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RESEARCH ARTICLE

Proximate composition of some selected seaweeds from Palk bay and Gulf of Mannar, Tamilnadu, India

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ABSTRACT

The Gulf of Mannar and Palk Bay of South East Coast are rich in seaweed resources. Seaweeds are one of the important marine living renewable resources and are used for human consumption, animal feed and as manure in several countries. So, some of the representatives from Chlorophyta, Phaeophyta and Rhodophyta were investigated in the present study for biochemical composition. The macroalgae showed varied quantities of biochemical constituent are namely Amino acids, Proteins, Lipids, Carbohydrates and Phenol. High concentration of Glutamic acid and Aspartic acid was recorded in red algae *Acanthopora spicefera* 17.4 % and 15.7% respectively and lowest value of Methionine was recorded in all species except *Chnoospora minima* (3.1%). Highest protein was recorded in *Acanthopora spicefera* 18.9% and low value was recorded in brown algae *Padina gymnospora* (10.5%). Lipid content was high in green algae *Caulerpa recemosa* (19.1%) and low value in *Ulva faciata* (0.5%). Carbohydrate content was high in green algae *Caulerpa racemosa* 83.2% and low in *Chnoospora minima* 28.5%. In phenol the highest value in *Acanthopora spicefera* and lowest in *Caulerpa racemosa* 14.3%.

Keywords: Proximate composition, Seaweeds, Gulf of Mannar & Palk Bay, India.

1. INTRODUCTION

Marine macroalgae, commonly referred to seaweeds, are categorized by their pigmentation, morphology, anatomy, and nutritional composition as red (Rhodophyta), brown (Phaeophyta) or green seaweeds (Chlorophyta) **[1].** About 250 macro algal species have been commercially utilized worldwide and about 150 species are favorably consumed as human food **[2].** Seaweeds are valuable sources of protein, fiber, vitamins, polyunsaturated fatty acids, macro and trace elements, as well as important bioactive compounds **[3].** Thus, they have been recognized as being beneficial for human and animal health **[4].** However the nutrient compositions of seaweeds are different depending on species, habitats, maturity and environmental conditions **[5].** Generally, green and red seaweeds contain higher protein contents (10–30% DW, dry weight) than brown seaweeds (5–15% DW). Proteins are composed of various amino acids and their nutritional quality can be evaluated against the recommended amino acid pattern **[6-8].** The lipid content of marine seaweeds accounts for 1–6% DW and provides a low amount of energy.

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 **[9].** Thus, seaweeds are important sources of elements vital for the metabolic reactions in the human and animal health, such as enzymatic regulation of lipid, carbohydrate and protein metabolism **[10 & 11].** In the Southern coast of Thailand, especially in the Pattani Bay, twelve seaweed species have been found **[12].** Red seaweed (*Gracilaria* spp.) and green seaweed (*Ulva* spp.) have been abundant in the coastal area. However, the utilization of seaweeds is restricted to

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communities living in the coastal area. *Gracilaria tenuistipitata* and *G. fisheri* have been served fresh or used in dried products for both human beings and animals, whereas *Ulva* species are still under-utilized because in Thailand the knowledge about their nutritional composition is still limited. Therefore the present study aimed to determine the chemical composition, amino acids, and element contents of *Ulva pertusa* and *U. intestinalis* collected from the Pattani Bay in rainy and summer seasons in order to gain extensive information about their nutritional value. Furthermore, this research also investigated some physicochemical properties in order to evaluate their physiological effects in functional and health food. Seaweeds are generally macroscopic algae and are used in many ways. They are harvested for food, fodder, fertilizer, medicine and chiefly for economically important phycocolloids **[13 &14].** The nutritional property of seaweeds from some regions of the world and Indian coast has been well documented **[15-17]** Climate and sea conditions may cause variations in nutrient composition of seaweeds **[18 & 19].** The aim of the present investigation was to study the proximate constituents of five species of seaweeds with potential economic value for use in human and animal nutrition.

2. MATERIALS AND METHODS

2.1. Collection of seaweeds

The seaweeds *Caulerpa racemosa, Padina gymnospora* and *Acanthopora spicifera* were collected from Mandapam coastal regions, Gulf of Mannar and *Ulva faciata, Choospora minima* were collected from S.P Pattinam and Jagatha Pattinam respectively, Palk Bay in Southeast coast of India. Seaweed sample was picked with hand and immediately washed with seawater to remove the foreign particles, sand particles and epiphytes. Then it was kept in an ice box containing slush ice and immediately transported to the laboratory and washed thoroughly using tap water to remove the salt on the surface of the sample. Then the seaweeds were spread on blotting paper to remove excess water. Samples were dried in oven at 37° C, till constant weight and obtained and ground in an electric mixer **[20]**. The powdered samples were than stored in refrigerator.

2.2. Preliminary Phytochemical screening

The dried, powdered samples were subjected to qualitative tests for the identification of phytochemical constituents according to standard procedures **[21-23].**

2.3. Estimation of amino acids

Amino acid analysis was carried out by ion-exchange chromatography under the experimental conditions recommended for protein hydrolysates. Samples containing 5.0 mg of protein were acid hydrolyzed with 1.0 ml of 6 N HCl in vacuum-sealed hydrolysis vials at 110°C for 22 h. Norleucine was added to the HCl as an internal standard. Tryptophan, cystine and cysteine are completely lost by acid hydrolysis, and methionine can be destroyed to varying degrees by this procedure. Hydrolysates were suitable for analysis of all other amino acids. The tubes were cooled after hydrolysis,

Opened, and placed in desiccators containing NaOH pellets under vacuum until dry (5–6 days). The residue was then dissolved in a suitable volume of a sample dilution Na-S buffer, pH 2.2 (Beckman Instr.), filtered through a Millipore membrane (0.22 µm pore size) and analyzed for amino acids by ion-exchange chromatography in a Beckman (model 7300) instrument, equipped with an automatic integrator. Nitrogen in amino acids was determined by multiplying the concentration of individual amino acids by corresponding factors calculated from the percentage N of each amino acid **[24].** The ammonia content was included in the calculation of protein nitrogen retrieval, as it comes from the degradation of some amino acids during acid hydrolysis **[25 &26**]. The ammonia nitrogen content was calculated by the multiplication of ammonia by 0.824 (NH_3 = 82.4% of N).

2.4. Estimation of Lipid

The lipid was estimated by using chloroform methanol mixture as described by **[27].** 10 mg of dried powder sample taken in a test tube, 5 ml of chloroform- methanol (2:1) mixture was added. The mixture was incubated at room temperature for 24hrs after closing the mouth of the test tube with aluminium foil. After the incubation, the mixture was filtered using a filter paper. The filtrate was collected in a 10 ml pre weighed beaker, which was kept on a hot plate. The chloroform methanol mixture was evaporated leaving a residue at the bottom of the beaker. The beaker with the residue and the weight of the empty beaker was calculated to know the weight of the lipid present in the sample.

2.5. Estimation of proteins

The protein was estimated by Biurette method **[28].** To 5 mg of dried powdered sample, 1ml of distilled water followed by 4ml of biurette reagent were added and incubated for 30 minutes in the room temperature. Then the mixture was centrifuged for 10 minutes at 4000rpm. The supernatant solution was collected and the optical density was measured in a Spectrophotometer at 540 nm.

2.6. **Estimation of Carbohydrates:** The total carbohydrate was estimated by following the Phenol-sulphuric acid method by **[29].**

2.7. Estimation of Phenols:

Total phenolic assay was determined by using Folin-Ciocalteu assay **[30].**

Nutritional constitution	*Caulerpa racemosa*	*Ulva faciata*	*Chnoospora minima*	*Padina gymnospora*	*Acanthopora spicefera*
Protein	18.3	14.7	11.3	10.5	18.9
Lipids	19.1	0.5	0.9	11.4	2.1
Carbohydrates	83.2	70.1	28.5	38.3	65.6
Phenol	14.3	18.1	19.7	32.3	34.7

Table-1: Protein, Lipid, Carbohydrates and phenol composition of seaweeds. (Quantity % dry weight)

Amino acids	*Caulerpa racemosa*	*Ulva faciata*	*Chnoospora minima*	*Padina gymnospora*	*Acanthopora spicifera*
Aspartic acid	8.3±0.2	10.7±0.3	10.9±0.2	12.7±1.3	15.7±0.6
Alanine	6.9±0.5	9.2±1.3	8.5±0.5	6.7±0.3	5.5±0.3
Arginine	5.9±0.7	6.3±0.7	4.0±0.1	4.7±0.2	5.7±0.3
Glutamic acid	15.3±0.6	11.9±0.5	13.2±0.4	13.9±1.2	17.4±0.6
Glycine	7.2±0.9	6.2±0.2	5.6±0.3	7.0±0.7	4.3±0.2
Histidine	3.3±1.0	3.3±0.5	2.6±0.2	2.7±0.5	2.2±0.4
Isoleucine	3.8±0.2	3.2±0.2	4.6±0.3	5.3±0.6	3.6±0.2
Leucine	7.8±0.4	8.6±1.0	7.3±0.3	7.9±0.4	7.8±0.6
Lysine	7.1±0.9	5.9±0.7	6.4±0.5	6.2±0.4	8.6±0.8
Methionine	1.8±0.9	1.3±0.4	3.1±0.3	1.5±0.5	1.2±0.3
Phenylalanine	5.2±0.2	5.5±0.5	4.7±0.2	5.3±0.3	5.3±0.4
Proline	5.8±1.1	3.9±0.1	4.3±0.3	4.0±0.5	5.7±0.7
Serine	7.2±1.1	6.7±0.5	6.7±0.7	6.7±0.4	4.3±0.1
Threonine	6.7±1.5	4.9±0.4	5.4±0.3	5.7±0.3	5.9±0.1
Tyrosine	2.2±0.4	4.7±0.5	2.5±0.4	2.9±0.6	3.7±0.3
Valine	6.9±0.8	6.3±0.6	5.3±0.5	6.5±0.6	6.1±0.5

Table-2: Amino acid composition of seaweeds:

3. RESULTS AND DISCUSSION

Totally five seaweeds were collected from east coast of India, during the month of September 2011 and estimated their nutritive properties viz. Amino acids, proteins, lipids, carbohydrates and phenol **[Table 1 & 2].**

Measurable differences in nutritional composition were apparent among the five species studied. Amino acids, protein, lipid, carbohydrates and phenol are the most important biochemical components in marine algae and their results are given in the **[Table: 1&2]** Proteins have crucial functions in all the biological processes. Their activities can be described by enzymatic catalysis, transport and storage, mechanical sustentation control. In the present study, Data of total amino acids are presented in **Table-2.** In all 16 amino acids have been detected in the protein hydrolysate of seaweeds. These amino acids may occur as combined or in a free state **[31-33].** The distribution pattern of these amino acids reveals some pronounced differences among the species of of Rhodophyceae, Phaeophyceae and Chlorophyceae. Glutamic acid and aspartic was the most abundant amino acid in all species. The percentage of methionine was found to be low in all species. When focusing on individual species, wider differences were found. For example, the highest concentration of glutamic acid and aspartic acid was found in the red alga *Acanthopora spicifera* 17.4% and15.7% respectively, while the green alga *Ulva faciata* 11.9% and *Caulerpa racemosa* 8.3% had the lowest concentrations. Metionine was the lowest value of amino acids in all species except in *Chnoospora minima* (3.1%) which the lowest value was tyrosine 2.5 %. protein content showed remarkable variation, with highest value of 18.9% in *Acanthopora spicefera* (Rhodophyceae) followed by 18.3% in *Caulerpa racemosa* (Chlorophyceae) and 14.7% in *Ulva faciata* (Chlorophyceae). The protein content of Brown algae (*Chnoospora minima* and *Padina gymnospora*) was low compared to green and red algae. This is in agreement with the findings of higher protein content in species of Rhodophyta, moderate in Chlorophyta and the lowest in Phaeophyta **[34]** Also observed maximum protein content in some of the Rhodophyta and Chlorophyta belonging to the genus of *Ulva.*

Lipids are rich in –C=O-bonds, providing much more energy in oxidation processes than other biological compounds. They constitute a convenient storage material for living organisms. In macro algae, the lipids are widely distributed, especially in several resistance stages **[35].** In the present study 19.1 %, 11.4 % and 2.1 % of lipid was recorded in *Caulerpa racemosa, Padina gymnospora* and *Acanthopora spicefera* respectively.

Carbohydrate is one of the important components for metabolism and it supplies the energy needed for respiration and other most important processes. The concentration of carbohydrate was higher in most the species of Chlorophyata followed by Rhodophyta and Phaeophyta. The carbohydrate content was 83.2 % in Caulerpa racemosa followed by *Ulva lactuca* (70.1 %) and *Acanthopora spicifera* (65.6%). **[36]** Studied two species of green algae *Enteromorpha intenstinalis* and reported the highest average total carbohydrate content from *Ulva rigida* (63.04±29.15g/kg dry weight). **[35].**

Phenols are the aromatic metabolites which trigger various biochemical processes of the organisms. They consist of hydroxide groups which are widespread in photosynthetic organisms. The highest phenol content was observed in *Acanthopora spicefera* (34.7%) followed by *Padina gymnospora* (32.3%) and *Chnoospora minima* (19.7%). Similar results were also obtained by **[37].** Seaweeds can be considered as promising plants of the future forming one of the important marine living resources of high nutritional value. Being plants with unique structure and biochemical composition, seaweeds could be exploited for their various properties in the form of food, energy, medicine and cosmetics and as biotechnological tools.

4. CONCLUSION

From the present study, it is evident that marine macro algae like *Caulerpa racemosa, Ulva faciata, Chnoospora minima, Padina gymnospora* and *Acanthopora spicefera* are rich in nutritive properties. The values obtained for protein and carbohydrate contents in the present study are similar to the earlier findings by **[15], [38].** The value of protein content is high in Acanthopora spicefera and Caulerpa racemosa and the carbohydrate concentration is high in Caulerpa racemosa, Ulva faciata and Acanthopora spicefera. The high lipid value was observed in the green algae Caulerpa racemosa and brown alga Padina gymnospora. The present findings will be useful to collect the selected seaweeds from South east coast of India and use them in the food and pharmaceutical industries for various purposes.

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Conflict of Interest: None Declared

