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Original Article

Assessment of Seaweeds in Biomonitoring and Biosorption of Heavy Metals

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Abstract

The brown seaweeds *Sargassum sp.* and the green seaweed *Ulva sp.* were harvested from the coastal areas of Rameshwaram, Tamil Nadu, India. Copper (Cu), Zinc (Zn), Cadmium (Cd), Iron (Fe) and Lead (Pb) content of selected seaweeds were determined using Atomic absorption Spectrophotometer. In both seaweeds, metal content sequence was observe to follow the trend Fe>Zn>Cu>Cd and Pb was not detected. Biosorption found that absorption of Cadmium from dilute aqueous solution by the native biomass resulted in the adsorption of hydrogen ions as well and the release of other non-toxic light metal ions. The brown seaweed *Sargassum sp.* showed a higher potential for adsorption of Cadmium compared to the green seaweeds *Ulva sp.*, with a maximum uptake capacity of 191.1µg/g of dried weight of *Sargassum sp.* This study clearly shows that local seaweeds such as *Sargassum sp.* may be used as a potential biomonitor as well as cadmium absorbent from Industrial effluent.

Key words: Biosorption, Biomonitoring, Seaweeds, Atomic Absorption Spectrophotometer, Heavy metal.

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Introduction

Marine algae commonly called seaweeds are considered as the best bioindicator of heavy metals pollution, which is considered as an environmental problem of worldwide concern (Rainbow 1995, Chan *et al.,* 2006). Seaweeds are ecologically important as well as, they supply oxygen to the sea and act as one of the primary producers in the marine food chain. Seaweeds are able to bioaccumulate heavy metals upto concentrations that are many times higher than the corresponding concentrations in seawater and do not undergo short term concentration fluctuations (Bryan and Langston,1992). The most common heavy metal found are lead (Pb), Copper (Cu), Cadmium (Cd), Zinc (Zn) and nickel (Ni). The toxicity of these metals to organisms, including humans is well documented (AQTSDR Public health Statements).The uptake of heavy metals may differ between seaweeds species e. g brown seaweeds are considered to be better bioaccumulators of heavy metals than their green counterparts. It could be used as a universal bioindicator, capable of assessing heavy metal contamination under all natural condition. Macroalgae biomass has been considered as a relatively high adsorption capacity for removal of heavy metal ions has attracted attention over the last decades.

Material and Methods

Samples collected from the coastal area of Rameshwaram, Tamil Nadu. They washed in the field with natural seawater thoroughly and kept in ice-box, transported to the laboratory. Seaweeds sample rinsed in excess deionized water to remove common ion such as Sodium (Na) and Calcium (Ca) ion present in seawater. Samples oven dried and digested using various concentration of acid : 5:1 mixture of HNO_3 : $HClO_4$; 3:1 mixture of HNO_3 : $HClO_4$; Mixture of 5:1 and 0.5 of HNO_3 : $HClO_4$: H_2SO_4

Solution made in various concentrated acid were analyzed by using Perkin Elmer AA_7 Atomic Absorption Spectrophotometer.

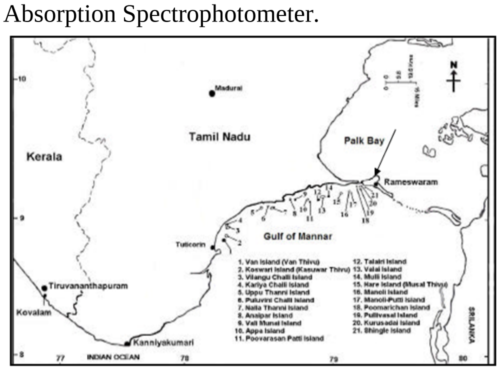

Figure 1: Map showing collection site of seaweeds from Rameshwaram (Arrow).

Result and Discussion

In this study, a total six species belonging to Chlorophyceae and Phaeophyceae were studied for the concentration of heavy metals (Fe, Cu, Zn, Cd & Pb) collected from Rameshwaram, Tamil Nadu, India. The accumulation of heavy metals for *Sargassum* and *Ulva* species were shown in Fig.2a – 2e.

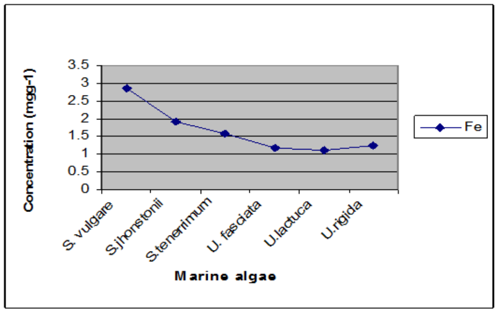

Fig. 2a: Showing the Iron (Fe) content in different types of Marine algae (Seaweeds)

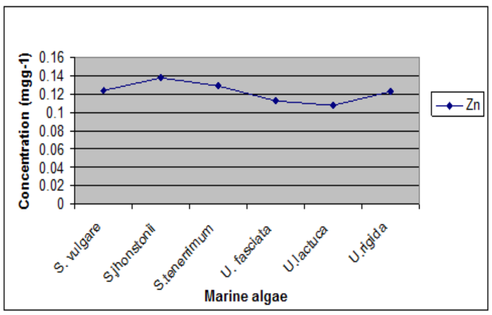

Fig.2b: Showing the Zinc (Zn) content in different types of Marine algae (Seaweeds)

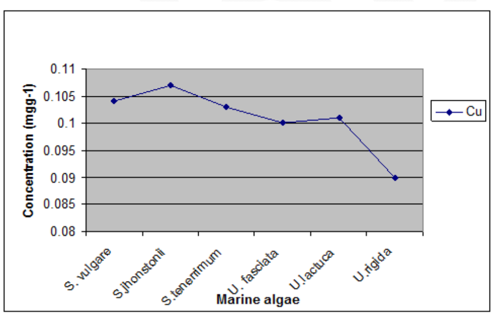

Fig.2c: Showing the Cupper (Cu) content in different types of Marine algae.

The concentration of Fe was vary from (2.872) mg/g to (1.104) mg/g, for Zn (0.108-0.137) mg/g, for Cu (0.090-0.107) mg/g, for Cd (0.027-0.0422) mg/g and for Pb (0.019-0.037) mg/g. There was a great variation found in the accumulation of metals among the different species of Phaeophyta and Chlorophyta. The concentration of Fe was highest in *S. vulgare* than *S. wightii* and *S. tenerrimum*. The most lowest concentration of Fe was observed in *U. lactuca*, belonging to Chlorophyta family (Fig. 2a).

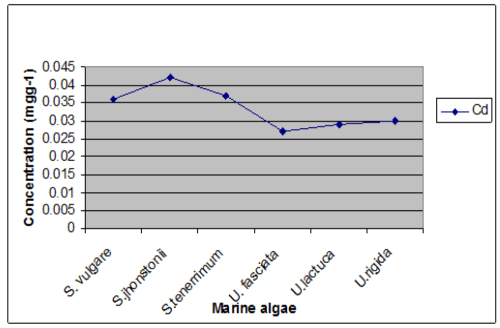

Fig.2d: Showing the Cadmium (Cd) content in different types of Marine algae.

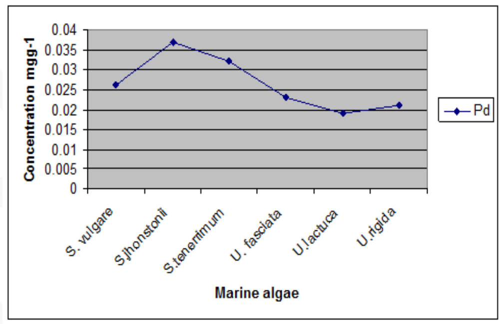

Figure 2e: Showing the Lead (Pb) content in different types of Marine algae.

Consequently, the concentration o9f Zn was observed highest *in S. jhonstonii* (0.137) m/gm. In figure 2b, the concentration of Zn slops down to *U.lactuca* (0.108) mg/g). The Cu and Cd & Pb concentration was highest in *S.jhonstonii* (0.107) mg/g, (0.042) mg/g, (0.037) mg/g than the species belonging to Chlorophyceae *U.rigida* (0.090) mg/g, *U. fasciata* (0.027) mg/g and *U. lactuca* (0.019) mg/g.

Among the biological materials investigated for heavy metals removal, the biomass of marine algae otherwise known as seaweeds has been reported to have high uptake capacities for a number of heavy metal ions (Bailey *et al.*, 1999; Pagnelli *et al.*, 2000; Bryan *et al.*, 1992; Rainbow *et al.*, 1992; Chen *et al.*, 1997; Wong *et al.*, 2002; Karthikkayan *et al.*, 2007).

Numerous studies on metal biosorption by brown seaweeds such as *Sargassum* have been reported in the literature. However, the application of green seaweeds biomass such as *Ulva* for metal removal has not been extensively investigated yet despite its large abundance in the world's shorelines.

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