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



#### Ahmed Hashim Ibrahim and Najm Abdullah Jumaa

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

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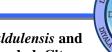
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### **Abstract**

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. spinachristi. 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 عنصرى النحاس والزنك في اوراق Eucalyptus Camaldulensis و Ziziphus Spina-Christi النامية على جوانب طرق مدينة بعقوبة

احمد هاشم ابراهيم و نجم عبدالله جمعة 2

1 المديرية العامة لتربية ديالي 2 قسم علوم الحياة - كلية التربية للعلوم الصرفة - جامعة ديالي

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 - ppm 74.62 في اوراق نبات E.camaldulensis وبين 21.25 – ppm 54.49 – وراق نبات Z. spina-christi في اوراق نبات عدل تركيز Zn في اوراق نبات camaldulensis فتر اوحت بين 24.60 – 6.72 ppm وبين 18.31 – 33.47 ppm في اور اق نبات Z. spina-christi اظهرت الدراسة قدرة اوراق نبات E. camaldulensis على مراكمة عنصر Cu وبفعالية اكثر من اوراق -Z. spina christi، و عدم و جود اي مراكمة لعنصر Zn في كلا النوعين من النباتات لقلة مصادره.

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

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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.

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### **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 (45° 16 39) to (47° 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].

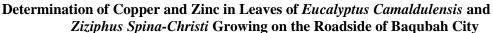
The samples were collected from ten selected sites within the city of Baqubah, divided into five sites for roadsides aspects around the city and five others in the city center (residential areas), as well as the samples collected from areas which is far from contamination (control sites) in Kanaan area 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.

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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<sub>3</sub>) 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.

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

	Study sites	Cu			Zn		
No.		Eucalyptus camaldulensis	Ziziphus spina-christi	LSD	Eucalyptus camaldulensis	Ziziphus spina-christi	LSD
1	Old Baghdad highway	74.62	54.49	F	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

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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].

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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

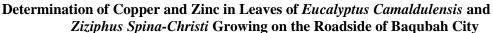
that in leave tissue [12].

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,

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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.

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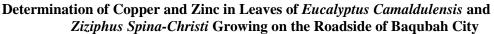
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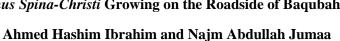
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