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BIOCHEMICAL COMPOSITION OF *TOLYPIOCLADIA GLOMERULATA* (C. AGARDH) F. SCHMITZ

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ABSTRACT

The biochemical composition of *Tolypiocladia glomerulata*, showed varied quantities of biochemical constituents such as total carbohydrates, total proteins, total lipids, vitamins and minerals. Among the biochemical content total protein is present in highest amount 206.45 ± 0.00 mg/g, total carbohydrates is 153.25 ± 0.10 mg/g and total lipid is 9.18 ± 00 mg/g. Among the vitamins, vitamin B_2 (671.50 ± 0.01µg/g) and vitamin C (123.99 ± 0.00 µg/g) was present in higher quantities. Macro elements such as sodium (1564 ± 2.08 µg/g) and calcium (1255 ± 1.00 µg/g) and micro element magnesium (1223 ± 1.15 µg/g) were present in higher amounts.

KEYWORDS: Red algae, *Tolypiocladia glomerulata*, biochemical, vitamins and minerals.

INTRODUCTION

Seaweeds are one of the commercially important living marine resources that belong to the primitive groups of non flowering plants.[1] This marine alga grows abundantly along the Tamilnadu coast. About 700 species of marine algae have been reported from different parts of the Indian coast. *Tolypiocladia glomerulata* is the genus of red algae with a high economic value, found in the sub tidal area in many parts of Tamilnadu. For the last few decades, scientist throughout the world has been searching for suitable and nutritional, healthy and readily available supplement to conventional food. Seaweeds are main source of renewable energy, although they are reported to be of nutritional value regarding vitamin, protein and mineral contents.[2,3] It is worthy to mention here that the marine algae are considered to be a potentially good source of nutrients. Therefore, interest in the use of edible seaweeds in the development of low-cost, highly nutritive diets for human and animal nutrition.[4] Hence the present study was conducted to evaluate the biochemical composition of the red alga *Tolypiocladia glomerulata.*

MATERIALS AND METHODS

Collection and processing of Seaweeds

The seaweed red alga *Tolypiocladia glomerulata* was collected from Mandapam, Southeast Coast of India. Collected seaweeds were washed thoroughly with seawater to remove all the unwanted impurities, adhering sand particles and epiphytes. Finally, the sample was washed thoroughly using sterilized seawater. The water was drained off and the seaweed was spread on blotting paper to remove excess water. The washed seaweeds were a shade dried and powdered, then used further analysis.

Carbohydrate Estimation

The total carbohydrate was estimated by following the Phenol-sulphuric acid method.[5]

Protein Estimation

The total protein was estimated using the Biuret method.[6]

Lipid Estimation

The estimation of lipid was done by the chloroform-methanol mixture method.[7]

Estimation of vitamins

An agilent 1100 chromatographic system[8] was used for the analysis and quantification of vitamins in the algal samples.

Mineral analysis

The mineral composition of experimental alga was determined by atomic absorption spectrophotometer (Perkin–Elmer model 303). Samples were subjected to acid digestion and analyzed according to the procedure described by Farias *et al*.[9]

RESULTS AND DISCUSSION

The proximate composition of the red alga *Tolypiocladia glomerulata* such as biochemicals, vitamins and minerals were expressed on a dry weight basis in Tables 1, 2 and 3 respectively. Carbohydrates, proteins and lipids are the most important biochemical components present in the algal biomass. Carbohydrate is one of the important components for metabolism and it supplies the energy needed for respiration and other most important processes.[10] In the present study, the carbohydrate content of *T. glomerulata* was found to be 153.25 ± 0.10 mg/g. In the present study carbohydrate content of *T.glomerulata* was lesser than those of several species of the red algae *Hypnea valentiae*,[11,12,13] *Ceramium rubrum*,[14] *Acanthophora spicifera*, *Gracilaria corticata*, *G. foliifera* and *Gelidium pusillum.*[15]

The present study falling in the same line of Manivannan *et al.*,[16] of the red algae *Gracilaria folifera, Hypnea valentiae* and *Acanthophora* spicifera. In the present investigation the carbohydrate content was higher than the earlier studies in the red algal species such as *Acanthophora taxiformis*,[17] *Acanthophora spicifera*,[18] *Gracilaria fisheri*,[19] *Chondrococcus hornemannii* and *Spyridia fusiformis*.[20] The result of the present study was contrast to earlier studies of Kumar,[11] Renaud *et al.*,[12] Wong and Cheung.[13]

Proteins have crucial functions in all the biological processes. Their activities can be described by enzymatic catalysis, transport and storage, mechanical sustentation, growth and cellular differentiation control.[21] In the present study, the protein content was estimated as 206.45 ± 0.00 mg/g, which is similar to the earlier works in marine red algae *Gracillaria corticata* and *Hypnea musiformis*,[22] *Ceramium rubrum* var. barbatum.[23] The protein content of *T. glomerulata* is higher than the earlier report of the red algae, *Spyridia filamentosa*, *Acanthophora nayadiformis* and *Halymenia floresii*,[24] *Pterocladia capillacea*,[25] *Polysiphonia dichotoma.*[26]

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. The macroalgal biomass can store large amounts of oil, which can be exploited for the production of biodiesel.[27] The present investigation exhibit lipid content of *T. glomerulata* 9.18 ± 0.00 mg/g. It was in the same order as reported in the red alga *Laurencia sp.*[28] In general, seaweeds exhibit low lipid content (29, 30). In fact, in comparison to other chemical constituents, lipid contents were the smallest component observed in the species studied. The lipid content of the present study was higher than the earlier report of Sukalyan Chakraborty and Santra[31] in the red algae *Polysiphonia mollis* and *Gelidiella acerosa*; *Ceramium rubrum*[14] The previous reports has established that in seaweeds in general the lipid content is less than 4%.[32]

Table 1: Biochemical content of *T. glomerulata.*

S. No	Biochemicals	mg/g dry wt
1	Total carbohydrates	153.25 ± 0.10^{b}
2	Total proteins	206.45 ± 0.00^{a}
3	Total lipids	9.18 ± 0.00^{c}
P-Value		0.000
F-Value		3.117777

Table 2: Vitamin content of *T. glomerulata.*

S. No	Name of Vitamins	µg/g dry wt
1	Vitamin A	0.311 ± 0.000^{a}
2	Vitamin B1	56.61 ± 0.010^{f}
3	Vitamin B2	671.50 ± 0.015^{h}
4	Vitamin B6	5.65 ± 0.015^{b}
5	Vitamin C	123.99 ± 0.005^{g}
6	Niacin	25.51 ± 0.017^{d}
7	Folic acid	19.80 ± 0.005^{c}
8	Pantothenic acid	39.11 ± 0.010^{e}
P-Value		0.000
F-Value		1.198999

Table 3: Mineral content of *T. glomerulata.*

S. No	Name of Minerals	µg/g dry wt
1	Potassium	166.67 ± 0.577^{d}
2	Calcium	1255 ± 1.000^{h}
3	Phosphorous	222 ± 1.000^{e}
4	Iodine	44.67 ± 0.577^{b}
5	Sodium	1564 ± 2.082^{i}
6	Magnesium	1223 ± 1.155^{g}
7	Zinc	59.80 ± 0.006^{c}
8	Iron	503.33 ± 1.155^{f}
9	Copper	0.01 ± 0.000^{a}
P- Value		0.000
F- Value		1.059666

Seaweeds have been used as a popular food additive in almost all parts of the world. Vitamin B_2 (671.50 ± 0.015 µg/g) and vitamin C (123.99 ± 0.005 µg/g) are rich in the red alga *T. glomerulata* (Table.2). Rajasulochana *et al.*, (33) reported same quantity of vitamin C in the red alga *Kappaphycus alvarezii*. All other vitamin contents of *T.glomerulata* is higher than in the red alga *Kappaphycus alvarezii*.[33] Generally, seaweeds are rich in vitamins A_1, B_1, B_2, B_6, B_{12}, C, E and K which can keep the body healthy and strong enough to fight against many types of diseases. Seaweeds are an important unconventional source of vitamins (liposoluble and hydrosoluble),[34] Algae are a source of vitamins from group B, which is particularly recommended in the treatment of the effects of ageing, chronic fatigue syndrome (CFS) and anemia.[35] Vitamin C strengthens the immune defense system, activates the intestinal absorption of iron, controls the formation of conjunctive tissue and the protidic matrix of bony tissue, and also acts in trapping free radicals and regenerates Vitamin E. The algae provides a worthwhile source of vitamin C.[36]

The mineral content of *T. glomerulata* are presented in Table 3. Among the mineral macro elements, sodium (1564 ± 2.082 µg/g), calcium (1255 ± 1.000 µg/g) and micro elements magnesium (1223 ± 1.155 µg/g) are rich. In the present study sodium and potassium content was high, which can help in balancing Na/K ratio diets and reduce hypertension risk as described in the studies of the red and brown seaweeds by Rupérez.[37] The mineral content of *T. glomerulata* is higher than the report of Manivannan *et al*.,[16] in the red alga *Gracilaria folifera.* The sodium, calcium, magnesium and iron contents were lesser in the experimental alga *T. glomerulata* than the red alga, Hypnea pannosa.[38] The mineral content varies according to seaweed species, oceanic residence time, geographical place of harvest, wave exposure, seasonal and annual environment, physiological factors, type of processing and method of mineralization.[39]

CONCLUSION

From the above results, it was observed that *T.glomerulata* are rich in protein content, vitamin C, vitamin B_2 and macro mineral (i.e., Na, Ca, K and Mg) contents, which concluded that the red seaweed *T.glomerulata* can be used as food supplements to improve the nutritional value for the human diet and animal feed.

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