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The Efficiency of the *Eucalyptus* sp. Plant in Absorbing Pollutants Results from Vehicle Exhausts in the Baghdad City

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Abstract

Air pollution is one of the serious problems facing the world today because of constant changes in environmental concentration levels of some gases and heavy metals due to humans. Especially when contaminants on the soil and leaves are deposited and transferred to the remainder of the plant. The present study was carried out to assess the theory concentrations of air pollutants in some areas of the city of Baghdad and their effects on the plant (Eucalyptus sp.) by calculating the heavy metal, exposed to roadside vehicles pollution in the city of Baghdad. The gaseous air pollutants levels were measured in five sites namely Al-Doura, Al-Kadhimiya, Palestine Street, and Al-Shaab to represent the urban areas and Al-Rashidiya site to represent the rural area. Included carbon dioxide CO_2, sulfur dioxide SO_2, and nitrogen dioxide NO_2. Also, heavy metal concentrations were measured cadmium Cd and lead Pb. Concentrations of air pollutants, for all studied sites, ranged between 281.33-702.33 ppm, 0.15-3.50 ppm, 0.004-0.532 ppm, 0.132-1.16 µg m^{-3}, 1.75-5.75 µg m^{-3}, for CO_2, NO_2, SO_2, Cd, and Pb, respectively. High concentrations of Cd and Pb were recorded in Eucalyptus sp. (1.51 mg/kg and 5.31 mg kg^{-1}, respectively).

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Introduction

Air pollution is an occurrence that harms the ecological system as well as the normal conditions of human existence and development when some compounds in the atmosphere surpass a certain concentration (Lohe *et al.*, 2015). Several studies refer to road traffic as one of the most important anthropogenic activities that affect the landscape. The burning of fuel in engines of motor leads to carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2), heavy metals (manganese (Mn), chromium (Cr), iron (Fe), cadmium (Cd), lead (Pb), zinc (Zn), nickel (Ni) and copper (Cu)) and as well as suspended particulate matter. These are emissions, the most serious problems of road traffic (Joshi and Swami, 2009; Sobrova *et al*., 2012; Karavalakis *et al*., 2011; Lu, 2011). Plants are the only living organisms that are subjected to significant harm from vehicle emissions; because they remain stationary in their habitat the plants are used as monitors of air pollution and also used as the first interceptors of air pollutants. Plants play the main role in preserving and assessing ecological equilibrium by participating in the cycling of nutrients and gases such as oxygen and carbon dioxide (Swain *et al.*, 2016). Researchers and environmentalists from all over the world are interested in *Eucalyptus* plants because they are a rapidly expanding source of wood and oil utilized for a variety of purposes (Dixit *et al*., 2012). It is a great source of commercially valuable eucalyptus oil, which is widely used in

pharmaceuticals, perfumery, and industry. Eucalyptus oil has been known for hundreds of years to have antibacterial, anti-fungicidal, and antiseptic properties in nature. It is composed of tall, majestic, evergreen trees with fragrant foliage rich in oil glands (Nicolle and Jones, 2018). Seyyednejad and Koochak (2011) mentioned that in urban environments, trees play a significant role in improving air quality by, taking up gases and particles. *Eucalyptus* Plants that are constantly exposed to, environmental pollutants absorb, accumulate and integrate these pollutants into their systems. When exposed to airborne pollutants, most plants experience physiological changes and Pollutants can harm leaves and reduce photosynthetic activity. Particles and harmful gases are being released into the atmosphere, causing the air quality in some places to decline. Thus, there is a lot of interest in how well urban trees can trap or hold onto pollutants is of great interest. The efficient capture of pollutants is mainly due to the surface of the canopy, formed by the branches and foliage of the plant. Urban trees with suitable canopy represent a valuable option for improving air quality, as they can contribute significantly to the rate of deposit of particles on their canopy and in some cases even on the stem (El-Khatib *et al*., 2020). Many different plant species, especially trees and shrubs, form sinks whose function is to trap and absorb many gases, particles, aerosols, and airborne pollutants. Plants provide an enormous leaf area to repel and absorb air pollutants, which contributes to reducing the level of pollution in the environment (Nawaz *et al*., 2022). The main objectives of this study are to assess climate elements (CO_2, NO_2, and SO_2). To assessment of the absorption efficiency of a *Eucalyptus* plant exposed to roadside vehicle pollution in Baghdad city by measuring heavy metals in *Eucalyptus* leaves' samples and comparing with heavy metals concentration in air samples.

Materials and Methods

The Study area

The fields of study were five major sites within Baghdad's city in Al-Rusafa and Al-Karkh districts. The areas are Al-Doura (industrial: 33.255606 N, 44.368942 E), Al-Kadhimiya (commercial: 33.361049 N, 44.335017 E), Palestine Street (roadsides: 33.367922 N, 44.405413 E), Al-Shaab (roadsides: 33.407357 N, 44.384460 E) and Al-Rashidiya (control site: 33.435017 N, 44.347949 E). Trees selected for the current study were huge, tall trees, evergreen and perennial (*Eucalyptus* sp.). For sampling, mature green leaves were selected and stored in clean plastic bags. They were then taken to a facility for analysis. Samples were collected during October month 2020 and June month 2021 at 8:00 am to 1:00 pm.

Air sampling

Five locations (S1, S2, S3, S4 and S5) were chosen with three replicates (P1, P2 and P3) for each site. The collection of Air pollutants (Nitrogen dioxide NO_2, Sulfur dioxide SO_2, and Carbon dioxide CO_2) was done with the assistance of the Ministry of Science and Technology, Environment and Water Research and Technology Directorate (EWRTD). On the one hand, the samples of NO_2 and SO_2 were collected by PG- 350 portable gas analyzer, and CO_2 (Extech, series 500) portable gas analyzer. The samples were collected every 15 min. Air sampling devices consist of sensors to detect required pollutant types. They were fixed on 1m height level and then the device recorded the result every 1 minute in a notebook. On the other hand, Sniffer was used to detect the air sampling locations in the study region and gather samples of heavy metals. The sniffer model number CF-995B-4/230(230 VAC), was utilized after being fixed to an electrical source. The breathing level was set at 1.5 meters; the

machine was then filled with filter paper (4.7 diameters) and operated at a rate of 50 L per minute for 30 minutes. Once the measurement was completed, the filter paper was moved to a Petri dish, kept dry and dark, and then brought into the lab for analysis (Neustadter *et al*., 1975).

Heavy metal determination

In air samples

After the filter paper was measured in an air sample by a sniffer device, the filter was taken to the stage digested to evaluate concentrations of heavy metals. According to (Perry and Young, 1977) study, the following criteria were used to identify heavy metals:

- The filters were dissolved with a combination of (2:5) volume of perchloric acid ($HClO_4$) and nitric acid (HNO_3), then, the samples were kept overnight.
- Then was transferred to a volumetric flask and nitric acid with distilled water. Then the volume was completed to (50) ml by adding distilled water.
- The flame atomic absorption spectrum gadget could identify the heavy metals with ready-made solutions.
- To rectify the results, a blank standard reference solution devoid of pollutants was created under identical conditions and applied to the model. The examined heavy elements were Cd and Pb by using atomic absorption spectroscopy (A.A.S) in the Ministry of Science and Technology, Environment and Water Research and Technology Directorate (EWRTD) Service Laboratory.

According to Perry and Young (1977), the amounts of heavy metal in the air sample were discovered by:

$$\textbf{Metal Concentration } (\mu g\ m^{-3}) = C * Vi / VT$$

Where:

C is the concentration of the element in the sample in ppm units, Vi is the size of the sample in ml units and VT is the total volume of air drawn size in cubic meters.

In *Eucalyptus* leaves' samples

Heavy elements in plant leaves were measured as follows: the samples were washed softly with tap water to remove the remaining soil, then with distilled water and then dried in an oven at 50 °C for 48 hours (Jones, 2001). After drying, the plant sample was mechanically crushed and passed through a sieve 2 mm (Jones, 2018). Then put in a dry and dark environment in clean plastic containers. The wet acid digestion method was applied according to the method described by (Jones, 2001) as described below:

- One gram of dry plants' leaves samples was weighed in an Erlenmeyer flask.
- 5 ml of concentrated nitric acid was added and left covered by a watch glass overnight.
- Digestion with a watch glass was placed for one hour on a hot plate at 80 °C.
- Once the samples were cooled, 2.5 ml of concentrated Perchloric acid was added and the samples were heated at a temperature of [180-200 °C] for two-three hours.
- After removing the glass covers, refrigerate the samples until the fume of the Perchloric acid is dispersed. The samples were then cooled and completed to 50 mL. The samples were stored in a cool place until the heavy elements including Cd and Pb by atomic absorption spectroscopy (A.A.S) in the Ministry of Science and Technology Environment and Water Research and Technology Directorate (EWRTD) Service Laboratory.

Statistical analysis

Experiments in this study were established in five different sites (Al-Kadhimiya, Al-Doura,

Al-Shaab, Palestine Street and Al-Rashidiya) as an incomplete random design for every parameter and were reproduced three times for each parameter. The Statistical Analysis System (Cary, 2012) applications were used to determine the impact of various factors on the study parameters. Variance analysis (ANOVA) was used followed by least significant differences (LSD) tests to ascertain differences between the sites. Statistical significance was determined at ($P \leq 0.01$).

Results and Discussion

Polluting gases

Carbon dioxide CO_2

The results of carbon dioxide (CO_2) demonstrated that the highest mean ± SE (702.33± 1.45 ppm) was in the Al-Kadhimiya site at October month, AL-Rashidiya site had the lowest mean ± SE (281.33± 6.12 ppm) during June month (Table 1).

Table 1. Effect of Site and Months in Carbon dioxide (CO_2) (ppm)

Site	Months		LSD value
	June	October	
Al-Doura	481.00 ±7.09 [a]	625.33 ±4.05 [b]	22.68 **
Al-Kadhimiya	490.00 ±2.88 [a]	702.33 ±1.45 [a]	8.97 **
Al-Rashidiya: (Control)	281.33 ±6.12 [c]	429.67 ±1.20 [e]	17.31 **
Palestine Street	426.67 ±1.45 [b]	478.33 ±4.41 [d]	19.58 **
Al-Shaab	483.67 ±1.45 [a]	591.67 ±4.41 [c]	12.89 **
LSD value	15.97 **	10.81 **	----
WHO (2010)	5000-30000		
MOE (2012)	5000-30000		

According to the results mentioned above, there were high significant differences ** ($P < 0.01$) between sites at both months when compared to the control site. The comparison of CO_2 between its determents according to the World Health Organization (2010) and its determinants according to Iraq (2012), both of which were (5000-30000 ppm). It was acceptable in of the studied sites and months. This indicates the presence of carbon dioxide pollution in the air of the city of Baghdad.

However, CO_2 emissions have increased as the number of cars on the road has increased (Ishii *et al*., 2008). Increasing its concentration leads to difficulty breathing and feeling congested with irritation of mucous membranes and bronchitis Aerobic and throat irritation (Hassan, 2018). In plants, CO_2 negatively affects plant physiology, reduces transpiration, and inhibits photosynthesis (Betts *et al.*, 2007).

Nitrogen dioxide (NO_2)

Concerning nitrogen dioxide (NO_2) levels, the results demonstrated that the highest mean ±SE (3.50 ± 0.50 ppm) was in the Al-Doura site in October month, and the lowest mean ±SE (0.150 ± 0.002 ppm) was in Al-Rashidiya site in June month (Table 2).

Table 2. Effect of Site and Months in Nitrogen dioxide (NO_2) (ppm)

Site	Months		LSD value
	June	October	
Al-Doura	0.450 ±0.050 [a]	3.50 ±0.50 [a]	2.16 **
Al-Kadhimiya	0.450 ±0.050 [a]	2.00 ±0.00 [b]	0.215 **
Al-Rashidiya: (Control)	0.150 ±0.002 [c]	0.250 ±0.05 [c]	0.3041 NS
Palestine Street	0.300 ±0.050 [b]	0.450 ±0.05 [c]	0.215 NS

Al-Shaab	0.400 ±0.00 [ab]	0.500 ±0.00 [c]	0.052 NS
LSD value	0.140 **	0.821 **	----
WHO (2010)	0.11		
MOE (2012)	0.04-0.05		

According to the results mentioned above, there were no significant differences between Al-Rashidiya, Palestine street, and Al-Shaab sites in both months, while the result records significant differences **($p<0.01$) between Al-Doura and Al-Kadhimiya as compared with control sites during both months. All sites, as shown in the table during October month and June month above, had higher values of NO_2 than the WHO (2010) and MOE (2012) determinants that were identified with less than (0.11 ppm) and (0.04-0.05 ppm), respectively. The current results indicated that the June month was the least polluted month by oxides compared to the October month, this is consistent with the results of (Tiwari *et al*., 2014). Socha (2007) demonstrated that this variation in concentrations could be explained by the possibility that there may be another source other than vehicles that pollute the air with these oxides, so, the difference in spatial concentrations of nitrogen oxides (NO_2) returns to the direction and wind speed. Nitrogen oxides are formed when nitrogen and oxygen in the air are combined at a high temperature. Automobile exhaust is the most significant source of outdoor NO_2, and it is a precursor to photochemical smog in urban and industrial regions. Although NO_2 is a less chemically reactive oxidant pollutant, it can cause respiratory difficulties (asthma, lungs infection), especially in youngsters. In addition, NO_2 is a key component in the creation of ozone near the surface (Abass *et al.*, 2016). According to Chauhan and Joshi (2008); and Swami *et al.*, (2004) Different pollutants such as (SO_2 and NO_2) have a crucial role in inhibiting photosynthetic activity, which can lead to chlorophyll depletion in many plants' leaves.

Sulfur dioxide (SO_2)

The present study results implied that the highest mean ± SE of sulfur dioxide (SO_2) (0.532 ± 0.009 ppm) was scored in Al- the Doura site in October month while the lowest mean ± SE (0.004 ± 0.001 ppm) was scored in Al-Rashidiya site in June month (Table 3).

Table 3. Effect of Site and Months in Sulfur dioxide (SO_2) (ppm)

Site	Months		LSD value
	June	October	
Al-Doura	0.155±0.001 [a]	0.532±0.009 [a]	0.039 **
Al-Kadhimiya	0.134 ± 0.003 [b]	0.434±0.002 [b]	0.0152 **
Al-Rashidiya: (Control)	0.004 ± 0.001 [d]	0.007 ±0.000 [e]	0.003 NS
Palestine Street	0.008 ±0.001[cd]	0.127 ±0.016 [d]	0.068**
Al-Shaab	0.009 ± 0.001 [c]	0.226 ± 0.001[c]	0.0048**
LSD value	0.0046 **	0.0302 **	----
WHO (2010)	0.01		
MOE (2012)	0.01-0.10		

According to the results mentioned above, significant differences ($P<0.01$) were observed in sites at both months, compared to the control site. When compared to the limits by the WHO (2010) and MOE (2012) which were (0.01ppm) and (0.01-0.10 ppm), respectively where all

sites exceeded this limitation, the values were within the limitations only for Palestine Street, Al-Shaab and control site during June month.

Sulfur dioxide (SO_2) is a crucial air pollutant emitted from numerous natural. Biogenic and non-biogenic sources of atmospheric sulfur are divided into two categories. When fossil fuels such as coal, gas, and oil are used to generate electricity, SO_2 is produced (Lenz and Cozzarini, 1999). According to Swain *et al (*2016) pollutant gases like SO_2 form oxyradicals in reaction with pollutants causes damage to the membrane and related components like chlorophyll pigment.

Heavy metals concentration

Heavy metals in air samples

Cadmium (Cd)

Airborne Cadmium (Cd) in the Al-Doura during October month recorded the highest value (1.160 ± 0.140 μg m^{-3}) compared to the other of the sites and recorded the lowest value (0.312 ± 0.002 μg m^{-3}) in the Al-Rashidiya during June month (Table 4).

Table 4. Effect of Site and Months in Cadmium (Cd) in air (μg m^{-3})

Site	Months		LSD value
	June	October	
Al-Doura	0.435 ±0.012 [c]	1.160 ±0.140 [a]	0.604 *
Al-Kadhimiya	0.556 ±0.006 [b]	0.623 ±0.033 [b]	0.0531 *
Al-Rashidiya: (Control)	0.312 ±0.002 [d]	0.334 ±0.023 [c]	0.101 NS
Palestine Street	0.430 ±0.008 [c]	0.409 ±0.001 [bc]	0.036 NS
Al-Shaab	0.666 ±0.002 [a]	0.370 ±0.005 [c]	0.023 **
LSD value	0.0264 **	0.231 **	----
WHO (2010)	Less than 0.3		
MOE (2012)	Less than1		

According to the results mentioned above, there were high significant differences **(P <0.01) in the Al-Shaab site as compared to other sites, and significant differences **(P<0.01) were found between sites at both months. In all sites, as shown in Figure (3-20) above, values of Cd were higher than the WHO determinants that were identified with lower than (0.3 μg m^{-3}) but within the Iraqi determinants limits which are lower than (1 μg m^{-3}) except for the Al-Doura site during October month which records value above at Iraqi determinants.

The concentration of this element is higher in specimens from streets of heavy traffic like Al-Doura, compared with the sample deposits of the Al-Rashidiya. Cadmium (Cd) is an extensively distributed heavy metal released into the environment by power stations, metal-working industries, heating systems, waste incinerators, cement factories and urban traffic (Di Toppi and Gabbrielli, 1999). Cadmium and toxic metals will continue to accumulate in urban environments because of their nonbiodegradability and extended residence time, thus they are known as "chemical time bombs" (Shi *et al*., 2008).

Cadmium (Cd) influences the growth of plants negatively. Cadmium reduces growth in roots, stems and leaves. This decrease, especially in the total leaf area and also dry weights of the leaf, is a result of cadmium toxicity. Significantly and seriously reduces the process of photosynthesis. Cd reduces chlorophyll and carotene. Similarly, cadmium caused a reduction in growth and biomass. The kind of plant, the amount of cadmium exposed and the length of exposure all affect how much a plant will shrink in size and biomass when

under cadmium stress (Di Toppi and Gabbrielli, 1999; Rizwan *et al*., 2017). Cadmium (Cd) has been noticed in road dust due to its presence in car fuels. In this study, cadmium concentrations were found to be lower than the other studied metals like lead. Also, our study's findings are in accordance with those of previous study of Al-Fatlawi and Al-Alwani (2012).

Lead (Pb)

According to this study, the maximum value of lead (Pb) contamination in the air occurred during October in the Al-Kadhimiya site, its values were (5.75± 0.04 µg m^{-3}), while the values that were recorded as lowest in the Al-Rashidiya site during June month and the values were (1.75 ± 0.02 µg m^{-3}) (Table 5).

Table 5. Effect of Site and Months in Lead (Pb) in air (µg m^{-3})

Site	Months		LSD value
	June	October	
Al-Doura	2.50 ±0.06 ^{c}	4.51 ±0.00 ^{b}	0.274 **
Al-Kadhimiya	2.15 ±0.04 ^{d}	5.75 ±0.04 ^{a}	0.277 **
Al-Rashidiya : (Control)	1.75 ±0.00 ^{e}	2.45 ±0.13 ^{d}	0.6029 **
Palestine Street	4.70 ±0.00 ^{a}	4.29 ±0.06 ^{b}	0.417 NS
Al-Shaab	3.12 ±0.00 ^{b}	3.39 ±0.01 ^{c}	0.0393 *
LSD value	0.198 **	0.246 **	----
WHO (2010)	Less than 0.5		
MOE (2012)	Less than 5		

According to the results mentioned above, there were very high significant differences **(P <0.01) between Al-Doura, Al-Kadhimiya and Palestine street sites at both months, while high significant *(P <0.05) were detected in Al-Shaab when compared to control site. All of the sites exceeded the bound permitted by the World Health Organization (WHO, 2010) and their worth is lower than (0.5 µg m^{-3}), for that all the sites were within the Iraqi determinants that were lower than (5 µg m^{-3}), except Al-Kadhimiya site during October month.

Exceed the Al-Kadhimiya location during October month and could increase the focus on the normal levels as a result of industrial activities carried out by the humans. The primary source of lead pollution in the environment is automobile exhaust because lead is added to gasoline as an additive to improve fuel, resulting in the concentration of lead and ethyl lead in the air when vehicle exhaust fumes are released. This has detrimental effects on the environment. It is probable that lead, one of the most frequent hazardous elements in the air and pollutants detrimental to humans and the environment, accumulates in the human body and causes harm such as mental retardation in children, general weakness and prejudice to the nervous system (Al-Azzawi and Al-Dulaimi,2015 ; Mohamed *et al.*,2016). Lead particles that land on the surface of leaves clog stomata, which lowers the rate of photosynthetic activity and consequently, lowers the amount of protein, sugar and chlorophyll (Iqba *et al.*, 2015).

Heavy metals in Plant samples

Cadmium (Cd)

To evaluate the concentration of cadmium (Cd) in the plant samples during the study periods, the values were high (1.51 ± 0.40 mg kg^{-1}) in the Al-Kadhimiya site, particularly in October month. While the lowest values were recorded in the reference (Al-Rashidiya) site during June month (0.52 ± 0.01 mg kg^{-1}) (Table 6).

Table 6. Effect of Site and Months in Cadmium (Cd) Conc. In plant (mg kg^{-1})

Site	Months		LSD value
	June	October	
Al-Doura	0.84 ± 0.01 [a]	1.28 ±0.05 [a]	0.219 **
Al-Kadhimiya	0.56 ± 0.01[c]	1.51 ±0.40 [a]	0.442 **
Al-Rashidiya: (Control)	0.52 ± 0.01 [d]	0. 95 ± 0.02 [a]	0.096 **
Palestine Street	0.86 ± 0.02 [a]	1.20 ± 0.01 [a]	0.077 **
Al-Shaab	0.62 ± 0.01 [b]	0.92 ±0.05 [a]	0.240 **
LSD value	0.037 **	0.670 NS	----
WHO (1996)	Less than 0.02		

The statistical analysis results showed a highly significant difference **(P <0.01) between means of concentrations of cadmium (Cd) in examined plant samples according to air analysis locations during (October and June) as compared with the control site. In comparison, this study sites are records values above the limits set by the (WHO, 1996), which were less than (0.02 mg kg^{-1}). Therefore, plant species, root activity and rooting pattern may have an impact on the buildup of Cd, which may lead to an increased buildup of the metal in the leaves (Nazir *et al.,* 2015).

It can be deduced from the aforementioned data that the leaves of plants obtained from polluted areas have significant levels of cadmium. This might be the outcome of the nearby area's contaminated air. This result is in agreement with the study of Khan *et al*. (2007). In this study, greater cadmium levels at the Al-Kadhimiya location could be due to the constant human activity in the dense both commercial and residential areas, like heavy traffic movement (Yin *et al*., 2011). This study is also in agreement with the study of AlObaidy and Rabee (2018).

Lead (Pb)

It was found that the concentrations of lead in plants samples were varied among study sites, the highest examined area was in Al-Doura which recorded the highest values (5.31 ± 0.00 mg kg^{-1}) during October month, while the lowest value recorded in the control site during June month and its value was (2.16 ± 0.01), as shown in (Table7).

Table 7. Effect of Site and Months in Lead (Pb) Conc. In plant (mg kg^{-1})

Site	Months		LSD value
	June	October	
Al-Doura	3.63 ± 0.00 [a]	5.31 ±0.00 [a]	0.0482**
Al-Kadhimiya	2.54 ± 0.02 [d]	4.54 ± 0.05 [c]	0.2236 **
Al-Rashidiya: (Control)	2.16 ± 0.01 [e]	3.89 ± 0.00 [e]	0.0654 **
Palestine Street	2.71 ± 0.00 [b]	4.92 ± 0.00 [b]	0.0232 **
Al-Shaab	2.62 ± 0.01 [c]	4.12 ± 0.01[d]	0.0788 **
LSD value	0.0422 **	0.0852 **	----
WHO (1996)	Less than 2		

The statistical analysis results showed that there was a high significant difference **(P<0.01) between means of Pb concentrations in plant samples found in current study sites as compared with the control site during June and October month. When contrasting the results of

the lead element with the global determinants of the global health associate (WHO, 1996) which are defined by less than (2 mg kg^{-1}) all values considered unacceptable and exceed the established limits.

Our results showed that leaves are capable of accumulating significant lead concentrations. The urban area roadside with most human activities along with high vehicle density, showed the highest mean Pb concentrations (5.31 mg kg^{-1}) in Al-Doura site in October month, additionally, the findings of this investigation concur with those of an earlier study conducted by Aksoy *et al.* (1999).They found that previous studies done by Gorbanova (2004) lead is found in soil contaminated by waste from numerous businesses and is released via automobile emissions, this is why plants from polluted locations have high quantities of lead in their leaves. As well as the results of this study are also in agreement with the study done by AlObaidy and Rabee (2018).

Conclusion

The main results of this research can be summed as follows: Levels of nitrogen dioxide (NO_2) in urban (Al-Doura, Al-Kadhimiya, Palestine Street and Al-Shaab) and control sites during October and June months exceeded the acceptable national and international limits. This influences the air quality of the whole region. While levels of sulfur dioxide (SO_2) in urban (Al-Doura and Al-Kadhimiya sites) during October and June month exceeded the acceptable national and international limits compared with the control site, this increase is due to car exhaust and negatively affected the chlorophyll and pH. The research showed that the concentrations of carbon dioxide (CO_2) are acceptable by Iraqi and international standards at all times of measurement, this indicates the presence of carbon dioxide pollution in the air of the city of Baghdad due to fuel consumption and the rise in the number of automobiles. Cadmium (Cd) and lead (Pb) which is considered the major pollutants produced by traffic flow. The percentage of cadmium and lead present in the plant's leaves was higher than what was found in the air. This means that the *Eucalyptus* plant has an effective role in absorbing pollutants issued by car exhausts. Therefore, it is preferable to plant this type of plant in urban areas to improve air quality and purify it.

Conflicts of Interest

The authors declare no conflict of interest.

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