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Research Paper

Comparative Account of Heavy Metal Level in Two Species of Chlorophyceae Inhabiting Indian Sundarbans

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Abstract: *We analyzed selective heavy metals (Zn, Cu and Pb) in two dominant species of family Chlorophyceae (Enteromorpha intestinalis and Ulva lactuca) in Indian Sundarbans by using AAS. The samples were collected during low tide from Gosaba, Bali Island and Jharkhali in premonsoon, monsoon and postmonsoon in 2014-15. The order of heavy metal accumulation is E. intestinalis > U. lactuca. In both the species, the order of metal accumulation of heavy metals is Zn > Cu > Pb. The seasonal sequence of accumulation is monsoon > postmonsoon > premonsoon. ANOVA carried on the observed data reflects pronounced variations between stations and seasons, but no significant variation between species is observed.*

Keywords: *Enteromorpha intestinalis*. *Ulva lactuca*. Heavy metals. Indian Sundarbans, AAS.

Introduction

Metal pollution due to anthropogenic sources may pose an adverse impact to marine and estuarine ecosystems as they can be introduced into food chain *via* accumulation in primary producers and may lead to toxic effects. Seaweeds are used as food by a wide variety of organisms including human beings and therefore the present study has considerable relevance. The seaweeds require hard substratum for their growth, which may be tree trunks (preferably mangroves) that get submerged during the high tide or even brick, boulders, pillars of jetties, concrete blocks that are often laid to enter the island from the adjacent bays or estuaries (Figure 1).

Seaweeds are classified mainly into three major classes *viz*. Chlorophyceae, Phaeophyceae and Rhodophyceae on the basis of pigmentation colour, morphological and anatomical characteristics[1-4]. The two seaweed species *Enteromorpha intestinalis* and *Ulva lactuca* are dominant in the intertidal zone of the mangrove dominated Indian Sundarbans, which is a Gangetic delta at the apex of Bay of Bengal in the north east coast of Indian sub-continent. These two species are distributed in almost all the islands of Sundarbans due to its wide range of tolerance to salinity[3-6]. Being benthic in nature, these species are exposed to heavy metals persisting in the estuaries of Sundarbans and therefore have been selected as the candidate species in the present study. The primary objective of this study was to compare the level of heavy metals (Zn, Cu and Pb) between two dominant members of Chlorophyceae (*E. intestinalis* and *U. lactuca*) in Indian Sundarbans through seasons during 2014-15.

Figure 1: Seaweeds on the boulders

Material and Methods

Sampling: The Indian Sundarbans (between 21°13′ N and 22°40′ N latitude and 88°03′ E and 89°07′ E longitude) is bordered by Bangladesh in the east, the Hooghly River (a continuation of the River Ganga) in the west, the Dampier and Hodges line in the north, and the Bay of Bengal in the south. With a considerable degree of marine characteristics in major portion of the ecosystem, the important geomorphologic features of deltaic Sundarbans are beaches, mudflats, coastal dunes, sand flats, estuaries, creeks, inlets and mangrove swamps[5] (Figure 2). The present study was carried out in three stations *viz.* Gosaba, Bali Island and Jharkhali in the central part of Indian Sundarbans (Table 1).

Figure 2: Creek in Indian Sundarbans

The samples were collected from each station during low tide and thoroughly washed with ambient water followed with double distilled water and brought to the laboratory for analysis in ice-freezed condition. This work was done during premonsoon, monsoon and postmonsoon in 2014-15.

Table 1: Sampling Stations in Indian Sundarbans

Station	Geographical Location	
	Latitude	Longitude
Gosaba (Stn. 1)	22°08'53.66" N	88°56'34.20" E
Bali Island (Stn. 2)	22°04'35.17" N	88°44'55.70" E
Jharkhali (Stn. 3)	22°05'52.82" N	88°41'47.25" E

Heavy metal analysis: 10 gm of the collected samples (from each station) were dried at 60ºC overnight. Each dried sample (1 gm on dry weight basis) was digested with a mixture of nitric acid and hydrogen peroxide followed by addition of hydrochloric acid[7]. The digested samples were analyzed for Zn, Cu and Pb against standard concentration of each metal on a Perkin Elmer Atomic Absorption Spectrophotometer (Model 3030) equipped with an HGA-500 graphite furnace atomizer and a deuterium background corrector. Blank correction was carried out to bring accuracy to the results.

Statistical analysis: Analysis of Variance (ANOVA) was performed through SPSS 16.0 to assess whether all the selected heavy metals varied significantly between species, stations and seasons; possibilities less than 1 % ($p < 0.01$) were considered statistically significant.

Results and Discussion

A comparative view of each of the selected heavy metals (Zn, Cu and Pb) in two selected species collected from three study sites during three different seasons is depicted in Figures 3-5. The accumulation of heavy metals followed the order Zn > Cu > Pb and the spatial variation was Gosaba > Jharkhali > Bali Island. ANOVA results confirm pronounced spatial and seasonal variations ($p < 0.05$) (Table 2). However, no significant difference between species was observed, which indicate their uniform uptake rate.

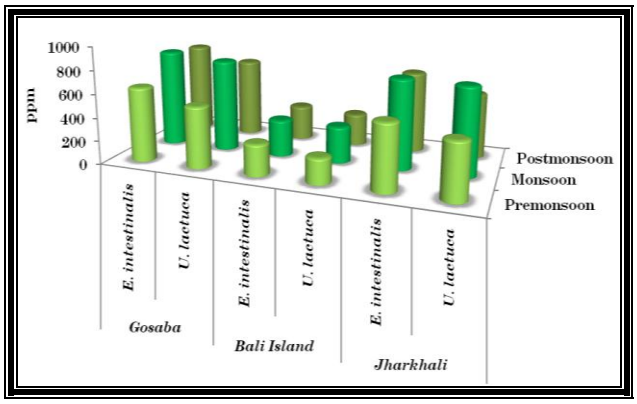

Figure 3: Concentrations of Zn (ppm dry weight) in *E. intestinalis* and *U. lactuca* in three stations during three seasons

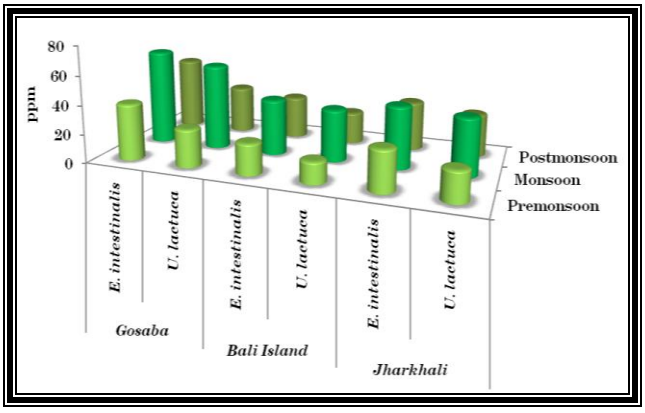

Figure 4: Concentrations of Cu (ppm dry weight) in *E. intestinalis* and *U. lactuca* in three stations during three seasons

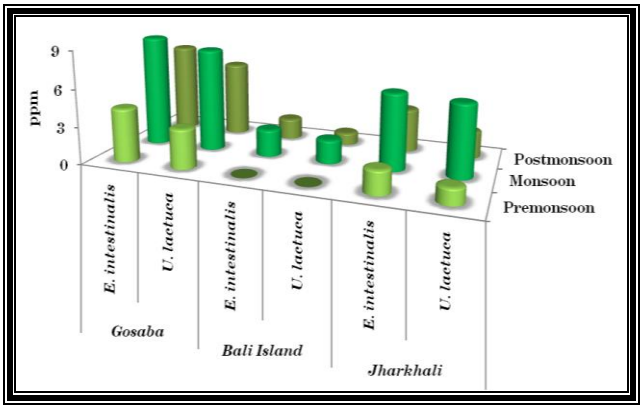

Figure 5: Concentrations of Pb (ppm dry weight) in *E. intestinalis* and *U. lactuca* in three stations during three seasons

Table 2: ANOVA results to depict spatio-temporal and inter-specific variations ($p < 0.05$)

Heavy metals	Variables	F_{cal}	F_{crit}
Zn	Between Species	11.046	18.513
	Between Stations	188.614	19
	Between Seasons	24.048	19
Cu	Between Species	9.819	18.513
	Between Stations	20.167	19
	Between Seasons	52.354	19
Pb	Between Species	12.645	18.513
	Between Stations	244.197	19
	Between Seasons	127.279	19

The three selected stations are located in and around the Matla River of central Indian Sundarbans. This river receives the discharge from the highly urbanized city of Kolkata through DWF (Dry Weather Flow) canal[3-5]. The variations in metal level between stations are due to proximity of the selected stations to the megacity. Gosaba, a busy fish landing station and a market place is extremely polluted on account of its proximity to Kolkata. This is reflected through the metal level in the body tissues of both the species. Jharkhali is a tourist place, where huge crowds are common throughout the year and this may be attributed to considerable level metals in the body tissues of these thallophytes. Bali, located almost close to the Reserve Forest is relatively free from pollution with minimum anthropogenic pressure. This may be the reason for lowest metal level in the species sampled from this station. Interestingly, the inter-specific variation of metal level is not observed in the present study, which suggests a similar uptake rate by both the species. According to many researchers both *E. intestinalis* and *U. lactuca* are the two different morphometric representations of the same species[8,9]. Thus the present research addresses towards DNA bar-coding of these two selected species to critically analyze the reason behind this inter-specific similarity.

The present study exhibited that these two Chlorophyceae members (*E. intestinalis* and *U. lactuca*) in Indian Sundarbans have unique seasonal variation in context to heavy metal accumulation with highest value during monsoon followed by postmonsoon and premonsoon.

The selected Chlorophyceae members followed the order of heavy metal accumulation Zn > Cu > Pb. The primary sources of heavy metals in the study sites are tourist boats, fishing vessels, use of antifouling paints for boats *etc*. (Figure 6) apart from industrial discharges[10]. Pb can also accumulate in the coastal ecosystem from the atmosphere[11].

Figure 6: Primary sources of heavy metals in the study site

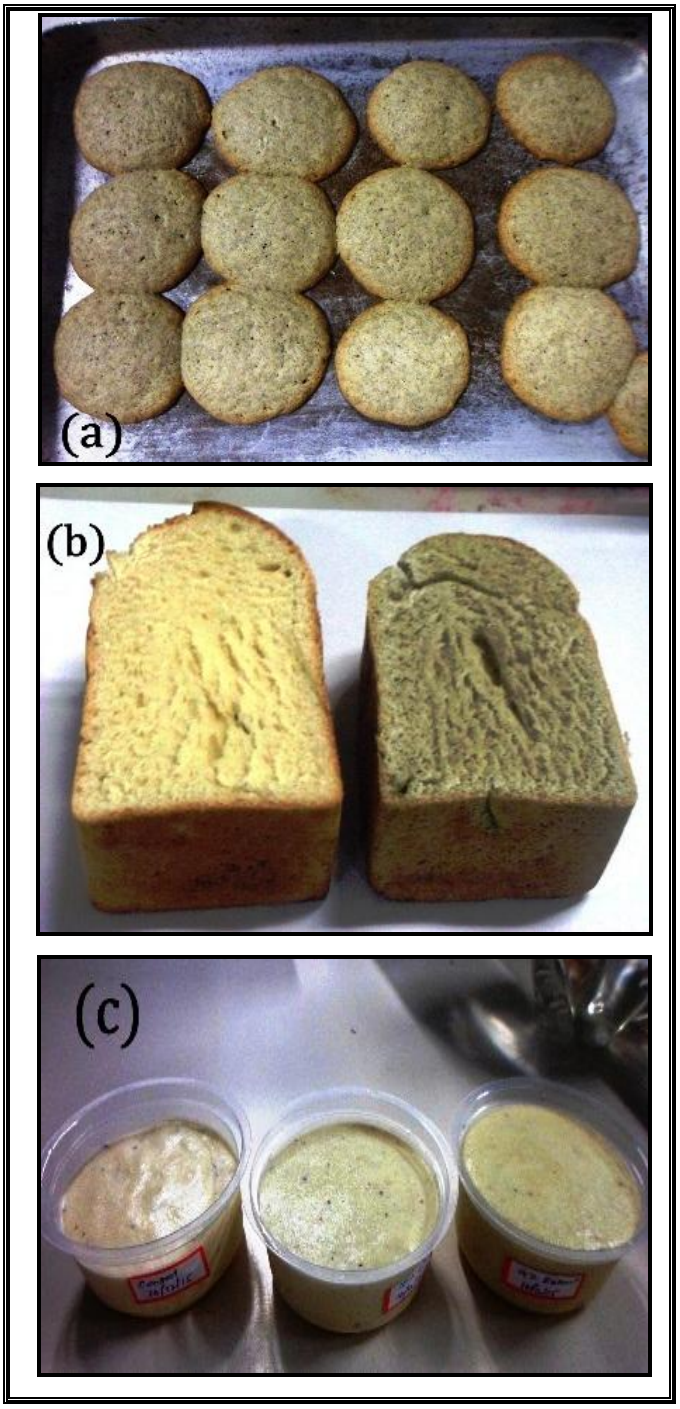

Figure 7: Food items from seaweeds collected from Indian Sundarbans: May be a road map for alternative livelihood

The present study has immense implications as seaweeds are consumed directly in many countries and even in Indian sub-continent pilot experiments have started to use seaweeds for preparing cookies, bread, ice creams and other food items (Figure 7a, 7b and 7c).

References

1. Manivannan K., Thirumaran G., Karthikai D.G., Anantharaman P. and Balasubramanian T. Proximate composition of different groups of seaweeds from Vedalai coastal waters (Gulf of Mannar): southeast coast of India, Middle-East, *Journal of Science Research*, **4 (2)**, 72–77 **(2009)**

2. Pramanick P., Zaman S. and Mitra P. A review on tropical seaweed diversity and benefits, *Journal of Chemical Biology and Physical Science*, **4 (4)**, 3909 – 3920 **(2014)**

3. Mitra A. and Zaman S. Blue carbon reservoir of the blue planet, published by Springer, ISBN 978-81-322-2106-7 (Springer DOI 10.1007/978-81-322-2107-4) **(2015)**

4. Mitra A. and Zaman S. Basics of Marine and Estuarine Ecology, (In press) **(2016)**

5. Mitra A. In: Sensitivity of Mangrove ecosystem to changing Climate. Springer DOI: 10.1007/978-; 81-322-1509-7, 323 **(2013)**

6. Mitra A. and Zaman S. Carbon Sequestration by Coastal Floral Community; published by The Energy and Resources Institute (TERI) TERI Press, India **(2014)**

7. Kumar S., Singh J., Das S. and Garg M. AAS Estimation of Heavy Metals and Trace elements in Indian Herbal Cosmetic Preparations, *Research Journal of Chemical Science*, **2 (3)**, 46-51 **(2012)**

8. Hayden H.S., Blomster J., Maggs C., Silva P., Stanhope M. and Waaland R. Linnaeus was right all along. Ulva and Enteromorpha are not distinct genera, *European Journal of Phycology*, **38**, 277-294 **(2003)**

9. Tan I.H., Blomster J., Hansen G., Leskinen E., Maggs C.A., Mann D.G., Sluimam, H.J. and Stanhope M.J. Molecular phylogenetic evidence for a reversible morphogenetic switch controlling the gross morphology of two common genera of sea weeds, *Ulva* and *Enteromorpha*, *Molecular Biology Evolution*, **16**, 1011-1018 **(1999)**

10.Mitra A., Banerjee K. and Sinha S. Shrimp tissue quality in the lower Gangetic delta at the apex of Bay of Bengal, *Toxicological and Environmental Chemistry*, **93 (3)**, 565 – 574 **(2011)**

11.Braune B., Muir D., DeMarch B., Gamberg M., Poole K., Currie R. et al, Spatial and temporal trends of contaminants in Canadian Arctic freshwater and terrestrial ecosystems: a review. *Science of the Total Environment*, **230**, 145 **(1999)**