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Using tree barks as atmospheric bio-indicator adsorbents of airborne pollutants

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Abstract

Environmental pollution is considered as one of the important and serious problem faces the humanity nowadays. Pollution can take the form of chemical substances or energy, such as noise, heat, or light. Pollutants are chemicals or materials that pollute the air, the water, or the soil in some form and are caused by human activities. Tree bark has been proven to be a valuable source of information on air pollution. bark has a large absorbent surface. Tree bark enables the identification and mapping of organic and inorganic air pollutants, Heavy metals are one of the important types of contaminants that can be found in the tree barks, which bark polluted with heavy metals have become common across the globe due to increase in geologic and anthropogenic activities. The Eucalyptus tree is an effective bio-indicator for heavy metals accumulation from road traffic. The aim of this study was to investigate and assess heavy metal pollution in the atmosphere such as zinc (Zn), cupper (Cu), cobalt (Co), cadmium (Cd), lead (Pb), nickel (Ni), and chromium (Cr) concentrated in the atmosphere of Tripoli city using Eucalyptus tree barks as a good indicator adsorbents of airborne pollutants. the samples were collected from 5 different localities in Tripoli city – Libya districts, which are having different traffic activities and all sites that have civil war, were takin in April 2024 and analyzed accomplished by flame atomic absorption spectroscopy technique (f - AAS).

In this study, the result from heavy metal determination showed the presence of all the seven targeted elements in the barks samples. Highest mean concentrations of lead (40.770±1.43mg/kg), while Cd gave the lowest concentration at (0.065±0.003 mg/kg).

Keywords: heavy metals, environment pollution, bio- indication, tree bark, (AAS)

INTRODUCTION

Heavy metals are generally referred to as those metals which possess a specific density of more than 5 g/cm^3 and adversely affect the environment and living organisms Heavy metal may be toxic when its concentration in the plant, animal and soil exceeds a certain threshold [1]. Some of the heavy metals are having so much of biological importance in trace amounts. [2] The biological importance of these metals is enzyme functioning, hormone functioning, production, cellular growth and metabolic growth. But these metals are required for the human in trace amounts only. if their amount in the body increases they cause adverse effects on human health. Some of the heavy metals are essential as nutrients for humans such as iron, cobalt and, zinc in small quantities but are toxic in higher quantities. But few metals, such as lead, cadmium and, mercury are poisonous even in small quantities. The toxicity of heavy metals is depending on concentration, period of exposure and route of exposure. Heavy metal exposure takes place on human beings through inhalation from the atmosphere, intake through drinking water and, ingestion through the skin by dermal- contact [3]. Although heavy metals differ in their chemical properties, they are used widely in electronic components, machinery and material. Consequently, they are emitted to the environment from a variety of anthropogenic sources to supplement natural background geochemical sources. Some of the oldest cases of environmental pollution in the word were caused by heavy metal extraction and use. The barks are among the most excellent bio-sorbent material and have been used as bio-accumulator of toxicants due to its porous surface, readily available, simple, reliable and cheap [4]. Accumulation of airborne pollutants on tree barks depended on the barks texture, the presence of epiphytic organisms and the exposure time. Since the contaminants are deposited on the outer bark surface, the depth of sampling has an influence on the level of contamination [5][6]. In this study the tree barks samples were collected near the road traffic.

SAMPLING

The samples of Eucalyptus tree barks were collected in the month of April 2014 from a plantation (Janzour, Wadi al-rabeea, Tariq almatar, Tajoura, Salah al-Din). Samples of bark

were collected from tree at a height of 2 meters from the ground, and about 3 mm in depth was removed by steel knife and that were located at 150 meters from road traffic (Wadi al-rabeea). 300 meters from road traffic (Tariq almatar and Tajoura) 200 meters from road traffic (Janzour and salah al-Din), The stem barks were cut to small pieces, soaked in distilled water for 2 days to remove impurities, then washed in (0.05M) NaOH and (0.05M) HCL, then washed by distilled water. finally, the washed barks were dried in the oven at a temperature of 80℃ f0r (4) hours to a constant weight. And ground to powder in an electric grinder. 15 samples were coded Wadi al-rabeea samples as A1, A2, A3 Janzour B1, B2, B3 Tariq almatar C1, C2, C3 Tajoura D1, D2, D3 Salah al-Din F1, F2, F3.

Sample digestion and heavy metals analysis

Samples extracted using hot block digestion method. 1 g of each sample was weighed in a 100 mL beaker. Followed by addition of 10 mL mixtures of 30 % (m/m) H2O2 and 65 % (m/m) HNO3 in the ratio (3:1 v/v) solution. The solution was digested on a hot plate at 120℃ in a fume cupboard for 120 minutes. The digested samples were allowed to cool to room temperature and final extracts were filtered into 25 ml volumetric flasks through 45 μm filters and then diluted to the mark with 1% HNO3 solution. Heavy metals concentrations were measured by flame atomic absorption spectroscopy (F - AAS).

Results and Discussion

The concentrations of heavy metals in the samples analyzed are shown in table1,2 and table 3. The highest mean value of Zing was found in samples collected from Tariq almatar site (14.316mg/kg), whereas the lowest mean value was found in Tajoura samples site (12.643mg/kg), Cupper has the highest mean concentration in sample from of Salah al-Din site (27.5mg/kg) and the lowest mean concentration is (20.22mg/kg) in the Wadi alrabeea sample. The levels of Cobalt and Cadmium elements in the all study sites are generally low. The highest mean value of lead was found in samples collected from the Salah al-Din site (40,77mg/kg) and the lowest mean value was found in Janzour site (27.597mg/kg). Nickel has the highest mean concentration in sample collected from Wadi alrabeea site (6.217mg/kg) and the lowest was (4.17mg/kg) from Tajoura samples. The mean Cr concentration was highest in Tariq almatar site (3.720mg/kg) and lowest in Tajoura site (2.927mg/kg). A higher level of concentration of Zink, Cupper, Lead and Nickel detected in all bark samples indicated that possible from have traffic density in the surrounding studied area and the result of the

severe pollution due to the gases emitted from fuel combustion, as well as the explosions caused by wars that have recently occurred in these areas.

Table 1- Level of heavy metal concentration values for (9) Eucalyptus Tree Barks Samples (mg/kg) collected from Wadi alrabee, Janzour and Tariq almatar sites

Metal mg/kg	Wadi alrabeea site			Janzour site			Tariq almatar site		
	A1	A2	A3	B1	B2	B3	C1	C2	C3
Zn	12.1	13.4	14.16	12.18	14.43	12.65	14.18	14.12	14.65
Cu	19.12	21.67	19.87	22.66	21.21	21.00	26.44	25.83	26.54
Co	0.176	0.242	0.277	0.298	0.254	0.288	0.198	0.290	0.284
Cd	0.089	0.091	0.091	0.081	0.080	0.088	0.091	0.095	0.087
Pb	30.88	28.42	27.71	26.86	28.22	28.90	40.00	38.90	37.31
Ni	6.56	6.00	6.09	4.57	5.76	5.32	4,06	4.93	5.36
Cr	3.33	3.65	3.31	2.16	3.11	2.48	4.04	3.84	3.28

Table 2- - Level of heavy metal concentration values for (6) Eucalyptus Tree Barks samples (mg/kg) collected from Tajoura and Salah al-Din sites

Metal mg/kg	Tajoura site			Salah al-Din site		
	D1	D2	D3	F1	F2	F3
Zn	12.12	12.81	13.00	13.32	13.66	13.21
Cu	20.91	20.44	20.11	26.18	28.00	28.32
Co	0.261	0.255	0.308	0.224	0.220	0.208
Cd	0.067	0.066	0.061	0.098	0.096	0.096
Pb	28.08	28.56	30.61	40.11	39.45	42.75
Ni	4.44	4.01	4.06	5.11	5.42	4.81
Cr	2.77	2.98	3.03	3.41	3.49	3.83

Table3. Level of heavy metal concentration values for 5 Eucalyptus Tree Bark Samples (mg/kg). data represent the (mean value ± S.D.)

Metal (mg/kg)	Wadi alrabeea	Janzour	Tariq almatar	Tajoura	Salah al-Din
Zn	13.22±0.85	13.087±0.97	14.316±0.24	12.643±0.38	13.397±0.19
Cu	20.220±1.5	21.623±0.74	26.270±0.31	20.487±0.34	27.500±094
Co	0.231±0.42	0.280±0.02	0.257±0.04	0.275±0.02	0.217±0.007
Cd	0.090±0.46	0.083±004	0.091±,0.003	0.065±0.003	0.097±0.001
Pb	29.08±1.4	27.597±0.94	38.737±1.10	29.083±1.1	40.770±1.43
Ni	6.217±0.25	5.217±0.49	4.783±0.54	4.170±0.19	5.113±0.25
Cr	3.430±0.16	2.583±0.39	3.720±0.32	2.927±0.01	3.577±0.18

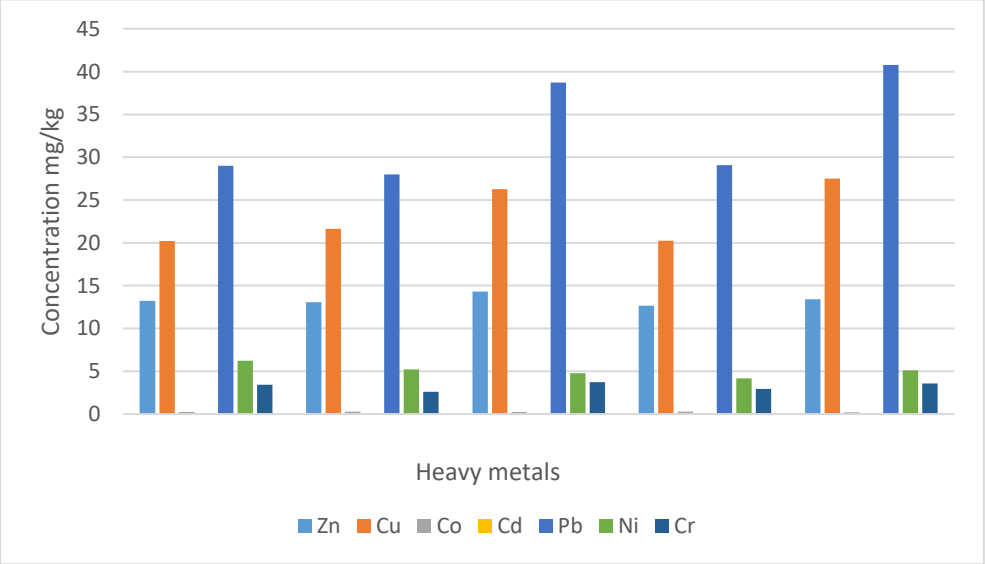

Figure1 - Distribution pattern of seven heavy metals mean concentrations for all sites

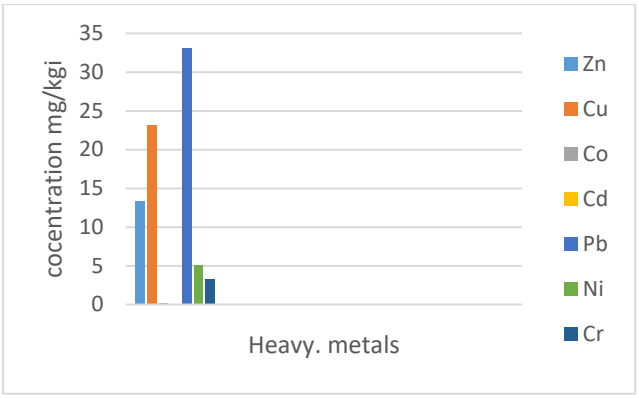

Figure 2. Average concentration of heavy metal detected

conclusion

The heavy metals distribution in the studied area indicates a high concentration of Zn, Cu, Pb, Ni, and Cr but low in Co and Cd element. The mean concentration of the studied metals where ordered as follows: Pb > Cu > Zn > Ni > Cr > Co > Cd. The result from this study proved that tree barks can act as bioindicators and good source of about pollutants in the environment.

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