

## Nutritive value of various breads in Saudi Arabia

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The nutritive value of nine Saudi breads prepared from wheat, millet and corn were measured chemically by proximate, minerals and vitamins analyses. On fresh weight basis, the bread contained 26.4–44.7% moisture, 6.6–10.4% protein, 0.4–2.4% fat, 40.2–60.6% available carbohydrates, 1.8–5.7% dietary fibre, 0.6–2.4% ash and 190–273 Kcal (metabolizable) per 100 g. All the breads were low in Ca (2.2–12.5 mg/100 g), P ranged from 41.9–320.8, Na 83.2–794.6, K 0.7–224.2 and Fe 1.6–7.8 mg/100 g. The contents of vitamin A (RE), thiamin and riboflavin ranged from 0–145 µg, 0.01–0.26 mg, 0.02–0.13 mg/100 g respectively. The bread contributed 12–18, 2–8 and 77–84% of the total food energy from protein, fat and carbohydrates respectively. Wheat bread (355 g/head/day) provided 45 and 61% of energy and protein requirements respectively at national level per person per day.

### Introduction

Cereal grains constitute the main staple of the diet and provide most of the calories and protein in the Middle Eastern countries (FAO, 1993). In Saudi Arabia, cereals contribute 41 and 40% of the total available food energy and protein in the diet respectively (Khan & Al-Kanhal, 1997). Wheat being the most commonly used for bread making, forms 64% of the total available cereals and per caput availability increased over 56%, while other cereals like millet, sorghum, corn, etc. decreased by 64% during a period of 1 decade (Khan and Al-Kanhal, 1997). The average per caput consumption of bread per day has been reported to be 355 g in Saudi Arabia (Al-Mohizea *et al.*, 1995), 277 g in Kuwait (Eid & Bourisly, 1986a), 548, 444, 438, 419 and 350 g in Libya, Egypt, Algeria, Morocco and Greece respectively (Pomeranz, 1988).

Cereal protein lacks the balance of essential amino acids for their biological utilization (Khan, 1981). According to Khan and Eggum (1978), the order of limiting amino acids for wheat bread was lysine, threonine and valine, for millet bread was lysine, threonine and isoleucine and for corn bread was lysine, tryptophan and threonine. However, such cereal breads were adequate to meet the requirements of protein and some of the micronutrients of various groups of the population if consumed in adequate amounts (Khan & Eggum, 1978; Khan, 1981, 1984).

Although some work on the chemical composition of wheat varieties (Al-Mashhadi *et al.*, 1989), wheat-based dishes (Al-Kanhal *et al.*, 1994) wheat flakes (Ewaidah & Al-Kahtani, 1992), wheat flour (Lorenz *et al.*, 1980), wheat bread (Sawaya *et al.*, 1984) consumed in Saudi Arabia, fortified wheat bread in Kuwait (Eid &

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Bourisly, 1986b), various wheat breads in Bahrain (Musaiger *et al.*, 1988) and Arabic bread used in the Middle East countries (Pellet & Shadarevian, 1970) has been reported, yet adequate information on the nutritional quality of Saudi breads made from different cereals and consumed in different parts of the country is not available. There are also conflicting reports with regard to the nutritive value of Arabic bread; this may be due to different types of flour, yeast, methods of dough fermentation and time and temperature used in baking of breads. The present investigation was undertaken to study the chemical composition including vitamins and minerals and nutritional adequacy of Saudi bread made from wheat, millet and corn used in different parts of the country.

### Materials and methods

Seven types of wheat breads, *viz.* Burr, Tamees, Tannouri, Mafroud, Samouli, white sliced loaf and brown sliced loaf commonly consumed all over the country, millet and corn bread used in main meals, mostly in the southern regions of Saudi Arabia were selected for this study. Samples of wheat bread were collected from ten commercial bread shops located in different areas of Riyadh city. All commercial wheat breads are made of locally milled wheat flour enriched with vitamins (B<sub>1</sub>, B<sub>2</sub> and niacin) and minerals (tri-calcium phosphate and iron), of variable extraction rates (75–95%). Yeast, salt, sugar, palm oil/ghee and milk powder in loaves are added to make dough. Sesame seeds are sprinkled on the surface of Tamees before baking. The breads are baked in a earthen oven at 225–550°C for 15 sec–20 min. Samples of millet and corn bread prepared traditionally without yeast were collected from Jizan area. A representative sample of each bread was analysed for moisture content while the remainder was freeze-dried, ground and stored in a deep-freezer for further chemical analysis.

#### Chemical analysis

Moisture, protein (N × 5.7), fat and ash were determined according to standard methods of AOAC (1984). Total dietary fibre was estimated using a combination of enzymatic and gravimetric methods as described in Technical Bulletin No. TDFAB-1 of Sigma Chemical Company (Sigma, 1985) based on the method of

Prosky *et al.* (1985). Carbohydrates were calculated by difference. Energy content was calculated by multiplying the protein, fat and carbohydrates by factors of 4, 9 and 4 respectively. For the analysis of vitamin A, beta-carotene, thiamin and riboflavin, standard methods of AOAC (1984) were used. For determination of beta-carotene, and vitamin A, samples were extracted with ether-hexane: beta-carotene was separated on a chromatographic column. Vitamin A activity and beta-carotene were converted to retinol equivalent (RE). For the estimation of minerals, 1–2 g samples were ashed in duplicate, dissolved in 20% HCl. Sodium and potassium were analyzed with a flame photometer according to AOAC (1984). Calcium and iron were determined with Perkin-Elmer model 1100-B atomic absorption spectrophotometer and phosphorus was estimated spectrophotometrically by the procedure of Watanabe and Olsen (1965). All assays were performed in duplicate.

### Results and discussion

#### Chemical composition

The proximate composition and mineral and vitamin contents of various breads are given in Tables 1 and 2. The moisture content was higher in corn bread (44.7%) and millet bread (43%) than wheat bread (26.4–37.7%). The protein content ranged from 6.6% in corn bread to 10.4% in brown sliced loaf. The protein quantity and quality of bread depend on variety and the extraction rate of the flour used. Brown sliced loaf, Mafroud and Burr prepared from flour of higher extraction rate (95%) had higher protein contents than Tamees, Tannouri, Samouli and white sliced loaf prepared from straight grade flour (75%). However, Khan and Eggum (1979) and Khan *et al.* (1987a) reported that wheat with higher protein content had low available carbohydrates, lysine and biological value than wheat low in protein. A significant positive correlation between protein content and dough development time has been reported (Khan *et al.* 1987b). The fat content, depending on the addition of oil in the preparation of dough, was highest in white sliced loaf (2.4%) and in Tamees (2.3%) while the lowest fat content was found in Burr (0.4%). Available carbohydrates varied from 40.2% in millet bread to 60.6% in Mafroud. Millet bread

**Table 1.** Chemical composition (wet basis) of Saudi bread

Breads	g/100 g						Kcal/100 g	
	Moisture	Protein (N × 5.7)	Fat	Available carbohydrates	Dietary fibre	Ash	Total	Metabolizable
Wheat breads								
Burr	31.9	9.1	0.4	52.9	4.8	1.0	252	239
Tamees	29.4	8.7	2.3	56.3	1.8	1.4	281	267
Tannouri	31.6	8.8	0.8	56.0	2.3	0.7	266	252
Mafroud	26.4	9.4	0.9	60.6	2.1	0.6	288	273
Samouli	32.1	8.7	1.4	54.8	2.7	0.7	267	253
White sliced loaf	34.5	8.8	2.4	50.7	1.9	1.8	260	247
Brown sliced loaf	37.7	10.4	1.0	46.2	2.5	2.2	235	223
Millet bread	43.3	8.1	1.9	40.2	5.7	2.4	202	192
Corn bread	44.7	6.6	0.7	41.9	4.8	1.3	200	190

**Table 2.** Mineral and vitamin contents (wet basis) of Saudi bread

Breads	mg/100 g							µg RE/100 g
	Calcium	Phosphorus	Sodium	Potassium	Iron	Thiamin	Riboflavin	Vitamin A
Wheat breads								
Burr	3.3	173.4	393.6	224.2	2.9	0.14	0.13	135
Tamees	3.5	86.4	794.6	0.7	1.8	0.18	0.02	145
Tannouri	9.9	81.6	83.2	115.4	3.6	0.08	0.03	140
Mafroud	2.2	41.9	207.7	67.2	1.9	0.01	0.04	45
Samouli	2.4	320.8	304.3	101.4	1.7	0.07	0.04	0
White sliced loaf	12.5	75.8	274.5	89.4	2.6	0.20	0.04	0
Brown sliced loaf	7.7	152.1	186.5	95.6	1.6	0.26	0.06	0
Millet bread	2.7	182.2	396.2	198.3	7.8	0.02	0.13	122
Corn bread	3.6	142.7	250.5	219.3	5.4	0.03	0.09	0

contained highest content of dietary fibre (5.7%) followed by corn bread (4.8%) and Burr (4.8%) due to the use of flour of higher extraction. The dietary fibre content was lowest in Tamees (1.8%) due to the use of lower extraction flour in the preparation of this bread. Khan *et al.* (1987c) found that wheat bread prepared from flour having higher contents of bran had poor texture and keeping quality. The phytic acid in high-fibre breads may prevent the absorption of Ca and Fe (Bender, 1978). However, cereal fibre has been reported to offer strong protection against colon and breast cancer (FAO, 1997). A 100 g of Saudi bread can meet 11–36% of lower limit of dietary fibre allowance (WHO, 1990) for the management of diabetes or coronary heart disease and for preventing constipation. The ash content ranged

from 0.6% in Mafroud to 2.4% in millet bread. The ash content of bread depends on the extraction rate of the flour and addition of salt and milk powder in the development of dough. The metabolizable energy ranged from 190 Kcal in corn bread to 273 Kcal/100 gm in Mafroud. According to Khan and Al-Kanhal (1998), the recommended dietary allowances (RDA) of Saudi adult male (18–29 y) vs female of the same age for energy and protein are 2800 vs 2100 Kcal and 65 vs 56 g respectively. A 100 g intake of Saudi breads meet 7–10% vs 10–14% and 10–16% vs 12–19% of RDA for energy and protein for adult male vs female respectively. The average daily per capita energy and protein requirements for Saudi population have been reported to be 2100 Kcal and 53 g respectively. Based on the average

consumption (355 g/head/day), wheat breads can meet 40–49% and 58–70% of energy and protein requirements respectively at national level per person per day. The proximate composition of Saudi bread made from different cereals in the present study compares well with the data on wheat bread used in Saudi Arabia, Yemen, Egypt, Kuwait and Bahrain (Tabekhia & Toma, 1979; Sawaya *et al.*, 1984, Musaiger, 1990) and also with the chemical composition of millet and corn bread consumed in Pakistan (Khan & Eggum, 1978).

The mineral composition data (Table 2) showed that all the breads were poor in Ca (2.2–12.5 mg/100 g). Similar results in breads made from different cereals have been reported by Khan and Eggum (1978). Cereal-based diets lower Ca intake, and inadequate dietary Ca has been associated with a number of common chronic health disorders worldwide, such as osteoporosis, cardiovascular disease, diabetes and hypertensive disorders of pregnancy, obesity and colon cancer (FAO, 1997). Due to the addition of different amounts of table salt in the preparation of the bread, Tamees contained the highest amount (794.6 mg/100 g) of Na and may not be suitable for hypertensive individuals. High Na intake may also increase the amount of Ca excreted in the urine and thereby increase the body need for Ca. Tannouri had the lowest content of Na (83.2 mg/100 g). Highest contents of K (224.2 mg/100 g) and Fe (7.8 mg/100 g) were found in Burr and millet bread respectively. When expressed in terms of recommended dietary allowances (RDAs) of an adult American (NRC, 1989), 100 g of fresh bread can meet 0.2–1% of RDA for Ca, 3.5–26.8% for P, 16.6–159% for Na, 0.04–11.2% for K and 16–78% for Fe.

Table 2 shows the vitamin contents (on wet basis) of breads. All the breads were a poor source of vitamin A. The thiamin (B<sub>1</sub>) content ranged from 0.01 mg in Mafroud to 0.26 mg/100 g in brown sliced loaf. Riboflavin (B<sub>2</sub>) was highest (0.13 mg/100 g) in Burr (wheat bread) and millet bread. Loss of thiamin in different types of bread depends on extraction rates and baking of bread destroys 15–30% of thiamin with no loss of riboflavin or niacin (Bender, 1978). A 100 g portion of Saudi bread could meet 0–15% vs 0–18% of RDA for vitamin A, 0.7–17% vs 0.9–24% for thiamin and 1.2–8% vs 2–10% of the daily intake of riboflavin

**Table 3.** Food energy adequacy in Saudi bread

Breads	Percent food energy (Kcal)		
	Protein	Fat	Carbohydrates
Wheat breads			
Burr	14	2	84
Tamees	12	7	81
Tannouri	13	3	84
Mafroud	13	3	84
Samouli	13	5	82
White sliced loaf	14	8	78
Brown sliced loaf	18	4	78
Millet bread	15	8	77
Corn bread	13	3	84

required by adult male vs female (NRC, 1989).

The contribution of calories from protein, fat and carbohydrates in various breads is given in Table 3. According to Khan and Al-Kanhal (1998) the levels of protein required in terms of protein energy requirement ratio (PE%) for different age/sex groups in Saudi Arabia ranges from 6–12%. In comparing the required ratios with protein energy per cent of Saudi bread (12–18%) all the breads are adequate to meet the protein requirements provided adequate energy is available. Based on net dietary protein calorie per cent (NDp cal%) values, Khan and Eggum (1978) found that wheat and millet breads were adequate for growing child and adult whereas corn bread was adequate for adult only to meet their protein requirements if consumed in adequate amounts.

In conclusion, the nutritive value of various breads differs due to flour extraction rates and recipes. Being staple, cereal breads contribute significant levels of energy and protein and considerable amounts of vitamin and minerals to the national diet. Cereal foods as a source of complex carbohydrates should replace the energy currently provided by fat in Saudi diet. Whole meal breads are more rachitogenic and less cariogenic than breads made from finely ground flour. Regular consumption of white bread such as Tamees may be involved in several gastrointestinal disorders. Ca level in the enrichment mix may be increased and vitamin A may be added to this mix to improve the absorption of Fe. Due to high fibre content, millet and corn flours may be mixed with wheat

flour to make good loaves and other bakery products. Research is needed to improve the keeping quality of some Saudi breads.

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