J. Sci. Fd Agric. 1978, **29**, 1023–1029

With the Compliments of the Author(s)

The Nutritive Value of Some Pakistani Diets

Mohammed Akmal Khan[a] and Bjørn O. Eggum

Department of Animal Physiology and Chemistry, National Institute of Animal Science, Roligheds vej 25, DK-1958, Copenhagen, Denmark

(*Manuscript received 28 April 1978*)

The nutritive values of Pakistani diets and meals commonly consumed by rural peasants and middle-class city dwellers was determined chemically (including fatty acid and amino acid analyses) and biologically in N-balance experiments with growing rats. The average national diet supplies 13% of the total calories from protein, 61% from carbohydrate and 11% from fat. Essential fatty acids, iron and calcium content are adequate to meet the dietary requirements. Lysine and threonine were found to be the limiting amino acids in the average national diet, the northern area diet and most of the meals. The national diet has a slightly higher net protein utilisation (NPU) value (66%) than that of the northern area (61%). Net dietary protein calories percentage (NDp cal %) was highest (8.5) for the national diet. The NDp cal % of the wheat bread and rice based meals lie between 5.9–8.3 and 5.4–6.4 respectively. The results suggest that protein is not a limiting factor in Pakistani diets when compared with FAO recommendations.

1. Introduction

Besides the nutrition surveys carried out in Pakistan,[1,2] there is no information available on the nutritive value of Pakistani diets consumed in different parts of this country. The protein quality of some Pakistani diets prepared according to the survey figures of the undivided Bengal and Punjab was measured,[3] but these values may not be representative for Pakistan. The nutritive value of several traditional diets has been examined by chemical analyses and N-balance experiments with rats.

2. Experimental

2.1. Experimental animal and diets

The experimental procedure has been described by Eggum.[4] Groups of five Wistar male rats weighing approximately 75 g were used. The preliminary period lasted for 4 days and the balance period for 5 days. The rats were weighed at the beginning of the experiments and divided into groups of five such that the average weights of the groups differed by no more than ± 0.5 g. Weighing was repeated at the end of the preliminary and balance periods; access to feed and water was restricted 3 h before weighing. Each animal received 150 mg N and 10 g dry matter daily throughout the preliminary and balance periods. The N content of the diet was adjusted by using a N-free mixture.

2.2. Selection and preparation of diets

Various food items common in Pakistan were selected on the basis of their popularity and availability[1,2] and purchased in Copenhagen. Eleven different diets and meals including the average national and northern area diets were selected from those consumed by the rural peasant up to the middle-class city dweller (Tables 1 and 2).

[a] Permanent address: Department of Nutrition, University of Agriculture, Faisalabad, Pakistan.

0022–5742/78/1200–1023 $02.00 ©1978 Society of Chemical Industry

Table 1. Composition of national and northern areas diets of Pakistan

Food items	National diet (g)	Northern area diet (g)
Wheat flour	360.0	274.0
Rice	50.0	—
Maize flour	13.0	52.0
Barley flour	—	98.0
Potato	23.0	13.0
Lentils	18.0	4.0
Spinach	31.0	174.0
Cauliflower	31.0	28.0
Minced beef	20.0	3.0
Egg	2.0	0.3
Fish	4.0	—
Milk (powder)	50.0	13.0
Vegetable oils	20.5	13.0
Sugar	28.0	4.0
Fruits (orange, apple, apricot)	3.0	186.0

Table 2. Composition (g) of some Pakistani meals

Food items	Meal no.								
	1	2	3	4	5	6	7	8	9
Wheat flour	120.0	120.0	120.0	120.0	120.0	120.0	120.0	—	—
Rice	—	—	—	—	—	—	—	100.0	100.0
Minced beef	20.0	—	—	—	—	—	—	—	—
Bengal gram (dhal)	—	18.0	—	—	—	—	—	—	—
Spinach	—	—	31.0	—	—	—	—	—	—
Green Peas	—	—	—	36.0	—	—	—	—	—
Beans	—	—	—	—	18.0	—	—	—	—
Mustard leaves	—	—	—	—	—	31.0	—	—	—
Milk (powder, skimmed)	—	—	—	—	—	16.0	16.0	—	—
Lentils	—	—	—	—	—	—	—	36.0	—
Milk (powder, whole)	—	—	—	—	—	—	—	—	20.0
Potato	23.0	—	23.0	23.0	—	—	—	—	—
Tomato	5.0	—	—	5.0	—	—	—	—	—
Onion	12.0	12.0	12.0	12.0	—	—	—	—	—
Sugar	—	—	—	—	—	—	28.0	—	28.0
Vegetable oil (ghee)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	—

All the diets and meals were prepared according to traditional cooking practices and then freeze-dried, ground, analysed and incorporated into the N-free mixture at the expense of autoclaved potato starch, to be measured in N-balance experiments with rats.

2.3. Analytical methods

The chemical composition of the diets was determined according to the standard methods.[5] The energy value was estimated by IKA-Calorimeter. Fatty acids were analysed[6] by g.l.c. on a Perkin–Elmer (model 900) gas chromatograph with a flame ionisation detector. Amino acid analyses were carried out according to Weidner and Eggum[7] and Eggum.[8] Tannin was estimated as described by Eggum and Christensen.[9]

3. Results

3.1. Chemical composition

The results of the chemical determination of the diets and meals are given in Tables 3 and 4.

Table 3. Chemical composition (per 100 g dry matter) of Pakistani cooked diets

Meals or diets	g per 100 g: Protein (N × 6.25)	Fat	Available carbohydrate	Crude fibre	Ash	Calories	mg per 100 g: Ca	P	S	Fe	g per 100 g: Tannin
National diet	14.6 (87 g)	5.4 (32 g)	69.1 (413 g)	1.1 (6.6 g)	2.5 (15 g)	452 (2700)	394 (2.4 g)	219 (1.3 g)	58 (0.35 g)	6.2 (37 mg)	0.44 (2.6 g)
1. Wheat bread, meat + potato	15.2	10.3	65.5	1.1	1.9	478	393	196	50	6.5	0.47
2. Wheat bread, Bengal gram dhal)	14.3	9.3	65.0	1.2	2.3	472	392	196	72	7.6	0.45
3. Wheat bread, spinach + potato	12.9	9.6	65.6	1.4	2.8	471	460	175	44	7.0	0.55
4. Wheat bread, green peas + potato	14.0	8.8	65.0	2.0	2.5	468	384	208	46	6.5	0.47
5. Wheat bread, beans	13.0	10.2	69.8	1.8	1.7	480	315	207	21	5.4	0.47
6. Wheat bread, mustard leaves, skimmed milk	14.0	10.1	66.8	1.9	2.9	479	476	303	32	5.3	0.64
7. Wheat bread, ghee, sugar, skimmed milk	11.7	7.9	73.3	1.4	1.9	463	364	235	21	3.6	0.50
8. Rice (boiled), lentils	11.6	16.0	68.2	2.1	1.2	510	59	162	41	2.3	0.38
9. Rice (boiled), sugar, milk	9.2	0.9	88.5	0.4	1.2	420	160	181	27	1.1	0.27
Northern area diet	14.3	6.3	69.4	2.5	2.9	456	305	262	57	6.1	0.65

Figures in parentheses indicate the total contents.

Table 4. Fatty acid composition (g per 100 g of dry matter) of Pakistani cooked diets

Diets	Lauric acid	Myristic acid	Palmitic acid	Palmitoleic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid
National diet	0.00	0.04	1.48	0.05	0.16	0.99	0.80	0.09
1. Wheat bread, meat + potato	0.02	0.09	2.94	0.11	0.37	2.92	1.50	0.11
2. Wheat bread, Bengal gram (dhal)	0.01	0.06	2.73	0.00	0.26	2.41	1.67	0.09
3. Wheat bread, spinach + potato	0.01	0.06	2.84	0.07	0.28	1.32	0.83	0.13
4. Wheat bread, green peas + potato	0.01	0.07	2.64	0.06	0.29	1.79	0.98	0.10
5. Wheat bread, beans	0.01	0.07	3.39	0.00	0.31	2.64	1.77	0.21
6. Wheat bread, mustard leaves, skimmed milk	0.01	0.08	3.32	0.00	0.32	2.51	1.55	0.18
7. Wheat bread, ghee, sugar, skimmed milk	0.01	0.06	2.73	0.00	0.26	2.15	1.38	0.11
8. Rice (boiled), lentils	0.01	0.13	5.58	0.00	0.55	4.71	2.12	0.24
9. Rice (boiled), sugar, milk	0.00	0.02	0.21	0.00	0.03	0.14	0.15	0.01
Northern area diet	0.00	0.04	1.50	0.00	0.15	1.13	1.06	0.16

The average national diet provides 87 g protein and 2700 kcal daily. These figures are higher than those reported in the survey report.[1] The fat content of the diet is 32 g and is low as compared to calculated value given in the survey report.[1] The diet supplies 2.4 g calcium and 37 mg iron. The chemical composition of northern area diet was similar to the national diet.

The protein contents of various meals based on wheat bread and boiled rice ranged from 9.2 to 15.2%. The meal based on boiled rice, sugar and milk supplied the lowest protein (12.8 g) while the highest protein content (24.4 g) was provided by the wheat bread, meat potato meal. The calcium and iron contents of meals based on boiled rice were comparatively lower than those of meals having wheat bread as a staple.

The fatty acid composition of the national diet and various meals are shown in Table 4. The contents of linoleic and linolenic acids in the national diet were 0.80 and 0.09% respectively and were slightly higher in the diet of northern area. The linoleic and linolenic acids content of the meals ranged from 0.15 to 2.12% and 0.01 to 0.24% respectively and were highest (2.12 and 0.24% respectively) in meal based on boiled rice and lentils.

3.2. Protein quality

The amino acid composition of the diets and meals is shown in Table 5. Protein scores are calculated using FAO scoring pattern[10] (Table 6). All the diets and meals containing wheat bread showed that lysine was the first limiting amino acid while threonine was the first limiting in the meals based on rice. Threonine was the second limiting amino acid in all diets and meals except rice based meals (boiled rice, lentils and boiled rice, sugar, milk), which were limited by methionine and lysine respectively.

Table 5. Amino acid composition (g per 16 g N) of Pakistani cooked diets

Amino acids	National diet	Meals[a]									Northern area diet
		1	2	3	4	5	6	7	8	9	
Aspartic acid	6.0	5.5	6.0	5.3	6.0	5.9	5.9	5.7	10.3	8.0	6.3
Threonine	2.7	2.6	2.5	2.6	2.6	2.8	3.3	3.1	3.5	3.7	3.0
Serine	3.9	3.8	4.1	4.1	4.1	4.5	4 8	4.9	5.0	4.9	4.1
Glutamic acid	28.6	29.5	29.4	31.7	29.9	29.7	31.1	30.7	18.2	20.0	26.0
Proline	8.8	8.8	8.6	9.5	8.7	8.9	10.5	10.4	4.2	6.7	9.0
Glycine	3.5	3.7	3.4	3.5	3.4	3.6	3.2	3.1	4.0	3.0	3.4
Alanine	3.6	3.4	3.2	3.1	3.2	3.3	3.3	3.2	4.7	4.1	3.8
Valine	4.3	3.9	3.9	4.0	3.9	4.2	4.9	4.8	5.2	5.7	4.3
Isoleucine	3.8	3.5	3.6	3.5	3.4	3.6	4.2	4.2	4.3	4.5	3.6
Leucine	7.1	6.6	6.6	6.6	6.5	6.9	8.1	7.9	7.9	8.7	7.5
Tyrosine	3.1	2.8	2.7	2.9	2.8	3.1	3.7	3.7	3.8	4.6	3.1
Phenylalanine	4.4	4.1	4.4	4.3	4.1	4.8	4.8	4.7	5.0	4.8	4.5
Lysine	3.4	3.0	2.9	2.3	2.8	3.1	4.2	4.1	5.0	5.5	3.3
Histidine	2.1	2.0	2.0	2.0	1.8	2.2	2.3	2.3	2.2	2.4	2.1
Arginine	4.6	4.3	5.0	4.1	4.9	4.7	4.1	4.0	8.1	5.4	4.2
Methionine	1.8	1.8	1.5	1.6	1.4	1.6	1.8	1.9	1.7	2.6	1.7
Cystine	1.6	1.8	1.8	1.8	1.7	1.8	1.8	1.7	1.5	1.3	1.6
Tryptophan	1.1	0.9	1.1	0.9	1.1	1.0	1.3	1.1	1.0	1.1	0.9

[a] 1, Wheat bread, meat + potato; 2, wheat bread, Bengal gram; 3, wheat bread, spinach + potato; 4, wheat bread, green peas + potato; 5, wheat bread, beans; 6, wheat bread, mustard leaves, skimmed milk; 7, wheat bread, ghee, sugar, skimmed milk; 8, rice (boiled), lentils; 9, rice (boiled), sugar, milk.

Valine was the third limiting amino acid in all diets and meals based on wheat breads except meals consisting of boiled rice, lentils and boiled rice, sugar and milk where lysine and methionine respectively were the third limiting amino acids.

The true digestibility (TD), biological value (BV), net protein utilisation (NPU) and net dietary protein calorie percentage[11] (NDp cal %) of Pakistani diets and meals are presented in Table 7. Of the national and northern area diets, the national diet has a much higher NPU value (66%) compared to the northern area diet (61%). NDp cal % was also highest (8.5) for the national diet.

Table 6. Protein score and limiting amino acids of Pakistani cooked diets

Diets	Protein score[a]	Limiting amino acids		
		First	Second	Third
National diet	67	Lysine	Threonine	Valine
1. Wheat bread, meat + potato	65	Lysine	Threonine	Valine
2. Wheat bread, Bengal gram (dhal)	62	Lysine	Threonine	Valine
3. Wheat bread, spinach + potato	50	Lysine	Threonine	Valine
4. Wheat bread, green peas + potato	61	Lysine	Threonine	Valine
5. Wheat bread, beans	63	Lysine	Threonine	Valine
6. Wheat bread, mustard leaves, skimmed milk	73	Lysine	Threonine	Valine
7. Wheat bread, ghee, sugar, skimmed milk	74	Lysine	Threonine	Valine
8. Rice (boiled), lentils	81	Threonine	Methionine	Lysine
9. Rice (boiled), sugar, milk	78	Threonine	Lysine	Methionine
Northern area diet	65	Lysine	Threonine	Valine

[a] Based on FAO/WHO scoring pattern (1973).

Table 7. Protein quality of Pakistani cooked diets

Diets	True digestibility		Biological value		Net protein utilisation		Net dietary protein calories	
	(%)	(s)	(%)	(s)	(%)	(s)	(%)	(s)
National diet	92.0	1.4	72.0	1.4	66.0	1.8	8.5	1.8
1. Wheat bread, meat + potato	94.0	0.6	69.0	1.2	65.0	0.8	8.3	0.8
2. Wheat bread, Bengal gram (dhal)	92.0	0.9	66.0	1.2	60.0	1.4	7.3	1.4
3. Wheat bread, spinach + potato	93.0	1.0	69.0	2.2	54.0	1.8	5.9	1.8
4. Wheat bread, green peas + potato	94.0	1.6	65.0	0.9	61.0	1.5	7.3	1.5
5. Wheat bread, beans	92.0	0.8	69.0	1.0	63.0	0.8	6.8	0.8
6. Wheat bread, mustard leaves, skimmed milk	92.0	0.7	76.0	1.1	70.0	1.6	8.2	1.6
7. Wheat bread, ghee, sugar, skimmed milk	95.0	0.3	76.0	1.5	72.0	1.1	7.3	1.1
8. Rice (boiled), lentils	91.0	0.9	65.0	1.5	59.0	1.9	5.4	1.9
9. Rice (boiled), sugar, milk	92.0	1.1	80.0	1.2	73.0	1.1	6.4	1.1
Northern area diet	88.0	1.4	70.0	1.7	61.0	2.2	7.6	2.2

Meals containing whole or skimmed milk had NPU values above 70% whereas the other meals had NPU values from 54.0 to 65.0%. The lowest NPU value (54%) was observed on the meal containing wheat bread, spinach and potato. The NDp cal % of wheat bread and rice based meals lie between 5.9 and 8.3 and 5.4 and 6.4 respectively.

4. Discussion

In a well-balanced diet 10–15% of the total energy is usually derived from protein, 55–70% from carbohydrate and 20–30% from fat.[12]

According to the chemical analysis in the present experiment the average Pakistani diet supplies 87 g protein and 2700 kcal and are well over the recommended allowances[13] of 59 g protein and 2078 kcal per day. It contributes 13% of the total calories from protein, 61% from carbohydrate and 11% from fat. Similarly 12.5, 77 and 12% of the total energy of the northern area diet are derived from protein, carbohydrate and fat respectively. It is evident that both diets are low in fat but are still adequate to meet the dietary protein and energy requirements.

The essential fatty acids contribute 1% of the total calories in a balanced diet.[12] The national and northern area diets are adequate in essential fatty acids and provide 1.8 and 2.3% respectively of the total calories. Similarly all the meals have adequate quantity of essential fatty acids to meet the dietary requirements.

The estimated iron content of the average national diet is 37 mg which is over three times the recommended allowances[13] of 11 mg. In spite of the high intake of iron widespread occurrence of anaemia has been reported by survey reports.[1,2]

The results indicate that the lysine and threonine are the limiting amino acids in most of the diets or meals. Compared with the FAO scoring pattern methionine does not appear to be the limiting amino acid in these diets and meals which is contrary to the findings in rat assay of Miller and Donoso.[14]

According to FAO[15] the protein allowances for different age groups in terms of NDp cal % 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. When adjudged in terms of NDp cal % the protein value of average national diet is adequate for all different groups except lactating mothers. The NDp cal % of the northern area diet is 7.6. Such a diet is suitable only for adults and children (4–9 years) and is inadequate for infants, toddler, adolescent and lactating mothers.

Three meals are usually taken a day in Pakistan. The meals assayed in the present experiment are suitable for all different age groups but fall short of the requirement of nursing mothers. The NDp cal % of meal no. 1 is similar to meal no. 6 and satisfy the protein requirement of all the groups except lactating mothers. Meals no. 2, 3, 4, 5 ,7 and 9 have NDp cal % between 5.9 and 7.3 and are suitable for children (4–9 years) and adults.

The boiled rice, lentil meal is low in NDp cal % (5.4) and can meet the protein requirement of adult only. A continued dependency on such a meal should be avoided.

According to Payne[16] the levels of protein required in terms of protein and energy requirement ratios for different age/sex groups, i.e. 6–9 months, 1 year, 2–3 years, adult male, adult female, pregnant and lactating mother are 6.9, 5.4, 5.3, 5.1, 4.2, 4.8 and 5.2 respectively. It is interesting to compare the requirement ratios with the utilisable protein contents of the Pakistani diets and meals represented by NDp cal % in the present study. All the diets and meals are adequate to meet the protein requirement of the all different age groups, with the exception of the meal based on boiled rice and lentils which is unsuitable for 6–9 month old infants. The present results suggest that protein does not seem to be a limiting factor in these diets and meals.

The national diet assayed in this experiment has been based on the average figure of dietary intakes and may not meet the dietary needs of the whole population as some people may be consuming below the average intakes. It seems quite certain that rural peasants and middle-class people living in the cities form the larger portion of the population and are in need of more food.

The present investigations suggest that the food problem in Pakistan is not primarily one of the deficiency of protein but related to insufficient supply of food.

In general, the average national diet is adequate to meet the dietary requirements of most groups of the population. The meals are more than adequate in quality in terms of protein. If the people were given more of the same kind of food as they are already eating, their food problems would probably be solved.

Acknowledgement

This investigation was financially supported by the Danish International Development Agency.

References

1. Ministry of Health, Government of Pakistan *Nutrition Survey of Pakistan* Directorate of Nutrition Survey Research, Islamabad, 1970.
2. Ali, S. M.; Khan, M. A. *Nutrition Survey of Northern Areas of Pakistan* University of Agriculture Press, Lyallpur, Pakistan, 1976.
3. Ali, S. M.; Miller, D. S. *Pakistan J. Sci. Ind. Res.* 1963, **6**, 290.
4. Eggum, B. O. *406. beretn. Forsøgslab* Copenhagen, Denmark, 1973.
5. Association of Official Agricultural Chemists *Official Methods of Analysis* Washington, DC, 1970, 10th edn.

6. Morrison, W. R.; Smith, L. M. *J. Lipid Res.* 1964, **5**, 600.
7. Weidner, K.; Eggum, B. O. *Acta Agric. scand.* 1966, **16**, 115.
8. Eggum, B. O. *Acta Agric. scand.* 1968, **18**, 122.
9. Eggum, B. O.; Christensen, K. D. *Breeding for Seed Protein Improvement using Nuclear Techniques* International Atomic Energy Agency, Vienna, 1975.
10. FAO/WHO *Energy and Protein Requirements* Technical report, Series No. 522, World Health Organization, Rome, 1973.
11. Miller, D. S.; Payne, P. R. *J. Nutr.* 1961, **74**, 413.
12. Davidson, S. S.; Passmore, R.; Brock, J. F.; Truswell, A. S. *Human Nutrition and Dietetics* Churchill Livingston, London, 1975, 6th edn.
13. *Guide Notes on Nutrition* National Health Laboratories, Islamabad, Pakistan, 1973.
14. Miller, D. S.; Donoso, G. *J. Sci. Fd Agric.* 1963, **14**, 345.
15. FAO/WHO, Committee on Protein Requirements *Nutrition Studies No. 37*, Rome, 1965.
16. Payne, P. R. *Plt. Fds Man.* 1977, **2**, 95.