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Concentration on Heavy Metals in Sediments and Magngroves from Manakudy Estuary (South West Coast of India)

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Abstract: The heavy metals (Fe, Zn, Mn, Pb, Cd) concentration in three different mangrove species (*Avicennia marina, Avicennia officinalis* and *Rhizophora mueronata*) from Manakudy estuary, Southwest coast of India, during January 2011. The metallic concentrations were analysed in sediment samples collected from surrounding root zone of mangrove species and in the leaves and roots of the same plant species. The samples of roots accumulate more concentration of metals than the leaves samples. The following orders of accumulation of metals were observed during the study period: Sediment> roots> leaves. Metals concentration in sediment samples during the study was in the order of accumulation: Fe> Mn> Zn>Pb >Cd respectively.

Key words: Heavy metal · Mangroves · Manakudy estuary · Southwest coast of India

INTRODUCTION

Mangroves are woody plants growing at the interface between land and sea in tropical and subtropical latitudes [1]. Mangrove ecosystems presently cover an area of about 20 million hectares worldwide. They are the main vegetation type in protected intertidal areas along tropical and subtropical coastlines. Within this broad geographic range, mangroves grow in environmental settings ranging from highly humid to extremely arid conditions and in soils which range from pure clays to peat, sand, or coral rubble [2]. Mangrove wetlands provide a good nursery ground for a number of commercially important aquatic organisms [3]. They are also important to humans for a variety of reasons, including aquaculture, agriculture, forestry, protection against shoreline erosion, as a source of firewood & building material and other local subsistence use [4-5]. Mangroves are highly adapted to the coastal environment, with exposed breathing roots, extensive support roots and buttresses, salt-excreting leaves and viviparous water-dispersed propagules. These adaptations vary among taxa and with the physico-chemical nature of the habitat [6]. Mangroves are physiologically tolerant to high salt levels and able to obtain fresh water despite the strong osmotic potential of the sediments [7]. They avoid heavy salt loads through a combination of salt exclusion, salt excretion and salt accumulation [1].

The sediments in such areas have a large capacity to retain heavy metals from tidal waters, fresh water rivers and storm water runoff and they often act as sinks for heavy metals [8-12]. The cycling of organic matter through litter production, decomposition and tidal transport may eventually export a fraction of the accumulated heavy metals and, therefore, convey it to detritus food chains in adjacent coastal waters [13]. Despite their potential exposure to metal contaminated sediments, mangroves appear to be highly tolerant to heavy metals [14]. Mangrove sediments are anaerobic and reduced, as well as being rich in

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sulphides and organic matter. They therefore favour the retention of water-born heavy metals [12, 15]. Hence, the present study gives comparative account of accumulation of the heavy metals concentration in water, sediment and mangroves (leaves and root) was carried out.

MATERIALS AND METHODS

The study area is the Manakudy mangrove (Lat. 8º4' N; Long. and 77°26' E) ecosystem of Southwest coast of India. Four mangroves sites were sampled for sediment and mangroves (leaves and root) of four species, during 28th May 2010 to 23th January 2011. The sediment samples surrounding the root systems of three different mangroves species were collected using vertical corer, transferred to clean polyethylene bags and shade-dried to constant weight. Sediments were ground and sieved through mesh (size of 0.5mm) before digestion [16]. Matured leaves (2nd and 3rd from the top of the branch) and root of the three-mangrove plant species viz., *R. mueronata, A. marina* and *A. officinalis* were collected. The leaves and root were washed thoroughly, shade-dried and powdered. For digestion process 20 ml of the concentrated HNO_3 and perchloric acid were added to 5g of dried samples in the beaker and the mixture was left for 24 h and then the same mixture was digested on the hot plate at 120°C. Than Thereafter 10 ml of (10%) nitric acid was added and the constituents were transferred to 20 ml polytop vials and allowed to stand for 24 h for residue to settle down [17]. The supernatant liquid was filtered through a 0.45 µm Millipore membrane filter. The filtered sample in the vial can directly be aspirated for metals were analyzed in Inductive coupled plasma system (ICP) (Optical Emission Spectrophotometer by using the instrument Optima 2100DV & quantified against a known standards).

RESULTS AND DISCUSSION

The concentration of metal analysed, for the study are found significantly different. It was highest in *A. marina* followed by the *R. Mueronata* and *A. officinalis*. The accumulation of metals in levels is significantly lesser than sediment. The maximum concentration of iron was recorded in root of *A. marina.* The detailed distributions of heavy metals and major elements in sediment samples around the root system of different mangrove zones and their leaves and root for three seasons are shown Fig. 1-5.

Most trace elements have average concentrations of less than 100 µg/g [18], in the earth's crust. When comparing heavy metal concentrations in the sediments of the study area with average concentrations in the earth's crust [19], results showed that Fe concentration in this study was much higher than average concentrations in the earth's crust, while concentrations of Cd and Pb were below average concentrations in the earth's crust. Also, when by comparing heavy metal concentration in the study area with the mean concentration of heavy metals in sedimentary rock (shales) [18], results showed that Zn and Mn were below mean concentration in shales, possibly indicating that the origin of these heavy metals is natural.

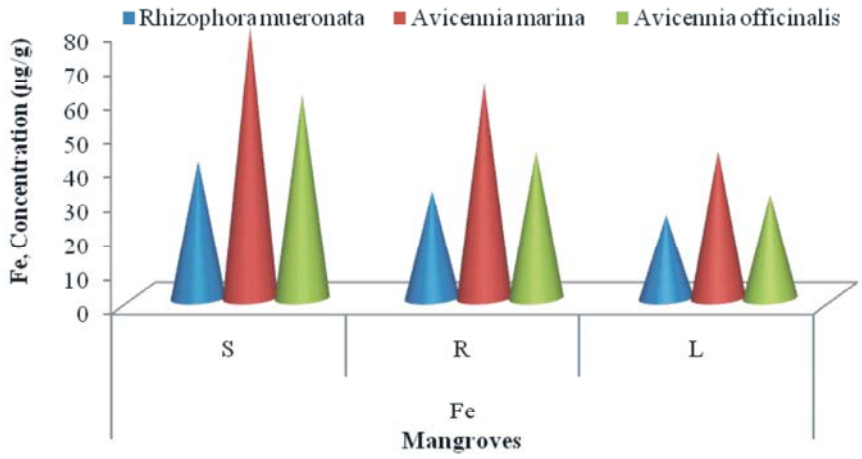

Fig. 1: Iron concentration in different species of mangroves.

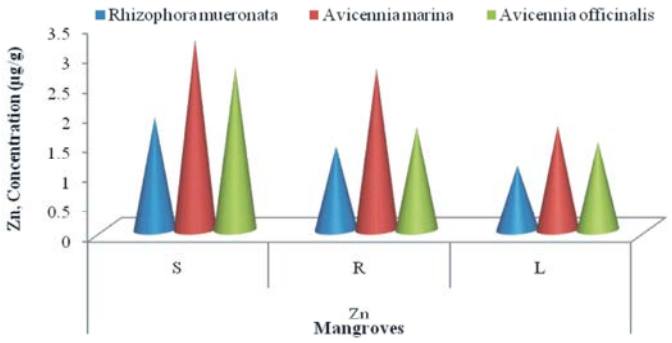

Fig. 2: Zinc concentration in different species of mangroves.

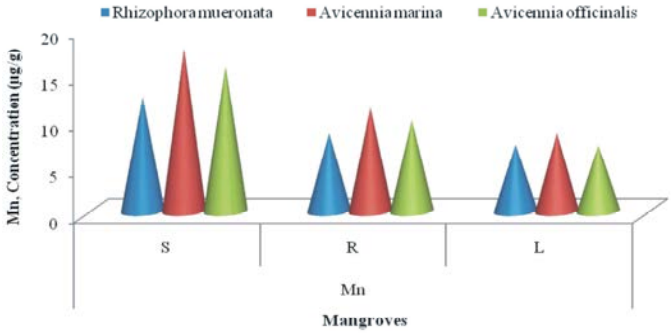

Fig. 3: Magnesium concentration in different species of mangroves

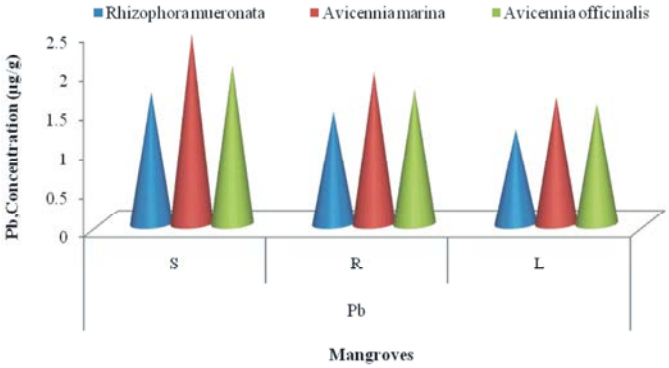

Fig. 4: Lead concentration in different species of mangroves

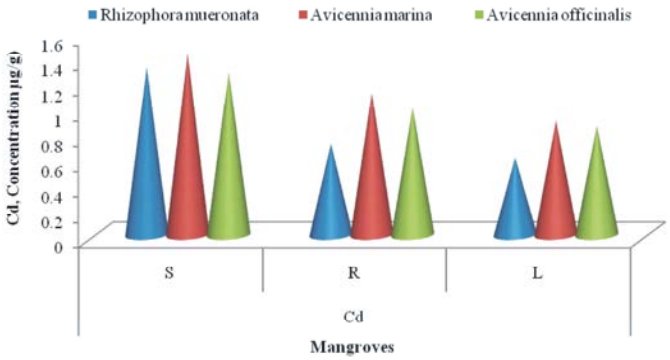

Fig. 5: Cadmium concentration in different species of mangroves.

Heavy metal concentration in plant tissues is influenced by the metabolic requirements for essential micronutrients such as Fe and Zn, while non-essential metals including Cd tend to be excluded or compartmentalized [20]. Zinc is an essential micronutrient of numerous enzyme systems, respiration enzyme activators and the biosynthesis of plant growth hormones [21]. Comparing the concentration of studied heavy metals in the mangrove leaves of the study area with those from other countries showed that the concentration of Fe was higher than those measured in China [22] and India [23]. Also, the concentration of Zn in this study was higher than those measured in Saudi Arabia [24], India [25], Pakistan [26, 27] and China [28]. However, while concentration of Zn was lower than those measured in China [22] and Australia [29], the concentration of Pb was lower than those measured in China [22] and Malaysia [30]. Although the total amounts of heavy metals retained in mangrove plants were lower than those in soil, heavy metals did accumulate in plants, especially in roots and leaves. Excess metals were translocated from root to stem, then to leaf and the degree of upward movement depends up on the mobility of heavy metals. The role of mangrove plants heavy metals related to plant age, growth and biomass production.

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