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Chemical composition of some traditional dishes of Oman

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Proximate, mineral, fatty acid and cholesterol compositions of 20 dishes consumed in Oman were analysed. Protein level ranged from 0.4 to 7.6%, while the fat content ranged between 0.3 and 28.1%. The dishes were found to be poor in Fe, Zn and Ca. Except for three dishes which had sodium levels less than 70 mg per 100 g, the sodium ranged from 108 to 571 mg 100 g. Two dishes were high in cholesterol (69.3 and 32.7 mg per 100 g), while the cholesterol level ranged from 0.0 to 9.64 mg per 100 g. The fatty acid analysis showed that palmitic, oleic and linoleic acids were predominant. In general, the chemical compositions of Omani dishes are similar to those of other Arabian Gulf countries. The present information can be used as a baseline for establishing food composition data for Oman. © 1998 Elsevier Science Ltd. All rights reserved

INTRODUCTION

Oman is an Arab Gulf country situated southeast of Saudi Arabia with a population of about two million. The country has faced rapid transition since 1970, and consequently marked changes in socio–economic status and food consumption patterns have occurred (Musaiger, 1996*a*).

The importance of food composition data has long been recognized by the Food and Agriculture Organization, and has received more attention in recent years. Accurate food composition data are needed to show association between food and nutritional status, to design interventions, to meet regulatory standards, to properly label food and to assist in product formulation (Lewis and Lupien, 1996).

Most of the Arab Gulf countries have initiated programmes to analyse their local foods. This is particularly true for Bahrain (Musaiger, 1994), Kuwait (Sawaya and Al-Awadi, 1996), Qatar (Al-Nagdy *et al.*, 1994) and Saudi Arabia (Al-Kanhal *et al.*, 1994). However, there is no information on the composition of local foods and dishes consumed in Oman. The present study was conducted to analyse the most commonly consumed dishes in Oman in terms of proximate composition, mineral, cholesterol and fatty acid profiles.

MATERIALS AND METHODS

Materials

Selection of dishes

Since there was no information on standard recipes and main dishes commonly consumed in Oman, a rapid survey on 65 households from three geographical regions of Oman was carried out. The regions were selected according to their geographical and population characteristics. The sample included 20, 25 and 20 households from the southern area, Muscat (the capital) and central (rural) area, respectively.

Housewives were interviewed by female home economic students using a structured questionnaire to obtain data on main dishes consumed in Oman. The questionnaire contained information on main dishes commonly consumed by the households, dishes consumed at puerperium and dishes consumed in Ramadan (the fasting month for Muslims). Ingredients and methods for preparation of three dishes commonly consumed, two dishes consumed at puerperium and one dish consumed in Ramadan were also obtained.

About 60 dishes were mentioned and described by the housewives. Only 20 dishes were selected in this project as a first phase. The criteria for selection of the dishes were: consumed by a large percentage of households,

consumed on special occasions, and consumed by special ethnic groups.

Standardization of the dishes
The list of ingredients and method of preparation for each dish was obtained from each household. Then the average of each ingredient was calculated and used as a general guide for preparation of the recipe. The number and quantity of ingredients for the same dish were found to differ from household to household. For the purpose of this project, therefore, only the major ingredients were included in the recipes.

Preparation of dishes
Dishes were prepared by an experienced Arabian Gulf housewife. Most ingredients were purchased from the market of Oman. Other ingredients, namely meat and fish, were obtained from the market of the United Arab Emirates. All the ingredients were weighed carefully using a scale accurate to 1.00 g. The dishes were prepared at least twice to adjust the recipe to the common texture and flavour. This led to decreasing or increasing the average of some ingredients to adjust the recipes. The final method of preparation was then adopted for each dish. Detailed information on ingredients and method of preparation of the 20 Omani dishes are published elsewhere (Musaiger, 1997). The main ingredients for these dishes are presented in Tables 1 and 2.

Methods

The dishes were stored in a freezer and sent to the Public Health Laboratory, Dubai, for analysis. The dishes were homogenized by blending in a homogenizer for 2–3 min. The homogenized samples were transferred into air-tight containers and were stored in a refrigerator. The samples were analyzed for their proximate composition, minerals, fatty acid profile and cholesterol contents, following the laboratory-validated methods. The samples were analysed in duplicate and the average result was reported for each parameter.

Proximate composition
Proximate analysis was done using the standard methods of AOAC (1990). Moisture was determined by drying a known quantity of sample at $102 \pm 3^{\circ}C$ in an air-oven. Acid-washed, ignited sand was used in some cases to facilitate removal of water. The ash content was determined by drying a known quantity of sample in a water bath, charring on a hot plate and ashing in a muffle furnace maintained at $450 \pm 20^{\circ}C$. Fat was measured by the Rose–Gottlieb method in samples containing sugars and by the Werner–Scmid method in samples containing meat. The Kjeldahl method was used to determine the crude protein. The nitrogen content was multiplied by a factor 6.25 for deducing the protein content. Crude fibre was measured according to the standard method of AOAC (1990). Total carbohydrates were calculated by difference. Energy was estimated using the factors 4.0, 4.0 and 9.0 kcal g^{-1} for protein, carbohydrates and fat, respectively. The energy value of dishes in kilojoules was calculated from kilo caloric value using the conversion factor 4.184 kJ $kcal^{-1}$.

Minerals content
The ash obtained was dissolved in 5 ml of conc. HCl and made up to 50 ml in a volumetric flask. The minerals (Na, K, Ca, Mg, Fe, Cu, Zn) were analysed by flame AAS using an Atomic Absorption Spectrophotometer (Varian Spectra AA.20). Phosphorus in the ash solutions was analyzed as phosphate on an ion chromatograph (Dionex, DX 100). Appropriate dilutions were made to ash solutions to bring the concentration of minerals within the calibration range of the Atomic Absorption Spectrophotometer and Ion chromatograph (Pearson, 1981; Leatherhead Food RA, 1987).

Table 1. Main ingredients used in preparation of Omani meat-based dishes

No.	Local name	Common name	Ingredients
M1	Al-laham al-mufour	Boiled meat	Meat, tomato, onion, garlic, black pepper, salt and water
M2	Mooz matbokh	Banana stew	Green banana, meat, coconut milk, mixed spices, salt and water
M3	Hareese	Beaten wheat with beef	Blanched wheat, meat (beef), ghee, salt and water
M4	Kabooli laham	Rice with meat	Rice, beef, tomato garlic, ginger, vegetable oil, mixed spices, salt and water
M5	Shorbat laham	Meat soup	Beef, blanched wheat, onion, ghee, mixed spices, salt and water
M6	Machbous laham	Rice with meat	Rice, beef, onion, tomato, garlic, green chili, vegetable oil, mixed spices, salt and water
M7	Machbous dajaj	Rice with chicken	Rice, chicken, onion, tomato, garlic, potato, eggplant, vegetable oil, mixed spices, salt and water
M8	Marrag dajaj	Chicken curry	Chicken, onion, tomato, potato, eggplant, okra, squash, garlic, mixed spices, salt and water
M9	Babloh smak	Fish stew	Fish, onion, tomato, mixed spices, garlic, coriander, wheat flour, salt and water
M10	Marraq al-samak	Fish curry	Fish, onion, tomato, mixed spices, potato, vegetable oil, salt and water
M11	Kalambah	Rice with fish	Fish, rice, lentil, onion, mixed spices, ghee, salt and water

Table 2. Main ingredients used in preparation of Omani cereal–legume-based dishes

No.	Local name	Common name	Ingredients
C1	Qahwah hamra	Brown-sugar coffee	Brown sugar, ghee, cinnamon, ginger, black pepper and water
C2	Aish abaid	Plain rice	Rice, onion, ghee, salt and water
C3	Skanah	Fenugreek soup	Fenugreek seeds, wheat flour, sugar, whole milk, ghee, cardamom, black pepper, salt and water
C4	Dahal	Lentil stew	Lentils, onion, tomato, vegetable oil, mixed spices and water
C5	Assalya	Date-syrup soup	Date syrup, butter, black pepper, cardamom and water
C6	Baranuosh	Sweet rice	Rice, date-syrup, fish, onion, vegetable oil, mixed spices, salt and water
C7	Chola bil-assal	Bread with honey	Wheat flour, black pepper, ghee, honey, salt and water
C8	Assidah	Flour with ghee (sweet)	Wheat flour, sugar, ghee, salt and water
C9	Muhogo	Cassava soup	Cassava, coconut milk, chili, salt and water

Fatty acid profile

Fatty acid composition was only analysed for dishes containing fat $\geqslant 1\%$. The fatty acid profile of the extracted fat was determined by transesterification using BF3/methanol and the resultant fatty acid esters were analysed by gas chromatography (Christie, 1982; AOAC, 1990). About 50 mg fat was dissolved in 1/ml of dry benzene in a reaction vial; 2 ml of BF3/methanol was added and the vial was closed with a cap provided with a septum. The reaction was carried out for 20 min at 80°C; the vial was cooled to room temperature, 2 ml of water was added and the separated benzene layer containing fatty acid methylesters was dried over anhydrous sodium sulphate and analyzed on a gas chromatograph fitted with FID (Pye Unicam 4450). The relative percentage of fatty acids were determined by normalization technique.

Cholesterol content

The cholesterol in the unsaponifiable fraction of fat was determined following the AOAC procedure (AOAC, 1990). About 2 g of the extracted fat was accurately weighed and saponified with alcoholic KOH and the resultant soap solution was extracted with 3×75 ml portions of diethyl ether. The combined ether layer was washed with water, dried over anhydrous sodium sulphate and the solvent was evaporated. The residue was dissolved in ethyl acetate and made up to a known volume. The cholesterol was separated and quantified by gas chromatography and the results were expressed as mg per 100 g of sample.

RESULTS AND DISCUSSION

Proximate compositions per 100 g for each Omani dish are given in Table 3. Excluding three cereal-legume based dishes, the highest protein contents ($\geqslant 4.0$ g per 100 g) were in meat, chicken or fish-based dishes. The highest fat levels ($\geqslant 4.0$ g per 100 g) tended to be in sweet dishes with ghee or butter in their ingredients,

Table 3. Proximate analysis of traditional dishes of Oman (g per 100 g)

No.	Dishes	Moisture	Fat	Protein	Ash	Crude fibre	CHO	Energy	
								kcal	kJ
Meat-based dishes									
M1	Al-laham al-mufour	82.2	0.7	6.7	1.7	0.07	8.6	68	285
M2	Mooz matbokh	86.5	0.9	6.0	0.8	Traces	5.8	55	230
M3	Hareese	80.2	1.4	5.4	0.9	0.21	11.9	82	343
M4	Kaboli laham	70.2	3.0	7.6	1.1	0.18	17.9	129	540
M5	Shorbat laham	82.9	0.8	3.3	0.9	0.16	12.0	68	285
M6	Machbous laham	70.0	2.2	5.0	1.0	0.38	21.5	126	527
M7	Machbous dajaj	72.6	2.0	4.8	1.0	0.30	19.4	115	481
M8	Marrag dajaj	82.7	4.3	4.7	1.4	0.28	6.6	84	352
M9	Babloh samak	90.1	0.6	3.6	1.2	0.10	4.5	37	155
M10	Marrag al-samak	83.9	2.9	4.4	1.7	Traces	7.1	72	301
M11	Kalambah	76.5	2.7	3.4	1.2	0.12	16.1	102	427
Cereal–legume-based dishes									
C1	Qahwah Hamra	88.4	0.3	Traces	0.1	Traces	11.5	49	205
C2	Aish Abiad	67.9	1.8	1.2	1.8	0.16	27.8	132	552
C3	Skanah	77.1	4.1	1.5	0.7	0.21	16.3	108	452
C4	Dahal	71.9	4.3	6.0	1.3	0.12	16.4	128	536
C5	Assalya	27.6	28.1	1.8	1.4	Traces	41.1	426	1778
C6	Baranuosh	59.7	2.8	5.2	1.5	0.20	30.6	169	707
C7	Chola bil-assal	21.8	13.4	6.4	1.2	0.81	56.4	372	1556
C8	Assidah	65.3	4.7	3.9	0.8	0.18	25.2	158	661
C9	Muhogo	79.8	0.7	0.4	0.7	0.36	18.0	80	335

while the highest carbohydrate values ($\geqslant$ 30 g per 100 g) were in dishes contain date-syrup or honey.

Some of the dishes were high in energy, particularly those with high fat and date-syrup levels. Assalya, Baranuosh, Chola and Assidah all had energy values of >150 kcal per 100 g. The dishes low in energy (<50 kcal 100 g) in general had a high content of water (>80 g per 100 g).

All the dishes had low fibre levels (<1.0 g per 100 g), indicating that vegetables, especially high-fibre vegetables, as well as legumes, are not used much in preparation of Omani dishes. However, some dishes contained considerable amounts of vegetables, but the practice of peeling the skin of most vegetables may reduce the fibre levels in these dishes. Also most of the dishes contained high percentage of water which in turn diluted the concentration of nutrients, including the fibre.

The results from analysis of minerals in Omani dishes show that the overall composition of minerals varied markedly among the dishes (Table 4). The sodium level in particular, was high in most dishes. Except for Qahwah Hamra, Babloh samak and Skanah which had sodium levels below 70 mg per 100 g, the sodium contents ranged from 108–571 mg per 100 g. The high concentration of sodium in Omani dishes is mainly attributed to the high amount of salt added to the ingredients. Another contributing factor is the use of spices in cooking. Some spices contain high amounts of sodium; these include coriander leaf, cumin and cloves (Murphy *et al.*, 1978). These spices are commonly used in Omani dishes.

In general meat, chicken and fish-based dishes have higher levels of iron ($\geqslant$0.3 mg per 100 g) and zinc ($\geqslant$0.7 mg per 100 g) than other dishes. An exception is Dahal which contained iron at about 1.3 mg per 100 g. Nevertheless, it can be said that Omani dishes are low in iron and zinc. Similar findings were reported in other Gulf studies (Musaiger and Sungpuag, 1985; Al-Kanhal *et al.*, 1994; Sawaya and Al-Awadi, 1996). These results are important from the nutritional point of view as iron deficiency anaemia is one of the main public health problems among infants, young children, adolescent girls and pregnant women in the Arab Gulf countries, including Oman (Musaiger, 1986*b*). It is highly believed that zinc deficiency is among the factors that affect the growth of children and adolescents in the Arab Middle East countries including the Gulf states (Musaiger and Miladi, 1996). Attempts, therefore, should be made to encourage intake of foods rich in iron and zinc, as well as foods that enhance absorption of iron, such as those containing ascorbic acid.

Cholesterol contents and fatty acid profiles of Omani dishes are presented in Table 5. Cholesterol level was very high in two dishes (Assalya and Chola, 69.3 and 32.7 mg per 100 g, respectively). Eight dishes had no cholesterol, and the rest of dishes had cholesterol contents of 1.64–9.64 mg per 100 g.

Palmitic, oleic and linoleic fatty acids tended to be predominant. However, oleic acid was found in low levels ($\leqslant$9.0 mg per 100 g) in five dishes, namely Kabooli laham, Machbous dajaj, Machbous laham, Marrag dajaj and Muhogo.

The chain length of a fatty acid has a big role in its effect on plasma cholesterol level. Short chain fatty acids raise blood cholesterol more than long chain fatty acids. Myristic (C14:0) and palmitic (C16:0) acids raise blood cholesterol level more than other fatty acids, while stearic acid has no effect on plasma cholesterol (Bonanome and Grundy, 1988). As regards Omani dishes, palmitic acid is available in a high concentration

Table 4. Mineral composition of traditional dishes of Oman (mg per 100g)

No.	Dishes	Na	K	Ca	Mg	Fe	P	Cu	Zn
Meat-based dishes									
M1	Al-laham al-mufour	108	34	7.4	12.5	0.39	272.0	0.03	0.12
M2	Mooz matbokh	180	19	21.0	6.6	0.18	66.0	0.04	0.88
M3	Hareese	362	26	12.9	5.5	1.60	35.6	0.03	1.03
M4	Kaboli laham	360	55	11.5	30.6	0.68	17.1	0.06	1.24
M5	Shorbat laham	191	43	16.6	49.5	0.71	28.4	0.06	0.62
M6	Machbous laham	180	14	28.2	35.3	0.54	59.9	0.09	0.92
M7	Machbous dajaj	190	48	20.1	38.4	0.36	77.1	0.07	0.69
M8	Marrag dajaj	228	68	24.5	13.6	0.52	6.4	0.06	0.70
M9	Babloh samak	54	20	7.3	9.7	0.63	17.8	0.02	0.12
M10	Marrag al-samak	438	190	23.8	27.1	0.56	71.6	0.05	2.25
M11	Kalambah	571	207	16.0	18.1	0.28	15.8	0.07	1.23
Cereal–legume-based dishes									
C1	Qahwah hamra	33	16	4.1	6.9	0.14	1.4	0.04	0.05
C2	Aish abiad	305	25	34.5	12.7	0.05	5.7	0.02	0.22
C3	Skanah	64	6	19.0	9.4	0.42	20.9	0.02	0.19
C4	Dahal	448	238	19.0	2.4	1.34	5.2	0.29	0.98
C5	Assalya	184	226	32.9	39.5	0.60	8.1	0.09	0.55
C6	Baranuosh	381	172	15.0	21.0	0.21	35.4	0.04	0.51
C7	Chola bil-assal	180	84	22.3	18.5	0.12	61.8	0.08	0.62
C8	Assidah	324	20	11.4	5.9	0.30	14.2	0.03	0.40
C9	Muhogo	128	81	24.8	7.0	0.20	6.1	0.03	0.07

Table 5. Cholesterol and fatty acid profiles for traditional dishes of Oman[a]

Dishes	M3	M4	M5	M6	M7	M8	M10	M11	C2	C3	C4	C5	C6	C7	C8
Cholesterol (mg/100g)	2.1	Traces[b]	1.6	Traces	Traces	3.3	2.3	2.2	2.3	7.7	Traces	69.3	Traces	32.7	9.6
Fatty acids															
Caproic 10:0	1.5	0.2	1.0	—	—	0.3	0.5	1.1	2.4	2.8	0.0	3.2	—	3.2	3.4
Lauric 12:0	1.9	0.4	1.4	—	0.2	0.3	0.5	1.5	3.0	3.6	0.2	4.0	0.2	3.8	3.9
Myristic 14:0	8.6	2.3	5.5	2.3	1.6	1.3	1.0	4.8	11.1	10.8	0.8	12.8	0.9	11.9	12.7
Pentadecanoic 15:0	1.2	0.5	1.4	0.3	0.2	0.3	0.1	0.7	0.2	2.0	0.0	1.6	—	2.2	1.5
Palmitic 16:0	26.6	45.8	25.8	54.7	48.4	41.6	38.3	34.1	30.8	29.4	32.5	32.2	34.1	31.9	36.8
Palmitoleic 16:1	3.4	2.2	5.2	3.3	2.4	3.7	0.4	0.7	3.2	3.3	0.1	3.4	0.1	3.4	3.6
Heptadecanoic 17:0	0.8	0.6	0.5	0.6	0.3	2.4	0.3	0.2	1.2	1.2	0.0	1.0	—	1.1	1.2
Stearic 18.0	9.6	3.4	8.3	5.5	3.4	6.6	4.6	7.0	11.4	11.5	3.9	11.9	4.0	12.8	2.0
Oleic 18.1	24.0	8.7	32.1	8.6	8.8	37.6	35.3	31.2	24.5	23.5	37.1	23.6	35.2	23.2	13.8
Linoleic 18.2	16.3	31.5	16.8	19.3	29.6	3.8	17.1	16.7	8.0	5.7	23.6	2.1	23.4	2.5	15.8
Linolenic 18.3	0.9	0.2	1.0	0.5	1.5	0.1	0.3	0.7	0.5	1.9	0.9	0.4	0.8	0.3	0.8
Arachidic 20.0	1.4	1.2	0.2	0.1	0.2	0.1	0.3	0.5	0.1	0.3	0.3	0.1	0.4	0.2	0.5
Gondonic 20.1	0.2	0.3	0.2	1.7	1.1	0.3	0.4	0.3	0.4	1.1	0.2	1.0	0.3	0.3	0.2
Behenic 22.0	1.5	0.5	0.2	1.9	1.2	0.6	0.7	0.6	0.2	0.3	0.1	0.2	0.4	0.6	0.9
Others	2.1	2.2	0.6	1.2	0.1	1.0	0.2	—	3.1	2.7	0.3	2.6	0.2	2.6	2.9

[a]For dishes that contain fat $\geqslant 1\%$; [b]traces: < 1.0 mg%.

in most dishes. It exceeded 30 mg per 100 g in 13 dishes. However, Machbous laham, Machbous dajaj and Kabooli laham had high levels of palmitic acid (54.7, 48.4 and 45.8 mg per 100 g, respectively). These three dishes, also had the lowest level of oleic acid (< 9 mg per 100 g), as all other dishes (except Muhogo) had oleic acid concentrations of 13.8–37.1 mg per 100 g. It is important to consider other accompanying fatty acids when evaluating the effects of fatty acids in the diet. There is enough evidence that polyunsaturated fatty acids have a cholesterol-lowering effect. Among polyunsaturated fatty acids, linoleic acid is of a particular interest as its diminishes the thrombotic tendency of blood platelets, thus reducing arterial thrombus formation (FAO, 1980). There were only five dishes that had a high level of linoleic acid (> 20 mg per 100 g), while the level ranged from 0.6–19.3 mg per 100 g in other dishes.

It is worth mentioning that some dishes are consumed on special occasion in Oman. Assidah, Chola and Skanah are the main dishes consumed during puerperium. It is believed that these dishes give more energy and improve the health of lactating mothers, increase milk secretion and clean the uterus of blood (Musaiger, 1996). Chola had higher levels of energy (372 kcal per 100 g) and protein (6.4 g per 100 g) than Assidah and Skanah (158 and 108 kcal per 100 g for energy, and 3.4 and 1.5 g per 100 g for protein, respectively). It can be concluded that these dishes are high in energy values but low in other essential nutrients such a good quality protein (protein is based on wheat flour), iron and zinc. The habit of high consumption of these dishes during puerperium should be modified, and nutrition education programmes should encourage mothers to reduce intake or supplement these dishes with other nutritious foods.

One of the difficulties encountered in standardizing the recipe is the wide differences in ingredients and methods for preparation of the same dish, mainly due to ethnic background and geographical location. The population of Oman is composed of several ethnic groups, from Africa and Asia. Geographical location and agricultural production are also play an important role. For example, coconut is only grown in the southern area of Oman, and therefore coconut milk is extensively used in their cooking in the preparation of the dishes in this area. Cassava, is not grown in Oman, but it is widely consumed by Omani of African origin (so-called Zingibari). Therefore dishes such as Mooz matbokh and Muhogo are mostly consumed by this ethnic group.

A comparison was made between Omani dishes and dishes consumed in other Arabian Gulf countries (Musaiger and Sungpuag, 1985; Sawaya *et al*., 1986; Al-Kanhal *et al*., 1994). A good agreement was generally found for values obtained for moisture, protein, crude fibre and minerals. Fat concentrations were found to be higher in some Omani dishes compared to cereals and meat based dishes consumed in other Gulf states. The highest level of fat reported in the literature for the Gulf dishes did not exceed 9 g per 100 g (except whole egg based dishes which had fat level of about 15 g per 100 g). However, two Omani dishes had a very high content of fat (Assalya, 28% and Chola, 13%).

In general, there are similarities in the compositions of Arabian Gulf dishes, and therefore the recommendation for establishing Food Composition Tables to be used for the region instead of preparing tables for each country should be supported. This will reduce the cost and efforts to analyse the foods. Studies on chemical analysis of other traditional foods and dishes are strongly recommended. We hope that this study will

stimulate other investigators to carry out further studies on this important topic.

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