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FOOD AVAILABILITY AND QUALITY OF DIET IN SAUDI ARABIA - A REVIEW

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ABSTRACT: The nutrient contents and nutritional quality of Saudi diet available during 1974-76 and 1983-86 were calculated from the Saudi Arabian Food Balance Sheets. An increasing trends in per caput availability of total food (55%), cereals (30%) roots and tubers (233%), pulses and beans (178%), fruits and vegetables (56%), nuts and oilseeds (71%), fats and oils (318%), sugar (71%), meat (179%) milk and milk products (21%), eggs (272%), fish (128%), coffee (48%) and tea (64%), whereas decreasing trends in per capita supply of traditional cereals (64%), and dates (13%) were observed over the period. The average national diet during 1983-86 provided 3012 calories, 84 g protein (11% of calories) and 95 g fat (29% of calories)/person/day. Cereals, animal foods and sugar constituted 41%, 20% and 11% of the total available food energy, respectively. The per capita dietary cholesterol (mg/day), saturated and polyunsaturated fatty acids (% of calories) in the available diet was 326 mg, 8.4% and 9.0% per day, respectively. The theoretical values for chemical score, digestibility and net protein utilization (NPU) of the national diet were 86, 94% and 0.8, respectively. The order of limiting amino acids was isoleucine, phenylalanine and tryptophan. The net dietary protein calories percent (NDP cal%) of the national diet was 9.5% and was adequate to meet the protein requirements of all different age groups.

Key Words: Diet; Nutrient Availability; Protein Requirement; Foods; Quality; Saudi Arabia.

INTRODUCTION

The agricultural and industrial revolutions due to unprecedented economic and social development in recent decades have introduced radical changes in food availability and nutritional composition of the diet in Saudi Arabia (Khan and Kanhal, 1994). Such rapid changes in life styles and dietary habits toward the affluent diet, may cause imbalance of nutrients (Thomas, 1988), effect quality of diet (Khan, 1989) and have been correlated with increased incidence of various chronic diseases (WHO, 1990).

Since information on the nutritional quality of Saudi national diet is not available, the present paper deals with the food availability situation and quality of diet in Saudi Arabia.

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FOOD AVAILABILITY SITUATION

Since there was no significant change in the food availability during 1983-86 and 1988-90, a period of one decade i.e., from 1974-76 to 1983-86 was selected for this purpose. The daily per capita availability of food during 1974-76 and 1983-86 is given in Table 1. An increase of over 55% in the average availability of total food can be explained by the rise in domestic food production and the levels of imports of some food items during this period.

Plant Products

Cereals constitute the main staple of Saudi diet. Wheat is by far the most common food grain consumed, constituting 53% and 64% of total cereals available during 1974-76 and 1983-86, respectively. The per capita availability of wheat and rice increased over 56% and 44%, respectively, while other cereals like corn, sorghum, millet, etc. decreased by 64%

Table 1. Food availability by food groups

Food group	g per person per day	
	1974-76	1983-86
Total cereals	258.4	335.9
Wheat	138.4	215.5
Rice	71.5	102.9
Other cereals	48.5	17.5
Roots and tubers	6.1	20.1
Pulses and beans	7.4	20.6
Fruits and vegetables	450.8	702.3
Nuts and oilseeds	5.6	9.6
Fats and oils	11.0	46.1
Total sweeteners	48.2	83.4
Sugar	45.2	77.1
Beverages etc.	7.0	30.9
Total animal products	164.6	313.5
Meat and offals	55.5	154.9
Milk and milk products	93.1	112.3
Eggs	6.8	25.3
Fish	9.2	21.0

Source: Saudi Arabian Food Balance Sheets (1987-89).

during this period. An increase in the per capita availability of roots, pulses and beans, fruits and vegetables, nuts and oilseeds, added oils, and fats and sugar was 233%, 178%, 56%, 71%, 318% and 71%, respectively, over the period. The per capita availability of dates decreased from 108g in 1974-76 to 94g in 1983-86.

The availability of coffee vs tea was 2.9g vs 2.8g per head per day and 4.3g vs 4.6g per head per day during 1974-76 and 1983-86, respectively, and the increase was 48% vs 64%, respectively, over the period.

Animal Products

The per capita availability of total foods of animal origin increased by 91% during the past ten years. The increase in the per capita availability of meat, milk and its products, eggs, and fish was 179%, 21%, 272% and 128% respectively, during 1974-76 and 1983-86.

Dietary Energy

Food availability from various food groups in terms of kilocalories (kcal) per caput per day as average for the triennium 1974-76 and 1983-86 were compared with FAO desirable pattern (FAO, 1989) (Table 2).

The cereals constituted the bulk of Saudi diets and their contribution to the total calories decreased from 51% in 1974-76 to 41% in 1983-86. The calories from cereals were 128% and 103% of the FAO desirable pattern (FAO, 1989) during 1974-76 and 1983-86, respectively. The contribution of calories from roots and tubers was only 10% of the desirable level over the period. The contribution of calories as percent of FAO desirable pattern from fruits and vegetables, pulses and beans, animal products, added fats and oils, nuts and oilseeds, and sugar was 360% vs 260%, 17% vs 23%, 60% vs 90%, 51% vs 133%, 37% vs 30% and 128% vs 133%, respectively, during 1974-76 and 1983-86.

NUTRITIONAL VALUE OF NATIONAL DIET

The average national requirements for energy and protein have been reported to be 2100 kcal and 53g protein (NPU 0.8) per head per day (Khan et al., 1994). During 1974-76, the national diet provided 86% energy and 97% protein of the requirement. However, due to economic development in the Kingdom, the national diet became surplus in energy (43%) and protein (59%) during 1983-86. An increase in the per capita availability of total calories, protein, fats and carbohydrates was 67%, 65%, 179% and 37%, respectively, over the period. The protein energy ratio percent (PE%), a measure of dietary quality of diet available during

1974-76 and 1983-86 were 11.4% and 11.2%, respectively (Table 3), indicating that quality of diet in terms of protein was adequate for all different age groups except lactating women when compared with recommended values (Khan et al., 1994).

Dietary scores of national diet available during 1974-76 and 1983-86 were calculated (Table 2) according to FAO scoring pattern (FAO, 1989). The dietary score increased from 73 in 1974-76 to 84 in 1983-86. The dietary score of national diets available in Australia, Japan and New Zealand were reported (FAO, 1989) to be 90, 87 and 89, respectively, during 1984-86. The dietary score of Saudi diet can be further improved by

Table 2. Availability of dietary energy and dietary score of Saudi diets

Food group	Kilocalories percent		
	1974-76	1983-86	FAO desirable pattern*
Cereals	51.2	40.5	40
Roots and tubers	0.5	0.6	5
Fruits and vegetables	18.1	13.2	5
Pulses and beans	1.0	1.4	6
Animal products	12.0	17.7	20
Added fats and oils	5.1	13.3	10
Nuts and oilseeds	1.1	0.9	3
Sugar	10.2	10.6	8
Others (Beverages etc.)	0.7	1.8	3
Dietary score*	73.0	84.0	100

**Based on FAO scoring pattern (1989).*

Table 3. Availability of energy and nutrients as percent of requirements

Energy/ nutrient	Per person per day			
	1974-76		1983-86	
	Available	% of requirement	Available	% of requirement
Total energy (Kcal)	1807	86	3012	143
Total protein (g)	51.3	97	84.2	159
Vegetable (g)	35.6	-	46.6	-
Animal (g)	15.7	-	37.6	-
Protein energy ratio (%)	11.4	-	11.2	-
Total fat (g)	33.6	-	95.0	-
Vegetable (g)	16.7	-	52.1	-
Animal (g)	16.9	-	42.9	-
Total carbohydrates (g)	342.0	-	469.5	-

decreasing fats, sugar, fruits and vegetables and increasing potatoes, pulses and beans in the national diet.

In a well-balanced diet 10-15% of the total energy is derived from protein, 15-30% from fat and 55-75% from carbohydrates (WHO, 1990). Calories from protein in both diets meet the requirement of a balanced diet (Table 4). Although the contribution of calories from fat (16.7 - 28.4%) lies within the recommended levels, yet there is a need to reduce the fat content in Saudi diet to the recommended lower limit of 15% of energy intake. A level of 11-15% of energy from fat would be adequate to meet essential fatty acids requirements (WHO, 1990 and Khan and Eggum, 1978). Calories from carbohydrates are adequate in both diets, however, there is a need to reduce sugar and to increase

Table 4. Percent kilocalories from nutrients

Nutrient	Percent kilocalories	
	1974-76	1983-86
Protein	11.4	11.2
Fat	16.7	28.4
Carbohydrate	71.9	60.4

complex carbohydrates (50% of energy) in the diet (WHO, 1990).

Fatty Acids and Cholesterol Contents

The fatty acids and cholesterol contents of diets available during 1974-76 and 1983-86 were calculated by using food composition tables (Paul and Southgate, 1978). These values may be different from the actual values obtained analytically. Since there is no information available on the subject, the present theoretical values may depict the situation. According to NRC (1989) less than 10% and 7% of calories should be provided from saturated and polyunsaturated fatty acids, respectively, and the dietary cholesterol should be less than 300 mg/day. Since there is no known requirement for saturated fatty acids per se, the lower limit has been set at 0% of energy and populations with an average saturated fat intake between 3% and 10% of energy intake were characterized by low mortality rates from coronary heart disease (WHO, 1990). The increase in the percent calories from saturated, and polyunsaturated fatty acids was 31%, 16%, and 91%, respectively from 1974-76 to 1983-86 (Table 5). The high availability of polyunsaturated fatty acids in the diet (9%) may be detrimental to health whereas high levels of monounsaturated fatty acids derived mainly from olive oil in Saudi diet may have beneficial effect in reducing the incidence of coronary heart disease (WHO, 1990).

Table 5. Fatty acids as percent of total energy and cholesterol in Saudi diets

Parameter	1974-76	1983-86
% Calories from fatty acids		
Saturated	6.4	8.4
Monounsaturated	3.1	8.1
Polyunsaturated	4.7	9.0
P/S ratio	0.8	1.1
Total cholesterol (mg)	115	326

The dietary cholesterol increased by 184% during ten years and the cholesterol content to 326 mg in Saudi diet was higher than the recommended levels during 1983-86. There is epidemiological evidence (WHO, 1990) that mortality due to coronary heart disease is related to dietary cholesterol intake even when the analyses are controlled for serum choles-

terol level. A reduction in intake of saturated fatty acids would be expected to reduce the intake of fat from animal sources and hence of cholesterol.

Protein Quality

The essential amino acid contents of the diet available during 1983-86 were calculated by using food composition tables (FAO, 1968). The chemical score and digestibility were calculated according to FAO (1985).

Table 6 shows the essential amino acid contents and the chemical score of Saudi diet available during 1983-86. The chemical score of the diet was 86 and the order of limiting amino acids in the diet was isoleucine, phenylalanine + tyrosine and tryptophan.

Table 6. Calculation of chemical score of diet available during 1983-86

Amino acid	Percentage of total EAA[1]		Chemical score[2]
	Saudi diet	Human milk	
Isoleucine	11.3	13.1	86
Leucine	20.5	18.2	112
Lysine	16.2	12.9	125
Methionine + Cystine	10.3	8.8	117
Phenylalanine + Tyrosine	19.1	20.7	92
Threonine	10.4	9.4	110
Tryptophan	3.5	3.3	94
Valine	13.8	13.5	102

[1] *Essential amino acids*
[2] *FAO/WHO (1985)*

The amino acid score alone may lead to an over estimation of the capacity of some proteins to meet physiological requirements unless digestibility of the diet is considered. The digestibility of Saudi diet relative to reference protein was calculated to be 94% (Table 7). When the amino acid score is multiplied by digestibility, it becomes analogous to the biologically determined net protein utilization (NRC, 1989). The net protein utilization (NPU), the product of chemical score (86) and the digestibility (94%) of Saudi diet is calculated to be 0.8. The protein quality of Saudi diet calculated in the present study is similar to the protein quality of diets (NPU 0.8) consumed in industrialized countries (Bender and Bender, 1982). According to FAO (1965) the protein allowances for different age groups in terms of net dietary protein calories percent (NDpcal%) are 8.0, 7.8, 5.9, 8.4, 4.6 and 9.5 for infants, toddler, child (4-9 years), adolescent, adult and lactating mothers, respectively. NDpca1% of Saudi diet calculated according to FAO (1965) was 9.5% and it was adequate to meet the protein requirement of all different age groups.

Table 7.Estimation of digestibility of protein of Saudi diet available during 1983-86

Food	Fraction of total dietary protein (%)	Digestibility relative to reference protein* (%)	Digestibility of total protein (%)
Wheat	0.30	90	27.0
Rice	0.08	93	7.4
Millet/sorghum	0.02	83	1.7
Pulses/beans	0.04	82	3.3
Vegetables	0.09	86	7.7
Nuts	0.01	80	0.8
Meat	0.03	100	30.0
Milk	0.12	100	12.0
Eggs	0.04	100	4.0
Mixed Saudi diet			94.0

**FAO/WHO (1985)*

In conclusion, the quality parameters of Saudi national diet estimated theoretically in the present study, may be used by the food scientists, nutritionists, dieticians and planners for the time being, till the quality of diet actually consumed in

the country, was measured by using chemical and biological methods.

LITERATURE CITED

1. Bender, A. E., and Bender, D.A. 1982. Nutrition for Medical Students. John Wiley and Sons. New York.
2. Food and Agriculture Organization for the United Nations. 1965. Committee on protein requirements. Nutrition Studies No. 37, FAO, Rome.
3. Food and Agriculture Organization for the United Nations. 1968. Amino acids content of foods and biological data on proteins. Nutrition Division. FAO, Rome.
4. Food and Agriculture Organization/World Health Organization. 1985. Energy and protein requirements. Report of a joint FAO/WHO/UNU Expert Consultation. Tech. Rep. Ser. 724. Geneva.
5. Food and Agriculture Organization of the United Nations. 1989. Report of the Regional Expert Consultation of the Asian Network for Food and Nutrition on Nutrition and Urbanization. RAPA Report 1989/4. Bangkok, 2-5 May.
6. Khan, M.A. 1989. Desirable dietary patterns for Pakistan. In: FAO/PARC workshop on Dietary Guidelines for Food and Agriculture Planning, National Agricultural Research Centre, Islamabad, Pakistan.
7. Khan, M.A., and Al-Kanhal, M.A. 1994. Nutrition trends and incidence of chronic diseases in Saudi Arabia. Ann. Saudi Med. (submitted).
8. Khan, M.A., Al-Kanhal, M.A., and Osman, A.K. 1994. Dietary energy and protein requirements for Saudi Arabia. Ann. Saudi Med. (submitted).
9. Khan, M.A., and Eggum, B.O. 1978. the nutritive value of some Pakistani diets. J. Sci. Fd. Agric. 29: 1023-1029.
10. Ministry of Agriculture and Water, Department of Economic Studies and Statistics. Saudi Arabian Food Balance Sheets (1987-89). Kingdom of Saudi Arabia.
11. National Research Council. 1989. Recommended Dietary Allowances. 10th Edn. National Academy Press. Washington D.C.
12. Paul, A.A., and Southgate, D.A.T. 1978. The composition of foods. 4th Edn. Her Majesty's Stationery Office. London.
13. Thomas, J.E. 1988. Changing lifestyles; effects on a balanced diet. In: Dobbing, J. (ed.) A Balanced Diet. Springer-Verlag.
14. World Health Organization. 1990. Diet, nutrition and the prevention of chronic diseases. Tech. Rep. Ser. 797 Geneva.