Open Journal of Ecology, 2016, 6, 554-561
Published Online August 2016 in SciRes. http://www.scirp.org/journal/oje
http://dx.doi.org/10.4236/oje.2016.69053

Determination Cadmium and Lead Pollution Resources of Ardabil Plain Underground Waters

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Received 10 June 2016; accepted 18 August 2016; published 22 August 2016

Abstract

Underground water is among the most important sources of drinking water. The aim of this study was to determine the concentrations of heavy metals (cadmium, lead) in providing plain of Ardabil in 2015. This study was cross-sectional, drinking water samples from 100 wells were prepared according to standard procedures. The dimensions of 350 × 350 meter grid station via a station in the network were determined by atomic absorption spectrometry AAS analysis of samples. The data obtained were analyzed using SPSS software. The average concentrations of lead, cadmium in groundwater wells in the area were also studied. The mean concentrations measured in the majority of groundwater wells in the plain of Ardabil lower than the allowed amount were designated according to a national standard.

Keywords

Pollution, Groundwater, Drinking, Ardabil Plain

1. Introduction

Population growth and rising living standards in many countries resulted in increased demand for various uses of underground water for agriculture, industry, and urban construction. Less pollution of underground water due to the talent as well as a large storage capacity compared to surface water is considered as an important source of water. An increase in electrical conductivity and concentrations of sodium, chloride, sulfate, and nitrate in groundwater is mostly due to human activities such as farming operations, intensive use of fertilizers, water, and industry. Infected surface increases the amount of TDS [1]. Unfortunately, because of the invisibility of many

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How to cite this paper: Hajjabbari, S. and Fataei, E. (2016) Determination Cadmium and Lead Pollution Resources of Ardabil Plain Underground Waters. *Open Journal of Ecology*, **6**, 554-561. http://dx.doi.org/10.4236/oje.2016.69053

people about the importance of ground water, the harmful effects of environmental pollution on them are not aware [2]. In the present society, not only water quantity but also water quality attention and research have proven that many diseases are caused by poor quality water. Substances that are potentially harmful to the consumer should be limited and those substances which can affect public acceptance of water should be controlled [3] [4]. Heavy metals including considering the importance of environmental pollutants have attracted attention in scientific communities. Heavy metals in food and tissues of organisms use the food [2]. Heavy metals naturally in groundwater resources due to geology and soils are found in small amounts [3] [4]. Underground water pollution caused by agricultural operations is not a new phenomenon. High consumption of fertilizers in order to achieve maximum agricultural production increased nitrate in groundwater and endangered human health. So with the use of nitrogen fertilizers, a substantial amount of them are underground water. High nitrate concentrations are harm to human health and aquatic animals [5]. According to [3], as the concentration of heavy metals (Cu, Cd, Pb) in drinking water in Mashhad had expressed heavy metal compounds through the various imported water sources [6]-[10].

2. Methodology

2.1. The Introduction of the Study Area

The plain with an area of 95 thousand hectares in the high plateau is between the mountain and into plain packages. Its height is about 1350 meters from all four sides surrounded by mountains, fields and alluvial deposits of eroded mountains surrounding the basin are closed. Plains due to having proper thickness of sediments and soil quality and numerous rivers, the perfect place for farming activities and production of agricultural products, particularly cereals and potatoes is. This plain, with the ground water and in the last half century has long been considered the most important source of water supply for agriculture, industry, and urban and rural drinking. The aquifer until the last two decades, the number of wells and semi-limited and consequently the withdrawal of ground water level were very low. 62 years later and with regard to agricultural development in the region and also and Ardabil urban sprawl and population growth, water extraction from aquifers has been increased for various uses [9] in addition, the network size is 350 in the 350 meters. Also sampled in two seasons of dehydration and over hydration and there is one sample per pixel. Sampling in the summer time months in August and in May 2015 was conducted in the spring. Chemical analysis results in Excel as a database was saved. Position wells were recorded using GPS to map production. Also in this study to analyze the data aggregated statistical software spss test, ANOVA and T-test was used (**Figure 1**).

2.2. Results

Results of the study data obtained from sampling at 100 stations in Ardabil plain dry and wet seasons in 2015 from ground water **Table 1** is provided.

The station that was detectable amounts of lead and cadmium in the comparison chart was prepared with the Iranian standards (**Diagram 1**, **Diagram 2**).

Figure 1. Ardabil Province map.

Table 1. Concentration of heavy metals cadmium and lead during dry and wet seasons in the plains of Ardabil.

Station number	Cadmium summer	Cadmium spring	Lead summer	Lead spring	Station number	Cadmium summer	Cadmium spring	Lead summer	Lead spring
1	0.003	0.002	0.0361	0.001	51	0.000	0.000	0.0027	0.002
2	0.002	0.000	0.0026	0.002	52	0.000	0.000	0.0023	0.002
3	0.002	0.000	0.0024	0.0018	53	0.000	0.0000	0.0017	0.001
4	0.003	0.001	0.003	0.0024	54	0.001	0.0007	0.0014	0.0011
5	0.001	0.001	0.002	0.0014	55	0.000	0.0005	0.0019	0.0014
6	0.001	0.002	0.0023	0.003	56	0.000	0.000	0.0033	0.0024
7	0.002	0.002	0.0022	0.002	57	0.0016	0.002	0.0026	0.002
8	0.0016	0.002	0.002	0.0042	58	0.002	0.000	0.0036	0.0031
9	0.000	0.001	0.0017	0.000	59	0.002	0.000	0.002	0.0013
10	0.002	0.000	0.002	0.0018	60	0.002	0.002	0.000	0.000
11	0.002	0.000	0.0033	0.0029	61	0.0018	0.0013	0.0000	0.000
12	0.000	0.000	0.0096	0.005	62	0.001	0.000	0.0000	0.000
13	0.000	0.00007	0.009	0.000	63	0.001	0.0007	0.0047	0.000
14	0.000	0.0000	0.0014	0.000	64	0.000	0.000	0.006	0.0033
15	0.0018	0.001	0.0023	0.0015	65	0.000	0.000	0.0079	0.0023
16	0.0025	0.001	0.0037	0.003	66	0.000	0.001	0.005	0.0019
17	0.002	0.003	0.003	0.0022	67	0.000	0.000	0.0083	0.007
18	0.000	0.0018	0.0012	0.001	68	0.0009	0.000	0.0089	0.007
19	0.000	0.002	0.001	0.0007	69	0.000	0.000	0.008	0.008
20	0.000	0.001	0.0012	0.000	70	0.000	0.001	0.006	0.0029
21	0.000	0.000	0.0015	0.000	71	0.002	0.000	0.0066	0.0024
22	0.000	0.000	0.0022	0.005	72	0.002	0.0016	0.002	0.0016
23	0.001	0.000	0.000	0.0009	73	0.003	0.001	0.0045	0.0021
24	0.0014	0.000	0.0024	0.000	74	0.003	0.002	0.0032	0.002
25	0.001	0.002	0.003	0.001	75	0.003	0.002	0.003	0.002
26	0.0009	0.000	0.0007	0.000	76	0.000	0.0001	0.008	0.000
27	0.000	0.000	0.0007	0.000	77	0.001	0.000	0.0033	0.002
28	0.000	0.0017	0.0009	0.000	78	0.000	0.000	0.0078	0.0056
29	0.001	0.001	0.0016	0.000	79	0.000	0.000	0.0039	0.0034
30	0.001	0.001	0.0016	0.000	80	0.000	0.000	0.005	0.000
31	0.0018	0.001	0.009	0.002	81	0.0006	0.001	0.0056	0.000
32	0.0016	0.000	0.016	0.01	82	0.001	0.001	0.007	0.000
33	0.0016	0.001	0.014	0.01	83	0.001	0.000	0.009	0.0043
34	0.0025	0.003	0.01	0.01	84	0.003	0.002	0.01	0.0076
35	0.0033	0.002	0.01	0.0088	85	0.001	0.003	0.01	0.008

Continued

36	0.003	0.002	0.008	0.000	86	0.004	0.003	0.0026	0.016
37	0.002	0.003	0.016	0.01	87	0.003	0.004	0.054	0.03
38	0.0034	0.003	0.019	0.015	88	0.004	0.003	0.0467	0.033
39	0.001	0.003	0.02	0.013	89	0.002	0.004	0.015	0.01
40	0.001	0.000	0.01	0.007	90	0.001	0.002	0.013	0.009
41	0.001	0.000	0.0094	0.005	91	0.005	0.003	0.022	0.0155
42	0.001	0.001	0.0067	0.003	92	0.005	0.002	0.0165	0.01
43	0.001	0.000	0.0059	0.002	93	0.001	0.003	0.019	0.016
44	0.000	0.001	0.007	0.000	94	0.001	0.002	0.015	0.01
45	0.001	0.002	0.0085	0.000	95	0.003	0.002	0.0078	0.000
46	0.000	0.0000	0.019	0.008	96	0.001	0.000	0.0056	0.000
47	0.0008	0.001	0.0034	0.000	97	0.000	0.000	0.0014	0.0002
48	0.001	0.001	0.0037	0.002	98	0.000	0.001	0.0012	0.0005
49	0.002	0.003	0.0101	0.003	99	0.001	0.002	0.000	0.000
50	0.002	0.003	0.0024	0.000	100	0.000	0.000	0.005	0.000

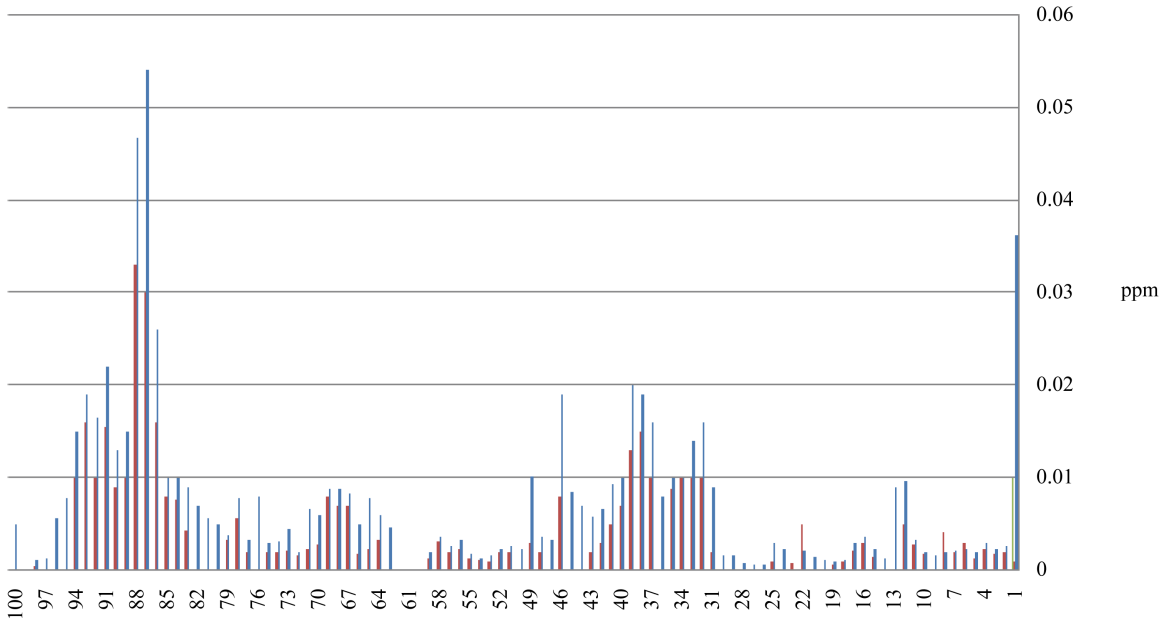

Diagram 1. Comparison of the lead with the Iranian standards.

2.3. ANOVA Analysis Results

The results of analysis of variance showed cadmium parameters (**Table 2**) that evaluated the stations; there was a significant difference at the 1% level. Results showed that mean comparison test stations (**Table 3**) with an average of 91 ppm 0.004 stations and mobile stations have the highest numbers 1, 17, 36, 38, 49, 50, 74, 75, 84, 95, 35, 34, 37, 89, 39, 86, 87, 88 and 92 groups were polluted stations 12, 14, 21, 22, 27, 46, 51, 52, 53, 56, 64 , 65, 67, 69, 78, 79, 80 and 97 with the least amount of pollution have zero value milligrams per liter, respectively.

The results of analysis of variance showed Lead parameters (**Table 3**) that the stations studied; there was no

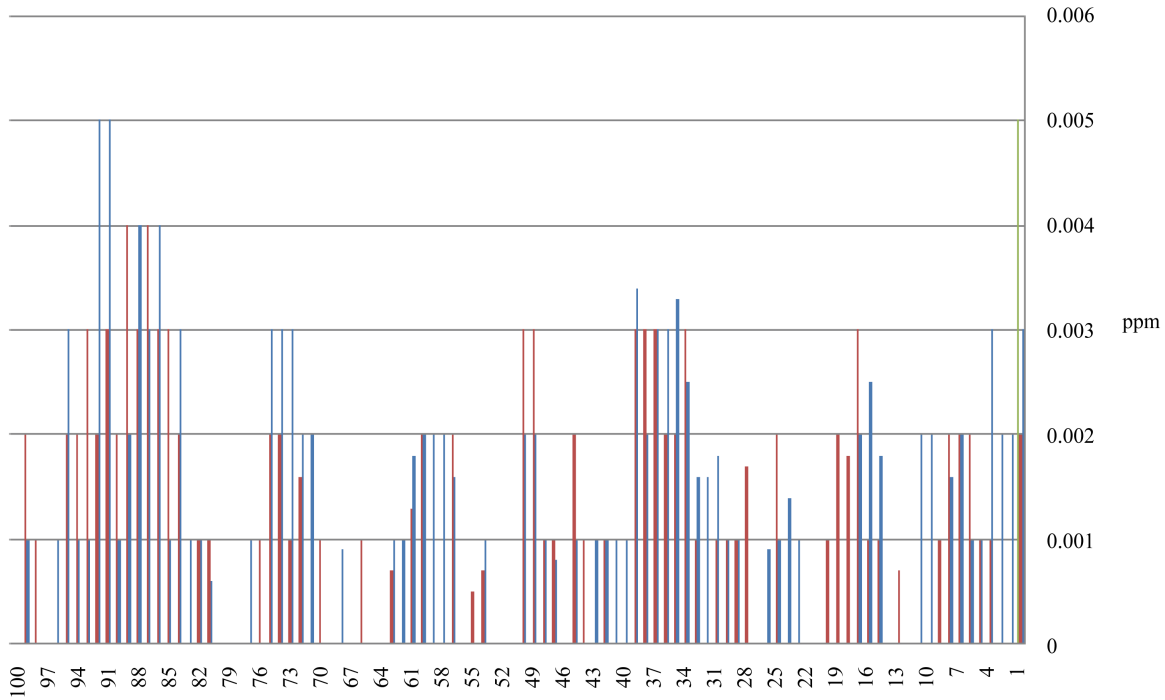

Diagram 2. Comparison of cadmium with the Iranian standards.

Table 2. Analysis of heavy metal cadmium in the plain of Ardabil in 2015.

Sources change	Degrees of freedom	Average of squares	F	Significant level.
Station	99	2.141E−6	3	0.000
Error	100	5.955E−7		

** Significant at the 1% level shows.

Table 3. Analysis of heavy metal lead in the plain of Ardabil in 2015.

Sources change	Degrees of freedom	Average of squares	F	Significant level.
Station	99	9.813E−5	5	0.000
Error	100	1.740E−5		

significant difference in the level of 1%. The comparison showed that the average stations (**Table 4**) stations 87 and 88, respectively, with an average of 0.042 and 0.03, 958 mg had the highest infection rates were higher in statistically class stations No. 26, 27, 60, 61, 62 and 99 with a mean of zero ppm were ranked the lowest.

For comparison Lead and Cadmium parameter values in spring and summer paired samples test were used in this experiment. The results showed that compared pairs of heavy metal lead and cadmium summer statistically significant difference was observed in 1% probability level (**Table 5**). Cadmium and cadmium spring summer pairs well with a statistically significant difference in the level of 1 percent.

For measurements with national standard values were used in this experiment One-Sample Test. The results showed that in both heavy metals lead and cadmium in both summer and spring, there was a statistically significant difference at the 1% level (**Table 6**).

3. Conclusions

Cadmium spring is also based on national standards and EPA (0.005 ppm) lower than standard and cadmium contamination exists.

Table 4. Comparison of measuring heavy metals lead and cadmium of Ardabil plain Duncan (ppm).

Station number	Heavy metals				Station number	Heavy metals			
	Lead		Cadmium			Lead		Cadmium	
1	0.0025	e-a	0.01855	bcd	51	0.0000	g	0.0023	klmn
2	0.001	gfed	0.0023	klmn	52	0.0000	g	0.00215	klmn
3	0.001	gfed	0.0021	klmn	53	0.0000	g	0.00135	mn
4	0.002	f-b	0.0027	j-n	54	0.00085	defg	0.00125	mn
5	0.001	gfed	0.0017	lmn	55	0.00025	fg	0.00165	lmn
6	0.0015	g-c	0.00265	j-n	56	0.0000	g	0.00285	i-n
7	0.002	f-b	0.0021	klmn	57	0.0018	b-g	0.0023	klmn
8	0.0018	b-g	0.0031	h-n	58	0.001	defg	0.00335	h-n
9	0.0005	fg	0.00085	mn	59	0.001	defg	0.00165	lmn
10	0.001	defg	0.0019	lmn	60	0.002	b-f	0.0000	n
11	0.001	defg	0.0031	h-n	61	0.0015	c-g	0.0000	n
12	0.0000	g	0.0073	e-n	62	0.0005	fg	0.0000	n
13	0.00035	fg	0.0045	h-n	63	0.00085	defg	0.00235	klmn
14	0.0000	g	0.0007	mn	64	0.0000	g	0.00465	h-n
15	0.0014	c-g	0.0019	lmn	65	0.0000	g	0.0051	h-n
16	0.00175	b-g	0.00335	h-n	66	0.0005	fg	0.00345	h-n
17	0.0025	a-e	0.0026	j-n	67	0.0000	g	0.00765	e-n
18	0.0009	defg	0.0011	mn	68	0.00045	fg	0.00795	e-n
19	0.001	defg	0.00085	mn	69	0.0000	g	0.0084	d-n
20	0.0005	fg	0.0006	mn	70	0.00005	fg	0.00445	h-n
21	0.0000	g	0.00075	mn	71	0.001	defg	0.0045	h-n
22	0.0000	g	0.0036	h-n	72	0.0018	b-g	0.0018	lmn
23	0.0005	fg	0.00045	mn	73	0.002	b-f	0.0033	h-n
24	0.0007	efg	0.0012	mn	74	0.0025	a-e	0.0026	j-n
25	0.0015	c-g	0.002	klmn	75	0.0025	a-e	0.0025	j-n
26	0.00045	fg	0.00035	n	76	0.0005	fg	0.004	h-n
27	0.0000	g	0.00035	n	77	0.0005	fg	0.00265	j-n
28	0.00085	defg	0.00045	mn	78	0.0000	g	0.0067	g-n
29	0.001	defg	0.0008	mn	79	0.0000	g	0.00365	h-n
30	0.001	defg	0.0008	mn	80	0.0000	g	0.0025	j-n
31	0.0014	c-g	0.0055	h-n	81	0.0008	defg	0.0028	i-n
32	0.0008	defg	0.013	b-j	82	0.001	defg	0.0035	h-n
33	0.0013	c-g	0.012	b-l	83	0.0005	fg	0.00665	g-n
34	0.00275	abcd	0.01	c-n	84	0.0025	a-e	0.0088	c-n

Continued

35	0.00265	a-e	0.0094	c-n	85	0.002	b-f	0.009	c-n
36	0.0025	a-e	0.004	h-n	86	0.0035	ab	0.021	b
37	0.003	abc	0.013	b-j	87	0.0035	ab	0.042	a
38	0.0025	a-e	0.017	b-f	88	0.0035	ab	0.03985	a
39	0.0032	abc	0.0165	b-g	89	0.003	abc	0.0125	b-k
40	0.0005	fg	0.0085	d-n	90	0.0015	c-g	0.011	b-m
41	0.0005	fg	0.0072	f-n	91	0.004	a	0.01875	bc
42	0.001	defg	0.00485	h-n	92	0.0035	ab	0.01325	b-i
43	0.0005	fg	0.00395	h-n	93	0.002	b-f	0.0175	bcde
44	0.0005	fg	0.0035	h-n	94	0.0015	c-g	0.0125	b-k
45	0.0015	c-g	0.00425	h-n	95	0.0025	a-e	0.0039	h-n
46	0.0000	g	0.0135	b-h	96	0.0005	fg	0.0028	i-n
47	0.0009	defg	0.0017	lmn	97	0.0000	g	0.0008	mn
48	0.001	defg	0.00285	i-n	98	0.0005	fg	0.00085	mn
49	0.0025	a-e	0.00655	g-n	99	0.0015	c-g	0.0000	n
50	0.0025	a-e	0.0012	mn	100	0.0000	g	0.0025	j-n

Table 5. Test paired samples test for heavy metals lead and cadmium contamination of ground water in the spring and summer in Ardabil plain.

C.		Average	The standard deviation	The average standard deviation	95% Confidence interval of the difference		t	Df	Sig. (2-tailed)
					Lower	Upper			
1 Pair	Lead and cadmium summer	−0.0043915	0.0071065	0.0005025	−0.0053824	−0.0034006	−8	199	0.000
Pair 2	Cadmium and cadmium spring summer	0.0001810	0.0010817	0.0001082	−0.0000336	0.0003956	1	99	0.097
Pair 2	Lead and lead spring summer	0.0033740	0.0048634	0.0004863	0.0024090	0.0043390	6	99	0.000

Table 6. Paired samples test for heavy metals lead and cadmium contamination of ground water in the spring and summer in Ardabil plain.

	T	df	Sig. (2-tailed)	Mean	95% Confidence interval of the difference	
					Lower	Upper
			Test Value = 0.005			
Cadmium summer	−45	100	0.000	−0.0037895	−0.003952	−0.003627
Cadmium spring	−34	99	0.000	−0.0038800	−0.004102	−0.003658
			Test Value = 0.01			
Lead summer	−8	199	0.000	−0.0043980	−0.005456	−0.003340
Lead spring	−10	99	0.000	−0.0060850	−0.007211	−0.004959

According to WHO, (ppm 0.003) summer cadmium in five sampling stations including (35-39-86-91-92) and cadmium spring at two stations (87-89) are higher than the standard. Also standard EPA (ppm 0.015) indicates lead summer in 12 stations (1-32-37-38-39-46-86-87-88-91-92-93) and lead spring in five sampling stations (86-87-88-91-93) are higher than the standard. Emissions in the vicinity are in Mollayousef, Guradel-Araluy Bozorg, Kalkhoran, Gorgan, Fuladlu, Dalilghureh, Jobbedar, Gharjur, Mireni, Khiyarak, GazSamian, Dowlatabad, Ali Bulaghi villages.

References

[1] Alidadi, H. (2011) The Concentration of Heavy Metals, Chromium, Cadmium, Lead in Drinking Water in Mashhad. *Medical Journal*, No. 116, 1-12.

[2] Davis, A., Kempton, J.H. and Nicholson, A. (1994) Ground Water Transport of Arsenic and Chromium at a Historical Tannery. *Applied Geochemistry*, **9**, 569-582.

[3] Eghbali Shamsabadi, P. (2010) The Heavy Metals Chromium, Cadmium, Lead and Organic Materials in Their Structural Sefidrood Attitude on the Origin of the Earth. *Journal of Islamic Azad University of Ahvaz Specialized Wetland*, No. 3, 20-45.

[4] Davis, A. (1995) Ground Water Transport. *Applied Geochemistry*, **10**, 150-165.

[5] Minareji, E. (2009) The Amount of Heavy Metals Cadmium, Chromium, Copper, Iron, Nickel, Lead in Water, Sediments and Fish Tissue Avshar Carp Lake. Iran.

[6] Asadi, A. (2003) The State of Sanitation in 22 Tehran and Its Effects on the Development Plan. A Graduate Thesis Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Tehran.

[7] Rezvani, M. (2013) Assessment of Contamination Levels of Heavy Metals Cadmium, Cobalt, Lead, Zinc, Manganese Bkhvn Eshtehard. *Science and Environmental Engineering*, No. 1, 45-53.

[8] Shirani, Z. (2013) The Assessment of Groundwater Pollution in the Urban Environment. Human and Environmental Quarterly, No. 24, 85.

[9] (2015) Groundwater Challenges and Solutions. Public Relations Logic of Ardabil Water.

[10] Hamzeh, M.A. (2009) To Evaluate Changes in the Concentration of Lead, Zinc, Copper and Cadmium In-City Environment, Science and Technology, the Environment. *Journal of Science and Technology*, **2**, 20-25.