EVALUATION OF MINERAL COMPOSITION IN THREE SPECIES OF ULVA FROM KERALA COAST

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ABSTRACT Seaweeds possess more bio-available minerals than any other class of food. They are an extraordinary source of colloidal minerals and trace elements. Seaweeds can accumulate essential mineral elements. The present study deals with the assessment of the elemental composition (Calcium, Iron, Potassium Magnesium, Sodium, Manganese, Copper and Zinc) of three Ulva species from Kerala coast. The minerals were detected by using ICP-AES method. In the present study the elemental concentration pattern was Mg>Ca>Na>K>Zn>Cu>Mn>Fe. The results revealed that, out of eight minerals detected, most abundant mineral was, Magnesium in all the samples analysed. Trace elements such as Zn, Cu, Mn, and Fe was found to be less in quantity in all the species compared to other minerals studied.

KEYWORDS : ULVA, MINERAL COMPOSITION, KERALA COAST, MARINE MACRO ALGAE

INTRODUCTION

Marine macro algae are non flowering primitive plants. Unlike other terrestrial plants, the plant body of seaweeds is not differentiated into true roots, stems or leaves. They are widely distributed in the intertidal and sub tidal regions of the sea, estuaries and back waters. Seaweeds flourish wherever rocky, coral or suitable substrata are available for their attachment. Based on morphology, cell wall and pigment composition, they are classified into green (Chlorophyceae), red (Rhodophyceae) and brown (Phaeophyceae) algae (Chapman, 1970).

Seaweeds have been used since ancient times as food, fodder, fertilizer and as a source of medicine. Today they are the raw material for many industrial productions like agar, algin and carrageenan but they continue to be widely consumed as food in Asian countries (Mishra *et al.*, 1993). Several reports and studies revealed that seaweeds are also used for waste water treatment (i.e. biofiltration, bioremediation). Fresh and dry seaweeds are extensively consumed by people especially living in the coastal areas. From the literature, it is observed that the edible seaweeds contain a significant amount of the protein, vitamins and minerals, which are essential nutrition for human (Fayaz *et al.*, 2005).

Seaweeds possess more bio-available minerals than anyother class of food. Seaweeds are an extraordinary source of colloidal minerals and trace elements.Seaweeds can accumulate essential mineral elements, such as Ca (Calcium), Mg (Magnesium), Co (Cobalt), Se (Selenium), Fe (Iron) andI (Iodine) from seawater at higher rates than land vegetables (Ruperez 2002). However, as a result of environmental pollution, seaweeds can also concentrate several toxic elements, such as arsenic (As), lead (Pb), and cadmium (Cd) (MacArtain *et al.,* 2007). Seaweed solutions are also utilized as tonics for detoxification and nutritional supplementation resulting from diseases such as rickets, tuberculosis and various states of debility.

Seaweed could be used as a food supplement in order to reach the recommended daily intakes of some macrominerals and trace elements (Rúperez, 2002). In general, the mineral content of seaweeds is as high as 8– 40% as this includes the essential minerals and trace elements needed for human nutrition (Mabeau and Fleurence, 1993; Ortega-Calvo *et al.*, 1993). 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 (Mabeau and Fleurence, 1993). The objective of the present investigation was to analyse the selected minerals and trace elements in three different species of *Ulva* from the algal class chlorophyceae.

MATERIALS AND METHODS

Study Area

Three different species of chlorophyceae, *viz*, *Ulva lactuca*, *Ulva fasciata* and *Ulva reticulata* were selected for the present study. The algal samples were collected from three coastal regions of Kerala at the time of low tides. The locations chosen for algal collection were Thikkody (11°28N lat. and 75°37E long.) in Calicut district, Njarakkal (10.047°N lat. 76.217°E long.) in Ernakulam district, and

Thirumullavaram in Kollam district (8°53 N lat & 76°33 E long.). *Ulva reticulata* were collected from Thikkody, *Ulva fasciata* were from Njarakkal and *Ulva lactuca* were obtained from Thirumullavaram. The sandy beaches are interrupted by rocky cliffs at Thikkody, inter tidal and sub tidal rocky substrates were observed at Thirumullavaram, while it is comprised of sandy beaches in Njarakkal with fairly good algal growth on the rocky boulders especially during the monsoons.

Sample preparation

The algal samples were handpicked and thoroughly washed first with seawater to remove all the impurities, sand particles and epiphytes. Then they were brought to the laboratory and washed thoroughly with freshwater to remove salt from the surface of the samples and finally with distilled water. After draining off water using blotting paper excess water was removed from the algal materials. They were then shade dried for 7-10 days, and grounded to fine powder. The powdered samples were subjected for the detection of minerals by ICP-AES method.

Mineral analysis

Minerals such as Mg (Magnesium), Na (Sodium), K (Potassium), Ca (Calcium), Fe(Iron), Mn (Manganese), Cu (Copper) and Zn(Zinc), were detected by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) method.1g of the dry sample was weighed and digested in 100ml glass beaker with 20 ml concentrated HNO_3 overnight. It was then mixed with 10ml of Concentrated HNO_3andPerchloric acid (4:1) solution followed by evaporating the acid mixture by keeping the beaker on a hot plate at 120^0C for complete dryness.The residue was then made up to 20 ml solution by milli-Q water with 20% HNO_3after filtering through Whatman No.1 filter paper. Then the element concentration was determined by ICP-AES. (Aceto *et al.*, 2002) The analysis were performed in triplicate and data represented on dry weight basisin mg/g as meanvalues (Mean ± standard deviation).

RESULTS AND DISCUSSION

Marine algae have high mineral content than that of land plants and animal products (Ito and Hori 1989) and it ranges as high as (8 – 40%) essential minerals and trace elements needed for human nutrition and been used as food materials, live stock feed and fish feed.In the present study, the amount of Magnesiumwas found to be more in *Ulvareticulata*(16.81 ±0.9) than *Ulva lactuca* (15.14±0.14) and *Ulva fasciata* (13.86±0.46).Calcium content was almost same in *U. fasciata* (7.18.±1.35) and *U. Reticulate* (7.43±0.48) compared to *U. lactuca* (8.91±1.90).The concentration of Sodium was found to be maximum in *U. fasciata* (3.26±0.84) and Potassium was in *U. Reticulate* (2.09± 0.17).Trace elements such as Zinc, Copper, Manganese, and Iron were found to be less in quantity in all the speciescompared to other minerals studied.Thevalues are graphically representedas mg/g DW in Fig 1-3.

Mineral contents are shown to vary according to species, wave exposure, seasonal, annual, environmental and physiological factors and the type of processing and method of mineralization (Yoshie *et al.,* 1994).In the present study, the concentration pattern of the elements

studied were Mg>Ca>Na>K>Zn>Cu>Mn> Fe. The results revealed that, out of eight minerals quantified, most abundant mineral was Magnesium in all the samples analysed.The Seaweeds are also one of the most important vegetable sources of calcium. Their calcium content may be as high as 7 % of the dry weight and up to 25 to 34 % in the chalky seaweed, Lithothamnion. So, seaweed consumption may be useful in the case of expectant mothers, adolescents, and elderly that all exposed to a risk of calcium deficiency (Burtin 2003).Seaweeds are known as an excellent source of vitamins and minerals, especially Sodium and Iodine, due to their high polysaccharide content which could also imply a high level of soluble and insoluble dietary fiber (Lahaye 1991). Defects in minerals are capable of producing severe impairment of health. For instances, Calcium malnutrition causes abnormal bone formation, namely Osteoporosis and anemia caused from Iron deficiency (Reinhold, 1988; Martinez – Navareete *et al.,* 2002). Deficiency in Magnesium can result in a variety of metabolic abnormalities, such as Potassiumdepletion and clinical presentations. The most common minerals found in seafood are iodine, Magnesium, Calcium, Phosphorus, Iron, Potassium Copper and Fluoride (Ensninger *et al.,* 1995). Minerals are very important for the biochemical reaction in the body as a co-factor of enzyme. For examples, Calcium, Phosphorous, and Magnesium build and maintain bones and teeth whereas, Sodium and Potassium help maintain balance of water, acids and bases in fluids outside of cells, an involve in acid-base balance and transfer of nutrients in and out of individual cells, respectively (Ensninger *et al.,* 1995).
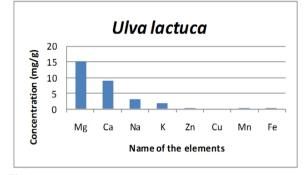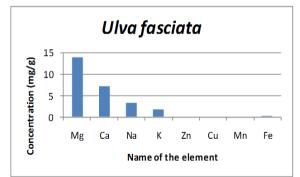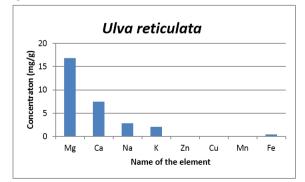

Fig:1

Fig: 2

Fig: 3

Fig1-3: Composition of elements in *Ulva fasciata*, *Ulva lactuca* and *Ulva reticulate* expressed in mg/g Dry Weight.

CONCLUSION

In the present study it was found that the concentration of elements varied at species level which can be attributed in taxonomic identification of the class. High amount of Magnesium, Calcium, Sodium and Potassium indicates the nutritive properties of the selected species of Ulva. The presence of trace metals such as Zinc, Manganese, Copper and Iron can be related to the bioaccumulation property of the seaweedsand their role as indicators of metal pollution.Further studies are required to confirm the role of these seaweeds to understand their role as food and pharmaceuticals industries.

REFERENCES

1. Aceto M., Abollino O., Bruzzoniti M.C., Mentasti E., Sarzanini C. and Malandrino M. 2002.Determination of Metals in vine with Atomic Spectroscopy (Flame – AS, GF-AAS and ICP-AES) a review. Food additives and contaminants. 19(2):126-133.
2. Burtin P. 2003. Nutritional value of seaweeds. EJEAF Che. 2: 498-503.
3. Chapman V J. 1970. Seaweedsand their Uses. 2nd Edn. Methuen, London.
4. Ensminger A.H, Ensminger M.E., Konlande J.E. and Robson J.R.K. 1995. The ConcisenEncyclopedia of Foods and Nutrition. CRC Press, Boca Raton Florida.
5. Ito K. and Hori, K. 1989. Seaweed: chemical composition and potential uses. Food Review International. 5: 101–144.
6. Lahaye M. 1991. Marine algae as sources of fibres: Determination of soluble and insoluble dietary fibre contents in some 'sea vegetables'. Journal of Science for Food and Agriculture. 54: 587-594.
7. MabeauS., and Fleurence J. 1993. Seaweed in food products: biochemical and nutritional aspects. Trends in Food Science and Technology 4: 103–107.
8. MacArtainR., Gill C.I.R., Brooks M., Campbell R and Rowland I.R.2007.Nutritional value of edible seaweeds. Nutr Rev. 65:535–543.
9. Martinez-Navarrete N., Camacho M.M., MartinezLahuerta J., Mertinez-Monzo J. and Fito P.2002.Iron deficiency and iron fortified foods a review. Food Res. Intern. 35: 225-231.
10. Mishra V.K., F. Temelli P.F. OoraikulShacklock and J.S. Craigie,.1993. Lipids of the red alga Palmariapalmata.Botanica Marina. 36(2): 169-174.
11. Mohamed Fayaz K.K., Namitha K.N., Chidambara Murthy M., MahadevaSwamy R., Sarada Salma Khanam and SubbaraoP.V2005.Chemical composition, iron bioavailability and antioxidant activity of Kappaphycusalvarezii (Doty). J Agri Food Chem, 53: 792- 797.
12. Ortega-Calvo J. J., Mazuelos C., Hermosı´n, B. and Sa´iz-Jime´nez,C.1993.Chemical composition ofSpirulinaandEukaryotic algae food products marketed in Spain. Journal of Applied Phycology. 5: 425–435.
13. Reinhold J.G. 1988. Problems in mineral nutrition: A global perspective. In: Smith KT (ed). Trace minerals in foods. Marcel Dekker Inc., New York. pp: 1-55.
14. Rupérez P. Mineral content of edible marine seaweeds.2002. Food Chem. 79:23–26.
15. Yoshie Y., SuzukiT.,ShiraiT.and Hirano T. 1994.Changes in the contents of dietary fibers, minerals, free amino acids and fatty acids during processing of dry Nori. Nippon Suisan Gakkaishi.60: 117-123.