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REGULAR ARTICLE

HEAVY METAL AND BIOCHEMICAL CONTENT OF *SARGASSUM WIGHTII* OCCURRING IN TUTICORIN COAST, TAMIL NADU, INDIA

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SUMMARY

Investigations have been made to study the heavy metal composition of *Sargassum wightii* occurring in Tuticorin, Tamil Nadu. Different parts of *S. wightii* such as stem, leaf receptacle and air-bladder were subjected to the scrutiny of heavy metals such as Cd, Cr, Cu and Fe present in those parts of brown algae under atomic absorption spectrophotometer. The highest concentration of Cd was observed in leaf and lowest in air-bladder of S. wightii. The maximum level of Cr was observed in air bladder and low in stem. The concentration of copper was higher in stem, low in leaf of *S. wightii*. The accumulation of iron in receptacle was higher and lower in air bladder of *S. wightii*. Biochemicals such as total carbohydrate, total protein and total lipid contents were also estimated. The results showed that the protein content of *S. wightii* was higher than lipid and carbohydrate.

Keywords: Heavy metals, Accumulation, *Sargassum wightii*, Atomic absorption spectrophotometer.

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1. Introduction

India has vast coastline of 7500 km and the seaweeds are found to occur along the inter-tidal, sub-tidal and estuarine areas. Seaweeds are commercially very important for their phycocolloids viz., agar, carrageenan and alginate. In recent decades, the major challenging problem posed against nature is the 'environmental pollution'. Industries and factories usually discharge the wastewater into rivers, streams and lakes or into sea. This damages the aquatic ecosystem, rendering the water not useful for human activities. Seaweeds, which contribute significantly to the primary production of near-shore and estuarine ecosystems, readily accumulate trace metals from solutions, and for this reason, have been used extensively as biomonitors of metal contamination of seawater. Despite recognition of fact that various intrinsic and extrinsic factors can influence metal uptake, determination of the metal concentrations in seaweed is still considered to provide useful information about the level of metal contamination and environmental quality of an area, albeit of a qualitative nature (Lobban and Harrison, 1994). Treatment of these effluents is quite expensive and time consuming process. Seaweeds are to determine the environmental monitoring and restoration. So, some seaweeds are used as a biomonitors to study the environmental contamination. The seaweed *Sargassum wightii* is known to accumulate metals and it is used as bioindicator for heavy metal pollution.

2. Materials and Methods

The brown algae *Sargassum wightii* (Greville.) was collected from Tuticorin coast of Tamil Nadu at intertidal region (78º8'E, 90º17'N), morning hours, December 2005. Among different macroalgae living in Tuticorin coast, *Sargassum wightii* has been selected because of their abundance, actual use and potential relevance. *Sargassum* species was harvested for algin extraction. *Sargassum wightii* is suggested as a good bioindicator for heavy metals. Hence this brown seaweed was taken for this study. To investigate the heavy metals and biochemical content of *Sargassum wightii* different parts such as stem, leaf, receptacle and air bladder were cut separately and analyzed for heavy metals accumulation by acid digestion method (Lozano et al., 2003). The digested samples were analyzed for heavy metals using Perkin Elmer AA7 atomic absorption spectrophotometer. The seawater samples also collected at the same locality where the algae were collected and heavy metals are analyzed. (Strickland and Parsons,1972). The S.wightii was analyzed immediately for total carbohydrate (Dubois et al., 1956) total protein (Bradford, 1976) and total lipid (Barnes and Blackstock, 1973) content.

3. Results and Discussion

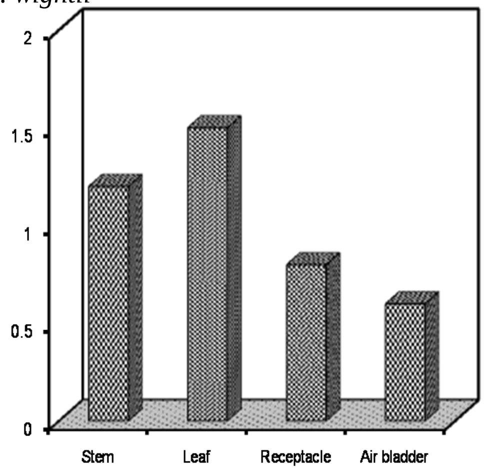
Different parts of *S. wightii* such as stem, leaf, receptacle and air bladder were subjected to the scrutiny of heavy metals present in those parts of brown algae under atomic absorption spectrophotometer. Among the four different heavy metals analyzed, iron concentration in the seawater showed highly elevated levels of 1800 mg L^{-1} followed by chromium 170 mg L^{-1} and copper 15 mg L^{-1}. The cadmium showed lowest concentration of 3.0 mg L^{-1} in the seawater sample (Table-1).

Table1. Different heavy metals available in seawater

S. No.	Heavy metals	Concentration (mg/L)
1.	Cadmium	3.0
2.	Chromium	170
3.	Copper	15.0
4.	Iron	1800

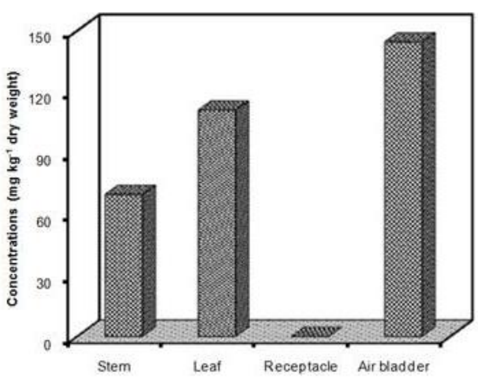
Marine macroalgae (seaweeds), which contribute significantly to the primary production of near shore and estuarine ecosystems, readily accumulate trace metals and for this reason seaweeds have been used extensively as biomonitors of metal contamination of seawater (Sawidis et al., 2001). Macroalgae are being widely used as biomonitors of metal pollution from point sources in estuarine and coastal environments (Phillips, 1995). Commonly, brown fucoid algae (*Fucus vesiculosus, Ascophyllum nodosum*) and green macroalgae belonging to Ulva and Enteromorpha are used, although other macrophytes including the members of Rhodophyta and seagrasses have been employed in some studies (Brown et al., 1999). Heavy metals such as cadmium, chromium, copper and iron were only analyzed. The highest concentration of cadmium of 1.5 mg Kg-1 dry weight was observed in *S. wightii* leaf followed by stem (1.2 mg Kg^{-1} dry weight) and receptacle (0.8 mg Kg^{-1} dry weight). The air bladder showed less concentration of cadmium of 0.6 mg Kg^{-1} dry weight (Fig. 1). There has been little research about the effects of Cd on macrophytes but some physiological investigations have been conducted on phytoplankton (Simpson, 1981).

Fig. 1. Cadmium concentration in different parts of *S. wightii*



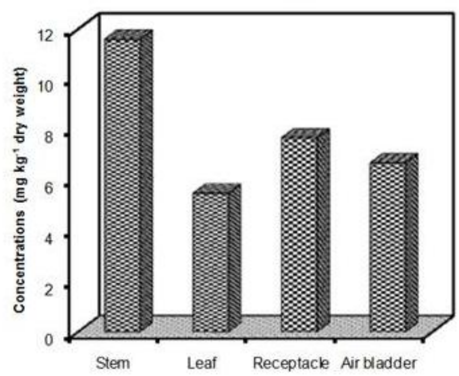
Cadmium is a serious pollutant for plants and animals, particularly in coastal waters near industrial areas and it occurs in seawater principally as $CdCl_2$. Among the different parts of *S. wightii* analyzed maximum chromium accumulation occurred in air bladder 144.5 mg Kg^{-1} dry weight whereas 69.7 mg Kg^{-1} dry weight was observed in stem. Moderate levels of 111 mg Kg^{-1} dry weight chromium were recorded in leaf. No chromium was noticed in receptacle (Fig. 2).

Fig. 2. Chromium composition in different parts of *S. wigthii*



The effect of Cr has not been thoroughly studied (Rai et al., 1980). Although Cr can occur in valence states from -2 to +6 Cr3+ and Cr6+ are the most commonly encountered in the environments. Chromium (iii) is an essential element for human beings and plants and Cr6+ is highly toxic to biota (Badich et al., 1982). In accordance with the observation made by Malea (1994) in the present study, maximum chromium accumulation was recorded in air bladder followed by leaf and stem. Analysis of heavy metal copper in stem of *S. wightii* revealed 11.6 mg Kg^{-1} dry weight, receptacle (7.7 mg kg^{-1} dry weight) and air bladder (6.7 mg Kg^{-1} dry weight). The lower concentration of copper accumulation observed in leaf was 5.5 mg Kg^{-1} dry weight (Fig.3).

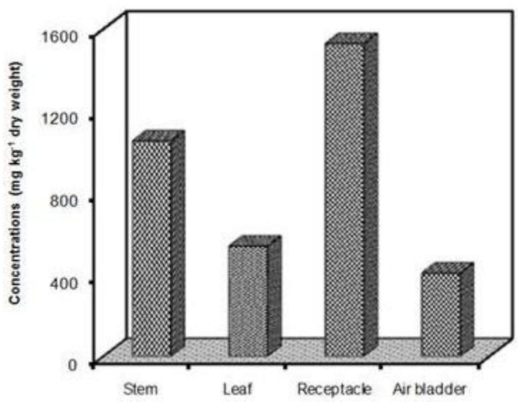
Fig. 3. Bioaccumulation of copper in different parts of *S. wigthii*



Higher concentration of copper caused irreversible damage to chloroplast lamellae, preventing photosynthesis and eventually causing death. Bioaccumulation of iron in different parts of *S. wightii* showed that elevated level of iron in receptacle (1529 mg Kg^{-1} dry weight) followed by stem (1053 mg Kg^{-1} dry weight), leaf (539 mg Kg^{-1} dry weight) and air bladder (408 mg Kg^{-1} dry weight) (Fig. 4). Even though iron-ore is non-toxic or absorbed by algae, juvenile plants and propagules can be adversely affected by it. But none describes the effect of iron-ore particles on the development of the macroalgae (Cristina et al., 2002) tested that the iron-ore particles are a physical barrier to the reproduction, growth and net photosynthesis of *Sargassum vulgare*. Among all the metals studied iron was higher than in all the other metals. It

may be the reason of the seawater contain higher amount of iron next to chloride and also it is a micronutrient to involve the algal growth and metabolism. Among the biochemicals studied maximum content of protein (60 μg mg-1 fresh weight), low content of carbohydrate (20 μg mg^{-1} fresh weight) and optimum content of lipid (42.0 μg mg-1 fresh weight) was observed in
S. wightii (Fig.5).

Fig. 4. Bioaccumulation of iron content in *S. wightii*



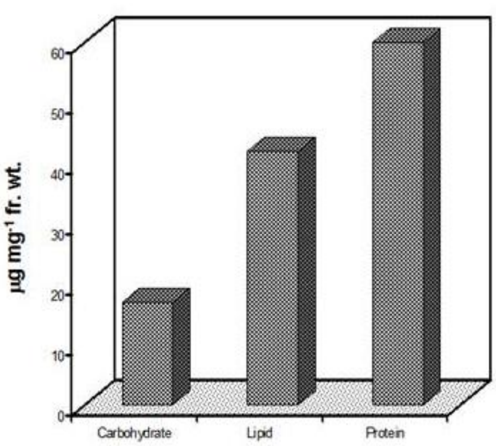


Fig. 5. Concentration of carbohydrate, lipid and protein contents of *S. wightii*

Studies on heavy metals and their accumulation have been carriedout in different marine algae viz. *Laminaria digitata* (Bryan, 1969), *Ectocarpus siliculosus*, (Russel and Morris, 1970) *Porphyra tenera* (Hiroyuki and Yoshishige, 1972) and Ulva rigida (Andyuschchenkok and Polikarpov, 1974), *Enteromorpha linza, Fucus vesiculosus* (Seelinger and Edwards, 1977). Dere et al., (2003) studied the total protein, total carbohydrate and pigment contents of macro algae.

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