Determination of Copper and Zinc in Leaves of *Eucalyptus Camaldulensis* and *Ziziphus Spina-Christi* Growing on the Roadside of Baqubah City

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Abstract

Samples of leaves from *Eucalyptus camaldulensis* and *Ziziphus spina-christi* were collected from the roadsides of Baqubah city in order to assess the concentrations of Cu and Zn in the leaves of these plants. The results of this study showed that the concentrations of copper in all samples of leaves of the studied plants grown on the roadsides of Baqubah city were high and showed many differences, depending on the location, ranging between 21.62 and 74.62 ppm in the leaves of *E. camaldulensis* and between 21.25 and 54.49 ppm in the leaves of *Z. spina-christi*. The concentrations of Zn in *E. camaldulensis* leaves ranged between 6.72 - 24.60 ppm and between 18.31 - 33.47 ppm in leaves of *Z. spina-christi*. The study showed the ability of leaves of *E. camaldulensis* to accumulate Cu and more effectively than *Z. spina-christi* leaves, and there was no accumulation of Zn in both types of plants due to its limited sources.

Keywords: Road sides, copper, zinc, *E. camaldulensis*, *Z. spina-christi*, accumulation.

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تقدير عنصري النحاس والزنك في اوراق *Eucalyptus Camaldulensis* و *Ziziphus Spina-Christi* النامية على جوانب طرق مدينة بعقوبة

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الخلاصة

تم جمع عينات اوراق نوعين من النباتات *Eucalyptus camaldulensis* و *Ziziphus spina-christi* في جوانب طرق مدينة بعقوبة بهدف تقييم تراكيز النحاس (Cu) والزنك (Zn) ومعرفة مدى تراكمهما في اوراق هذه النباتات، ومن خلال الدراسة تبين ان معدل تركيز النحاس في جميع عينات اوراق النباتات المدروسة على جوانب طرق مدينة بعقوبة كانت مرتفعة وتظهر اختلافات كثيرة، باختلاف الموقع، اذ تراوحت بين 21.62 – 74.62 ppm في اوراق نبات *E.camaldulensis* وبين 21.25 – 54.49 ppm في اوراق نبات *Z. spina-christi*. اما معدل تركيزZn في اوراق نبات *E. camaldulensis* فتراوحت بين 6.72 – 24.60 ppm وبين 18.31 – 33.47 ppm في اوراق نبات *Z. spina-christi*. اظهرت الدراسة قدرة اوراق نبات *E. camaldulensis* على مراكمة عنصر Cu وبفعالية اكثر من اوراق *Z. spina-christi*، وعدم وجود اي مراكمة لعنصر Zn في كلا النوعين من النباتات لقلة مصادره.

الكلمات المفتاحية: جوانب الطريق، النحاس، الزنك، *E. camaldulensis*، *Z. spina-christi*، التراكم.

Introduction

The first attempt to assess environmental pollution from vehicle exhaust emissions was the use of plants as an indicator of pollution by analyzing the various trees, grasses and vegetables that grow on highways and in car-congested cities and this problem has become the focus of attention of many researchers [1].

Emissions from heavy vehicles and road passengers contain lead (Pb), cadmium (Cd), zinc (Zn), nickel (Ni) and copper (Cu) present in the fuel as an anti-knock agent that leads to air pollution and soil where plants are grown [2]. The accumulation of heavy metals in agricultural

land through traffic emissions to soil pollution and the high absorption of heavy metals by crops, and thus affect the quality and safety of food [3, 4].

Most heavy metals are emitted from anthropogenic sources; industrial wastes, transport, manure, herbicides used in agronomy, as well as from sewage silt [5]. Lead, cadmium, copper and zinc are major mineral contaminants on roadside environments and are released from burning fuel, burning tires, leaking oils, and eroding batteries and metal parts such as radiator etc. [6,7].

Several studies have shown that leaves of the plants are the most vital evidence of heavy metals, as in a study of two types of plants *Eucalyptus citriodora* and *Melia azdarach* in the possibility of using them as vital evidence for the detection of heavy metals, and trying to create a safe environment [8]. A few plant species have high adaptations that enable them to survive and multiply in heavy soils contaminated with zinc, copper, lead, cadmium, nickel and arsenic [9]. *E. camaldulensis* can be used as a device to clean contaminated soil if the plant is capable of assembling high concentrations of heavy metals in its tissues by a method known as phytoremediation [10]. phytoremediation is the use of plants to remove, detoxify or freeze environmental pollutants in an environmentally growth (soil, water or sediments) through natural, biological, chemical, physical and plant processes [11].

The contents of copper deficiency in the sterile mature leaf tissue of different plant species range from 2 to 5, normal from 5 to 30 and from 20 to 100 ppm (DW), while the zinc deficiency content in the sterile mature leaf tissue of different plant species ranges from 10 to 20, and natural from 27 to 150 and toxicity from 100 to 400 ppm (DW) [12].

In the present study, samples of leaves from *Eucalyptus camaldulensis* and *Ziziphus spina-christi* were collected from the roadsides of Baqubah city in order to assess the concentrations of Cu and Zn in the leaves of these plants.

Materials and Methods

Study area and collection of plant leaves

The city of Baqubah is located in the eastern of Iraq with a geographic coordinate of latitude (37° 25 50) to (37° 40 52) on north, and longitude (45º 16 39) to (47º 55 32) east on both sides of Diyala river. The city is located 50 km north of Baghdad, and it is one of the developing cities as a result of improved economic and living conditions, which caused the increase in ownership of vehicles, but the city suffers from weakness of the old planning to model the movement of transport within the city [13]. In recent years, the rate of vehicular access to the city has increased at a tremendous rate and in excess of the roads in the city, causing heavy traffic congestion. According to statistics recorded by the Directorate General Traffic. the period from June 2010 until August 2013 the number of vehicles entering to Iraq and registered with the registration plate as a temporary motor was about 1.470.000 million vehicles of different types (private, public, vehicle load, agricultural, government) and the share of Diyala Province was 73,000 vehicles, as well as other types, which amounted to the number of 10,000 vehicles in the Province [14].

The samples were collected from ten selected sites within the city of Baqubah, divided into five sites for roadsides aspects around the city and five others in the city center (residential areas), as well as the samples collected from areas which is far from contamination (control sites) in Kanaan area table 1. The leaves of plants were collected on 10/1/2017 and at a height of 1-2 meters (at the level of the respiratory area of individuals) taking the fresh growth of leaves from the four sides of each plant, and mixed together to form a single composite sample, the number of samples collected is 60 samples (three replicates per sample).

The samples were placed in plastic bags of polyethylene and transferred to the laboratory, washed with tap water then distilled water, dried and then kept until the completion of special tests.

Table 1: The sites of study area

No.	Study sites	Location Attributes
1	Old Baghdad highway	Roadsides around the city of Baqubah
2	New Baghdad highway	Roadsides around the city of Baqubah
3	Tourism route	Roadsides around the city of Baqubah
4	Bab Al-Darub	Roadsides around the city of Baqubah
5	Al-Sadeeq	Roadsides around the city of Baqubah
6	Jorf Al-Maleh	Roadsides around the centre of Baqubah city
7	Al- Sharif	Roadsides around the centre of Baqubah city
8	General Hospital	Roadsides around the centre of Baqubah city
9	Baqubah	Roadsides around the centre of Baqubah city
10	Al-Sariya	Roadsides around the centre of Baqubah city
11	Control	Kanaan as an agricultural area

Digestion of plant leaves

Two grams of dried leaves were taken, then the distilled water was added to form up to 5 ml and then digestive acid (3HCL: 1HNO_3) was added to the mixture and then put on a hot plate at 280° C for 2 hours. The samples were then filtered to a 25 ml flask and the size was added to the mark with the addition of distilled water [15]. Heavy metals such as copper and zinc were analyzed using Flame atomic absorption spectrometer model Shimad 24 AA-680.

Statistical analysis

The results of the study were analyzed by program (SPSS V.22) using analysis of variance to compare the differences between the average using a value less significant difference (LSD) at a significant level of <0.05.

Results and Discussions

Concentration of copper in the studied plants

The concentrations of copper in the samples of the leaves of the studied plants in the roadsides Baqubah city are shown in table 2.

Table 2: Average concentrations of copper and zinc (ppm) in the leaves of some plant leaves collected from the roadsides, Baqubah City, diyala Province.

No.	Study sites	Cu		LSD	Zn		LSD
		Eucalyptus camaldulensis	*Ziziphus spina-christi*		*Eucalyptus camaldulensis*	*Ziziphus spina-christi*	
1	Old Baghdad highway	74.62	54.49		24.60	26.73	
2	New Baghdad highway	45.60	22.26		22.70	23.25	
3	Tourism route	53.30	21.25		22.92	18.31	
4	Bab Al-Darub	47.14	26.60		19.72	24.85	
5	Al-Sadeeq	28.26	43.92		19.08	33.47	
6	Jorf Al-Maleh	35.76	24.40	NS	15.58	29.26	0.89
7	Al- Sharif	26.71	21.72		17.15	25.31	
8	General Hospital	21.70	33.63		10.54	25.17	
9	Baqubah	21.62	37.42		16.14	27.93	
10	Al-Sariya	22.68	27.77		6.72	32.17	
Average		37.73	34.24		17.51	26.64	
11	Control	26.68	19.01		11.07	19.65	
LSD		3.21	1.81		0.78	0.56	

The results showed that the concentration of copper in the leaves of plants collected from Kanaan district (control sites) was within the normal limits of reported by Kabata-Pendias and Pendias [12]. The percentage of copper concentrations in the studied plant leaves samples in all roadsides of Baqubah city was high and it showed significant differences in different sites ($P<0.05$) between the leaves of *E. camaldulensis* and *Z. spina-christi* with samples sites study the value of 3.21 and 1.81 respectively. and exceeded the limits of excessive toxicity of the copper element in the leave tissue [12].

The leaves collected from the sides of roads around the city of Baqubah showed relatively high concentrations. The highest measured value of copper concentration was 74.62 in leaves of *E.camaldulensis* plants and 54.49 ppm in leaves of *Z. Spina-chrsti* plant for old Baghdad highway samples, with an increase of 179.6% and 186.6%, respectively, from control sites.

Thus, the potential increase of copper in the samples of the studied leaves in the roadsides around the city of Baqubah could be related to the exhaust emissions of the vehicles operating in these roads, especially the highways which are highly traffic-driven due to the large number of diesel and diesel-powered vehicles (In residential areas), as well as emissions from small

factories and maintenance workshops of vehicles scattered and the volatilization of various types of small metal particles arising from the combustion of tires and wastes of solids and plastics.

It has been shown that the copper is deposited from poor engine and brake linings that can find its way into the roadside soils of heavy trucks and other vehicles, especially on highways [16]. Heavy metal contaminants such as Cd, Cu, Pb and Zn are reported to originate primarily from gasoline, automotive components, lubricating oils, vehicles and factories engines emissions [7,17]. As for the percentage of copper concentrations in the samples of leaves taken from the sides of the roads of Baqubah city were less than samples of roadsides around the city, as we move to the center of the city (residential areas) less environmental pollutants and the emission of mineral toxins despite the density and congestion high traffic due to overcrowding for vehicles and checkpoints that helped in the slow operation of motor vehicles and fuel combustion heavily and to which the reason for this increase is due to copper pollution and toxicity to the samples of these papers.

When we compared between content of copper in leaves of *E. camaldulensis* and leaves of *Z. spina-christi*, the analysis of variance showed that the leaves of *E. camaldulensis* were more accumulating copper element than the leaves of *Z. Spina-chrsti*, and this can be attributed to the many sources of pollution in copper in the study area and to the form of *E. camaldulensis* leaves with sufficient surface area for sedimentation and absorption.

Zinc concentration in the studied plants

Table 2 showed a decrease in the concentration of zinc in the leaves of plants collected from Kanaan district (control sites) over the natural limits [12].

The concentration of zinc was low and uncontaminated or non-toxic in all studied plant samples on the roadsides of Baqubah and the analysis of variance showed significant difference ($P<0.05$) the leaves of *E. camaldulensis* and *Z. spina-christi* (0.78 and 0.56 respectively). The limits of excessive toxicity of the zinc element did not exceed the tissue of the leaf [12].

It is noted in the results of the samples of the studied plants leaves in different roadsides of Baqubah city that the highest content of zinc concentration was in the leaves of the plant *E.camaldulensis* 24.60 in the samples of roadsides of the old Baghdad highway, and leaves of plant *Z. Spina-chrsti* was 33.47 ppm in the samples of the roadsides of the Al-Sadeeq road, with an increase of control positions of 2.4% and 33.% respectively.

In general, the low, convergent, non-polluting or non-toxic concentration of all studied plant samples in roadsides areas around the city of Baqubah is due to the low zinc input in the environments surrounding the plants in theses roadsides, in particular the emissions of the compounds of the zinc element and its deposition and absorption from the leaves by the air way, and for the lack of human activities that deal with this element.

Finally, when we compared between the content of zinc in leaves of *E. camaldulensis* and leaves of *Z. spina-christi*, the analysis of variance showed significant difference ($P<0.05$) between the two types of plants regarding the ability to accumulate Zn, and the results of the present study showed that both types of plants do not show any accumulation of zinc in the study area, because of the lack of its sources.

Conclusions

The results of this study showed that the percentage of copper concentrations that were assessed in the leaves of *E. camaldulensis* and *Z. Spina-chrsti* in all roadsides of Baqubah City were high and showed significant differences between different sites, and it exceeded the limits of excessive toxicity of the copper element in the leave tissue reported previously [12]. Zinc concentrations were low and non-polluting and non-toxic in all studied plant samples on the roadsides of Baqubah City, as the limits of excessive toxicity of the zinc element did not exceed that in leave tissue [12].

The main source of copper contamination in the studied plant leaves in the aspects of the roads of Baqubah City is the emissions of various compounds that are released into the atmosphere,

so there is imminent danger in the near future of their accumulation and their impact on plant, human and animal health, drawing attention to it.

E. camaldulensis leaves were found to be more densely packed than the copper element of leaves in *Z. Spina-chrsti* has high levels of copper in the city of Baqubah, and we propose further detailed studies to assess the possibility of *E.camaldulensis* and other leaves to carry and accumulate high concentrations of different metals (especially toxic heavy metals) and identify an appropriate method for disposal.

References

1. Aksoy, A.; Demirezen, D. Polish Journal of Environmental Studies 2006, 15(1), 27-33.

2. Ikeda, M.; Zhang, Z. W.; Shimbo, S.; Watanabe, T.; Nakatsuka, H.; Moon, C. S.; Matsuda-Inoguchi, N.; Higashikawa, K. Science of the Total Environment 2000, 249, 373-384.

3. Ho, Y. B.; Tai, K. M. Environmental Pollution 1988, 49(1), 37-51.

4. Garcia, R.; Millan, E. Chemosphere 1998, 37(8), 1615-1625.

5. Fargašová, A. *Bulletin of environmental contamination and toxicology* 1998, 61(6),762-769.

6. Akbar, K. F.; Headley, A. D.; Hale, W. H. G.; Athar, M. Soil Water Res. 2006 ,1(4), 158-163.

7. Ikenaka, Y.; Nakayama, S. M.; Muzandu, K.; Choongo, K.; Teraoka, H.; Mizuno, N.; Ishizuka, M. *African Journal of Environmental Science and Technology* 2010, 4 (11), 729-739.

8. Khattaki, M. I.; Jabeen, R. *Pakistan Journal of Botany* 2012, 44(2), 675-681.

9. Baker, A. J. M. *New phytologist* 1987, *106(1)*, 93-111.

10. Nenman, D. V.; Nimyel, N. D.; Ezekiel, D. I. International Journal of Engineering Research and Applications (IJERA) 2012, 2 (2),346-349.

11. Doty, S. L.; James, C. A.; Moore, A. L.; Vajzovic, A.; Singleton, G. L.; Ma, C.; Khan, Z.; Xin, G.; Kang, J.W.; Park, J. Y.; Meilan, R. *Proceedings of the National Academy of Sciences* 2007, *104*(43), 16816-16821.

12. Kabata-Pendias, A.; Pendias, H. Trace Elements in Soil and Plants 3rd. Ed.; CRC Press LLC.: Boca Raton London New York Washington, D. C., 2001.

13. Abad alstayer, Z. A.; Hameed, A. H. Journal of Engineering and Development 2015, 19 (5), 1813-7822.

14. Zidane, L. J.; Shahab, A. I.; Hasnaoy, L.A. Diyala Journal of Engineering Science 2015, 8 (4) ,768-775.

15. Marczenko, Z. Spectrophotometric Determination of elements; John Wiley and Sons Inc.: Newyork, 1976

16. Manno, E.; Varrica, D.; Dongarra, G. Atmosphere and Environment 2006,40(30), 5929-5941.

17. Popoola, O.E.; Bamgbose, O.; Okonkwo, O.J.; Arowolo, T. A.; Popoola, A.O. Research Journal of Environmental and Earth Sciences 2012,4 (4) ,434-439.