Determination of Some Elements in Local Food Products in Kingdom of Saudi Arabia

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Abstract. Vegetable and fruit samples were collected from their major area of Kingdom of Saudi Arabia (KSA), together with locally bred fish and meat and locally manufactured products as cheese and macaroni. These samples were analysed for Na, K, Mg, Ca, Fe, Zn, Cu and Mn using Flame Photometer and Atomic Absorption Spectrometer. The results showed that the level of Na & K in local foodstuff do not vary greatly from the reported values. But Mg shows much higher concentration than the reported value. On the contrary, levels of Ca, Fe, Zn, Cu and Mn are lower than the reported values.

The daily intake of essential elements was calculated taking into account the concentration of these elements in the edible part and the daily consumption data which were derived from two sources: (a) the food balance sheet of KSA given by Food and Agriculture Organization FAO and (b) from questionnaire distributed to 200 families in Jeddah. The results show that the daily intake of these essential elements according to FAO satisfy the daily requirements except Ca & Zn. But according to the questionnaire the daily intake of these elements are less than the required daily intake except for Mg.

Introduction

Essential elements are those if removed from diet result in consistent and reproduceable impairment of physiological function[1]. The deficiencies of these elements result from a combination of poor availability and low intake[2].

Metals in human body are divisible into two groups the major elements (Na, K, Mg and Ca) form the main proportion of the total elements content of the

body and trace elements (Fe, Cu, Mn and Zn) which found in low or even minute, quantities[3].

Sodium and potassium are the principle cations in the extra and intracellular fluid, respectively. They regulate nerves and muscles function.

Magnesium enters in the constituent of bone and teeth. It is important in the hydrolysis and energy storage reaction of phosphate derivatives, also it plays important role in enzymatic reaction catalyzed by certain kinase. In plant, magnesium ion plays a pivotal role in the process of photosynthesis. All of the chlorophylls which participate in photosynthesis are coordination compound of Mg^{2+}[4].

Calcium beside its constituent of bone and teeth it plays a major regulatory role in numerous biochemical and physiological processes, it involves in photosynthesis, oxidative phosphorylation, blood clotting, muscle contraction, cell division, transmission of nerve impulses, enzyme activity, cell membrane function and hormone secretion[2].

Iron plays many key roles in biological systems, including oxygen transport and storage, ATP (adenosine triphosphate) generation, DNA synthesis and chlorophyll synthesis[2].

Zinc enters in many physiological function as, taste sensation, metabolism of skin, reproductive process, bone formation, wound healing, brain function and metabolism of carbohydrate, protein and nucleic acid. It enters in many metallo enzymes[1].

Copper is a cofactor in many enzymes including phenolase and is at active center of hemocyanin, an oxygen carrying protein in some erthropods. It has critical importance in hemosynthesis, bone development, nerve function and connective tissues[1].

Manganese plays an essential role in cellular metabolism where a number of enzymes require the presence of this elements for their function. These include enzymes for the synthesis of mucopolysaccharides, for protein and energy metabolism and for cell protection from free radical damage[5].

Due to the importance of these elements several researchers had determined them in different food matrix during the last years[6-16].

In the present work, it is proposed to determine the concentration of essential major (Na, K, Mg and Ca) and trace (Fe, Zn, Cu and Mn) elements in local foodstuff of KSA. From the results the daily intake of these elements by KSA people can be estimated and compared with the requirement of these elements according to recommended dietary allowances (RDA)[17].

Experimental

Materials

Samples from local foodstuff of Kingdom of Saudi Arabia (KSA) were collected during 1998-1999. The vegetables, fruits and grains were collected from their major growing area in KSA together with fish and meat from animals which have been bred in KSA and locally manufactured products.

The groups of foodstuff studied were:

– Meat (chicken, lamb, beaf, camel and fish) "edible part".

– Leafy vegetable (mallow, spinach, garden rocket, lettuce, parsley curly, cabbage, mint and sweet basil).

– Non leafy vegetable (squash, okra, green pepper, egg plant (black), stringed beans, cucumber and cauliflower).

– Tubers (potato white and carrots).

– Fruits (mandarine, dried dates, pumpkin and tomatoes).

– Grains (wheat and corn).

– Manufactured products (macaroni and cheese).

From each sample 5 specimens were analysed. Two hundred grams of edible part from each specimen were taken, rinsed with tap water and then washed with double distilled water (except wheat and corn), dried at 100ºC till constant weight and ground with special mills with provision to prevent contamination (wearing parts made of aluminum and titanium).

The water used was double distilled water of high quality and all reagents used were of analytical grade from BDH Poole England. Measurements were done against metal standard solution, Spec pure from Alfa - Aesar - Ubichem - England.

The instruments used are Flame Emission Spectrometry (FES) Corning model 410. Atomic Absorption Spectrometer (AAS) with deuterium back ground correction model UNICAM-939 Supply with Flame system from England.

Methods

The representative samples, performed by quartering process, were digested using the Official Method AOAC. In nargent beaker 40 ml of conc. nitric acid (Analar) was added to 4 g of sample and allow to stand overnight at room temperature. Heat at 70ºC till the volume of nitric acid was reduced to about 5 ml, after cooling 3 ml of 60% $HClO_4$ was added and heating was continued till near dryness. The residue was dissolved by double distilled water, then the solution was filtered quantitatively in 100 ml measuring flask. The filterate was diluted

to mark with deionised water. The same previous procedure was performed without sample to give blank[18].

Sodium and potassium concentrations were measured using flame emission spectrometry against standard solution of NaCl and KCl. AAS with flame system was used for Mg, Ca, Fe, Zn, Cu and Mn concentration measurements. Hallow cathod lamps of Mg, Ca, Fe, Zn, Cu and Mn were used and the measurements were performed at wave lengths 285.2, 422.7, 248.3, 213.9, 324.8, and 279.5 nm respectively against metal standard solution[19].

Measurements were performed at Center Laboratory of Radiation Technology Center, Cairo, Egypt.

A questionnaire was distributed among two hundred families in Jeddah. The answers on the quantities of food they consumed independent of financial situation were collected and the mean values were calculated.

Results and Discussion

The level of Na, K, Mg and Ca in the local foodstuff of KSA are presented in Table 1. The concentrations were calculated in mg/kg fresh weight ± standard deviation of five species per each kind of food.

Table 1. Level of some major elements in mg/kg fresh weight in local foodstuff of KSA.

No.	Samples	Concentration in mg/kg fresh weight			
		Na	K	Mg	Ca
	Meat				
1	Chicken	669 ± 21	2155 ± 18	689 ± 44	96 ± 11
2	Lamb	460 ± 8	1980 ± 8	676 ± 37	107 ± 4
3	Beef	560 ± 10	2430 ± 9	537 ± 36	64 ± 6
4	Camel	680 ± 7	2170 ± 10	500 ± 30	46 ± 2
5	Fish	634 ± 9	1642 ± 11	445 ± 26	106 ± 3
	Leafy vegetables				
6	Mallow	407 ± 12	4950 ± 41	1770 ± 91	2122 ± 80
7	Spinach	370 ± 8	4697 ± 17	7572 ± 284	2437 ± 68
8	Garden rocket	557 ± 13	2110 ± 8	1065 ± 24	990 ± 8
9	Lettuce	383 ± 5	1780 ± 22	280 ± 8	190 ± 16
10	Parsley curly	2120 ± 71	5137 ± 13	1250 ± 83	1275 ± 78

TABLE 1. Contd.

No.	Samples	Concentration in mg/kg fresh weight			
		Na	K	Mg	Ca
11	Cabbage	317 ± 9	2250 ± 8	389 ± 14	241 ± 8
12	Mint	546 ± 5	4700 ± 16	2653 ± 40	1790 ± 66
13	Sweet basil	830 ± 8	5747 ± 13	3421 ± 84	2117 ± 83
	Non leafy vegetables				
14	Squash	210 ± 10	2963 ± 13	789 ± 18	90 ± 5
15	Okra	540 ± 8	3437 ± 12	2073 ± 62	733 ± 51
16	Green pepper sweet	433 ± 9	1840 ± 22	312 ± 3	72 ± 2
17	Egg plant (black)	280 ± 7	2897 ± 13	302 ± 7	108 ± 2
18	Stringed beans	340 ± 10	3180 ± 22	1029 ± 49	336 ± 34
19	Cucumber	220 ± 6	1880 ± 25	340 ± 16	143 ± 13
20	Cauliflower	410 ± 8	3117 ± 13	491 ± 27	197 ± 6
	Tubers				
21	Potato white	250 ± 9	3163 ± 17	604 ± 13	71 ± 7
22	Carrots	930 ± 7	2410 ± 8	360 ± 5	193 ± 8
	Fruits				
23	Mandarine	123 ± 5	1513 ± 5	394 ± 16	318 ± 6
24	Dry dates	610 ± 8	7707 ± 13	1942 ± 116	482 ± 24
25	Pumpkin	173 ± 5	2260 ± 16	243 ± 6	211 ± 7
26	Tomatoes	297 ± 9	3110 ± 23	390 ± 8	86 ± 3
	Grains				
27	Wheat	520 ± 7	3620 ± 16	3354 ± 225	340 ± 37
28	Maize (corn)	430 ± 8	3650 ± 8	5064 ± 374	90 ± 14
	Manufactured products				
29	Macaroni	440 ± 6	2257 ± 13	1522 ± 131	194 ± 23
30	White cheese	7820 ± 9	587 ± 49	682 ± 31	2617 ± 72

From the table it is clear that the higher concentration of Na in cheese while the lower in mandarine. In contrast to Na, K shows lower concentration in cheese but the higher level was in dry dates.

Also from the table it is clear that leafy vegetables have higher concentration of Mg. This is due to the presence of Mg as essential element in chlorophyll formation[4,20].

The highest Ca concentration was found in cheese while camel meet shows the lowest one. In vegetables there is a positive correlation between Ca and Mg concentration this can be explained that Ca involves in photosynthesis as Mg[2], this result confirms with the results obtained by Salah *et al.* (1996)[21].

The level of trace elements in mg/kg fresh weight in Saudi Arabia foodstuff are presented in Table 2.

TABLE 2. Level of some trace elements in mg/kg fresh weight in local foodstuff of KSA.

No.	Samples	Concentration in mg/kg fresh weight			
		Fe	Zn	Cu	Mn
	Meat				
1	Chicken	6.15 ± 1.44	13.92 ± 2.96	0.42 ± 0.04	0.13 ± 0.02
2	Lamb	16.71 ± 2.19	24.34 ± 4.01	0.90 ± 0.06	0.04 ± 0.1
3	Beef	12.46 ± 2.26	30.71 ± 6.38	0.50 ± 0.03	0.12 ± 0.02
4	Camel	9.55 ± 1.60	24.14 ± 5.85	0.33 ± 0.02	0.06 ± 0.02
5	Fish	2.56 ± 0.35	4.47 ± 0.27	0.19 ± 0.05	0.07 ± 0.01
	Leafy vegetables				
6	Mallow	31.40 ± 3.66	6.18 ± 0.19	1.83 ± 0.17	10.76 ± 0.76
7	Spinach	82.94 ± 5.45	6.77 ± 0.20	1.98 ± 0.53	6.67 ± 0.81
8	Garden rocket	27.56 ± 0.35	3.20 ± 0.29	0.22 ± 0.01	1.40 ± 0.11
9	Lettuce	9.06 ± 0.71	1.91 ± 0.04	0.30 ± 0.02	0.60 ± 0.08
10	Parsley curly	34.96 ± 0.52	3.26 ± 0.25	1.09 ± 0.01	5.34 ± 0.51
11	Cabbage	3.11 ± 0.18	0.89 ± 0.02	0.19 ± 0.01	0.62 ± 0.05
12	Mint	134.11 ± 0.73	5.76 ± 0.84	1.30 ± 0.14	9.51 ± 1.11
13	Sweet basil	137.21 ± 1.97	5.51 ± 0.11	1.79 ± 0.12	11.42 ± 0.36
	Non leafy vegetables				
14	Squash	6.38 ± 0.29	5.45 ± 0.11	0.70 ± 0.05	0.82 ± 0.01
15	Okra	11.76 ± 1.08	5.85 ± 0.23	1.59 ± 0.02	3.55 ± 0.15
16	Green pepper sweet	9.53 ± 0.27	1.25 ± 0.13	0.35 ± 0.02	0.35 ± 0.01
17	Egg plant (black)	4.33 ± 0.11	2.42 ± 0.13	0.80 ± 0.06	0.70 ± 0.03

TABLE 2. Contd.

No.	Samples	Concentration in mg/kg fresh weight			
		Fe	Zn	Cu	Mn
18	Stringed beans	7.31 ± 0.27	1.76 ± 0.01	0.40 ± 0.02	0.78 ± 0.02
19	Cucumber	2.55 ± 0.22	1.24 ± 0.12	0.22 ± 0.02	0.31 ± 0.02
20	Cauliflower	7.25 ± 0.65	3.42 ± 0.20	0.29 ± 0.01	0.63 ± 0.04
	Tubers				
21	Potato white	3.13 ± 0.06	4.37 ± 0.07	1.19 ± 0.01	0.68 ± 0.01
22	Carrots	3.08 ± 0.08	1.19 ± 0.14	0.27 ± 0.03	0.46 ± 0.02
	Fruits				
23	Mandarine	2.02 ± 0.21	0.81 ± 0.13	0.30 ± 0.02	0.19 ± 0.02
24	Dry dates	19.26 ± 0.67	4.08 ± 0.34	3.09 ± 0.07	1.13 ± 0.04
25	Pumpkin	0.88 ± 0.07	1.70 ± 0.24	0.12 ± 0.01	0.03 ± 0.01
26	Tomatoes	3.37 ± 0.13	1.22 ± 0.11	0.68 ± 0.02	0.24 ± 0.02
	Grains				
27	Wheat	28.75 ± 1.38	20.03 ± 0.94	3.21 ± 0.20	10.76 ± 0.23
28	Maize (corn)	44.81 ± 1.06	25.28 ± 2.19	3.10 ± 0.21	6.40 ± 0.11
	Manufactured products				
29	Macaroni	17.62 ± 0.74	12.82 ± 2.76	2.97 ± 0.29	3.97 ± 0.18
30	White cheese	3.40 ± 0.22	16.10 ± 2.17	0.25 ± 0.06	0.20 ± 0.02

Based on the data presented in Table 2 the higher concentration of Fe in green vegetable can easily be noticed this can be explained by the assimilation of Fe in chlorophyll and stored as ferritien[2].

Regarding Zn, the higher concentration of this element was recorded in meat due to its binding with proteins and albumin[1,4]. Also grains show high concentration of Zn and the lower concentration is in fruits, these results confirm with the previous results[1,11,15].

Concerning Cu level in different foodstuff, Table 2 shows that dates and grains are the richest food samples with Cu while fish is the poorest one. It can be also considered that the vegetables are good source of Cu whereas it is found in plastocyanin (Cu-containing protein) which is essential electron carrier in photosynthesis[20].

Grains show a remarkable higher concentration of Mn than other samples this is in agreement with the previous studies of Owen[2] and Farady *et al.*[11]. The lower concentration of Cu was found in tubers, meat and fish this result is confirmed by the results of Farady *et al.*[8] and Mcdonald[22].

Comparing our results with the reported values, it was found that the levels of Na and K are similar to those reported values[2,13]. According to the same references Mg concentration was found much higher than the reported values. This higher concentration of Mg could be attributed to the high level of Mg in the underground water of arid country which is used in irrigation[23]. It was found also that the levels of Ca, Fe, Zn, Cu and Mn in Saud Arabia foodstuff are lower than that in the other reported values[2,11-13,15]. This lower concentration may be referred to the sandy soil that does not contain organic materials which work towards buffering the pH of soil. The pH increases as CaO is added and the result is the formation of calcium phosphate which is not absorbed by plant. In addition as the pH increases above 7 the elements Fe, Zn, Cu, and Mn are less absorbable by plants[20].

From the concentration of major and trace elements in food the daily intake of these elements by KSA inhabitants were calculated in correlation with: a) food balance sheet of KSA (FAO 1994-1996)[24], b) questionnaire data. Tables 3 & 4 represent the daily intake of major and trace elements in mg/day. According to FAO the results show that the daily intake of major and trace elements exceeds the daily requirements except Ca and Zn where their daily intake is less than the daily requirements.

TABLE 3. Daily intake* of major elements by KSA inhabitants from local foodstuff.

No.	Foodstuff	Daily* consumption of food in g	Daily intake of elements in mg/day			
			Na	K	Mg	Ca
1	Chicken meat	78.10	52.25	168.31	53.81	7.50
2	Lamb meat	20.80	9.57	41.18	14.06	2.23
3	Beef meat	11.80	6.61	28.67	6.34	0.76
4	Camel meat	6.50	4.42	14.11	3.25	0.30
5	Fish meat	17.80	11.29	29.23	7.92	1.90
6	Vegetables	289.50	146.78	296.00	393.43	199.18
7	Potatoes	47.60	11.90	150.56	28.75	3.38
8	Carrots	0.26	0.25	0.65	0.10	0.05
9	Mandarine	56.00	6.89	84.73	22.06	17.81
10	Dry dates	74.70	45.57	575.71	145.07	36.01

TABLE 3. Contd.

No.	Foodstuff	Daily* consumption of food in g	Daily intake of elements in mg/day			
			Na	K	Mg	Ca
11	Pumpkin	16.40	2.84	37.06	3.99	3.46
12	Tomatoes	82.50	24.50	256.58	32.18	7.10
13	Wheat	332.00	172.64	1201.84	1113.53	112.88
14	White cheese	50.00	391.00	29.35	34.10	130.85
	Sum		686.50	3513.98	1858.59	523.41
	Daily requirement*		500.00	2000.00	222.00	600.00 - 1200.00

*In accordance with FAO[23].

TABLE 4. Daily intake * of trace elements by KSA inhabitants from local foodstuff.

No.	Foodstuff	Daily* consumption of food in g	Daily intake of elements in mg/day			
			Fe	Zn	Cu	Mn
1	Chicken meat	78.10	0.4803	1.0872	0.0328	0.0102
2	Lamb meat	20.80	0.3476	0.5063	0.0187	0.0008
3	Beef meat	11.80	0.1470	0.3624	0.0059	0.0014
4	Camel meat	6.50	0.0621	0.1589	0.0021	0.0004
5	Fish meat	17.80	0.0376	0.0662	0.0021	0.0011
6	Vegetables	289.50	5.3036	0.9698	0.2287	0.7180
7	Potatoes	47.60	0.1490	0.2080	0.0566	0.0324
8	Carrots	0.26	0.0008	0.0003	0.0001	0.0001
9	Mandarine	56.00	0.1131	0.0454	0.0168	0.0106
10	Dry Dates	74.70	1.4387	0.3048	0.2308	0.0844
11	Pumpkin	16.40	0.0144	0.0279	0.0019	0.0005
12	Tomatoes	82.50	0.2780	0.1007	0.0561	0.0198
13	Wheat	332.00	9.5450	6.6500	1.0657	3.5723
14	White cheese	50.00	0.1700	0.8050	0.0125	0.0100
	Sum		18.0872	11.2929	1.7308	4.4620
	Daily requirement*		10 - 15	12 - 15	1.5 - 3	2 - 5

*In accordance with FAO[23].

According to the questionnaire,Tables 5 and 6 represent the daily intake of major and trace elements in mg/day. The results show that except Mg the daily intake of major and trace elements are lower than the required values.

TABLE 5. Daily intake of essential major elements by KSA inhabitants from local foodstuff in correlation with questionnaire.

No.	Kind of food	Sample	Daily consum. of food in g/d	Daily intake mg/day			
			Edible	Na	K	Mg	Ca
	Meat						
1		Chicken	59.8	40.01	128.89	41.20	5.72
2		Lamb	54.8	25.24	108.50	37.04	5.86
3		Beef	9.2	51.52	22.36	4.94	0.59
4		Camel	2.6	1.77	5.64	1.30	0.12
5		Fish	16.7	10.58	27.41	7.42	1.78
	Leafy vegetables						
6		Mallow	5.5	2.24	27.23	9.74	11.67
7		Spinach	3.3	1.20	15.50	24.99	8.04
8		Garden rocket	2.7	1.50	5.70	2.88	2.67
9		Lettuce	11.8	4.52	21.00	3.30	2.30
10		Parsley curly	6.3	13.36	32.36	7.88	8.03
11		Cabbage	8.2	2.60	18.45	3.19	1.98
12		Mint	3.7	2.02	17.39	9.82	6.62
13		Sweet basil	1.6	1.33	9.20	5.47	3.39
	Non leafy vegetables						
14		Squash	22.6	4.75	66.96	17.83	2.03
15		Okra	13.0	7.02	44.68	26.95	9.53
16		Green pepper sweet	12.7	5.50	23.37	3.96	0.91
17		Egg plant (black)	12.3	3.44	35.63	3.71	1.33
18		Stringed beans	15.4	5.24	48.97	15.85	5.17
19		Cucumber	32.4	7.13	60.91	11.02	4.63
20		Cauliflower	7.0	2.87	21.82	3.44	1.38
	Tubers						
21		Potato white	40.9	10.23	129.37	24.70	2.90
22		Carrots	20.3	18.88	48.92	7.31	3.92

TABLE 5. Contd.

No.	Kind of food	Sample	Daily consum. of food in g/d	Daily intake mg/day			
			Edible	Na	K	Mg	Ca
	Fruits						
23		Mandarine	20.2	2.48	30.56	7.96	6.42
24		Dry dates	19.9	12.14	153.37	38.65	9.59
25		Pumpkin	2.5	0.43	5.65	0.61	0.53
26		Tomatoes	63.7	18.92	198.11	24.84	5.48
	Grains						
27		Wheat	47.46	24.68	171.81	159.18	16.14
	Manufactured products						
28		Macaroni	24.7	10.87	55.75	37.59	4.79
29		White cheese	15.9	124.34	9.33	10.84	41.61
	Sum			416.81	1544.84	553.61	175.13
	Daily requirement			500	2000	222	600 - 1200

TABLE 6. Daily intake of essential trace elements by KSA inhabitants from local foodstuff in correlation with questionnaire.

No.	Kind of food	Sample	Daily consum. of food in g	Daily intake mg/day			
			Edible	Fe	Zn	Cu	Mn
	Meat						
1		Chicken	59.8	0.3676	0.8322	0.0251	0.0078
2		Lamb	54.8	0.9157	1.3338	0.0493	0.0022
3		Beef	9.2	0.1146	0.2825	0.0046	0.0011
4		Camel	2.6	0.0248	0.6354	0.0009	0.0001
5		Fish	16.7	0.0352	0.0621	0.0020	0.0009
	Leafy vegetables						
6		Mallow	5.5	0.1727	0.0034	0.0010	0.0592
7		Spinach	3.3	0.2737	0.0223	0.0065	0.0220

Table 6. Contd.

No.	Kind of food	Sample	Daily consum. of food in g	Daily intake mg/day			
			Edible	Fe	Zn	Cu	Mn
8		Garden rocket	2.7	0.0744	0.0086	0.0006	0.0038
9		Lettuce	11.8	0.1069	0.0225	0.0035	0.0071
10		Parsley curly	6.3	0.2202	0.0205	0.0069	0.0034
11		Cabbage	8.2	0.0255	0.0073	0.0016	0.0051
12		Mint	3.7	0.4962	0.0213	0.0048	0.0352
13		Sweet basil	1.6	0.2771	0.0088	0.0029	0.0343
	Non leafy vegetables						
14		Squash	22.6	0.1442	0.1232	0.0158	0.0185
15		Okra	13.0	0.1529	0.0761	0.0207	0.0462
16		Green pepper sweet	12.7	0.1210	0.0159	0.0044	0.0044
17		Egg plant (black)	12.3	0.0533	0.0298	0.0098	0.0086
18		Stringed beans	15.4	0.1126	0.0271	0.0061	0.0012
19		Cucumber	32.4	0.0826	0.0402	0.0071	0.0100
20		Cauliflower	7.0	0.0653	0.0239	0.0020	0.0044
	Tubers						
21		Potato white	40.9	0.1280	0.1787	0.0487	0.0278
22		Carrots	20.3	0.0810	0.0242	0.0548	0.0093
	Fruits						
23		Mandarine	20.2	0.4080	0.0164	0.0061	0.0038
24		Dry dates	19.9	0.3833	0.0812	0.0615	0.0225
25		Pumpkin	2.5	0.0022	0.0425	0.0003	0.0001
26		Tomatoes	63.7	0.2147	0.0777	0.0433	0.0153
	Grains						
27		Wheat	47.46	1.3645	0.9506	0.1523	0.5107
	Manufactured products						
28		Macaroni	24.7	0.4352	0.3167	0.0734	0.0953
29		White cheese	15.9	0.0541	0.2550	0.0040	0.0032
	SUM			6.9074	5.5409	0.6200	0.9635
	Daily requirement	0- 15	12 - 15	1.5 - 3	2 - 5		

Conclusion

The levels of Na & K elements in Saudi Arabian foodstuff do not differ greatly from the reported values. At the same time, Mg is much higher than the reported values. In case of Ca, Fe, Zn, Cu and Mn their concentrations are little lower than the reported values. These results are suggested to be due to the nature of soil and irrigation water. The daily intake of most essential elements are lower than requirement values due to the low concentration of these elements in food and the low consumption of vegetables and grains which are rich in these elements.

Acknowledgement

The authors would like to thank King Abdulaziz City for Science and Technology for financial support.

References

[1] **Under Wood, E.J.** and **Mertz, W.,** *"Introduction in Trace Elements in Human and Animal Nutrition"*, 5th. ed. Academic Press. San Diego, pp. 1-19 (1987).

[2] **Owen, R.F.,** *"Food Chemistry",* 3rd. ed. Marcel Dekker, Inc. New York (1996).

[3] **Robert, K.M., Daryl, K.G., Peter, A.M.** and **Vector, W.R.,** *"Harpert's Biochemistry"* 22 ed. Prentice-Hall International Inc. (2000).

[4] **Maureen, J.K., Michael, T.M., Martin, J.P.** and **Kerry, D.R.,** *"Metals in Biological Systems"*, Ellis Horwood London (1992).

[5] **Mceuen, A.R.,** *"Manganese Metalloproteins and Manganese Activated Enzymes in Inorganic Biochemistry",* Hill H.A.O. (Ed) Royal Society of Chemistry. Burtington House, London, p. 249 (1981).

[6] **Ogorevec, B., Krasna A.** and **Hudnik, V.,** "A Novel Approach to Decomposition of Food Stuffs for Stripping-Voltammetric Determination of Lead, Cadmium and Copper", *J. Analytica Chemica Acta.* **196:** 183-191 (1987).

[7] **Maihara, V.A.** and **Vasconcellos, M.B.A.,** "Determination of Trace Elements in Brazilian Rice Grains and in Biological Reference Materials by Neutron Activation Analysis". *Radioanal. and Nucl. Chem.* **132**(2): 329-337 (1989).

[8] **El-Sayed, A.A.,** "Assessment of Some Trace Elements in Certain Egyptian Agriculture Products Using ICP-AES". *Arab Journal of Nuclear Science and Applications.* **35**(2): 91-102 (2002).

[9] **Armelin, M.J.A., Maihara, V.A., Vasconcellos, M.B.A., Favaro, D.I.T.** and **Nascimento V.F.,** "Neutron Activation Analysis of the Distribution of Inorganic Elements Among Five Varieties of Brazilian Corn". *J. Radioanal. and Nucl. Chem. Letters* **164**(4): 265-274 (1992).

[10] **Favaro, D.I.T., Maihara, V.A., Armelin, M.J.A., Vasconcellos, M.B.A.** and **Cozzolino, S.M.,** "Determination of As, Cd, Cr, Cu, Hg, Sb and Se Concentrations by Radiochemical Neutron Activation Analysis in Different Brazilian Regional Diets". *J. Radioanal. and Nucl. Chem.* **181**(2): 385-394 (1994).

[11] **Tsoumbaris, P.** and **Tsoukali, Papadopoulou, H.,** "Heavy Metals in Common Foodstuff: Daily Intake". *Bull. Environ. Cont. Toxicol.* **53:** 61-66 (1994).

[12] **Fardy, J.J., Mcorist, G.D., Farrar, Y.J., Bowles, C.J.** and **Warner Tan Mingguang, I.M.,** *"Application of Neutron Activation Analysis and Inductively Coupled Plasma Mass Spectrometry to the Determination of Toxic and Essential Elements in Australian Foods".* Report on IAEA Coordinated Research Programme. 296 pp. 19-70 Vienna (Austria) (1994).

[13] **Food Composition Tables for Egypt,** *Nutrition Institute* A.R.E., 1st. ed. (1996).

[14] **Jose, L.F.C., Antonio, O.S.S.** and **Renata, S.M.**, "Simultaneous Determination of Potassium and Sodium in Vegetables by Flame Emission Spectrometry Using a Flow-Injection System With Two Dialysis Units". *Analytical Sciences.* Feb. 12 (1996).

[15] **Hussein, L.** and **Bruggeman, J.,** "Zinc Analysis of Egyptian Foods and Estimated Daily Intakes Among an Urban Population Group". *J. Food Chemistry.* **58**(4): 391-398 (1997).

[16] **Storelli, M.M., Zizzo, N.** and **Marcotriglano, G.O.,** "Heavy Metals and Methylmercury in Tissues of Risso's Dolphin (Grampus griseus) and Cuvier's Beaked Whale (Ziphius Cavirostris) Stranded in Italy (South Adriatic Sea)". *Bull. Environ. Contam. Toxicol.* **63:** 703-710 (1999).

[17] **Food and Nutrition Board. National Research Council.** *Recommended Dietary Allowances,* 10th. ed. National Academy Press, Washington D.C. (1989).

[18] **Official Method of Analysis.** *J. Association of Official Analytical Chemist.* Washington, DC (1995).

[19] **Gary, D. Chrisian,** *"Analytical Chemistry"* Fifth edition. John Wiley and Sons Inc. (1994).

[20] **Robert, M.D.** and **Francis, H.W.,** *"Plant Physiology"*, 4th. ed., Wadsworth California (1983).

[21] **Salah, S.** and **Abdulmalik, A.A.,** "Periodical Changes of Some Nutrients of Seven Atriplex SPP. Grown Under the Arid Conditions of Saudi Arabia" *J. Biol. Sci.* pp. 55-61. Riyadh (1996).

[22] **Mcdonald, M.W., Humphries C., Shor, C.C., Smith, L.** and **Solvyns, A.,** Proc. Aust. Poult. Sci. Conv. 233 (1969) in "Assessment of Some Trace Elements in Certain Egyptian Agriculture Products Using ICP-AES" *Arab Journal of Nuclear Sciences and Applications.* **35**(2): 91-102 (2002) .

[23] **Hegab, O.A., El-Assy, I.E., Mahdy, M.A.** and **Sheta, A.E.,** "Monitoring of Uranium in Ground Water Southwestern Sinai, Egypt" *4th. Radiation Physics Conference.* Nov. 15-19, Alexandria, Egypt (1999).

[24] **Food Balance Sheets for the Arab Countries Series of FAO's,** Periodical publication of food balance sheets for specified countries. FAO U.N. (1996).

تقدير العناصر الأساسية في السلسلة الغذائية المحلية للمملكة العربية السعودية

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**قسم الحماية الإشعاعية ، مركز البحوث النووية ، هيئة الطاقة الذرية*

القاهـــرة – جمهورية مصر العربية

***قسم الكيمياء ، كلية التربية للبنا ، جـــدة – المملكة العربية السعودية*

المستخلص. تم تحليل المعادن الأساسية الثانوية منها والضئيلة في السلسلة الغذائية المحلية للمملكة العربية السعودية وذلك بجمع عينا من الخضراوا والفواكه من أماكن زراعتها في المملكة ولحوم حيوانا وأسماك تمت تربيتها في المملكة بالإضافة إلى منتجا صناعية محلية.

وتم استخدام جهاز طيف الانبعاث اللهبي في تعيين الصوديوم والبوتاسيوم ، أما باقي العناصر (الكالسيوم – المغنيسيوم – الحديد – الزنك – النحاس – المنجنيز) فقد استخدم جهاز الامتصاص الذري لتعيينها.

ولقد دلت النتائج على أن مستوى الصوديوم والبوتاسيوم في السلسلة الغذائية المحلية لا يختلف كثيرا عن مثيلاتها في الدراسا السابقة خارج المملكة. ولكن مستوى المغنيسيوم وجد أنه أعلى بكثير من الدراسا المرجعية السابقة في جميع العينا ما عدا الأسماك.

وعلى النقيض وجد أن مستوى كل من الكالسيوم والحديد والزنك والنحاس والمنجنيز أقل من مستواه في الدراسا السابقة خارج المملكة.

ولقد تم حساب المتناول اليومي للفرد السعودي حسب كمية الطعام المستهلكة بواسطة الفرد السعودي بناء على ما أقرته منظمة الأغذية والزراعة. ودلت النتائج على أن المتناول اليومي لهذه العناصر من الأغذية المحلية كاف لاحتياج الفرد اليومي ما عدا الكالسيوم والزنك.

كما تم حساب المتناول اليومي للفرد السعودي بناء على استبيان تم توزيعه على ٢٠٠ أسرة في مدينة جدة. ودلت النتائج على أن المتناول اليومي من هذه العناصر أقل من احتياج الفرد ما عدا المغنيسيوم.