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The Level of Heavy Metals in Selected Vegetables Crops Collected from Baghdad City Markets

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Abstract: Nineteen raw vegetable crops were collected from major markets in Baghdad areas uncontaminated by human activities other than normal agricultural practice. Six hundred samples were prepared and analyzed under carefully controlled conditions for cadmium, lead, iron, copper and Zinc. The Levels of these Heavy Metals in the vegetables were relatively low with respect to the proposed maximum acceptable concentrations for human consumption. In lettuce, spinach and parsley relatively high level of lead and cadmium were noticed compared with tomato, eggplant and onion. Iron was the only element that showed statistical variation among the different of vegetables.

Key words: Heavy metals, vegetable, crops, dietary toxicity, nitric acid, perichoric acid, atomic absorption spectrophotometer

INTRODUCTION

In recent years much public interest focused on the subject of environmental contamination with toxic elements such as cadmium and lead. Intake of relatively low dose of these elements over a long period of time can lead to malfunction of certain organs such as kidney and chronic toxicity to human (Pier and Bang, 1980; Sherlock and Walter, 1983). Many of these metals have contaminated water, soil and entered the food chain (Wolink and Fricke, 1985; Reilly, 1991; Sanchez-Camazao *et al*., 1994). Cadmium and lead partially ingested with edible parts of agricultural and horticultural crops or derived products (Reilly, 1991; Sanchez-Camazao *et al*., 1994). Application of fertilizer and sewage sludge increase the level of Pb and Cd in crops (Wong, 1996). Vegetables constitute essential component of the diet. However, these plants may contain both essential and toxic elements, such as heavy metals, at a wide range of concentrations (Afshin and Masoud, 2008).

In a number of countries a survey of trace metals in various crops have been carried out e.g. the major agricultural crops of united state of America were analyzed for Pb and Cd. These extensive studies lead to established a maximum acceptable levels of heavy metals in edible parts of crops or processed food in several countries (Wolink and Fricke, 1985; Sanchez-Camazao *et al*., 1994; Wong, 1996; Afshin and Masoud, 2008; Khairiah *et al*., 2004; Kursad *et al*., 2002).

Little information is available in Iraq concerning the levels of Heavy Metals in different type of agricultures products. Therefore the aim of this study is to obtain some information concerning the levels of Heavy Metals in vegetables available in Iraqi markets.

Vegetables selected for this study based on the market volume.

MATERIALS AND METHODS

A wide selection of vegetables such as tomato, onion, leafy vegetables...etc were collected from different markets in Baghdad city in sufficient quantities to provide a representative samples. More than 600 samples of different types of vegetables were analyzed. All samples were put in plastic bags to avoid contamination and taken to laboratory for analyses. The edible parts of the vegetables used for human consumption were washed with double distilled water, dried in air oven at 75°C for one to two days until it reached constant weight, then ground in special mills with provision to prevent contamination. About (1 to 2) gram of samples were wet digestion with nitric-per choreic acid according to method (Reilly, 1991). Certain precautions were taken to avoid possible contamination of samples, reagents and equipments during digestion. Concentrations of Pb, Cd, Fe, Cu and Zn were determined using flame atomic absorption spectrophotometer. Acetified standard reference material was used to ensure accuracy. Data processing, mean ($\bar{x}$), standard error ($S\bar{x}$), F-test with critical probability p 0.01 (**) and LSD were determined.

RESULTS AND DISCUSSION

Table 1 and 2 clearly list the concentrations of lead, cadmium, iron, copper and Zn in different types of vegetables. Relatively high concentration of Fe was found in spinach and lettuce. Leafy vegetables accumulate higher concentration of iron than other crops. The levels of iron in nearly all the samples examined were lower or within the proposed maximum level (0.15 mg/kg) fresh weight (Khairiah *et al*., 2004; Kursad *et al*., 2002; Parveen *et al*., 2003). However, tomato and onion contained relatively higher

Table 1: The concentration of Pb, Cd, Fe, Zn and Cu in vegetables (ppm)

	Pb		Cd		Fe		Zn		Cu	
Samples	$\bar{x}$	S $\bar{x}$	$\bar{x}$	S $\bar{x}$	$\bar{x}$	S $\bar{x}$	$\bar{x}$	S $\bar{x}$	$\bar{x}$	S $\bar{x}$
Okra	0.034	0.005	0.081	0.037	4.873	0.329	0.625	0.042	0.182	0.09
Marrow	0.037	0.024	0.043	0.007	5.259	0.342	0.599	0.051	0.158	0.039
Egg plant	0.026	0.019	0.046	0.005	5.733	0.474	0.576	0.037	0.186	0.03
Radish	0.036	0.025	0.042	0.006	8.788	0.665	0.550	0.033	0.188	0.03
Red radish	0.035	0.024	0.048	0.007	8.113	0.616	0.568	0.043	0.213	0.043
Cucumber	0.030	0.021	0.046	0.005	4.539	0.423	0.667	0.035	0.167	0.033
Tomato	0.024	0.017	0.044	0.007	5.388	0.399	0.519	0.049	0.195	0.039
Pepper	0.031	0.020	0.051	0.006	9.717	0.778	0.545	0.046	0.205	0.050
Green pepper	0.032	0.020	0.046	0.006	12.994	1.209	0.582	0.044	0.200	0.034
Onion	0.028	0.019	0.047	0.007	7.325	0.944	0.525	0.052	0.209	0.045
Calculated F-test	$0.779^{n.s}$		$0.245^{n.s}$		15.767**		$0.783^{n.s}$		$0.190^{n.s}$	
LSD (Last significant difference)	1.429		0.018		1.874		0.127		0.115	

$\bar{x}$ = Mean, S $\bar{x}$ = Standard Error, n.s = not significant. **Significant at 0.01 probability levels

Table 2: The concentration of Pb, Cd, Fe, Zn and Cu leafy vegetables (ppm)

	Pb		Cd		Fe		Zn		Cu	
Samples	$\bar{x}$	S $\bar{x}$	$\bar{x}$	S $\bar{x}$	$\bar{x}$	S $\bar{x}$	$\bar{x}$	S $\bar{x}$	$\bar{x}$	S $\bar{x}$
Parsley	0.038	0.003	0.048	0.006	16.50	0.088	0.573	0.060	0.197	0.041
Celery	0.033	0.005	0.043	0.006	15.54	0.626	0.515	0.055	0.204	0.034
White radish	0.032	0.003	0.048	0.006	15.31	0.638	0.595	0.054	0.211	0.053
Leek	0.031	0.003	0.044	0.007	16.47	0.549	0.548	0.052	0.1730	0.029
Mantis	0.035	0.004	0.049	0.007	11.50	0.702	0.594	0.047	0.208	0.038
Beet	0.037	0.004	0.043	0.004	14.15	0.802	0.543	0.037	0.144	0.032
Spinach	0.041	0.004	0.076	0.006	17.66	0.641	0.595	0.045	0.158	0.032
Lettuce	0.031	0.004	0.065	0.004	6.81	0.813	0.533	0.035	0.148	0.025
Green Onion	0.036	0.006	0.046	0.006	9.30	0.645	0.542	0.043	0.209	0.046
Calculation F-Test	$1.134^{n.s}$		$0.550^{n.s}$		26.693**		$0.320^{n.s}$		$0.532^{n.s}$	
LSD (least significant difference)	0.744		1.636		1.977		0.135		0.110	

concentration of iron than that reported in the literatures. A variety of factors may be responsible for such variation e.g. sampling, handling, harvesting…..etc.

Statistical analysis (F-test and LSD) indicated no significant differences between different types of vegetables in their lead concentration.

The level of cadmium varied according to the type of vegetables. In okra, spinach and lettuce the level of cadmium were relatively high. On the other hand, the cadmium level in eggplant, onion and tomato were quiet low.

It has been reported that spinach, lettuce and carrot are likely to accumulate cadmium at higher levels compared to other vegetables (Wong, 1996; Afshin and Masoud, 2008; Radwan and Salama, 2006). Radish and onion do not normally accumulate elevated concentration of cadmium. However; soil which normally contains significant amount of cadmium could be the sources of cadmium in vegetables (Sanchez-Camazao *et al.*, 1994; Sherlock and Walter, 1983). It has been reported that soil amended with sewage sludge has higher level of cadmium which subscuntly absorbed by vegetables roots (Sanchez-Camazao *et al.*, 1994). Apparently the levels of cadmium found in all the sample of vegetables examined were below the proposed maximum acceptable daily intake (Sherlock and Walter 1983; WHO, 1992). Provisional tolerable human intake of cadmium have been established at 57-71 microgram per day or 1 microgram per day kilogram body weight (Sherlock and Walter, 1983). However, although the levels of cadmium were below the acceptable level (Radwan and Salama, 2006), the effect of chronic low level exposure to cadmium and lead are not well studied in human because of the difficulties in assessing of such exposure accurately.

Statistical analysis (F-test) showed no significant difference between the different types of vegetables. However, LSD showed significant differences only for okra (Table 1) when comparison was made with the other types of vegetables.

Levels of zinc were quite low in all the sample of vegetables examined, even lower than that reported in the literatures (Parveen *et al.*, 2003).

A wide variation between the types of vegetables and the level of iron were observed Table (1-3). Green pepper contained the higher level of iron compared with okra and cucumber which contained the lowest levels.

It is obvious from the results obtained that leafy vegetables that leafy vegetables such as spinach, manties and parsley contained a high levels of iron compared with fruity types (Table 1, 2). Statistical

Table 3: Statistical analysis (F-Test and LSD) of tested metals concentration for the different types of vegetables

Samples	Zn	Fe	Pb	Cd
	($\bar{x}$)			
Parsley	0.573	16.500	0.038	0.048
Opium	0.595	15.540	0.033	0.043
Beet	0.543	14.150	0.037	0.043
Spinach	0.595	17.660	0.033	0.046
Lettuce	0.533	6.810	0.027	0.035
Eggplant	0.576	5.730	0.026	0.046
Tomato	0.599	5.388	0.024	0.044
Cucumber	0.667	5.539	0.030	0.046
Okra	0.625	4.879	0.028	0.081
Onion	0.625	4.873	0.028	0.081
Calculation F-Test	0.903n.s	69.23**	1.10n.s	0.30n.s
LSD (least significant difference)	0.041	0.574	0.005	0.0036

$\bar{x}$ = Mean, S $\bar{x}$ = Standard Error, n.s = not significant. **Significant at 0.01 probability levels

analysis indicated a significant differences (F-test) between the different types of vegetables (Table 1-3). Even such differences were observed between individual samples (LSD). The possible sources of such variation in the levels of the iron are plant it self soil and condition of the crops during harvesting and processing (Afshin and Masoud, 2008; Khairiah *et al*., 2004). Although human are generally well protected from over doses of iron, children age 1-2 years are vulnerable to high level of iron in diet (WHO, 1992).
The levels of copper found in samples of vegetables examined were lower than that reported in the literatures (Sherlock and Walter, 1983; WHO, 1992, 1995; Jarup, 2003). Even some of the samples examined were below the detected limited.

Conclusion: The present study have shown that the levels of heavy metals in the major vegetables crops found in Baghdad are within the acceptable levels, although lead were reported high in some of the samples examined especially in leafy vegetables. It is Therefore, suggested that regular monitoring of Heavy Metals in plant tissues is essential in order to prevent excessive build-up of these metals in the human food chain.

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