

Determination of Lead and Cadmium in Parley Tissues Grown in the Riyadh Area

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Riyadh area is located in the center of the Kingdom of Saudi Arabia. There is a huge increase in vehicles numbers and industrial plants in Riyadh city and surrounding areas as a result of the progressive growth of the city and the rapid increase in its population. By the end of 1994 there were 672,000 vehicles on road, while the population of Riyadh was 2.4 million. It is now projected to exceed 6 million by the year 2006 (The High Commission for Development of Riyadh). It is thus necessary to record and evaluate the impact of population growth and increased vehicles traffic on the environment of the area. One of the most common pollutant metal is lead. It is because the lead content in gasoline is high as compared to international level. It was 0.84 g/l and gradually reduced to 0.42 g/l which is still high comparing with international level by Ahmed et al. (1988). Further, at present all the gasoline vehicles in Saudi Arabia are of 2000 cm³ engine capacity and larger. Uptill now, few reports have been published on lead and cadmium pollution in Riyadh city. Early 1980s, El-Shobokshy (1984) showed that the lead concentration in the atmosphere is strongly related to the atmospheric stability, and the concentration may be as high as 8 µg/m³ during the peak traffic hours. In another work, El-Shobokshy (1983) carried out a preliminary analysis of inhalable lead particulate in the city. He concluded that the average concentration of lead during the working day is 4.37 µg/m³ to 5.83 µg/m³, which is about twice the international standards, it decreases during the weekends (Thursday and Friday) due to reduction in traffic loads and it reaches the minimum on Friday when most of industrial activities are stopped. He showed that the industrial site of Riyadh is an effective contributor of the measured lead in the study.

Ahmed et al. (1993) studied the concentration of Cd, Pb and other metals in the street dust in the city of Riyadh. Ahmed et al. (1991) measured lead concentrations in children hair and blood in different cities of Saudi Arabia. They suggested a further study to evaluate the effect of other environmental factors such as air, soil, water etc. in order to have a more meaningful interpretation of the present data. The use of Atomic Absorption Spectrometry (AAS) has increased during the last three decades. Graphite Furnace Atomic Absorption Spectrometry (GFAAS) is used in this work specially suitable for direct analysis and freedom from

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interference effects from the associated major elements because of its high sensitivity. Parley is an important cattle crops in Saudi Arabia. Its quality reflects many characteristics in cattle, such as purity of milk, meat safety, health of animals. This leads ultimately to the health of the people who consume milk and meat. In this study we evaluate the contamination of lead and cadmium in Parley tissues grown in Riyadh Area. Some samples have been taken from suburbs of Riyadh city while other samples are from the city itself. This work is part of a study suggested by the Ministry of Agriculture and Water in Saudi Arabia.

MATERIALS AND METHODS

All glassware was washed with detergent solution, rinsed with tap water followed by distilled water, and placed in 40% v/v nitric acid (concentrated) (analytical-reagent grade) for at least 48 h before use. The glassware was then rinsed with distilled water and doubly distilled water and oven-dried at 60°C.

Analar nitric acid, standard solutions for Cd and Pb (Spectrosol; for atomic spectrometry) were obtained from BDH (Poole, Dorset, UK).

Samples were collected from seven different locations around Riyadh city. The locations of the sampling sites are shown in figure 1. Some of these locations are the most important contributors of forage crops in the kingdom. Samples were collected from polluted and unpolluted sites of each location. In the following a brief description for each area is given.

Nisah is a small village located about 80 km in the south west of Riyadh city. It is surrounded by many large farms. These farms are irrigated with potable ground water which is used for drinking by the people living in the area. There is no highway road around the area.

A1-Kharj is a populated town located on a wide area in about 80 km in the south east of Riyadh. In this area, there are three of the most producers of milk in the Kingdom of Saudi Arabia which are A1-Safi Diary Est., A1-Marai Limited and Al-Aziziah Agriculture Product Company Ltd.

A1-Ammariyah is a rather polluted village located about 30 km in the north of Riyadh. Its farms are irrigated with ground and sewage water.

A1-Muzahmiyah is a comparatively polluted town located about 50 km in the west of Riyadh city. It is very closed to a heavy traffic highway.

Nmar is a valley that separates the most populated quarters in Riyadh. It lies between two heavy traffic highway roads. It is very close to the city center. Some locations in the valley have heavy traffic with trucks carrying various different materials for constructions.

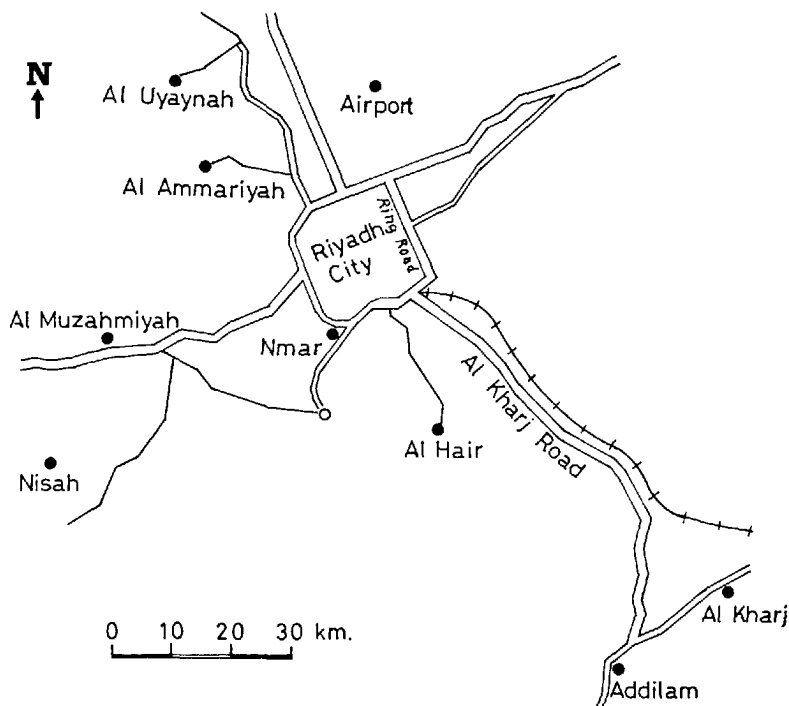


Figure 1. Locations of the sampling sites in Riyadh area.

Ring Road South is the most crowded section of the Ring Road of Riyadh is the south section. Furthermore, it is surrounded by cement factory, sewage and industrial plants. There are some old farms on the sides of this road irrigated by surface sewage water.

Al-Hair is a group of large farms. It is located in about 20 km south of Riyadh city. Collected plants were dried in an oven at 70 °C for 24 hours.

The digestion of plant samples was carried out by using nitric acid (Analar) bomb digestion. General purpose bomb 45 ml and large capacity bomb 125 ml. were used in a closed system, with a PTFE vessel contained within a stainless steel sheath. A portion of the sample about 1.0g was placed in a PTFE vessel and 5 to 10 ml. of concentrated nitric acid was added. The whole vessel was placed in a pre-heated electric oven at 150-160 °C for two hours.

A Perkin Elmer 5100 PC Atomic absorption spectrometer fitted with a model HGA graphite furnace with Auto sampler (AS-60) was used. Absorption signals were obtained with the N₂ stopped-flow method. Hollow-cathode lamps were employed for lead and cadmium. The instrument was calibrated with standard solutions using the concentration mode.

RESULTS AND DISCUSSION

Two Standard Reference Materials (SRMs) from the National Institute of Standard and Technology (NIST) were examined namely of SRM 1577b Bovine Liver and SRM 1567a wheat flour. The method of digestion was in good agreement. Table 1 presents a comparison of total lead and cadmium level in the SRMs using GFAAS.

Table 1. Analysis of standard references materials for total lead and cadmium.

Sample	Element	No. of Samples	Mass taken/g	Certified Value/ $\mu\text{g g}^{-1}$	Experimental Value/ $\mu\text{g g}^{-1}$ by GFAAS
SRM 1577B	Pb	6	0.50	0.129 ± 0.004	0.130 ± 0.005
Bovin Liver	Cd	6	0.50	0.50 ± 0.03	0.48 ± 0.035
SRM 1567A	Pb	6	1.00	(<0.020)	0.015 ± 0.006
Wheat Flour	Cd	6	1.00	0.026 ± 0.002	0.025 ± 0.004

Al-Attar et al. (1988) and (1990) carried out digestion of plant samples by using nitric acid-bomb digestion, and recommended to use a closed system to reduce loss of volatile elements like selenium, with a PTFE vessel contained within a stainless-steel sheath.

Sheath portion of the plant sample was placed in a PTFE vessel and 5 ml of concentrated nitric acid was added. The whole vessel was placed in a pre-heated electric oven at 150°C for 60-75 min.

In the present work, the digestion of plant samples was carried out by using nitric acid (Analar) bomb digestion. General purpose bomb 45 ml and large capacity bomb 125 ml were used, in a closed system, with a PTFE vessel contained within a stainless steel sheath. A portion of the sample about 1.0g was placed in a PTFE vessel and 5 to 10 ml of concentrated nitric acid was added. The whole vessel was placed in a pre-heated electric oven at 150-160 °C for two hours.

In Table 2 we show data of lead and cadmium concentration in Parley crops for 29 samples for each element in all locations. Clearly, differences in concentrations rates for Pb and Cd in plants are related to the degree of concentration of the site from which the samples are collected. Lead and cadmium pollution depends on the distance to the traffic. The main source of lead pollution in Saudi Arabia is the leaded gasoline while transportation, construction works and paints are the main sources of cadmium pollution

Figure 2 and 3 show this relation by comparing concentration of Pb and Cd in Parley on the seven locations.

Table 2. Concentration of Lead and Cadmium [$\mu\text{g/g}$] in Parley.

Location	Sample No.	Pb	Cd	Location	Sample No.	Pb	Cd
Al-Ammariyah	1	1.10	80.00	Al-Kharj	1	0.75	40.00
	2	3.10	105.00		2	1.10	45.00
	3	3.33	280.00		3	3.00	85.00
	4	10.00	625.00		4	4.70	105.00
Nisah	1	1.60	25.00		5	8.33	125.00
	2	1.60	37.00	Nmar	1	7.10	30.00
	3	2.00	40.00		2	8.60	170.00
	4	2.10	100.00	Ring Road	1	0.70	33.00
Al-Muzahmiyah	1	3.10	33.00		2	14.60	200.00
	2	3.13	40.00	Al-Hair	1	0.75	30.00
	3	4.70	40.00		2	0.85	33.00
	4	5.06	50.00		3	1.30	40.00
	5	5.55	50.00		4	1.50	90.00
	6	5.55	60.00		5	1.70	100.00
	7	10.46	75.00		6	3.05	114.00

In Figure 2, the lowest concentrations of lead is in Al-Hair and Nisah area while the most polluted lead areas are the closest to the heavy traffic which are Nmar and the Ring Road south area.

While the lowest concentration of Cadmium are in Al-Muzahmiyah, Al-Hair, Al-Kharj and Nisah

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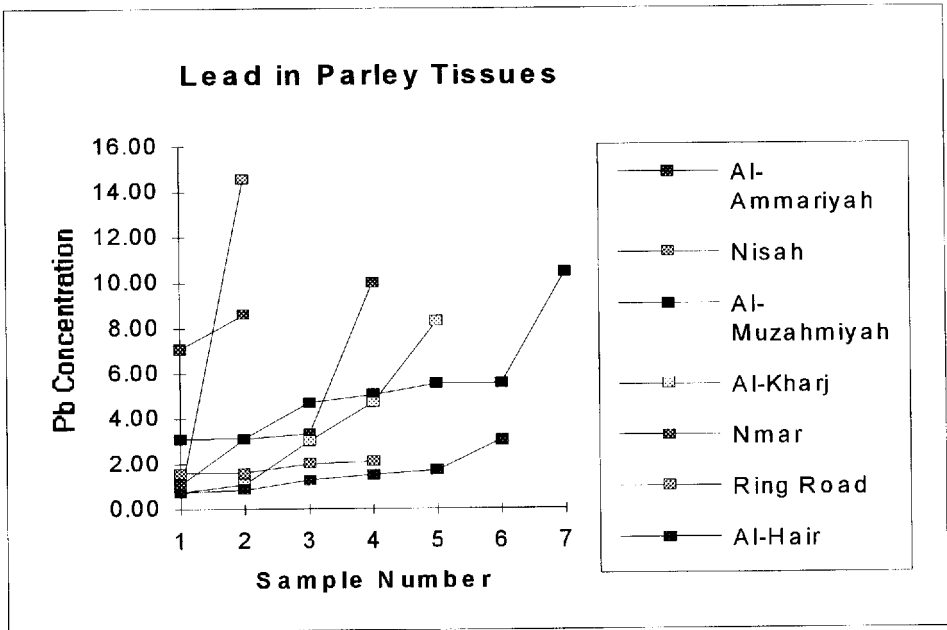


Figure 2. Differences in Lead Concentration rates in Parley on the seven locations.

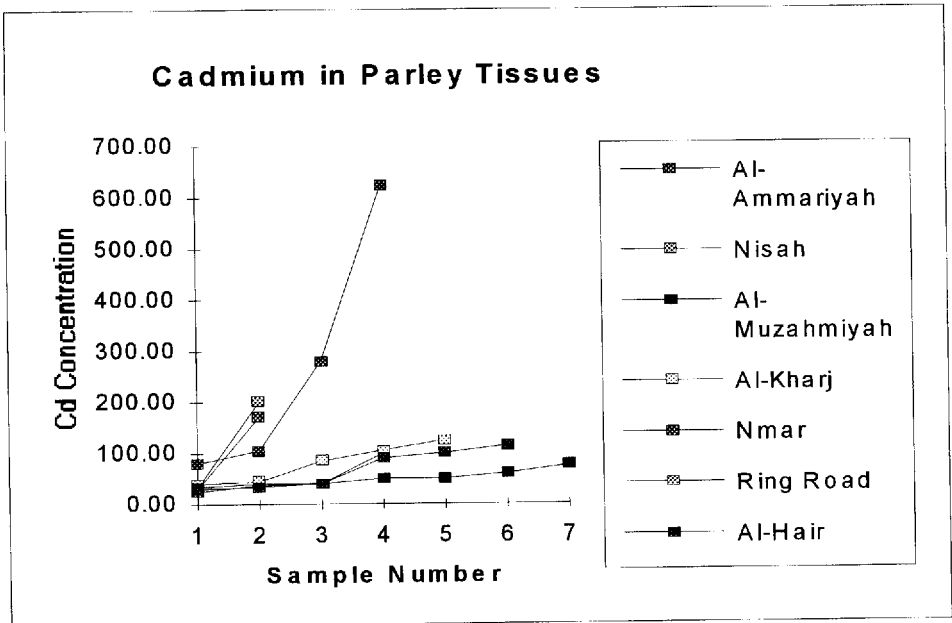


Figure 3. Differences in Cadmium Concentration rates in Parley on the seven locations.

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