

Chemical Composition and Nutritional Quality of Commonly Consumed Traditional Omani Foods and Composite Dishes

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Abstract

Traditional foods are an important part of the folklore of a country and play a significant role in meeting the nutritional requirements of different populations. The traditional Omani dishes are generally prepared in a fairly simple way. The use of various marinades and spices to infuse flavor particularly in meat dishes distinguishes them from meals of other Arab countries. Twenty-six traditional and commonly consumed Omani dishes were analyzed for their chemical composition, nutritional quality and contribution of nutrients per portion size. These traditional foods and dishes may be grouped into various categories based on their contribution to different nutrients such as carbohydrate, protein and energy-rich foods/dishes. A wide variability was observed in the moisture, protein, fat, ash, total carbohydrate and gross energy contents of these dishes. The moisture, protein, fat and total carbohydrate contents of these traditional foods/dishes ranged between 20.47 to 82.01%, 3.42 to 29.34%, 0.91 to 38.50% and 0.17 to 75.04% respectively. Various types of breads and other cereal-based dishes are the main sources of carbohydrates; whereas meat-based dishes contribute to protein. The meat-based dishes are rich in fat and contributed to higher caloric values. The amounts of macronutrients (carbohydrates, protein, and fat) on per serving basis have also been calculated. The data presented here on chemical composition and nutritional quality of traditional Omani foods/dishes, is not only of great significance for developing the nutrient composition tables in daily meal planning but is also useful in planning and developing special therapeutic diets for developing nutritional intervention programs.

Keywords: Traditional Omani Foods/Dishes; Chemical Composition; Nutritional Quality

Introduction

Traditional foods may be defined as the foods, which are locally available, ethnically and culturally acceptable and confirm to the established traditional practices of preparation/processing and ingredient specifications. They reflect the culture, traditions, geographical location environmental features and culinary practices, supporting the taste and good health of a society. They are consumed by a large segment of the community in their everyday diet over extended periods of time. The cultures, which principally continued eating their traditional foods enjoyed better health than those who turned to modern Western-style readymade refined/processed foods. Traditional foods exhibit the creativity and treasure of food heritage, food culture and differentiate the local dietary patterns from others as well as

help in understanding, maintaining and protecting the food resources and values. Generally, they focus on four basic principles: avoidance of modern, refined and processed foods; adherence to unrefined, whole and natural foods; respecting the importance of nutrient-density in daily diet plan as well as preparing and consuming foods in the same ways as our ancestors did that kept them well. With the changing consumer's trends and attitudes for better food quality and health, the traditional food products are gaining popularity in the growing food market [1].

Several factors, such as the visual food cues in the eating environment, the hedonic value of food as well as an individual's energy status, can influence the intake of food [2,3]. The dietary intake patterns are governed by food production, availability, geographic location, occupation, economic status, culture, customs and traditional practices. The overall physical, mental, emotional and spiritual health as well as nutritional status of a person may depend upon the foods consumed associated with their tradition and culture. The typical food preparation methods for traditional foods are part of the folklore of a country or a region. Many of such traditional foods play important role in daily diet/meal planning and make significant contributions in meeting the nutritional requirements of low-income rural populations, particularly for those living in remote areas such as in deserts or mountains. Some of the traditional foods have become extinct and some are endangered due to urbanization, mechanization, migration, increased number of working women, and modified eating habits. There is a gradual shift from traditional foods to modern easy to prepare or ready-made foods. A decline in the consumption of traditional foods was observed among the native Canadians, Nuxalks of Bella Coola, in British Columbia indicating a lower of traditional food recipes [4]. Tongans prefer healthier traditional foods and consider them as more nutritious [5]. Although distinct dietary patterns still exist in different population groups of India, the food consumption patterns in India have changed over the past years. With the increase in availability and demand for Western-style readymade fast foods, the people in India, in particular the adolescents are now consuming more fast foods as compared to traditional foods [6]. Similar trends have been reported from Pakistan, which have been related to various population characteristics [7]. Oman has rich heritage of tradition and culture and represents a fine mix of several ethnic groups from Asia and Africa. Arabic cuisines are generally valued for their ethnicity and aroma. However, Omani cuisine is somewhat distinct from other Arab states as the long traditions of maritime and trade brought many culinary influences from several different regions to Sultanate, which have been adopted, practiced overtime and transformed into delicacies and ethnic taste of Oman. The Omani dishes are simple in their ingredient composition, preparation methods, and use of herbs and spices. Wheat and rice are the two staple foods in Oman. However, fish, chicken, mutton, vegetables and legumes-based dishes are also regularly consumed. Omani coffee (Kahwa) mixed with cardamom powder is a very popular drink and is often served with dates and Omani halwa, as a symbol of hospitality [8]. Laban (buttermilk), other yoghurt drinks, and fruit juices flavoured with cardamom and pistachio and nuts, are also popular.

The importance of food composition tables, for the analysis and evaluation of human diets is well recognized by all levels of governments, consumer's organizations as well as the individual consumers throughout the world [9-11]. The nutrients profiling of traditional foods and composite dishes is essential in order to accurately estimate the population's dietary intakes and identify the role of these foods in health and disease prevention. It has been suggested that a common methodology should be used to evaluate the nutrient contents of traditional foods for promoting the local biodiversity for sustainable healthy diets [10,12]. The Gulf Cooperation Council (GCC) countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and UAE) are making substantial efforts not only to increase their food production to meet the nutritional needs but also to improve the dietary eating patterns to promote health and well-being of their population [13-15]. Several attempts have been made to evaluate the chemical composition and nutritional quality of Saudi Arabian traditional foods and dishes based on cereals, legumes and meat [16-19]. The chemical composition and nutritional quality of some traditional foods and dishes from other GCC countries has also been documented [20-27]. Traditional Arabian Gulf-dishes are reported to contain high moisture, low protein, high fat, variable carbohydrates and low level of minerals [24]. Musaiger, *et al.* [28] reported the chemical composition of some traditional Omani dishes and observed that they were low in dietary fiber, iron and zinc and high in sodium and fats as compared to traditional dishes from other Arab-Gulf countries. Ali, *et al.* [29] evaluated the chemical composition and glycemic index of some traditional Omani breads. However, very limited information is available about the chemical composition and nutritional value of many traditional

and commonly consumed Omani foods and composite dishes. There is an urgent need to study and document the chemical composition and nutritional quality of traditional Omani foods and composite dishes and to develop a nutrient profiling database. This will not only be useful in making healthy meal plans for individuals but will also be helpful for developing nutrition intervention programs based on these traditional foods to promote the health and well-being of the Omani community. It will also help to preserve the essence of culture, ethnicity and tradition related to local eating patterns. The present study was therefore conducted to ascertain the chemical composition and nutritional value of commonly consumed traditional Omani foods and composite dishes.

Materials and Methods

Procurement and preparation of foods and composite dishes

Twenty-six traditional Omani foods and composite dishes were evaluated. Some of these foods were purchased from the local markets in Muscat, whereas the others were prepared according to homemade recipes in the experimental kitchen (Table 1). Representative samples of these foods and composite dishes were used for the analysis of their chemical composition. The moisture, ash, crude protein, crude fat and crude fiber contents were determined by The Official Methods of Analysis of AOAC International [30]. The nitrogen-free extract (NFE) content representing the amount of carbohydrates was estimated by subtracting the sum of the percentages of all other proximate components from 100 (i.e. % total carbohydrate = 100 - (% moisture + % crude protein + % crude fat + crude fiber + % ash). The gross energy (GE) content was calculated by using the formula, $GE \text{ (Kcal/100g)} = \text{Protein} \times 4 + \text{fat} \times 9 + \text{NFE} \times 4$.

Statistical analysis

The data was statistically analyzed using one-way analysis of variance (ANOVA) and the means were compared as described by Snedecor and Cochran [31] using the least significant difference (LSD). The data is presented either as percentages (%) or as means \pm standard deviation (SD). All the statistical analyses were carried using SPSS v.16.0 software.

Results

Chemical composition of traditional Omani dishes

The chemical composition of traditional Omani foods and composite dishes is presented in table 2. Large differences were observed in the moisture content of the traditional foods and composite dishes ranging from 5.19 to 82.01%. The moisture content in various types of breads ranged between 26 - 37% apart from a special type of dry bread Al-Kaak (a thick dried bread from Salalah, Dhofar region of Oman), which showed the least amount of moisture only 5.19%. We observed significantly higher percentage of protein in traditional foods. The protein contents in breads ranged between 8 - 11%, while in meat and chicken Harees, it was observed as 3.87 and 3.91%, respectively. The crude protein contents in chicken and meat Biryani were 11.28% and 10.39% respectively, whereas the only chicken from chicken Biryani had 28.37% protein. A wide range of fat content (0.91% to 12.76%,) was observed in different dishes, except for Majeen (dried meat dish). The fat content in Harees (with meat) and Harees (with chicken) was found to be 1.36% and 1.35% respectively. The crude fiber content in the traditional Omani dishes ranged from 0.89% to 2.51%, being the highest in Al-Kaak and the least in Rekhla. The ash content among different dishes was ranged from 0.61% to 2.72%. All types of breads evaluated in this study showed a good amount of ash content. The ash content of meat-based foods and dishes was low. The energy values of various traditional Omani dishes ranged from 71 kcal to 467 kcal per 100g of food sample, being the lowest (71 Kcal) in Harees (with meat) followed by Harees (with chicken) and Arsiya (77 Kcal/100g) and the highest (467 Kcal per 100g) in Majeen.

Table 4 shows the amounts of nutrients (carbohydrates, proteins and fats in grams) per serving of traditional and commonly consumed Omani. The least amount of per serving carbohydrate was observed in Majeen (0.21 gm), while highest amount was in rice of Kabuli (37.14 gm). Similarly, the highest and least per serving protein were 17.02 gm in Chicken Biryani, 1.51% in Goleh plain, respectively. Majeen produced 11.52 gm per serving fat and it was the highest of all the dishes, whereas the least 0.23 gm, per serving fat was noted in brown Khubz Lebanani. The carbohydrate, fat and protein content per serving in breads (White bread, Brown bread, White Khubz Leba-

Table 1: The list of ingredients used for the preparation of traditional Omani dishes.

| Traditional dishes | Ingredients used |
|-----------------------------------|---|
| White Toast Bread | Wheat Flour 2 cups, salt 1 tsp (teaspoon), sugar 1 tsp, yeast 1 tsp, milk 1 cup, butter, 3 tsp, egg 1 |
| Brown Toast Bread | Whole wheat Flour 2 cups, salt 1 tsp, sugar 1 tsp, yeast 1 tsp, milk 1 cup, butter, 3 tsp, egg 1 |
| White Khubz Lebanani | wheat Flour 1 cups, salt 1.5 tsp, sugar 1 tsp, yeast 2 tsp, |
| Brown Khubz Lebanani | Whole wheat Flour 1 cups, salt 1.5 tsp, sugar 1 tsp, yeast 2 tsp |
| Chapati (without oil) | Wheat flour 3 cups, salt 0.5 tsp, water 1 cup |
| Chapati (with oil) | Wheat flour 3 cups, salt 0.5 tsp, water 1 cup, butter fat (ghee) to fry 50g |
| Paratha | Wheat flour 3 cups, salt 0.5 tsp, water 1 cup, oil to fry 100g |
| Rekhal (without oil) | Wheat Flour 500g, water 350 ml, salt 2g |
| Rekhal (with oil) | Wheat Flour 500g, water 350 ml, salt 2g, butter fat (ghee) 50g |
| Goleh plain (type of Omani bread) | Wheat flour 1 cup, water 1 cup, salt 0.5tsp, date molasses 2 cup, butter fat (ghee) 1tsp |
| Goleh (with garlic) | Wheat flour 1 cup, water 1 cup, salt 0.5tsp, date molasses 2 cup, butter fat (ghee) 1tsp, garlic 4 pieces |
| Goleh (with onions) | Wheat flour 1 cup, water 1 cup, salt 0.5tsp, date molasses 2 cup, butter fat (ghee) 1tsp, garlic, 1 onion |
| Thakhin (Thick bread, Salalah) | Whole wheat flour, ghee, sugar, salt |
| Al-Kaak (Dry bread, Salalah) | White Wheat flour, cardamom, white sugar, ghee, black cumin, water |
| Majeen (Dried meat, Salalah) | Beef fried with beef tallow in proportion of 4:1 |
| Harees with meat | Meat 100g, wheat 100g, water 600 ml, salt 2g, clove 2g, cardamom 2g, black pepper 2g, water 800 ml |
| Harees with chicken | Chicken boneless 100g, wheat 90g, salt 2g, clove 2g, cardamom 2g, black pepper 2g, water 800ml |
| Arsiya | Chicken 100g, ghee 58g, salt 25g, water 400 ml |
| Thareed | Chicken 105g, minced onions 30g, potatoes 50g, tomato paste 10g, salt 2g, garlic 5g, green pepper 1g, minced green coriander 1g, ground dried lemon 1g, Rekhal bread 100g, oil 50 ml, water 1000 ml |
| Kabuli Chicken | Chicken 75g, rice 100g, onions 30g, tomato paste 30g, tomatoes 20g, garlic 2g, salt 1g, mixed spices turmeric powder 1g, salt 2g, cinnamon 1g, cloves 1g, black pepper 1g, yogurt 1tsp, |
| Biryani (with chicken) | Rice 100g, chicken 70g, onions 30g, tomatoes 40g, garlic 5g, water 300 ml, potatoes 50g, turmeric powder 1g, salt 2g, cinnamon 1g, cloves 1g, black pepper 1g, yogurt 1tsp, |
| Biryani (with meat) | Rice 100g, meat 70g, onions 30g, tomatoes 40g, garlic 5g, water 300 ml, potatoes 50g, turmeric powder 1g, salt 2g, cinnamon 1g, cloves 1g, black pepper 1g, yogurt 1tsp, lemon 2g |
| Rice of Kabuli | Only rice of Kabuli chicken was analyzed separately |
| Chicken of Kabuli | Only chicken of Kabuli chicken was analyzed separately |
| Rice of Biryani | Only rice of biryani chicken was analyzed separately |
| Chicken of Biryani | Only chicken of biryani was analyzed separately |

Table 2: Proximate chemical composition of traditional and commonly consumed Omani dishes.

| Traditional dishes | Moisture (%) | Crude protein (%) | Crude fat (%) | Crude fiber (%) | Ash (%) | NFE (%) | Energy (kcal/100g) |
|-------------------------------------|--------------|-------------------|---------------|-----------------|-------------|---------|--------------------|
| White Toast Bread | 30.33 ± 3.72 | 8.22 ± 0.43 | 1.22 ± 0.37 | 1.24 ± 0.12 | 1.51 ± 0.18 | 57.48 | 273.78 |
| Brown Toast Bread | 36.85 ± 3.58 | 9.02 ± 0.41 | 1.16 ± 0.32 | 1.49 ± 0.33 | 1.77 ± 0.22 | 49.71 | 245.36 |
| White Khubz Lebanani | 25.79 ± 1.27 | 9.22 ± 0.66 | 0.96 ± 0.34 | 1.01 ± 0.02 | 1.24 ± 0.24 | 61.78 | 292.64 |
| Brown Khubz Lebanani | 29.41 ± 1.39 | 10.18 ± 0.35 | 0.91 ± 0.22 | 1.02 ± 0.23 | 1.78 ± 0.61 | 56.70 | 275.71 |
| Chapati without oil | 27.25 ± 0.35 | 10.51 ± 0.43 | 3.91 ± 0.27 | 1.53 ± 0.24 | 2.27 ± 0.25 | 54.33 | 295.35 |
| Chapati with oil | 25.43 ± 2.16 | 10.13 ± 0.39 | 6.73 ± 1.19 | 1.51 ± 0.20 | 1.89 ± 0.33 | 54.31 | 318.33 |
| Paratha | 30.66 ± 2.18 | 8.50 ± 0.45 | 11.25 ± 0.63 | 1.43 ± 0.38 | 1.38 ± 0.21 | 46.78 | 322.37 |
| Rekhal (without oil) | 21.57 ± 0.39 | 10.10 ± 0.63 | 3.77 ± 0.41 | 0.89 ± 0.21 | 2.72 ± 0.39 | 60.95 | 318.13 |
| Rekhal (with oil) | 20.47 ± 2.77 | 8.38 ± 0.95 | 8.39 ± 1.31 | 0.96 ± 0.23 | 2.65 ± 0.23 | 59.15 | 345.63 |
| Goleh plain (a type of bread) | 50.71 ± 2.07 | 6.31 ± 0.94 | 7.05 ± 0.93 | 1.23 ± 0.04 | 1.99 ± 0.62 | 32.71 | 219.53 |
| Goleh with garlic (a type of bread) | 53.18 ± 0.29 | 7.41 ± 0.73 | 7.67 ± 1.19 | 1.25 ± 0.05 | 1.86 ± 0.44 | 28.63 | 213.19 |
| Goleh with onions (a type of bread) | 54.69 ± 1.72 | 6.85 ± 0.60 | 4.73 ± 1.33 | 1.22 ± 0.05 | 2.08 ± 0.39 | 30.43 | 191.69 |
| Thakhin (Thick bread from Salalah) | 21.67 ± 2.13 | 8.27 ± 0.48 | 8.40 ± 0.68 | 1.56 ± 0.34 | 1.62 ± 0.13 | 58.48 | 342.60 |
| Al-Kaak (Dry bread Salalah) | 5.19 ± 0.55 | 9.67 ± 0.73 | 6.33 ± 0.36 | 2.29 ± 0.57 | 2.51 ± 0.43 | 75.04 | 395.81 |
| Majeen (Dried meat from Salalah) | 26.65 ± 1.03 | 29.34 ± 1.53 | 38.50 ± 3.63 | 2.51 ± 0.17 | 2.51 ± 0.17 | 0.71 | 466.70 |
| Harees (with meat) | 80.86 ± 1.58 | 3.87 ± 0.89 | 1.35 ± 0.23 | 0.82 ± 0.25 | 0.82 ± 0.25 | 12.13 | 76.15 |
| Harees (with chicken) | 82.01 ± 2.59 | 3.91 ± 1.08 | 1.36 ± 0.28 | 0.79 ± 0.16 | 0.79 ± 0.16 | 10.87 | 71.36 |
| Arsiya | 81.33 ± 1.35 | 4.21 ± 0.82 | 1.76 ± 0.59 | 0.61 ± 0.14 | 0.61 ± 0.14 | 10.97 | 76.56 |
| Thareed | 77.45 ± 2.93 | 5.63 ± 1.42 | 3.19 ± 0.73 | 1.74 ± 0.33 | 1.74 ± 0.33 | 10.05 | 91.43 |
| Kabuli Chicken | 58.48 ± 2.24 | 12.20 ± 1.17 | 5.85 ± 1.31 | 1.27 ± 0.12 | 1.27 ± 0.12 | 21.16 | 186.09 |
| Biryani (with chicken) | 61.55 ± 1.98 | 11.28 ± 2.17 | 6.15 ± 0.93 | 1.32 ± 0.23 | 1.32 ± 0.23 | 18.52 | 174.55 |
| Biryani (with meat) | 64.62 ± 1.47 | 10.39 ± 2.93 | 6.33 ± 0.79 | 1.35 ± 0.49 | 1.35 ± 0.49 | 15.94 | 162.29 |
| Rice of Kabuli | 59.81 ± 0.53 | 3.42 ± 0.36 | 3.93 ± 0.39 | 0.78 ± 0.15 | 0.78 ± 0.15 | 30.95 | 172.85 |
| Chicken of Kabuli | 53.88 ± 2.71 | 27.99 ± 0.75 | 12.76 ± 1.82 | 1.90 ± 0.41 | 1.90 ± 0.41 | 1.79 | 233.96 |
| Rice of biryani | 61.58 ± 0.56 | 3.59 ± 0.24 | 3.32 ± 0.24 | 0.98 ± 1.03 | 0.98 ± 0.13 | 29.44 | 162.00 |
| Chicken of Biryani | 56.02 ± 2.76 | 28.37 ± 1.05 | 11.14 ± 1.18 | 1.31 ± 0.21 | 1.99 ± 0.19 | 1.17 | 218.42 |

Table 3: The scientific, English and Arabic names of the ingredients used in the preparation of traditional dishes.

| English name | Scientific name | Arabic name |
|--------------|---------------------------------|--------------|
| Wheat | <i>Triticum aestivum</i> | Qamah |
| Rice | <i>Oryza sativa</i> | Ruz |
| Potato | <i>Solanumtuberosum</i> | Batatah |
| Tomato | <i>Lycopersicum esculantum</i> | Tamatem |
| Date | <i>Phoenix dactylifera</i> | Balah |
| Garlic | <i>Allium sativum</i> | Thum |
| Onion | <i>Allium sepa</i> | Bassal |
| Cumin | <i>Cuminum cyminum</i> | Kumun |
| Cardamom | <i>Elettaria cardamomum</i> | Hab el hal |
| Black pepper | <i>Piper nigrum</i> | Fulfulaswad |
| Turmeric | <i>Curcuma logum</i> | Kurkum |
| Clove | <i>Eugenia caryophyllata</i> | Qurunfiljaaf |
| Cinnamon | <i>Cinamomum zeyalaniuem</i> | Qirfah |
| lemon | <i>Citrus limon</i> | laymun |
| Yeast | <i>Saccharomyces cerevisiae</i> | Yeast |
| Yoghurt | - | Rob |
| Milk | - | Haleeb |
| Sugar | - | Sukkar |
| Salt | - | Maleh |
| Egg | - | Baith |
| Beef | - | Laham |
| Meat | - | Laham |
| Chicken | - | Dajaj |

nani, Brown Khubz Lebanani, and Chapati) ranged between 12.23 to 15.45, 0.24 - 1.68 and 2.06 - 2.63g, respectively. In Harees with meat and chicken per serving carbohydrate, fats and protein values were comparable. Meat and chicken-based dishes not only showed excellent amount of protein and fat per serving, but also per serving carbohydrate.

Discussion

Chemical composition of traditional Omani dishes

The chemical composition of Traditional Omani foods and composite dishes is presented in table 2. Large differences were observed in the moisture content of these traditional foods and composite dishes ranging from 5.19 to 82.01%, which may be attributed to their ingredient composition as well as due to variability in preparation methods. The moisture content in various types of breads ranged between 26 - 37% except for a special type of dry bread Al Kaak (a thick dried bread from Salalah, Dhofar region of Oman), which showed the least amount of moisture only 5.19%. The baked breads generally contain about 35% of moisture as has been indicated from our results too. The moisture content in breads plays significant role in the quality of breads. The high moisture content not only encourages the microbial proliferation leading to quick spoilage of foods but may also affect the gelatinization of starch. However, enough amounts of moisture are

Table 4: Amount of nutrients per serving in traditional Omani dishes.

| Traditional dishes | Amount per serving (g) | Protein (g) | Fat (g) | Carbohydrates (g) | Gross energy (kcal) |
|--------------------------------|------------------------|-------------|---------|-------------------|---------------------|
| White Toast Bread | 25 | 2.06 | 0.31 | 14.37 | 69 |
| Brown Toast Bread | 25 | 2.26 | 0.29 | 12.43 | 61 |
| White Khubz Lebanani | 25 | 2.31 | 0.24 | 15.45 | 73 |
| Brown Khubz Lebanani | 25 | 2.55 | 0.23 | 14.18 | 69 |
| Chapati (without oil) | 25 | 2.63 | 0.98 | 13.58 | 74 |
| Chapati (with oil) | 25 | 2.53 | 1.68 | 13.58 | 80 |
| Paratha | 25 | 2.13 | 2.81 | 11.70 | 81 |
| Rekhal (without oil) | 25 | 2.53 | 0.94 | 15.24 | 80 |
| Rekhal (with oil) | 25 | 2.10 | 2.10 | 14.79 | 86 |
| Goleh plain | 25 | 1.58 | 1.76 | 8.18 | 55 |
| Goleh (with garlic) | 25 | 1.85 | 1.92 | 7.16 | 53 |
| Goleh (with onions) | 25 | 1.71 | 1.18 | 7.61 | 48 |
| Thakhin (Thick bread, Salalah) | 25 | 2.07 | 2.1 | 14.62 | 86 |
| Al-Kaak (Dry bread, Salalah) | 20 | 1.93 | 1.27 | 15.00 | 80 |
| Majeen (Dried meat, Salalah) | 30 | 8.80 | 11.52 | 0.21 | 140 |
| Harees (with meat) | 120 | 4.64 | 1.62 | 14.55 | 91 |
| Harees (with chicken) | 120 | 4.69 | 1.63 | 13.04 | 86 |
| Arsiya | 90 | 3.78 | 1.59 | 9.87 | 69 |
| Thareed | 90 | 5.07 | 2.88 | 9.06 | 83 |
| Kabuli Chicken with rice | 60 | 10.98 | 5.27 | 18.99 | 167 |
| Biryani (with chicken) | 60 | 10.16 | 5.54 | 16.67 | 158 |
| Biryani (with meat) | 60 | 9.35 | 5.70 | 13.35 | 146 |
| Rice of Kabuli | 60 | 4.10 | 4.72 | 37.14 | 207 |
| Chicken of Kabuli | 60 | 16.80 | 7.66 | 1.08 | 140 |
| Rice of biryani | 60 | 4.31 | 3.98 | 35.33 | 194 |
| Chicken of Biryani | 60 | 17.02 | 6.68 | 0.70 | 138 |

allowed in the finished breads to make them more palatable for longer period of time. Similar results on the moisture content of various traditional foods have been reported in the literature from the Gulf Cooperation Council (GCC) countries [17,18,23,32].

Protein is considered as one of the most important nutrients for humans and animals in growth, development and maintenance. As expected, the highest amount of protein was observed in traditional foods containing animal protein sources such as chicken or meat based composite dishes. The protein contents in breads ranged between 8 - 11%. Our results are in line with those reported by some other studies from the region [33,34]. Cereal grains, particularly, wheat, rice and maize are considered as the staple foods for humans since the advent of agricultural practices in human civilization. They are the main source of energy and protein in our daily diet. The protein content of cereal grains can vary depending upon the variety, geographical and climatic conditions as well as on agricultural production

practices. In addition to this, the cereal proteins are low in certain essential amino acids such as lysine (1.5 - 4.5% vs. 5.5%), tryptophan (0.8 - 2.0% vs. 1.0%), and threonine (2.7 - 3.9% vs. 4.0%) according to the Joint WHO/FAO/UNU Expert Consultation Group recommendations [35]. However, their quality can be improved either by supplementing with limiting amino acids or by preparing composite dishes/meals with legumes. The gluten protein present in wheat plays an overbearing role in bread quality. Its concentration, water absorption capacity, elasticity and extensibility determine the baking quality of wheat flour. Gluten proteins stabilize the gas-containing pores, which are relevant for gas retention and loaf volume and give a chewy texture to bread [36,37]. Breads made from white flour are not considered very nutritious as many of the essential micronutrients are lost in industrial refining of cereal grains, and therefore, should be enriched/restored with lost micronutrients [38].

Harees, also called as Harissa or Jareesh in other countries, is a typical traditional Omani dish that is prepared by boiling cracked or coarsely ground wheat, mixed with meat or chicken. Its consistency varies between porridge and a dumpling. The protein content in meat and chicken Harees was observed as 3.87 and 3.91%, respectively which were in accordance to Habib., *et al.* [25] from United Arab Emirates (UAE) as they reported 3.33% protein in chicken Harees. In contrast to our results, Musaiger., *et al.* [28] however, reported higher amounts of protein (5.4%) in Omani Harees but lower amounts (2.4%) in Saudi Arabian Harees [33]. The crude protein contents in chicken and meat Biryani were 11.28% and 10.39% respectively, whereas the only chicken from chicken Biryani had 28.37% protein. The lesser amount of protein in chicken and meat Biryani could be due to the dilution effect exerted using rice and other ingredients in Biryani preparation. Similar results have been reported by some other studies [18,39,40]. Al Jebrin., *et al.* [18] reported that the protein content of Saudi Arabian cereals and legumes-based dishes ranged from 2.6 - 7.5%. Similar protein content of Pakistani wheat-based dishes was reported by Khan., *et al.* [41,42].

Table 2 shows the fat content in traditional and commonly consumed Omani foods and composite dishes. The data indicates that fat content in different dishes varied from 0.91% to 12.76%, except for Majeen. Majeen is a traditional meat dish from Salalah, Dhofar region of Oman that is prepared by cooking the meat in tallow of meat, until the meat is dried. It contained 38.5% fat, which may be attributed to its preparation method. The fat content in dishes depends on the addition of oil during the food preparation process. The fat content in various traditional Omani dishes was reported to range from 0.3% to 13.4% [28]. The fat contents in Harees (with meat) and Harees (with chicken) was found to be 1.36% and 1.35% respectively, which agree with the previously reported results by Musaiger., *et al.* [28] and Habib., *et al.* [25]. Harees dishes from Saudi Arabia and Kuwait have been reported to contain 0.4% and 2.6% of fat respectively [33]. Our results are in line with these findings.

The crude fiber content in the traditional Omani dishes ranged from 0.89% to 2.51%, being the highest in Al-Kaak and the least in Rekhah. Musaiger., *et al.* [28] reported that the Omani dishes contained a low amount of crude fiber (< 1.0%). A low amount of fiber was also observed in Kuwaiti dishes [33]. As most of the dishes contain high amounts of moisture, which may in turn dilute the concentration of nutrients including the fiber. Vegetables and cereal grains are rich in both soluble (viscous) and insoluble (non-viscous) fiber, with the highest amounts in wheat, oats and corn. The addition of vegetables or cereal grains to meat-based dishes can not only help to improve the overall fiber content in these dishes but may also help to increase the overall daily fiber intake in people [43,44]. The brown bread contained slightly higher fiber content as compared to white bread, which may be due to the higher degree of extraction of fiber during grain milling process. The whole grain-based foods and dishes are therefore recommended in place of the processed ones not only because of the presence of fiber but also because of many functional ingredients such as phytochemicals, minerals, and vitamins [43,45]. The high intake of fiber is inversely related with incidences of chronic diseases such as obesity, hypertension, diabetes, constipation and cardiovascular disorders [44,46,47].

The chemical composition of the traditional Omani dishes showed that there was a wide variation in the ash content among different dishes that ranged from 0.61% to 2.72%. All types of breads evaluated in this study showed a good amount of ash content. The ash content

of meat-based foods and dishes was low, which may be due to use of boneless meat in the preparation of these dishes. The nitrogen free extract (NFE) contents or the total carbohydrates varied from 0.71% to 75.04%, the highest amount was noted in Al Kaak. Our results are in line with findings reported in the literature from various other parts of the world [17,20,34,48]. Because of its high fat content, the traditional meat dish Majeen showed the highest energy content. Overall the low carbohydrate and low-fat contents in the traditional dishes resulted in their lower energy values. The energy values of various traditional Omani dishes ranged from 71 kcal to 467 kcal per 100g of food sample, being the lowest (71 Kcal) in Harees (with meat) followed by Harees (with chicken) and Arsiya (77 Kcal/100g) and the highest (467 Kcal per 100g) in Majeen. The low caloric value of Harees is due to its higher moisture and low-fat content, so the inclusion of Harees in daily diet should be encouraged. The overall variability in the nutrient composition of various traditional Omani foods and dishes may be attributed to type and amount of ingredients used as well as to the method of food preparation.

Incorporation of traditional Omani dishes in healthy meal planning

Food portion sizes are important in meal planning. The estimation of food portion size is a complex process and may influence the evaluation of daily food intake [49]. Without an accurate portion size estimate, it is difficult to get a true picture about one's daily calorie and nutrient intake [50,51]. Food portion sizes have also been directly related with food and energy intake in children, adolescent and adults [52,53]. Consumption of larger food portion sizes have been associated with increased weight gain and obesity [51], which is a major health concern worldwide. To tackle the obesity epidemic, reduction in food portion size, particularly for energy-dense foods, is being increasingly addressed in healthy eating guidelines. Only few studies have reported a direct relationship between the portion size and body mass index [54]. A variety of portion size measurement aids (PSMAs) have been developed and used in dietary assessment research studies to accurately report the amounts of food consumed. PSMAs in dietary assessment studies frequently include measuring cups, measuring spoons, rulers, scales, thickness sticks, bean bags, wedges, glassware and cartons of varying sizes, and life-size color pictures of actual foods. In addition to this, common objects like card deck, Tennis ball, thumb tip, handful, fist, palm of hand are also used for estimating portion sizes [55,56].

Every culture in the world has developed its own food system that meets the nutritional needs of its people. Shared plate eating is a common culture in Oman and must be addressed in estimating the correct amounts of food consumed by individuals. Meal planning exchange lists were initially developed by the American Diabetes Association and the American Dietetic Association for people with diabetes to incorporate a variety of foods into their diets while maintaining the same level of energy, carbohydrate, protein, and fat in the daily meal. Good health depends on eating a variety of foods, which contain carbohydrate, protein, fats, minerals, vitamins, water and fibre [57,58]. The amounts of nutrients (carbohydrates, proteins and fats in grams) per serving of traditional and commonly consumed Omani dishes are summarized in table 4. The carbohydrate, fat and protein content per serving in breads (White bread, Brown bread, White Khubz Lebanani, Brown Khubz Lebanani, and Chapati) ranged between 12.23 to 15.45, 0.24 - 1.68 and 2.06 - 2.63 g, respectively, which is quite close to the American Dietetic Association's recommendations. Foods in the starch list such as bread, cereal, and grains contain about 15g carbohydrates, 0 - 1g fat and 0 - 3g protein [59,60]. Although we observed lesser amount of carbohydrate in chapatti (both with and without oil), however, the energy content in Chapati was same as suggested by American Dietetic Association's recommendations. Considerably high amounts of energy content (80 vs 60 kcal) per serving of Rekhel was noted, because of high amount of fat was used for Rekhel preparation. Despite high fat content per serving of Goleh (plain, or with garlic and onion), the energy content did not meet the American Dietetic Association's recommendations. It may be due to the high amount of moisture content in Rekhel. Higher amounts of protein per serving of composite dishes with meat and chicken were observed. Meat and meat products provide 7g protein, 0 - 8g of fat and 100 calories per serving of lean, medium and high fat products. Habib, *et al.* [25] calculated 1 exchange per 100g of carbohydrate with Emirati meat and chicken Harees. Majeen a traditional Omani dish showed 8.8g protein, 11.52g fat and 140 kcalories of energy per serving, whereas chicken from chicken Kabuli and chicken from chicken Biryani had similar amounts of protein per serving but significantly less amount of fat which certainly influenced the energy content. Accurate food composition data is therefore needed to show association between food intake and nutritional status, to design interventions, to meet regulatory standards, and to properly label foods as well as to

assist in product formulation. It is recommended that the energy contribution from fat should not exceed 30% of the total energy, whereas the energy contribution from carbohydrates may range from 55% to 65% and energy from protein may range from 10 to 15% of the total energy. The present data indicated that on the average, Omani dishes were within these recommendations.

Conclusion

Only limited data is available regarding the proximate composition of traditional and commonly consumed Omani foods and dishes. The findings of the present study will fill the missing link in food composition data and will be very useful in preparing the daily meal plan and dietary guidelines for Omani people. It would be a helping tool for nutritional intervention programs and useful applications in food consumption patterns, nutritional assessment of population and clinical nutrition research, as well as planning adequate, normal and special diets for therapeutic purposes. It would open new doors for future research in nutritional, therapeutic, and dietetic programs. Further research is required to explore the amino acids profile, fatty acids, minerals and vitamins composition of these dishes.

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