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Research Article

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Determination of Lead Metal in roadside plants in some of Baghdad's Highways, Iraq

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ABSTRACT

The vehicle's fuel considered as the main source of lead contamination. Therefore, determination the concentrations of lead in plants which exist nearby the traffic area has a significant importance in terms of lead content that comes from the exhaust may contaminate the plants which exist on the roadsides. The Lead concentrations in four types of vegetables (Celery, Cress, Leek and Peppermint) in 4 sites at different Baghdad's Highways (Al Dora, Abu ghraib, Al mahmoudia and Al qadisiyah) were determined. All the samples were collected from fields near to the roadside and the concentrations of lead were measured by Flame atomic Absorption spectrophotometry. The results show that the mean values of lead concentrations in these samples ranged from 2.0573 to 3.7106, 2.1991 to 2.6799, 0.2813 to 1.4803, and 0.8850 to 1.7890 mgkg^{-1}for lead in Al Dora, Al qadisiyah, Abu ghraib and Al mahmoudia respectively. In this study, the levels concentration of lead in two locations (Al Dora and Al qadisiyah) were found exceeding the allowable limit of lead metal according to WHO/FAO which recommended that the safe value of lead in vegetables is 2.0mgkg^{-1}[1, 2]. Whereas, within the vegetable types the highest concentration of lead was noticed in the peppermint followed by leek, cress and celery.

Keywords: Roadside plants, Lead, Traffic contaminations, Vegetables, Heavy metals

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INTRODUCTION

Lead considered as one of the heavy metals which have many of toxic effects that were well studied [3-6]. It is known that people always consume the edible plants (vegetables) which may contain heavy metals. Uptake of heavy metals could occur by vegetables which allow to entry these types of metals to the food chain as a result of uptake process. Heavy metals can be found in two forms either in individual metals or metals compounds and each form can impact human health. The most common heavy metals are barium, arsenic, chromium, lead, silver, selenium, mercury and cadmium. These metals generally exist at low levels in the environment but if they found at large amounts, it can be very dangerous for human health [7]. Exposure to these metals can be occurred by breathing, eating and drinking. Exposure to these metals can cause many diseases for example: exposure to high levels of arsenic can cause cancer of the bladder, liver and skin, while exposure of low level of arsenic can cause nausea, vomiting, damage to blood vessels, decreased production of red and white blood cells and abnormal heart rhythm [8-12]. Cadmium also can cause many diseases like breathing high levels of cadmium can damage the lungs, fragile bones and kidney diseases [13, 14]. Breathing problems like wheezing, cough, shortness of breath and asthma during exposure to high levels of chromium [15, 16]. Another heavy metal which can cause also serious problems to the human is mercury can cause damage to the kidneys, brain and developing fetuses [17]. Finally, exposure to lead at high levels can damage kidneys, brain and cause death. Also, responsible for miscarriage for the pregnant women

and responsible for low sperm production for men. For the adult, exposure for long term of lead can decrease the performance in some tests that measure functions like weakness in fingers, wrists, nervous system, anemia, ankles and small increases in blood pressure [18]. Therefore, it is very important to determine the heavy metals levels in environmental samples like plants. Lead considered as one of the heavy metals that has significant toxic effects on human health. These effects include anemia, hyperactivity, blood enzyme changes and neurological disorders [3]. So, it is obvious that monitoring of the concentrations levels of Lead metal in the environment has a high importance. According to the World Health Organization (WHO), there is a tolerable intake of Lead metal as 0.025 mg kg^{-1} body weight for all human groups [19]. As a summary, this metal (Lead) can dangerously affect on human body even if found at ultra trace concentrations. In our country (Iraq), the contamination of environment with heavy metals has poorly investigated which making this report is a good opportunity to determine contamination of environment with Lead. It is known that the main sources of Lead are domestic heating, traffic and long range transport. The changes in the Lead levels in roadside plants are directly related to the traffic density [20]. Also, the dispersion of contamination can be influenced by meteorological conditions such as rainfall, wind and traffic intensity [21]. Because of the Pb is still using in fuel since many years till nowadays in Iraq and the Lead has long half-life, therefore the concentrations of Lead is expected to be high and that may cause to contamination the environment. The main sources responsible in raising the lead concentrations in roadside plants are motor vehicles exhausts to contain organic tetra alkyl Lead additives like tetra methyl Lead, tetraethyl lead and ethyl trimethyl Lead. Also, a lot of chemical compounds such as Methylcyclopentadienyl manganese tricarbonyl (MMT) have been largely replaced by Lead additives as antiknock compound in gasoline. In addition, the tires cover of motor vehicles and combustion of fossil fuel are also other sources for Lead in the environment [22]. Therefore, determination of heavy metals is important due to many reasons including determine the quality of plants, toxicological and nutritional effects which related to the concentration of Lead.

EPERIMENTAL SECTION

2.1 Apparatus and Reagents

Flame atomic absorption spectrometer (FAAS) accompanying with standard hallo cathode lamp of lead was used. All the measurements were conducted under the conditions which are given in Table 1. Also, to ash the vegetable sample, Muffle Furnace (High Temperature, 1200°C) was used for this purpose. Sulfuric acid (99.999% with vapor density <0.3 (25 °C, vs. air)), Nitric acid (ACS reagent, 70%) and Hydrogen peroxide solution (30 % (w/w) in H_2O) were used.

Table 1: The operation conditions of FAAS.

Wavelength (nm)	217
Lamp (mA)	10
Width (nm)	0.7
Flame	Air-Acetylene
Flow rate of Acetylene (ml/min)	2.0

2 .2 Materials and Method

This study has investigated the emissions of lead from some of Baghdad's Highways. 48 vegetable samples (Three aliquots for each sample) were collected from four fields nearby roadside of highways in summer 2012. For the purpose of analysis the vegetations, all plant parts were taken from the roadside and firstly washed with a tap water, then with distilled water twice. After that placed inside furnace to dry at 100C°. From each dried sample, 5 gram was taken and placed in a clean crucible and 0.5 ml of concentrated H_2SO_4 was added to each sample in order to decrease the volatilization during the ashing. Then, all crucibles containing samples were placed into ashing furnace at 480 C° and left for 4-5 hours. 3.0 ml of mixture of concentrated HNO_3 and H_2O_2 (2/1) was poured on each ashed sample and dried using a hot plate with stirring at low temperature. Finally, 2 ml of 1.0 mol l^{-1} HNO_3 was added to the residue and diluted to the suitable volume. The samples were analyzed using Flame Atomic Absorption Spectrometer (FAAS) to determine the lead contents (each sample was analyzed three times). Finally, in order to confirm the results, another technique called recovery test was used. For this purpose, a series of lead concentrations were added to the digested samples. The same analyses procedure was used to recover the added amounts of lead. It was found that 94% of lead was recovered using this analysis, the effects of another contaminations were eliminated by subtract the measured values from the blank.

RESULTS AND DISCUSSION

This study reports on the content of lead which was determined in the collected vegetables from different sites in Iraq, Baghdad. All the observed concentrations of lead in vegetables were compared with allowable limit of lead by WHO/FAO in 1999 of food contamination [23]. The lead concentrations which were found in the vegetables are summarized in the (Table 2 & Fig1). The results of lead concentration are not surprised since there are increase in the number of cars which in turn increasing the emission of lead to the environment. The lead concentrations were found higher in comparison with that noticed values in Turkey, Libya and Kuwait vegetables [1, 24, 25] .Within the selected sites, the highest lead concentration were found in Al dora area followed by Al qadisiyah, Al mahmoudia, and Abu ghraib and that could be related to features of the area. As known al Dora area contains oil refinery and main station for electric power generation in addition to highway. The previous factors considered us the main source for lead emission and probably help in increasing the lead levels. Whereas, within the vegetable types the highest concentration of lead was noticed in the peppermint followed by leek, cress and celery

Table 2: Concentrations of Lead ($mgkg^{-1}$) in four different types of vegetation in four different sites

Sample	Al Dora	Al qadisiyah	Al mahmoudia	Abu ghraib
Celery/Mean Levels	**2.2915**	**2.1991**	**0.8850**	**0.7914**
Sample 1	2.2188 ± 0.1	1.9331 ± 0.1	0.8444 ± 0.2	0.7634 ± 0.1
Sample 2	2.1238 ± 0.2	2.2221 ± 0.1	0.9553 ± 0.2	0.7874 ± 0.1
Sample 3	2.5132 ± 0.1	2.4423 ± 0.1	0.8554 ± 0.2	0.8235 ± 0.1
Cress/Mean Levels	**2.0573**	**2.4248**	**1.4262**	**0.2813**
Sample 1	2.7548 ± 0.3	2.7885 ± 0.2	1.4532 ± 0.1	0.3501 ± 0.05
Sample 2	2.6341 ± 0.2	1.9877 ± 0.2	1.3522 ± 0.1	0.2533 ± 0.05
Sample 3	2.7832 ± 0.3	2.4982 ± 0.2	1.4732 ± 0.1	0.2407 ± 0.05
Leek/Mean Levels	**2.6185**	**2.6799**	**1.2386**	**1.3591**
Sample 1	2.6508 ± 0.3	2.7433 ± 0.2	1.2663 ± 0.2	1.2343 ± 0.2
Sample 2	2.5558 ± 0.2	2.6443 ± 0.2	1.3243 ± 0.2	1.4776 ± 0.2
Sample 3	2.6491 ± 0.2	2.6523 ± 0.2	1.1253 ± 0.2	1.3654 ± 0.2
Peppermint/Mean Levels	**3.7106**	**2.3830**	**1.7890**	**1.4803**
Sample 1	3.7716 ± 0.2	2.5976 ± 0.3	1.7523 ± 0.3	1.3331 ± 0.3
Sample 2	3.5725 ± 0.2	2.1955 ± 0.2	1.8621 ± 0.3	1.4527 ± 0.3
Sample 3	3.7877 ± 0.2	2.3576 ± 0.3	1.7527 ± 0.3	1.6552 ± 0.3

M.A.Elbagermi, H.G.M.Edwards and A.I.Alajtal have conducted scientific research on 180 persons to calculate the daily intake of metals through vegetables per person per day according to the following equation: [23]

Daily intake of lead (g/person/day) = **Daily vegetable consumption X vegetable heavy metal concentration ... (1)**

They found that safety limit of the daily intake of vegetables is 98g per person per day for a person who has 60 kg body weight according to WHO/FAO [22]. They estimated the mean daily intake levels of lead from vegetables which is $0.25mgkg^{-1}$. Therefore, the lead will contribute as a heavy metal for human being from vegetable is 24.8µg [23]. When the above equation was applied on the results of the present study, the mean daily levels concentrations of Pb was found to be 2.6694, 2.4217, 1.3347 and 0.9780 mg kg^{-1} for Al dora, Al qadisiyah, Al mahmoudia, and Abu ghraib respectively. Therefore, the estimated daily intake of lead will be 261, 237, 130 and 95 µg for Al dora, Al qadisiyah, Al mahmoudia, and Abu ghraib respectively. It can conclude that our estimated daily intake of lead metal which determined here are divided into the two types: the first (130 and 95 for Al mahmoudia, and Abu ghraib) is below than those reported by WHO/FAO as 214µg, while the second (261 and 237 for Al dora and Al qadisiyah) is higher than those reported values by WHO/FAO.

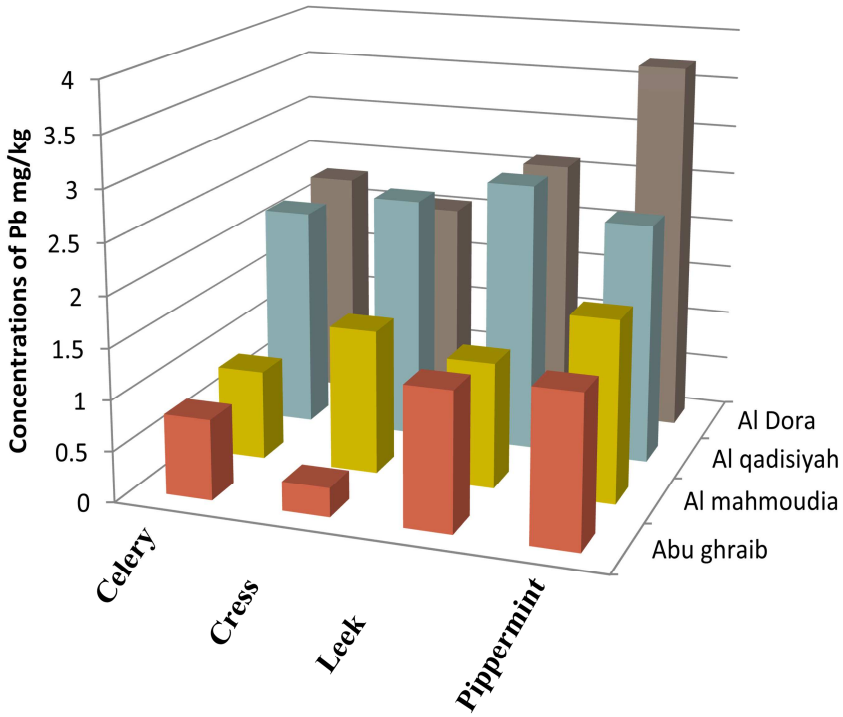

Figure 1/ Concentrations of Lead in vegetables

The general trend of the obtained results showed a clear gradually decreasing in lead levels for vegetables especially for those plants which exist faraway from al dora area where the oil refinery and main station for electric power generation (Fig 2).

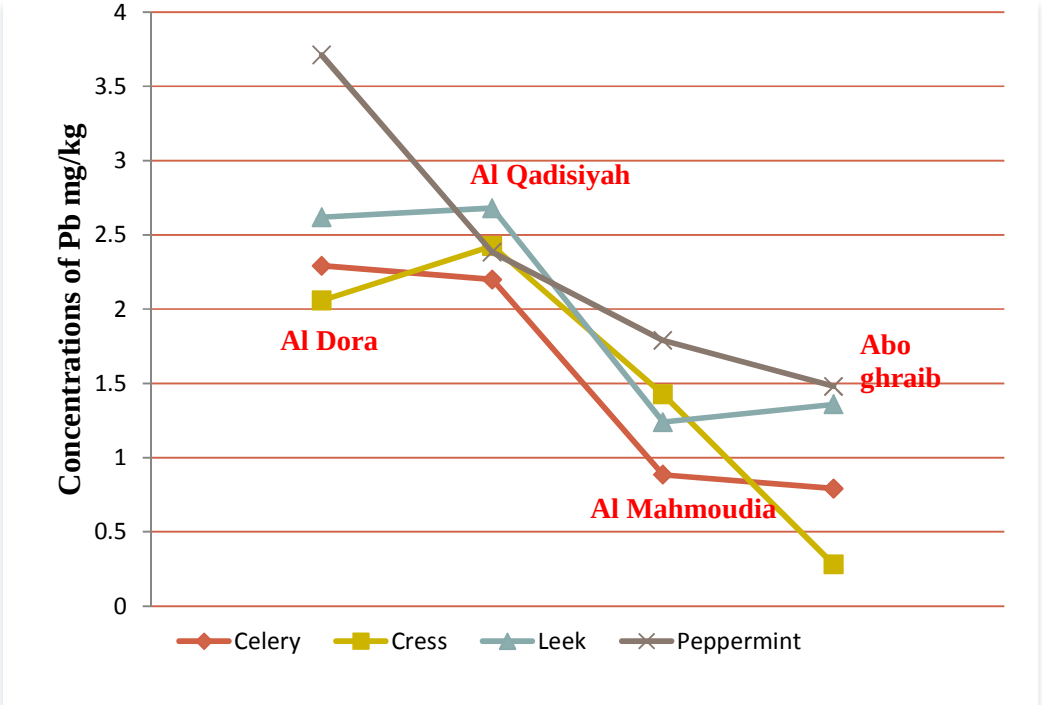

Figure 2/ General trend rate of lead concentrations distributed depending on chosen sites

CONCLUSION

As a summary, from the obtained results in this study, it can concluded that the concentration levels of lead in two of chosen sites (Al dora and Al qadisiyah) exceeded the maximum allowance level of lead as recommended by WHO/FAO and different countries like Turkey, Libya and Kuwait [1, 24]. Therefore, in this paper we strongly recommend that the people who live in these areas (Al dora and Al qadisiyah) should reduce consumption of the vegetations. While the people who live in other two sites (Al mahmoudia, and Abu ghraib) can consume the normal amounts because the concentrations of lead did not exceed the allowable level of lead and within the safety limit. Therefore, the biomonitoring for lead in vegetables is important and needs to be continued due to that type of plants are considered as a main food in different parts of this world.

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