Lead Content in Two Vegetable Species Collected from Several Local Markets

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ABSTRACT

This study was designed to assess lead content in soil and two vegetable species collected from several sites in Baghdad. The results showed that Swiss chard had lead content varied from 0.930 ± 0.23 µg/g to 1.988 ± 0.42 µg/g and these data were higher than those found in celery which ranged from 0.216 ± 0.08 µg/g to 0.935 ± 0.22 µg/g.

In case of celery plants cultivated in both Al- Autyfia and Al- Qanat sites, lead content has been found to be affected significantly ($P \geq 0.5$) by the distance from motor road where higher content was found in plants closed to motor verge than those 15 meter away. For soil lead content, the results showed that lead content was almost two times greater than those of vegetable plant and again lead concentration was affected by the distance from the motorway verge in both sites where lead content varied from 1.512 ± 0.42 µg/g to 2.279 ± 1.04 µg/g and from 2.102 ± 0.82 µg/g to 2.656 ± 0.62 µg/g in Al- Autyfia and Al- Qanat samples respectively. However, these data in celery plants ranged from 1.389 ± 0.36 µg/g to 1.607 ± 0.88 for Al- Autyfia and from 1.359 ± 0.68 µg/g to 1.582 ± 0.92 µg/g for Al- Qanat cultivated yard.

Key words: Lead, Motor Road, Cultivated Yards, Celery, and Swiss chard.

تركيز الرصاص في عينات من الخضراوات و التربة من مواقع مختلفة من بغداد

الخلاصة

ان الدراسة الحالية صممت لتقييم مستويات الرصاص في نوعين من الخضراوات (السلق و الكرفس) جمعت من عدد من الاسواق المحلية في بغداد فضلا عن عينات من نبات الكرفس والتربة المزروعة في مواقع قريبة من طرق مرور السيارات (القناة و العطيفية) وعلى مسافات تراوحت من صفر الى 15 م من هذه الطرق.

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وجدت الدراسة ان مستويات الرصاص في نبات السلق كانت اكبر من مثيلتها في نباتات الكرفس حيث تراوحت من 0.930 ± 0.23 مايكروغرام/ غم الى 1.988 ± 0.42 مايكروغرام/ غم ومن 0.216 ± 0.08 مايكروغرام/ غم الى 0.935 ± 0.22 مايكروغرام/ غم في نباتي السلق و الكرفس على التوالي.

بالنسبة لعينات الكرفس و التربة من موقعي العطيفية و القناة ، سجلت الدراسة مستويات مختلفة في كلا العينتين اعتمادا على بعد العينة من الشارع. بشكل عام ، كانت مستويات الرصاص في عينات التربة اعلى من تلك التي وجدت في عينات النبات و كان لبعد العينة من الشارع تأثير معنوي بدلالة الاحتمالية التي وجدت ≤ 0.05 .

في حالة عينات التربة، فقد وجدت الدراسة ان مستويات الرصاص كانت تقريبا ضعف مثيلاتها في النبات حيث تراوحت من 1.512 ± 0.42 مايكروغرام/ غم الى 2.279 ± 1.04 مايكروغرام/ غم في موقع العطيفية و من 2.102 ± 0.82 مايكروغرام/ غم الى 2.656 ± 0.62 مايكروغرام/ غم في موقع القناة.

كذلك بينت النتائج ان مستويات الرصاص في عينات الكرفس من موقع العطيفية كانت اقل معنويا من مثيلتها في عينات شارع القناة حيث تراوحت من 1.389 ± 0.36 مايكروغرام/ غم الى 1.607 ± 0.88 مايكروغرام/ غم و من 1.359 ± 0.68 مايكروغرام/ غم الى 1.582 ± 0.92 مايكروغرام/ غم في موقعي العطيفية والقناة على التوالي.

INTRODUCTION

Heavy metals are those chemical elements that used intensively in various industrial, agricultural, medical and others applications. There is no doubt that these metals have sever environmental and health impacts particularly when they occur at elevated concentrations. However, these heavy metals have received considerable attention worldwide which focused in their resources, applications, and probable effects upon environment and public health. The obtained data of different toxicological studies have shown that some of these metals very hazard while others seem to be carcinogenic [1,2,3,4] (For more details refer to WHO; INCHEM program, environmental health criteria monographs).

Plants may intake different quantities of heavy metals from surrounding environments being exposed to the polluted air and contaminated soils [5, 6, 7, 8, 9, 10, 11, and 12]. Heavy metal contamination of vegetables may also occur due to irrigation with contaminated water [1, 3, 13, 14, and 15] and emission of heavy metals from the industries and vehicles [1, 2, and 4] during transport and marketing, the addition of fertilizers and metal based pesticides [15, 16, 17, 18]. The elevated levels of lead in urban areas are mainly attributed to automobile exhaust, particularly from leaded gasoline, motor vehicle tires, and lubricant oil. Recently it was claimed that lead in urban areas could be over 1000 µg/g [1, 3, and 4].

Cultivation areas near highways are also exposed to atmospheric pollution in the form of metal containing aerosols. These aerosols can be deposited on soil and are absorbed by vegetables, or alternatively deposited on leaves and fruits and then absorbed. In previous studies [7,8,9,10,15,17], it was found that high accumulated concentration of lead, chromium, and cadmium were found in leafy vegetables due to atmospheric depositions [19, 20, 21] . There is a positive relationship between atmospheric metal deposition and elevated concentrations of heavy metals in plants and top soils [13, 15]. The levels of heavy metals in vegetables collected from periurban areas of New Delhi were found to be high due to atmospheric deposition. The magnitude of heavy metal deposition on vegetable surfaces varied with morphological nature of the vegetables [6, 7, 8, and 9]. Several studies have examined different heavy metals content in various vegetable and crop plants such as vanadium, copper, zinc, nickel, lead, aluminum and few others particularly those grown in sites adjacent to the motor verge and reported toxic levels of these metals [4, 9, 16, 17, 22]. Monitoring and assessment of heavy metal concentrations in vegetables from the square sites have been carried out in some developed and developing countries but limited published data are available on such studies particularly those urban vegetable cultivated yards in Iraq.

Current study was planned to assess lead content in celery and Swiss chard vegetable samples collected from different local markets and in only celery and soil samples grown in two urban yards but at different distances from motorway verge.

MATERIAL AND METHODS

Experiment I. Celery and Swiss chard

Samples of both celery and Swiss chard were collected from five different markets well away from each other in Baghdad during winter 2012. The samples were to dry at lab temperature for one week. Each sample was grinded by and divided into three sub-samples. From each of these sub-sample, 0.5 g was digested by 5 ml 1N nitric acid and left overnight following the method used by (Al-Hiyaly S.A.K.) [23] And examined for lead content using atomic absorption spectrophotometer (AAS).

Experiment II. Urban cultivated celery

Two sites adjacent to motor roads in Baghdad that used for growing celery species were selected; the first was Al-Autyfia while the second was Al- Qnat motorway. Samples of both soil and celery were collected from three sites at different distances (0.0, 5.0, and 10 m) from each road during February 2012. Soil and plant samples were air dried at lab temperature for seven days and soil samples were sieved using 2mm stainless steel sieve. Air dried celery samples were examined for lead content by digesting 0.5 g in 5 ml 1N nitric acid as described above while relative soil samples were digested by using 1.5 in 10 ml 1N nitric acid again following the method used by a study mentioned above [23] for evaluating lead content.

RESULTS AND DISCUSSION

Table (1) shows mean lead content ± standard deviation in both celery and Swiss chard samples collected from Baghdad local different markets. In general highest lead content was found in Swiss chard which ranged from 0.638 ± 0.034 µg/g in sample collected from Hayfae street market to 1.988 ± 0.124 µg/g in Al-Shaeb market. However for celery samples, lead values were almost lower than those found in Swiss chard where varied from 0.216 ± 0.02 µg/g in Abu-Desheer samples to 0.935 ± 0.12 µg/g in samples collected from Al- Baladyat market.

Table (1) Mean lead content ± Sd (μg/g) in both celery and Swiss chard samples collected from various markets.

Collecting Sites	Mean ± Sd μg/g	
	Celery	Swiss chard
Al- Baladyat	0.935 ± 0.12	1.041 ± 0.221
Al-Shaeb	0.791 ± 0.10	1.988 ± 0.124
Senae street	0.786 ± 0.15	0.930 ± 0.042
Al-Dora	0.639 ± 0.82	1.065 ± 0.062
Hayfae street	0.446 ± 0.42	0.638 ± 0.034
Abu-Desheer	0.216 ± 0.02	1.789 ± 0.322

Analysis of variance of lead content Table (2) shows significant differences ($P \geq 0.001$) of between lead content of these two species and between also collected samples from various markets. However, lead content in Swiss chard of all samples was significantly much higher (LSD = 0.342 μg/g) than that of celery plants form these sites. Regarding each plant species, the variation was significant since least significant differences were 0.145 μg/g and 0.015 μg/g for celery and Swiss chard respectively.

Table (2) Analysis of variance of lead content in celery and Swiss chard collected from different markets.

Source of variance	Df	SS	MS	P
Replicates	2	0.026	0.013	NS
Treatment	11	7.775	0.707	0.001
Plants (P)	1	3.309	3.309	0.001
Market (M)	5	2.287	0.457	0.001
P X M	5	2.179	0.436	0.001
Error	22	0.905	0.0411	
Total	35			

Data of lead content in soil and celery samples collected at different distances from cultivated yards adjacent to motor road near Al-Autyfia and Al-Qanat are given in Table (3). Lead content was found at higher levels in soil samples than those of celery lead level in all examined sites of both cultivated yards.

Table (3) Mean lead content ± Sd (μg/g) in soil and celery samples Collected at three sites a way from cultivated yards adjacent to motor road at Al-Autyfia and Al-Qanat.

Distance (M)	Mean ± Sd μg/g			
	Al-Autyfia		Al-Qanat	
	Soil	Celery	Soil	Celery
0.0	2.279 ± 1.04	1.607 ± 0.88	2.656 ± 0.62	1.582 ± 0.92
5.0	1.972 ± 0.83	1.582 ± 0.72	2.266 ± 0.76	1.435 ± 0.59
10.0	1.512 ± 0.42	1.389 ± 0.36	2.102 ± 0.82	1.359 ± 0.68

In Al-Autyfia cultivated yard, lead content was ranged from 1.512 ± 0.42 µg/g at 10 m away from motor road to 2.279 ± 1.04 µg/g in a site closed to the road and from 1.389 ± 0.36 µg/g to 1.607 ± 0.88 µg/g at same sites for soil and celery samples respectively. Similar pattern of range of lead levels in both soil and celery samples was found in case of Al-Qnat cultivated yard where these values lied between 2.102 ± 0.82 µg/g and 2.656 ± 0.62 µg/g for soil samples and from 1.359 ± 0.68 µg/g and 1.582 ± 0.92 µg/g for celery samples again at distances of 10 and 0.0 meter away from the motor road respectively see Figure (1).

In general, lead concentration in soil samples of Al-Qanat cultivated yard collected at different distances away from motor road were significantly higher (LSD= 0.236) than those of Al-Autyfia cultivated yard while in case of celery lead content, the data were found at a verse pattern where higher values recorded in samples of Al-Autyfia cultivated yard but not significant (LSD = 0.176).

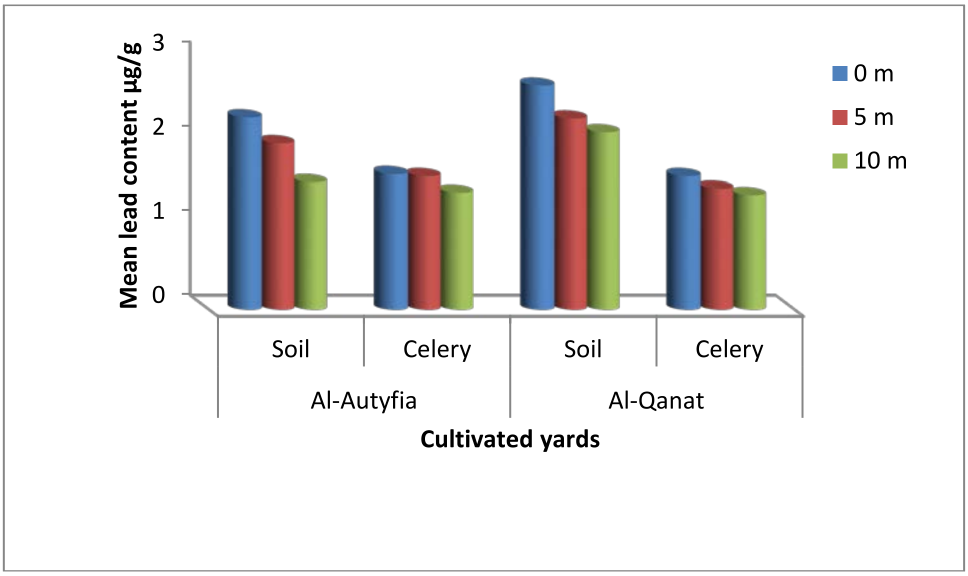

Figure (1) Mean lead content (ug/g) in soil and celery samples collected from two cultivated yards adjacent to moto road.

Analysis of variance of these data Table (4) shows significant differences ($P \geq 0.001$) in soil lead content between both examined yards and between distances. However, similar significant differences were found for celery lead content but at lower probability ($P \geq 0.05$).

Table (4) Analysis of variance of lead content in soil and celery samples collected from two cultivated yards at different distances from motor road.

Source of variance	df	Soil			Celery		
		SS	MS	P	SS	MS	P
Replicates	2	0.001	0.0005	NS	0.013	0.0065	NS
Treatment	5	2.670	0.534	0.001	0.144	0.0288	0.05
Sites (S)	1	0.958	0.958	0.001	0.053	0. 053	0.05
Distance (D)	2	1.575	0.783	0.001	0.076	0.038	0.05
S X D	2	0.147	0.0735		0.015	0.0075	
Error	10	0.169	0.0169		0.084	0.0084	
Total	17						

Such higher accumulated lead concentrations in both soils and examined vegetation grown on cultivated yards adjacent to motor ways are expected to be related mainly to aerial deposition of the metal particulates emitted from motor vehicles [4, 23].The amount of lead in roadside soil is relatively high but inversely correlated with the increase of the distance from road. Considering the general range of the total lead content, it appears that the total lead content in about 85% soil samples was below the critical concentration (400 mg/kg). In the last decades much attention has been focused upon lead levels in the roadside environments since it is used as an anti-knocking agent in gasoline 21-24. So, there is growing concerns about the problems associated with lead emitted from leaded gasoline and resulted in forcing national communities to search for alternative agent or even producing free lead gasoline. Such step has resulted in global decreasing fuel lead emitting at an annual rate of about 7% at maximum level of less than 0.15 g/L since July 1989 but nevertheless, there are still many countries that still using leaded gasoline at rate of 0.4 g/L. Furthermore, increasing number of automobile that using leaded gasoline also in elevated lead concentrations emitted to the environment to cause various health effects particularly on communities living in adjacent habitats [24, 25, 26, 27, 28, 29, 30] . In addition, wearing down of vehicle tires may also release Pb that would be accumulated at motor road verges [31, 32, and 33].

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