Seasonal variation of copper and potassium in diverse sea weeds at selected location of Kollam Sea coast

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Abstract - **Elevated metal concentrations are lethal for animals and plants. Algae and sea plants accumulate extremely high levels of metals in chronically contaminated areas. Trace metals cannot be eliminated from water bodies as they are accumulated in sediments and are slowly released in the water column by currents creating serious risks of contamination for sea organisms. The knowledge of trace metals levels in marine algae is a basic requirement for their use as biological indicators of metal pollution. The present was conducted to assess the level of metals such as potassium and copper found in the different species of seaweeds collected from the coastal areas of Kollam District of Kerala. The results showed a variation in the metal uptake by different species during different seasons.**

keywords - **Algae, seaweeds, bio-indicators, copper and potassium**

I. Introduction

The application of organisms as indicators of trace metal enrichment in natural waters is based on the existence of a linear relationship between biological accumulation and concentrations of metals in seawater (Fostner&Whitman 1979).Seaweeds contribute a key role in the nutrient dynamics of coastal systems as well as reflect alterations in water quality efficiently. Therefore, every change in the nature of the dynamics will likely be reflected by them (Zbikowski et al., 2007).Seaweeds are capable of binding various trace metals. They are usually considered as excellent bio-indicators of aquatic bodies for nutrients and heavy metals. Various field and laboratory studies offered helpful information regarding the accumulation of metals by macroalgae, the factors affecting it as well as on the capability of these organisms to act as bioindicators of trace metals (Phillips, 1994). One such example is that of the brown seaweed *Fucusvesiculosus* L. which has been used as a biological indicator for metals such as Copper, Zinc, Manganese, Lead and Iron.

Elevated metal concentrations are lethal for animals and plants. Algae and sea plants accumulate extremely high levels of metals in chronically contaminated areas (Rai et al., 1981), which are hazardous for plants and for organisms that directly or indirectly feeding on plants. Human activity may be accountable for a 1000-fold increase in metal concentration over natural background levels (Wedepohl, 1991). These trace metals cannot be eliminated from water bodies as they are accumulated in sediments and are slowly released in the water column by currents creating serious risks of contamination for sea organisms.The knowledge of trace metals levels in marine algae is a basic requirement for their use as biological indicators of metal pollution. Hence, this study was conducted to assess the level of trace metals found in the different species of seaweeds collected from the coastal areas of Kollam District of Kerala.

II. Materials and Methods

Samples were collected seasonally from the coastal areas of Kollam district from January 2006 to December 2006. The levels of copper in the algae collected from this area were determined by using the Atomic Absorption Spectrometer. The level of potassium in the collected algae was determined by flame photometry.

For the determination of these elements, the algal samples were dried and powdered, and carefully digested with 10ml of a 5:1 mixture of nitric acid and perchloric acid. The digested matter was extracted with water filtered and made up to 25ml. The filtrate was used for analysis. Sample solutions were directly aspirated in to the flame and the concentration in the digest was measured. Standards and blanks were also prepared and read wherever necessary. All the analyses were performed in duplicate.

III. Results and Discussion

There were19 species of seaweeds collected form the 6 stations of coastal areas which included 7 species (*Chaetomorphaindica,Chaetomorphaantemina EnteromorphaLinza, Enteromorpha intestinalis Ulvalactuca,Ulvafasciata and Calulerpataxifole.*) from *Chlorophyceaeae,* 9 species (*Ceramium, Gracilariacerticata, Gracilariacorticata, Hypneavalantea, Centroceros, Hypnea, Spongomorpha, Valanopsispanchenema and Spongomorphaindica*) from *Rhodophyceae* and 3 species (*Chnoosporafastigata, Sargassamlilicifolum, Sargassam*) from *Phaeophyceae*. The levels of potassium and copper detected in these seaweeds are tabulated below

Table.1 Monthly variation of potassium content in seaweeds at different station during 2006.

SITE	Name of the Algae	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
SITE A	**CHLOROPHYCEAE**												
	CHEATOMORPHA MEDIA	0.165	0.038	0.346	~	0.167	0.218	0.25	0.462	0.43	0.358	0.555	0.44
	CHEATOMORPHA ANTEMINA	0.18	0.26	0.28	0.49	0.277	0.276	0.35	0.25	0.36	0.55	0.64	0.73
	ULVA LACTUCA	0.46	0.58	0.086	0.02	0.022	~	~	~	0.62	0.49	0.59	0.32
	ULVA FASCIATA	0.15	0.08	0.19	0.38	~	~	0.74	0.187	0.222	0.04	0.112	0.02
	RHODOPHYCEAE												
	CERAMIUM	0.26	0.6	0.17	0.05	0.07	0.068	0.34	~	~	~	1	0.65
	GRACILARIA CERTICATA	0.69	0.46	0.196	0.445	0.39	0.48	0.576	0.69	0.72	0.8	0.79	0.228
	GRACILARIA	0.229	0.25	~	~	~	0.38	0.231	0.35	0.61	0.92	0.28	0.237
	HYPNEA VALANTEA	~	0.69	0.73	~	~	0.132	0.24	0.32	0.26	0.35	0.11	0.34
	PHAEOPHYCEAE												
	CHNOOSPORA FASTIGATA	0.9	0.57	0.48	0.34	0.35	~	~	~	0.845	0.209	0.544	0.64
	SARGASSAM LILICIFOLUM	0.232	~	0.36	0.45	0.29	0.38	0.47	0.52	~	0.67	0.28	0.95
SITE B	**CHLOROPHYCEAE**												
	CHEATOMORPHA MEDIA	0.257	0.81	0.055	0.64	0.46	~	~	0.275	~	~	~	0.235
	CHEATOMORPHA	0.22	0.69	0.54	0.59	0.545	~	~	1.007	1.01	0.95	0.678	~
	ENTEROMORPHA LINZA	0.13	0.28	0.47	0.56	0.77	0.78	0.498	0.91	0.38	~	~	~
	ULVA LACTUCA	0.3	~	0.029	0.365	0.042	~	~	0.49	0.71	0.116	0.29	~
	ULVA FASCIATA	0.64	0.87	0.54	0.25	~	0.074	0.28	0.64	~	0.83	0.71	~
	RHODOPHYCEAE												
	CENTROCEROS	0.27	0.23	0.46	0.19	0.33	0.59	0.84	0.566	0.72	0.69	0.01	0.23
	CERAMIUM	1.06	0.56	~	0.015	~	0.46	0.65	0.05	0.45	0.159	0.16	0.56
	GRACELAREA CERTICATA	0.25	0.37	0.265	0.35	0.481	0.43	0.84	~	0.152	0.232	0.89	0.28
	HYPNEA VALANTEA	0.73	0.188	0.48	0.356	0.7	0.66	0.41	~	~	0.75	0.73	0.48
	HYPNEA	0.84	0.043	0.15	0.34	0.62	0.66	0.72	~	~	0.217	0.154	0.17
	SPONGOMORPH	0.5	0.54	0.655	0.102	0.46	0.43	0.369	0.34	0.29	0.31	~	~
	VALANOPSIS PANCHENEMA	0.41	0.46	0.57	0.59	0.26	0.51	0.68	0.7	0.91	~	~	0.036
	PHAEOPHYCEAE												
	CHNOOSPORA FASTIGATA	~	~	0.65	0.48	~	0.278	0.34	0.733	0.259	0.164	0.447	~
	SARGASSAM LILICIFOLUM	0.332	0.64	0.53	0.55	0.468	0.48	0.51	~	~	~	0.506	0.344
SITE C	**CHLOROPHYCEAE**												

	CAULERPA TAXIFOLEA	0.555	0.66	0.108	~	0.28	0.385	0.45	0.19	0.37	~	~	0.19
	CHEATOMORPHA MEDIA	0.55	~	0.31	0.37	0.4	0.48	0.22	~	0.234	0.64	0.7	0.32
	ENTEROMORPHA INTESTINALIS	~	0.162	~	~	0.28	0.39	0.472	0.38	0.39	0.43	~	0.41
	ULVA LACTUCA	0.032			0.081	~	0.175	~	0.094	0.214	0.41	0.108	0.02
	ULVA FASCIATA	0.29	0.28	0.16	0.06	0.02	0.09	0.378	0.87	~	0.054	~	~
	RHODOPHYCEAE												
	CERAMIUM	0.27	0.44	~	0.28	0.035	0.089	0.048	0.276	0.29	0.37	0.43	~
	GRACELAREA CERTICATA	0.26	0.124	~	~	0.24	0.028	0.94	1.049	~	0.299	0.46	0.409
	HYPNEA VALANTEA	1.02	0.91	0.033	0.124	0.06	0.28	0.35	~	~	0.42	0.51	0.58
	VALANOPSIS PANCHENEMA	0.98	0.76	0.71	0.1	0.068	0.28	0.39	0.47	0.65	~	~	0.81
	PHAEOPHYCEAE												
	CHNOOSPORA FASTIGATA	1.02	0.96	0.93	0.67	~	~	0.54	0.59	0.444	0.334	0.49	0.479
SITE D	**CHLOROPHYCEAE**												
	CAULERPA TAXIFOLEA	1.26	0.46	0.656	0.016	0.263	0.46	~	0.546	0.549	0.44	0.73	0.87
	CHEATOMORPHA MEDIA	0.02	0.7	0.96	~	0.9	0.47	0.41	~	0.13	~	0.17	0.54
	ENTEROMORPHA INTESTINALIS	0.16	0.37	0.72	~	0.8	~	0.29	~	~	0.15	0.26	~
	ULVA LACTUCA	1.4	0.94	0.85	~	~	0.041	0.64	0.51	0.43	0.246	~	~
	ULVA FASCIATA	0.73	0.84	0.65	~	0.51	~	~	~	0.143	0.054	0.104	0.546
	RHODOPHYCEAE												
	CERAMIUM	0.82	0.64	0.013	0.36	0.73	0.64	~	~	0.19	0.27	0.38	~
	GRACELAREA CERTICATA	0.48	0.677	0.155	0.64	~	~	0.456	0.84	0.91	0.65	0.404	~
	SPHYNGOMORPHA INDICA	~	0.029	0.37	0.645	0.056	0.28	0.107	0.5	0.37	~	~	0.092
	SPONGOMORPH	~	0.069	0.374	0.48	~	~	0.297	0.56	0.68	0.59	0.22	~
	VALANOPSIS PANCHENEMA	0.028	0.036	0.19	0.016	0.021	~	~	0.26	0.11	~	0.56	0.166
	PHAEOPHYCEAE												
	SARGASSUM	1	0.92	0.96	0.81	0.7	~	~	0.66	0.53	~	~	0.526
SITE E	**CHLOROPHYCEAE**												
	CHEATOMORPHA MEDIA	0.298	0.37	0.265	0.172	~	0.42	0.336	~	0.25	0.52	0.523	~
	ENTEROMORPHA INTESTINALIS	0.023	~	~	0.76	0.062	0.184	1.02	~	~	0.022	0.8	~
	ULVA LACTUCA	0.028	0.04	0.166	0.46	0.6	0.55	0.65	0.57	~	0.44	0.9	~
	ULVA FASCIATA	~	0.73	0.476	~	0.43	0.66	0.06	0.203	0.132	0.053	0.14	~
	RHODOPHYCEAE												
	CERAMIUM	0.07	0.088	~	~	0.35	0.81	0.83	0.71	0.64	0.46	~	0.35

	GRACELAREA CERTICATA	0.119	0.05	0.113	0.7	0.06	0.73	~	~	1.29	0.123	0.27	~
	HYPNEA VALANTEA	0.84	0.03	0.054	0.073	~	~	0.332	0.12	0.416	~	0.63	0.84
	VALANOPSIS PANCHENEMA	0.39	0.089	0.48	0.65	0.49	0.19	~	~	~	~	0.73	0.44
	PHAEOPHYCEAE												
	CHNOOSPORA FASTIGATA	0.121	0.32	0.44	0.98	0.16	~	0.49	0.54	0.24	0.41	0.39	0.203
SITE F	**CHLOROPHYCEAE**												
	ENTERO MORPHA LINZA	~	0.66	0.46	0.166	~	0.29	0.73	0.185	0.58	0.81	0.162	~
	ENTEROMORPHA INTESTINALIS	0.025	0.166	0.013	0.197	~	0.095	1.243	0.11	~	~	0.019	0.181

Table.2 Monthly variation of Copper content in seaweeds at different station during 2006.

Copper	**Name of the Algae**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**JULY**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
SITE A	**CHLOROPHYCEAE**												
	CHAETOMORPHA MEDIA	0.04	0.58	0.65	~	0.49	0.11	0.415	0.56	0.36	0.46	0.1	0.11
	CHAETOMORPHA ANTENNINA	0.14	0.46	0.41	0.119	0.2	~	~	0.03	0.2	0.22	0.73	0.3
	ULVA LACTUCA	1.02	0.46	0.26	0.05	0.04	~	~	~	0.64	0.81	0.72	0.33
	ULVA FASCIATA	0.83	0.17	0.18	0.72	~	~	0.653	0.26	0.12	0.14	0.12	0.09
	RHODOPHYCEAE												
	CERAMIUM	0.5465	0.6	0.23	0.41	0.8	0.54	0.62	~	~	~	0.63	0.8
	GRACILARIA CORTICATA	0.33	0.25	0.08	0.2	0.29	0.61	0.33	0.55	0.58	0.51	0.48	0.32
	GRACILARIA	0.27	0.39	~	~	~	0.25	0.27	0.45	0.55	0.59	0.2	0.48
	HYPNEA VALENTIEA	~	0.8	0.73	~	~	0.43	0.554	0.07	0.015	0.19	0.08	0.06
	PHEAOPHYCEAE												
	CHNOOSPORA FASTIGATA	0.65	0.72	0.81	0.88	0.92	~	~	~	0.17	0.12	0.05	0.09
	SARGASSAM ILICIFOLIUM	0.3	~	0.46	0.52	0.66	0.73	0.81	0.7	~	0.96	0.73	0.18
SITE B	**CHLOROPHYCEAE**												
	CHAETOMORPHA MEDIA	0.12	0.6	0.49	0.58	0.73	~	~	0.17	~	~	~	0.16
	CHAETOMORPHA ANTENNINA	0.43	0.28	0.34	0.41	0.09	~	~	0.15	0.13	0.66	0.136	~
	ENTEROMORPHA LINZA	0.7	0.554	0.14	0.044	0.05	0.47	0.09	0.24	0.1	~	~	~
	ULVA LACTUCA	1.3	~	0.25	0.31	0.23	~	~	0.18	0.7	0.34	0.39	~
	ULVA FASCIATA	0.165	0.15	0.156	0.25	~	0.23	0.44	0.48	~	0.5	0.7	~
	RHODOPHYCEAE												
	CENTROCEROS	0.19	0.27	0.36	0.25	0.17	0.16	~	0.15	0.09	0.08	0.05	0.1
	CERAMIUM	0.16	0.24	~	0.22	~	0.216	0.065	0.16	0.16	0.21	0.15	0.285
	GRACILARIA CORTICATA	0.05	0.14	0.1	0.15	0.16	0.16	0.47	~	0.13	0.1	0.47	0.16

	HYPNEA VALENTIEA	0.465	0.14	0.16	0.49	0.64	0.43	0.65	~	~	0.57	0.59	0.53
	HYPNEA	0.61	0.12	0.21	0.4	0.38	0.37	0.29	~	~	0.16	0.44	0.54
	SPONGOMORPH	0.16	0.59	0.65	0.26	0.235	0.35	0.12	0.02	0.07	0.25	~	~
	VALONIOPSIS PACHYNEMA	0.22	0.09	0.15	0.168	0.62	0.2169	0.61	0.34	0.21	~	~	0.08
	PHEAOPHYCEAE												
	CHNOOSPORA FASTIGATA	~	~	0.13	0.165	~	0.18	0.58	0.23	0.94	0.12	0.17	~
	SARGASSAM ILICIFOLIUM	0.03	0.28	0.44	0.413	0.156	0.34	0.25	~	~	~	0.21	0.16
SITE C	**CHLOROPHYCEAE**												
	CAULERPA TAXIFOLIA	0.28	0.39	0.64	~	0.58	0.73	0.155	0.88	0.28	~	~	0.29
	CHAETOMORPHA MEDIA	0.63	~	0.52	0.489	0.43	0.82	0.47	~	0.54	0.29	0.13	0.16
	ENTEROMORPHA INTESTINALIS	~	0.52	~	~	0.19	0.27	0.15	0.34	0.6	0.24	~	0.28
	ULVA LACTUCA	0.33	0.29	0.23	0.29	~	0.37	~	0.15	0.39	0.54	0.17	0.6
	ULVA FASCIATA	0.28	0.15	0.16	0.84	0.12	0.247	0.47	0.25	~	0.11	~	~
	RHODOPHYCEAE												
	CERAMIUM	0.13	0.06	0.016	0.25	0.16	0.145	0.45	0.4	0.6	0.732	0.18	~
	GRACILARIA CORTICATA	0.36	0.42	~	~	0.35	0.6	0.07	0.19	~	0.11	0.68	0.59
	HYPNEA VALENTIEA	0.37	0.29	0.13	0.07	0.43	0.19	0.37	~	~	0.28	0.016	0.15
	VALONIOPSIS PACHYNEMA	0.25	0.28	0.36	0.38	0.15	0.31	0.55	0.9	0.71	~	~	0.6
	PHEAOPHYCEAE												
	CHNOOSPORA FASTIGATA	0.25	0.06	0.34	0.5	~	~	0.42	0.28	0.16	0.16	0.6	0.64
SITE D	**CHLOROPHYCEAE**												
	CAULERPA TAXIFOLIA	0.63	0.42	0.49	0.21	0.119	~	~	0.14	0.19	0.8	0.64	0.28
	CHEATOMORPHA MEDIA	0.77	0.16	0.326	~	0.25	0.645	0.21	~	~	0.39	0.106	0.235
	ENTEROMORPHA INTESTINALIS	0.43	0.51	0.59	~	0.068	~	0.14	~	~	0.43	0.863	~
	ULVA LACTUCA	0.16	0.25	0.6	~	~	0.18	0.97	0.69	0.09	0.05	~	~
	ULVA FASCIATA	0.49	0.48	0.26	~	0.03	~	~	~	0.24	0.53	0.28	0.61
	RHODOPHYCEAE												
	CERAMIUM	0.56	0.61	0.42	0.25	0.92	0.73	0.81	~	0.28	0.53	0.36	~
	GRACILARIA CORTICATA	0.25	0.28	0.24	0.65	0.88	~	0.156	0.13	0.06	0.17	0.19	~
	SPONGOMORPHA INDICA	~	0.14	0.18	0.16	0.17	0.05	0.12	0.09	0.07	~	~	0.1
	SPONGOMORPH	~	0.19	0.24	0.366	~	~	0.08	0.34	0.11	0.17	0.34	~
	VALONIOPSIS PACHYNEMA	0.35	0.56	0.27	1.47	0.34	~	~	0.08	~	~	0.01	0.28
	PHEAOPHYCEAE												

	SARGASSAM ILICIFOLIUM	0.33	0.25	0.2584	0.5	0.28	~	~	0.19	0.72	~	~	0.21
SITE E	**CHLOROPHYCEAE**												
	CHAETOMORPHA MEDIA	0.27	0.24	0.2	0.78	~	0.26	0.16	~	0.54	0.238	0.13	~
	ENTEROMORPHA INTESTINALIS	0.24	~	~	0.35	0.16	0.33	0.27	~	~	0.45	0.26	~
	ULVA LACTUCA	0.21	0.37	0.43	0.15	0.32	0.36	0.87	0.33	~	0.19	0.06	~
	ULVA FASCIATA	~	0.36	0.45	~	0.654	0.65	0.3586	0.2	0.49	0.34	0.32	~
	RHODOPHYCEAE												
	CERAMIUM	0.73	0.7	~	~	0.185	0.35	0.25	0.6	0.33	~	~	0.28
	GRACILARIA CORTICATA	0.25	0.9	0.06	0.07	0.28	0.47	~	~	0.48	0.08	0.5	~
	HYPNEA VALENTIEA	0.84	0.56	0.58	0.32	~	~	0.49	0.247	0.36	~	0.246	0.45
	VALONIOPSIS PACHYNEMA	0.73	0.29	0.82	0.83	0.94	0.61	~	~	~	~	0.37	0.51
	PHEAOPHYCEAE												
	CHNOOSPORA FASTIGATA	0.13	0.25	0.38	0.36	0.49	~	0.71	0.46	0.18	0.44	0.07	0.35
SITE F	**CHLOROPHYCEAE**												
	ENTERO MORPHA LINZA	~	0.95	0.84	~	~	0.8	0.76	0.11	0.61	0.54	0.06	~
	ENTEROMORPHA INTESTINALIS	0.21	1.92	0.15	0.09	~	0.45	0.27	0.584	~	~	0.54	0.5

The indicator organism chosen for examining the chemical and biological properties of pollution should have essential characteristic features such as a broad geographic distribution, dominant member of coastal and estuarine communities,accumulate contaminants in their body tissue, responsive to numerous environmental pollutants etc. The application of organisms as indicators of trace metal enrichment in natural waters is based on the existence of a linear relationship between biological accumulation and concentrations of metals in seawater.Seaweeds contribute a key role in the nutrient dynamics of coastal systems as well as reflect alterations in water quality efficiently. Therefore, every change in the nature of the dynamics will likely be reflected by them (Zbikowski et al., 2007).Seaweeds have a high capacity to bind trace metals. They are usually considered as excellentbioindicators of aquatic bodies for nutrients and heavy metals. The use of organisms like algae to identify areas of trace metal contamination is attractive as these organisms concentrate metals from the ambient water. In the present investigation an attempt has been made to highlight season wise accumulation of metals such as copper and potassium in selected seaweeds at six stations from Kollam coast. Macroalgae have a wide range of tolerance to environmental variables.The present study reveals that the highest concentration of copper was observed in*Enteromorphaintestinalis* collected from station F, while the highest concentration of potassium was found in *Ulvalactuca* collected from Station D. The accumulation of metals in algae occurs by different mechanism depending on the algae species, metal and ambient solution condition (Greene and Bedell, 1990). These mechanisms include intracellular accumulation of metals by active biological transport, intracellular chelation by biological polymers, accretion or precipitation of the metals on the cell wall surface and adsorptive surface binding to various cell wall chemical function group including amine, phosphate, thiol, sulphate, carboxylate, imidazole or other groups associated with various biopolymers found in the cell wall. Since wide variations in biopolymers are found in the cell wall structures depending upon the algal division, genera, species and variety, there can be variations in the side chain and monomeric chemical that would be available to coordinate or electrostatically bind various heavy metals ions. This may be the reason for the observed species wise differences in metal accumulation.

IV. CONCLUSION

Since, elevated trace metal contents are harmful to plants and animals, it is essential to find an effective biosorbents that can uptake heavy metal from water bodies. The present study revealed that the various seaweeds collected from Kollam coastal areas could take up metal such as copper and potassium. Thus these seaweeds can be considered as better biosorbents for the removal of heavy metals from contamination sites or industrial effluents due to its large abundance and easy accessibility.

V. REFERENCES

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