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Influence of Coconut Husk Retting on the ambient levels and Bioaccumulation of Selected Heavy Metals of Paravur Backwaters

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ABSTRACT

One of the major sources of pollution of the kayal's in Kerala, particularly of the interior shallow regions of Paravur kayal, is the phenomenon of retting of coconut husk. The extensive retting activity has made these water bodies into a foul smelling, black, dirty, turbid soup of suspended organic debris with practically the whole oxygen dissolved in it replaced with hydrogen sulphide. The retting of coconut husk has resulted in the formation of a curious and complex ecosystem of micro-aerobic and anaerobic properties in the extensive kayal system of Kerala. There is thus severe deterioration of the quality of water in and around the retting zones. The coconut husk retting has also heavily influenced the sediment characteristics. Apart from this the heavy metal distribution in the aquatic system is taken into consideration due to its toxic and harmful effects. In this context it was thought worthwhile to study the accumulation of few heavy metals on the sediments and biotic components of the retting zone and compare the results with similar information collected from a nearby clean area of the Paravur kayal.

Keywords: Coconut husk, Retting, Heavy metals, Sediment, Biotic components.

Introduction

Kerala, the southernmost state of India, is blessed with comparatively extensive estuarine system. These water bodies are locally known as ‘backwaters’ or ‘kayals’. Unfortunately these water bodies have become highly polluted due to various anthropogenic activities. One of the major sources of pollution of the kayals in Kerala, particularly of the interior shallow regions, is the phenomenon of retting of coconut husk for the production of Coir. Retting of coconut husk have resulted in severe depletion of dissolved oxygen along with the production of H_2S and accumulation of a mixture of several undesired compounds, all which deteriorate the quality of the water[1,9]. Knowledge on the distribution of heavy metals in the aquatic environment is important in studying the environmental pollution because such elements can be toxic even in traces and cause harmful

effects[5, 10].Many marine organisms are known to accumulate and concentrate metals. Mangroves may be long term sinks for metals, and deposited metals may be remobilized through plant uptake and exported with plant detritus, increasing the possibility of metals entering coastal food chains. In this context the present study was aimed at evaluating the contents of some metals in sediments and biotic components of the coconut husk retting zone and non–retting zone of the Paravur kayal.

Materials and methods

The area chosen for the present study was the Paravur Kayal in Kollam district. The Paravur Kayal is a small backwater body situated north of Paravur town. It lies between 8^0 18' and 12^0 48' N lat. and between 74^0 52' and 77^0 2' E long. Two areas of the kayal were selected for the study.

Site 1 : **Manjadimukku** This area is situated 2 km west of the Paravur town. It is a highly polluted site because of the hectic coconut retting activity. This retting zone remains virtually a cesspool of dark, foul smelling, stagnant water for almost the whole year. Both the water and air at and around this part stinks of hydrogen sulphide.

Site 2**:Kappil** This a very clean area near to the bar mouth, was chosen as the non-retting zone.

Samples for heavy metal assay were collected for both the study areas. Bottom sediments, one selected mangrove plant and one species of fish were the samples selected for analysis. Sediment samples were collected, using a PVC corer. The mangrove species selected were *Acrostichium aurum* (mangrove fern). Aplocheilus lineatus was the fish chosen. Samples were collected from both the study areas at monthly intervals during the pre-monsoon (Jan –Mar)and post monsoon (Oct –Dec) periods . All the sample materials were oven dried and grounded using precleaned mortar and pestle. Assay of Fe, Cu, Zn, Pb and Cd in the sediment, mangrove and fish was carried out adopting standard methods [2] by Atomic Absorption Spectrophotometry. The map of Paravur town in Kollam and the retting and non retting areas selected are shown in fig: 1, 2 and 3.

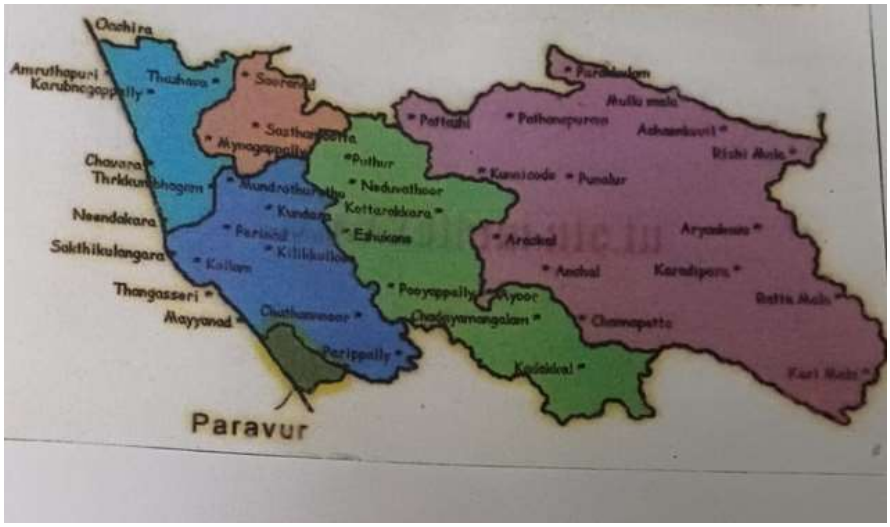

Fig: 1 Map showing Paravur Town of Kollam Dustrict

Fig:2 retting area (Manjadimukku)

Fig:3 Non retting area (Kappil)

Results and discussions

The results obtained from the analysis for heavy metal content in sediments, fish and mangrove in the pre monsoon period and post monsoon period are shown in table 1 and in table 2.

Table 1

Heavy metal concentrations (mg g-1) in the sediment, fish and mangrove plant from the retting and non-retting zones of the Paravur kayal (Premonsoon period)

Heavy Metals		Study area 1 (Retting Zone)				Study area 2 (Non-retting)			
		Jan.	Feb.	Mar.	Mean	Jan.	Feb	Mar	Mean
Sediment	Cadmium	0.011	0.010	0.011	0.011	0.010	0.011	0.011	0.011
	Lead	0.026	0.026	0.025	0.026	0.016	0.018	0.033	0.022
	Iron	45.540	16.315	26.440	29.432	0.860	5.685	6.145	4.230
Fish	Cadmium	0.021	0.175	0.055	0.084	0.028	0.073	0.160	0.087
	Lead	ND	ND	0.066	0.022	ND	0.101	ND	0.034
	Iron	0.959	0461	34.547	11.989	2.634	3.119	1.708	2.487
Mangrove	Cadmium	0.027	0.021	0.020	0.023	0.021	0.021	0.021	0.021
	Lead	0.032	ND	ND	0.011	ND	ND	0.027	0.009
	Iron	7.510	2.785	3.600	4.632	1.340	1.046	1.911	1.432

Table 2

TablTable 2

Heavy metal concentrations (mg g^{-1}) in the sediment, fish and mangrove plant from the retting and non-retting zones of the Paravur kayal (Post monsoon period)

Heavy Metals		Study area 1 (Retting Zone)				Study area 2 (Non-retting)			
		Oct.	Nov.	Dec.	Mean	Oct	Nov	Dec	Mean
Sediment	Cadmium	0.025	0.02	0.022	0.022	0.02	0.023	0.03	0.024
	Lead	0.06	0.06	0.05	0.056	0.05	0.04	0.052	0.047
	Iron	53.5	46.3	46.44	48.74	15.45	15.22	11.12	13.93
Fish	Cadmium	0.033	0.035	0.035	0.034	0.045	0.043	0.0460	0.0446
	Lead	0.06	0.07	0.06	0.063	ND	ND	ND	0.00
	Iron	10.59	10.67	10.54	10.60	3.52	3.9	2.8	3.41
Mangrove	Cadmium	0.07	0.09	0.07	0.076	0.02	0.03	0.032	0.0273
	Lead	0.052	0.036	0.033	0.040	ND	ND	ND	0.00
	Iron	7.60	7.53	7.500	7.54	2.40	2.06	2.11	2.19

ND- Not Detectable

Heavy Metal Contents in Sediment

The concentration of Cd in the sediment of the retting zone was found to be between 0.010 - 0.011 ppm which was similar to that of non-retting zone for the pre monsoon period while in the post monsoon period retting zone showed a conc.0.022ppm, non- retting a con. 0.024ppm the present results suggest that the change in the physical and chemical changes caused by coconut husk retting did not have any influence on the Cd load in the sediment. In the retting zone, the mean lead concentration was 0.026 ppm. In the non-retting zone the mean concentration of Pb was 0.022 ppm for the pre monsoon period while the retting zone reported a mean conc. of 0.056ppm in the post monsoon period compared to non-retting zone.. The present results are in agreement with these. In Ashtamudi estuary[4] reported that concentration of Pb in the sediment varied from 0.008 ppm to 0.035 ppm, which is also similar to the present observation. Further, the present results suggest that coconut husk retting does not have any significant effect on the content of Pb in sediments of back water. In the pre monsoon retting zone showed a mean iron concentration 29.43 ppm. In the non-retting zone, it was 4.23 ppm, while retting zone in post monsoon showed a still higher range. The average Fe concentration in the retting zone was more than seven times higher than in the non-retting zone. In comparison, in the Ashtamudi estuary [4, 6, 11] have reported Fe concentration in the sediments to range from 1.1 to 3.9 ppm and in the Quilon mangrove sediment [4, 10] reported Fe concentration ranging from 46.91 to 149.45.ppm. The higher concentration of Fe in the sediments of retting zone might be due to the precipitation of Fe as ferric hydroxides. In retting zone there was a foul smell of H_2S due to thiosulphate reduction, which is favored under anaerobic conditions. Thus the retting zone contains large amounts of sulphate ions. But sulphate reducing bacteria and iron reducing bacteria are competitors for donors of electrons. By the action of sulphate reducing bacteria on Fe (III) the ferrous sulphide formed is oxidized by acidophilic Fe oxidizing bacteria with production of ferric hydroxides and H_2SO_4. This may be the reason for the observed higher Fe content in the sediment of the retting zone.

Heavy Metal Contents in Fish

The present results also indicate- that retting activity did not have any appreciable influence on the accumulation of these heavy metals by fish .In both the retting and non-retting zones Fe showed an elevated level of concentration in fish, which was significantly higher in fish in the retting zone. In the Ashtamudi estuarine system [3,7] reported that Villorita cyprinoids had the highest concentration of Fe throughout the study. [5,6] had reported very high value of Fe content in *Villorita oyprinoides* of Ashtamudi estuary ranging from 6.710 to 13.420 ppm. The present results are in agreement with the earlier studies. The sediments of the retting zone had higher concentration of Fe and it can be expected that the biota in this zone would be have a higher concentration of this metal. It is also noteworthy that majority of animals have a higher requirement of Fe as a conjugant of the respiratory pigment hemoglobin. Therefore, it is likely that animal accumulate more of this element when it is plentiful in the environment. In fish Pb concentrations recorded were 0.066 ppm and 0.101 ppm dry weight in retting and non-retting zone, respectively. The concentration of Pb in the tissues of fishes in Ashtamudi estuary ranged between 0.005 and 0.066 ppm [3, 4]. A concentration of Pb up to 0.050 ppm has been reported from Caribbean waters, indicates that such levels are indeed possible. The mean Cd concentration in fish from the retting zone in pre monsoon was 0.083 ppm. In fish from the non-retting zone the mean Cd concentration was 0.087 ppm. For post monsoon retting showed a mean value of 0.034 and non-retting0.044ppm. In this case in both the zones Cd residue in fish was comparatively low and it did not vary much between the two zones.

Heavy Metal Contents in Mangrove

Both in the retting and non-retting zones, cadmium concentrations in mangrove were almost the same in the pre monsoon but in post monsoon conc. varied with retting showing a mean value 0.07 and non-retting 0.027ppm. As in the case of Pb residue in fish, in mangrove also Pb was detected only in one month in both retting and non-retting zones. The values recorded were 0.032 and 0.027 ppm, respectively. High values of Pb have been reported in mangrove from the retting zone the mean concentration of Fe was 4.631ppm. In the non-retting zone, average Fe concentration was 1.432ppm. High concentration was noted in non-retting zone in the post monsoon period many mangrove species are reported to contain very high concentrations of heavy metals such as Fe and Mn. The toxic effects of these metals get reduced due to the action of chelating substances present in these plants. According to[5, 6, 8] the value of Fe recorded in the mangrove species Sonneratia alba in Goa mangroves was 8.112ppm. The species Avicennia officinalis has been reported to contain 0.281to 6.344ppm dry wt. of Fe.

Conclusion

The results on the assay of heavy metal concentration in the sediment, fish and mangrove from the retting and non-retting regions of Paravur kayal show that, the concentrations of Cd and Pb in all three components were negligible and were not markedly different between the two regions and the concentrations of Fe in all three components assayed were high and differed significantly between the retting and non-retting

regions, its concentrations being much higher in all three compartments in the retting zone than those in the non-retting zone.

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Conflicts of Interest

The authors declare that there are no conflict of interest regarding the publication of this paper.

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