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Biochemical composition of Marine Red alga *Champia parvula* (C. Agardh)

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Abstract : Seaweeds are regarded to be a significant source of bioactive molecules. The macroalgae showed diverse amounts of biochemical constituents such as, total carbohydrate, total protein and total lipids. In the present study, biochemical composition of edible seaweeds was examined. The result was indicated that *Champia purvula* consists of an elevated amount of protein followed by carbohydrates and lower lipid molecule. The biochemical composition of alga indicates their suitability for use in food and pharmaceutical industry.
Keywords : *Champia parvula,* biochemical composition, proteins, amino acids.

1. Introduction

Marine algae have evolved unique and highly specialized biochemical pathways to adapt to their seawater medium and survival pressures which gave rise to an unparallel variety of biochemical composition in marine algae. For human benefit these nutritional biochemical constituents have been used for centuries[1]. Many algae species have been used in the industry, principally for the extraction of phycocolloids (algin, carrageenan, and agar) and as a source of pharmaceutical substances. They are being used as herbal medicine, fertilizer, fungicides, and herbicides and for direct use in human nutrition too[2]. Certain edible seaweeds contain significant quantities of protein, lipids, minerals, vitamins[3] and 20-50% minerals in their dry weight[4]. Biochemical compositions of marine algae in Indian coast have been studied considerably[5-7]. The aim of the present study was to determine the biochemical composition of marine red alga *C. Parvula.*

2. Experimental

The shade dried, powdered materials of the experimental alga were used for biochemical examinations.

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2.1. Estimation of Carbohydrate

The carbohydrate content was estimated using the Dubois method[8]. 20 mg of dried seaweed powder was taken and to this 1 ml of 4% phenol solution and 5 ml of concentrated sulphuric acid were added. After that, they kept in a dark room for 30 minutes. The color intensity developed was read on a spectrophotometer at 490 nm. Sugar content was calculated by referring to a standard D- Glucose and the results have been expressed as mg/g sugar.

2.2. Estimation of Protein

The protein content was estimated by Biurette method[9].To 5 mg of dried powdered sample, 1ml of distilled water, followed by 4 ml of biuret reagent were added and incubated for 30 min at room temperature. Then the mixture was centrifuged for 10 min at 4000 rpm. The supernatant was collected and the optical density was measured in a Spectrophotometer at 540 nm. The protein content was calculated using BSA as standard and expressed as mg/g protein.

2.3 Estimation of total lipids

The method sketched out by Bligh and Dyer [10] was used with a few changes to decide the total lipids in the samples. Known amounts of clean, dry and finely powdered thalli were extracted from a known volume of chloroform. 10 mL of methanol was added to 20 mL of chloroform (1:2 v/v) in a hot air oven at 45°C to de-fat the material. The mix was then centrifuged at 8000 rpm for 5 minutes and the supernatant was spared. To the supernatant, the added of 1/3 volume of distilled water and vortexed. To this, a little measure of anhydrous sodium sulphate was added and was again vortexed for elimination of the moisture. The resultant solution was set aside in a separate funnel to enable the phase separation. The lower chloroform stage containing lipids was recovered in pre-weighed crucibles and was kept in a hot air oven at 40°C to get rid of the solvent. The dry deposit in crucibles was treated with pure acetone to de-fat and was dried again. The last marc obtained in this manner was weighed to get the lipid substance of the sample.

2.4 Estimation of total amino acids

The chromatographic conditions employed were in accordance with the Agilent method [11] except for mobile phase A, which consisted of 5.678 g of Na_2HPO_4 per 1 dm^3 water, adjusted to the pH 7.8 with a 6 mol dm^{-3} HCl solution (buffer strength 40 mmol dm^{-3}). The mobile phase B was acetonitrile–methanol–water (45:45:10, vol. %). Briefly, the hydrolyzed samples or the solutions the standard amino acid mixture were automatically derivatised with OPA and FMOC by programming the auto sampler(1. draw 2.5 µl from vial 1 (borate buffer), 2. draw 0.5 µl from sample (position X), 3. Mix 3 µl in air, max. speed, 2×, 4. wait 0.5 min, 5. draw 0 µl from vial 2 (water, uncapped vial), 6. draw 0.5 µl from vial 3 (OPA), 7. mix 3.5 µl in air, max speed, 6×, 8. draw 0 µl from vial 2 (water, uncapped vial), 9. draw 0.5 µl from vial 4 (FMOC), 10. mix 4 µl in air, max speed, 6×, 11. draw 32 µl from vial 5 (water), 12. mix 18 µl in air, max speed, 2× and 13. Inject). After derivatisation, 0.5 µl of each sample was injected into a Zorbax Eclipse-AAA column at 40°C, with detection at λ1 = 338 nm and λ2 = 262 nm. The separation was performed at a flow rate of 2 cm^3 min^{-1} employing a solvent gradient (vol. %,) as follows: 0 min, 0 % B, 1.9 min, 0 % B, 18.1 min, 57 % B, 18.6 min, 100 % B, 22.3 min, 100% B, 23.2 min, 0% B and 26 min, 0 % B.

3.0 Results

3.1 Total proteins, carbohydrates and lipids

Total proteins, carbohydrates and lipids of *C. parvula* were investigated and are summarized in Table.1. Based on the analysis, the total protein content was observed to be higher (319 ± 0.63 mg/g dry wt) than the carbohydrates (301 ± 0.33 mg/g dry wt) and lipids (12 ± 0.01 mg/g dry wt) (Table 1). Typically, the red seaweeds contain a higher protein content than other seaweeds. The lipids were present in lesser quantities as compared to carbohydrates and proteins. Hence, *C. parvula* could be a dietary option, because of its nourishing quality.

Table 1 Quantitative analysis of total protein, carbohydrate and lipid (mg/g dry wt) of *C. Parvula*

S.No	Biochemical composition	Mean ± S.E
1	Total Protein	**319± 0.63**
2	Total Carbohydrate	**301±0.33**
3	Total Lipid	**12±0.01**

3.2 Total Amino acids

The amino acid content of *C. parvula* is summarized in Table 2. As many as 20 amino acids were identified (Table 2). The amino acid assessment of *C. parvula* confirmed a high content of essential amino acids (57.50%) (Table 2); while, the non-essential amino acid accounted for 42.50%. The level of various essential amino acids ranged from 1.69 to 13.99 and that of non-essential amino acids ranged from 1.69 to 7.61. *C. parvula* contains a more elevated amounts of essential amino acids such as, methionine (13.99%), cysteine (7.02%), leucine (6.50%), valine (5.97%) and histidine (5.62%) and non-essential amino acids such as, proline (7.61%), serine (7.11%), aspartic acid (5.72%), glycine (5.61%) and glutamic acid (4.52%) were shown at a lower amount when compared with the other amino acids (Table 2).

Amino acids	**Composition (%)**
Essential Amino Acids	
Threonine	2.80
Cysteine	7.052
Tyrosine	1.69
Histidine	5.62
Valine	5.97
Methionine	13.99
Isoleucine	1.69
Phenyl alanine	2.94
Leucine	6.50
Lysine	4.89
Tryptophan	4.39
Total essential amino acids	**57.50**
Non-essential amino acids	
Aspartic acid	5.72
Glutamic acid	4.52
Arginine	3.01
Alanine	4.35
Asparagine	2.88
Serine	7.11
Glutamine	1.69
Glycine	5.61
Proline	7.61
Total non-essential amino acids	**42.50**
Total amino acids	100

4.0 Discussion

4.1 Proteins

In the present investigation, the total protein content was found to be higher in *C. parvula*. Similarly, Anitha *et al.*,[12] recorded the high protein content in *Gracilaria corticata*. Moreover, Selvi *et al.*,[13]

detailed more protein content in the red alga *Hypnea valentiae,* while, Eswaran *et al.,* [14] determined the total protein content in the *Gracilaria* species as variations in the vicinity of 3.9 and 1.07 g kg^{-1} d.wt. (0.39%–0.1%). This runs parallel to our investigation, Wong and Cheung (2000) examined *in vitro* the protein digestibility of red seaweeds (*Hypnea charoides* and *H. japonica*) and green seaweed (*Ulva lactuca*). These authors revealed that the protein digestibility of red seaweed (around 88%) was marginally higher than that of green seaweed. The protein content of seaweeds varied not only between species, but also between seasons[6-7.]

4.2 Carbohydrates

Carbohydrate is the most vital part of metabolism, it supplies the energy required for respiration and other metabolic processes. Carbohydrates are macromolecules used as a perfect source of energy. Anantharaman *et al.,* [15] found that the carbohydrate content of five species of seaweeds ranged from 10.63% to 28.58%, and that the high carbohydrate content was observed in the green seaweed *Enteromorpha intestinalis* and the brown seaweed *Dictyota dichotoma* recorded the lowest value. In the current examination, the carbohydrate content of *C. parvula* was 301 ± 0.33 mg/g dry wt. Similarly, Ravi *et al.,* [16] revealed that the red alga *G. crassa* had a higher carbohydrate content (42.0 ± 1.2 %). The results of the present examination have recorded a higher carbohydrate content.

The results of the present investigation concur, well with the previous studies by Bhuvaneswari and Murugesan [5]. Hossain *et al.,* [17] reported that the carbohydrate contents were respectively 19.93 and 20.81% in sample one and two from *Sargassum horneri*. Giuseppe Impellizzeri *et al.,* (1975) [18] detailed the event of low molecular weight carbohydrates in macroscopic marine algae. The significant variations in carbohydrate content of the seaweed are additionally seen in the present examination ($p<0.05$). The variation in the carbohydrate content of the experimental alga could be credited to species variety, hydrographic and ecological conditions and reproductive patterns of the alga.

4.3 Lipids

Lipids were available in lower concentration than carbohydrates and proteins, since seaweeds usually accumulate fatty acids and lipids in smaller amounts[19]. In the present examination, the lipid content of *C. parvula* was observed to be low (12 ± 0.01 mg/g dry wt). The variation in lipid contents could be due to the of geographical origin, seasonal changes, temperature and light intensity [20]. The consequences of the present examination are in concurrence with that of Wong and Cheung[21]. They found that the crude lipid contents of red seaweeds (*Hypnea charoides* and *H. japonica*) and green seaweed *Ulva lactuca* are very low (1.42 to 1.64% dry weight). Comparable outcomes were additionally detailed by Bhuvaneswari and Murugesan[5] Mohanapriya and Murugesan[7] in the case of *Spyridia fusiformis, Chondrococcus hornemannii, Lobophora variegata* and *Tolypiocladia glomerulata.*

4.4 Amino acids

The protein content in algae contains essential amino acids (EAA) which create the nutritional value of seaweeds, although some seasonal variations in their concentrations are known to happen [22].The amino acid composition, of *C. parvula* comprises of essential amino acids (EAA) constituting 57.50% and non-essential amino acids (NEAA) were found to form 42.50%. The essential amino acids, such as, methionine, cysteine, leucine, valine and histidine were observed to be higher in *C. parvula*. Whereas, the non-essential amino acids proline, serine, glutamic acid and alanine were observed to be in higher amounts. Different investigations have been recorded in the case of *Porphyra tenera, Grateloupia turuturu, Ulva pertusa* and *Codium fragile, U. lactuca* and *Gelidium amansii* [23]. Wong and Cheung [21] observed that a large portion of the essential amino acids (EAA) from selected subtropical seaweeds (*Hypnea charoides, H. japonica* and *U. lactuca*), accounted for 42.1-48.4% of the total amino acids. Further, the levels of all the essential amino acids can be contrasted with those of the FAO/WHO [24] necessity design. These results are similar to the findings revealed by Ravi *et al.,* [16] and Sathish Kumar and Murugesan[25]. Cysteine can fill in as a wellspring of carbon, nitrogen and sulphur for the synthesis of coenzyme and iron proteins, and they assume an imperative part in the algal nitrogen metabolism[22].

There are various examinations which contended that the red seaweed contains higher rates of both aspartic acid and glutamic acid [21]. Be that as it may, the glutamic acid and aspartic acid levels appear to be brought down in some red seaweed species such as *Palmaria palmata* and *Porphyra tenera* which indicated 14 and 19% of the total amino acids, respectively[27]. As per the report of Mohanapriya and Murugesan[7], a higher level of aspartic acid and glutamic acid give effect to a change of the special flavour and taste of the seaweeds. The measures of amino acid appear to be shifting in various algal species. As indicated by Wong and Cheung[21], the sulphur-containing amino acids of *Hypnea* species were around 5% and those of *Ulva lactuca* was 3% of the total amino acids. In general, the vast majority of the seaweeds contain a moderately high amount of free amino acids [28]. These amino acids give distinctive kinds of flavors in few types of seaweed.

The evaluation of amino acid profile of *C. parvula* is of awesome incentive from the nutritional, chemical and biochemical viewpoints. It can be concluded that, *C. parvula*, has a higher amino acid content and might be used as a dietary supplement in both the animal and human feed.

5. Conclusion

Thus, the findings of the current investigation suggest that the marine red alga *C. parvula* consists of rich in nutrients. Considerable levels of carbohydrate, proteins, amino acids, have been reported, although lipid has been present in restricted quantities and can therefore be a potential health food in human diets and can be used in the food industry as a source of elevated dietary quality ingredients in the food industry.

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7. References

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