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Macro- and microelements contents of 32 Kuwaiti composite dishes

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Abstract

Thirty-two commonly consumed Kuwaiti dishes were analyzed for 15 elements. These dishes were fish dishes, sandwiches, pastries, soups, sweets, salads, *kubas* and dairy dishes. The results were as follows in milligrammes per 100 g edible portion (unless otherwise indicated): 13–1567 sodium, 181–1033 potassium, 9.97–677 calcium, 26.2–528 phosphorus, 10.4–133 magnesium; 14–5.12 iron, 0.01–1.25 copper, 13–4.16 zinc, 0.01–0.7 manganese, <0.02–0.34 boron, <0.03–0.08 chromium, <0.02–0.29 molybdenum, <0.03–5.64 aluminium, 0.01 mg/100 g–0.37mg/100 g selenium, and 7.4 ug/100g–61.2 ug/100 g iodine.

Keywords: Kuwaiti dishes; Minerals; Nutritive; Value; Macro and micro elements

1. Introduction

Due to the increased interest in defining the biological roles of nutrients and their function in the etiology of chronic diseases, knowledge of dietary nutrient intake is needed to optimize human health. Nutritional assessment of food intakes is a major concern for food and medical scientists. Here in Kuwait, the first food composition tables were established in 1998 (Sawaya, Al-Awadi, Eid, & Dashti, 1998). The nutrient content of 38 Kuwaiti composite dishes was tabulated including, proximate analysis, fatty acids profile, minerals, dietary fibre, cholesterol, amino acids, vitamins, and phytate content. The data in this book were based on laboratory analyses of standardized recipes. This database has been used by many research groups in Kuwait and the Arabian Gulf Countries, in dietary surveys and nutritional assessment studies, and for dietary planning and advising on therapeutic diets. The growing need to enlarge the reliable nutrient database to cover other Kuwaiti dishes has been recognized by health and nutrition professionals. Dashti, Al-Awadi, Khalafawi, Al-Zenki, & Sawaya (2001) reported the proximate composition and phytate content of 32 traditional Kuwaiti dishes. Moreover, plans are presently underway to evaluate more than 70 composite Kuwaiti dishes.

The objective of this study was to determine the mineral contents (macro- and microelements) of 32 commonly consumed dishes in Kuwait.

2. Methodology

2.1. Preparation and standardization of the recipes

A total of 32 dishes were selected for the present study. Among these, three dishes were ready-made, while the remaining 29 were cooked dishes.

For the standardization and preparation of the cooked dishes, a procedure reported earlier by Sawaya et al. (1998) was followed; however, for the three ready-made dishes, *labnah* (strained yogurt), *hallomi* cheese and *rahash* (a traditional sweet made of sesame pulp and sugar), 3 kg of five popular selected brand names of *labnah, hallomi cheese* and *rahash* were collected, pooled and prepared for analysis. The total weight of the pooled samples of each ready-made dish was 15 kg. The analyses were done in triplicate. Major ingredients (% w/w) of the 32 recipes and their codes are presented in Table 1. Dishes were coded according to the type and nature of the raw ingredients used in the preparation. Classification of the dishes was as follows: seven fish dishes (F1–F7), six salad dishes (V1–V6), six pastries (P1–P6), four sweet dishes (S1–S4), two soup dishes (L1–L2), two sandwich dishes (SN1–SN2), three *kuba*

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Table 1
Ingredients of 32 Kuwaiti dishes

Dish	Major ingredients (%)
Fish-based dishes	
F1. Fish *Saneya* (Baked Fish with Vegetables)	Fish (54.61), Onion (10.75), Tomato (14.2), Green Pepper (12.62), Lemon Juice (2.5), Oil (2.0), Garlic (1.32), Spice (0.23), Cumin (0.36), Black Pepper (0.27), Salt (1.28)
F2. Fish *Kofta* (Fried Fish Ball)	Fish (52.47), Onion (20.41), Egg (11.16), Fresh Coriander (5.99), Rusk (5.75), Salt (1.5), Garlic (1.95), Spice (0.34), Dried Lemon (0.47)
F3. *Matfee* (Thick Fish Stew)	Fish (43.69), Tomato (21.59), Onion (12.23), Water (9.07), Fresh Coriander (4.47), Tomato Sauce (5.26), Garlic (1.73), Dried Lemon (0.69), Turmeric (0.31), Salt (1.21), Spice (0.32)
F4. *Khathra* (Mixed Fish and Rice)	Fish (24.00), Rice (21.66), Water (25.61), Tomato (12.85), Onion (6.01), Coriander (1.73), Garlic (0.98), Turmeric (0.17), Black Pepper (0.05), Tomato Sauce (4.26), Spice (0.15), Salt (0.72), Dried Lemon (0.62), Oil (1.34)
F5. Fried Fish	Fish (93.22), Garlic (2.24), Lemon Juice (1.48), Salt (1.51), Turmeric (0.96), Spice (0.59)
F6. Shrimp *Banee* (Fried Shrimp)	Shrimp (63.99), Flour (12.15), Egg (10.7), Sumak (7.35), Lemon Juice (3.27), Garlic (2.19), Spice (0.59), Black Pepper (0.35), Salt (1.4)
F7. Grilled Shrimp	Shrimp (93.08), Salt (3.17), Garlic (1.97), Lemon Juice (1.76), Spice (0.75)
Salad	
V1. *Tabola*	Burgol (6.88), Onion (13.89), Tomato (22.69), Olive Oil (3.37), Parsley (41.45), Salt (0.70), Mint (7.11), Lemon Juice (4.18)
V2. *Motabal*	Eggplant (83.38), Tahina (7.27), Garlic (1.43), Salt (1.03), Lemon Juice (4.80), Cumin (0.58), Olive Oil (1.69)
V3. *Hommas*	Hommas (82.63), Tahina (8.49), Olive Oil (2.54), Lemon Juice (2.84), Garlic (2.06), Salt (1.32)
V4. *Foul Modammas*	Broad Beans (66.49), Tomato (23.39), Garlic (1.33), Cumin (2.12), Salt (1.39), Olive Oil (3.17), Lemon Juice (2.11)
V5. *Fattoosh*	Tomato (23.19), Cucumber (20.08), Parsley (6.42), Mint (6.54), Onion (8.70), Garlic (0.25), Olive Oil (2.46), Lettuce (6.74), Bread (Arabic) (5.55), Lemon (2.11), Salt (0.78), Semak (0.51), Leek (6.69), Pepper (Green) (9.96)
V6. *Falafel*	Broad Beans (51.02), Parsley (10.16), Salt (0.94), Coriander (5.36), Cumin (0.98), Green Onion (13.22), Garlic (2.37), Onion (13.78), Black Pepper (0.72), Sodium Bicarbonate (0.64), Red Pepper (0.27), Spice (0.54)
Pastries	
P1. Spinach Pastry (baked)	Flour (39.73), Water (14.74), Fresh Spinach (21.2), Onions (9.65), Oil (5.49), Powdered Milk (1.72), Sumak (1.22), Lemon Juice (1.92), Salt (0.6), Yeast (0.55), Eggs (3.7)
P2. Cheese Pastry (baked)	Flour (47.3), Water (18.69), Cheese (11.76), Powdered Milk (1.58), Mint (6.81), Oil (6.74), Egg (5.25), Sugar (0.82), Yeast (0.58), Salt (0.52).
P3. Cheese Sambosak (deep fried cheese pastry)	Sambosak (59.98), Cheese (24.19), Mint (7.57), Water (6.59), Flour (2.60)
P4. Meat Samboask (deep fried meat pastry)	Sambosak (46.12), Minced Meat (30.79), Onion (20.72), Spices (0.58), Black Pepper (0.52), Salt (1.25)
P5. Thyme Pastry (baked)	Flour (47.2), Powdered Milk (2.79), Oil (6.03), Egg (6.23), Thyme (7.3), Water (17.39), Olive Oil (7.71), Salt (0.56), Yeast (0.67), Sugar (1.25)
P6. Vegetable Sambosak (deep fried vegetable pastry)	Sambosak (47.14), Frozen Vegetables (33.59), Onion (17.75), Salt (0.95), Spices (0.58)
Sweet	
S1. Mahalabia (milky sweet)	Milk (80.51), Sugar (11.01), Starch (7.17), Rose Water (0.91), Cardamom (0.40)
S2. Legemat	White Flour (20.071), Brown Flour (25.55), Yoghurt (24.59), Water (28.59), Yeast (1.2)
S3. Sab-Al-Gafsha (fried dumpling dipped in sugar syrup)	Brown Flour, (15.67), Gramflour (9.73), Water (40.58), Egg (16.31), White Flour (16.43), Cardamom (0.36), Saffron (0.13), Yeast (0.78)
S4. Rahash	Readymade traditional sweet made of 50% sesame pulp and 50% sugar
Sandwiches	
SN1. Chicken Shawerma (chicken sandwich)	Chicken (50.64), Bread (25.13), Tomato (9.6), Oil (1.56), Garlic (0.46), Salt (0.93), Spice (0.25), Onion (10.64), Black Pepper (0.3), Sumak (0.46)
SN2. Meat Shawarma (meat sandwich)	Meat (48.96), Onion (11.95), Bread (22.38), Oil (1.57), Salt (1.25), Tomato (12.98), Black Pepper (0.29), Spice (0.25)
Kuba Dishes	
C1. Rice Kuba (fried meat-rice balls)	Rice (37.84), Meat (24.64), Onion (27.57), Egg (5.5), Currant (1.45), Salt (1.49), Spice (0.5), Turmeric (0.48)
C2. Burgol Kuba (fried burgol-meat balls)	Burgol (32.72), Meat (48.87), Onion (14.5), Pine (1.53), Salt (0.83), Black Pepper (0.29), Spice (0.36), Garlic (0.79)
C3. Potato Kuba (fried potato-meat balls)	Potato (40.8), Meat (18.9), Egg (6.17), Onion (13.07), Rusk (4.98), Salt (1.29), Rice (11.52), Pine (3.02), Spice (0.24)
Soup	
L1. Vegetable Soup	Squash (10.93), Potato (12.8), Onion (11.93), Tomato (13.84), Water (29.51), Green Beans (7.84), Black Pepper (0.26), Salt (0.62), Parsley (2.78), Oil (0.94)
L2. Lentil Soup	Lentil (24.6), Water (58.74), Onion (10.62), Oil (2.03), Garlic (1.43), Black Pepper (0.27), Cumin (0.3), Black Lemon (0.6)
Dairy Products	
D1. Labnah	Strained Yoghurt
D2. Hallomi Cheese	

dishes (C1–C3), and two dairy products (D1–D2). All dishes were prepared in triplicate.

2.2. Sample preparation

The cooked dishes, along with the ready-made dishes, were thoroughly homogenized and then sampled for moisture analysis. Additional samples were freeze-dried for further analysis.

2.2.1. Mineral analysis

For the determination of sodium, potassium, calcium, phosphorus, lithium, silicon, fluoride, lead, magnesium, iron, zinc, copper, manganese, boron, chromium, aluminium and molybdenum, about 1.0 g of sample was digested with a nitric and perchloric acid mixture (20 ml:10 ml). The final solution was taken to 25 ml in 1% nitric acid. The analyses were done (Wolnik, Fricke, & Gaston, 1998) using inductively coupled plasma-optical emission spectrometry (ICP-OES, Jobin-Yvon model JY-24), and the results were evaluated from calibrations of the method using metal-mixed standard (E-Merck, Germany). Selenium was analyzed using hydride generation atomic absorption spectrometry (Model VGA-77 with Spectra20 Varian Plus, Australia). The accuracy of the method was checked by analyzing certified reference standards with the samples, for example, wheat flour standard (SRM 1567a), oyster tissue (SRM 1566a), bovine liver (SRM 1577b) and tomato leaves (SRM 1573). Iodine was analyzed calorimetrically according to the AOAC 932.21 1990).

3. Results and discussion

Table 2 presents the results of the analyses of macro- and microelements expressed per 100 g edible portion. The sodium content ranged from a low of 13.9 mg/100 g in *sub-al-gafsha* (S3) to a high of 1567 mg/100 g in grilled shrimp (F7), whereas the potassium ranged from a low of 181 mg/100 g in rice *kuba* (C1) to a high of 1033 mg/100 g in *matfee* (F3). The calcium content was the highest (677 mg/100 g) in *hallomi* cheese (D2), whereas it was the lowest (9.97 mg/100 g) in meat *shawerma* (SN2). For phosphorus, the range was from 26.2 mg/100 g in *fattoosh* (V5) to 528 mg/100 g in *hallomi* cheese (D2), and magnesium ranged from 10.4 mg/100 g in *khathra* (F4) to 133 mg/100 g in *rahash* (S4).

The highest Na concentration was found in the fish dishes F1 to F7, ranging from 228 mg/100 g in *khathra* (F4) to 1567 mg/100 g in grilled shrimp (F7), with an average of 825 mg/100 g edible portion. These results are in agreement with the findings of Phase II (Sawaya & Al-Awadhi, 1995), where the average Na concentration was highest in the seafood dishes (799 mg/100 g). The shrimp dishes F6 and F7 each had relatively high sodium levels of 1256 and 1568 mg/100 g, respectively. The high Na content is mainly due to the added salt in the different recipes. The sodium content in the dairy products was also high. In *labneh* (D1), the Na concentration was 254 mg/100 g, and in *hallomi* cheese (D2), it was 1358 with an average of 806 mg/ml. The high content of Na in *hallomi* cheese came mainly from the addition of salt during the processing of the cheese.

Chicken and meat *shawerma*, SN1 and SN2, had relatively high sodium contents of 681 and 646 mg/100 g, respectively, with an average of 663 mg/100 g. These were followed by the salads V1 to V6, ranging from 271 mg/100 g in *taboula* to 789 in *foul modamas*. The average sodium content in the vegetable dishes was 512 mg/100 g. The pastry dishes, P1 to P6, came next with a range of 403 mg/100 g in cheese pastry to 595 mg/100 in meat *sambosak*. The average sodium content of the pastry dishes was 492 mg/100 g. The *kuba* dishes, C1 to C3, and soup dishes, L1 and L2, showed similar Na contents, with averages of 397 mg/100 g for the *kuba* dishes and 396 mg/100 g for the soup dishes.

The sweet dishes, S1 to S4, had the lowest Na contents. The average Na content ranged from 13.9 mg/100 g in *sub-al-gafsha* (S3) to a high of 53.5 in *mahalabia* (S1).

The major Na content in most of the dishes comes from the salt used in the recipes, or in the processing of the food, such as in *hallomi* cheese. Salt intake is now recognized as most detrimental for blood pressure (Elliot et al., 1996; MacGregor and Sever, 1996). Na could interfere with many chronic diseases, such as heart disease, bone loss and some renal diseases. High intake of salt is likely to hasten deterioration of renal function in patients with renal disease (Benstein et al., 1990). Furthermore, high intake of Na could lead to high urinary calcium excretion. Matkovic, Ilich, Andon (1995) suggested that during rapid growth in young girls, low calcium intake and high obligatory calcium loss in urine caused by high salt intake may reduce calcium retention in the skeleton with a concomitant reduction in peak bone mass. People with high blood pressure should be restricted from high Na diets. Hypertension is one of the major risk factors for coronary heart disease (Osborne, McTyre, Dudek, Roche, Scheuplein, Silverstein, Weinberg, & Salkeld, 1996).

For potassium (K), the highest concentration was found in fish dishes, ranging from a low of 236 mg/100 g in *khathra* (F4) to a high of 1033 mg/100 g in *matfee* (F3), with an average of 583 mg/100 g. The K content in *matfee* was attributed mainly to the fish in the recipe. The K contents in fish of mixed species is 475 mg/100 g, in fresh coriander it is 542 mg/100 g, in tomatoes it is 222 mg/100 g, and in onions it is 157 mg/100 g (USDA, 1998).

The salads, V1 to V6, recorded a potassium range of 257 mg/100 g in *hommas* (V3) to 808 mg/100 g in *falafel*

Table 2
Mineral contents of Kuwaiti composite dishes (mg/100 g edible portion)

Mineral	F1	F2	F3	F4	F5	F6	F7	V1	V2	V3	V4	V5	V6	S1	S2	S3	S4
Na	667±55	673±8	885±11	228±5	502±95	1256±42	1567±195	271±4	513±25	645±34	789±175	339±32	496±21	53±1	14.0±1	13.9±2	36±5
K	776±48	587±28	1033±41	236±13	682±37	426±22	337±17	432±26	479±43	257±5	428±0	395±10	808±49	313±7	249±24	214±23	346±10
Ca	47.4±2	22.0±2	87.7±9	13.1±0.7	46.2±16	63.1±4	48.1±2	66.1±8	22.5±0.9	36.6±2	49.2±2	24.6±3	35.6±3	93.4±5	18.0±5	10±1	62.6±7
P	185±11	113±3	169±63	49.1±2	197±14	182±5	213±9	46.5±5	69.6±17	91.5±16	78.8±6	26.2±3	163±7	86.6±4	57.5±4	47.61±6	271±13
Mg	28.5±0.4	24.44±0.7	36.3±2	10.4±0.1	24.0±0.8	43.4±1	37.51±2	40.6±1	39.8±2	51.0±3	28±2	13.8±2	39.9±2	13.2±1	23.5±3	17.16±2	133±3
Fe	2.01±0.6	1.66±0.1	2.09±0.2	0.17±0.02	0.29±0.04	1.59±0.1	2.57±0.3	1.92±0.1	1.43±0.2	1.00±0.3	4.22±0.3	0.65±0.3	3.36±0.3	0.17±0.01	0.80±0.2	0.97±0.3	5.12±0.4
Cu	0.1±0.01	0.07±0.01	0.09±0	0.06±0	<0.03	0.25±0	0.28±0	0.12±0	0.24±0	0.30±0	0.23±0	0.04±0.01	0.50±0	<0.03	<0.03	<0.03	1.25±0.1
Zn	0.1±0.01	0.67±0.1	0.63±0	0.42±0	0.59±0.09	1.27±0	1.45±0.1	0.86±0	0.63±0.1	1.27±0.2	0.77±0.1	0.13±0	1.68±0.3	0.37±0.2	0.50±0.1	0.54±0.1	3.08±0.1
Mn	0.1±0.01	0.1±0.01	0.23±0.02	0.18 0.01	0.05±0.01	0.49±0.03	0.07±0.003	0.41±0.03	0.24±0	0.4±0.02	0.23±0	0.13±0	0.50±0	0.12±0.01	0.53±0.1	0.37±0.1	0.67±0.4
B	0.12±0	0.09±0.03	0.19±0	<0.02	<0.02	<0.02	<0.02	0.34±0.1	<0.02	<0.02	0,09±0	0.06±0.02	0.10±0	0.08±0	0.09±0.03	0.22±0.1	<0.03
Cr	0.03±0	0.03±0.001	0.03±0	<0.03	<0.03	<0.03	<0.03	0.03±0	0.03±0	0.03±0	0.03±0.001	0.03±0.001	0.03±0.02	<0.03	<0.03	<0.03	0.08±0.02
Al	2.73±0.1	0.83±0.1	3.35±0.2	<0.3	<0.3	<0.3	<0.3	1.32±0.5	2.21±0.4	0.39±0	3.45±0	0.74±0.1	1.51±0	0.52±0.05	<0.3	<0.3	5.61±0.1
Mo	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02±0	0.02±0	0.05±0.02	0.08±0.01	0.01±0.002	0.29±0.1	<0.02	<0.02	<0.02	<0.02
$Se_{\mu g/100g}$	40.9±0	30.8±0.001	25.1±0	7.40±0.0004	56.6±0.01	39.4±0.002	61.2±0.002	<0.1	<0.1	3.50±0.003	1.10±0.001	1.00±0.0002	1.50±0	1.50±0.001	4.20±0.0004	5.20±0.001	<0.1
I	0.06±0	0.12±0	0.04±0	0.01±0	0.13±0	0.12±0	0.14±0	0.11±0	0.18±0	0.12±0	0.04±0	0.01±0	0.17±0	0.01±0	<0.01	0.01	<0.01
Mineral	C1	C2	C3	P1	P2	P3	P4	P5	P6	SN1	SN2	L1	L2	D1	D2		
Na	415±36	224±12	553±17	421±5	403±28	536±17	595±20	466±24	534±9	681±28	646±13	436±5	357±10	254±9	1358±50		
K	181±15	259±49	469±51	327±105	267±4	242±12	389±22	299±17	255±24	350±18	531±17	273±22	338±20	364±16	184±4		
Ca	12.8±1	17.5±3	11.4±0.8	48.9±2	59.7±1	86.4±9	16.5±1	58.3±8	21.6±3	16.1±1	9.97±0.2	16.2±0.6	12.8±2	123±5	677±26		
P	47.3±3	103±18	55.6±3	83.4±4	96.2±1	108±12	79.2±6	94.4±7	53.5±6	85.3±7	127.4±2	31.1±3	58.9±1	174±3	528±8		
Mg	10.6±0.8	32.10±4	19.2±0.8	338±5	27.4±0.8	30.98±2	23.1±1	33.3±3	22.9±2	24.9±0.5	21.7±0.1	13.7±0.1	15.2±1	14.2±1	34.81±7		
Fe	1.12±0.04	1.64±0.3	0.92±0.2	1.92±0.3	1.19±0	1.17±0.2	2.10±0.2	2.19±0.1	1.24±0.1	0.95±0	1.74±0	0.51±0	1.35±0.3	0.14±0.03	0.40±0.1		
Cu	0.13±0.004	0.16±0.04	0.12±0.02	0.12±0	0.12±0	0.14±0.01	0.15±0.03	0.21±0.04	0.17±0.04	0.09±0	0.10±0	0.06±0.004	0.20±0.04	0.03±0.01	0.10±0		
Zn	0.89±0.04	1.67±0.2	1.06±0.1	0.71±0.03	0.72±0	0.82±0	1.22±0.1	0.78±0.04	0.44±0.1	0.95±0	2.32±0.2	0.20±0	0.71±0	0.54±0	4.16±0		
Mn	0.20±0.01	0.70±0.2	0.19±0.01	0.46±0	0.48±0	0.52±0.05	0.35±0.03	0.58±0.04	0.46±0.03	0.38±0	0.22±0.02	0.12±0	0.25±0.01	0.01±0	0.03±0		
B	0.03±0.01	<0.02	0.05±0.01	0.04±0.004	<0.02	<0.02	0.02±0	<0.02	0.04±0.004	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		
Cr	0.03±0.002	0.03±0	0.03±0.003	0.04±0.01	0.03±0	<0.03	0.03±0.005	0.03±0.004	0.03±0.004	<0.03	<0.03	<0.03	<0.03±	<0.03±	0.03±0		
Al	1.28±0.1	0.65±0.3	0.59±0.2	1.73±0	1.19±0	1.14±0.1	1.37±0.2	3.17±0.4	1.11±0.4	0.55±0.1	0.30±0.04	0.30±0	0.56±0.1	<0.3	<0.3		
Mo	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02±0.003	<0.02	<0.02		
$Se_{\mu g/100g}$	2.30±0.0004	2.80±0.001	3.20±0.0004	7.30±0.001	6.30±0.0004	9.00±0.001	6.40±0	7.30±0	3.20±0.002	12.9±0.001	8.00±0	0.70±0	5.10±0.0004	5.50±0.0002	12.1±0.002		
I	0.02±0	0.04±0	0.13±0	0.01±0	0.01±0	0.01±0	0.02±0	0.01±0	0.01±0	0.01±0	0.01±0	0.02±0	0.05±0	0.04±0	0.37±0		

(V6), with an average of 467 mg/100 g. The high potassium content in these dishes was mainly due to the different kinds of vegetables and legumes used. The K contents in broad beans and chickpeas are 1062 and 1375 mg/100 g, respectively. The rest of the dishes contained relatively high amounts of K, with averages of 441 mg/100 g for the sandwiches, 305 mg/100 g for the soup dishes, 303 mg/100 g for the *kubas*, 296 mg/100 g for the pastries, 280 mg/100 g for the sweets, and 273 mg/100 g for the dairy products. The relatively high K contents are due to the high content of K in the raw materials, i.e., wheat flour in chicken *shawerma*, *sub-al-gafsha, legemat*, pastry dishes and powdered milk.

Potassium plays an important role in reducing blood pressure. Hui Guang, Hu, Dong, Yang, and Nan (1996) suggested that increased potassium intake and reduction in sodium, especially cooking salt, are needed for the nutritional control of hypertension. Here in Kuwait, hypertension is a major public health problem and controlled amounts of Na and K in the diet could lead to a decrease in blood pressure. Reducing sodium intake and increasing potassium intake have been proposed to prevent hypertension (National Research Council, 1989; WHO, 1990).

The calcium (Ca) content of all the dishes ranged from a high of 677 mg/100 g in *hallomi* cheese (D2) to a low of 9.97 mg/100 g in meat *shawerma* (SN2). Dairy-based dishes had the highest Ca levels: *hallomi* cheese (D2)—677 mg/100 g, *labneh* (D1) 123 mg/100 g, *mahalabia* (S1)—93.42 mg/100 g, and cheese *sambosak* (P3)—86.4 mg/100 g. The high Ca content of these dishes came from milk. The Ca content in milk is 1330 mg/100 g (Posati and Orr, 1976). The mean concentrations of Ca in the dishes were 400, 48.6, 46.8, 46.0, 39.1, 15.0, 13.9, and 13.0 mg/100 g for dairy products, pastries, fish dishes, sweets, salads, soups, *kuba* dishes, and sandwiches, respectively. The relatively low Ca levels in these dishes, except the dairy dishes, is mainly due to the low Ca content in the major ingredients of the dishes.

Ca has important physiological and biochemical roles in humans. Besides its vital role in bone structure, dietary calcium plays an integral role in the maintenance of normal blood pressure, and adequate calcium intake may help reduce this risk of high blood pressure (Osborne et al., 1996). Studies on animals and humans suggest that there is an inverse relationship between Ca and blood pressure.

The phosphorus (P) content in the cooked dishes ranged from a high of 528 mg/100 g in *hallomi* cheese (D2) to a low of 26.2 mg/100 g in *fattoosh* (V5). Cheese, in general, is considered to be a rich source of P. The rest of the dishes contained varied amounts of P, with averages of 351, 150, 116, 106, 85.7, 79, 68, and 45 mg/100 g for dairy products, fish dishes, sweets, sandwiches, pastries, salads, *kuba* dishes and soups, respectively. The major source of P in these dishes was the lamb, fish and chicken used in the recipes.

Phosphorus plays an important role in the body, especially in bone structure, where it occurs in the mass ratio of 1 phosphorus to 2 calcium (National Research Council, 1989). Furthermore, it is an essential mineral in many chemical reactions in the body.

The magnesium (Mg) concentration in the dishes ranged from 10.4 mg/100 g in *khathra* (F4) to 133 mg/100 g in *rahash* (S4). The high levels in *rahash* could be attributed to the sesame used in *rahash* processing. The Mg content in sesame seeds is 556 mg/100 g (USDA, 1998). The rest of the dishes contained relatively small amounts of Mg, with averages of 14.5 mg/100 g for the soups, 20.6 mg/100 g for the *kuba* dishes, 24.4 mg/100 g for the dairy products, 23.3 mg/100 g for the sandwiches, 28.6 mg/100 g for the pastries, 29.2 mg/100 g for the fish dishes, 35.6 mg/100 g for the salads, and 46.7 mg/100 g for the sweets.

Magnesium has an important role in all biosynthetic processes, glycolysis, and the formation of cyclic AMP. It is also essential in the activation of more than 300 enzymes (Shils & Rude, 1996).

The iron (Fe) content of the dishes ranged from 0.14 mg/100 g in *labnah* (D1) to 5.12 mg/100 g in *rahash* (S4). The average iron contents for the different dishes were 2.10 mg/100 g in the salads, 1.77 mg/100 g in the sweets, 1.64 mg/100 g in the pastries, 1.48 mg/100 g in the fish dishes, 1.35 mg/100 g in the sandwiches, 1.22 mg/100 g in the *kuba* dishes and 0.93 mg/100 g in the soups.

The relatively high content of Fe in *rahash* (S4) came mainly from the sesame seeds used in processing *rahash*. The Fe content in sesame seeds is 14.8 mg/100 g. In the *foul modammas* (V4), the Fe content was 4.22 mg/100 g, and in *falafel* (V6) it was 3.36 mg/100 g. The high iron content in these two dishes came from the broad beans, parsley and, to a lesser extent, spices used in the preparation. Cumin contains 66 mg/100 g of Fe and black pepper contains 28 mg/100 g iron. Broad beans, on the other hand, which constitute the major ingredient in the *foul modammas* and *falafel* dishes (51 and 66%, respectively), contain 1.5 mg Fe/100 g.

Adequate iron in a diet is very important for decreasing the incidence of anemia, which is considered a major health problem in Kuwait, especially in young children. Iron deficiency occurs when the demand for iron is high, e.g., in growth, high menstrual loss, and pregnancy, and the intake is quantitatively inadequate or contains elements that render the iron unavailable for absorption (Lynch & Baynes, 1996). Poor bioavailability is considered to be an important factor leading to iron deficiency in many countries.

The copper (Cu) content of all dishes was relatively low, except for *rahash* (S4) with 1.25 mg/100 g and *falafel* (V6) with 0.5 mg/100 g. The high content of Cu in *rahash* came from sesame seeds which contain 4.08

mg/100 g whereas, in the *falafel,* the copper source could be attributed to broad beans, which have a Cu content of 0.824 mg/100 g, and parsley, which has a Cu content of 0.149 mg/100 g. The copper levels in the rest of the dishes had ranges of 0.03 to 0.1, 0.01 to 0.1, <0.03 to 0.28, 0.12 to 0.16,0.12 to 0.21, <0.03 to 1.25, 0.04 to 0.5 mg/100 g for dairy products, sandwiches, fish dishes, *kuba* dishes, pastries, sweets, and salads, respectively. The soups contained an average of 12.7 mg Cu/100 g.

The zinc (Zn) content was the least (0.13 mg/100 g) in the *fattoosh* (V5), whereas in the *hallomi* cheese (D2), it was the highest (4.16 mg/100 g). Cheese, in general, contains >3 mg Zn/100 g (Randall-Simpson, Gibson, & Donovan, 1995). The Zn content of the fish dishes (F1 to F7) ranged from 0.42 mg/100 g in *khathra* (F4) to 1.45 g in grilled shrimp (F7), with an average of 0.787 mg/100 g. The shrimp dishes, F6 and F7, had the highest Zn levels (1.24 and 1.45 mg/100 g, respectively) among all the fish dishes. The Zn content in shrimp (mixed spices) is 1.11 mg/100 g (USDA, 1998). Of the salads (V1 to V6), *fattoosh* (V5) had the lowest Zn level (0.13 mg/100 g) while *falafel* (V6) had the highest (1.68 mg/100 g). The average Zn content of all salads was 0.89 mg/100 g. The high Zn content in *falafel* came mainly from the broad beans and parsley in the recipe. The Zn contents in broad beans and parsley are 1.01 and 1.07 mg/100 g, respectively (USDA, 1998). The amount of Zn recovered from *hommas* was 1.27 mg/100 g. The relatively high Zn content in *hommas* came mainly from the chickpeas used in the recipe. The Zn content in chickpeas is 1.53 mg/100 g (USDA, 1998). For the sweets, the Zn content in *mahalabia* (S1) was 0.37 mg/100 g, while that in *rahash* (S4) was 3.08 mg/100 g. The Zn content of sesame seeds is high (7.75 mg/100 g, USDA, 1998). The Zn levels in the *kuba* dishes ranged from 0.89 mg/100 g in rice *kuba* (C1) to 1.67 mg/100 g in burgol *kuba* (C2), with an average of 1.21 mg/100 g. The zinc in these dishes is derived mainly from the meat used in the recipes. Chicken and meat sandwiches (SN1 and SN2) contained 0.95 and 2.32 mg/100 g zinc, respectively, with an average of 1.63 mg/100 g. According to Randall-Simpson et al. (1995), the Zn content in meat is >3 mg/100 g. For the pastries, there was a variation in the Zn content from 0.44 mg/100 g in vegetable *sambosak* (P6) to 1.22 in meat pastries (P4), with an average of 0.78 mg/100 g. Since meat contains high amounts of Zn, all the meat-based dishes recorded high amounts of Zn. This is clearly shown in meat *sambosak* and in other dishes such as *kuba* and meat sandwiches. Soups (L1 and L2) recorded the lowest Zn average (0.455 mg/100 g) of all the dishes while dairy products recorded the highest (2.35 mg/100 g). The dairy products, D1 and D2, had Zn contents of 0.54 and 4.16 mg/100 g, respectively.

Zinc is known to be involved in most metabolic pathways in plants, animals and humans (Hambidge et al., 1986). Zinc deficiency can lead to loss of appetite, growth retardation, skin changes and immunological abnormalities (National Research Council, 1989).

The manganese (Mn) content of the dishes studied ranged from 0.1 mg/100 g in *labneh* (D1) to 0.7 in burgol *kuba* (C2). The dairy products recorded the lowest Mn contents (0.01 and 0.03 mg/100 g). The *kuba* dishes, which consist of 32% burgol (C2), had the highest Mn content of 0.7 mg/100 g. The Mn content of burgol is 3.05 mg/100 g. *Rahash* (S4), with about 50% of its content being sesame pulp, recorded 0.67 mg Mn/100 g. The rest of the dishes contained varied amounts of Mn, including fish dishes (0.07 to 0.49 mg Mn/100 g), salads, (0.13 to 0.58 mg Mn/100 g), sweets (0.12 to 0.67 mg Mn/100 g), *kuba* dishes (0.19 to 0.7 mg Mn/100 g) pastries (0.35 to 0.50 mg Mn/100 g) meat sandwiches (0.22 to 0.30 mg Mn/100 g), soups (0.12 to 0.25 mg Mn/100 g), and dairy products (0.01 to 0.03 mg Mn/100 g). The higher amounts found in thyme pastry (P5) (0.58 mg/100 g) came mainly from the sesame seeds and thyme. The Mn contents in sesame seeds and thyme are 2.50 and 7.81 mg/100 g, respectively (USDA, 1998).

Manganese, in general, is found in high amounts in nuts, seeds, tea and whole grains; only miniscule amounts are present in meat and dairy products (Freeland-Graves, Behmardi, Bales, Dougherty, Lin, Crosby, & Trickett, 1988; Freeland-Graves & Turnlund, 1996). This coincides with the results obtained from the study.

Molybdenum, chromium and boron were detected in trace amounts in most of the dishes.

The aluminium (Al) content ranged from <0.03 in the fish dishes, sweets and dairy products to 5.64 in *rahash* (S4). There was variation in the aluminium content within the same group, with levels of <0.03 to 3.35, 0.39 to 3.45, <0.03 to 5.61, 0.59 to 1.28, 1.11 to 3.17, 0.3 to 0.55, and 0.3 to 0.50 mg/100 g being found in the fish dishes (F1-F6), salads (V1 to V6), sweets (S1 to S4), *kuba* dishes (C1 to C3), pastries (P1 to P6), sandwiches (SN1 to SN2), and soups (L1 to L2), respectively. The aluminium content of the dairy products (L1 and L2) was <0.03 mg/100 g. The highest aluminium contents were found in *rahash* (S4), *foul modammas* (V4), *matfee* (F3), and thyme pastry (P5) (5.61, 3.45, 3.35, and 3.17 mg/100 g, respectively).

For selenium, fish dishes recorded the highest content, with a range from 61.2 μg/100 g in grilled shrimp (F7) to 7.4 μg/100 g in *khathra* (F4). In the literature, fish-based foods have the highest selenium contents among all food types, with a selenium content of 226 μg/kg being the average (Amodio-Coccheri et al., 1995). The rest of the dishes analyzed contained varied amounts of selenium: 0.1 to 3.5, 0.5 to 5.2, 2.3 to 3.2, 3.2 to 9.0, 8 to 12.9, 0.7 to 0.51, 5.5 to 12.1 μg/100 mg for salads (V1 to V6), sweets (S1 to S4), *kuba* dishes (C1 to C3), pastries (P1 to P6), sandwiches (SN1 and SN2), soups (L1 and L2) and dairy products (D1 and D2), respectively. The

relatively high selenium contents in cheese *sambosak* (μg/100 mg), *labneh* (5.5 μg/100 mg), and *hallomi* cheese (9 μg/100 mg) were derived mainly from the cheese. The Se content in milk is 35 μg/100 g (Amodio-Coccheri et al., 1995). The high selenium content in *sub-al-gafsha* (S3) of 5.24 μg/100 g was derived from the egg. The Se content in eggs is 58 μg/kg.

Selenium plays a protective role in preventing carcinogenesis and other chronic diseases (Arthur & Becket, 1989; Arthur, Nicol, & Beckett, 1990; Clark, 1985; Clark & Combs, 1986; Combs & Mercurio, 1986; WHO, 1975). There is evidence that Se has an antioxidant role in man (Stadtman, 1990).

The main source of iodine, which is an important element for the thyroid hormones, is iodized salt (76 μg/g salt) (Orville & Whanger, 1996) and milk (49–59 μg/100 g milk) (Pennington, Schoen, Salmon, Young, Johnson, & Marts, 1995). *Hallomi* cheese (D2) had the highest iodine content among all the dishes (0.37 mg/100 g), followed by *motaba*l (V2) with an iodine content of 0.18 mg/100 g. The ranges of iodine for the rest of the dishes were 0.01 to 0.14, 0.01 to 0.18, 0.02 to 0.13, 0.02 to 0.05, and 0.04 to 0.37 for fish dishes (F1 to F7), salads (V1 to V6), *kuba* dishes (C1 to C3), soups (L1 and L2) and dairy products (D1 and D2), respectively. Iodine was below the detection limit in the sweets, pastries and sandwiches.

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