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Research Article

Heavy Metals contents in Neem Tree (*Azadirachta indica*) Parts and Surroundings

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Abstract

The heavy metal content in neem (*Azadirachta indica*) samples were analyzed using ICP-OES technique and different samples such as neem leaf, neem wood and neem gum were collected from the university of Sharjah, university city. The environmental pollution can be monitored using metal content in different neem samples easily grown in UAE. The metal contents of Fe, Mn, Co, Ni, Cu, Zn, Cr, Cd, Pb, Mo, As, B, Ca were analyzed using ICP-OES method. The average metal concentrations of different samples in ppm were Fe (155.48), Mn (8.63), Co (0.12), Ni (1.42), Cu (7.11), Zn (5.91), Cr (0.63), Cd (0.02), Pb (0.50), Mo (0.91), As (1.85), B (68.09), Ca (10832.07) respectively.

The environmental pollution arises from different ways such as hazard gases released into the atmosphere due to factories, contaminated water release in seas (or) river and deposition of heavy metals in soils, plants. These contaminations effect the earth atmosphere, leads to climate change, increase salinity of sea water and heavy metal deposition. The neem plants absorb carbon dioxide and maintains the balance between the CO_2 and O_2 on the earth atmosphere. By using the photosynthesis, these plants produce more amount of oxygen by absorbing CO_2. These plants were acted excellent air filters and absorb polluted gaseous present in the environment and other advantages of neem plants, they can survive in heat, water pollution and used as a soil fertilizer. The toxicity due to the different kind of pollution in the atmosphere was low, shows the healthier environment in the area located in the University of Sharjah, university city.

Keywords: Heavy Metals; Neem Parts; Environmental Pollution.

Introduction

Importance of heavy metals was steadily increasing in cities as a consequence of air contamination in the environment arise health risks [1]. Current studies shown that natural vegetation was useful in observing the atmospheric metal outgrowth [2]. Reports of contamination of metals due to plant residues in industrial areas and cities have an excessive amount of micronutrient such as Zn and Cu [3,4]. The pollution of the environment due to heavy metal concentration was carried out geochemical studies by collecting dust and soil samples.

The possible ways of people exposed to high levels of trace metals are inhalation of dust particles and swallow of soils and dust (in case of children). The Atmosphere of cities influence on people's health as well as the quality of life [5].

According to reports, the accumulation of world population increased in urban areas by the next 30 years. The elevated pollution levels due to industrial centers and irresponsible industrial actions put an impact on the city environment [6].

The sources of deposition of trace metals in the urban atmosphere due to domestic business, factories and city traffic collected in plants, soils and polluted water was examined [7].

The source of heavy metal contamination in an urban environment can vary anthropogenic sources in different ways, such as the combustion of fossil fuel, city traffic, metallurgical factories, and other industries [8]. Pollution particles can be composed of elements such as Zn, Pb, Cr, Cu [9].

Air pollution in the cities arise in many ways such as combustion coal, pesticides reuse cremation and use the age of leaded gasoline [9] the content of Pb deposition leads to lichens measures the level of Pb in street traffic [10]. The other factors also influence the plants due to air pollution [11].

According to the survey, the levels of Cu, Zn, and Fe found higher in herbs such as white clover than paspalum [12] the main source of cadmium pollution is due to utilization of residual water for irrigation as well as use age constitutes of fertilizers [13].

The pollution due to Cu come from many sources such as industries, automobile, and soils [14]. The changes in the environments can be monitored using plant species or plants related to biological organisms. Few plants are very sensitive to single or more toxicants present in the atmosphere, these plants are grown to detect the effect on pollution, are called biomonitoring plants. They have a potential advantage to illustrate the presence of phytotoxicity in the environmental air and also indicate the spatial spreading of pollution effects. Monitoring needs standard methods to measure pollution air [15].

Plants accumulate the heavy metals in their tissue but released into the surrounding atmosphere. The uptake amount was depending on the genotype of the plants, there are two types of plants named as excluders and includes. The excluder plants uptake low amount of metals, even external concentrations are very high. These plants build a barrier to control the uptake of the element, but the outside concentrations are very high. The barrier loses its role, increasing toxic metal concentration. In which the includes or accumulators' plants, they can deposit more levels of metals even though the outside concentration were very low. This kind of plants have detoxification technique builds within the tissues, which permit the plant to deposit large levels of metals. The includes the uptake accumulation of elements not increased, if the external concentrations increased.

A distinct kind of accumulators called hyperaccumulator, which illustrate the greater deposition of metal content in the leaves of the plants. for example, the metal content in leaves in (mg/g) shown as > 0.1 for Cd > 1 for Pb, Co, Cu, Ni or > 10 for Mn and Zn [16].

The heavy metal contamination in the environment arises from different factors such, the release of pollution in water or soils and air. Many heavy metals were toxic nature, but other metals are essential for living such as Fe, Zn, Cu, Co, and Cr, were needed for the metabolic activities for the main class of organisms. Depending upon daily intake some heavy metals are necessary micronutrients for plants, animals, and various micro-organism [17].

The present study shows the concentration of heavy metals and biomonitoring of elements in lichen plant. The samples collected from the neem trees trunk, leaves and gum in the University of Sharjah UAE for the analysis of heavy metal concentration.

Materials

Area of the study

Sharjah is the third large city of UAE, located in the southern coast of the Persian Gulf of Arabian Peninsula, known for its nation's cultural capital. The economic growth of 7.4% of the GDP contributes to UAE. In 2016 WHO officially accounted as a healthy city [18]. In summer the temperature reaches 40°C with 50% humidity. The google map shows samples collection for the present study.

https://www.google.com/maps/place/25%C2%B017'14.4%22N+55%C2%B028'45.6%22E/@25.2873268,55.4771547,17z/data=!3m1!4b1!4m5!3m4!1s0x0:0x0!8m2!3d25.2873268!4d55.4793434?hl=en

Sample collection

The samples of Neem (*A. indica*) tree trunk bark, leave, and gum collected in January 2019 from the University of Sharjah situated in the university city, Sharjah. The analysis of the samples (bark and leaves) collected by using a stainless-steel knife. The samples were stored in polyethylene bags and named according to Radojevic and Bashkin (1999). (19) The standards prepared for the determination of Cd, Pb, Zn, C, and Ni using ICP-OES method.

Sample digestion

The sample was digested using wet digestion method, one gram of sample taken into keddahs flask having the 1000cm3 capacity and the sample was digestion in 3:1 ratio of HCl and HNO_3 and leave for a whole day inside a fume hood. The mixture heated for 40°C for more than half hour, the heat was increased up to 100°C and heating continued till the solution become clear, and the white fumes disappeared indicates the completion of the digestion process [20].

The digestion solution diluted with distilled water and boiled about 15minutes. The solution was cooled, and filter using Whatman filter paper and filled till the mark of keddahs flask using distilled water. The digested solution transferred into a polyethylene bottle for further analysis of heavy metal concentration using ICP-OES.

Preparation of standard solutions

Zinc Standard solutions preparation: One gram of zinc metal was dissolved in 30 ml of 5 M HCl solution and diluted to 1000 ml with deionized water. From this stock solution of zinc, standard diluted solutions of 2 ppm to 25ppm prepared.

Cadmium standard solutions preparation: A stock solution of cadmium was prepared by dissolving 2.0360g of cadmium chloride in 250 ml of deionized water and diluted to 1000ml in a volumetric flask. From the stock solution of cadmium, standard, dilute solutions ranging from 0ppm to 10 ppm prepared.

Lead standard solution Preparation: A stock solution of lead was prepared by dissolving 1.60 g Lead (II) nitrate ($Pb(NO_3)_2$) in 20ml of deionized water and diluted to 1000 ml in a volumetric flask. From the stock solution of lead, standard, dilute solutions ranging from 0 ppm to 10 ppm prepared.

Nickel standard solution preparation: A stock solution of Nickel was prepared by dissolving 4.9530 g of Nickel nitrate ($Ni(NO_3)_2$) in 1000 ml of deionized water and diluted to 1000 ml in a volumetric flask. From the stock solution of Nickel, standard, dilute solutions ranging from 0 ppm to 10 ppm prepared.

Chromium standard solution preparation: A stock solution of chromium was prepared by dissolving 7.6960 g of Chromium nitrate ($Cr(NO_3)_3.9H_2O$) in 250 ml of deionized water and diluted 1000 ml in a volumetric flask. From the stock solution of chromium, standard, dilute solutions ranging from 0 ppm to 10 ppm prepared.

Results and Discussion

The heavy metal concentrations of neem gum, neem wood, and neem leaf presented in Table 1. The metal contents of Fe, Mn, Co, Ni, Cu, Zn, Cr, Cd, Pb, B, Ca were analyzed using ICP-OES technique. In this study, three neem wood, two neem gum, and three neem leaf samples collected from the University of Sharjah, university city for the analysis. The neem leaf samples contain a high amount of Fe, Co, Ni, Zn, Cr, Cd, As, B, Ca, while gum samples have a high content of V and Mg, and wood samples have greater levels of Co, Mn, and Mo.

The maximum value of heavy metals found in our study were in ppm as follows Co was 0.21 present in leaf (L3),Cu was 13.66 present in wood(W3),Ni was 2.40 present in leaf (L3), Cr was 1.33 present in leaf (L3), As was 5.54 present in leaf (L3), Zn was 13.44 present in leaf (L3), Mo was 2.97 present in wood(W3), Pb was 0.79 present in leaf (L3) ,V was 6.27 present in gum(G1), and Cd was equally present in seven samples as 0.01 respectively.

Sample	Fe (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Cr (ppm)	Cd (ppm)	Pb (ppm)	Mo (ppm)	As (ppm)	B (ppm)	Ca (ppm)
neem wood1 (w1)	158.66	7.20	0.16	1.74	7.46	3.48	0.61	0.00	0.63	0.00	0.00	28.85	8611.59
neem wood2 (w2)	131.14	6.04	0.14	1.53	6.57	2.85	0.44	0.01	0.58	0.00	0.00	28.21	7575.47
neem wood3 (w3)	148.66	16.67	0.11	1.42	13.66	7.08	0.81	0.11	0.49	2.97	4.52	23.48	-
neem gum 1(g1)	131.61	3.99	0.10	1.20	9.38	2.98	0.92	0.01	0.42	2.43	4.75	4.16	-
neem gum 2(g2)	92.81	2.68	0.08	0.88	4.96	3.66	0.27	0.01	0.26	0.00	0.00	3.31	7667.00
neem leaf1(l1)	79.71	7.16	0.04	0.61	BDL	5.10	0.18	0.01	0.25	0.00	0.00	121.15	11188.15
neem leaf2(l2)	171.37	9.87	0.13	1.58	2.42	8.68	0.45	0.01	0.61	0.00	0.00	117.60	19118.16
neem leaf3(l3)	329.87	15.41	0.21	2.40	5.32	13.44	1.33	0.01	0.79	1.89	5.54	217.91	-

Table 1: Heavy metal concentration of Neem tree.

In the present study iron levels in neem samples ranges from 79.71- 329.87ppm. In lettuce (357.78 μgg^{-1}) and spinach (211.00 μgg-1) contain a low content of Iron [21]. According to Yahaya and Amusan, the concentration of Fe was 1075.79 μgg-1, in cocoyam leaves (211.64 μgg-1), was nearly the same compared to the present study [22,23]. The amount of Fe in plants ranging from 500.00-100.00 μgg-1 recommended by ICAR [24].

The concentration of Mn in neem samples ranging between 2.68- 16.67ppm. These levels compared with different studies. The amount of Mn in neem was higher compared to spinach (7.00 μgg^{-1}), lettuce (7.50 μgg^{-1}) [21], while spinach leaves (165.00 μgg^{-1}) contains significantly higher levels of Mn reported by Miller-ihli and Baker [25]. Usually, the concentration of Mn normal in dry mass of plants lies within the range 500.00-25.00 μgg^{-1} [24].

The content of Ni in the present study lies between 0.61 -2.40ppm. The Ni content in onion (0.24 μgg^{-1}), spinach (0.69 μgg-1), bitter leaf (0.86 μgg^{-1}) and drum tree (0.78 μgg^{-1}) were lower compared to our neem samples [26].

	Fe	Mn	Zn	Cr	Co	Pb	Ni	Cu
Nigeria	2-210	12.0-37.0	1.5-12.50	0-30	0.5-18	0-5	0-6	0-3.50
WHO	425.0	500.0	100.0	2.30	NS	0.30	NS	40.0
present study	155.48	8.63	5.91	0.63	0.12	0.30	1.42	7.11

Table 2: Shows the metal content of different studies.

The results compared with other neem samples of Nigeria and WHO, in which the metal concentrations of Fe, Mn, Zn, Cr, Co, Pb, Ni, Cu were low. The samples were taken from the university city, Sharjah, the covered with the many plants, non-industrial, non-commercial, far from highways. In the year 2016, the world health organization declared the Sharjah city as a healthy city, with low air pollution [18].

Several studies show that the monitoring of pollution using metal deposition in plants and neem plants are medicinal plants, deposited the heavy metal content and good absorber of CO_2 from the atmosphere.

Conclusion

The present study shows the heavy metals content in neem leaves, wood, gum samples using ICP-OES, and the samples collected from the University of Sharjah (UAE). The higher concentration of metals such as Fe, Co, Ni, Zn, Cr, Cd, As, B, Ca found in neem leaves compared to neem gum and neem wood. The heavy metal concentrations within the permissible limit suggested by WHO.

The pollution causing due to automobiles, factories and release a vast amount of CO_2 and NO into the air causes earth atmosphere warmer. These lead to global warming or climate change and increases sea levels, as well as change the pattern of rainfall and affect food production. The neem plantation absorbs carbon dioxide and maintains the balance between the CO_2 and O_2 on the earth atmosphere. By using the photosynthesis, these plants produce more amount of oxygen by absorbing CO_2. These plants were acted excellent air filters and absorb polluted gaseous present in the environment and other advantages of neem plants they can survive in heat water pollution and used as a soil fertilizer. The toxicity due to the different kind of pollution in the atmosphere was low, shows the healthier environment in the area located in the University of Sharjah, university city.

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