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Nutritional evaluation of some legume-based dishes consumed in Saudi Arabia

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Chemical composition and nutritional quality of five Saudi dishes based on legumes were evaluated. On fresh weight basis, the dishes contained 35.3–78.1% moisture, 4.4–10.2% protein (NX6.25), 1.2–19.1% fat, 8.0–24.8% carbohydrates, 2.4–7.7% dietary fibre, 1.4–2.9% ash and 71–311 Kcal (297–1301 KJ) per 100 g dish. The contents of vitamin A (retinol equivalent), thiamin, riboflavin and vitamin C ranged from 85–378 μg, 0.01–0.12 mg, 0.02–0.46 mg and 0.3–1.2 mg per 100 g respectively. The mineral contents (mg/100 g) were calcium 2.1–22.1, phosphorus 49.1–330.3, iron 1.1–13.3, sodium 348.3–1356.9, and potassium 119.1–624.8. The dishes contributed 13–25%, 15–64% and 16–60% of the total food energy from protein, fat and carbohydrates respectively. Most of the dishes were good sources of dietary fibre, vitamin A and iron.

Introduction

Food legumes as a valuable source of dietary proteins contribute to the diets of most people in the world. Although the protein content in legumes on dry basis is higher than that of meat, fish and eggs (Khan, 1987) yet the protein quality is unsatisfactory because of their low content of methionine (Khan, 1980; Khan *et al*, 1979a; 1995). However, legumes, being rich in lysine, improved the protein quality of cereal-based diets (Khan *et al.*, 1976, 1979b) and were comparable with the protein quality of meat-based diet (Khan & Eggum, 1978). Legume-based products were reported to have medicinal properties of being astringent, antibilious, aphrodisiac, diuretic and were also effective in the management of hyper-cholesterolemia and diabetes (Chopra *et al.*, 1956; Khan, 1991; Khan *et al.*, 1995).

In Saudi Arabia, an increasing trend in the *per capita* availability of food legumes has been reported to be 178% during the last decade (Khan & Al-Kanhal, 1997). According to the National Nutritional Survey (KACST, 1995) the average consumption of legume-based products and dishes in Saudi Arabia is 63 g/head/day, contributing 2.6, 3.9, 8 and 34% of the total energy, protein, dietary fibre and iron intake respectively.

Although some work on the chemical composition of food dishes based on cereals (Al-Kanhal *et al.*, 1994), cereal and legumes (Al-Jebrin *et al.*, 1985) and meat (Sawaya *et al.*, 1986) consumed in Saudi Arabia, mixed diets used in Kuwait (Kamel & Allam, 1979) and in Bahrain (Musaiger & Al-Dallal, 1985) has been reported, yet adequate data on the nutritional quality of Saudi

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dishes, being different in their recipes from other Gulf States, are not available. In this article, results on the chemical composition and nutritional quality of five popular Saudi dishes based on legumes are reported.

Materials and methods

Selection and description of dishes
Five legume-based dishes commonly consumed in Saudi Arabia were selected for this study. Since all these dishes were easily available in restaurants and food shops, 10 samples of each dish were purchased from different locations in Riyadh city and were pooled to make one representative sample and homogenized. A portion of the representative sample was withdrawn for the determination of moisture and vitamin C while the remainder was freeze dried, ground and stored in a deep freezer for further analysis.

The description of dishes is given below.

Foul medammis This is a popular breakfast dish. Broad beans (faba beans) are soaked in water for about 4 h and cooked in water for about 2 h. Then tomatoes, pepper, salt and palm oil are added. It is eaten with Arabic bread, cheese and olives.

Falafil This is mainly prepared from soaked chickpeas with a small amount of soaked faba beans and blended along with peppers, corriander (green), spices, garlic and salt to make a thick paste. After addition of baking powder it is fried in palm oil in small circular shape. It is served with salad as a sandwich or as a dish in the main meal.

Hummus A very popular dish, composed of boiled chickpeas blended with tehineh (a paste of dehulled roasted sesame seeds), lemon juice, garlic, salt and olive oil/palm oil to make a paste. It is used as a salad dip.

Belila Chickpeas are cooked in water, mixed with vinegar, lemon juice, spices, and salt and served with vegetable salad (cucumber, carrot and onion) as a snack.

Shourbat addas This is a popular soup prepared by cooking lentils in water with peppers, onions, tomatoes and salt. Blended and sieved. Palm oil is added and served as a soup before the main meal.

Chemical analysis

Moisture, protein (NX6.25), fat, and ash were determined according to standard methods of AOAC (1984). Total dietary fibre was estimated using a combination of enzymatic and gravimetric methods as described in Technical Bulletin No. TDFAB-1 of Sigma Chemical Company (Sigma, 1985) based on the method of Prosky *et al.*, (1985). Carbohydrate was calculated by difference. Energy content was calculated by multiplying the protein, fat and carbohydrates by factors of 4, 9 and 4 respectively. For the assays of vitamin A, beta-carotene, thiamin, riboflavin and vitamin C, standard methods of AOAC (1984) were used. For determination of beta-carotene and vitamin A, samples were extracted with ether-hexane, beta-carotene was separated on a chromatographic column. Vitamin A activity and beta-carotene were converted to retinol equivalent (RE). For the estimation of minerals, 1–2 g samples were ashed in duplicate, dissolved in 20% HCl Sodium and potassium were analysed with a flame photometer according to AOAC methods (1984). Calcium and iron were determined with Perkin-Elmer model 1100-B atomic absorption spectrophotometer and phosphorus was estimated spectrophotometrically by the procedure of Watanabe and Olsen (1965). All assays were performed in duplicate.

Results and discussion

Chemical composition
Table 1 shows the proximate composition of legume-based dishes commonly consumed in Saudi Arabia. The moisture content ranged from 35.3% in Falafil to 78.1% in Shourbat addas. The protein content varied between 4.4% in Belila and 10.2% in Falafil. The protein content in Belila was similar to Nekhee (5.0%) a similar dish used in other Arabian Gulf States (Musaiger & Sungpuag, 1985). The higher content of protein in Falafil is ascribed to chickpea and broad beans used in this dish. Similar protein content in cooked chickpeas, beans and lentils have been reported (Khan, 1980; Khan *et al.* 1979a, 1987). All the dishes in the present study contributed 13–25% of the total food energy from protein. In practice, meals/diets in most parts of the world provide 7–12% of calories as protein and any food with

Table 1. Chemical composition (wet basis) of some legume-based Saudi dishes (g/100 g)

Products	*Moisture*	*Protein (NX6.25)*	*Fat*	*Carbohydrate*	*Dietary fibre*	*Ash*	*Energy/100 g*	
							Kcal	*KJ*
Foul medammis	74.2	5.5	4.5	9.9	4.5	1.4	102	427
Falafil	35.3	10.2	19.1	24.8	7.7	2.9	311	1301
Hummus	61.0	9.7	14.3	8.0	5.1	2.0	199	833
Belila	78.0	4.4	1.2	10.6	3.8	2.1	71	297
Shourbat addas	78.1	5.4	3.4	9.2	2.4	1.5	89	372

less than 6–7% Kcal as protein is presumably inadequate to assume the protein needs of a population (Bender & Bender, 1982). The fat content ranged from 1.2% in Belila to 19.1% in Falafil. The high fat content in falafil may be due to frying of the products in oil. Similar results in the fat content of some chickpea products consumed in Pakistan has been reported (Khan, 1991; Khan *et al.*, 1995). The contribution of food energy from fat in the present dishes ranged from 15–64% as compared to 15–30% recommended for a balanced meal (WHO, 1990). The hypocholesterolemic effect of chickpea fat being rich in essential fatty acids has been reported (Ghirardi *et al.*, 1974). The carbohydrate was highest (24.8%) in Falafil and lowest (8.0%) in Hummus, contributing 16–60% of the total calories in these dishes. Legumes being rich in complex carbohydrates have been reported to improve glucose tolerance of diabetics (Quillin, 1989). The dietary fibre ranged from 2.4% in Shourbat addas to 7.7% in Falafil. The consumption of legume fibre can reduce serum cholesterol level (Bender & Bender, 1982; Jenkins *et al.*, 1979), enhance glucose tolerance and increase insulin sensitivity (LSRO, 1987). An inverse association between fibre intake and coronary heart disease (Liu *et al.*, 1982) and cancer of colon and breast (WHO, 1990) has been reported.

The ash content varied between 1.4 and 2.9%. The energy value ranged from 71 Kcal/100 g in Belila to 311 Kcal/100 g in Falafil. Musaiger and Sungpuag (1985) found similar value of 98 Kcal/100 g in Nekhee, a dish similar to Belila used in other Gulf States. The high energy density in Falafil may be due to frying of the product in oil. It is important to compare the composition data with the daily need of these nutrients. According to Khan and Al-Kanhal (1997), the recommended dietary allowances (RDA) of Saudi adult male (18–29 years) vs female of the same age for energy and protein (NPU 0.8) are 2800 vs 2100 Kcals and 65 vs 56 g respectively. A 100 g intake of Saudi legume-based dishes meet 3–11 vs 3–15% and 7–16 vs 8–18% of the RDA for energy and protein for adult male vs female respectively. The average daily *per capita* energy and protein requirements for Saudi population have been reported to be 2100 Kcal and 53 g (NPU 0.8) respectively (Khan & Al-Kanhal, 1997). Based on these requirements, 100 g of these dishes can meet 3–15 and 8–19% of energy and protein requirements at national level per person per day respectively.

The recommended allowances for dietary fibre for the management of diabetes or coronary heart disease and for preventing constipation are 16–24 g per day (WHO, 1990). A 100 g of Saudi legume-based dishes can meet 15–48% of lower limit of the allowance for the management of diabetes or for individuals at risk of coronary heart disease. The vitamin contents of Saudi legume-based dishes are given in Table 2. Vitamin A was highest (378 μg RE/100 g) in Hummus and was lowest (85 μg RE/100 g) in Belila. The thiamin content ranged from 0.01–0.12 mg/100 g. Riboflavin was highest (0.46 mg/100 g) in Foul medammis and lowest (0.02 mg/100 g) in Falafil and Belila. All the products were poor in vitamin C.

In the absence of local RDA for vitamin and mineral, the present data are compared with the RDA of American adult male (19–24 years) and female of the same age (NRC, 1989). The daily allowances for vitamin A, thiamin and riboflavin for adult male vs female are 1000 vs

Table 2. Vitamin contents (wet basis) of some legume-based Saudi dishes

Products	*Vitamin A retinol equivalent ug/100 g*	*Thiamin*	*Riboflavin*	*Vitamin C*
		mg per 100 g		
Foul medammis	137	0.07	0.46	1.2
Falafil	214	0.12	0.02	0.8
Hummus	378	0.04	0.28	0.3
Belila	85	0.01	0.02	0.3
Shourbat addas	135	0.04	0.25	0.7

800 μg RE 1.5 vs 1.1 mg and 1.7 vs 1.3 mg respectively (NRC, 1989). A 100 g of intake of Hummus can meet 38 vs 47% of RDA for vitamin A, whereas Falafil provided vitamin A to meet 21 and 27% of daily allowances for adult male and female respectively. Falafil can meet 8 and 11% of daily thiamin requirement for adult male and female respectively. Riboflavin in 100 g of Foul medammis can meet 27 and 35% of the requirement of adult male and female respectively.

The mineral contents of Saudi legume-based dishes are shown in Table 3. All products are poor source of calcium (2.1–22.1 mg/100 g). The phosphorus content varied from 49.1–330.3 mg/100 g. The concentration of iron was highest (13.3 mg/100 g) in Shourbat addas and lowest (1.1 mg/100 g) in Belila. The sodium contents were quite high in Shourbat addas (1356.9 mg/100 g), Falafil (1261.7 mg/100 g) and in Foul medammis (1200.2 mg/100 g). The high content of sodium in these dishes is due to addition of sodium chloride in their preparation. The concentration of potassium was highest (624.8 mg/100 g) in Falafil and lowest (119.1 mg/100 g) in Hummus.

The daily allowances for calcium, phosphorus, iron, sodium and potassium for adult male and female are 1200, 1200, 10–15, 500 and 2000 mg respectively (NRC, 1989). Legume-based dishes (100 g) will not provide a significant amount of calcium however, Foul medammis, Shourbat addas and Falafil can meet 28, 24 and 23% of daily phosphorus requirements of adult male and female. Shourbat addas, falafil and foul medammis can meet 133 vs 89%, 79 vs 53% and 73 vs 49% of daily iron requirements of adult male vs female respectively. However, the absorption of calcium and iron may be prevented by phytic acid present in legumes (Bender & Bender, 1982). A 100 g of Foul medammis, Falafil and Shourbat addas can meet 240–271 and 30% of daily sodium and potassium requirements of adult male and female respectively. Sustained overconsumption of sodium, particularly as salt has been related to development of hypertension in sensitive individuals (NRC, 1989) may increase the risk for stroke, heart attack and other cardiovascular events leading to death.

In conclusion, the nutrient composition and nutritional quality of legume-based Saudi

Table 3. Mineral contents (wet basis) of some legume-based Saudi dishes (mg/100 g)

Products	*Calcium*	*Phosphorus*	*Iron*	*Sodium*	*Potassium*
Foul medammis	11.4	330.3	7.3	1200.2	591.2
Falafil	9.5	275.9	7.9	1261.7	624.8
Hummus	2.1	162.3	2.5	348.3	119.1
Belila	22.1	49.1	1.1	721.7	177.3
Shourbat addas	7.7	291.5	13.3	1356.9	603.0

dishes indicate that most of the dishes are moderate sources of protein, high in fat, iron, sodium, potassium and vitamin A, low in carbohydrates, calcium and vitamin C, poor in thiamin and riboflavin but are good sources of dietary fibre. There is a need to reduce fat and sodium contents in some dishes. These dishes may be used in the management of hypercholesterolemia and diabetes. The data should be useful for planners and educational purpose and for compiling local food composition tables.

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References

Al-Jebrin A, Sawaya WN, Salji JP, Ayaz M & Khalil JK (1985): Chemical and nutritional quality of some Saudi Arabian dishes based on cereal and legumes. *Ecol Food Nutr* **17**, 157–164.

Al-Kanhal MA, Al-Mohizea IS, Al-Othaimeen AI & Khan MA (1994): Nutritive value of some wheat based dishes consumed in the Kingdom of Saudi Arabia Ecology. *Food Nutr* **32**, 219–226.

AOAC (1984): *Official Methods of Analysis*, 13th edn. Washington, DC: Association of Official Analytical Chemists.

Bender AE & Bender DA (1982): *Nutrition for Medical Students*. New York: John Wiley.

Chopra RN, Nayar SN & Chopera IE (1956): *Glossary of Indian Medicinal Plants*. New Delhi: Council of Scientific and Industrial Research.

Ghirardi P, Marzo A & Ferrari G (1974): Lipid classes and total fatty acid pattern of *Cicer arietinum*. *Phytochemistry* **13**, 755–756.

Jenkins DJA, Reynalds D, Leeds AR, Waller AL & Cummings JH (1979): Hypocholesterolemic action of dietary fiber unrelated to fecal bulking effect. *Am J Clin Nutr* **32**, 2430–2435.

Kamel BS & Allam M (1979): *Composition of Foods Consumed in Kuwait, Phase 1*. Kuwait: Kuwait *Institute for Scientific Research*,

KACST (1995): Evaluation of nutritional status of the people of Saudi Arabia. Final Report, King Abdul Aziz City for Science and Technology, Riyadh, Saudi Arabia.

Khan MA (1980): Nutritional evaluation of cooked Bengal gram. *Pak J Agric Sci* **17**, 37–42.

Khan MA (1987): Nutritional attributes of food legumes. Progress. *Farming (Pakistan)*, **7**, 36–40.

Khan MA (1991): Utilization of chickpea and groundnut in Pakistan. In *Uses of Tropical Grain Legumes*, pp. 95–106. *Proceedings of a Consultant's Meeting*, International Crops Research Institute for the Semi Arid Tropics, India, 27–30 March.

Khan MA, & Al-Kanhal MA (1997): Food availability and quality of diet in Saudi Arabia. *Pak J Agric Res* (Accepted).

Khan MA & Al-Kanhal MA (1997): Dietary energy and protein requirements for Saudi Arabia. *Pak J Agric Res* (Accepted).

Khan MA & Eggum BO (1978): The nutritive value of some Pakistani diets. *J Sci Food Agric* **28**, 1023–1029.

Khan MA, Almas K, Abid AR & Yaqoob M (1976): The effect of gram flour on the quality of wheat flour. *Pak J Agric Sci* **13**, 167–172.

Khan MA, Jacobsen I & Eggum BO (1979a): Nutritive value of some improved varieties of legumes. *J Sci Food Agric* **30**, 395–400.

Khan MA, Yasmin SF & Abid AR (1979b): Nutritional evaluation of (Lens-esculenta) as protein supplement for wheat protein. *Acta Agric Scand* **29**, 109–111.

Khan MA, Rana IA, Ullah I & Jaffery S (1987): Physiochemical characters and nutrient composition of some improved lines of lentils grown in Pakistan. *J Food Comp Anal* **1**, 65–70.

Khan MA, Neghmana A, Ullah I & Jaffery S (1995): Nutritional evaluation of desi and kabuli chickpeas and their products commonly consumed in Pakistan. *Int J Food Sci Nutr* **46**, 215–223.

Liu K, Stamler J, Trevison M, and Moss D (1982): Dietary lipids, sugar, fiber and mortality from coronary heart disease: bivariate analysis of international data. *Arteriosclerosis* **2**, 221–227.

LSRO (1987): *Physiological Effects and Health Consequences of Dietary Fiber*. Bethesda, MD: Federation of American Societies for Experimental Biology.

Musaiger AO & Al-Dallal Z (1985): *Food Composition Tables for Use in Bahrain*. Bahrain: Nutrition Unit, Ministry of Health.

Musaiger AO & Sungpuag P (1985): Composition of mixed dishes commonly consumed in the Arab Gulf States. *Ecol Food Nutr* **16**, 153–160.

NRC (National Research Council) (1989): *Recommended Dietary Allowances*. Washington, DC: National Academy Press.

Prosky L, Asp N, Furda I, Devries JW, Schweizer TF & Harland BF (1985): Determination of total dietary fibre in food products. *J Ass Off Anal Chem* **68**, 677–680.

Quillin P (1989): *Healing Nutrients*. New York: Random House.

Sawaya WN, Khalil JK & Safi WJ (1986): Nutritional evaluation of selected meat based Saudi Arabian dishes. *Ecol Food Nutr* **18**, 171–182.

Sigma (1985): *Total Dietary Fibre Assay Kit*. Technical Bulletin No. TDFAB-1. St Louis, MO: Sigma Chemical Company.

Watanabe FS & Olsen SS (1965): Test of an ascorbic acid method for determining phosphorus in water and $NaHCO_3$ extract from soil. *Soil Sci Soc Am Proc* **29**, 677–678.

WHO (1990): *Diet Nutrition and the Prevention of Chronic Diseases*. Technical Report Series 797. Geneva: World Health Organization of the United Nations.