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Heavy Metals Analysis in *Avicennia Marina* (Forsk.)Vierh.) From saravali region, Palghar district, Maharashtra, India

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Abstract-

Recently, there has been a worldwide concern regarding heavy metal contamination.It is observed that Palghar District are polluted by the domestic and industrial waste water. Present study includes the estimation of heavy metals from polluted water,soil, salt and plant from Saravali saltpan area.Accumulation of five heavy metals (HM), Cd, Pb,Hg,Zn and As was assessed in the leaves, Stem of Avicennia marina (Forsk.) Vierh.) at two sites using AAS(Atomic Absorption Spectrophotometer). For this study Mithbav, Sindhudurg site was considered as a control i.e.non-polluted. In this current study, we investigated the accumulation capacity of metals in Avicennia marina.The research parameters include levels of Cd, Pb, Hg, As and Zn metals in soil,water,salt and mangrove stem and leaves.The results of Zn heavy metal concentrations ranged from 20.64 ± 0.031ppm and 12.305 ± 0.00 ppm with the highest values found in stem and leaves respectively. The maximum concentrations of metals were accumulated (Hg-2.621±0.168 ppm in water, Hg-2.964±0.160 ppm in soil and Zn-8.203±0.605 ppm in salt).In all of the samples, heavy metal contamination was found. As a result, the Avicennia marina is a good bioaccumulator and is recommended for phytoremediation.These findings point to the necessity for government mitigation measures as well as new waste management policies to address the issues associated with uncontrolled Industrial waste effluent in Saravali Region.

Keywords- Heavy metals,Accumulation,Pollution, Mangrove, *Avicennia marina*

Introduction-

All the organisms are made up of elements with different combinations. These elements are in three categories macro elements, microelements and trace elements. Microelements and trace elements are essential for body but in large quantity they are toxic to the living organisms. Human have been introducing heavy metals into the environment since they first gained knowledge of their many useful properties.

In India, metals have been known since antiquity of the four vedas, the Yajurveda makes many references to the use of metals and metallic salt (Chandra 1980). Heavy metals occurin all ecosystem of the world. The total concentration in soil and waters, however, it varies at a regional and continental scale.The metals introduced by human activities often exceed the natural levels and represents a risk to human and animal health (PRIETO et. Al.,2008).
Mangrove ecosystems are known for their activity viz., Primary producers, shoreline protectors and nursery grounds and as habitats for a variety of animals. They play a crucial role in the biogeochemical cycling of phosphorus, carbon, nitrogen and other nutrients. Mangroves with their ability to trap sediments are believed to be an important sink of suspended sediments which are introduced into coastal areas by river discharge. They have a high capacity to retain heavy metals received from water. Many mangrove ecosystems which are close to urban development areas are impacted by urban and industrial runoff which contain trace and heavy metals in the dissolved or particulate form. Heavy metals are natural components of earth's crust. They cannot

be degraded or destroyed. To a small extent they enter our bodies via food, drinking water and air. As trace elements, some heavy metals (Cu, Zn, and Selenium) are essential to maintain the metabolism of the human body. However at higher concentrations they can lead to poisoning.The aquatic environment is more susceptible to the harmful effects of heavy metal pollution because aquatic organisms are in close and prolonged contact with the soluble metals. It is observed that in Mumbai sea and estuaries are polluted by the domestic and industrial waste water. Sewage water directly dumped into the estuary which leads to heavy metal pollution in the soil and estuarine water. Saltpan companies always use this polluted soil and water for preparation of salt in different area.Salt is one of the basic need of our food which made by this polluted water must contain heavy metals. Metal pollutants which most often contaminate mangrove ecosystems originate from industry(MacFarlane, Koller and Blomberg, 2007). The toxicity caused by heavy metals is considered a serious threat to mangrove ecosystems that have the potential to affect human health and other organisms (Wu *et al.*,2014).

Based on above problems in this study, we will discuss the accumulation of heavy metals from polluted water, soil, salt and plant (*Avicennia marina*)from sarawali saltpan area.For this study Mithbav, Sindhudurg site was considered as a control i.e. non-polluted.in this currunt study, we investigated the accumulation capacity of metal in *Avicennia marina* plant.

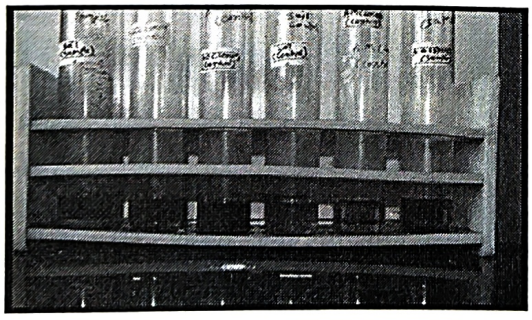
Materials and Methods-

For the Extraction of Heavy Metal from Mangroves plant (*Avicennia marina*) leaves and stem are collected from polluted site of Sarawali,Palghar and non-polluted Mithbav, Sindhudurg, Maharashtra collected in the month of November 2014. Also the soil, water and salts sample is collected from the same polluted area. The sample is collected in the month of January 2015. Plant samples are then oven dried and powered for further analysis. Water is directly used for the acid digestion.

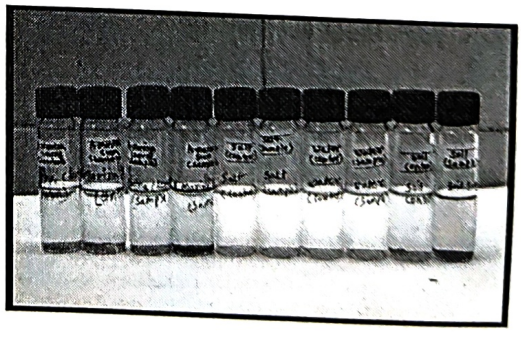
Plant sample stem and leaves were transported to the laboratory, oven dried under 60^0c for one and half day. Soil and water around the plant were collected for the analysis. Leaves, stem, soil and salt was dried separately, ground to powder.

Sample were wet digested separately prior to heavy metal analysis with a mixture of concentric nitric (HNO_3),Conc.Perchloric acid ($HCL0_4$), and Conc. Sulphuric acid (H_2SO_4) in 5:1:2 ml proportion (Ternary acid treatment). Afterward gently heated on a hot-plate until fully digestion. Total volume of the filtrate sample adjusted 100ml before sample aspiring to the flame for absorbance. Concentration of various heavy metals in the soil, salt and plant sample were determine by its heavy metal accumulation capability.

Sample were then analysed for five heavy metals including Zinc(Zn), Lead(Pb), Cadmium(Cd), Mercury(Hg) and Arsenic (As) using Atomic Absorption Spectrophotometer (AAS) Carried out in Institute of Science, Mumbai.



During Acid digestion process



Acid digested samples

Results and Discussion-

Metallic content in the mangrove plant indicates gross degree of pollution present in the surrounding soil and water.All five heavy metals (Cadmium, Lead, Mercury, Zinc and Arsenic) were detected in the all ten samples.

Table 1. Heavy metal estimate in *Avicennia marina*

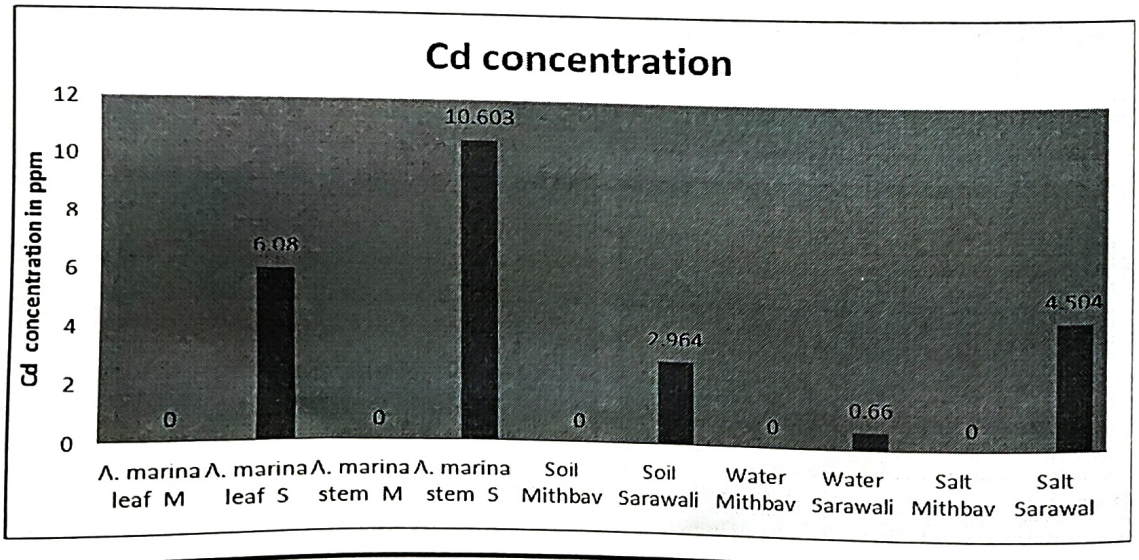
Sr. No	Sample	Heavy metals in ppm				
		Cd	Pb	Hg	Zn	As
1	*A. marina* leaf M	ND	0.164 ± 0.160	ND	0.056±0.00	ND
2	*A. marina* leaf S	6.080 ± 0.036	5.621 ± 0.168	2.1 ± 0.00	12.305 ± 0.00	0.02 ± 0.00
3	*A. marina* stem M	ND	0.164 ± 0.160	ND	0.102 ± 0.047	ND
4	*A. marina* stem S	10.603 ± 0.25	9.821 ± 0.108	2.9 ± 0.036	20.64 ± 0.031	0.019 ± 0.01
5	Soil Mithbav	ND	0.060 ± 0.086	ND	0.206 ± 0.00	ND
6	Soil Sarawali	2.964 ± 0.160	1.386 ± 0.202	0.950 ± 0.00	0.996 ± 0.031	0.02 ± 0.00
7	Water Mithbav	ND	ND	ND	0.305 ± 00	ND
8	Water Sarawali	0.660 ± 0.286	0.068 ± 0.169	2.621 ± 0.168	0.568 ± 0.163	0.010±0.00
9	Salt Mithbav	ND	0.02± 0.00	ND	0.520± 0.00	ND
10	Salt Sarawali	4.504 ± 0.605	2.803 ± 0.605	6.602 ± 0.605	8.203 ± 0.605	0.603 ± 0.60

ND means less than 0.01 ppm

M-Mithbav, Sindhudurg (Non-Polluted site), S- Saravali,Palghar (Polluted site)

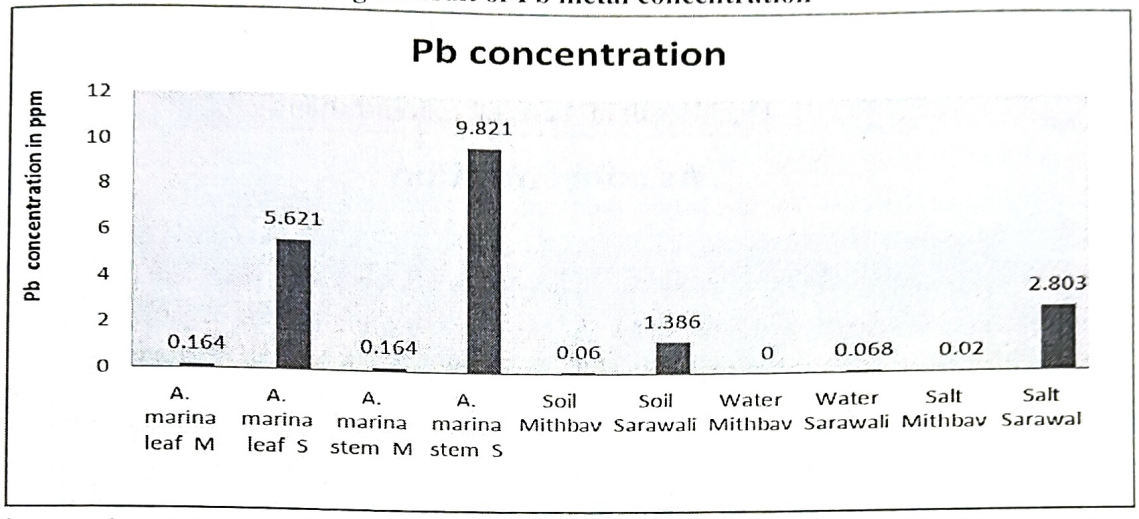
Cadmium was estimated above the permissible level in all polluted site samples. The highest estimate for Cd was observed in stem sample of *A. marina* of polluted site i.e.(10.603 ± 0.25 ppm) (Table. 1, Fig.1) and lowest concentration was detected in all the samples of Mithbav site i.e below detectable limit.(Table.1, Fig. - 1). Highest estimate for Pb found in *A. marina* stem of Saravali site (9.821 ± 0.108 ppm). (Table. 1, Fig.2).

Fig.1 Result of Cd metal concentration



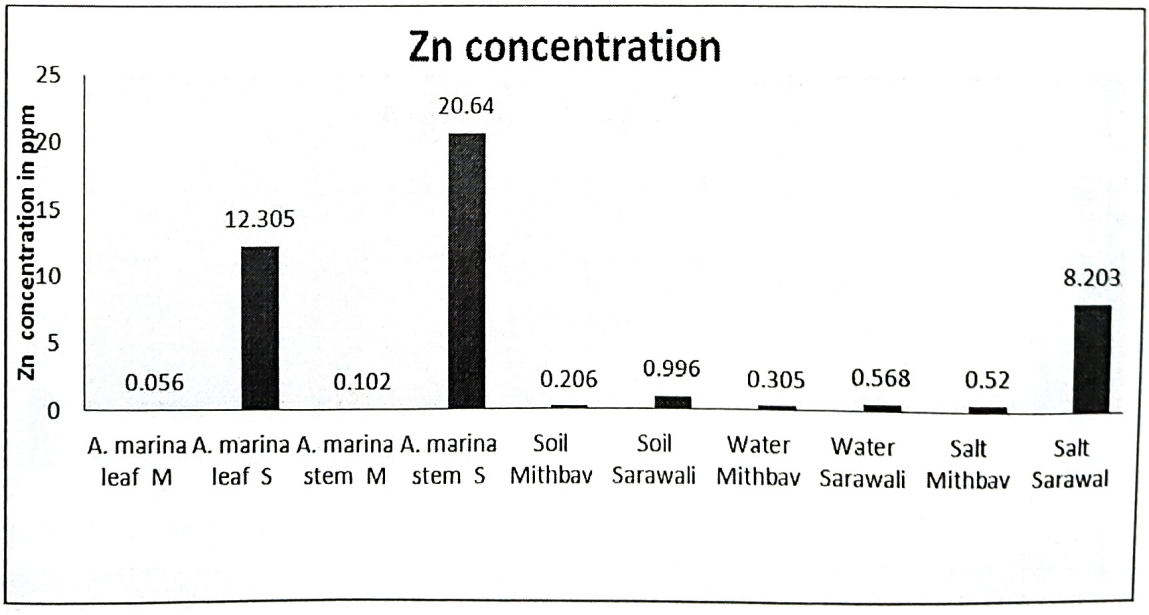
Lead indicate its presence by exceeding the limit of Maximum Level Recommended for Livestock (MLRL), i.e.(2 ppm). Pb was extremely high in all samples of Saravali as compare to control (Table.1, Fig.2). In soil, lead was detected below the permissible limit for Mithbav site (0.060 ± 0.086ppm) in control and (1.386 ± 0.202ppm) polluted site sample respectively. (Table.1, Fig.2).

Fig.2 Result of Pb metal concentration



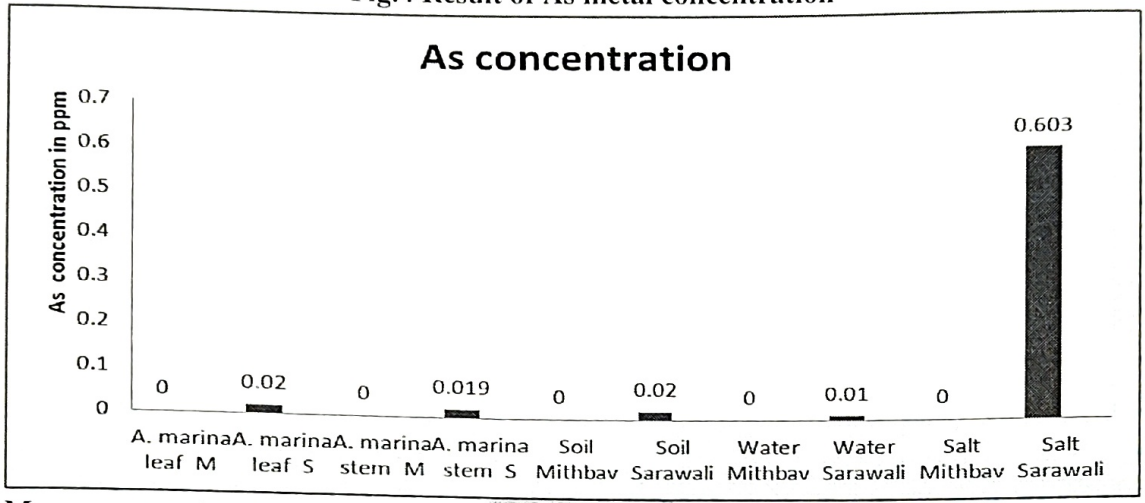
Zinc was found above the MLRL level in the leaf samples (12.305 ± 0.00). The highest estimate for Zn was observed in stem sample of polluted site i.e. (20.64 ± 0.031ppm) compared to control (0.102 + 0.036 ppm) with 20.50 ppm more in quantity (Table.1, Fig. - 3). The depositing of these elements in leaf of mangroves plant have also been reported by Gorbanova and Gorbanov (2004);ATSDR(1993) and Goyer(1988).Dang(2005)reported high concentration of Zinc (above the level of MLRL) in Singapore mangroves.Soil sample of control site indicates lowest concentration below the detectable limit but the polluted soil of Saravali site indicates comparatively higher Zn concentration (0.950 ± 0.00ppm) but less to the MLRL level i.e.(6.00 ppm) (Table.1; Fig.3).

Fig.3 Result of Zn metal concentration



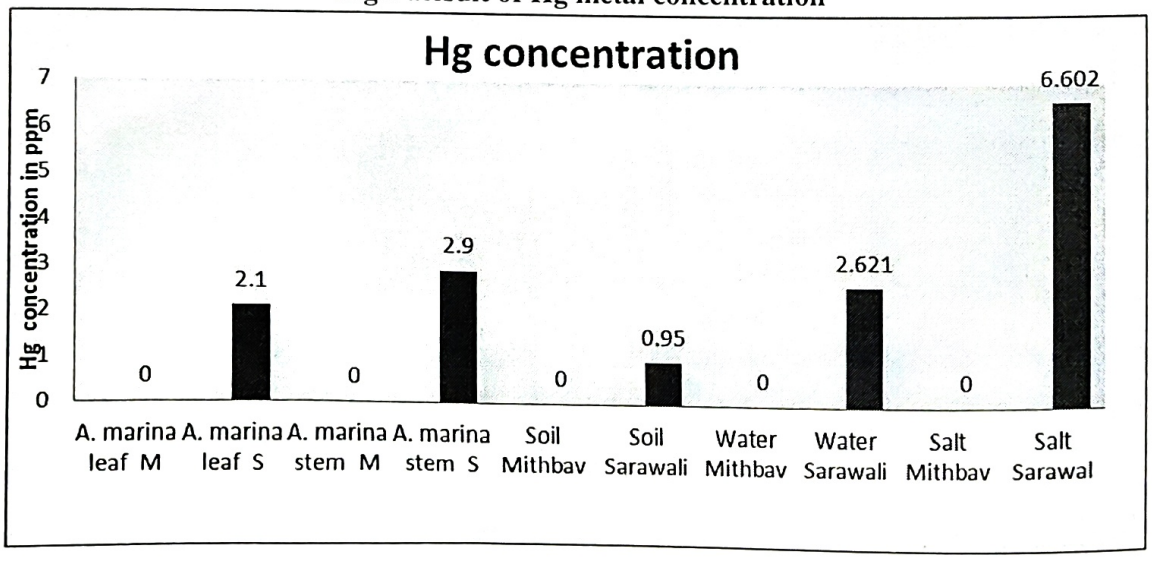
Arsenic is another metal element which is occurs in excess, because of its harmful effects on the nervous, lung, kidneys and may be fatal. This element was detected in plant samples in the quantity exceeding the MLRL i.e.(0.015ppm). Highest concentration of As detected in Salt of polluted Saravali site i.e. (0.603 ± 0.60 ppm) and lowest concentration detected which was below detectable limit in all the samples of the Mithbav site.(Table.1, Fig.4) In soil sample highest concentration of arsenic was detected in Saravali site sample i.e.0.996 ± 0.031 ppm) (Table.1 Fig.4). This may be due to high level of arsenic available in the soil of Saravali area. Similar results were observed by (Nath,1986).

Fig.4 Result of As metal concentration



Mercury was also detected in all samples of polluted area in the quantity exceeding the MLRL i.e. (0.1 ppm). The highest concentration of Hg was detected in salt sample of Saravali (6.602 ± 0.605 ppm) and lowest concentration detected in sample collected from Mithbav site under detectable level (Table. 1, Fig. 5). In soil sample, the highest concentration of Hg was detected in Saravali site i.e. (0.950 ± 0.00ppm) and lowest concentration was estimated in Mithbav site under detectable level.i.e.(0.00ppm). (Yeragi L and Mendhulkar, 2014) found same result i.e.Bioaccumulation of Heavy Metals in Mangrove plant, *Excoecaria agallocha* Linn. Collected from Polluted area in Vikhroli, Mumbai.

Fig.5 Result of Hg metal concentration



Salt samples of Sarawali site indicates all studied elements above the MLRL level (4.504 ± 0.605, 2.803 ± 0.605, 6.602 ± 0.605, 8.203 ± 0.605 and 0.603 ± 0.60 Cd, Pb, Hg, Zn and As respectively. (Table.1).

The Cadmium, Zinc, Mercury, Lead, and Arsenic are responsible for adverse effects on plant metabolism and inducing toxicity in the plants studied area.

Conclusion-

The present analysis greatly helped to understand the status of metal element deposition in the soil and plant samples in Saravali area Palghar district when compared with non-polluted Mithbav Zone. Saravali site found polluted in term of heavy metal which may be the wastes of the commercial industries which is disposed off in the mangrove area of Saravali causing the site most polluting. Exceeding metal concentrations above this level is considered as an indication of a risk of food chain contamination. Salt pan area salt samples extremely dangerous to the food chain. From this study, it is evident that the sample collected from Mangrove region of Saravali creek being close to the proximity of the sea act as a sink for metal deposition. The unprocessed aqueous discharge is drained in the estuaries and thus flushed into the mangroves with suspended toxic particles and it is matter of serious concern and it generates high risk of toxicity in the studied area. Wastewater discharged through drains in the estuaries get flushed into the mangroves which is a serious issue for the food chain.

However, the total concentrations for Cadmium, Zinc, Mercury, Lead, and Arsenic in the sediments were above the general critical soil concentration values except Mithbav site samples. Above all studied heavy metals the permissible level in soil, plant and salt in polluted site of Saravali was found to be the most critical site as it was considered to be the most polluted due to the presence of inorganic toxic pollutants in plant, salt and soil.It has the highest number of heavy metal pollutants exceeding the target as well as Intervention Values of the international guideline level for soil and plants.

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References-

1. Akshayyashete; gunale, v r; pandit, g g (2007).Bioaccumulation of Zn and Pb in *Avicennia marina* (Forsk.) Vierh. And *Sonneratia apetala* Buch. Ham. From Urban Areas of Mumbai (Bombay), India, J. Appl. Sci. Environ. Manage Vol. 11(3) 109 – 112.

2. Vikrant A. Kulkarni, Dr. Tanaji G. Jagtap ,Namrata M. Mhalsekar, Anuradha N. Naik (2010). Biological and environmental characteristics of mangrove habitats from manori creek, west coast, india Author version: Environ. Monit. Assess., vol.168(1-4);587-596.

3. B. Y. Kamaruzzaman*, m. Z. Rinasharlinda, b. Akbar john & a. Sitiwaznah (2011). Accumulation and Distribution of Lead and Copper in *Avicennia marina* and *Rhizophora apiculata* from Balok Mangrove Forest, Pahang, Malaysia, Sains Malaysiana 555-560.

4. Abdulmajeed Bashir Mlitan, Adel ImhemedAlajtal, Abdullah Mohamed Alsadawy (2013).Toxicity of Heavy Metals and Microbial Analysis of Soil Samples Collected from the Area around Zliten Cement Factory, *Open Journal of Air Pollution*, 2, 25-28.

5. Yeragi, L.A. and Mendhulkar, V. D. (2014). ICP-AESAnalysis for Bioaccumulation of Heavy Metals in Mangrove plant, *Excoecaria aghallocha* Linn. Collected from Polluted area in Mumbai. Journal of Advances in Plant Sciences India, 27 (II) 497- 500.

6. H. B. Almahasheer1, W. A. Al-Taisan1 & M. K. Mohamed1 (2014). Metals Accumulation in Grey Mangrove (*Avicennia marina* (Forsk.) Vierh.) Inhabiting Tarut Bay, Eastern Saudi Arabia, Journal of Agricultural Science; Vol. 6, No. 1.

7. Rashida Qari and Shabir Ahmed(2014)Heavy Metal Distribution in Avicennia Marina from Sonmiani, Pakistan Coast, Journal of Shipping and Ocean Engineering 4 (2014) 38-42.