The Chemical Properties of Seaweed *Caulerpa lentifera* from Takalar, South Sulawesi

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**Abstract.** Indonesia is known as a maritime country having many types of seaweed. The type of seaweed that is still little studied is the type of green seaweed. One of the most common types of green seaweed found in Indonesia is *Caulerpa lentifera*. Green seaweed is informed to contain beta-glucan. Beta glucan has widely studied because it contains bioactive compounds. The bioactive content of green seaweed, in this case, is obtained from *Caulerpa* type. In this study, the type of *Caulerpa* studied derived from cultivation (Takalar, South Sulawesi). Test of chemical properties of seaweeds parameters observed were protein quality, fat content, carbohydrate, water content, and dietary fibre. This study is a preliminary treatment to determine the primary metabolite content of *Caulerpa* seaweed cultivation. The methods used to include rinsing, washing with water, drying and grinding. The result of analysis for moisture content (5.4%), protein (14.4%), fat (0.85%), total ash (41.85%) and carbohydrate (32.95%). Protein and carbohydrate were the most sources in this species. This study suggests that *C. lentifera* could potentially be used as a nutritious and functional food item for the human diet.

1. **Introduction**

Generally, the tradition of consuming seaweed as fresh vegetables has become a custom for Asians since ancient times. Utilization of different kinds of seaweeds not only limited to human nutrition, but also used as an ingredient for animal and poultry feed [1]. *Caulerpa* spp is a green seaweed *Chlorophyta*, widely distributed in tropical areas, living on rocks or in association with other seaweed, which introduced into the Mediterranean Sea. Since 1990, it has been invading the Mediterranean Sea and the Canary Islands, causing ecological problems [2]. Several environmental factors such as water temperature, salinity, light, and nutrients can influence the nutritional contents of seaweeds. Most seaweed has more ash contents than terrestrial plants and animal products. Some of the trace elements in seaweeds are rare or absent in terrestrial plants. Red seaweed (*Gracilaria* spp, *Gelidium* spp, and *Eucheuma cottonii*) and green seaweed (*Ulva* spp. and *Caulerpa* spp) have been abundant in the coastal area. However, the utilization of seaweeds is restricted to received communities living in the coastal zone [3]. *Caulerpa* sp. is a green alga that has not been widely used and is included in the feather seaweed / edible seaweed (edible seaweed). Seaweed habitat *Caulerpa* sp. found in the lower subtidal zone, spreading between rock or seagrass by attaching to the sand substrate or rock fragments, having soft thallus resembling cartilage, light green, growing between stones, thallus attached to the substrate with holdfast fiber [4]. Seaweed is a natural substance that contains a variety of organic and...
inorganic substances which are beneficial to human health, contain vitamins and minerals that are very high which has been used in industry pharmaceutical, biomedical, and nutraceutical [5][6].

The nutritional value of seaweeds has been scarcely studied; however, some reports have shown that they present low lipid content but are rich in proteins and carbohydrates [7]. Seaweeds have nutrition compositions, which are; water 27.8%, protein 5.4%, carbohydrate 33.3%, fat 8.6%, crude fiber 3%, and ashes 22.25% [8]. Seaweeds also contain high vitamins and minerals which are useful for human health. The mineral content of seaweeds is 7-38% (dw). Seaweeds can be classified based on its pigment into red algae (Rhodophyta), brown algae (Phaeophyta), and green algae (Chlorophyta); based on its nutrition and chemical composition. Red algae and brown algae are often used as food resources for humans [9]. The biotechnological importance of natural products (e.g., phenolic compounds, sulfated polysaccharides, lectins, carotenoids, and organic acids) [10]. The structure of algae is strongly influenced by the season, age, species, and geographical location [11].

The typical carbohydrates in brown algae varieties consist of alginate, fucoidan, laminaran (β-1.3-glucan), cellulose, and mannitol. The amorphous, slimy fraction of brown algae fiber mainly consists of water-soluble alginates and fucoidan and main reserved are laminaran (β-1.3-glucan) and mannitol [9]. Dietary fiber consists of soluble and insoluble fiber. Soluble dietary fiber has a function to prevent diseases such as colon cancer, cardiovascular disease, and obesity [12] whereas insoluble dietary fiber can decrease intestinal transit time [13]. A few numbers of studies on C. racemosa have been reported especially on general morphology, abundance, distribution, standing stock [14] and micronutrients and trace elements [1]. Only a few studies have documented the nutritional composition of some other edible seaweeds in the sub-tropical coastal area of Bangladesh but the proximate composition and amino acid profile of C. racemosa is very scantly, and nutritional data on C. racemosa is not yet available in the literature. In Indonesia type C. lentifera almost find and abundance. It has always realized that dietary fact study has prime importance to make the species edible and commercially viable to the consumers. The main objective of this study was to determine the properties chemical composition (protein, carbohydrate, lipids, fibre, and ash) of C. lentifera from the coastal Takalar, South Sulawesi.

2. Methods

The green seaweed C. lentifera was collected from the coastal Takalar, South Sulawesi May 2018. Firstly, fresh samples were washed under running seawater, then rinsed and gently washed again with distilled water and then to dry with the sun. The dried seaweeds were powdered manually using a blender. Until the chemical tested, the powder seaweed packaging and stored in desicators at room temperature.

The moisture content of C. lentifera determined by drying the seaweed samples at 105°C to constant weight. Then the moisture content was calculated by subtracting the final weight from the initial weight of the sample. The protein content of C. lentifera was analyzed by the Kjeldahl’s method, where a conversion factor of 6.25 has been used to convert total nitrogen into the crude protein. The crude lipid of C. lentifera extracted from the seaweed powder with petroleum ether in a Soxhlet extractor. Ash content was conducted by ashing the ground dried samples overnight in the muffle furnace at 525°C. Crude fiber analysis determined by filtering with a FiberTec system.

The crude lipid estimated by using the chloroform-methanol mixture, 10 mg of dried powder samples taken in a test tube, 5 ml of chloroform-methanol (2:1) mix added. The mixture was incubated at room temperature for 24h after closing the mouth of the test tube with aluminum foil. After the incubation, the mixture was filtered using a filter paper, the filtrate collected in a 10 ml pre-weighted beaker, which kept on a hot plate. The chloroform-methanol mixture was evaporated leaving a residue at the bottom of the glass beaker. The beaker with the residue and the weight of the empty beaker was calculated to know the importance of the lipid present in the sample.

This assay was based on Kumar [15]. Briefly, the fresh algal matter was oven dried at 60°C to constant weight and then samples the dehydrated algal weight value from the wet weight.
Ash determination. The determination of the ash content was performed based on De Oliveira et al. (2009) [16] gravimetrically after heating at 550°C for 18h in a muffle furnace.

The analysis of the carbohydrate content (including dietary fiber) performed using methods Dubois, 1956 [17].

Statistical analysis the data were presented as mean ± standard deviation (SD) for the chemical components. Analysis of variance (ANOVA) run for unpaired values. Values of p < 0.05 were considered statistically significant.

3. Results And Discussion

The mean percentages (dry weight basis) of protein, crude lipid, carbohydrates, crude fibre, ash and moisture in C. lentifera as shown in Figure 1.

![Figure 1. Chemical Composition of C. lentifera](image)

The green seaweed C. lentifera was found to contain a higher amount of protein, crude lipid, and fibre content. The same result from other green seaweed-like C. racemosa high protein content [1]. The protein contains amino acid essential and non essential. Base on the result analysis obtains high of aspartic acid and glutamic acid concentration on C. lentifera. It was apparent that C. lentifera has a rich nutritional composition. The ash content in these three Caulerpa species was found to be much higher than that found spinach. High content in ash also indicates the presence of several minerals [18][19]. The green seaweed higher protein content compared to brown seaweed like a Sargassum filipendula and Padina gymnaspora, but higher phenol content in brown seaweed compared to green seaweed. The several by research the nutrition content of types Caulerpa among them has the proximate composition protein 12.5%; lipid 0.6%; crude fiber 3.17%; ash 24.21% [20]. Compare to those reported in other seaweeds, the protein content of Caulerpa racemosa (14.4%) was comparable to the red algae Palmaria sp. (13.87%), notably higher than some green algae Ulva lactuca (7.06%) [21].

Moreover, its consumption has a positive effect on health because they can reduce the blood lipid level, obesity, and risk of coronary heart diseases. Their nutritional compositions together with their physicochemical properties suggest that Ulva species have potential food to be functional ingredients in the food industry [22]. As many of the studied Caulerpa spp contained the right amount of fatty acids, especially PUFA/SAFA ratio, increased intake of these fatty acids are known to associate with a lower risk of human coronary heart disease. Many of the studied Caulerpa spp have the potential of being used as a food source or as supplements [23].
The characteristic absorptions of *C. lentifera* polysaccharides were present in the FT-IR spectra (Figure 2), showing similar IR signal bands of typical absorption peaks assigned to the saccharide moiety. The absorbance band at 1200-1000 cm\(^{-1}\) was attached to the stretch vibration of C-O-C and C-O-H. There were absorption peaks of sulfation groups (SO\(_3^-\)) representing an asymmetrical S=O stretching vibration. There were absorption peaks of carboxyl groups (COO\(-\)) at 1640 cm\(^{-1}\). These IR peaks suggested that the obtained *Caulerpa* polysaccharides were anionic polysaccharides contained uronic acids and sulfation groups in the sugar molecule.

**Figure 2. Spectra FT-IR from *C. lentifera***

Seaweed is a rich source of polysaccharides, especially cell-wall sulfated polysaccharides that are of great interest for the hydrocolloid industries but not for lipid in generally. The high protein and carbohydrate content in seaweeds suggesting them as food supplements intended to reduce obesity [15]. The proximate composition found in various *Caulerpa* species (*Chlorophyta*) by Kumar was reasonable in terms of nutrients. Seaweeds could be considered as promising plants of the future forming one of the important marine living resources of high nutritional value [3]. Nutritional data for *C. lentifera* were for populations from shrimp culture ponds and might not reflect the natural nutritional composition in wild or cultured populations.

**4. Conclusions**
The results based of analysis from this study suggested that *C. lentifera* contained high protein (14.4%), dietary fibre (8.5%), carbohydrate (32.95%) and low lipid (0.84%). The green seaweed could be potential as a functional food ingredient with high nutrition. Hence, the consumption of *Caulerpa lentifera* as a functional food rich in elements of nutritional properties.

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