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Nutritional Profile of Bakery Products Consumed in Bahrain

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Abstract: Proximate, mineral, sterol and fatty acid composition of nine local bakery items consumed in Bahrain was determined. Protein levels ranged from 5.63-14.81%w/w while the carbohydrate content ranged from 26.81-55.88%w/w. The fat content was in the range of 6.36-14.59%w/w and most of the foods had moderate energy values ranging from 193.28-388.59Kcal/100g. The sodium (2281.0-6243.4ppm) and potassium (1426.9-2824.7ppm) levels were quite high while the rest of the minerals including iron and zinc were low. Cholesterol levels were low in most of the foods and addition of dairy products increased the cholesterol levels (range from <1.00-88.54mg/100g). β-sitosterol was also present in the range of <1.00-26.70mg/100g while lower amount of campesterol and stigmasterol was seen. Palmitic acid was dominant in most of the foods (29.3-34.0mg/100g) as was oleic acid (7.8-41.0mg/100g) while linoleic and stearic acid were present to a lesser extent.

Key words: Bakery, proximate composition, mineral composition, sterols, fatty acids

Introduction

Bakery products are an important part of a balanced diet and today, a wide variety of such products can be found on the supermarket shelves (Smith *et al*., 2004). However consumption of bakery foods has also been associated with increased consumption of trans fatty acids (Pedersen *et al*., 1998). Furthermore, higher consumption of bakery products is associated with higher intake of energy, saturated fats and sugars (Rodriguez-Artalejo *et al*., 2003). In fact, bakery products, confectionery and snacks were a major source of trans fatty acids in maternal diet in Poland (Mojska *et al*., 2003). Several studies in both industrialized and developing countries showed that bakery products were highly consumed by children and adults, and provided a considerable portion of energy intake (Vanelli *et al*., 2005; Bartrina *et al*., 2004; McMahon *et al*., 1993; Park and Yetley 1993; Barber *et al*., 1986; Agte *et al*., 2002). Another cause of concern is that, although bakery products are important ready-to-eat processed foods, the nutritional quality of these products is low because of the inferior nutritional composition of wheat grain per se which is further accentuated with the use of refined flours in their preparations (Chavan and Kadam, 1993). Although researchers in the Arabian Gulf have investigated many commonly consumed foods in this region (Al-Jedah and Robinson, 2000; Musaiger *et al*., 1998; Al-Khalifa and Al-Othman, 1999; Rasha *et al*., 2002), very little work has been done on bakery foods. Al-Khalifah (1993) found that fatayer ma, laham a take away bakery food in Saudi Arabia had high levels of carbohydrates while another bakery food fatayer ma, jibn was high in calcium. Hassan *et al*. (1991) found that the local Kuwaiti bakery foods tested provided adequate amount of major nutrients.

The purpose of this study, therefore, was to ascertain the chemical composition of the regularly consumed bakery foods in Bahrain. This would offer an insight into the nutritional profile of these foods and also provide important data to the already existing food composition tables.

Materials and Methods

Selection and preparation of foods: Three main bakeries in Manama city, the capital of Bahrain, were the target for this study. Foods were purchased from these bakeries and similar types of foods were pooled into one sample. Samples were thoroughly mixed to give a single large representative bulk sample; mixing was done by a high powered Buchi Mixer B-400. All prepared samples were rapidly transferred to dry clean plastic containers with well fitting closures and labeled and stored in freezers. Common and local names as well as the main ingredients of the foods analyzed are presented in Table 1.

Proximate composition: Proximate composition was determined by measuring the moisture, ash, fat, protein (Nx6.25), crude fiber and carbohydrate (by difference) in duplicate by the standard procedure of AOAC (2000). The energy evaluation was done by multiplying the protein, fat and carbohydrate by the factors 4, 9 and 4 respectively.

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Table 1: Local names, common names and main ingredients used in the bakery products consumed in Bahrain

Local name	Code	Common name	No. of pooled samples	Main ingredients
Baidh ma jebin	CEB	Cheese and egg bakery	3	Cheese, egg, bread
Moajanat biljebin	CB	Cheese bakery	3	Cheese bread
Moajanat lebanah	CYB	Condensed yoghurt bakery	3	Condensed yoghurt, bread
Moajanat mehiawa	FS	Fish sauce bakery	3	Fish sauce, spices, bread
Moajanat sapanekh	SP	Spanish bakery	3	Spinach, spices, bread
Moajanat sapanekh ma lebanah	SPY	Spanish with condensed yoghurt	3	Condensed yogurt, spinach, bread
Moajanat spanekh ma laham	SMB	Spanish with meat bakery	3	Beef, spinach, bread
Moajanat zatar	TB	Thymes bakery	3	Thyme seeds, spices, bread
Moajanat zatar biljebin	TCB	Thymes with cheese bakery	3	Thyme seeds, spices, cheese, bread

Table 2: Proximate composition of bakery products consumed in Bahrain (%w/w)

Proximate Comp.	CEB	CB	CYB	FS	SP	SPY	SMB	TB	TCB
Water	38.97	32.16	43.52	29.47	49.80	54.20	55.36	18.76	32.13
Protein	14.38	14.81	7.25	8.56	6.88	5.63	7.56	8.44	13.94
Fat	10.74	9.89	10.60	6.36	6.98	7.23	6.20	14.59	10.26
Ash	1.79	1.95	1.02	1.86	1.38	1.38	1.50	1.36	2.05
Fiber	2.24	1.28	2.59	1.81	2.39	2.15	2.57	0.97	1.17
Carb.	31.88	39.91	35.02	51.94	32.57	29.41	26.81	55.88	40.45
Energy									
Kcal/100g	281.7	307.9	264.5	299.2	220.6	205.2	193.3	388.6	309.9
KJ/100g	1178.6	1288.2	1106.6	1251.9	923.1	858.7	808.7	1207.5	1296.6

Carb: Carbohydrate

Mineral composition: The samples were processed by microwave digestion technique and mineral concentrations were determined by using either electro thermal or flame atomic absorption spectrophotometer. The elements Ca, Mg, Na, Fe, Zn, Cu, and Mn were measured using the flame system (Air Acetylene Flame). Pyrolytically coated graphite tubes in an inert atmosphere or Argon were used in the furnace (AOAC, 2000).

Fatty acid and sterol analysis: Fatty acids were analyzed by gas liquid chromatography (GLC) as their methyl esters as per IUPAC (2000). For extraction of fat from samples, an extraction mixture of chloroform and methanol (2:1) were used (AOAC, 2000). Sterols in the extracted fat were determined quantitatively by GLC (Packard 439 GC) according to the modified procedure outlined in IUPAC (2000).

Results

Proximate composition: The proximate composition of local bakery items consumed in Bahrain is given in Table 2. The moisture content was the highest in moajanat spanekh ma laham (55.36%w/w) and the least in moajanat zatar (18.76%w/w). In fact, the moisture content in all the three foods composed of sapanekh was high with little variation between them (5.56%w/w). As expected the protein content was the highest in foods containing cheese, (14.81%w/w) and the lowest in moajanat sapanekh ma lebanah (5.63%w/w). The fat content varied between 6.36-14.59%w/w the highest was in moajanat zatar and the lowest in moajanat mehiawa. The ash content did not vary to a great extent between all the foods tested. Fiber content ranged between 0.97-2.59%w/w the least was in moajanat zatar and the highest in moajanat lebanah. The energy values ranged between 193.30-388.60Kcal/100g, with moajanat zatar having the highest energy values and moajanat spanekh ma laham having the lowest energy values.

Mineral composition: The mineral composition of local bakery items consumed in Bahrain is given in Table 3. On the whole all the foods were high in their sodium content and a wide variation was seen ranging from 2281.0-6243.4ppm, the highest was in moajanat zatar biljebin and the least in moajanat sapanekh ma lebanah. The potassium levels did not vary much in all the foods tested with most of the foods leaning towards the lower values of potassium as seen in baidh ma jebin (1426.9ppm), while the highest (2824.7ppm) was seen in moajanat zatar biljebin. Moajanat zatar had the highest levels of five minerals namely calcium, magnesium, iron, copper and manganese their values being 1694.0, 484.0, 35.27, 11.72, and 12.41ppm respectively. Moajanat spanekh ma laham had the least calcium and iron (254.4 and 3.58 ppm of calcium and iron respectively) while moajanat sapanekh ma lebanah had the lowest levels of magnesium and copper (200.0 and 3.44ppm of magnesium and copper respectively). Zinc was high in moajanat biljebin (13.16ppm of zinc) compared to other bakery products tested.

Sterol composition: The sterol composition of the bakery items consumed in Bahrain is given in Table 4. As expected the highest levels of cholesterol was in

Table 3: Mineral composition of bakery products consumed in Bahrain (ppm)

Code	Na	K	Ca	Mg	Fe	Cu	Zn	Mn
CEB	4248.9	1426.9	488.2	297.83	8.67	5.67	11.28	3.20
CB	3313.0	1795.0	1620.0	206.0	9.08	5.18	13.16	4.76
CYB	3725.9	1593.3	512.3	223.1	8.84	4.30	7.42	3.14
FS	4456.7	1935.3	528.3	306.1	11.24	5.56	9.27	4.15
SP	3205.8	1634.5	406.1	228.4	8.50	4.95	7.56	2.67
SPY	2281.0	1580.0	1125.0	200.0	7.44	3.44	5.39	3.11
SMB	4089.5	1847.2	254.4	241.9	3.58	4.46	7.72	0.32
TB	2954.0	1821.0	464.0	484.0	35.27	11.72	7.43	12.41
TCB	6243.4	2824.7	1694.0	376.7	5.44	9.10	12.12	0.51

Table 4: Sterol composition of bakery products consumed in Bahrain (mg/100g)

Code	Cholesterol	Campesterol	Stigmasterol	β-Sitosterol
CEB	88.54	7.89	<0.50	22.00
CB	19.84	3.39	<0.50	13.85
CYB	14.87	<1.00	<0.50	8.37
FS	3.71	4.27	<0.50	18.01
SP	<1.00	3.04	<0.50	20.21
SPY	9.16	2.19	<0.50	13.23
SMB	4.27	<1.00	<0.50	5.91
TB	<1.00	5.43	<0.50	26.70
TCB	3.59	<1.00	<0.50	<1.00

baidh ma jebin (88.54mg/100g) while the least was in moajanat zatar and moajanat sapanekh (<1.00ppm). The other major sterol was β-sitosterol ranging from <1.00-26.70 mg/100g between moajanat zatar biljebin and moajanat zatar. Campesterol was low in many foods with values of <1.00 mg/100g in three foods (moajanat lebanah, moajanat spanekh ma laham and moajanat zatar biljebin) while the highest was in baidh ma jebin. Stigmasterol was low in all the foods analyzed (<0.50 mg/100g).

Fatty acid profile: The fatty acid profile of the bakery items consumed in Bahrain is given in Table 5. The most prominent fatty acids were oleic, linoleic and palmitic acids while stearic acid was present to a lesser extent. The highest amount of oleic acid was seen in moajanat mehiawa (41.0 mg/100g) while the least was in moajanat biljebin (7.8 mg/100g). The levels of palmitic acid varied between 34.0 to 29.3 mg/100g, the highest was in moajanat lebanah and the least in moajanat spanekh ma laham. Linoleic acid was predominant in moajanat sapanekh (22.5 mg/100g) while the least was in moajanat biljebin (0.5 mg/100g). In general, stearic acid was low in most of the foods analyzed (<0.5 mg/100g).

Discussion

Water plays a key role in the stability of food and when the local bakery items were analyzed all the sapanekh based foods were high in moisture. This could be mainly due to the ingredients (vegetables) or the process of preparation (boiling) both of which contribute higher levels of water to the final product. In foods, water is often the key component which determines the extent and rate of several chemical reactions, as well as the growth of microorganisms (Schmidt, 1991). Studies on bakery foods indicate that while physical and chemical spoilage limits the shelf life of low and intermediate moisture bakery products, microbiological spoilage by bacteria, yeast and molds is the concern in high moisture products (Smith *et al.,* 2004). On the whole the water level was high in all the foods except for zatar which had low levels but addition of cheese to zatar nearly doubled the water content. The foods containing cheese had higher levels of protein but the contribution of protein by cheese was not too high and on the whole all the foods were comparable in their protein content. This is due to the fact that cheese does not contribute much towards protein in a diet and studies indicate that calcium was the only micronutrient positively associated with cheese intake (Weinberg *et al.,* 2004).

Chavan and Kadam (1993) have suggested that the nutritional composition of bakery products can be improved by using quality wheat for milling, increasing extraction rates, air classification of flours, so as to obtain protein-rich non-wheat flours and their products. The fat content was moderate in many of the foods tested but presence of cheese and milk products increased the fat content. Studies by Ranganathan *et al.* (2005) indicate that the bakery products are associated with higher intakes of saturated fat, total energy, and lower intake of fiber suggesting that it may be useful to consume lower-fat dairy products and/or modify eating patterns to optimize the nutritional contributions of dairy products. The fiber content was generally comparable in most of the foods analyzed and foods composed of vegetable had higher levels of fiber. On the whole, all the foods tested were deficient in fiber levels which could be due to the high extraction rate of flour used in Bharain (Musaiger *et al.,* 1998) Generally, consumption of

Table 5: Fatty acid profile of bakery products consumed in Bahrain (mg/100g)

Fatty Acid	CEB	CB	CYB	FS	SP	SPY	SMB	TB	TCB
Butyric acid	2.5	3.2	3.4	-	-	2.3	-	-	3.1
Caproic acid	1.6	1.9	2.0	-	-	1.3	-	-	1.9
Caprylic acid	0.8	1.0	1.1	-	-	0.7	-	-	1.0
Capric acid	1.7	2.1	2.2	-	-	1.3	-	-	2.0
Lauric acid	2.0	2.4	2.5	0.3	0.3	1.6	0.2	0.3	2.4
Myristic acid	6.0	7.3	8.3	1.1	1.2	5.6	1.4	1.1	7.2
Pentadecanoic acid	0.3	0.3	0.4	0.1	0.1	0.4	0.1	0.0	0.3
Pentadecenoic acid	0.6	0.8	0.8	0.0	0.0	0.5	0.2	0.0	0.8
Palmitic acid	30.1	31.4	34.0	31.6	31.8	32.1	29.3	33.7	31.8
Palmitoleic acid	1.6	1.4	1.4	0.4	0.3	1.0	1.0	0.4	1.2
Margaric acid	0.3	0.2	0.5	0.1	0.1	0.4	0.6	0.1	0.4
Heptadecenoic acid	0.2	9.6	0.2	0.0	0.1	0.3	0.4	0.0	0.2
Stearic acid	9.5	29.7	8.2	3.8	4.0	6.7	9.4	4.0	9.4
Oleic acid	33.4	7.8	26.9	41.0	37.6	29.7	38.1	39.9	30.2
Linoleic acid	9.0	0.5	7.8	16.8	22.5	15.2	17.6	19.5	7.6
Linolenic acid	0.4	0.0	0.3	1.5	1.3	0.9	1.1	0.4	0.5
Arachidic acid	0.0	0.0	0.0	0.4	0.4	0.0	0.3	0.3	0.0
Gadoleic acid	0.0	0.0	0.0	1.3	0.4	0.0	0.3	0.3	0.0
Eicosadienoic acid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eicosatrienoic acid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Arachidonic acid	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

bakery products has been associated with the proportion of energy derived from intake of total carbohydrates and sugars but did not show any association with the healthy-eating index (Rodriguez-Artalejo *et al.*, 2003). The energy levels were moderate in all the foods and best suited the role of a dietary snack. Addition of cheese to the foods did not alter the energy values considerably.

The sodium levels were high in all the foods and addition of cheese to zatar increased the sodium content to more than double fold. The high sodium levels are mainly due to the salt added to foods. The major reason for this is that people judge many salted foods as more palatable than the same foods without salt (Beauchamp and Engelman, 1991). Witschi *et al.* (1987) have demonstrated that 30% of the average daily sodium intake in diets of adolescents was contributed by bakery foods and ready-to-eat cereals. Potassium levels were high in the foods containing dairy products, thereby making a contribution towards potassium (Gaucheron, 2005) which is confirmed by the fact that addition of cheese to zatar raised the potassium level in the foods. Similar was the case of calcium where the addition of yogurt to sapanekh increased the calcium levels. The contribution of magnesium was also quite substantial but well below the dietary norms. Ranganathan *et al.* (2005) have demonstrated that intake of calcium, magnesium, potassium, zinc and sodium was higher with greater number of dairy servings consumed. Grajeta *et al.* (2002) in their study have found that the highest contribution of dietary calcium comes from foods containing cheese.

The iron content was low in most of the foods except for zatar which had substantial levels of iron and this is in accordance to the findings by Uma Pradeep *et al.* (1993) that some spices and herbs are a good source of iron. Zinc levels were low in all the foods and these findings are in accordance to previous studies wherein researchers have found deficiency of iron and zinc in many of the Gulf dishes tested (Musaiger and Sungpang, 1985; Sawaya and Al-Awadi, 1996; Musaiger *et al.*, 1998). These findings are important since anemia is the most prevalent nutritional problem in the Arabian Gulf mainly due to iron deficiency (Jackson and Al-Mousa, 2000) and zinc deficiency is now known to occur in children and adolescents from widely diverse areas extending from the Arabian Gulf to the USA (Sandstead, 1991).

When an attempt was made to compare the results of proximate and mineral composition of moajanat mehiawa with that of Musaiger *et al.* (1998) no correlation could be drawn for the two sets of values except for protein content. Similar was the case for minerals where only a similarity for manganese was observed while the rest of the values in the previous data were higher.

Foods composed of vegetables had no cholesterol while all foods composed of dairy products had varied levels of cholesterol. Addition of cheese to foods increased the cholesterol content as seen in case of moajanat zatar biljebin and studies indicate that cheese contains about 44.6-147.69 mg cholesterol in 100 g of cheese (Donmez *et al.*, 2005). Also studies by Scharer and Schulthess (2005) show that egg yolk has the highest content of cholesterol observed in different types of food which is accordance with our study where inclusion of egg in the cheese further increased the cholesterol levels. All foods contained considerable levels of β-sitosterol with lower levels of campesterol

and stigmasterol levels. The presence of β-sitosterol in a diet is of importance since dietary sitostanol has a hypocholesterolemic effect as it decreases the absorption of cholesterol (Connor *et al.*, 2005; Vivian *et al.*, 2005).

The fatty acid profile indicates that the presence of fatty acids in the foods is in the order of; palmitic (saturated fatty acid), oleic acids (monounsaturated fatty acid) followed by linoleic (polyunsaturated fatty acid) and traces of stearic acid (saturated fatty acid). Vicario *et al.* (2003) in their study on bakery foods found that saturated fatty acids were the most predominant followed by monounsaturated fatty acids, polyunsaturated fatty acids and trans-fatty acids with the mean fat content being 22.7%. It was reported that stearic acid had no effect on total cholesterol and lipoprotein cholesterol (Yu *et al.,* 1995) while palmitic acid has cholesterol-raising effect (Grundy and Denke, 1990). Further, replacement of saturated fat with either monounsaturated or polyunsaturated fat can lead to significant decreases in total and LDL cholesterol (Gardner and Kraemer, 1995).

Our study indicates that most of the bakery foods analyzed were deficient in the micro and macronutrients required for the proper nutrition of a healthy individual. There is compelling evidence that micro-nutrient deficiency of zinc, magnesium, selenium and manganese can profoundly affect health and immunity in human being (Wanja, 2004). Clinical studies also demonstrate that consumption of trans fatty acids or hydrogenated fat results in higher blood cholesterol levels than consumption of natural oils (Lichtenstein, 1997). Therefore, consumption of bakery products should be in moderation and priority given to consumption of foods with high mineral content and low cholesterol levels. It is important to replace saturated and trans-fatty acids in a diet by unsaturated plant oils, and products with refined carbohydrates by fruits, vegetables and whole-wheat products and to educate the population about hidden sources of trans-fatty acids and emphasize the importance of dietary fat composition.

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