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NUTRITIVE VALUE OF VARIOUS RICE BASED DISHES IN SAUDI ARABIA

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Chemical composition and nutritional quality of eight Saudi dishes based on rice were investigated. On a fresh weight basis, the dishes contained 59.6–71.8% moisture, 2.5–4.7% protein (N × 6.25), 1.2–5.4% fat, 20.4–32.1% carbohydrates, 0.1–1.7% dietary fibre, 0.5–1.7% ash and 124–165 kcals (metabolizable energy) per 100 g dish. Among vitamins, vitamin A (Retinol Equivalent) ranged from 0–900 μg, thiamin 0.02–0.10 mg, riboflavin 0.01–0.64 mg and vitamin C 0.22–1.26 mg/100 g. The mineral contents (mg/100 g) were: Ca 0.6–125, P 26–101, Fe 0.2–1.2, Na 1–446 and K 24–150. The dishes contributed 7–12%, 8–28% and 60–84% of the total food energy from protein, fat and carbohydrate respectively. The average per caput consumption of rice dishes (160 g/day) could meet 11% and 10% of daily energy and protein requirements respectively of the Saudi population at the national level. However, the dishes were adequate to meet the protein requirements of various age groups when compared with protein energy ratios (PE%). Because of their nutritional quality, rice based dishes may be recommended for the management of some diet related chronic diseases.

KEY WORDS: Saudi Arabian dishes, rice based diets, nutrient composition, nutritional quality

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INTRODUCTION

Rice, the staple food of over half of the world's population, produces not only more food energy and utilizable protein per hectare than the other cereals but also provides employment to the largest sector of the rural population (Khan and Rashid, 1986; Juliano, 1985) The protein content of world rice collection varies from 5.3–13.5% depending on the variety and the production environment (Houston and Kohler, 1970). In Asian diets, rice provides 40–80% of the food energy and 40% of the protein (Khan and Rashid, 1986). Rice grain has comparatively higher contents of carbohydrates, total saturated fatty acids, lysine and sulphur amino acids resulting higher protein quality and has lower contents of protein, fat, linoleic acid, crude fibre, calcium, phosphorus, iron and tannin than other cereals (Khan, 1981; 1985).

In Saudi Arabia, the per capita availability of rice increased over 44% during the period of one decade (Khan and Al-Kanhal, 1996), and according to recent national nutrition survey, the average per caput consumption of rice based products/dishes was 160 g/day (KACST, 1995). Some work on the chemical composition of some rice based dishes consumed in Saudi Arabia (Al-Jebrin *et al*., 1985, Al-Kanhal, 1991), in Kuwait (Kamel and Allam, 1979), in Bahrain (Musaiger and Al-Dallal, 1985) and in Middle East (Pellett and Shadarevian, 1970; Musaiger and Sungpuag, 1985) has been reported. Most Saudis according to their food habits, consume the rice-based dishes at lunch and these are usually purchased from restaurants. Information on the nutritional quality of these dishes is limited since they differ in their recipes from other Gulf states. The present paper, therefore, provides information on the nutrient composition and nutritive value of eight rice based dishes commonly consumed in Saudi Arabia.

MATERIALS AND METHOD

Selection and Description of Dishes

Eight rice based dishes commonly consumed in Saudi Arabia were selected for this study. Ten samples of each dish were purchased from restaurants in Riyadh, were pooled to make one

representative sample and were then 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 deep freezer for further analysis. Due to variations in composition of the dishes from one restaurant to another, the general description of the main ingredients used in the dishes are given below.

Kabsah It is composed of rice, meat (chicken or mutton or beef or camel meat), onions, tomatoes, carrots, salt, spices and vegetable oil or animal fat. It is a very popular dish consumed daily and served at all social functions.

Ruz Briani Cooked rice mixed with plenty of meat (beef or mutton), tomatoes, onions, green pepper, salt spices and cooking oil. It is commonly consumed on special occasions.

Ruz Bukhary Mix grilled chicken after boiling in water with rice cooked in the cooking water with onions, garlic, carrots, salt, spices and palm oil.

Ruz ma khudar Mushakal This dish is composed of rice, mixed vegetables (peas, carrots and green beans), onions, salt, spices and palm oil.

Ruz Kabli Cooked rice with brown onions in butter or oil, salt and spices. It is eaten alone or mixed with cooked vegetables, meat or fish.

Ruz Mandi Prepare a dressed young lamb by applying a paste consisting of yoghurt, tomato paste, garlic, ginger, black pepper, salt, spices and lemon juice and cover the carcass with tinfoil. Hang it with head upside over a pan containing rice, water and salt, placed on live coals in a pre-heated earthen oven, covered and sealed with mud or clay. It is a very special dish and is served with lamb meat (Mandi meat) on special occasions.

Mahlabiyeh It is a pudding, composed of rice, milk, sugar, ground almonds and vanilla flavour. It is consumed after chilling.

Ruz Mufalfal Boil rice with little oil and onions. It is mainly eaten with fried fish; chicken or meat stews.

Chemical Analysis

All the samples were analysed for moisture, protein ($N \times 6.25$), fat and ash according to AOAC (1984). Total dietary fibre was

estimated using combinations of enzymatic and gravimetric methods (Prosky *et al.*, 1985). Available carbohydrate was calculated by difference. Energy content was calculated by multiplying the protein, fat and carbohydrates by factors of 4, 9 and 4 respectively and metabolizable energy (M.E.) according to Miller and Payne (1959).

For the assays of vitamins A (R.E.), thiamin, riboflavin and vitamin C, standard methods of AOAC (1984) were used. For the determination of β-carotene and vitamin A, samples were extracted with ether-hexane, β-carotene was separated on a chromatographic column vitamin A activity and β-carotene was converted to retinol equivalent (R.E.). For the determination of minerals, 1–2 g samples were ashed, dissolved in 20% HCl. Sodium and potassium were analysed with a flame photometer according to AOAC (1984). Calcium and iron were estimated with Perkin-Elmer model 1100 B atomic absorption spectrophotometer and phosphorus was determined spectrophotometrically (Watanabe and Olsen, 1965). Descriptions of the analytical procedures have been reported (Al-Kanhal *et al.*, 1994).

RESULTS AND DISCUSSION

The nutrient composition and energy values of rice based dishes are shown in Tables I–III. The moisture content varied from 59.6% in Ruz Briani to 71.8% in Mahlabiyeh (Table I). The protein content (N × 6.25) was lowest (2.5%) in Ruz Kabli and Ruz Mufalfal and was highest (4.7%) in Ruz ma khudar Mushakal. This may be due to mixing of peas and French beans in this dish. Similar low protein contents in Shailaani (plain rice mixed with onion) used in other Arab Gulf States (Musaiger and Sungpuag, 1985) and similar high protein contents in rice based dishes consumed in Pakistan (Khan and Eggum, 1978b, 1979) and in Saudi Arabia (Al-Jebrin *et al.*, 1985) have been reported. A higher protein content (3.5%) in Saudi Kabsah than the protein content of 2.8% in the present study (Table I) has been reported (Al-Kanhal, 1991). The fat content ranged from 1.2% in Ruz Mufalfal to 5.4% in Ruz ma khudar Mushakal. In view

TABLE I
Chemical composition (wet basis) of some rice based Saudi dishes

Dishes	g per 100 g						Energy (kcal)/100 g	
	Moisture	Protein (N × 6.25)	Fat	Carbohydrate	Dietary Fibre	Ash	Gross	Metabolizable
Kabsah	64.7	2.8	1.7	28.8	0.8	1.2	142	134
Ruz Briani	59.6	3.4	2.9	32.1	1.0	1.0	168	160
Ruz Bukhary	65.5	3.2	2.3	26.2	1.1	1.7	138	131
Ruz ma khudar Mushakal	60.2	4.7	5.4	26.6	1.7	1.4	174	165
Ruz Kabli	66.5	2.5	2.3	27.0	0.8	0.9	139	132
Ruz Mandi	61.9	3.4	2.4	30.5	0.6	1.2	157	149
Mahlabiyeh	71.8	4.1	4.2	20.4	0.1	0.5	136	129
Ruz Mufalfal	65.7	2.5	1.2	27.6	1.7	1.3	131	124

of low fat content in Ruz Mufalfal, a special use could be for low-fat diets. However, the fat content in Kabsah (Table I) was lower than that reported (3.6%) by Al-Kanhal (1991). The variation in fat content may be due to addition of oil/animal fat in the preparation of these dishes. Similar high fat content was found in Kichri (rice with green gram) cooked in Pakistan (Khan and Eggum, 1979). The carbohydrates showed a variation between 20.4–32.1% with Mahlabiyeh and Ruz Briani containing the lowest and highest concentration of this nutrient respectively. All the diets were low in dietary fibre. The food energy value, depending on the amount of fat/oil used in their preparation, ranged from 131 kcal in Ruz Mufalfal to 174 kcal/100 g in Ruz ma khudar Mushakal.

It is of interest to compare the composition data with the daily need of these nutrients. According to Khan and Al-Kanhal (1998), the RDA of Saudi adult (18–29 years) male vs female for energy and protein (NPU 0.8) are 2800 vs 2100 kcals and 65 vs 56 g respectively. A 100 g portion of Saudi rice based dishes can meet 5–6% vs 6–8% and 4–7% vs 5–8% of the RDA for energy and protein for adult male vs female respectively. The average daily per caput energy and protein requirements for Saudi population have been reported to be 2100 kcal and 53 g (NPU 0.8) respectively (Khan and Al-Kanhal, 1998). Based on these requirements, 100 g of these dishes meet 6–8% of the per capita energy and 5–9% of the protein requirements at the national level. Since Kabsah is used as a main dish daily and is also served in all social functions in the country, a 100 g of Kabsah can meet 7% of the daily energy and 5% of protein requirements of Saudi population. The vitamin contents of Saudi rice dishes are given in Table II. The vitamin A was highest (900 μg R.E./100 g) in Ruz Mandi while the rest of the dishes were poor in vitamin A. The thiamin content ranged from 0.02–0.10 mg/100 g. Riboflavin was highest (0.64 mg/100 g) in Kabsah and Ruz Kabli and lowest (0.01 mg/100 g) in Ruz Mufalfal. All rice based dishes were poor in vitamin C. The B-vitamins are subject to the most serious reductions during cooking process of rice dishes. A loss of thiamin (54%) and riboflavin (18%) has been reported during cooking of rice in excess water and loss of

TABLE II
Vitamin contents (wet basis) of some rice based Saudi dishes

Dishes	Vitamin A Retinol Equivalent µg/100 g	mg per 100 g		
		Thiamin	Riboflavin	Vitamin C
Kabsah	56	0.04	0.64	0.31
Ruz Briani	36	0.02	0.02	0.54
Ruz Bukhary	44	0.03	0.03	1.26
Ruz ma khudar Mushakal	96	0.05	0.40	0.40
Ruz Kabli	34	0.10	0.64	0.56
Ruz Mandi	900	0.02	0.02	1.06
Mahlabiyeh	27	0.05	0.15	1.0
Ruz Mufalfal	0	0.03	0.01	0.22

thiamin (60–70%) if cooked in hard water (Houston and Kohler, 1970). The low contents of thiamin and riboflavin in the present study (Table II) may be due to effects of rinsing or washing and cooking of rice in excess water.

According to NRC (1989a), the daily allowances for vitamin A, thiamin and riboflavin for adult male vs female are 1000 vs 800 µg R.E., 1.5 vs 1.1 mg and 1.7 vs 1.3 mg respectively. A 100 g intake of Ruz Mandi, Ruz ma khudar Mushakal and Kabsah can meet 90 vs 113%, 10 vs 12% and 6 vs 7% of RDA respectively for vitamin A. Ruz Kabli and Kabsah can meet 7 vs 9% and 3 vs 4% of daily thiamin requirements respectively. Riboflavin in 100 g of Kabsah can meet 38 vs 49% of daily allowances for adult man vs woman.

The mineral contents of rice based dishes are given in Table III. All the dishes are poor sources of Ca (0.6–125 mg/100 g). The P content ranged from 26–101 mg/100 g. The Fe concentration was low in all dishes (0.2–1.2 mg/100 g). The Na content varied from 1.0 mg in Ruz Mandi to 446 mg/100 g in Ruz Mufalfal. The high Na content may be due to addition of table salt in this dish. The concentration of K was also low (25–150 mg/100 g) in all dishes. The daily allowances for Ca, P, Fe, Na and K for adult man and woman are 1200, 1200, 10–15,

TABLE III
Mineral contents (wet basis) of some rice based Saudi dishes

Dishes	mg per 100 g				
	Calcium	Phosphorus	Iron	Sodium	Potassium
Kabsah	0.6	27	0.2	201	34
Ruz Briani	1.2	26	0.9	252	35
Ruz Bukhary	4.5	30	0.8	310	49
Ruz ma khudar Mushakal	3.8	63	1.0	285	133
Ruz Kabli	0.9	52	1.2	214	62
Ruz Mandi	2.4	52	0.8	1	24
Mahlabiyeh	125	101	0.4	50	150
Ruz Mufalfal	1.1	38	0.2	446	25

500 and 2000 mg respectively (NRC, 1989a). Rice based dishes (100 g) will not provide significant amount of these minerals except that Mahlabiyeh can meet 11% and 8% of daily Ca and P requirements of adult man and woman. Ruz Briani, Ruz Bukhary, Ruz Kabli and Ruz ma khudar Mushakal can meet 8–12% vs 5–8% of daily Fe requirements of adult man vs woman respectively. A 100 g of Ruz Mufalfal, Ruz Bukhary, Ruz ma khudar Mushakal and Ruz Briani can meet 89%, 62%, 57% and 50% of daily Na requirements of adult man and woman respectively. Mahlabiyeh and Ruz ma khudar Mushakal can meet 8% and 7% of daily K requirements of adult man and woman respectively.

Nutritional Quality

The contributions of food energy from protein, fat and carbohydrates in the rice based dishes are shown in Table IV. Protein to energy ratio (PE%) has been used as an index of dietary quality (FAO/WHO, 1985). According to Khan and Al-Kanhal (1998), the PE% for different age/sex Saudi groups is 6–12%. A comparison of the required PE% with the protein energy percent (7–12%) of Saudi rice dishes (Table IV) indicates that all the rice based dishes can meet the protein requirement of

TABLE IV
Nutritional quality of some rice based Saudi dishes

Dishes	Percent food energy (kcal)		
	Protein	Fat	Carbohydrate
Kabsah	8	11	81
Ruz Briani	8	16	76
Ruz Bukhary	9	15	76
Ruz ma khudar Mushakal	11	28	61
Ruz Kabli	7	15	78
Ruz Mandi	9	14	77
Mahlabiyeh	12	28	60
Ruz Mufalfal	8	8	84

various age groups provided adequate quantity of the diet is eaten to meet the energy requirements. In practice, diets in most part of the world provide 7–12% of calories as protein and any diet less than 6–7% kcal as protein is presumably inadequate to assume the protein needs of a population (Bender and Bender, 1982). Regarding the quality of rice protein although the order of limiting acids was lysine, threonine and isoleucine yet the true protein digestibility (TD) was 100% and net protein utilization (NPU) was 0.71 in rats (Khan and Eggum, 1978a) and biological value (BV) in humans and children was comparable to that obtained with milk (Houston and Kohler, 1970). However, net dietary protein calories percent (NDpcal%) of bread, home-made baby foods (similar to Mahlabiyeh in the present study) and other dishes based on rice in Pakistan has been reported to vary from 5.4–7.3% and were adequate to meet the protein requirements of babies/children from 6 months to 3 years, 4–9 years and adults (Khan and Eggum 1978a; 1978b; 1979). Mahlabiyeh in the present study, may be used as a weaning food for Saudi infants and growing children.

According to WHO (1990), fat should contribute 15–30% of the total calories in a balanced diet. Since most of the dishes are consumed as a whole meal, the contribution of food energy from fat was adequate in all rice based dishes except Kabsah (11%) and Ruz Mufalfal (8%) which were low in fat (Table IV).

According to Al-Kanhal (1991), Kabsah contained cholesterol (2.9 mg/100 g) and provided 19% of the total calories as fat. There is a need to reduce the fat content (28%) in Ruz ma khudar Mushakal and Mahlabiyeh to the recommended lower limit of 15% of energy intake. This level of intake would not only be adequate to meet the essential fatty acids requirements (WHO, 1990), but would also reduce the risk of chronic diseases prevalent in the country (Khan and Al-Kanhal, 1998). However, Khan and Eggum (1978b) reported that 11% of total energy as fat in the diet was adequate to meet the requirement of essential fatty acids.

In a well-balanced diet 55–75% of the total energy is derived from carbohydrates (WHO, 1990). According to Table IV, all the rice based dishes contribute 60–84% of the total food energy from carbohydrates. The high content of digestible carbohydrate in rice based dishes is perhaps part of the reason that the marginal amount of protein has proved so nearly adequate for rice eating people, as the carbohydrate in the diet seems to have a specific effect in improving protein utilization and lack of fibre in these diets also aids in the same direction. A change from a Western-type diet to a very high carbohydrate (60% or more of calories from any type of carbohydrate), low in fat diets such as most of the rice based diets in the present study have been shown to cause a reduction of HDL (Gonen *et al.*, 1981) and LDL (Abbott *et al.*, 1989) and a transient increase in fasting plasma triglyceride levels (Reaven, 1986) in people living in most parts of Asia. However, people who subsist on diet high in starchy foods like rice, do not have high plasma triglycerides unless they are obese (Passmore and Eastwood, 1986). High carbohydrate diets do not appear to be associated with the development of coronary heart disease (NRC, 1989b), but have been claimed to be associated with hypoglycemia, juvenile delinquency as well as aggressive, antisocial and even criminal behaviour (Gray, 1987). However, scientific data supporting such beliefs are inadequate. High carbohydrate, low-fat diets similar to rice based dishes in the present study, have been recommended both for the management of diabetes mellitus and for lowering glucose and lipid levels and reducing insulin requirements (NRC, 1989b).

In conclusion, the chemical composition and nutritional quality of rice based Saudi dishes tested in the present study indicate that these dishes in general do not provide significant amount of many nutrients, however, they contain high levels of carbohydrates and the quantity of protein is marginally adequate. The scientific data do not support the belief that Kabsah is a rich source of fat. Mahlabiyeh can be used as a weaning food for Saudi infants and growing children. Because of their nutritional quality, the rice based dishes may be used in the management of persistent diarrhoea in young children (Roy *et al.*, 1994) hypertension, coronary heart disease and diabetes mellitus (Houston and Kohler, 1970).

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