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Fatty acid profile and cholesterol content of 32 selected dishes in the state of Kuwait

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Abstract

Thirty-two Kuwaiti composite dishes were analyzed for their fatty acid and cholesterol contents. The fatty acid profile showed that palmitic and stearic acid were predominant, whereas cis-oleic was the major mono-unsaturated fatty acid. Some dishes contained relatively low levels of trans 18:1 fatty acids. The ratio of poly- to mono-unsaturated and saturated fatty acids (P:M:S) showed that only three dishes were close to the recommended ratio of 1:1:1 with the rest being substantially higher, particularly with respect to the saturated fatty acids. Cholesterol content of the dishes, ranged from traces to 150 mg/100 g. The shrimp dishes contained the highest levels (115-151 mg/100 g), followed by dairy dishes, with an average of 47.4 mg/100 g and sandwiches with 41.4 mg/100 g (on average). The other dishes contained lower amounts of cholesterol.

Keywords: Kuwaiti composite dishes; Fatty acid; Palmitic; Stearic acid; Cholesterol; P:M:S ratio; Shrimp

1. Introduction

During the past 3–4 decades, the increased revenue of the oil-producing countries of the Arabian Gulf countries (Kuwait, Saudi Arabia, United Arab Emirates, Oman, Qatar and Bahrain) has been reflected in their increasing prosperity. The greater abundance of a variety of foods, coupled with the great exposure of the people of these countries to new types of foods, including all known fast foods, has drastically affected the eating habits of native population, their lifestyle and the constituents and methods of the preparation of their commonly-consumed dishes. Nutrition-related diseases, that are known in the West and were almost unknown two decades ago in these countries, have now become a major concern.

Several experimental and epidemiological studies have provided strong and consistent evidence that dietary lipids play an important role in the etiology of degenerative diseases, particularly coronary heart diseases (CHDs), and the importance of reducing fat and cholesterol intake is increasingly emphasized as a step in the prevention of CHDs, (Kris-Etherton et al., 1988; NCEP, 1993; NIH, 1987). Fatty acid composition, including the ratio of polyunsaturated to saturated fatty acids, has an influence on the relationship of dietary fat to cholesterol content (US Senate Select Committee, 1977). Recent studies show that higher levels of polyunsaturated fatty acids (PUFAs) and monounsaturated fatty acids (MUFAs) and lower levels of saturated fatty acids could decrease the negative biological effects of high cholesterol intake (Grundy & Denke, 1990; Hayes, Pronczuk, Lindsey, & Siersen-Shade, 1991; Hegsted, McGandy, Myers, & Stare, 1965; Hopkins, 1992; Keys, Anderson, & Grande, 1965; Khosla & Hayes, 1992; Pyorala, 1987; Rudel, Haines, & Sawyer, 1990).

Information on the nutritive value of commonly consumed dishes is scarce, and before any dietary manipulation or intervention can be implemented, an initial step should be to determine the current sources of fat and other targeted nutrients in habitual eating patterns.

The purpose of this study is to characterize the fats, saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids and cholesterol in 32 most commonly consumed composite dishes in Kuwait. Such data are also critically needed for conducting food

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Table 1
Ingredients of 32 Kuwaiti dishes

Dishes	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

(continued on next page)

Table 1 (*continued*)

Dishes	Major Ingredients (%)
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 025, 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	

consumption surveys and assessment of the nutritional status of the population.

2. Materials and methods

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, Al-Awadhi, Naeemi, Al-Sayegh, Ahmad, and Khalafawi, (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 *labenah, 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 analysis were done in duplicate. 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 those 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* dishes (C1–C3), and two dairy products (D1–D2). All dishes were prepared in triplicate.

2.2. Sample preparation

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

2.3. Cholesterol and fatty acids analysis

Cholesterol was determined quantitatively by gas–liquid chromatography (GLC) according to AOAC (1990) (976.26 and 974.26) using cholestane (Aldrich,

Table 2
Fatty acid composition of Kuwaiti dishes (Saturated Fatty Acids)

Code	<14.0	14.0	15.0	16.0	17.0	18.0	20.0	21.0	22.0	23.0	24.0	Sum
F1	ND	0.118	N.D.	0.991	ND	0.212	ND	ND	ND	ND	0.067	1.39
F2	ND	N.D.	N.D.	0.686	ND	0.197	ND	ND	ND	ND	ND	0.883
F3	ND	0.210	0.028	1.69	0.041	0.486	ND	ND	ND	ND	0.069	2.53
F4	ND	0.036	0.006	0.294	0.017	0.078	ND	ND	ND	ND	0.013	0.444
F5	ND	0.044	0.014	1.24	0.014	0.212	0.016	ND	0.032	ND	0.033	1.60
F6	ND	0.013	N.D.	1.82	0.019	0.470	0.089	ND	0.006	ND	0.025	2.44
F7	ND	0.006	0.006	0.279	0.003	0.108	0.011	ND	0.019	ND	0.099	0.531
V1	0.005	ND	ND	0.305	ND	0.108	ND	0.010	0.014	ND	ND	0.442
V2	ND	ND	ND	0.813	ND	0.469	0.055	ND	0.006	ND	0.007	1.35
V3	ND	ND	ND	0.282	ND	0.153	0.021	ND	0.016	0.009	0.003	0.484
V4	ND	ND	ND	0.322	ND	0.131	0.030	ND	N.D.	ND	0.009	0.492
V5	ND	ND	ND	0.413	ND	0.084	0.030	ND	0.015	ND	ND	0.542
V6	ND	ND	ND	0.841	ND	0.166	0.040	ND	N.D.	ND	ND	1.05
S1	0.129	0.226	0.028	0.625	ND	0.233	ND	ND	0.019	ND	ND	1.26
S2	0.013	0.064	ND	3.00	0.013	0.477	0.057	ND	ND	0.013	0.019	3.65
S3	ND	ND	ND	1.38	ND	0.440	ND	ND	ND	ND	ND	1.82
S4	ND	ND	ND	2.43	ND	1.77	ND	ND	ND	ND	ND	4.20
C1	ND	0.062	0.016	1.35	0.047	0.023	0.039	ND	ND	ND	ND	1.54
C2	ND	0.285	ND	3.75	0.154	N.D.	0.131	ND	ND	ND	ND	4.32
C3	ND	0.099	0.016	1.28	0.032	0.024	0.032	ND	ND	ND	ND	1.48
P1	ND	ND	ND	0.869	ND	ND	ND	ND	0.092	ND	ND	0.961
P2	ND	0.215	ND	1.42	ND	ND	ND	ND	0.155	ND	ND	1.79
P3	0.114	0.342	0.041	3.39	0.049	ND	0.114	0.041	ND	ND	ND	4.09
P4	ND	0.122	0.032	2.95	0.090	ND	0.077	0.032	ND	ND	ND	3.30
P5	ND	0.051	ND	1.46	ND	ND	0.080	ND	ND	0.051	0.029	1.67
P6	ND	0.026	ND	2.27	ND	ND	ND	0.045	ND	ND	ND	2.34
SN1	ND	0.014	0.005	0.780	0.151	ND	ND	ND	ND	ND	ND	0.950
SN2	ND	0.038	0.017	0.817	0.059	0.017	ND	0.007	ND	ND	ND	0.955
L1	ND	ND	ND	0.149	ND	ND	ND	ND	ND	ND	ND	0.149
L2	ND	ND	ND	0.019	ND	ND	0.010	ND	ND	ND	0.005	0.034
D1	0.998	1.12	0.138	2.69	0.073	ND	ND	ND	ND	0.473	ND	5.49
D2	1.96	2.55	0.281	6.79	0.177	ND	ND	ND	ND	ND	ND	11.8

All data are given in g/100 g edible portion. ND: not detected.

USA) as internal standard. The limit of detection was 0.5 μg/g.

The fatty acids were analysed by GLC as their methyl esters according to Aziz and Abu-Dagga (1991).

3. Results and discussion

3.1. Fatty acid composition

Results of the fatty acid composition of the dishes are presented in Tables 2–6. For the SFAs (Table 2), the most abundant in the dishes investigated were palmitic acid (C16:0) and stearic acid (C:18). Palmitic acid is one of the major SFAs; it raises serum cholesterol while stearic acid does not (Grundy, 1997). Dairy products (D1 and D2) had the highest contents of SFAs among all dishes studied. Milk, which is the major constituent of these dishes, is characterized by relatively high proportions of short and medium fatty acid chains (Chapman & Hall, 1992). These were reflected in the results of the SFA composition of all dairy dishes studied (S1, *mahalabia*; P3, cheese pastry; D1, *labneh*; and D2, *halloumi* cheese), with the major source of fatty acids being in C16 and less.

The other dishes contained varied amounts of SFAs, depending on the major fat sources of each recipe. For example, palmitic acid is the predominant SFA in all dishes. According to the literature, palmitic acid is found in greater quantities than any other SFA in eggs, meat fat, and sesame seeds (2.2, 4.7, 4.3 g/100, respectively; USDA, 1998), which are the fat sources in many dishes studied, i.e. sandwiches (SN1 and SN2), *sub-a-gafsha* (S3), *burgol kuba* (C2) and *rahash* (S4).

For the fish dishes, palmitic acid was also the major SFA, whereas the second most abundant SFA was stearic acid. These results are consistent with other studies on fish found in the literature. In the shrimp dishes, the concentrations of palmitic acid in both shrimp panéé and grilled shrimp (F6 and F7) were 1.816 and 0.279 g/100 g, respectively, and the corresponding concentrations of stearic acid were 0.47and 0.108 g/100 g,

Table 3
Monounsaturated fatty acids (MUFA)

Code	14.1	16.1	17.1	18.1		20.1	22.1	24.1	Sum
				T	C				
F1	ND	0.260	ND	ND	0.974	ND	ND	ND	1.234
F2	ND	0.045	ND	ND	1.24	ND	ND	ND	1.287
F3	ND	0.132	0.013	ND	1.70	0.097	0.053	ND	1.995
F4	ND	0.021	ND	ND	0.323	0.027	ND	ND	0.371
F5	ND	0.061	ND	ND	1.36	0.026	ND	ND	1.444
F6	ND	0.064	ND	ND	4.53	0.140	0.038	ND	4.776
F7	ND	0.041	0.008	ND	0.590	0.028	ND	ND	0.667
V1	ND	0.017	ND	ND	1.95	ND	ND	ND	1.963
V2	ND	0.026	ND	ND	4.18	0.019	ND	ND	4.220
V3	ND	0.009	ND	ND	1.46	0.009	ND	ND	1.479
V4	ND	0.012	ND	ND	1.77	0.012	ND	ND	1.790
V5	ND	0.012	ND	ND	0.774	ND	ND	ND	0.786
V6	ND	ND	ND	ND	2.11	0.020	ND	ND	2.134
S1	0.016	0.044	ND	ND	0.062	ND	ND	ND	0.122
S2	ND	0.019	ND	ND	4.04	0.025	ND	ND	4.083
S3	ND	0.039	ND	ND	3.33	0.058	ND	ND	3.426
S4	ND	0.030	ND	ND	9.64	0.118	ND	ND	9.789
C1	ND	0.054	0.023	ND	2.88	0.070	ND	ND	3.030
C2	ND	0.337	ND	0.285	5.10	ND	ND	0.094	5.816
C3	0.024	0.130	0.024	ND	2.87	0.047	ND	ND	3.099
P1	ND	ND	ND	ND	1.49	ND	ND	ND	1.490
P2	ND	ND	ND	ND	2.10	ND	ND	ND	2.100
P3	ND	0.082	ND	ND	6.03	0.057	ND	ND	6.164
P4	ND	0.103	ND	ND	5.79	0.045	ND	ND	5.936
P5	ND	0.051	ND	ND	5.69	0.051	ND	ND	5.791
P6	ND	ND	ND	ND	4.31	0.090	ND	ND	4.402
SN1	ND	ND	ND	ND	1.34	0.028	ND	ND	1.366
SN2	ND	0.049	0.017	0.118	1.37	ND	ND	ND	1.554
L1	ND	0.010	ND	ND	0.269	0.007	ND	ND	0.286
L2	ND	0.002	ND	ND	0.450	0.005	ND	ND	0.457
D1	0.092	0.173	ND	0.227	1.62	ND	ND	ND	2.112
D2	0.239	0.514	ND	0.348	4.00	ND	ND	ND	5.102

All data are given in per 100 g edible portion. ND: not detected.

respectively. This variation in these similar dishes is due to the frying oil (corn oil) and egg used in the shrimp panéé (F6), which contributed to the higher concentration of palmitic and stearic acids. The amounts of palmitic and stearic acid in corn oil are 10 and 1.8 g/100 g, respectively (USDA, 1998). Of the salads, *mutabal* (V2) had the highest palmitic acid content (16:0). This was due to the olive oil and sesame oil of the *tahina* used in this recipe (C16 in olive oil = 11 g/100 g).

The health impacts of SFAs lie in the fact that some SFAs raise cholesterol levels, which is a major risk factor in CHD (Grundy, 1997). These include lauric (12:0), myristic (14.0) and palmitic (16:0) acids (Denke & Grundy, 1992; Zock, de Vries, & Katan, 1994). These three SFAs make up about two-thirds of the SFAs in the American diet. In the Kuwaiti dishes studied here, these three cholesterol-raising fatty acids contribute from 55 to 98% of the total SFAs. These percentages are highest in dairy dishes (D1 and D2), pastries (P1–P6) and fried *kubas* (C1 and C2).

3.2. Monounsaturated fatty acids

For the MUFAs (Table 3), the predominate MUFA was cis oleic acid (C18:1). The highest concentration of C18:1 was found in *rahash* (S4) (9.64 g/100 g). This is due to the high content of C18:1 in sesame seeds used in *rahash* as *tehina* (C18:1 in sesame seed = 17.9 g/100 g).

Other dishes high in C18:1 were mostly fried dishes, for example shrimp panéé (F6), legemat (S2), *sub-al-gafash* (S3), *burgol kuba* (C2) cheese pastry (P3), and meat pastry (P4) with C18:1 contents of 4.53, 4.039, 3.32, 5.1, 6.025, 5.78 g/100 g, respectively. The major sources of C18:1 in these dishes were the frying oil, which was corn oil (C18:1 in corn oil = 24.2 g/100 g), and meat fat, egg and cheese. Recipes high in olive oil also recorded high C18:1 contents, such as *motabal* (V2) = 4.18 mg/100 g, and thyme pastry (P5) = 5.69 mg/100 g. Olive oil is characterized by a high percentage of MUFA (C18:1 in olive oil is 72 g/100 g). MUFAs, which are found in olive oil, can lower serum LDL

Table 4
Polyunsaturated fatty acids (PUFA)

Code	18.02		18.03	20.02	20.03	20.04	20.5	22.06	Sum
	T	C							
F1	ND	1.24	ND	ND	ND	ND	ND	0.043	1.28
F2	ND	1.66	ND	ND	ND	ND	ND	ND	1.66
F3	0.019	1.87	0.104	ND	0.028	0.050	ND	0.166	2.24
F4	ND	0.246	0.015	ND	ND	ND	ND	0.011	0.272
F5	ND	0.282	ND	ND	ND	0.049	ND	0.063	0.394
F6	ND	7.68	ND	ND	ND	ND	ND	0.025	7.70
F7	ND	1.08	0.019	ND	ND	0.055	ND	0.094	1.24
V1	ND	0.29	0.065	ND	ND	0.007	ND	ND	0.347
V2	ND	2.49	0.038	ND	ND	ND	ND	ND	2.52
V3	ND	0.873	0.015	ND	ND	ND	ND	0.021	0.909
V4	ND	0.048	ND	ND	ND	ND	ND	0.014	0.062
V5	ND	0.157	ND	ND	ND	ND	ND	ND	0.157
V6	ND	4.28	0.060	ND	ND	ND	ND	ND	4.34
S1	ND	0.082	ND	ND	ND	ND	ND	ND	0.082
S2	ND	2.50	0.045	ND	ND	ND	ND	ND	2.55
S3	ND	6.32	0.149	ND	ND	ND	ND	ND	6.46
S4	ND	9.74	0.148	ND	ND	ND	ND	ND	9.89
C1	ND	3.95	ND	ND	ND	ND	0.019	ND	3.97
C2	ND	0.271	ND	ND	ND	ND	ND	ND	0.271
C3	ND	3.26	ND	ND	ND	ND	ND	ND	3.26
P1	ND	3.00	ND	0.092	ND	ND	ND	ND	3.09
P2	ND	3.40	ND	0.155	ND	ND	ND	ND	3.56
P3	ND	8.93	0.139	ND	ND	ND	0.057	ND	9.12
P4	ND	6.43	0.103	ND	ND	ND	0.032	ND	6.57
P5	ND	4.10	0.088	ND	ND	ND	ND	ND	4.19
P6	ND	6.87	0.051	ND	ND	ND	ND	ND	6.92
SN1	ND	1.29	ND	ND	ND	ND	ND	ND	1.29
SN2	ND	0.122	0.017	ND	ND	0.017	ND	ND	0.156
L1	ND	0.379	0.005	ND	ND	ND	0.007	ND	0.391
L2	ND	0.790	0.029	ND	ND	ND	ND	ND	0.819
D1	ND	0.189	ND	ND	ND	ND	ND	0.119	0.308
D2	ND	0.577	ND	ND	ND	ND	ND	ND	0.577

All data are given in per 100 g edible portion. ND: not detected.

cholesterol and can play a protective role in many CVDs. The other dishes contained varied amounts of C18:1.

Trans C18:1 was only detected in the *burgul kuba* dish (C2), meat sandwiches (SN2), *labneh* (D1) and *hallomi* cheese (D2), with C18:1 contents of 0.285, 0.118, 0.227, and 0.348 g/100 g, respectively. Trans fatty acids (TFAs) are formed during partial hydrogenation of vegetable oil, but they do occur naturally in small amounts in dairy products, milk, and the animal fat of ruminant animals. TFAs cause adverse effects of raising LDL levels and lowering HDL levels. The health effects of TFAs have been extensively reviewed by many researchers (Clement, 1997; Kris-Etherton, 1995; Senti, 1985).

For the long-chain MUFAs, such as C20:1, C22:1, and C24:1, only small amounts were found.

3.3. Polyunsaturated fatty acid

The predominant PUFA (Table 4), in all dishes, was cis linoleic acid (C18:2). Linoleic acid is considered one of the main omega-6 PUFAs, which occur particularly in vegetable oil (Newton, 1997). This was reflected in the fried dishes' PUFA compositions. Fried dishes and *rahash* had the highest PUFA contents. Sesame seeds, which are a major raw ingredient in *rahash*, contain 38–50% of omega-6 linoleic acid. Fish dishes were characterized by Omega-3 PUFAs (C22.06) and (C18.03). Omega-3 PUFAs have a hypocholesteremic effect and are found in the fat of oily fish and green leafy vegetables. This is clearly shown in the vegetable and fish dishes. The health effect of omega-3 PUFAs is mainly in inhibiting the atherosclerotic process and coronary thrombosis (Connor & Connor, 1997). Most nutritionists agree on the need to increase the intake of n-3 fatty acids as a preventive measure for coronary disease. This could be achieved by increasing fish consumption or by substituting fish for meat.

The fatty acid composition of the Kuwaiti dishes studied becomes more meaningful when the ratio of saturated, polyunsaturated and monounsaturated fats is

Table 5
Sum of fatty acids in Kuwaiti dishes

Code	Sum SFA	Sum MUFA	Sum PUFA	SFA/PUFA	MUFA/PUFA	PUFA/SFA
F1	1.39	1.23	1.28	1.08	0.964	0.922
F2	0.883	1.29	1.66	0.531	0.774	1.88
F3	2.53	2.00	2.24	1.13	0.892	0.886
F4	0.444	0.371	0.272	1.63	1.36	0.613
F5	1.60	1.44	0.394	4.07	3.665	0.246
F6	2.44	4.78	7.70	0.317	0.620	3.16
F7	0.531	0.667	1.24	0.427	0.536	2.34
V1	0.442	1.96	0.347	1.27	5.66	0.785
V2	1.35	4.2	2.52	0.535	1.67	1.87
V3	0.484	1.48	0.909	0.532	1.63	1.88
V4	0.492	1.79	0.062	7.94	28.9	0.126
V5	0.542	0.79	0.157	3.45	5.01	0.290
V6	1.05	2.13	4.34	0.241	0.491	4.15
S1	1.26	0.12	0.082	15.4	1.49	0.065
S2	3.65	4.08	2.55	1.44	1.60	0.697
S3	1.82	3.43	6.46	0.282	0.530	3.55
S4	4.20	9.79	9.89	0.425	0.990	2.35
C1	1.54	3.03	3.97	0.387	0.763	2.58
C2	4.32	5.82	0.271	15.9	21.5	0.063
C3	1.48	3.10	3.26	0.455	0.952	2.20
P1	0.961	1.49	3.09	0.311	0.482	3.22
P2	1.79	2.10	3.56	0.504	0.591	1.99
P3	4.09	6.16	9.12	0.449	0.676	2.23
P4	3.30	5.94	6.57	0.503	0.904	1.99
P5	1.67	5.79	4.19	0.399	1.38	2.51
P6	2.34	4.40	6.92	0.339	0.636	2.95
SN1	0.950	1.37	1.29	0.736	1.06	1.36
SN2	0.955	1.55	0.156	6.12	9.96	0.163
L1	0.149	0.286	0.391	0.381	0.731	2.62
L2	0.034	0.457	0.819	0.042	0.558	24.01
D1	5.49	2.11	0.308	17.8	6.86	0.056
D2	11.8	5.10	0.577	20.34	8.84	0.049

All data are given in g per 100 g edible portion. SFA, saturated fatty acid; MUFA, monounsaturated fatty acid, PUFA, polyunsaturated fatty acid.

calculated. Table 5 and 6 present the different ratios of the fatty acids.

Many nutritional associations recommend a ratio of 1:1 for PUFA:SFA. According to the PUFA:SFA ratios of the Kuwaiti dishes, only three are close to this ratio (F1, fish *saneya*; F3, *matfee*; V1, *tabola*) while four dishes had ratios lower than 0.1 (D2, *hallomi* cheese; D1, *labneh*; C2, *burgol koba*; and S1, *mahalabia*). This could be mainly due to the lamb fat and milk fat found in the recipes. The highest ratio was found in lentil soup, L2 (24.08), which is considered a very low fat dish. Six dishes had a PUFA ratio of less than 1, and five dishes were between 1 and 2. The remaining dishes (12 dishes) had ratio of above 2. It is highly recommended, health-wise, to reduce the cholesterol-raising fatty acids (i.e. the SFAs lauric acid, myristic acid and palmitic acid). This can be achieved by reducing the intake of animal fat (milk and meat fat).

For the PUFA:SFA:MUFA, the US Senate Select Committee (1977) recommended a ratio of 1:1:1. Most of the dishes investigated here had an unbalanced ratio in respect to PUFA:SFA:MUFA. Only three dishes were close to the recommended ratio. These dishes were fish *saneya* (F1), *matfee* (F3) and *tabola* (V1).

The quality and quantity of fat are very critical in terms of CVDs. The American Heart Association recommended, for general health, that fat intake be limited to 30% of total energy, with an intake of MUFA of 15–16% of total energy. The contribution of SFAs and PUFAs to the diet is recommended to be 7–8% of the total energy. This will change the ratio for MUFA:PUFA from 1:1 to 3:1. This range appears, for most people, to be healthy (Grundy, 1997).

Only three dishes are approximately close to the 3:1 ratio. These dishes are fish *kofta* (F2), *hommas* (V3), and *legemat* (S2). The recommended decrease in PUFAs in favor of MUFAs is due to the potential harmful effect of a high intake of PUFA (Abbey, Belling, Noakes, Hirata, & Nestel, 1993; Carroll & Khor, 1971; Grundy, 1997; Keys, 1970; Parthasarathy, Khoo, Miller, Barnett, Witztum, & Steinberg, 1990; Reddy, 1986; Weyman, Berlin, Smith, & Thompson, 1975).

Table 6
Fatty acid ratios of Kuwaiti dishes

Code	SFA Total	MUFA Total	PUFA Total	SFA:MUFA:PUFA	PUFA:SFA
F1	1.39	1.23	1.28	1.08:1.14:1	0.922
F2	0.883	1.29	1.66	0.531:2.42:1	1.88
F3	2.55	2.00	2.24	1.14:1.75:1	0.876
F4	0.444	0.371	0.272	1.63:0.227:1	0.613
F5	1.60	1.44	0.394	4.07:0.355:1	0.246
F6	2.44	4.78	7.70	0.317:15.1:1	3.16
F7	0.531	0.667	1.24	0.427:1.56:1	2.34
V1	0.442	1.96	0.347	1.27:1.54:1	0.785
V2	1.35	4.22	2.52	0.535:7.89:1	1.87
V3	0.484	1.48	0.909	0.532:2.78:1	1.88
V4	0.492	1.79	0.062	7.94:0.226:1	0.126
V5	0.542	0.786	0.157	3.45:0.228:1	0.290
V6	1.05	2.13	4.34	0.241:8.85:1	4.15
S1	1.26	0.122	0.082	15.4:0.008:1	0.065
S2	3.65	4.08	2.55	1.44:2.85:1	0.697
S3	1.82	3.43	6.46	0.282:12.2:1	3.55
S4	4.20	9.79	9.89	0.425:23.0:1	2.35
C1	1.54	3.03	3.97	0.387:7.82:1	2.58
C2	4.32	5.82	0.271	15.9:0.365:1	0.063
C3	1.48	3.10	3.26	0.455:6.82:1	2.20
P1	0.961	1.49	3.09	0.311:4.79:1	3.22
P2	1.79	2.10	3.56	0.504:4.17:1	1.99
P3	4.09	6.16	9.12	0.449:13.7:1	2.23
P4	3.30	5.94	6.57	0.503:11.8:1	1.99
P5	1.67	5.79	4.19	0.399:14.5:1	2.51
P6	2.34	4.40	6.92	0.399:13.0:1	2.95
SN1	0.950	1.37	1.29	0.736:1.86:1	1.36
SN2	0.955	1.55	0.156	6.12:0.254:1	0.163
L1	0.14	0.286	0.391	0.381:0.751:1	2.62
L2	0.034	0.457	0.819	0.042:11.0:1	24.1
D1	5.494	2.11	0.308	17.8:0.118:1	0.056
D2	11.8	5.10	0.577	20.4:0.251:1	0.049

All data are given in grams per 100 g edible portion. SFA, saturated fatty acid; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid.

3.4. Cholesterol content

The cholesterol contents are presented in Table 7. The highest cholesterol content was found in the shrimp dishes, F6 and F7 (115 and 150.1 mg/100 g, respectively). The cholesterol came mainly from shrimp, the major ingredient in the two dishes, and the egg used for coating in the shrimp panéé (F6). The cholesterol contents of shrimp and eggs are 152 and 425 mg/100 g, respectively (USDA, 1998). No cholesterol was detected in the vegetable-based dishes, except in *fattoosh* (V5) and *falafel* (V6) (1.79 and 3.573 mg/100 g, respectively). The small amount of cholesterol found in *fattoosh* could be attributed to the milk used in the bread recipes.

In general, fish dishes recorded the highest cholesterol contents among all dishes, ranging from 2.73 in *khathra* (F4) to 151 mg/100 g in grilled shrimp (F7), and an average of 92.4 mg/100 g for all the fish dishes. This variation is due to the amounts of major ingredients in each recipe. Dairy dishes (D1 and D2) were also high in cholesterol, ranging from 37.1 to 57.7 mg/100 g, respectively. The high cholesterol content is derived from the whole milk and during the processing of cheese and *labneh*.

For the sandwich dishes (SN1 and SN2), the average cholesterol content was 41.4 mg/100 g. The major source of cholesterol in these dishes is derived from the animal fat found in the chicken and lamb meat used in the recipes. The remaining of the dishes, *kuba* (C1 to C3), pastries (P1 to P6) and sweets (S1 to S4), contained varied amounts of cholesterol (4.7–8.8, 4.68–14.5, 1.72–18.78 mg/100 g, respectively). The main sources of cholesterol in these dishes are mainly the milk, egg and meat used in the recipes.

4. Conclusion

A high dietary fat intake, coupled with low fat quality, can raise serum cholesterol and negatively affect several CHD risk markers (Sandstorm, 1993). Since most of the commonly consumed dishes investigated

Table 7
Cholesterol content of the Kuwaiti dishes

Sample	Cholesterol Content (mg/100 g)
F1	45.9
F2	63.0
F3	32.9
F4	2.73
F5	96.0
F6	116
F7	151
V1	ND
V2	ND
V3	ND
V4	ND
V5	1.79
V6	3.57
S1	5.14
S2	1.72
S3	18.8
S4	ND
C1	8.70
C2	8.81
C3	4.79
P1	8.29
P2	8.62
P3	5.71
P4	14.45
P5	14.1
P6	4.68
SN1	21.9
SN2	60.9
L1	1.01
L2	ND
D1	37.1
D2	57.7

ND, not detected.

have a low PUFA:SFA ratio and unbalanced ratios of SFA:MUPA:PUFA, there is a need for dietary manipulation as one of the approaches for balancing the quality of fat in the diet. These may include modification of fat composition towards higher PUFA:SFA, by partial substitution of animal fats with vegetable fats, particularly those rich in both PUFA and MUFA, such as olive oil and canola oil. There is also a need for generation of data on food consumption and nutrient intake by the Kuwaiti population, including quantities of fat consumed by different age groups, to be able to study the relationship between the nutritional factors and etiology of CVDs and other nutrition-related diseases.

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