and Analysis.09.004
5. Azizah, R.T.N, 2006. Percobaan Berbagai Macam Metode Budidaya Latoh (*Caulerpa racemosa*) Sebagai Upaya Menunjang Kontinuitas Produksi. Jurnal Ilmu Kelautan, Universitas Diponegoro. 11(2): 101 – 105.
6. Burtin, P. 2003. Nutritional Value of Seaweeds. Electron. J. Environ. Agric. Food Chem., 2(4), (498-503)
7. Charles, R.K. 2000. KandunganNutrisi Alga Hijau *Caulerpa racemosa* (Forsskal) J.Agardh yang diambildari Perairan Tongkeina, Manado. Jurnal Fakultas Perikanan Vol.II No.1, Fakultas Perikanan dan Ilmu Kelautan, Universitas Samratulangi, Manado.
8. Dennis. C., Michele Morancaisa, Min Li, Estelle Deniaud, Pierre Gaudin, GaetaneWielgsZ-Collin, Gilles Barnathan, Pascal Jaouen, Joel Fleurence. 2010. Study ofThe Chemical Composition of Edible Red Macroalgae *Grateloupia turuturu* from Brittany (France). Food Chem (119) 913-917).
9. Dewi, E.N. dan Susanto, E., 2011. Alga: Teknologi Pengolahan dan Produk Pengembangannya. BP Undip. Semarang.
10. Diaz-Pulido, G., and Laurence J. McCook. 2008. Environmental Status: Macroalgae (Seaweeds). Great Barrier Reef Marine Park Authority: Australia.
11. Guo, H., J. Yao., Z. Sun and D. Duan. 2014. Effects of Salinity and Nutrients on the Growth and Chlorophyll Fluorescence of Caulerpalentillifera. Chinese Journal of Oceanology and Limnology. 33(2): 410 - 418
12. Hold, S.L., and Kraan, S. 2011. Bioactive Compounds in Seaweed: Functional Food Applications and Legislation. Journal Applycation Phycology. 23: 543-597.
13. Hurtado A.O., Richter P. and Roxas M.J., 2008. A review on the seaweed research development program in the Bimp-Eaga region. Proceeding of the 1st Indonesia Seaweed Forum. Makassar Indonesia.
14. Kadi, A. 2004. Potens Rumput Laut Dibeberapa Perairan Pantai Indonesia. Jurnal. Oseana, Volume XXIX, Nomor 4, Tahun 2004 : 25–36
15. Mata, L., M. Magnusson, N. A. Paul, R. de Nys. 2015. The intensive land-based production of the green seaweeds Derbesiatenuissima and Ulvaohnoi: biomass and bioproducts. ApplPhycol. 28: 365.
16. Ortiz, J., Romero N., Robert P, Araya J, Lopez-Hernandez J, Bozzo C, Navarrete E, Osorio A, Rios A., 2006. Dietary Fiber, Amino Acid, Fatty Acid and Tocopherol Contents ofthe Edible Seaweeds *Ulvalactuta* and *Durvillaeaantartica*. Food Chemistry (99): 98-104.
17. Pereira, L., 2011. A review of the nutrient composition of selected edible seaweeds. Seaweed: Ecology, Nutrient Composition and Medicinal Uses. Nova Science Publishers, Inc., New York, USA, pp. 15–47.
18. Putra, U.N.S.S,Jumriadi, Michael Rimmer, danSugeng Raharjo. 2012. Budidaya Lawi-Lawi (*Caulerpa* sp.) Di Tambak SebagaiUpayaDiversifikasi Budidaya Perikanan. Indonesian Aquaculture dan Forum Inovasi Teknologi Akuakultur. Center for Brackish water Aquaculture Development Takalar.

19. Rodrigues, D., Ana, C. F., Leonel, P., Teresa A. P., Rocha-Santos, Marta W. V., 2015. Chemical Composition of Red, Brown and Green Macroalgae from Buarcos Bay in Central West Coast of Portugal. Journal of Agricultural and Food Chemistry 183, 197–207.
20. Sanchez-Machado DJ, Lopez-Cervantes, Lopez-Hernandez J, Paseiro-Losada P. 2004. Fatty Acids, Total Lipid, Protein and Ash Contentof Processed Edible Seaweeds. Food Chemistry (85):439-444.
21. Sánchez-Camargo, A. D. P., Montero, L., Stiger-Pouvreau, V., Tanniou, A., Cifuentes, A., Herrero, M., & Ibáñez, E. 2016.Considerations on the use of enzyme-assisted extraction in combination with pressurized liquids to recover bioactive compounds from algae. Food Chemistry, 192, 67-74
22. Sanjaya, Y.A., Simon B. Widjanarko, DwiSetijawati, Masruri.,2016. Phytochemicals Properties and Fatty Acid Profile of Green seaweed *Caulerpa racemosa* from Madura, Indonesia. International Journal of ChemTech Research. 9(5): 425-431.
23. Sharma, B.R., K.H. Jung and D.Y. Rhyu. 2015. *Caulerpa lentillifera* Extract Ameliorates Insulin Resistance Andregulates Glucose Metabolism in C57BL/KsJ-db/dbMice Via PI3K/Aktsignaling Pathway in Myocytes.Journal of Translational Medicine. 13(62) : 1-10
24. Slamet, D.S., M.K. Mahmud, Muhilal, D. Fardiaz, danSimarmata. 1990. PedomanAnalisisZatGizi. Jakarta: DepartemenKesehatan RI, Dirjen Bina GiziMasyarakat.
25. Talakua, S., Fanny F. C. Simatauwdan Marlena Nurhayati. 2011. Analisis Kandungan Gizi Makroalga *Caulerpa racemosa* Dari Pantai Arowi, Kabupaten Manokwari. Jurnal Perikanandan Kelautan, Volume 7 Nomor 2. UNIPA.
26. Wang, L., Wang, X., Wu, H., Liu, R., 2014. Overview on biological activities and molecular characteristics of sulfated polysaccharides from marine green algae in recent years. Mar. Drugs 12, 4984–5020
27. Wong, KH dan Cheung Peter CK. 2000. Nutritional Evaluation Of Some Subtropical Red and Green Seaweeds Part II. In-vitro Protein Digestibility and Amino Acid Profiles of Protein Concentrates. Food Chem (72):11-17.

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