ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 8, Issue, 12, pp. 22399-22406, December, 2017

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

ASSESSMENT OF THE SPECTRAL AND BIOCHEMICAL PROPERTIES OF *SPYRIDIA FILAMENTOSA* (WULFEN) HARVEY AND *ACANTHOPHORA SPICIFERA* (M.VAHL) BORGESEN WITH SPECIAL REFERENCE TO THEIR PHYCOBILIPROTEINS

Suresh Kumar G., Marisamy K and Senthilkumar N*

Botany, Centre for Research and P.G. Studies in Botany, Ayya Nadar Janaki Ammal College, Sivakasi- 626 124 - Tamilnadu, India

DOI: http://dx.doi.org/10.24327/ijrsr.2017.0812.1260

ARTICLE INFO

Article History:

Received 10th September, 2017
Received in revised form 14th October, 2017
Accepted 08th November, 2017
Published online 28th December, 2017

Key Words:

Phycobiliproteins, Biochemical, Seaweeds, *Spyridia filamentosa* and *Acanthophora spicifera*

ABSTRACT

Today a very broad research work focused on seaweeds in order to harvesting biochemical properties, particularly on phycobiliproteins. Among the various bioactive compounds obtained from the marine resources, phycobiliprotein occupies a prominent position due to its variety and novelty of applications. The present study is aimed at assessing the spectral and biochemical properties of *Spyridia filamentosa* and *Acanthophora spicifera*.

INTRODUCTION

Human dependence on marine resources is an age old story that dates back to the pre – civilization era. Modern day scientific development, has indeed, aggravated the situation leading to the commercial and economical exploitation of the marine flora and fauna. Seaweeds, being abundant source of bioactive components, have evoked much interest among the scientific community in recent times. Among the various types of seaweeds, Rhodophyta occupies very important place due to the presence of the pigment called Phycobiliproteins. Phycobiliproteins are water soluble proteins that capture light energy, which is then passed on to chlorophylls during photosynthesis. Among the various bioactive compounds obtained from the Marine resources, phycobiliprotein occupies prominent position due to its variety and novelty of applications. Phycobiliproteins are widely used in food, pharmaceuticals, cosmetics, textiles and as printing dyes. Under these circumstances, the present study is conceived to explore and analyse the various properties of the phycobiliproteins of the two red seaweeds *Spyridia filamentosa* (Wulfen) Harvey and *Acanthophora spicifera* (M.Vahl) Borgesen dwindling along the coast of Pamban, Gulf of Mannar National Marine Biosphere Reserve, Tamilnadu, India.

MATERIAL AND METHODS

Description of the Collection Site

Fresh and healthy specimens of *Spyridia filamentosa* (Wulfen) Harvey and *Acanthophora spicifera* (M. Vahl) Borgesen were collected from the coast of Pamban, Gulf of Mannar National Marine Biosphere Reserve, Tamil Nadu, India.

Experimental design

Five hundred gram of the above seaweed was collected for the analysis of total carbohydrate, total protein, total lipid and phycobiliproteins.

The various Photosynthetic and biochemical activities were estimated following the methods proposed by those mentioned within the bracket. Total carbohydrate (Dubois *et al*., 1956), Total protein (Bradford, 1976), Total Lipid (Folch *et al*., 1956) and Photosynthetic pigments was done by the method of Smith and Benitez (1955). The extraction and estimation of phycobiliproteins was done by the method of Bennet and

Corresponding author:* **Senthilkumar N
Botany, Centre for Research and P.G. Studies in Botany, Ayya Nadar Janaki Ammal College, Sivakasi- 626 124 - Tamilnadu, India

Bogorad (1973). Total antioxidant activity was done by the method of Prieto *et al*., (1999).

UV–Visible Spectral Analysis of Phycobiliproteins

UV-Visible absorption spectra of Phycobiliproteins of both seaweeds were determined using a double-beam 1800 UV–Visible spectrophotometer (Shimadzu, Japan).

HPLC Analysis of Phycobiliproteins

The phycobiliproteins from *Spyridia filamentosa* and *Acanthophora spicifera* were analysed under Agilante 1100 High Performance Liquid Chromatography (HPLC) (Agilante Technologies, Santa Clara, CA, USA) on a C18 column (ZORBAX Eclipse XDB-C18, 4.6 x 150 mm; 3.5 micron) as described by Broekart *et al*. (1988).

FT–IR Spectral Analysis of Phycobiliproteins

The Fourier Transform–Infrared spectrum of Phycobiliproteins of both seaweeds was recorded using an FT–IR Spectrophotometer with a spectral range of 450 – 4500 cm-1 (Perkin Elmer, Waltham, MA, USA).

Fluorescence Emission Spectral Analysis of Phycobiliproteins

The fluorescence emission spectrum of Phycobiliproteins of both seaweeds was recorded using a Spectrofluorometer fitted with 150 W Xenon Lamp (Perkin Elmer, Waltham, MA, USA).

Statistical Analysis

All experiments were performed in triplicate and the experiments were repeated at least three times.

RESULTS

Morphological Characters of Spyridia filamentosa

Thallus erect, irregularly branched, main axes corticated throughout by tiers of nodal and internodal cells. Short determinate branches, radially arranged corticated only at nodes, with or without spines or hooks, often caducous. Cells uninucleate. Procarps on short lateral branches, 4-celled carpogonial branch on one (supporting cell) of 2 or 3 pericentral cells. Auxiliary cells leading to carposporophytes with carposporangia enclosed within a bi- or tri-lobed cystocarp. Spermatangia covering lower cells of determinate branches. Tetrasporangia sessile on cells of determinate branches, tetrahedrally-divided (Fig. 1).

Biochemical and Pigment Profile of Spyridia filamentosa

The red seaweed, *Spyridia filamentosa* was analysed for the biochemical and pigment profile. In the present analysis, the total carbohydrate content was found to be 20.245 mg/g and the corresponding figure for total protein was 13.25 mg/g. As far as the total lipid is concerned in *Spyridia filamentosa* it was 1.547 mg/g body fesh weight. Among the two principal photosynthetic pigments Chl. *a* accounts for 0.459 mg/g whereas the corresponding figure for Chl. d was 1.825 mg/g (Table 1).

Extraction and Estimation of Phycobiliproteins of Spyridia filamentosa

In the phycobiliprotein analysis, it was observed that R–Phycoerythrin (R-PE) was maximum with 4.245 mg/g followed by Allophycocyanin (APC) with 1.478 mg/g and Phycocyanin (PC) with 1.325 mg/g (Table 1).

Fig 1 Thallus of Spyridia filamentosa

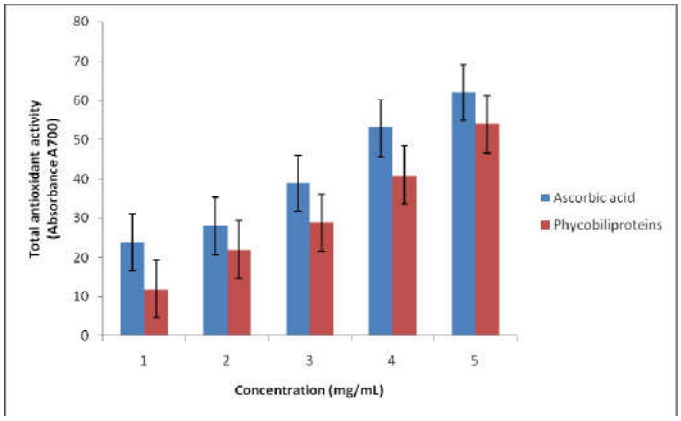

Fig 2 Total antioxidant activity of the phycobiliproteins of *Spyridia filamentosa*

Table 1 Biochemical and pigment profile of spyridia filamentosa

S.NO	Biochemical Attribute	Quantity (mg/g Fresh weight)
1.	Total carbohydrate	20.245±0.12
2.	Total protein	13.25±0.15
3.	Total Lipid	0.157±0.12
4.	Chlorophyll a	0.459±0.1
5.	Cholrophyll d	1.825±0.3
6.	Phycobiliproteins-Phycocyanin	1.325±0.4
7.	Allophycocyanin	1.478±0.21
8.	R-phycoerythrin	4.245±0.12

Antioxidant Properties of Phycobiliproteins of Spyridia filamentosa

Total antioxidant activity of the phycobiliproteins exhibited a similar trend with ascorbic acid which is used as a standard (Fig. 2). The reducing power of phycobiliproteins was found to be much less at all the tested concentrations when compared to that of ascorbic acid (Fig. 3).

UV – Visible Spectral Properties of Phycobiliproteins of Spyridia filamentosa

The absorption spectrum of the eluting Phycobiliproteins were obtained using UV-Visible spectrophotometer at wavelengths ranging from 200 to 800 nm. The spectrum exhibited three peaks with absorption maxima at 280 nm, 370 nm and 590 nm which are typical of Phycobiliproteins (Fig. 4).

HPLC Analysis of Phycobiliproteins of Spyridia filamentosa

In the HPLC analysis, four prominent subunit cores were detected in the phycobiliproteins of *Spyridia filamentosa*. The first major peak was registered at Rt 2.560. The other three sub peaks were recorded at Rt 2.793, 3.017 and 4.353 (Fig. 5).

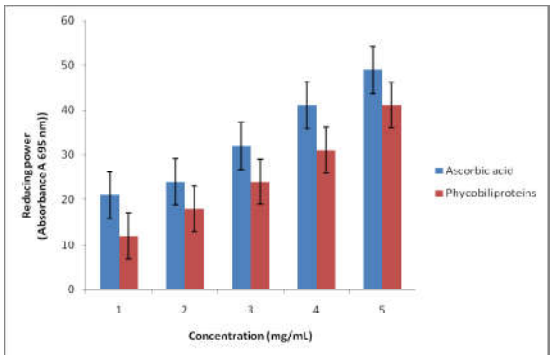

Fig 3 Reducing power of the phycobiliproteins of Spyridia filamentosa

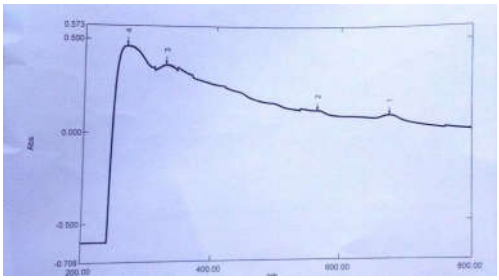

Fig 4 UV –Visible spectral analysis of phycobiliproteins of spyridia filamentosa

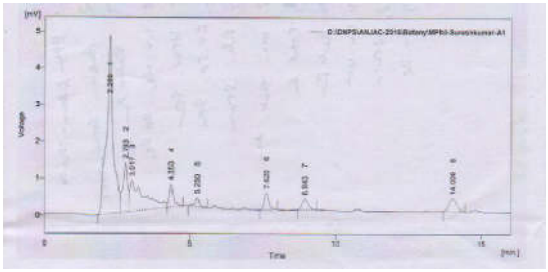

Fig 5 HPLC Profile of the phycobiliproteins of Spyridia filamentosa

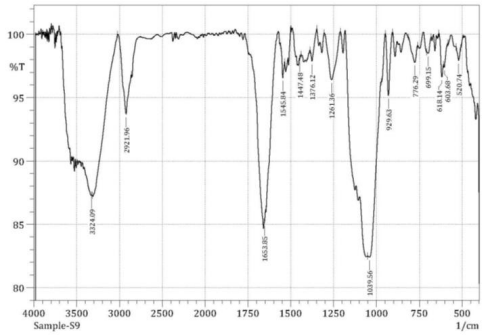

Fig 6 FT-IR Spectral analysis of the phycobiliproteins of spyridia filamentosa

FT-IR Spectral Analysis of Phycobiliproteins of Spyridia filamentosa

The Phycobiliproteins of *Spyridia filamentosa*. was characterized by FT–IR Spectroscopy and the spectrum showed typical bands at 3324 cm-1 (C=O stretching) and 2921 cm-1 (N–H bending) indicating the presence of protein specific amide group. It also revealed the presence of α–helix as major element of the secondary structure (Fig. 6).

Fluorescence Emission Spectral Analysis of Phycobiliproteins of Spyridia filamentosa

In the fluorescence emission spectral studies conducted in the Phycobiliproteins of *Spyridia filamentosa,* it was observed that there was a single peak at 680 nm (Fig. 7).

Morphological Characters of Acanthophora spicifera

Acanthophora spicifera is an erect macroalgae which grows up to 40 cm tall. It has solid cylindrical branches, 2-3mm wide, branched either sparingly or repeatedly. The main branches have short, determinate branches, irregularly shaped and spinose, with spines numerous and radially arranged. There are no spines on main axes. The plant grows from a large, irregularly shaped holdfast. In intertidal high-motion water areas, *A. spicifera* has short (4 – 10 cm), compact and very dense thalli. In moderate or low water motion areas, the thalli are tall (10 – 25 cm), more openly branched and occur in scattered clumps. Apices are pyramidal, with incurved trichoblasts. Pericentral cells are corticated densely, with central axial cells usually evident. In older axes, central axial filaments may be surrounded by small-celled adventitious filaments. *A. spicifera* is highly variable in colour: it can be shades of red, purple, yellow, orange, or brown. Thalli are often very dark in colour in intertidal, high motion areas, and are usually lighter colour in shallow areas with low water motion and reflective sandy or silty bottoms (Fig. 8).

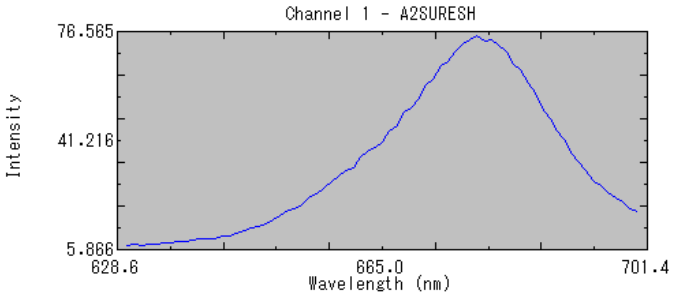

Fig 7 Fluorescence Emission Spectral analysis of phycobili Proteins of Spyridia Filamentosa

Fig 8 Thallus of Acanthophora spicifera

Biochemical and Pigment Profile of Acanthophora spicifera

In the biochemical and pigment analysis, it was observed that *Acanthophora spicifera*, recorded interesting concentrations. Accordingly, in the present observation, the total carbohydrate content was found to be 12.36 mg/g and the corresponding figure for total protein was 10.18 mg/g. Total lipid was found to be 0.958 mg/g of body fresh weight. Regarding the photosynthetic pigments, Chl. *A* and Chl. d was found to be 0.748 mg/g and 3.745 mg/g respectively (Table 2).

Extraction and Estimation of Phycobiliproteins of Acanthophora spicifera

In the phycobiliprotein complex, the red seaweed *Acanthophora spicifera*, exhibited an amount of 4.576 mg/g fresh weight for R–Phycoerythrin (R-PE) followed by Allophycocyanin (APC) with 1.798 mg/g and Phycocyanin (PC) with 1.223 mg/g (Table 2).

Table 2 Biochemical and pigment profile of *Acanthophora spicifera*

S.No.	Biochemical Attribute	Quantity (mg/g Fresh weight)
1.	Total carbohydrate	12.36±0.32
2.	Total protein	10.18±0.21
3.	Total Lipid	0.958±0.20
4.	Chlorophyll *a*	0.748±0.27
5.	Cholrophyll d	3.745±0.12
6.	Phycobiliproteins-Phycocyanin	1.223±0.32
7.	Allophycocyanin	1.798±0.24
8.	R-phycoerythrin	4.576±0.11

Antioxidant Properties of Phycobiliproteins of Acanthophora spicifera

Total antioxidant activity of the phycobiliproteins of *Acanthophora spicifera* exhibited a similar trend with ascorbic acid which is used as a standard (Fig. 9). The reducing power of phycobiliproteins was found to be much less at all the tested concentrations when compared to that of ascorbic acid (Fig. 10).

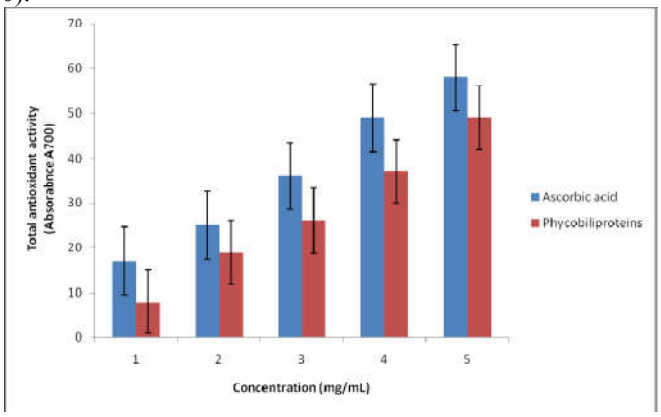

Fig 9 Total antioxidant activity of the phycobiliproteins of Acanthophora Specifera

Uv–Visible Spectral Properties of Phycobiliproteins of Acanthophora Spicifera

The absorption spectrum of the eluting Phycobiliproteins were obtained using UV- visible spectrophotometer at wavelengths ranging from 200 to 800 nm. The spectrum exhibited two peaks with absorption maxima at 300 nm and 450 nm (Fig. 11).

HPLC Analysis of Phycobiliproteins of Acanthophora spicifera

In the HPLC analysis, five prominent subunit cores were detected in the phycobiliproteins of *Acanthophora spicifera*. The first major peak was registered at Rt 1.393. The other four sub peaks were recorded at Rt 2.007, 2.233 and 2.957 (Fig. 12).

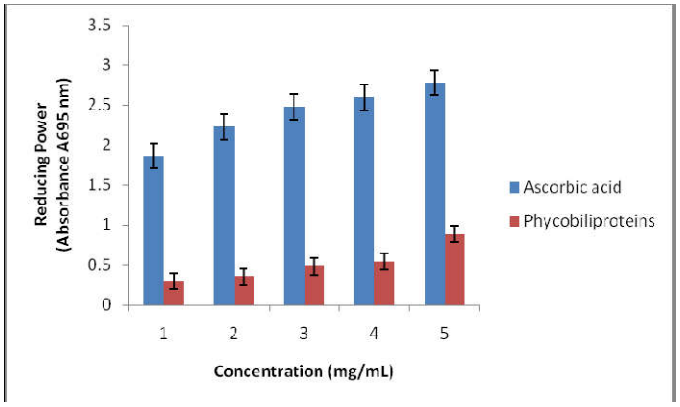

Fig 10 Reducing Power of the phycobiliproteins of Acanthophora Specifera

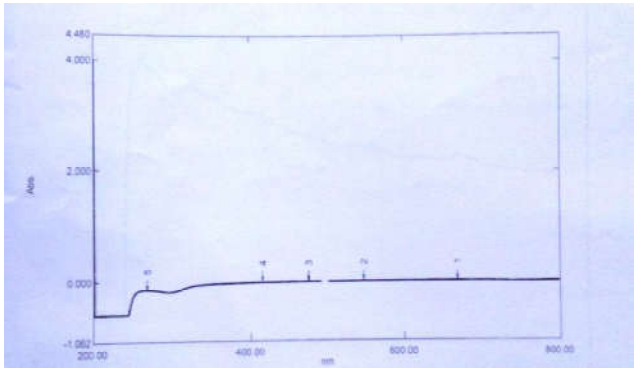

Fig.11 Uv- visible spectral analysis of phycobiliproteins of Acanthophora spicifera

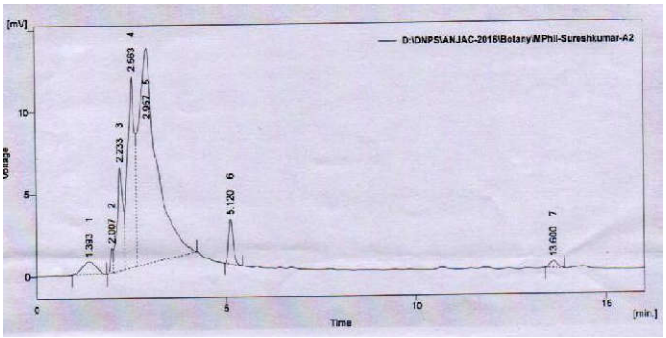

Fig.12 HPLC Profile of the phycobiliproteins of Acanthophora Specifera

FT-IR Spectral Analysis of Phycobiliproteins of Acanthophora spicifera

The Phycobiliproteins of *Acanthophora spicifera* was characterized by FT–IR Spectroscopy and the spectrum showed typical bands at 3504 cm-1 and 3100 cm-1 indicating the presence of protein specific amide group. It also revealed the presence of α–helix as major element of the secondary structure (Fig. 13).

Fluorescence Emission Spectral Analysis of Phycobiliproteins of Acanthophora spicifera

In the fluorescence emission spectrum of the Phycobiliproteins of *Acanthophora spicifera,* it can be noticed a characteristic peak at around 670 nm (Fig. 14).

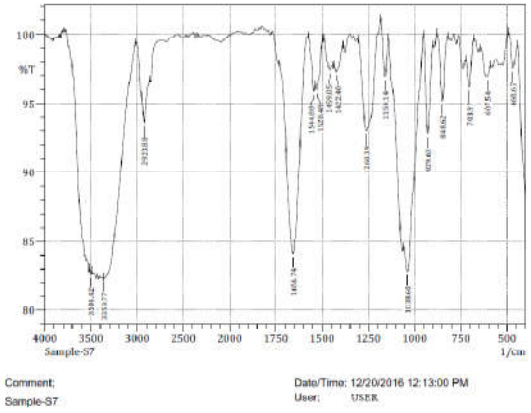

Fig.13 FT-IR Spectral Properties of phycobiliproteins of Acanthophora Spicifera

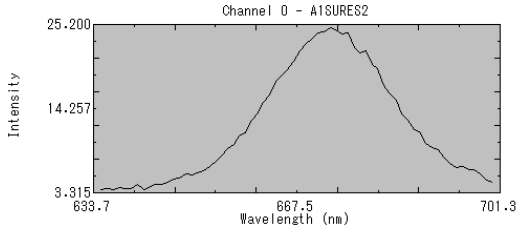

Fig.14 Flurescence Emission Spectral analysis of phycobiliproteins of *Acanthophora specifera*

DISCUSSION

The present study is an attempt on the assessment of the spectral and biochemical properties of the two red seaweeds namely *Spyridia filamentosa* (Wulfen) Harvey and *Acanthophora spicifera* (M. Vahl) Borgesen dwindling along the coast of Pamban, Gulf of Mannar National Marine Biosphere Reserve, Tamil Nadu, India especially with reference to their phycobiliprotein complex.

In the present study, the proximate composition of the two red seaweeds namely *Spyridia filamentosa* (Wulfen) Harvey and *Acanthophora spicifera* (M. Vahl) Borgesen were analysed. In the total carbohydrate concentration, it was observed that *Spyridia filamentosa* possess 20.245 mg/g and the corresponding figure for total protein was 13.25 mg/g. As far as the total lipid is concerned in *Spyridia filamentosa* possess 1.547 mg/g body fresh weight. Likewise, in *Acanthophora filamentosa,* carbohydrate content was 12.36 mg/g and total protein content was 10.18 mg/g. Marine algae from Indian coasts have been fairly well surveyed since several decades. The latest systematic account list accounts 844 species distributed among 217 genera. Holdt and Kraan (2011) reviewed the bioactive compounds obtained from various seaweeds. Marine algae contain large amounts of polysaccharides, notably cell wall structural, but also mucopolysaccharides and storage polysaccharides (Kumar *et al*., 2008). Polysaccharides are polymers of simple sugars (monosaccharides) linked together by glycosidic bonds, and they have numerous commercial applications in products such as stabilizers, thickeners, emulsifiers, food, feed, beverages etc (Tsang, 2001).

Powder mixtures obtained from the three algal species: *Enteromorpha* spp., *Ulva* spp., and *Ceramium* spp. presented the following chemical composition: carbohydrates average (51.14%); proteins average (15.54%); lipids average (1.93%). The average content of mineral substances in green algae (*Enteromorpha* spp. and *Ulva* spp.) 24% is statistically different compared to that of red algae (*Ceramium* spp) 13.83%. Proteins content in algal powder from green algae (13.34%) is statistically lower than that in red algae powder (19.94%). The average lipids content presents statistically insignificant differences between green algae (1.19%) and red algae (3.43%). Carbohydrate content of algal powder obtained from green algae species (50.76%) showed statistically insignificant differences compared to that of powders obtained from red algae (51.90%). The carotenoids content of algae, expressed as β-carotene, is generally small, being slightly increased in red algae compared to the green ones. Concluding, in the red macroalgae species were registered increased values for proteins, lipids and carbohydrates compared with the ones of the green macroalgae species. On the other hand, for the mineral substances content, increased values for green algae species compared with the red algae species were registered (Negreanu-Pîrjol *et al*., 2011). Similar reported by Haque *et al*., (2009) they investigated the proximate biochemical composition, such as protein, fat, carbohydrate, fibre, minerals, moisture and ash from different sea weeds, namely *Hypnea musciformis*, *H. pannosa*, *Sargassum coriifolium*, *Padina tenuis* and *Dictyota dichotoma* of Saint Martin's Island and reported that the biochemical parameters of these sea weeds were higher than that of *Spirulina* except the protein contents. In these sea weeds, the protein contents ranged from 8.32 to 16.07%, whereas in *Spirulina*, it was 55-65%. But in respect of Carbohydrate, these seaweeds were richer than that of *Spirulina*. Carbohydrate content was lower (38.94%) in *Dictyota dichotoma*, but higher (56.29%) in *Hypnea musciformis* whereas, in *Spirulina* sp. it was only 10-20%. So, *Hypnea* sp. were rich in carbohydrate as compared to other species.

It is well known that red seaweeds have high protein levels. Reports have shown that these seaweeds have almost 47% w/w of dry matter. In contrast, green algae contain moderate amounts (9–26 g protein 100 g−1 dry weight), while brown algae display much lower protein contents (3–15 g 100 g−1 dry weight). In this regard, the crude protein content of genera *Pyropia* and *Porphyra* is comparable with that of high protein plant foods such as soy. It is noteworthy that the protein content of seaweeds varies not only between species but also among seasonal periods (Cian *et al*., 2015). Rajasulochana *et al*., (2012) observed that the carbohydrate available in *Kappaphycus alvarezii* was 2.67 gm/100 gm. The total lipid content was 1.09 gm / 100 gm. The total protein content was very high about 18.78 gm /100 gm compared to all other substances. Fat content in the species is 1.09 gm/100 gm. Total phenol content was 4.565 gm/100 mg. Further, it was observed that the phenolic content was very much less than proteins and it was more than carbohydrates, lipids and fats. From the overall study, it can be concluded that *K.alvarezii* can serve as functional food with vital nutritional and biological values.

Carbohydrate content of seaweeds ranged from 10.63% and 28.58%. The maximum carbohydrate content was recorded in the green seaweed *Enteromorpha intestinalis* and the brown seaweed *Dictyota dichotoma* recorded the minimum value (Parthiban *et al*., 2013). Similarly Chakraborthy and Santra (2008) recorded higher carbohydrate in the green seaweeds *Ulva lactuca* (35.27%) and *E. intestinalis* (30.58%). Kaliaperumal *et al*. (1987) also reported similar kind of results that the green seaweed have high carbohydrate than the red and brown. Dhargalkar *et al*. (1980) from the Maharashtra coast noted maximum value of carbohydrate content in Rhodophycean members than in Phaeophycean and Chlorophycean members. In the present study, contrastingly, Chlorophycean members showed high carbohydrate content than Rhodophycean and Phaeophycean members. The high content of carbohydrate in red algae might be due to higher phycocolloid content in their cell walls (Dhargalkar *et al*., 1980).

Photosynthetic pigments are an important characteristic feature that reveals the potential of the plant system. In red seaweeds, the role of photosynthetic pigments is all the more relevant. The concentration of the photosynthetic pigment has been studied in detail in various red seaweeds. Being autotrophic, the algae contain an array of pigments that contribute to the photosynthetic efficiency by their light transduction ability. In addition, these pigment act as photoprotectants too. In the present study, *Spyridia filamentosa* recorded the Chl. *a* at 0.459 mg/g whereas the corresponding figure for Chl. d was found to be 1.825 mg/g. In the case of *Acanthophora filamentosa,* it was 0.748 mg/g and 3.745 mg/g respectively for Chl. *a* and Chl. d. Similar observations were reported by Roman *et al*. (2002) for the levels of Chl. *a* and Chl. d in red seaweeds.

Phycobiliprotein is a functional chromoprotein involved in the photosynthesis of algae, such as blue-green and red algae. Because phycobiliprotein is a natural and highly fluorescent pigment in the light-harvesting complexes of the algae, it is of great interest in many areas, including food, cosmetic, dye, medical diagnosis, immunochemistry and bioengineering. Based on its structure and spectral properties, phycobiliprotein is categorized into three types: phycoerythrin (PE), phycocyanin (PC) and allophycocyanin (APC). Currently, most phycobiliproteins are either directly derived from algae or prepared by genetic engineering. Various studies have reported that phycobiliprotein appears to enhance immunity, suppress tumor development, and slow aging. The primary cause of aging may be the elevated superoxide anion levels in the body, and phycobiliprotein has been found to facilitate the removal of superoxide anion radicals with its superoxide dismutase (SOD)-like properties. Therefore, phycobiliprotein could be a promising natural antioxidant (Ji *et al*. 2011).

In the present study, the concentration of Phycobiliproteins obtained from both the seaweeds exhibited concentrations which were in agreement with the previous studies.

Various kinds of redox processes can produce free radicals in organisms. Oxidative damage is caused either by an increase in active oxygen and reactive oxygen radicals, or by a decrease in antioxidant levels, which are involved in many kinds of diseases. In recent years, great attention has been paid to the antioxidation activity of phycobiliproteins in algae.

In a study conducted by two types of phycobiliproteins (PC and APC) in wild *Nostoc* community, it was observed that the phycobiliproteins possess antioxidant activities in terms of the superoxide anion radical scavenging with the inhibition rates of PC, APC and BHT with 72.0%, 62.8% and 80.1%, respectively, at 8 mg/mL. The inhibition rate of PC was lower than that of common antioxidant BHT. At concentrations of 0 to 8 mg/mL, the scavenging effect of phycobiliprotein was dose-dependent, with PC superior to APC. In the system of ·OH scavenging, the dose-dependent manner was observed among experimental concentrations, with PC being more effective than APC, and the activity of PC was similar to that of BHT. The inhibition rates of PC, APC and BHT were 91.3%, 80.32% and 93.35%, respectively, at 6 mg/mL; while the inhibition rate of PC was 10% higher than that of APC. In the system of DPPH scavenging, the minimal concentrations of PC, APC and BHT at 90% inhibition rate were 5 mg/mL, 7 mg/mL and 4 mg/mL, respectively, which suggested that phycobiliprotein had a similar DPPH scavenging effect as BHT. In the system of rat blood cell haemolysis, both PC and APC showed good effects on inhibiting H2O2-induced blood cell haemolysis, and their effects were stronger than that of common antioxidant Vc. PC was the strongest inhibitor of haemolysis. In the system of lipid peroxidation of rat liver homogenate, both PC and APC had strong effects on the inhibition of lipid peroxidation, which was induced by ·OH radicals. Both PC and APC along with Vc had similar effect. In conclusion, both PC and APC had positive effects on free radical scavenging and anti-lipid peroxidation effects *in vitro*. Because no apparent significant differences in the antioxidant activity of phycobiliproteins and other common antioxidants exist, it is possible to use these phycobiliproteins as natural antioxidant (Ji *et al*., 2011).

The present study is also in total agreement with the other studies conducted earlier in various other red seaweeds. In the present study, the phycobiliprotein complex extracted from both the seaweeds, exhibited characteristic antioxidant studies in both the assays that were used to determine their antioxidant potential.

Phycobiliproteins due to their fundamental feature, absorbs and emits the light at the UV-Visible region and exhibits characteristic peaks. In the present study, the phycobiliprotein obtained from both the sea weeds showed characteristic peaks in the UV–Visible spectral analysis. Thus, the present study was in total conformity with the observation made by Sepulveda-Ugarte *et al*., (2011) who analysed the UV–Visible spectral properties of the phycobiliprotein complex of *Gracilaria chilensis*.

Bermejo *et al*., (2001) extracted and analysed the HPLC profile of the B-Phycoerythrin obtained from *Porphyridium cruentum* and reported about the three-peak arrangement of the phycoerythrin. In the present study also, the HPLC profile of the two phycobiliproteins obtained from *Spyridia filamentosa* and *Acanthophora spicifera* yielded similar results. Mishra *et al*., (2010) purified C-Phycoerythrin from *Pseudanabaena* sp. and characterized by FT-IR spectroscopy. IR spectra showed

protein specific amide I band at 1643 cm-1 (C = O stretching) and 3435 cm-1 (N–H bending). The sharp amide band at 1643 and 3435 cm-1 for C-Phycoerythrin indicates the alpha-helix as the major element of its secondary structure. In the present study also, the FT-IR spectrum obtained from the phycobiliproteins obtained from both the seaweeds exhibited characteristic peaks which were in total agreement with the previous reports.

Spectrofluorometric studies conducted in both the phycobiliproteins exhibited characteristic peak at around 570 nm which is typical of a phycobiliprotein. This is in total agreement with the work of Senthilkumar *et al*. (2013). In the present study conducted on the spectral and biochemical properties of the phycobiliprotein obtained from *Spyridia filamentosa* and *Acanthophora spicifera* exhibited characteristic features which need to be accounted for the economic potential of the red seaweeds.

CONCLUSION

The present study, an attempt, on the assessment of the spectral and biochemical properties of the Phycobiliproteins of the two red seaweeds namely *Spyridia filamentosa* (Wulfen) Harvey and *Acanthophora spicifera* (M. Vahl) Borgesen inhabitating the Pamban coast off Gulf of Mannar National Marine Biosphere Reserve, Rameshwaram, Tamil Nadu has provided the following points to ponder over

The red seaweed, *Spyridia filamentosa* was analysed for the biochemical and pigment profile. In the present analysis, the total carbohydrate content was found to be 20.245 mg/g and the corresponding figure for total protein was 13.25 mg/g. As far as the total lipid is concerned *Spyridia filamentosa* possess 1.547 mg/g body fresh weight. Among the two principal photosynthetic pigments, Chl. *a* accounts for 0.459 mg/g whereas the corresponding figure for Chl. d was found to 1.825 mg/g. In the other red seaweed, in the biochemical and pigment analysis, it was observed that *Acanthophora spicifera*, recorded interesting concentrations. Accordingly, in the present observation, the total carbohydrate content was found to be 12.36 mg/g and the corresponding figure for total protein was 10.18 mg/g. Total lipid was found to be 0.958 mg/g of body fresh weight. Regarding the photosynthetic pigments, Chl. *a* and Chl. d was found to be 0.748 mg/g and 3.745 mg/g respectively.

In the phycobiliprotein analysis of the red seaweed *Spyridia filamentosa*, it was observed that R–Phycoerythrin (R-PE) was maximum with 4.245 mg/g followed by Allophycocyanin (APC) with 1.478 mg/g and Phycocyanin (PC) with 1.325 mg/g. However, in the case of the phycobiliprotein complex of *Acanthophora spicifera*, R–Phycoerythrin (R-PE) accounted for 4.576 mg/g fresh weight followed by Allophycocyanin (APC) with 1.798 mg/g and Phycocyanin (PC) with 1.223 mg/g.Regarding the antioxidant studies, it was found that the Phycobiliproteins of both the seaweeds are similar in their response in alleviating the free radicals. With reference to the UV–Visible, HPLC, FT-IR and Fluorescence Emission Spectral analysis, it was observed that the Phycobiliproteins of both the tested seaweeds, *Spyridia filamentosa* (Wulfen) Harvey and *Acanthophora spicifera* (M. Vahl) Borgesen exhibited similar results.

From the present study, it can be summed up that phycobiliproteins, a ubiquitous pigmented protein, with wide potential for lot of applications in a variety of industries, can be explored further and exploited.

References

Bennet, A. and Bogorad, L. 1973. Complementary chromatic adaptation in a filamentous blue-green alage. *Journal of Cell Biology.* 58: 419-435.

Bermejo, R., Acien, F. G., Ibanez, M. J., Fernandez, J.M., Molina, E. and Alvarez, J.M. 2003. Preparative purification of B-Phycoerythrin from the microalga *Porphyridium cruentum* by expanded-bed absorption chromatography. *J. Chromatogr. B Analyt. Technol. Biomed. Life Sci.* 790: 317-325.

Bradford, M. M. 1976. A rapid and sensitive method for the quantification of microgram quantities of protein utilizing the principle of protein dye binding method. *Analytical Biochemistry*. 72: 248-254.

Broekaert,W. F., Pariis, J.V., Allen, A.K. and Penumans, W.J. 1988. Comparison of some molecular, enzymatic and antifungal properties of chitinase from thorn-apple, tobacco and wheat. *Physiological and Molecular Plant Pathology.* 33: 319 - 331.

Chakraborty, S. and Santra, S. C. 2008. Biochemical composition of eight benthic algae collected from Sunderban. *Indian Journal of Marine Sciences.* 37(3): 329 - 332.

Cian, R.E., Drago, S.R., de Medina, F.M. and Martínez-Augustin, O. 2015. Proteins and Carbohydrates from Red Seaweeds: Evidence for Beneficial Effects on Gut Function and Microbiota. *Mar. Drugs.* 13: 5358-5383.

Dhargalkar, V.K., Jagtap, T.G. and Untwale, A.G. 1980. Biochemical constituents of seaweeds along the Maharashtra coast. *Indian Journal of Marine Science*. 2(4): 297-299.

Dubois, M., Gilles, K. A., Hamilton, J. K., Robers, P. A. and Smith, F. 1956. Colorimetric method for determination of sugars and related substances. *Analytical Biochemistry*. 28(3): 350-356.

Folch, J., Lees, M. and Stanely, G. H. S. 1956. A simple method for isolation and purification of total lipids from animal tissues. *Journal of Biological Chemistry.* 226: 497-509.

Haque, K.M.F., Chy, S.Y., Akter, S., Wahab, M.A. and Nath, K.K. 2009. Collection, Identification and Biochemical analyses of different seaweeds from Saint Martin's Island. *Bangladesh J. Agril. Res.* 34(1): 59-65.

Holdt, S.L. and S. Kraan. 2011. Bioactive compounds in Seaweed: functional food applications and legislation. *Journal of Applied Phycology.* 23 (3): 543-597.

Ji, L., Cui, G. and Zhao, X. 2011. Antioxidant Activities of Phycobiliproteins Isolated from Wild *Nostoc* Commune. IN *: Proc.* International Conference on Agricultural and Natural Resources Engineering *Advances in BiomedicalEngineering*. 3-5.

Kaliaperumal, N., Chennubhotla, V.S.K., Kalimuthu, Ramalingam, J.R., Selvaraj, M. and Najmuddin, M. 1987. Chemical composition of seaweeds. *CMFRI Bulletin.* 41: 31-51.

Kumar, C.S., Ganesan, P., Suresh, P.V. and Bhaskar, N. 2008. Seaweeds as a source of nutritionally beneficial compounds - a review. *Journal of Food Science Technology*. 45: 1-13.

Mishra, S. K., Shrivastav, A., Pancha, I., Jain, D. and Mishra, S. 2010. Effect of preservatives for food grade C-Phycoerythrin, isolated from marine cyanobacteria *Pseudanabaena* sp. *International Journal of Biological Macromolecules*. 47: 597-602.

Negreanu-Pîrjol, B., Negreanu-Pîrjol, T., Paraschiv, G., Bratu, M., Sîrbu, R., Roncea, F. and Meghea, A. 2011. Physical-chemical characterization of Some green and red macrophyte algae from the Romanian black sea littoral. S*cientific Study & Research Chemistry & Chemical Engineering, Biotechnology, Food Industry.* 12 (2): 173 - 184.

Parthiban, C., Saranya, C., Girija K., Hemalatha, A., Suresh, M. and Anantharaman, P. 2013. Biochemical composition of some selected seaweeds from Tuticorin coast. *Advances in Applied Science Research*. 4(3): 362-366.

Prieto, P., Pineda, M. and Aguilar, M. 1999. Spectrophotometric quantitation of antioxidant capacity through the formation of a phosphomolybdenum complex: specific application to the determination of vitamin E. *Analytical Biochemistry*. 269(2): 337-341.

Rajasulochana, P., Krishnamoorthy, R. and Dhamotharan. R. 2012. Biochemical investigation on red algae family of *Kappahycus* Sp. *Journal of Chemical and Pharmaceutical Research*. 4(10):4637- 4641.

Roman, R. B., Pez, J. M. A., Fernandez, F. G. A. and Grima, E. M. 2002. Recovery of pure B-Phycoerythrin from the microalga *Porphyridium. J Biotechnol.* 93 (1): 73 - 85.

Senthilkumar, N., Suresh, V., Thangam, R., Kurinjimalar, C., Kavitha, G., Murugan, P. and Rengasamy, R. 2013. Isolation and characterization of macromolecular protein R-Phycoerythrin from *Portieria hornemannii*. *International Journal of Biological Macromolecules.* 55: 150 – 160.

Sepulveda - Ugarte, J., Brunet, J.E., Matamala, A.R., Oyanedel, J.M. and M. Bunster. 2011. Spectroscopic parameters of phycoerythrobilin and phycoroubilin on phycoerythrin from *Gracilaria chilensis*. *Journal of Photochemistry and Photobiology. A : Chemistry*.

Smith, J. H. C. and Benitz, A. 1955. Chlorophylls: analysis of plant materials. IN: Modern Methods of Plant Analysis (Eds.). Peach, K. and Tracey, M.V., Springer Publications, Berlin. 4. 142:196.

Tsang, C. K. 2001. Algal biotechnology industries and research activities in China. *J. Appl. Phycol*. 13: 375-380.

How to cite this article:

Suresh Kumar G., Marisamy K and Senthilkumar N..2017, Assessment of The Spectral And Biochemical Properties of Spyridia Filamentosa (Wulfen) Harvey And Acanthophora Spicifera (M.Vahl) Borgesen With Special Reference To Their Phycobiliproteins. *Int J Recent Sci Res.* 8(12), pp. 22399-22406. DOI: http://dx.doi.org/10.24327/ijrsr.2017.0812.1260

****