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Dietary fiber content of 21 Kuwaiti composite dishes

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Dietary fiber analyses were carried out on 21 commonly consumed Kuwaiti composite dishes. The dietary fiber content was determined by an enzymatic–gravimetric method for the determination of soluble (SDF), insoluble (IDF) and total (TDF) dietary fiber.

The IDF was the major dietary fiber fraction in all the dishes. The average content of IDF in the 21 dishes was 3.7 g/100 g fresh weight compared with 1.00 g/100 g for the SDF fraction. The mean content of TDF was highest in the sweet dishes (4.2 ± 1.3722 g; $n = 10$), particularly those containing dates, followed by the cereal-based dishes (3.9 ± 1.9523 g; $n = 10$) containing whole grain wheat flour. The meat- (3.46 ± 1.3722 g; $n = 14$) and chicken-based (2.7 ± 0.1331 g; $n = 4$) dishes contained moderate levels of TDF, with the vegetables (3.87 g; $n = 2$) in the recipes contributing most of the TDF in these dishes. However, since most of the dishes contained 2–4 g dietary fiber per 100 g fresh weight, and more than 100 g is consumed in a serving (average 300–400 g), then these dishes can generally be considered as good sources of dietary fiber. © 1997 Elsevier Science Ltd

INTRODUCTION

The current surge of interest in dietary fiber is attributed to the potential health implications of this diet component, which was considered at one time as nutritionally non-essential. The physiological effect of dietary fiber has been studied extensively (Nicklas *et al.*, 1995; Williams, 1995; Kritchevsky, 1986; Kritchevsky & Banfield, 1995; Anderson, 1986; Jenkins, 1982; Story & Thomas, 1982). Dietary fiber directly affects bowel function from ingestion through defecation, and also indirectly modifies postprandial glycemia and lipid metabolism. Epidemiological studies of rural Africans in the early 1970s (Trowell, 1960; Burkitt, 1973) also demonstrated links between a lack of fiber in Western diets and higher incidences of chronic degenerative diseases.

Although no recommended daily allowances have been set, most health/nutrition professionals agree on the benefit of increased consumption of dietary fiber to over 20 g per day (Dreher, 1987). The National Cancer Institute in 1986 recommended a dietary fiber intake of 25–35 g per day in the US diet compared with the current average intake of 10–13 g per day (NCI, 1984). Likewise, a national advisory committee on nutrition education in Great Britain recommended increasing fiber intake to 25 and 30 g per day over the short- and long-term, respectively (NACNE, 1983). In view of such recommendations and the health and potential therapeutic benefits of the increasing consumption of dietary fibers, accurate information on its content in commonly consumed diets is needed. Many investigations have reported dietary fiber contents of individual foods (Southgate, 1978; Prosky *et al.*, 1985; Anderson & Bridges, 1988; Marlett, 1992), although much has still to be done to accumulate a database on the dietary contributions of many different food groups. Data on the dietary fiber content of representative diets/composite dishes are scanty. Such information is critically needed to assess the dietary fiber intake pattern of the population and recommend any intervention measures needed.

The purpose of this article is to present the dietary fiber content of 22 most commonly consumed composite dishes in the Arabian Gulf country of Kuwait, including soluble and insoluble components.

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MATERIALS AND METHODS

Preparation of the dishes

Twenty-two Kuwaiti dishes that are commonly consumed locally were selected for this study. Information on cooking procedures and on the ingredients and their quantities was collected based on a field survey of over 250 Kuwaiti households. The recipes were standardized by identifying the major ingredients of each recipe and their weight ratio from the total, and ensuring that the coefficient of variation (CV) of the major ingredients did not exceed 20%. If the CV exceeded 20%, more households were surveyed and the new data obtained pooled with the earlier data and statistically analysed until the CV of the final weight of each major ingredient was within ±20%. The major ingredients of the 21 recipes and their amounts are presented in Table 1.

The cooked dishes were prepared at the Ibn-Sina Hospital kitchen of the Ministry of Public Health based on the standardized recipes and under the supervision once again of experienced Kuwaiti cooks. All ingredients including water were weighed, and three identical preparations of each dish were cooked separately and weighed after each cooked dish was cleared of bones. They were then homogenized and sampled for moisture

Table 1. Ingredients of 21 selected Kuwaiti cooked dishes

Dish	Ingredients (%)
Meat-based dishes	
Warag Enab	Minced meat 23.58, Grape leaves 19,93, Sweet pepper 14.07, Rice 11.37, Tomato 10.75, Onion 11.22, Parsley 1.98, Spice 0.21, Limes 0.16, Salt 0.18, Water 5.56
Mahshi Bil Koosa	Zucchini 41.15, Rice 14.91, Minced meat 15.96, Tomato 12.61, Onion 5.62, Sweet pepper 4.79, Parsley 3.28, Salt 0.73, Oil 1.01, Spice 0.45, Limes 0.15
Kofta	Minced meat 56.48, Onion 18.88, Parsley 6.31, Tomato 15.23, Salt 1.40, Oil 1.14, Spice 0.55
Gabbout	Meat 23.82, Brown flour 12,99, Onion 16.82, Tomato 12.47, Oil 0.82, Salt 0.60, Water 31.71, Spice 0.42
Marag Shabzi	Meat 20.32, White beet 14.56, Leek 6.64, Coriander 4.54, Tomato 5.13, Onion 8.25, Green beans 10.91, Fenugreek 1.36, Limes 0.54, Tomato paste 1.64, Garlic 1.18, Spice 0.25, Water 24.07, Salt 0.61
Qouzi	Lamb 45.01, Rice 15.21, Onion 4.72, Boiled eggs 2.76, Pine seeds 1.45, Almonds 0.95, Oil 1.80, Spices 0.26, Salt 0.96, Saffron 0.01, Rosewater 0.90, Currant 1.29, Cinnamon 0.04, Cardamom 0.05, Water 24.56
Tashreeb	Meat 20.82, Bread 12.46, Potato 14.46, Tomato 11.06, Onion 5.43, Gourd 6.18, Tomato paste 2.05, Water 25.32, Salt 0.93, Limes 0.41, Spice 0.27, Oil 0.81
Chicken-based dishes	
Biryani	Chicken 24.37, Rice 11.25, Potato 9.47, Sweet pepper 6.83, Onion 4.91, Tomato 6.22, Carrot 8.63, Oil 1.69, Salt 0.68, Spice 0.41, Water 25.11, Limes 0.43
Dajaj Belferen	Chicken 53.23, Tomato 9.06, Potato 21.28, Carrot 7.12, Onion 8.42, Salt 0.58, Spice 0.30
Fish-based dishes	
Hameset Rubyan	Shrimp 54.05, Coriander 4.92, Tomato 18.00, Onion 17.42, Garlic 2.54, Oil 1.39, Spices 0.38, Salt 1.10, Limes 0.20
Samak Mashwi	Fish 69.15, Dates 4.58, Onion 10.38, Garlic 2.62, Coriander 4.37, Salt 1.60, Spice 0.61, Limes 0.15, Water 6.53
Sweet	
Balaleet	Vermicelli 25.99, Eggs 13.46, Sugar 11.52, Oil 2.85, Cardamom 0.25, Saffron 0.05, Rosewater 1.26, Salt 0.44, Water 44.81
Okaili	Brown flour 31.94, Eggs 26.61, Milk 16.37, Sugar 11.64, Rose water 4.32, Oil 7.03, Saffron 0.07, Cardamom 0.37, Bicarbonate 0.19, Sesame 1.46
Rangena	Dates 64.81, White flour 21.48, Butter 12.37, Cinnamon 1.34
Tamrea	Dates 80.81, White flour 10.85, Butter 9.28
Vegetables	
Mixed salad	Tomato 22.56, Cucumber 19.89, Sweet pepper 14.34, Carrot 8.57, Parsley 5.89, Lettuce 24.93, Salt 0.24, Lemon juice 1.49, Oil 2.08
Cereal-based dishes	
Mashkoul	Rice 29.62, Onion 6.97, Oil 1.51, Salt 1.85, Water 60.00, Spices 0.05
Khoubiz Ragag	Brown flour 46.15, Fat 4.30, Salt 0.63, Cardamom 0.30, Water 48.62
Khoubiz	Brown flour 55.76, Sesame 5.12, Yeast 0.72, Salt 0.64, Water 37.76
Macaroni Bil Bashamel	Macaroni 24.53, Minced meat 20.31, Onion 11.47, Tomato 21.02, White flour 2.46, Eggs 2.20, Milk 13.15, Butter 4.10, Spice 0.26, Salt 1.01, Water 1.73
Mashkoul Bil Bathengen	Rice 28.94, Aubergine 22.13, Onion 8.89, Potato 19.12, Tomato 12.63, Salt 0.82, Oil 7.23, Spice 0.24

Numbers after each ingredient represent weight of each ingredient as percentage of total weight of ingredients.

analysis. The remaining sample was freeze-dried (Unitop 800 L, Virtis), ground and kept in tight bottle containers in a deep freeze (−18°C) for further analysis.

Sample preparation

The freeze-dried samples (1.0 g each) were defatted with petroleum ether three times with 25 ml portions before milling. After the weight loss due to fat and/or water was measured, the samples were ground to < 0.5 mm by a cemotic mill (Tecator, Sweden). The sweet dishes, which are high in sugar content, were extracted three times each with 10 volumes of 85% methanol to remove sugars, lyophilized overnight until dry and weighed to determine loss due to sugars. The samples were then dried at 70°C in a vacuum oven and stored at room temperature in airtight vials.

Dietary fiber analysis

Soluble (SDF), insoluble (IDF) and total (TDF) dietary fiber were determined by an enzymatic–gravimetric method according to Prosky *et al.* (1988), (1992).

Duplicate test samples were sequentially treated for starch gelatinization and enzymatic starch and protein digestion in three incubation steps: heat stable α-amylase (or termamyl) (1500–3000 units mg^{-1} protein; Sigma Chemical Co.) at 100°C, 30 min, pH 6.0; amyloglucosidase (5000–8000 units ml^{-1}; Sigma Chemical Co.) at 60°C, 30 min, pH 4.0–4.6; and protease (7–15 units mg^{-1} protein; Sigma Chemical Co.), pH 7.5. The enzyme digestate was then filtered using acid-washed celite on a Fibertec system E1023 filtration unit (Tecator, Sweden). For IDF and SDF, after the enzyme digestate is filtered, the residue left is the IDF and the filtrate is the SDF. For SDF, filtrate is precipitated with 95% ethanol before filtering. TDF, IDF and SDF residue values are all corrected for undigested protein, ash and blank. Crude protein was determined as nitrogen×6.25; nitrogen was measured by a micro-Kjeldahl method (Kjeltec, Model 1035 analyser). Ash was determined by incinerating at 600°C in a muffle furnace for 6 h.

Statistical analysis

Analysis of variance (ANOVA) and Duncan's multiple range test were performed by computer using Statistical Analysis Systems Institute methods (SAS, 1991).

RESULTS AND DISCUSSION

Information on the major ingredients of the 21 composite dishes investigated are presented in Table 1 and include seven meat-based dishes (all lamb meat), chicken-based, two seafood-based, four sweets, one green salad and five cereal-based dishes. Except for the sweets, which are usually consumed both at lunch and/or dinner, most of the dishes are commonly consumed at lunch, the main meal of the day in the GCC countries (Saudi Arabia, Kuwait, United Arab Emirates, Oman, Bahrain, Qatar), and less frequently at dinner.

Table 2 presents the dietary fiber content (soluble, insoluble and total dietary fiber). The TDF content of the meat-based dishes ranges from 2.0 to 5.4 g per 100 g fresh weight with an average of 3.5 ± 1.3722 g per 100 g ($n = 14$) fresh weight. The IDF was the major dietary fiber fraction, ranging from 1.2 to 3.4 with an average of 2.2 ± 0.7687 g per 100 g ($n = 14$) fresh weight. The SDF content ranged from 0.30 to 2.3, with an average of 1.3 ± 0.6913 g per 100 g ($n = 14$) fresh weight. In addition to meat, all these dishes contain varying amounts of different vegetables and grains, mostly Basmati rice (Warag Enab, Mahshi Bil Koosa, Quoozi) and all-wheat flour or bread (Gabbout, Tashreeb).

In the literature, the existing databases of food composition contain only limited information on dietary fiber. In addition, discrepancies still exist in the data available on the dietary fiber contents of different foods for several reasons, the most important being: the method of fiber analysis; the variety, maturity or portion of the plant analysed; the processing of the food before analysis. Few studies have compared the effects

Table 2. Insoluble, soluble and total dietary fiber of Kuwaiti composite dishes (g per 100 g fresh weight)

Dish	Insoluble	Soluble	Total
Meat-based dishes			
Warag Enab	2.4 ± 0.046	1.4 ± 0.043	3.8 ± 0.1904
Mahshi Bil Koosa	1.2 ± 0.161	0.9 ± 0.028	2.1 ± 0.1760
Kofta	2.9 ± 0.047	1.6 ± 0.073	4.6 ± 0.2163
Gabbout	1.5 ± 0.065	0.5 ± 0.001	2.0 ± 0.0952
Marag Shabzi	3.4 ± 0.092	2.0 ± 0.109	5.4 ± 0.2884
Qouzi	1.7 ± 0.097	0.3 ± 0.021	2.0 ± 0.2286
Tashreeb	2.5 ± 0.041	2.3 ± 0.071	4.8 ± 0.0971
Chicken-based dishes			
Biryani	2.4 ± 0.055	0.4 ± 0.021	2.8 ± 0.0809
Dajaj Belferen	2.3 ± 0.059	0.3 ± 0.022	2.6 ± 0.0916
Fish-based dishes			
Hameset Rubyan	2.1 ± 0.018	1.1 ± 0.018	3.2 ± 0.0274
Samak Mashwi	2.2 ± 0.019	0.4 ± 0.009	2.6 ± 0.0186
Sweet			
Balaleet	1.8 ± 0.062	0.7 ± 0.029	2.5 ± 0.0652
Okaili	3.3 ± 0.058	1.6 ± 0.081	4.9 ± 0.0311
Rangena	4.6 ± 0.031	0.9 ± 0.022	5.5 ± 0.1210
Tamrea	7.1 ± 0.065	1.2 ± 0.044	8.2 ± 0.1122
Vegetables			
Mixed salad	3.0 ± 0.011	0.9 ± 0.018	3.9 ± 0.0285
Cereal-based dishes			
Mashkoul	0.8 ± 0.018	0.6 ± 0.021	1.4 ± 0.0495
Khoubiz Ragag	4.7 ± 0.175	0.9 ± 0.062	5.8 ± 0.2049
Khoubiz	4.8 ± 0.169	1.6 ± 0.056	6.3 ± 0.3146
Macaroni Bil Bashamel	1.7 ± 0.038	1.0 ± 0.039	2.7 ± 0.0407
Mashkoul Bil Bathengen	2.2 ± 0.028	0.9 ± 0.016	3.1 ± 0.1151

Values are given as mean ± standard deviation.

of variety, processing or cooking on dietary fiber content (Marlett, 1992; Valverde & Frias, 1991; Philips & Palmer, 1991; Mullin & Smith, 1991); however, the generally similar concentrations of fiber expressed as g per 100 g fresh weight within a food group (e.g. fruits, vegetables, refined grains and legumes) suggest that an average fiber concentration for that group can be used to rank the food sources of dietary fiber and/or intakes into low, medium or high. However, the typical intake of these dishes is not 100 g, and the classification of low, medium and high that is being used here for comparison purposes should not give the wrong perception that the dietary fiber content of those dishes considered to be moderate sources of dietary fiber. Consequently, when the TDF contents of the meat dishes are compared with published data of the TDF of the individual major ingredients (fresh) of the recipes (Marlett, 1992; Dreher, 1987), the TDF of these dishes may be slightly higher, probably due to some or all of the reasons mentioned, such as cooking and/or freezing–drying, method of TDF analysis or to the difference of the varieties, maturity, and parts of the plants analysed. Similarly, the mean proportions of soluble fiber are also slightly higher than published data, although most of the data reports on the fresh rather than the cooked ingredients.

The mean TDF of the dishes Biryani and Dajaj Belferen (2.7 ± 0.1331 g, $n = 4$) as well as Hameset Rubyan and Samak Mashwi (2.9 ± 0.2901 g, $n = 4$) can be considered as a moderate source of dietary fiber although its TDF contents are slightly less than those of the meat-based dishes. The SDF and IDF contents of the same dishes range from 0.31 to 1.07 g per 100 g (0.4 ± 0.0620 g) and 2.3 to 2.4 (2.40 ± 0.1437 g), and from 0.4 to 1.1 (0.8 ± 0.3900 g) and 2.1 to 2.2 (2.2 ± 0.1017 g) respectively, with the SDF mean proportion constituting about 24% of the TDF. The rice and/or vegetables are the sources of dietary fiber in these dishes.

As for the sweet dishes, the TDF content ranges from 2.5 to 8.2 g per 100 g (5.3 ± 2.2200 g, $n = 10$). The dish 'Tamrea' has the highest TDF content with the major ingredient being dates, representing over 80% of the weight of the recipe. Among the dried fruits, dates contain about 8.7 g dietary fiber per 100 g (Lintas & Cappeloni, 1992). Also, dates are the major ingredient ($\approx 65\%$ of the weight of the recipe) of the dish 'Rangena', and are a major contributor to its high TDF content. The ratios of SDF to TDF of the dishes Tamrea and Rangena are both about 16.0, which is close to the ratio of SDF to TDF of dates, $\approx 14\%$ cited in the literature (Lintas & Cappeloni, 1992). As for the dish 'Quors Okaili' (TDF 4.91), its high dietary fiber content is mainly due to the wholemeal flour in the recipe, representing about 32% of the total ingredients. Wholemeal flour was reported to contain about 11.8 g TDF per 100 g (Dreher, 1987). In the dish 'Balaleet', the dietary fiber is mainly from vermicelli, which is a major ingredient of the recipe.

With respect to the cereal-based dishes, the TDF content ranges from 1.4 to 6.3 (3.9 ± 1.9523 g, $n = 10$), with 'Khoubiz' and 'Khoubiz Ragag' being the highest. The main dietary fiber source in these dishes is wholemeal flour, representing 58% and 46% of the weight of the recipes of these two dishes, respectively. The ratios of SDF to TDF are about 25% and 16% for dishes 'Khoubiz' and 'Khoubiz Ragag', respectively, which is close to the same ratio in the literature for wholemeal flour (25%) (Dreher, 1987). The main source of dietary fiber in 'Mashkoul' is rice ($\approx 30\%$ of the weight of the recipe), in 'Macaroni Bil Bashamel' macaroni, flour and vegetables, and in 'Mashboul Bil Bathengen' rice and different vegetables. As for the dish 'Vegetables' (mixed salad), the fiber sources are the different vegetables, including parsley (6% of the weight of the recipe).

ANOVA was carried out to study the intervariation of the dietary fiber content among the different types of dishes (e.g. meat, chicken, seafood, etc.). Significant differences were found among the various types of dishes with respect to all of the dietary fiber components, i.e. IDF, SDF and TDF. Using Duncan's multiple range test at a significant level of $\alpha = 5\%$, revealed that the sweet dishes, having the highest IDF and TDF mean contents, were significantly different from the chicken, meat and seafood dishes for IDF content and from the seafood and chicken for the TDF content, whereas the SDF content of the meat dishes was significantly different from that of the chicken dishes.

Duncan's multiple range test carried out to determine the intravariation among individual dishes in the different categories (e.g. M1, M2, M3, M4, M5, M6, M7, etc.) showed that the sweet dish Tamrea and the cereal-based dish Mashkoul, containing the highest and lowest levels of IDF and TDF, respectively, were significantly different from all other dishes; whereas the meat dish, Tashreeb, and the chicken dish, Biryani, containing the highest and lowest contents of SDF, respectively, were significantly different from all other dishes.

Data on food consumption intake of the different age groups of the population in Kuwait are still lacking; however, typical individual portions of these composite dishes (average TDF of the 21 dishes is 3.7 g per 100 g), ranging from 300 to 400 g, will supply about 11.2–14.9 g TDF per 100 g, which is considered as a moderate source of dietary fiber (CACDF, 1985). The consumption of other food items, including bread, will also add to the TDF intake.

Based on data obtained, the dietary fiber content of the 21 composite dishes investigated indicates that most of them contain 2–4 g dietary fiber per 100 g fresh weight (i.e. moderate contents of dietary fiber). However, sizeable portions of these dishes, 300–600 g, are usually eaten during a meal. Hence, the dietary fiber contribution of these dishes becomes substantial when compared to the recommended daily dietary fiber intake. Divergent serving sizes, however, may increase the variation of the dietary fiber intake from these

dishes. The recommended dietary fiber intake of 20–35 g per day can possibly be met by consuming a wide variety of foods and might be a feasible goal in a country like Kuwait, with a great abundance of food, particularly fruits and vegetables, all the year round, and the traditional habit of eating wheat bread. But, in the absence of food consumption data, any projections on the intake of TDF by the population will not be accurate,and thus warrants the necessity for generating such data.

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