



Accumulation of Heavy Metals (Pb, Cd, V) in Sediment, roots and leaves of Mangrove species in Sirik Creek along the Sea Coasts of Oman, Iran

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ABSTRACT: Sirik mangrove forests harbour two species, *Avicennia marina* and *Rhizophora macronata* living in Azini Creek. Because of a fishing port at Azini Creek, this study was conducted to determine heavy metals concentrations in the Sirik mangrove forests along the Oman Sea coasts. Substantial component analysis of heavy metal concentration in sediments surrounding roots zones of mangrove species showed that Cd and V were negligible, while the Pb concentrations were higher than those found in leaves and roots. Concentrations of Cd and V in the leaves and roots also were negligible.

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Mangrove forests are one of the most productive ecosystems in the world. Hence, they bear many advantages, such as coastal water enrichment, commercial production, coastlines preservation and increasing fisheries production (Kathiresan and Bingham, 2001). Mangrove forests cover 162,000 Km² of the land area of the world (Araujo *et al.*, 2010). Mangrove forests in Iran are located in three provinces along the Persian Gulf and the Oman Sea coasts, Bushehr province (Davari *et al.*, 2010), Hormozgan province (Taghizade *et al.*, 2009) and Sistan and Balouchestan province (Erfani *et al.*, 2010). A portion of the mangrove forest of Sirik has been developed in the Azini Creek area (Parvaresh *et al.*, 2010). Azini Creek has two species of mangrove trees, *Avicennia marina* and *Rhizophora macronata*. *Rhizophora macronata* only was developed in the Azini Creek.

Several factors threaten mangrove forests, human actions, including fishing ports and dams, invasion of sand dunes, camels grazing on mangrove leaves (Parvaresh, 2011), heavy metals (Agoramoorthy *et al.*, 2008), and sewage (Tam and Wong, 1997). Because heavy metals are retained in mangrove forests through plant uptake (Machado *et al.*, 2002), they subsequently move through the organic matter cycle and are transported by tidal current to the coastal waters (Ramos *et al.*, 2006).

Despite the importance of the mangrove ecosystem, a few studies have been conducted to determine the accumulation of heavy metals in mangrove plants and their environment in Iran (Khorasani *et al.*, 2006; Parvaresh *et al.*, 2010; Davari *et al.*, 2010; Sharifan and Davar, 2010; Azarbad *et al.*, 2011).

This study has been accomplished to determine the concentration of heavy metals, including Pb, Cd, and V in sediment, leaves and roots of mangrove trees in Azini Creek, Sirik, Iran.

MATERIAL AND METHODS

The survey was performed in the Azini Creek area of the Sirik mangrove forest. The Sirik mangrove forest is located in an arid environment (26 ° 19'N, 57° 05' E) along the Oman Sea. The studied location is next to a fishing port (Fig 1).

In Fall, three samples of leaves and roots of *Avicennia marina* and *Rhizophora macronata* were collected along with sediment samples surrounding root zones of mangrove species from Azini Creek. While being transported to the laboratory, all samples were stored in clean acid-washed plastic containers. In the laboratory, sediments were removed from the roots. Afterward, samples were dried, grounded and homogenized. Analyses of samples were initiated after being digested in a concentrated

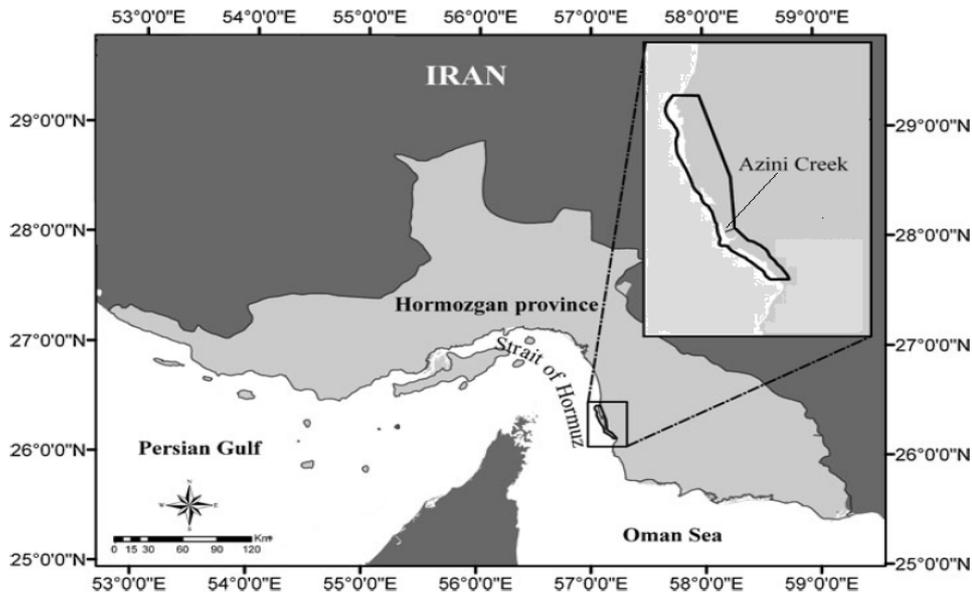


Fig 1. Location of Sirik Azini Creek

nitric–perchloric acid solution. Metal concentration analyses were performed using flame atomic absorption spectrophotometry (Khak Azma Negin Co, Tehran, Iran).

The Mann-Whitney Test was used for comparing the heavy metals concentrations between mangrove species.

RESULTS AND DISCUSSION

Lead (Pb) had the highest concentration of the measured metals. Cadmium (Cd) and V had the lowest concentration among the metals. Table 1 shows mean concentrations of Pb, Cd and V in the

sediments in the definite areas; Table 2 provides mean concentrations of Pb, Cd and V in the leaves mangrove species; and, Table 3 delineates mean concentrations Pb, Cd and V in the roots mangrove species. Mann-Whitney Test indicated that Pb concentrations were significantly different among sediment and leaves of *A. marina* and *R. macronata*, while there was no significant difference in Pb concentrations in the roots of *A. marina* and *R. macronata*. Maximum and minimum Pb concentrations in the sediments around *A. marina* and *R. macronata* were 7.45, 16.3, 4.35 and 9.45, respectively.

Table 1. Heavy metals concentration in sediment surrounding of mangrove species

| | Pb | Cd | V |
|-----------------------------|-----------|-------|-------|
| <i>Avicenna marina</i> | 13.8±4.25 | <0.01 | <0.01 |
| <i>Rhizophora macronata</i> | 6.90±3.60 | <0.01 | <0.01 |
| Fishing Port | 8.77±3.21 | <0.01 | <0.01 |
| Away FP and MF | 14.1±1.90 | <0.01 | <0.01 |

FP: Fishing Port, MF: Mangrove Forest

Table 2. Heavy metals concentration in leaves mangrove species

| | Pb | Cd | V |
|-----------------------------|-----------|----|----|
| <i>Avicenna marina</i> | 8.21±0.37 | ND | ND |
| <i>Rhizophora macronata</i> | 6.36±0.00 | ND | ND |

ND: Not Significant

Table 3. Heavy metals concentration in roots mangrove species

| | Pb | Cd | V |
|-----------------------------|-----------|----|----|
| <i>Avicenna marina</i> | 6.09±1.12 | ND | ND |
| <i>Rhizophora macronata</i> | 6.89±0.74 | ND | ND |

ND: Not Significant

Nutrient and metal cycling can be affected by mangrove ecosystems (Harbison, 1981; Lacerda and Abrao, 1983). Trace metal accumulation levels

depend on the season (Ashokkumar *et al.*, 2009 ; Lacerda *et al.*, 1985). In addition, the difference in salinity is affected by the apparent difference in

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uptake in plants (Lacerda *et al.*, 1985). Heavy metal concentrations in mangrove species tissues are associated with the concentration in sediments (Machado *et al.*, 2002). For this reason, lower concentrations of Cd and V in our results may be associated with the negligible concentrations in the surrounding sediments.

Based on the soil critical concentration value of Pb (Parvaresh *et al.*, 2010), the recorded concentrations in the sediments in our study area were not significant. The Cd concentration in our study was lower than the soil critical concentrations value, while the Cd concentration was higher than soil critical concentrations value when measured in the fall 2009 (Parvaresh *et al.*, 2010). This event may result in improved management of Azini Creek. Another survey conducted in the Bushehr mangrove forest showed the heavy metals concentrations in the roots of mangrove species were higher than those in the sediments (Davari *et al.*, 2010), but our data did not agree with that.

Industrial activity in every area, led to the accumulation of metal pollution, including Cu, Zn and Cr in the sediments. Heavy metals pollution in Iranian waters are mainly derived from the ships carrying chemicals and oil (Khorasani *et al.*, 2006). Except for the presence of the fishing port, no industrial activity currently exists on Azini Creek. Low concentrations of heavy metals were associated with it. Furthermore, a huge amount of fine sediments are washed into the Sirik mangrove forest by the Gaz River, where places receiving the fine sediments have a high potential for absorbing heavy metals (Parvaresh *et al.*, 2010). Compared to findings by Parvaresh *et al.*, (2010) in Azini Creek, Cd concentrations were higher than our concentrations in leaves mangroves species. However, the amount of Pb concentration was nearly the same mean in leaves. Despite the findings of Parvaresh *et al.*, (2010) of higher concentrations of Pb in sediments than our findings, the mean concentration of Pb has not differed in both studies in the leaves *A. marina* ($P > 0.05$). It shows that however the metals in sediments are increased, capacity of the leaves in *A. marina* is restricted.

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