

Proximate composition of Bio Potential Seaweeds from Mandapam, South East Coast of India

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ABSTRACT. Proximate composition of the three green seaweeds viz., *Chaetomorpha aerea*, *Enteromorpha intestinalis*, *Enteromorpha compressa* one brown seaweed *Dictyota dichotoma* and one red seaweed *Gracilaria corticata* was investigated by determination of protein, carbohydrates, lipid, moisture and ash content. In the present study, the total protein was recorded upper most in *E. intestinalis* and bare minimum in *E. compressa*. The maximum carbohydrates recorded in *C. aerea* and minimum in *G. corticata*. The lipid content was acquired upper limit in *E. compressa* and least in *C. aerea*. The ash and moisture content in following of 5 different seaweeds are as follows: 7.45mg/g, 3.91mg/g were recorded in the *C. aerea*, 8.52mg/g, 3.42mg/g in the *E. intestinalis*, 8.58mg/g, 3.75mg/g in the *E. compressa*, 9.47mg/g, 4.23mg/g in the *D. dichotoma* and 6.95mg/g, 3.98mg/g in *G. corticata*. The proximate composition of 5 different seaweed species exhibited high nutritional value for human consumption.

1. INTRODUCTION

Seaweeds are an important source for food, fodder fertilizer and medicine from the ancient times. They are good sources of proteins, carbohydrates, vitamins and minerals in human nutrition. Seaweeds are the raw material for many industrial productions like agar-agar, alginate derivatives and carrageenan but they continue to be widely consumed as food in Asian countries. ^[1] Nutrient content of seaweeds vary with species, geographical location, season, humidity and temperature. ^[2] They are nutritionally valuable as fresh or dried vegetables, or as ingredients in wide prepared foods. ^[3] In particular, certain edible seaweeds contain significant quantities of protein, lipids, minerals and vitamins. ^[4, 5] Many macroalgal species have been used as ingredients in both medicinal and food preparations, traditionally, in different regions across the world. ^[6,7] There are 250 macro algal species which have been listed as commercially utilized worldwide, among which 150 are consumed as human food. ^[8] Seaweeds are also considered as low calorie foods with high contents of minerals, vitamins, proteins and carbohydrates. Being rich in minerals, vitamins, trace elements and bioactive potential substances, seaweeds are called medical food of the 21st century. ^[9]

Commercially available varieties of marine macroalgae are commonly referred to as 'seaweeds'. Macroalgae are classified as red algae (Rhodophyta), brown algae (Phaeophyta) or green algae (Chlorophyta), depending on pigmentation, morphological and anatomical characters. ^[10] Red and brown algae are chiefly used as human food sources. ^[11] The industrial applications of macroalgae are varied from each other and the by-products viz., polysaccharides are used in food, cosmetics, paint, crop, textile, paper, rubber and building industries. Additionally, seaweeds are used in medicine and in pharmacology for their antimicrobial, antiviral, antitumor, anticoagulant and brinolytic properties. Recently, abundant studies reported that *Ulva* can be of potential interest for food, development of novel drugs and functional foods, pharmaceutical and agricultural applications. ^[12, 13]

Seasonal variation in growth and biochemical constitutions such as protein, carbohydrate and lipid in *Hypnea valentiae*, *Acanthophora spicifera*, *Laurencia papillosa*, *E. compressa*, *Ulva lactuca* and *Caulerpa racemosa* were observed for one year from Mandapam coast.^[14] Seasonal variation in biochemical constitutions of *Sargassum wightii* with special reference to yield in alginic acid content from Pudumadam has been reported.^[15] The objective of the present investigation was to evaluate the biochemical composition of the green algae *C. aerea*, *E. intestinalis*, *E. compressa* brown alga *D. dichotoma* and red alga *G. corticata* about their nutritional value of 5 different seaweeds of Mandapam coast, South east coast of India.

2. MATERIALS AND METHODS

Collection of Seaweeds

The green algae *C. aerea*, *E. intestinalis*, *E. compressa* brown alga *D. dichotoma* and red alga *G. corticata* were collected from the coastal region of Mandapam. The algal samples were brought to the laboratory using sterile polythene bags for biochemical characterization. Upon collection the samples were washed repeatedly under running tap water followed by distilled water twice to eliminate the adhering impurities. The samples were then air-dried prior proximate composition evaluation.

Biochemical Analysis

Estimation of total protein:

The total protein was estimated using the Folin-Ciocalteu Phenol method of Lowery *et al.*^[16]

Estimation of total carbohydrates:

The total carbohydrate was estimated following the Phenol-sulphuric acid method of Dubois *et al.*^[17]

Estimation of total lipids:

The extraction of lipid was done by the chloroform-methanol mixture Folch *et al.*^[18]

3. RESULTS

A highest and lowest level of protein was noticed as 24.52 and 15.69mg/g in the *E. intestinalis* and *E. compressa*, carbohydrate of 56.78 and 27.57mg/g in the *E. compressa* and *C. aerea*. Fat content of 21.25 and 11.67mg/g in the *C. aerea* and *G. corticata*. The ash content of 9.42 and 6.59mg/g in the *D. dichotoma* and *G. corticata*. Similarly the highest and lowest moisture level was recorded as 4.23 and 3.42mg/g respectively in the *D. dichotoma* and *E. intestinalis* etc. Among the five different seaweeds studied, a higher level of ash and moisture of 9.47 and 4.23mg/g was recorded in the *D. dichotoma*. The biochemical composition of the 5 different seaweeds are shown in Fig.1 and the level of protein, carbohydrates, fat, ash and moisture content of the seaweeds are as follows

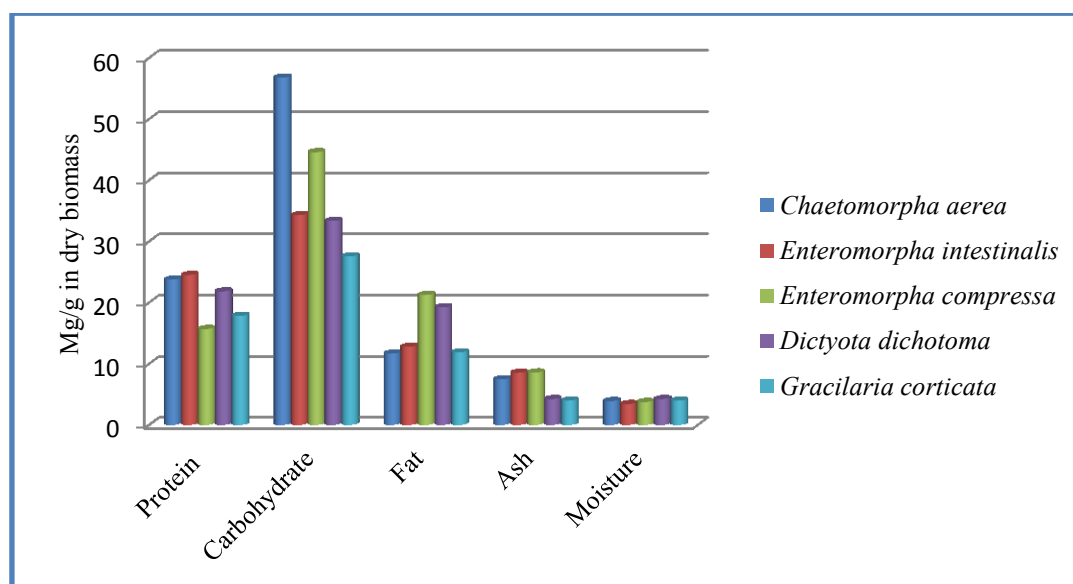


Fig. 1 Proximate composition of marine seaweeds

Proteins: *E. intestinalis* (24.52 mg/g) > *C. aerea* (23.76 mg/g) > *D. dichotoma* (21.83 mg/g) > *G. corticata* (17.84 mg/g) > *E. compressa* (15.69 mg/g).

Carbohydrates: *C. aerea* (56.78 mg/g) > *E. compressa* (44.57 mg/g) > *E. intestinalis* (34.28 mg/g) > *D. dichotoma* (33.35 mg/g) > *G. corticata* (27.57 mg/g).

Fat: *E. compressa* (21.25 mg/g) > *D. dichotoma* (19.23 mg/g) > *E. intestinalis* (12.79 mg/g) > *G. corticata* (11.87 mg/g) > *C. aerea* (11.67 mg/g).

Ash: *D. dichotoma* (9.47 mg/g) > *E. compressa* (8.58 mg/g) > *E. intestinalis* (8.52 mg/g) > *C. aerea* (7.45 mg/g) > *G. corticata* (6.95 mg/g).

Moisture: *D. dichotoma* (4.23 mg/g) > *G. corticata* (3.98 mg/g) > *C. aerea* (3.91 mg/g) > *E. compressa* (3.75 mg/g) > *E. intestinalis* (3.42 mg/g).

4. DISCUSSION

Among the five different seaweeds studied, a higher level of ash and moisture of 9.42 and 4.23 mg/g recorded in the seaweed *D. dichotoma*. Subsequently, the biochemical composition of selected marine seaweeds shows rich amount of fat and protein contents of 56.78 and 24.52 mg/g which were recorded in the seaweeds viz., *C. aerea* and *E. intestinalis* etc., The above parameters are in merge (10-29%) previously reported on *Ulva pertusa*, *Ulva* sp. *U. lactuca* and *Ulva rigida*.^[19,20,21,22] A smaller level of protein contents (7.1 - 8.5%) was recorded in *U. lactuca* in the northeast of Hong Kong and in Tunisia.^[5] However, presence of highest protein content of 21.25 mg/g recorded in the *E. intestinalis* of our study is considered as important criteria.^[23] Moreover, the variations recorded in the previous research in the same line are due to seasonal changes at the different coastal areas. Nirmal kumar *et al.*, were registered the lowest level of protein concentration than our investigated selected seaweed. This seaweeds were ranged from 0.429 to 1.8887 mg/g; highest protein was registered in *G. corticata* (1.8887 mg) followed by *Padina boergesenii* (1.8392) and *Monostroma latissimum* (1.384), *C. indica* (1.367), *S. cinctum* (1.2507). Whereas the lowest protein content was recorded from *Sargassum tenerrimum* (0.429) followed by *Dictyopteris acrostichoides* (0.4235), *T. ornate* (0.4939) and *D. dichotoma* (0.7777). The protein content of seaweed varieties varies greatly and depends on such factors as season and environmental growth conditions.^[24]

In general, the carbohydrate is the most important elements for metabolism as it supplies the energy needed for respiration and other metabolic processes in human diet. Murugaiyan *et al.*, were reported the maximum carbohydrate in *Sargassum wightii* (25.5 ± 1.37) followed by *Stoechospermum marginatum* (15.8 ± 0.8) and *Caulerpa taxifolia* (9.7 ± 0.47) and the minimum carbohydrate content was found in *Caulerpa racemosa* (8.5 ± 0.84).^[25] Siddique *et al.*, were estimated the carbohydrate level is 40.64% in sub-tropical red seaweed of *Gelidium pusillum*.^[26] The Carbohydrate concentration was high in previously recorded 33.38% in seaweed *Sargassum myriocystum*.^[27] Ricketts observed that carbohydrate level 5-57% of various golden brown algae in dry weight basis. Carbohydrate contents must appear that be very variable depending upon the state of nutrition cells. Presence of highest carbohydrate content of 56.78 mg/g in the seaweed *C. aerea* and a minimum of 27.57 mg/g in *G. corticata* of the current study closely resemble with the previous work carried out in this line.^[28]

In general, the lipid provides very much level of energy in oxidation process than other biological compounds. They comprise as a storage material for living organisms. In macro algae lipids are widely spread in world-wide.^[29] Many researchers previously observed the lipid concentration on some algal species. Murugaiyan *et al.*, were studied the lipid concentration on *Stoechospermum marginatum* (3.58%) and minimum lipid level was observed in *Caulerpa racemosa* (0.9%).^[26] Although, according to the previously reported values in the literature, most of the macro algae are covered lipid lesser value than 4% DW however, some macroalgae had higher amount of crude lipid such as *Dictyota acutiloba* (16.1% DW) and *D. sandvicenis* (20.2 % DW).^[30] The measured lipid contents in the present study are in consistency with that reported in *Caulerpa racemosa*, and *Padina gymnospora*, 19.1 %, and 11.4%, respectively However, they are upper than those determined previously for *Ulva lactuca*, (7.87-1.64 % DW) and (0.3-1.64% dry weight).^[22,23,31] Presence of highest fat content of 21.25 mg/g in the seaweed *E. compressa* and a minimum of 11.67 mg/g in *C. aerea* of the current study closely depicting with the previous work carried out in this line.

Mohammadi *et al.*, were investigated the ash content on green seaweed and brown seaweed of *Ulva rigida*, *Codium bursa*, *Cystoseira barbata* and *Ceramium diaphanum* having 25.74%, 29.08%, 14.24%, 11.35% respectively.^[32] Pattama Ratana-arporn and Anong Chirapart were reported that *Caulerpa lentillifera* and *Ulva reticulata* containing 24.21% and 17.58% of ash content. *Himanthalia elongata* (26.78%), *Laminaria ochroleuca* (29.47%) and *Porphyra* sp. (19.07%).^[33] Contrarily, highest and least ash content of 9.42 and 6.59 mg/g were noticed in the *D. dicotoma* and *G. corticata* respectively and the results obtained in the present study is not correlating with any of previous work carried out in the biochemical studies of seaweeds. Generally, the ash content of seaweeds is much higher than those of terrestrial vegetables other than spinach.^[34] The variability of ash content among the studied algae was related to the capacity of each species to accumulate minerals according to environmental conditions, seasons and geographical location.^[2,35]

The moisture content noticed in the present study varied from 3.42 to 4.23 mg/g as resembling with the studies conducted previously in some similar line (other algal species). The moisture content of the fresh seaweed samples ranged between 75.95 and 96.03%. Faisal Ahmad *et al.*, were investigated the moisture content among the 9 different red seaweeds.^[36] The *Laurencia* sp. was found to have the highest moisture content (96.03%) followed by *Laurencia* sp. (93.59%), *Gracilariaverrucosa* (85.45%), *Eucheumadenticulatum* (84.54%), *Kappaphycus alvarezii* (aring-aring) (79.78%), *Kappaphycus striatum* var. sacol (79.70%), *K. striatum* var. sacol (76.69%) and *K. striatum* var. sacol (75.95%). The moisture concentration obtained in *C. racemosa* was close to the values previously reported and these consequences were might be due to the influence of many abiotic factors such as atmosphere, geography and season.^[37,38]

CONCLUSION

The study revealed seaweed can also be used as an organic ingredient in some of the food products in the food industry. Seaweeds could be used as a major feed ingredient in the (alternative feed) aquaculture as well as poultry industry. It is suggested that the cultivation of seaweeds at larger scale in the barren long coastal line of our country augment economy and employment opportunities through setting up of small scale seaweed based units to the coastal area people. By establishing such small scale seaweed production units would immensely helpful in producing the bio-fuel to boost up Indian economy.

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