International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979, Impact Factor: RJIF 5.72
www.allsubjectjournal.com
Volume 4; Issue 7; July 2017; Page No. 368-371

Comparitive study on heavy metal composition of different species of Ulva from selected coast of Kerala and Tamil Nadu

[*1] Geena George, [2] Lizzy Mathew

[1] R & D Centre, Bharathiar University Coimbatore, Tamil Nadu, India
[2] Department of Botany, St. Teresa's College, Ernakulum, Kerala, India

Abstract
Seaweeds or marine macro algae constitute one of the commercially important renewable marine living resources. They are one of the ecologically and economically important living resources of the world oceans. Seaweeds contain different vitamins, minerals, trace elements, proteins and bioactive substances. They are an extraordinary source of colloidal minerals and trace elements. Analysis of heavy metals such as Manganese (Mn), Copper (Cu), Cobalt (Co), Zinc (Zn), Chromium (Cr), Nickel (Ni), Lead (Pb) and Cadmium (Cd) were done in three *Ulva* species viz, *Ulva reticulata*, *Ulva lactuca* and *Ulva fasciata* of the class Chlorophyceae. Algal samples were collected from Thikkody from Kerala and Mandapam from Tamil Nadu coast. There was a comparable variation was found in heavy metal concentration among the studied seaweed samples and location wise difference was also noticed. The results indicated that different species possessed various degrees of metal accumulation. Among the heavy metals studied, Mn was found to be high in all the algal samples in both localities. It was observed that Zn concentration was found to be high in all the species of *Ulva* from Tamil Nadu compared to Kerala. It was found that the concentration of Pb was below the Acceptable daily Intake (ADI) in all the studied samples from Tamil Nadu coast. General trend found in the present study was that more quantity of heavy metals from Thikkody compared to Mandapam.

Keywords: heavy metals, seaweeds, acceptable daily intake, chlorophyceae, ulva species

1. Introduction

Seaweeds are simple plants widely distributed from the tidal level to considerable depths, floating freely or attached to substrates. They grow in the intertidal as well as in the sub tidal region up to a certain depth where 0.1% photosynthetic light is available. They are one of the ecologically and economically important living resources of the world oceans. Seaweeds contain different vitamins, minerals, trace elements, proteins and bioactive substances [1]. About 20,000 species of seaweeds are distributed throughout the world, of which 221 are commercially utilized, which includes 145 species for food and 110 species for phycocolloid production [2]. Algae are very closely associated with the human health are being exhaustively used in numerous ways as a source of food, feed, fertilizer, medicine and chiefly for economically important phycocolloids[3]. The pharmaceutical industry has shown great interest in the use of algae as a source of biochemically active substances[4]. The fact that algae may produce chemical prototypes of new therapeutic agents has stimulated bio prospecting for new algal secondary metabolites and the synthetic modification of compounds with potential pharmaceutical applications [5]. In addition to novel biologically active substances, algae also provide compounds essential to human nutrition [6].

India is one of the 12 leading bio-diversity centers with the presence of over 45,000 different plant species. From this flora 15,000 to 20,000 have good medicinal values [7]. Amongst all of these herbal alternatives algae, especially marine algae are least explored for their medicinal properties. The identification of bioactive compounds present in marine algae is a new potential area [8]. About 221 seaweeds are utilized commercially world-wide of which 65% are used as human food [9]. From nutritional point of view, seaweeds are characterized by high concentrations of fiber and minerals [10, 11], low fat content and in some cases relatively high protein levels [12]. Seaweeds may contain a high mineral content, as their cell wall polysaccharides and proteins contain anionic carboxyl, sulphate and phosphate groups that are excellent binding sites for metal retention [13]. Seaweed could be used as a food supplement in order to reach the recommended daily intakes of some macro minerals and trace elements [14]. In general, the mineral content of seaweeds is as high as (8–40%) and this includes the essential minerals and trace elements needed for human nutrition [15, 16]. This wide range in mineral content is not found in edible land plants and it is related to factors such as seaweed phylum, geographical origin, and seasonal, environmental and physiological variations [15].

2. Materials and Method

2.1 Sample collection and Evaluation

Ulva fasciata, *Ulva lactuca* and *Ulva reticulata* were collected from Thikkody of Kerala and Mandapam of Tamil Nadu. All the samples were harvested manually from their respective sites during low tides, washed with seawater to remove the foreign particles, sand particles and epiphytes and then transported to the laboratory in wet condition in an ice box. They were thoroughly cleaned using tap water followed by distilled water to remove the salt on the surface of the sample. Algal samples were spread on blotting paper to remove excess amount of water and shade dried at room temperature until constant weight was obtained. The dried algal samples were subjected to grinding to make fine powders for the present studt. Heavy metal analysis was carried out using Inductively Coupled Plasma – Atomic Emission Spectroscopy (ICP-AES) [17]. Heavy metals like Mn (Manganese), Cu (Copper), Co (Cobalt), Zn (Zinc), Cr (Chromium), Ni (Nickel), Pb (Lead) and Cd (Cadmium) were evaluated. All determinations were performed in triplicate and data represented in ppm on dry weight basis as mean values (Mean ± standard deviation).

3. Result and Discussion

Heavy metals being non-biodegradable can accumulate at various tropic levels through the food chain and can cause human health problems [18]. In humans, these metals build up in living tissues and thus increase the dangers they pose by causing physical distress and life threatening illness such as damage to vital body systems [19]. Seaweeds are excellent agents for filtering heavy metals such as zinc, cadmium, copper, nickel and iron from the sea. Seaweeds are able to accumulate these metals from their environment into body cells to as much as 4,000 to 20,000 times more than in the surrounding waters [19].

Many studies have been conducted to determine the toxic levels of heavy metals for certain plants, especially those metals considered as public health threats [20]. At the low concentrations some of the heavy metals excite some biological processes, but at threshold concentration these become toxic. Being non-biodegradable, these metals accumulate at various tropic levels through food chain and can cause human health problems. The composition of heavy metals such as Manganese (Mn), Copper(Cu), Cobalt (Co), Zinc (Zn), Chromium (Cr), Nickel (Ni), Lead (Pb) and Cadmium (Cd) were studied in *Ulva fasciata*, *Ulva lactuca* and *Ulva reticulata* collected from Mandapam (Tamil Nadu) and Thikkody (Kerala) coast.

Acceptable daily intake for Mn is 69.2 ppm. Among the studied green seaweeds collected from Thikkody, concentration of Mn was found to be high in *U.reticulata* (21.85± 0.17) compared to *U.lactuca* (11.49±0.45), but the quantity was found to be almost of the same in *U.fasciata* (21.72±0.27). Distribution of Mn from Mandapam coast was found to be maximum in *U.reticulata* (90.73±0.1) which is much higher than the acceptable daily intake level. It was noticed a species wise and location wise difference in the quantity of Mn in all the Ulva species collected from both the sites selected for the study. Concentration of Mn in the selected species from Thikkody decreased in the order as: *Ulva reticulate* > *Ulva fasciata* >*Ulva lactuca* and from Mandapam as *U.reticulata*>*U.lactuca*>*U.fasciata*. Occurrence of higher concentration of Mn in plants is a common feature for maintaining osmotic balance, ion regulation and for enzyme catalysis [21]. The earlier report [22] also observed the high concentrations of manganese in seaweeds. Although they are essential micronutrients for plants it became more toxic at higher concentrations than the amount required for normal growth [23].

Copper which also fell within the toxic range is an essential micronutrient in plants but at high concentrations can affect photosynthesis and lead to de-pigmentation as well as depressing growth in plants [24]. All algal species from Kerala coast showed approximately similar pattern of Cu levels *Ulva lactuca* > *Ulva reticulata* >*Ulva fasciata* and maximum quantity of Cu was found in *U.lactuca* (7.91±0.32). Compared to the distribution of Cu in all the species of Ulva from Thikkody and Mandapam, maximum was reported in *Ulva fasciata* (15.20±0.23) from Mandapam. All the algal samples studied from both the locations were found to be below the ADI (169 ppm). It was observed the Zinc concentration was found to be high in all the species of Ulva from Mandapam compared to Thikkody and maximum in *U. lactuca* (85.66±0.21). The range of Zn concentration of the studied samples from Kerala varied from 5.84 ppm to 7.91 ppm. The concentration of Zinc may be attributed or controlled by activators of dehydrogenases and protein-synthesis enzymes in this species[25]. The ADI for Cr is 1.54 ppm. It was observed that the concentration of Cr was above ADI in all the studied samples from both the locations. There was not much variation in the concentration of Cr among Ulva species from Thikkody. But a comparable difference was observed in the studied samples from Mandapam. The maximum concentration of Cr from Mandapam was (10.64±0.35) in *U.lactuca.*

Maximum concentration of Ni was observed in *U.lactuca* from Thikkody (4.27±0.29) which is above ADI of Ni (1.85 ppm). From Mandapam coast, the level of Ni was found to be (1.67±0.39) and (1.38±0.29 ppm) in *U.fasciata* and *U.lactuca* respectively. But in *U.reticulata* the concentration of Ni was below detection level. Heavy metals, such as Cd and Pb have unknown roles in living organisms, and are toxic even at lower concentrations. It was found that the concentration of Pb was below the ADI (10ppm) in all the studied samples from Mandapam coast of Tamil Nadu, and it ranges from (0.55 ±0.38) to (6.11±0.20). The concentration of Cd was found to be more than ADI (0.3ppm) in all the species from both Kerala and Tamil Nadu except for *U.lactuca* (0.3±0.22ppm). The order of decreasing concentration of Cd from Thikkody was *U.lactuca* > *U.reticulata* > *U.fasciata*. (Figure 1 – 3 represents the distribution of heavy metals in three Ulva species from selected coast of Kerala and Tamil Nadu)

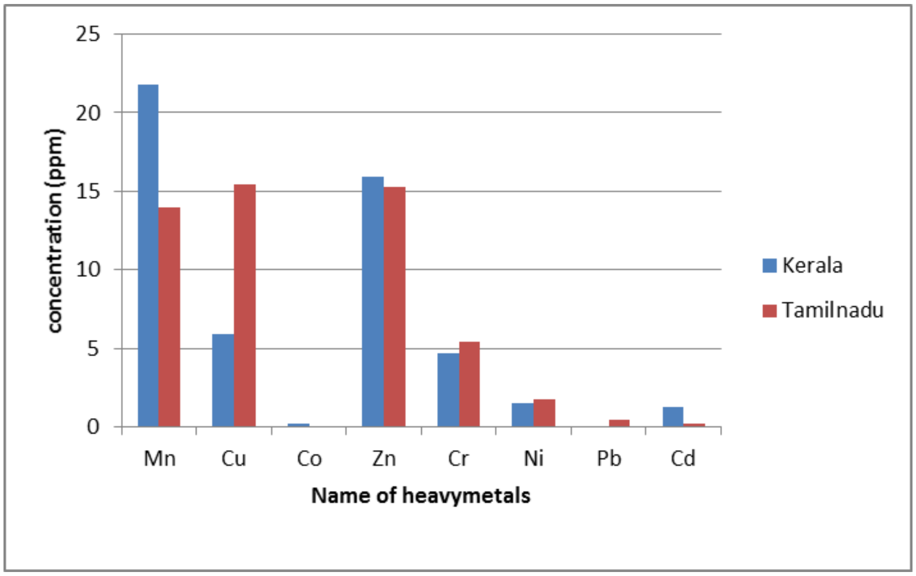

Fig 1: Distribution of Heavy metals in *Ulva fasciata* from Kerala (Thikkody) and Mandapam (Tamil Nadu)

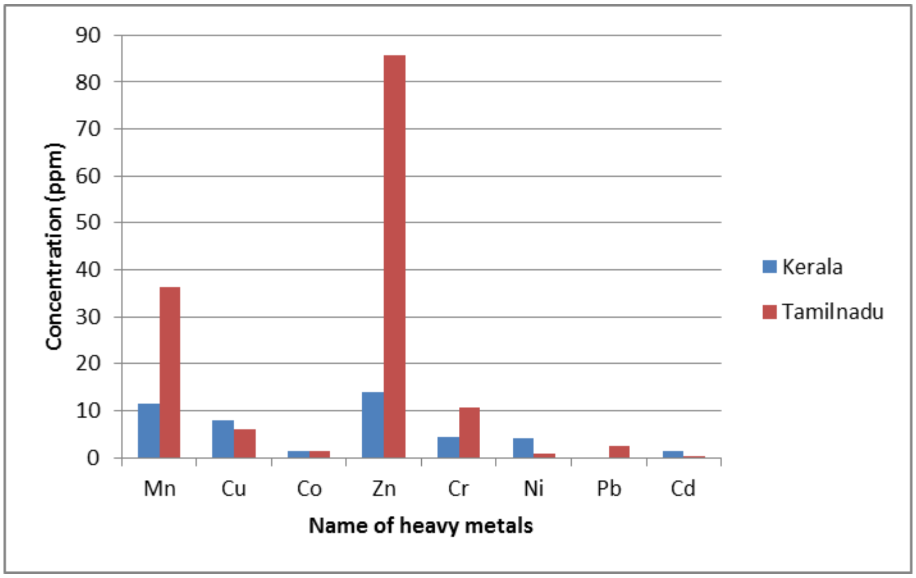

Fig: 2- Distribution of Heavy metals in *Ulva lactuca* from Kerala (Thikkody) and Mandapam (Tamil Nadu)

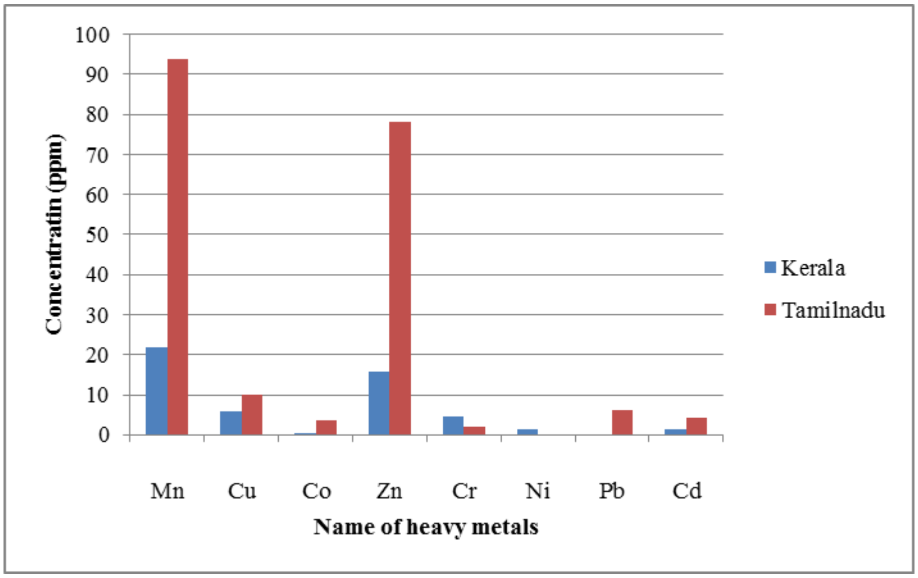

Fig: 3- Distribution of Heavy metals *in Ulva reticulata* from Kerala (Thikkody) and Mandapam (Tamil Nadu)

4. Conclusion

The present study indicated that there was species wise and location wise difference in heavy metal concentration among the Ulva species. It was also found that less content of heavy metals were present in Ulva species from Thikkody coast, Kerala compared to Mandapam coast, Tamil Nadu. The investigation of heavy metal concentrations in the Ulva species may provide useful information on the transfer of potentially toxic elements from biotic compartments (water and sediments) to higher consumers, including human beings. However, even if the use of Ulva species as bio monitors for heavy metals seems advantageous for many reasons, further studies are needed in order to strengthen the routine use in marine bio monitoring, aiming to fully clarify their actual accumulation pattern.

5. Acknowledgement

The authors are thankful to the authorities of, Sophisticated Test and Instrumentation Centre, Cochin for giving their help in completing the present work. The authors wish to thank the authorities of CMFRI Cochin, for providing proper guidance in identification of the selected seaweed species.

6. References

1. Dharmesh R, Stalin K, Ramavatar M, Siddhanta AK. Antioxidant activity and phytochemical analysis of a few Indian seaweed species Indian J Geo-Mar. Sci. 2014; 43:507-51.
2. Chennubhotla VSK, Umamaheswara Rao M, Rao KS. Commercial importance of marine macroalgae. Seaweed Res. Utiln. 2013; 35(1-2):118-128.
3. Levering T, Hoppe HA, Schmid OJ. Marine Algae. A survey of research and Utilization. Granm be Gruyter & Co., Hamburg, 1969, 1-421.
4. Singh S, Kate BN, Banerjee UC. Bioactive compounds from cyanobacteria and microalgae: an overview. Crit Rev Biotechnol. 2005; 25:73-95.
5. Cardozo KHM, Guaratini T, Barros MP, Falcão VR, Tonon AP, Lopes NP, *et al.* Metabolites from algae with economical impact. Comp Biochem Physiol C-Toxicol Pharmacol. 2007; 146:60-78.
6. Gressler V, Fujii MT, Martins AP, Colepicolo P, Mancini-Filhod J, Pinto E. Biochemical composition of two red seaweed species grown on the Brazilian coast. J Sci. Food Agric. 2011; 91:1687-1692.
7. Kamboj VP. Herbal Medicine. Current Science. 2000; 78:35-39.
8. Rizvi SI, Mishra N. Traditional Indian medicines used for the management of diabetes mellitus. J Diabetes Res. 2013; doi: 10.1155/2013/712092.
9. Zemke-White LW, Ohno M. World seaweed utilization: end-of-century summary. Journal of Applied Phycology. 1999: 11:369-376.
10. Burtin P. Nutritional value of seaweeds. EJEAF Che. 2009; 2:498-503.
11. Bocanegra A, Bastida S, Benedí J, Ródenas S, Sánchez-Muniz FJ. Characteristics and nutritional and cardiovascular-health properties of seaweeds. J Med. Food. 2003; 12:236-258.
12. Galland-Irmouli AV, Fleurence J, Lamghari R, Lucon M, Rouxel C, Barbaroux O, *et al.* Nutritional value of proteins from edible seaweed *Palmaria palmata* (Dulse). Journal of Nutrition Biochemistry.1999; 10:353-359.
13. Davis TA, Volesky B, Mucci A. A review of the biochemistry of heavy metal biosorption by brown algae. Water Research. 2003; 37:4311-4330.
14. Rúperez P. Mineral content of edible marine seaweeds. Food Chem. 2002; 79:23-26.
15. Mabeau S, Fleurence J. Seaweed in food products: biochemical and nutritional aspects. Trends in Food Science and Technology. 1993; 4:103-107.
16. Ortega-Calvo JJ, Mazuelos C, Hermosı´n B, Sa´ iz-Jime´nez CO. Chemical composition of Spirulina and eucaryotic algae food products marketed in Spain. Journal of Applied Phycology. 1993; 5:425-435.
17. Farias S, Arisnabarreata SP, Vodopivez C, Simichowski P. Levels of essential and potential toxic metals in Antarctic macroalgae. *Spectrochimica Acta* Part B. 2002; 57:2133-2140.
18. He M, Wang Z, Tang H. The chemical, toxicological and ecological studies in assessing the heavy metal pollution in the Le River, China. Water Resour. 1998; 32:510-518.
19. Sudharsan S, Seedevi P, Ramasamy P, Subhapradha N, Vairamani S, Shanmugam A. Heavy metal accumulation in seaweeds and sea grasses along Southeast Coast of India. J Chem. Pharm. Res. 2012; 4(9):4240-4244.
20. Plaza M, Cifuentes A, Ibáñez E. In the search of new functional food ingredients from algae. Trends Food Sci. Technol. 2008; 19:31-39.
21. Clarkson DT, Hanson JB. The mineral nutrition of higher plants, 1980.
22. Homaidan AA, Al-Ghanayem AH, Alkhalifa. Green algae as bioindicators of heavy metal pollution in Wadi Hanifah Stream, Riyadh, Saudi Arabia Int. J Water Resour. Arid Environ. 2011, 10-15.
23. Nies DH. Microbial heavy metal resistance Appl. Microbiol. Biotechnol. 1999; 51:73-75.
24. Sathya KS, Balakrishnan KP. Physiology of phytoplankton in relation to metal concentration: Effect of cadmium on *Scenedesmus bijugatus* and *Nitzschia palea*. Water Air Soil Pollut. 1988; 38(3-4):283-297.
25. Besada V, Andrade JM, Schultze F, Gonzalez JJ. Heavy metals in edible seaweeds commercialised for human consumption J Mar. Syst. 2009, 305-313.