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BIOCHEMICAL STUDIES ON MARINE ALGAL SPECIES OF PADINA (PHAEOPHYCEAE) FROM MANDAPAM COASTLINE, TAMIL NADU, INDIA

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ABSTRACT

The present study was to quantify the biochemical of a few seaweeds. The brown algal seaweeds *Padina gymnospora* and *Padina tetrastomatica* were collected and selected from the coastline of Mandapam, South East Coast of India. The major biochemical content of proteins, carbohydrate, lipid, crude fibre and pigments were quantitatively analyzed. The maximum of total carbohydrate, soluble protein, lipid, fibre, chlorophyll, and carotenoid contents are 53%, 31%, 3% in *Padina gymnospora*, 15% in *Padina tetrastomatica*, 27%, and 23% in *Padina tetrastomatica* respectively. The fucoxanthin content of *Padina gymnospora* and *Padina tetrastomatica* was 59% and 50% respectively.

KEYWORDS: Biochemical, *Padina gymnospora*, *Padina tetrastomatica*, Mandapam.

INTRODUCTION

Marine macro algae are seaweeds which are being occurred along the coastline and about 8,000 species of marine macro-algae were reported.[1] Seaweeds are commercially important because of their protein, amino acid and mineral contents.[2] The marine algae have specialized biochemical pathways to adapt and survival in their environment. They have variety of biochemical compositions which have been used for centuries by human being.[3] The seaweeds have been used in different manmade industries. The products of the seaweeds, such as align, carrageenan, and agar. Now, they are used in medicine as drugs, agriculture as bio-fertilizer, fungicides, and herbicides. In food industrials, they are used as a human nutrition. Edible seaweeds contain significant quantities of protein, lipids, minerals, vitamins

and 20-50% minerals in their dry weight were reported by Kazutosi.[4] The seaweeds or their products have a variety of compounds which been reported that they possess biological activity of potential medicinal value.[5-8] Cahyana[9] reported that seaweeds are having rich source of antioxidants. Heo *et al*.,[10] reported that the potential antioxidant compounds were identified such as fucoxanthin, astaxanthin, carotenoid, phenolic acid, flavonoid, and tannins.

Fucoxanthin is a seaweed extract and it is also a carotenoid (an accessory pigment in the chloroplast) found in brown seaweed that is structurally similar to Vitamin A and beta-carotene. It is giving to the seaweed a brown or olive-green colour. Fucoxanthin is one of the most abundant carotenoids, and contributes to more than 10% of the estimated total production of carotenoids in nature, especially in the marine environment.[11-12] Rather than act as a vitamin though, this supplement functions as a potent fat burner when used consistently. Effects are not acute and require 1-4 months for results to show; however, the resulting fat loss is steady and reliable.[13] Sachindra *et al*.,[14] stated that the seaweeds are one of major components are popular in Japan, China and Korea diet. More *et al*.,[15] reported that brown seaweed pigments especially carotenoids are of interest as antioxidant and anti-cancer.[15]

The primary benefit of a fucoxanthin supplement is fat loss. Unlike many of the weight loss supplements available on the market, seaweed extract has proven effective in both animal and human studies.[13,16] This particular weight loss aid takes time to go into effect as it is non-stimulatory and must build up in your fat tissue first before inducing fat loss.

Other effects include a range of cardiovascular health benefits. Fucoxanthin supplements can reduce cholesterol and triglyceride absorption as well as inhibit their production within the body.[17] This may also play a role in its fat-loss properties. This supplement can also help individuals regulate and improve their blood pressure.[13]

This supplement is also an effective cellular health supplement.[18] While it is not as effective as other cellular health supplements such as Vitamin C, it does scavenge free radicals.[18] This sets it apart from other carotenoids, which do not typically possess this capability. Additionally, it can protect against the damaging effects of UV rays.[19] Early reports that the brown algae fucoxanthin had a variety of effects on human health such as anti- carcinogen, anti-inflammation, antioxidant, antiobesity, radical scavenging activities, and an increase utilization of this seaweed as food due to its beneficial for human health.[20-26]

MATERIALS AND METHODS

Two species of marine brown algae *Padina gymnospora*, *Padina tetrastomatica* were handpicked from substratum like mud, rocks, and concrete surface from Mandapam coastline. The samples were washed thoroughly to remove adhering soil particles and immediately transferred to the laboratory in ice box for analysis of biochemical status.

The standard methods were used to estimate the total carbohydrate,[27] protein[28] and total lipid.[29] The chlorophyll, carotenoid, and fucoxanthin contents were estimated by Arnon[30] Kirk and Allen[31] and Seely *et al.*[32] respectively. The pigment compositions were analyzed by using standard method.[33]

RESULTS AND DISCUSSION

Carbohydrate, protein, lipid, crude fibre are the most important biochemical composition in algae and the results obtained from the two seaweeds namely *Padina gymnospora* and *Padina tetrastomatica* are presented in Table 1. Carbohydrate is the most important component for metabolism and it supplies the energy needed for the respiration and other most important processes.[34] The carbohydrate content was maximum recorded from *Padina gymnospora* (55%) followed by *Padina tetrastomatica* (54%) (Fig. 1 & 2).

Table 1: Biochemical content of the selected brown algal seaweeds.

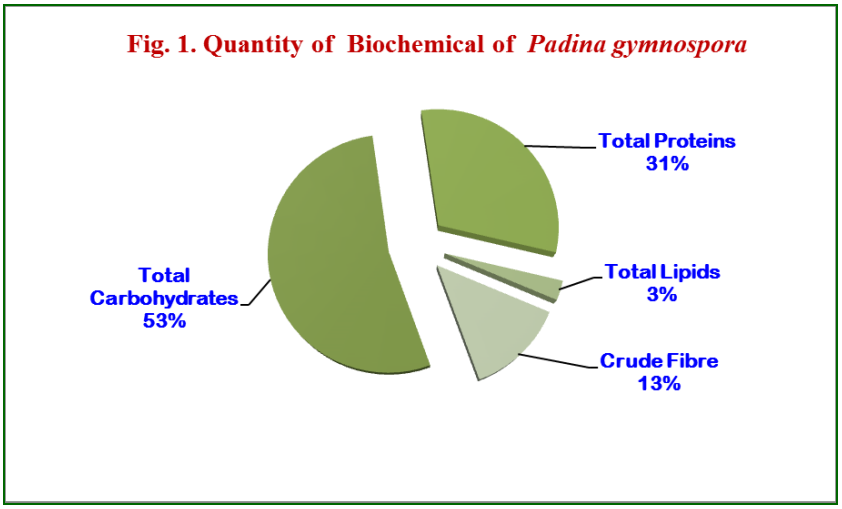
Bio-chemicals	*Padina gymnospora* (mg/g of dry weight)	*Padina tetrastomatica* ((mg/g of dry weight)
Total Carbohydrates	29.85	27.34
Total Proteins	**17.32**	**15.77**
Total Lipids	1.5	2.55
Crude Fibre	7.33	8.4

Data obtained from 3 replications.

Table 2: Total chlorophyll, Carotenoid and Fucoxanthin content of selected brown algal seaweeds.

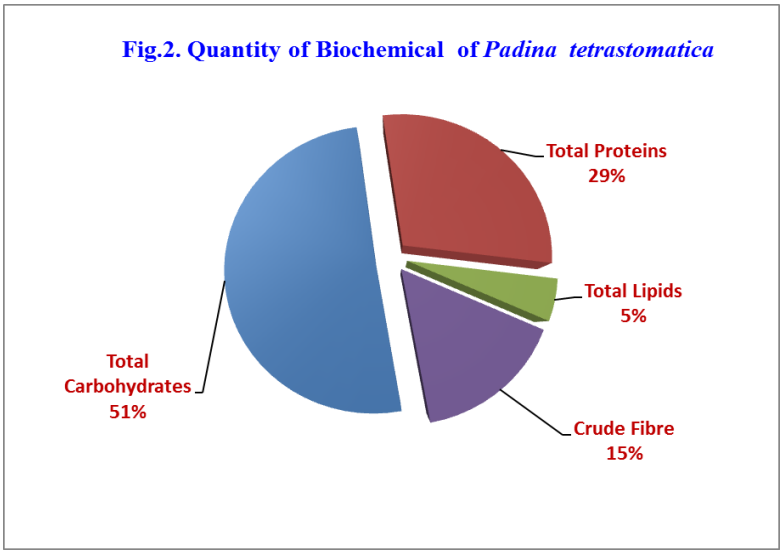
Pigments of Brown Algae	*Padina gymnospora*	*Padina tetrastomatica*
Total chlorophyll a, b (mg g-1)	71	72
Carotenoids (mg g-1)	62	85
Fucoxanthin (mg g-1)	192	155

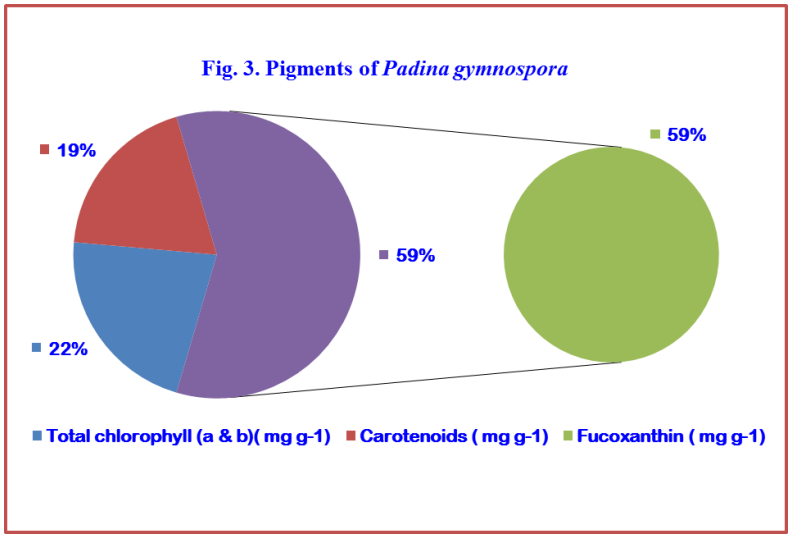
Data obtained from 3 replications.



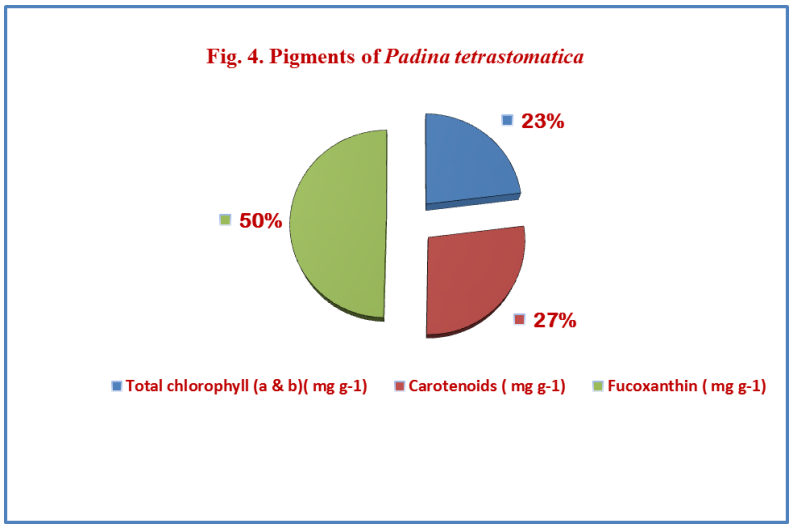
A protein has crucial functions in all the biological processes. Their activities can be described by enzymatic catalysis, transport and storage, mechanical sustentation, growth and cellular differentiation control.[35] The protein content exhibited with the highest value of *Padina gymnospora* (31%) and followed by *Padina tetrastomatica* (29%) (Fig.1& 2).

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.[36] The highest lipid content was observed in *Padina tetrastomatica* (5%) and in *Padina gymnospora* (3%). The consumption of dietary fibre and plant cell walls containing such fibres components protects human organism against a number of chronic disease. Eg, colon cancer.[37] The crude fibre content was exhibited 15% in *Padina tetrastomatica* and 13% in *Padina gymnospora* (Fig.1&2).





Fucoxanthin is a type of non-provitamin A carotenoid and it belongs to xanthophyll. The fucoxanthin content of the different seaweeds is presented in Table: 2. The *Padina gymnospora* (59%) was found higher amount of fucoxanthin compared to *Padina tetrastomatica* (50%). However these brown algal seaweeds could be cultivated as potential and rich source of natural fucoxanthin (Fig. 3 & 4).



Seaweeds produce a great variety of secondary metabolites possessing several biological activities like antiviral, antihelminthic, antifungal, antibacterial etc.[38] Phytochemical and pharmacognostical studies of a few seaweeds from India such as *Sargassum wightii, Cladophora glomerata, Ulva lactuca, Ulva reticulata, Gracilaria corticata, Kappaphycus alvarezii* etc.[39] for their pharmaceutical studies have been carried out. This study showed that the selected species of *Padina* have an adequate amount of phyco-chemicals for industrial and pharmaceutical uses in future.

CONCLUSION

The research points out the selected brown algal seaweeds contain substantial amount of protein, lipid, carbohydrate and crude fibre. The total chlorophyll and carotenoid content were high in chlorophyceae and phaeophyceae respectively. This study showed that the total chlorophyll carotenoids and the fucoxanthin contents were high amount in selected brown algae. The pigment content was influenced by environmental parameters. Seaweeds were used as food ingredients as they are potential source of natural pigments that has nutritional value. The therapeutic effect of seaweeds shows a promising result. Seaweeds should be an ideal food adjunct and be used to combat nutritional deficiency at large. As nature's wealth seaweeds have to be used to promote future health.

REFERENCES

1. Luning, K. Seaweeds their environment, biogeography and Ecophysiology, Wiley, Newyork, 1990.
2. Santhanam, R. N., Ramanathan, and Jagathisan G. Coastal Aquaculture in India C.B., 1990.
3. Dawczyski, C., Schubert, R., and Jabresis, G. Amino acids fatty acids and dietary fibre in edible seaweed products. *Food chem*, 2007; 103(3); 891-899.
4. Kazutosi, N. Seaweeds kasio; Bountiful harvest from the seas. Sustenance for health and well-being. Japan seaweed association kochi, 2002.
5. Moore, R. E. Algal non isoprenoids. In: P.J. Scheuer, (Ed.), Marine Natural Products, *Chemical and Biological Perspective, vol. 1. Academic Pres*s, New York, 1987; 44–171.
6. Konig, G.M., Wright, A.D., Sticher, O., Anghofer, C.K., and Pezutto, J.M. Biological activities of selected marine natural products. *Planta Med*., 1994; 60: 532–537.
7. Tutour, B.L., Benslimane, F., Gouleau, M.P., Gouygou, J.P. Saadan, B., and Quemeneur, F. Antioxidant and pro-oxidant activities of the brown algae, *Laminaria digitata*, *Himanthalia elongata*, *Fucus vesiculosus*, *Fucus serratus* and *Ascophyllum nosduum*. *J. Appl. Phycol*, 1998; 10: 121–129.
8. Satoru, K., Noboru, T., Hiroo, N., Shinji, S., and Hiroshi, S. Oversulfation of fucoidan enhances its anti-angiogenic and antitumor activities. *Biochem. Pham*, 2003; 65: 173–179.
9. Cahyana, A.H., Shuto, and Kinoshita, Y. 1992. Pyropheophytin a as an antioxidative substance from the marine alga, Arame (*Eisenia bicyclis*). *Biosci. Biotechnol. Biochem*, 56: 1533–1535.

10. Heo, S. J., Park, E. J., Lee, K.W., and Jeon, Y.J. Antioxidant activities of enzymatic extracts from brown seaweeds. *Biores. Technol*., 2005; 96; 1613–1623.
11. Dembitsky, V.M., and Maoka, T. Allenic and cumulenic lipids. *Prog. Lipid Res*, 2007; 46: 328–375.
12. Takaichi. S. Carotenoids in algae: Distributions, biosyntheses and functions. *Mar. Drugs*, 2011; 9: 1101–1118.
13. Abidov, M., Ramazanov, Z., Seifulla, R., and Grachev, S. The effects of Xanthigen in the weight management of obese premenopausal women with non-alcoholic fatty liver disease and normal liver fat. *Diabetes Obes Metab*, 2010; 12(1): 72-81.
14. Sachindra, N.M., Airanthi, M.K.A.W., Hosokawa, H., and Miyashita, K. Radical scavenging and singlet oxygen quenching activity of extracts from Indian seaweeds, *J. Food Sci. Technol*, 2010; 47: 94-99.
15. Mori,K., Ooi,T., Hiraoka, Oka, N., Hamada, H, and Tamura, M. Fucoxanthin and its metabolites in edible brown algae cultivated in deep sea water, *Mar. Drugs,* 2004; 2: 63-72.
16. Kang, S.I., Shin, H.S., Kim, H.M., Yoon, S.A., Kang, S.W., Kim, J.H., Ko, H.C., and Kim, S.J. *Petalonia binghamiae* extract and its constituent fucoxanthin ameliorate high-fat diet-induced obesity by activating AMP-activated protein kinase. *J. Agric.Food Chem*, 2012; 4: 60(13): 3389-95.
17. Ha, A.W., and Kim, W.K., The effect of fucoxanthin rich power on the lipid metabolism in rats with a high fat diet.*Nutr Res Pract*, 2013; 7(4): 287-93.
18. Sachindra, N.M., sato, E., Maeda, H., Hosokawa, M., Niwano, Y., Kohno, Y., Miyashita, K. Radical scavenging and singlet oxygen quenching activity of marine carotenoid fucoxanthin and its metabolites. *J Agric Food Chem*, 2007; 17: 55(21): 8516-22.
19. Heo, S.J and Jeon, Y.J. Protective effect of fucoxanthin isolated from *Sargassum siliquastrum* on UV-B induced cell damage *J Photochem Photobiol*, 2009; 4: 95(2): 101-7.
20. Okozumi, J., Nishino,H., Murakoshi, M., Iwashima,A., Tanaka, Y., and Yamane,T. Inhibitory effects of fucoxanthin, a natural carotenoid on N-mye expression and cell cycle progression in human malignant tumor cells, *Cancer Lett*, 1990; 55: 75-81.
21. Nomura, T. Kikuchi, M., Kubodera, A., and Kawakami, Y. Proton donative antioxidant activity of fucoxanthin with 1,1-diphenyl-2-picrylhydrazyl (DPPH), *Biochem. Mol. Biol. Int*, 1997; 42: 361-370.
22. Kim, J.M., Araki, S., Kim, D.J., Park, C.B., Takasuka, N., and Toriyama, H.B. Chemo

preventive effects of carotenoids and cucumins on mouse colon carcinogenesis after 1, 2-dimethylhydrazine initiation, *Carcinogenesis*, 1998; 19: 81-85.

23. Shiratori,K.K., Ohgami,I., Ileiva,X.H., Yin, Y., Koyama, K., and Miyashita. Effects of fucoxanthin on lipo polysaccharide induced inflammation *in vitro* and *in vivo*, *Exp. Eye Res*, 2005; 81: 422-428.
24. Maeda, M. Hosokawa, T. Sashima, K. Funayama, and Miyashita, K. Fucoxanthin from edible seaweed *Undaria pinnatifida* shows antiobesity effect through UCP1 expression in white adipose tissues, *Biochem. Biophys. Res. Commum*, 2005; 332: 392-397.
25. Gerasimenko, N.I., Chaykina, E., Busarova,N.G., and Arisimov, M.M. Antimicrobic and hemolytic activity of low molecular metabolites of brown seaweed *Laminaria cichorioides* (Miyabe), *Appl. Biochem. Microbiol*, 2010; 46: 426-430.
26. Sachindra, N.M., Sato, E., Maeda, H., Hosokawa, M., Niwano, Y., Kohno,M. Radical, scavenging and singlet oxygen quenching activity of marine carotenoid fucoxanthin and its metabolites, *J. Agric. Food Chem*, 2007; 55: 8515-8522.
27. Hedge, J. E., and Hofreitter, B.T. Carbohydrate chemistry in biochemical methods for agricultural sciences edited by Sadasivam S and Manickam A (Wiley eastern ltd.pub), 1991; 8.
28. Lowry, O.H., Rosenbrough, N.H., Farr, R.J., and Randall, A.L. Protein measurements with folinphenol reagent *J.Biol.chem*, 1951; 193: 265-275.
29. Folch, J., Lees,M., and Solane Stanley, G.H. A Simple method for isolation and purification of cloat lipid from animal tissue. *J.Biol.Chem*, 1957; 226: 497-509.
30. Arnon, D.I. Copper enzymes in isolated chloroplasts, polyphenol oxidase in beta vulgaris. *Plant physiol*, 1949; 2: 1-15.
31. Krik, J.T.O., and R.L. Allen. Dependence of chloroplast pigments synthesis on protein synthetic effects on actilione. *Biochem. Biophysics Res. J. Canada*, 1965; 27: 523-530.
32. Seely,G.R., Duncan,J., Vidaver, W.E. Preparative and analytical extraction of brown algae with dimethyl sulfoxide, *Marine Biol*, 1992; 12: 184-188.
33. Hegazi, M.M., Ruzafa, A.P., Almela, L., and M.E. Candela. Separation and identification of chlorophylls and carotenoids from Claupera prolifera, Jania rubens and padinapovonica by reversed phase. *High performance liquid chromatogr*. A, 1998; 829: L153-159.
34. Bligh, E.G., and W.J. Dyer, A rapid method of total lipid extraction and purification. *Can.J.Biochem.Physiol*, 1959; 37: 912-917.
35. Sukran Dere, Nurhayat DalKiran, Didem Karacao glu, Gamez yildiz, Egemen Dere. The

determination of total soluble carbohydrate and pigment contents of some macro algae collected from Germlik Karalaali (Bursa) and Erdek-ormanli (Balikesir) in the Sea of Marmara, Turkey. *Oceanologia,* 2003; 45(3): 453-471.

36. Norziah, M.H., and Ching, C.Y. Nutritional composition of edible seaweed Gracilaria changgi. *Food chem*, 2000; 68: 69-76.
37. Kaliaperumal, N., Chennjbhotl, V.S.K. Kalimuthu, S., Ramalingam, Selvaraj, M., Najmuddin. Chemical composition of seaweeds. *CMRI Bulletin*, 1987; 41: 31-51.
38. New man D, Cragg G, and Snader K, Natural products as sources of new drugs over the period 1981-2002, Journal of Natural Products, 2003; 66: 1022-1037.
39. Pandurangan A, Perisamy M, Sekaran S, Jebamalai S.K, and Sarangam B, Pharmacognostical and antifungal activity of selected seaweeds from Gulf of Mannar region, Recent Research in Science and Technology, 2010; 2(1): 115-119.