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Determination of Selected Essential and Trace Elements in Traditional Vegetables in Middle Euphrates, Iraq

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Abstract:

In this research, some essential and trace elements such as, Sodium, Potassium, Calcium, Magnesium, Manganese, Zinc, and Lead in ppm unites in some Iraq's vegetables determined to investigate the causes of pollution. Sodium level increases in the silty Loam soil while the potassium increases in the sandy soil. Lettuce has the highest manganese concentration and radish has the highest zinc level. Calcium is absent in several vegetables while lead concentration in vegetables was increased. Also, darker green vegetables are richer in magnesium.

Keywords: Trace elements, essential elements, pollution, vegetables.

Introduction

Carbohydrates, lipids and proteins are the main source of energy that required in the human body. Elements such as Sodium, Potassium, Calcium, Magnesium, Manganese, Zinc, and Lead are also needed by the body in small amounts to help balance the physiological and structural functions. These elements are found as a salts of organic acids or complexes with proteins and lipids [1].

In general, elements can be classified into three main categories, essential trace elements which include elements that vital processes need it to happen in the body. They are required in the body in relatively large amounts (several grams), such as iron, manganese and zinc…etc. Semi-essential trace elements: the absence of these elements has a small effect on the body, such as fluorine, nickel, bromine....etc. Non-essential trace elements, include elements with no biochemical importance for the body but it is presence can disrupt important chemical reactions causing poisoning as a result of it is accumulation, such as mercury, gold, silver and aluminum [2].

The amount of elements was increasing above normal limits in the plants that consider as a main source for human food as a result of increasing the amounts of pollutants in the soil and water by the sewage waste and fertilizer residues, causing imbalance of the eco-system [3] due to accumulation of difficult bio-degradable elements in the soil [4].

As a result of its importance, Tuzen and Soylak [5] have estimated some elements in a group of vegetables (tomatoes, some green vegetables) in Turkish markets using flame and non-flame atomic absorption in gravity furnace after a process of digestion. Then it was compared to studies done in several other countries. Sharma [6] was estimated some heavy elements in some of the vegetables produced and marketed during December, February, October and November in one Indian city in 2009.

Also some of the essential elements were estimated [7] in some vegetables grown and consumed in Ghana using neutronic analysis and found increasing in concentration of some metals such as Mg, Ca, Na, K, Co, Mn, and Br in the studied vegetables. Tomatoes, eggs, onions and carrots have the highest concentration levels of these elements.

The aims of this research is to determine of elements concentrations such as sodium, potassium, calcium, magnesium, manganese, zinc and lead in some of Iraq's vegetables to investigate the level of air, water and soil pollution by toxic elements which causes poisoning to humans as a result of ingestion of food containing them.

Material and Methods

Experimental part:

There are many instruments have been used in this research, digital balance Sartorius (Bp- 2015- Germany), atomic absorption spectrophotometer (pye Unicam SP-9 Phillips), flame photometer (Coring- EEI- Scientific), and Furnace (mke-Pe100- canada).

Different summer and winter Iraq's vegetables that are grown in middle Euphrates area were collected for the study in this research:

1	2	3	4	5	6	7	8	9	10	11	12
Sweet potato	Carrot	Lettuce	Cucumber	Garden Cress (Rashad)	Basil	Spinach	beets	tomatoes	radishes	leeks	Celery

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Method:

After specimen of vegetables collection, they were washed thoroughly with distilled water, squeezed and dried at 105 ˚C in a drying furnace for about 24 hrs to remove water completely to ease the grinding process by a ceramic mortar. Then 1 g was measured carefully using a sensitive scale by a ceramic pot. Each specimen was incinerated at 500 ˚C to ashes to ensure complete destruction of all organic materials of the specimens.

After that, digestion process was done by adding drops of water to the specimens to prevent scattering in a Pyrex beaker, then 10 ml of nitric acid was added. Each beaker was covered by a watch-glass. All specimens were then put in a sand bath at 80-90 ˚C and the heating process continued till the volume became approximately 2 ml. Then 5 mL of distilled water was added and every specimen was filtered and the filtrate transferred to a 10 mL volumetric flask and completed with distilled water [8].

Sodium and potassium were determined in studied specimens using a standard curves, intensity and concentration were measured using atomic absorption spectrophotometer. Calcium and manganese were determined in studied specimens using standard curves, intensity was measured using flame photometer. Zinc, magnesium and lead concentration were calculated using titration vis. EDTA [9].

Results and Discussion

Figure (1) shows the fluctuation of sodium and potassium levels, because they are affected by the type of soil. In middle Euphrates area the type of soil usually is the silty Loam, which is rich in sodium due to watering, while the sandy soil is rich in potassium [1].

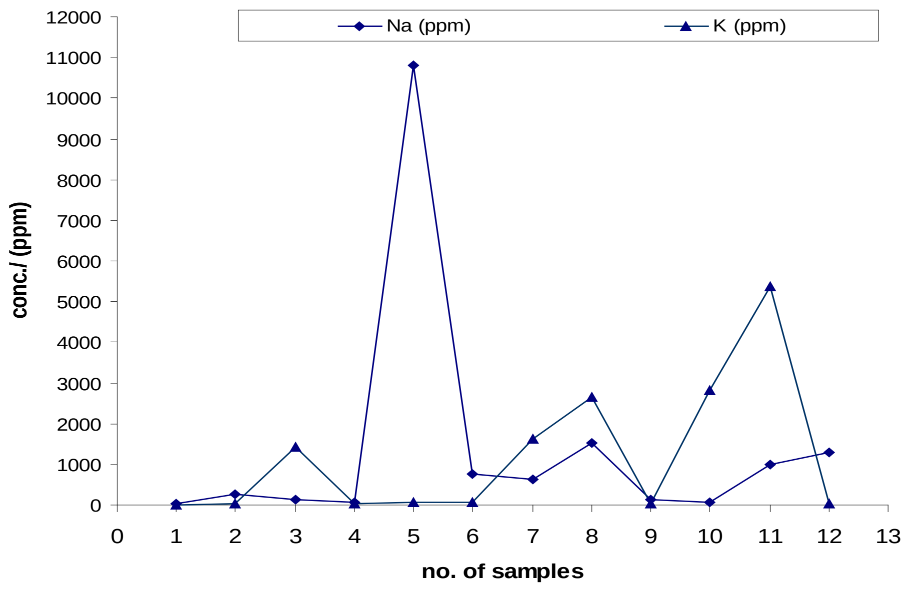

Figure (1): The values of sodium and potassium in (mg/L) for the studied specimens.

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The usual level of sodium in vegetables is (2.0 - 160 mg/mL). Ingestion of higher sodium levels could cause heart failure, kidney diseases and pre-eclampsia in pregnant women. While the deficiency can cause growth retardation, anorexia, edema and osteoporosis[1,7]. Extracellular sodium (20 meq/L) is in a state of balance with intracellular potassium (140

meq/L).Eating foods with higher potassium levels can cause sodium loss and disturb the water balance in the body [1,8]. Vegetables that contain lesser amounts of starch have higher potassium levels, for this reason tomatoes are the richest in potassium [9,8]. the amount of manganese in the studied samples are shown in the following figure.

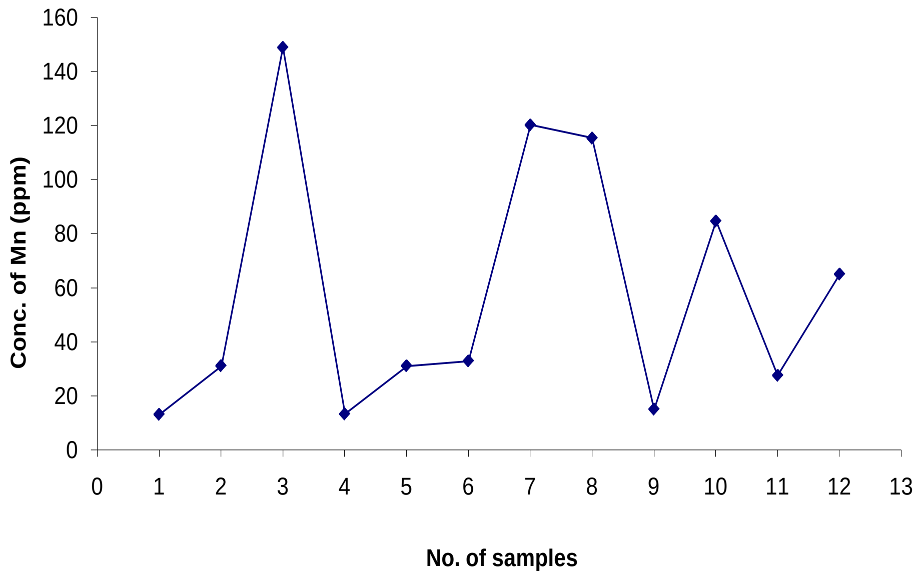

Figure (2): Levels of manganese in (mg/L) for studied specimens.

According to this figure, lettuce has the highest manganese level followed by spinach, beet and radish due to the use of sewage water for fertilization [3,10]. levels of calcium in the studied specimens are presented in Table 1.

Table (1): Levels of calcium in (mg/L) for studied specimens.

	1	2	3	4	5	6	7	8	9	10	11	12
Ca (mg/L)	-	2710.800	1070.800	-	1558.800	4236.800	1098,800	-	-	-	1958,800	4118,800

From these results, calcium is not found in several vegetables especially tomatoes due to formation of insoluble calcium oxalate. For this reason the calcium level decrease in vegetables which rich in oxalate. Deficiency of calcium can affect bone and teeth structure as well as clotting process in the body [1]. In addition, increase calcium level in food increase the need to foods rich in manganese to support the process of glucogenesis [2]. levels of magnesium in the studied samples are shown in Figure 3.

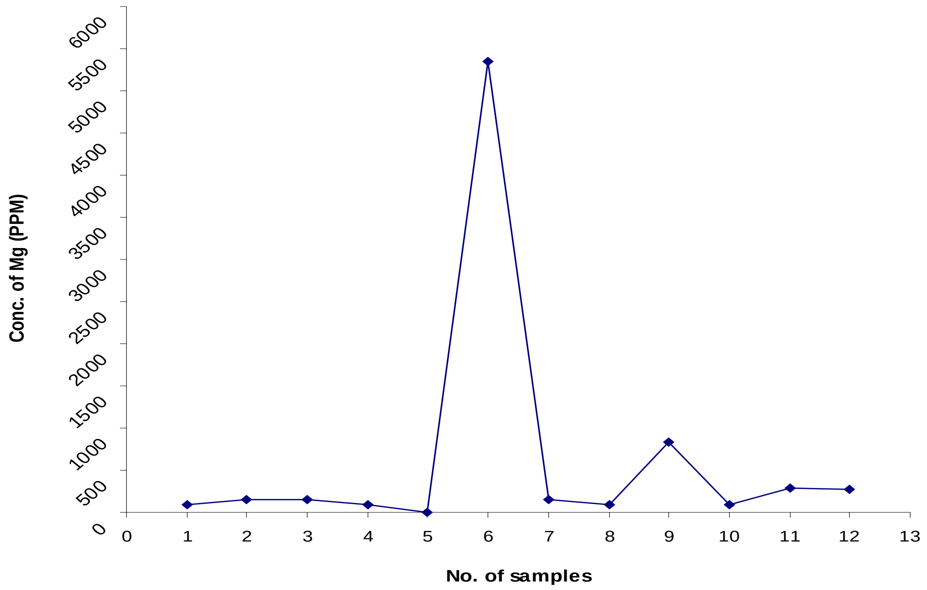

Figure (3): Levels of magnesium in (mg/L) for studied specimens.

Green vegetables especially darker ones are considered richer with magnesium because it is a consistent of chlorophyll structure and therefore the basil has the highest magnesium level [7]. Magnesium considers an important element that regulates the action of enzymes in the body. The body needs about 300 mg/day of magnesium. Deficiency of magnesium can cause tremor, headache, hypertension, musculopathy and liver damage [1]. Amount of zinc in the studied samples are presented in Table 2.

Table (2): Levels of zinc in (mg/L) for the studied specimens.

	1	2	3	4	5	6	7	8	9	10	11	12
Zn (mg/L)	-	-	65.400	1308.180	130.818	-	-	-	-	1438.990	291,660	830.690

Zinc is an important element for wound healing [1]. Foods rich in zinc are advised after surgical procedures. According to Table 2, radish has the highest zinc level followed by cucumber and celery. The level of zinc is affected by lead level. Zinc level decreases in the vegetable if lead level increases [2]. The levels of lead in the studied specimens are shown in Table 3.

Table (3): Levels of lead in (mg/L) for the studied specimens.

	1	2	3	4	5	6	7	8	9	10	11	12
Pb (mg/L)x 10^{-2}	16.576	16.576	12.433	2.072	20.720	53.872	-	8.288	16.576	290.080	26.936	2.693

According to these results, zinc and lead have an inverse relationship. This relationship shows in radish. Lead concentration in vegetables increases due to air pollution from vehicle exhaust when farmers grow them near main streets exposing them to lead [11, 13]. Soil pollution by lead can cause delay in enzymatic action of many micro-organisms which prevent complete degradation of organic substances in the soil which affect photosynthesis, water absorption and cellular division in vegetables [14]. The danger of increase lead level in vegetables is due to decrease calcium metabolism causing fainting, intestinal colic, anorexia, fatigue, headache, constipation, anemia, renal failure brain damage and death. Lethal level of lead is about 80 mg/100 ml of blood, while the standard level is about 30-40 mg/100 ml of blood [15, 18].

Conclusions

Sodium level increases in the middle Euphrates area which is silty Loam soil due to watering while the potassium increases in the sandy soil. Lettuce has the highest manganese concentration followed by spinach, beet and radish due to the use of sewage water for fertilization. Calcium is absent in several vegetables especially tomatoes due to formation of insoluble calcium oxalate. Green vegetables especially darker ones are considered richer in magnesium because it is exist in chlorophyll structure and therefore basil has the highest magnesium level. Radish has the highest zinc level followed by cucumber and celery. Lead concentration in vegetables increases due to air pollution from vehicle exhaust when farmers grow them near main streets exposing them to lead.

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