

PROTEIN REQUIREMENTS OF YOUNG ADULT MEN FED A MEXICAN RURAL DIET¹

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SUMMARY

A study was conducted to determine the protein requirements of normal young male subjects fed a model Mexican rural diet. The multiple-level nitrogen-balance technique was used in eight subjects; three of them were also studied when ingesting a milk diet. The mean requirements for the rural and milk diets were 112 and 105 mg N/kg body weight, respectively; accordingly, the amount of protein needed to cover the requirements of 97.5% of the population, calculated by method 3 of Rand, Scrimshaw and Young were 136 mg N/kg body weight for the rural diet, and 122 mg N/kg body weight for the milk diet. Interestingly, the NPU and the digestibility of the rural diet increased as the intake approached the requirement level.

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INTRODUCTION

Protein requirements have been the subject of a great deal of research, particularly in the last two decades. In general, single high-quality proteins (milk or egg) have been used in experiments involving the nitrogen balance technique. Little is known, however, about protein requirements for whole mixed diets, especially those typical of poor groups in developing countries which is ultimately the kind of knowledge needed for practical purposes.

The United Nations University (UNU), through its World Hunger Programme, has given emphasis to this area and has proposed a standard protocol for research in this field in order to collect comparable data from different countries. This protocol follows the multiple-level nitrogen-balance approach, wherein slopes for each subject are obtained, the individual protein requirements being the intercept with the zero balance line (1).

The present study was carried out to obtain data on the protein requirements of Mexican subjects with a Mexican diet.

Actually, dozens of different dietetic patterns may be observed in the country; therefore, it was decided to concentrate on rural diets since, in urban areas, diets are more similar to Western patterns.

Rural diets are also somewhat different from region to region; thus, the more common pattern in the Central Plateau of the country was selected, since this region is relatively more densely populated.

An average of the diets found in dietary surveys in the Central Plateau was obtained (2, 3). Although animal protein was present some days along the year, particularly on holidays, it was eliminated in calculating the averages, since its absence would be the rule for most of the days of the year.

This model diet was administered to eight subjects and, in three of them, a study with a milk protein diet was also performed as a control for possible abnormal metabolic responses.

METHODOLOGY

Subjects

Eight healthy young male adults were studied. They had been born and still lived in Malinalco (State of Mexico), a rural

town with a population of 3,500 inhabitants located 120 km away from Mexico City, at an altitude of 1,700 m above sea level, whose main economical activity is agriculture. Their age, body weight, height and energy intake are presented in Table 1.

Ethnically, they were mestizoes, a term meaning a wide variety of combinations of Spaniard and Indian background; however, they represent most of the Mexican population. The subjects were deparasited on admission, and during the study there was no evidence of infection or parasites in any of them.

Results of chest X-rays, VDRL, urianalysis, blood chemistry, blood cytology, and serum determinations (electrolytes, total proteins, cholesterol, triglycerides and GP and GO amino transferases) were normal in all cases.

Diets

a) Mexican rural diet. The main protein sources in this model diet were corn tortillas, whole boiled beans (*P. vulgaris*) and wheat pasta, representing 52.2, 31.5 and 6.3% of the total dietary protein, respectively; fruits and vegetables, varying seasonally and regionally, completed the diet. In the experiment, banana, papaya, guaba, sweet lemonade, apple juice, carrots, potato, sweet potato, onion, tomato, and chile were used and provided 10% of the total protein. Based on the FAO/WHO 1973 Provisional Pattern the chemical score of this diet was 71%, with lysine as the limiting amino acid.

This diet was fed at random at four levels: 0.4, 0.5, 0.6 and 0.7 g of protein/kg body weight. Each daily ration for each subject was prepared individually, carefully weighing the ingredients, and stored in individual containers. Kjeldahl nitrogen was measured for every ingredient whenever a new batch was used. Beans and tortillas were prepared in the typical way, and pasta was offered as soup which included onion, tomato and chicken broth (the broth provided 0.1 mg N/kg body weight, which is negligible).

b) Milk diet. The only protein source, except for some amount in the vegetables (15%), was milk. Different dishes made with cream, cheddar cheese and fluid milk, which supplied 4, 60 and 21% of the total protein of the diet, were used. The chemical score (FAO/WHO 1973 Provisional Pattern) was 94.3% with metionine plus cystein as the limiting amino acid.

This diet was fed in random order at different levels: 0.3, 0.4, 0.5 and 0.6 g of protein/kg body weight.

TABLE 1
SUMMARY OF SUBJECT'S CHARACTERISTICS

Code	Protein source	Age (y)	Body weight (o/o of ideal, kg)	Height (cm)	Energy intake (kcal/kg body weight)
ADF	Mexican rural	20 11/12	60.0 (94)	170	45.06
AF	Mexican rural	15 5/12	49.6 (86)	160	43.38
JS	Mexican rural	18 3/12	58.4 (96)	166	41.75
IG	Mexican rural	21 9/12	49.9 (90)	163	44.08
AR	Mexican rural	20 4/12	54.3 (94)	159	40.56
SR	Mexican rural	21 9/12	57.4 (99)	160	39.36
UR	Mexican rural	29 11/12	52.2 (92)	159	42.36
ER	Mexican rural	23 2/12	58.0 (106)	155	37.36
\bar{x}		21 10/12	55.0 (95)	162	41.74
SD \pm		3 8/12	3.8 (6)	4	2.39
SR	Milk	21 11/12	57.4 (99)	160	39.13
ADF	Milk	21 9/12	60.0 (94)	170	44.95
UR	Milk	30 1/12	52.2 (92)	159	42.03
\bar{x}		24 10/12	55.0 (95)	163	42.04
SD		5 2/12	3.2 (3)	5	2.37

c) *Nitrogen-free diet.* This consisted of apple juice, jelly, gruels and desserts made of maizena, salad, cookies, marmalade, margarine, lemon sherbet, soft drinks, sweet potato, lemonade, sugar and corn oil. The protein content was 0.08 g/kg body weight.

Dietary calculations were done by a trained dietitian who also supervised the preparation of meals. These were taken at 8:00 a.m., 1:30 p.m. and 7:00 p.m., respectively.

d) *Energy intake.* On admission to the metabolic unit, a detailed clinical and dietary history was taken for each subject to obtain information as to his customary caloric and fluid intakes, as well as exercise habits. During the stabilization period, adjustments in energy intake were also done until a level was reached wherein body weight remained stable.

To substitute for customary physical activity, a program of physical exercise (stationary bicycle) was started on admission. This varied from 30 to 60 minutes daily, according to each subject's own habits, but it was kept constant along the study for any given subject. Otherwise, activity was sedentary.

Once the energy intake for a subject was established, it remained unchanged through the study despite changes in body weight while on the balance period. Since some decrease in body weight was expected while consuming a low-protein diet, body weight would become a variable affecting total energy intake; therefore, a "reference" body weight (body weight on the first day of depletion of the first balance) was used to calculate both energy and protein intakes during the whole study.

As derived from Table 1, energy intake was 41.4 ± 2.8 kcal/kg for subjects on the Mexican rural diet, and 42.0 ± 2.9 kcal/kg for those on the milk diet.

To obtain the different levels of protein intake, the standard diet had to be "diluted" with non-protein calories. Table 2 details the way in which this dilution was obtained.

e) *fluid intake.* This was maintained constant during the balance period, averaging 2,200 ml per day for all subjects.

f) *Vitamins and minerals:* To avoid vitamin and mineral deficiencies, two capsules of Unicap "T" were administered daily during the study period. This supplement provides generous amounts of vitamins and most minerals.

Experimental Design

The studies were conducted in the Metabolic Unit at the National Institute of Nutrition in Mexico City. The Unit's environmental temperature varied little, around an average of 19°C in winter and 23.8°C in fall, with intermediate mean temperatures

TABLE 2

PROPORTION OF THE ENERGY INTAKE DERIVED FROM PROTEIN, FAT, AND CARBOHYDRATE OF THE RURAL AND MILK DIETS AT DIFFERENT LEVELS OF PROTEIN INTAKE (o/o)

Source of energy		Protein intake levels (g/kg body weight)				
		0.3	0.4	0.5	0.6	0.7
Milk diet	Protein	2.93 ±0.17	3.83 ±0.28	4.78 ±0.28	5.92 ±0.17	— —
	Fat	25.69 ±2.92	31.66 ±0.62	32.35 ±3.07	31.49 ±6.11	— —
	Carbohydrates	71.40 ±2.88	64.50 ±0.54	62.86 ±3.16	62.57 ±6.27	— —
Mexican rural diet	Protein	— —	3.87 ±0.24	4.86 ±0.28	5.71 ±0.37	6.73 ±0.41
	Fat	— —	27.29 ±8.82	29.38 ±6.52	31.34 ±7.07	26.03 ±7.21
	Carbohydrates	— —	68.92 ±8.94	66.13 ±6.84	62.78 ±7.30	66.97 ±7.12

in spring and summer; temperatures in Malinalco are usually above these values. Average relative humidity also showed little variation, from an average of 56.2% in fall to 45.9% in spring, with intermediate mean values in winter and summer. Variations along the day were $\pm 1^{\circ}\text{C}$, and 3% relative humidity. Each subject stayed at the Metabolic Unit approximately 71 days; the subjects showed a remarkable adaptation to confinement in the Unit, probably because they were allowed to participate in simple tasks and to move around interacting with other patients and the staff. An initial stabilization period of 15 days was allowed for the subjects' adaptation to the diet and environment, and for adjustment of the energy intake to each individual's requirements as judged by body-weight stability. During this period, protein intake was kept at the customary level (mean = 1.028 g P/kg body weight).

After the stabilization period, each subject was submitted to four different nitrogen balance studies; each nitrogen-balance period consisted of the following sequence:

1. One day on a nitrogen-free diet.
2. Ten days on the test diet. On the first six days neither urine nor fecal collections were done, considering this period as an adaptation stage; the next four days, collections were made and the data obtained were used to calculate nitrogen balance.
3. A three-day rest period between balances, during which the subjects were fed the same diet, but with a protein intake of 1 g/kg body weight.

Measurements

a) *N Balance.* The diet, and the four-day fecal-pools were analyzed by the macrokjeldahl technique and daily urine samples by microkjeldahl. "True digestibility", "true nitrogen balance" and NPU were calculated from these data; integumental nitrogen losses were taken as 5 mg/kg body weight (4), and the metabolic urinary and fecal nitrogen were taken as 2.58 and 0.60 mg N/kg body weight (5), respectively.

b) *Anthropometry.* Body weight was registered daily. Bicipital, tricipital, subscapular and suprailiac skinfolds and arm, waist and buttocks circumferences were taken on the first and last day of each balance period. Height was measured at the beginning

of the study. Lean body mass and body fat were estimated by the Durnin and Womersley method (6).

c) Blood. Complete hematic cytology (Coulter counter), blood chemistry (autoanalyzer AA-1 technicon), serum Na, Cl, K, Mg, Ca and P (flamometer and atomic absorption spectrophotometer), total serum proteins (7), seroalbumin (8), serum cholesterol (9) and triglycerides (10) as well as serum GP and GO aminotransferases (11) were measured just before starting and finishing each balance period.

d) Urine. Urinalysis was done on the same days of the blood determinations. Urinary creatinine (12) and urea (13) excretion were measured in every 24-hr urine collection.

e) Miscellaneous. Chest X-rays, fecal culture, copro-parasitoscopic tests and VDRL were done on admission.

f) Protein requirement. This was calculated for each individual as the intersection of the zero-balance line with the line obtained from the four balance levels.

With the pooled data for all the subjects and levels, the mean nitrogen requirement (PR_m) and the nitrogen requirement for 97.5% of the population (PR_α) were calculated according to "method 3" proposed by Rand, Scrimshaw and Young (14).

RESULTS AND DISCUSSION

Nitrogen Balance and Protein Requirement

Individual nitrogen ingestion, urinary nitrogen and fecal nitrogen for each of the balance levels, for the rural and the milk diets are presented in Tables 3 and 4, respectively. The nitrogen balance for each level, and the nitrogen requirements (NR_i) for each individual with the rural and the milk diets are shown in Tables 5 and 6. From the data in Table 5 it may be derived that for the Mexican rural diet, the average and standard deviation for nitrogen balances at each level were, for 0.4, 0.5, 0.6 and 0.7 g of protein intake/kg body weight, -31.2 ± 6.4 ; -22.6 ± 5.4 ; -9.7 ± 5.6 and -1.6 ± 10.6 mg N/kg body weight, respectively; similarly, for milk protein, at intakes of 0.3, 0.4, 0.5 and 0.6 g P/kg body weight, the nitrogen balances were: -24.9 ± 1.1 ; -17.1 ± 4.5 ; -12.4 ± 2.8 and -2.8 ± 2.9 .

The mean nitrogen balances for each of the four levels of nitrogen intake with the rural diet fitted a straight line following

TABLE 3
 INGESTED, URINARY AND FECAL NITROGEN FOR EACH BALANCE LEVEL
 WITH THE MEXICAN RURAL DIET
 (mg N/kg body weigh/day)

Code	Level of protein intake (g prot/kg body weight)											
	0.4			0.5			0.6			0.7		
	In	Un	Fn	In	Un	Fn	In	Un	Fn	In	Un	Fn
ADF	65	49	32	82	60	34	—	—	—	113	84	33
AF	65	56	31	81	78	25	99	89	25	113	89	28
JS	64	75	24	81	84	24	—	—	—	114	87	14
IG	65	70	22	82	71	32	97	76	25	113	68	20
AR	65	68	31	81	84	17	97	79	17	113	80	22
SR	65	55	34	82	65	28	98	72	28	113	67	32
UR	67	67	28	82	62	35	96	63	33	113	72	27
ER	65	64	23	81	65	30	97	73	31	114	83	30
Mean	65.1	63.0	28.1	81.5	71.1	28.1	97.3	75.3	26.5	113.2	78.8	25.7
SD	0.78	8.24	4.28	0.50	9.08	5.60	0.94	7.84	5.15	0.43	8.05	6.13

In = Ingested N; Un = Urinary N; Fn = Fecal N.

TABLE 4
 INGESTED, URINARY AND FECAL NITROGEN FOR EACH BALANCE
 LEVEL WITH THE MILK DIET
 (mg N/kg body weight/day)

Code	Level of protein intake (g prot/kg body weight)											
	0.3			0.4			0.5			0.6		
	In	Un	Fn	In	Un	Fn	In	Un	Fn	In	Un	Fn
SR	49	54	15	63	56	23	79	62	24	94	69	25
ADF	48	55	19	64	53	18	80	74	18	—	—	—
UR	48	53	15	63	53	22	78	67	22	96	77	15
Mean	48.3	54.0	16.3	63.3	54.0	21.0	79.0	67.7	21.2	95.0	73.0	20.0
SD	0.47	0.81	1.88	0.47	1.41	2.16	0.81	4.92	2.49	1.00	4.00	5.00

In = Ingested N; Un = Urinary N; Fn = Fecal N.

TABLE 5

NITROGEN BALANCE AT DIFFERENT LEVELS OF PROTEIN
INTAKE AND INDIVIDUAL NITROGEN REQUIREMENTS WITH
THE MEXICAN RURAL DIET
(mg N/kg body weight/day)

Code	Level of protein intake (g prot/kg body weight)				NRi
	0.4	0.5	0.6	0.7	
ADF	-20	-18	-	- 8	146
AF	-28	-27	-22	-10	147
JS	-39	-32	-	+ 8	126
IG	-32	-24	- 9	+20	100
AR	-39	-25	+ 4	+ 6	105
SR	-30	-16	- 7	+ 9	103
UR	-35	-21	- 5	+ 9	103
ER	-26	-19	-12	+ 4	123
Mean	-31.1	-22.8	- 8.5	+ 2.8	119.1
SD ±	6.13	4.94	7.8	9.88	18.18

TABLE 6

NITROGEN BALANCE AT DIFFERENT LEVELS OF PROTEIN
INTAKE AND INDIVIDUAL NITROGEN REQUIREMENTS WITH
THE MILK DIET
(mg N/kg body weight/day)

Code	Level of protein intake (g/kg body weight)				NRi
	0.3	0.4	0.5	0.6	
SR	-26	-22	-11	- 5	104
ADF	-24	-13	-10	-	105
UR	-25	-17	-15	- 8	102
Mean	-25.0	-17.3	-12.0	- 6.5	103.6
SD ±	0.81	3.68	2.16	1.5	1.24

the equation $y = 0.66x - 73.52$, the coefficient of correlation being 0.99; if individual values rather than averages are used, the equation becomes $y = 0.70x - 77.60$ with a correlation coefficient of 0.87. Utilizing Rand's method 3 (14) —which uses mean N balances for each level of protein intake— the average nitrogen requirement (PR_m) was 112 mg N/kg body weight/day, and the requirement for 97.50% of the population (PR_α) was 136 mg N/kg body weight/day. Taking a nitrogen to protein conversion factor of 6.21 for this diet, these values would represent 0.69 and 0.84 g prot/kg body weight/day, respectively.

For the milk diet, the mean nitrogen balance values for each of the four levels fitted a straight line following the equation $y = -0.46x - 46.87$ with a correlation coefficient of 0.99. If individual points are utilized, the equation becomes $y = 0.45x - 46.76$ with a correlation coefficient of 0.95. With this diet, using Rand's method 3 (14), PR_m and PR_α were 103 and 122 mg of N/kg body weight, equivalent to 0.66 and 0.78 g of protein/kg body weight, respectively, using a conversion factor of 6.38 x N.

Figure 1 plots nitrogen balance as a function of nitrogen ingestion for both the Mexican rural and the milk diets. Extrapolation of the curves to zero N intake would not give the same value for the two diets, but such extrapolation is not valid since below an intake of 30 mg N/kg body weight, the response is non-rectilinear (17). In the lower right, the PR_m for both diets as well as ± 2 SD. are represented. The requirements for milk protein to attain zero balance in these subjects were higher than those reported in the literature. The reason for this difference may be a) inaccuracy of the zero intercept when using data of only three cases; b) the presence of more fiber in our diet as compared to other studies; or c) a possible subclinical lactose intolerance. The relatively high fecal nitrogen observed in our subjects favors the last two possibilities. Although lactase deficiency was not investigated, it is known to be frequent in the Mexican adult population (15); in this regard it must be mentioned, that none of our subjects presented clinical manifestations of milk intolerance and that the amount of milk ingested as such was small, accounting for 25% of the milk-protein intake.

The values for both diets were closer to each other than expected, although more data on milk protein would be necessary to collect for a definitive conclusion.

Correcting for chemical score (PR_m for milk x 100/ChS) PR_m for the rural diet would be 136 mg N/kg body weight and

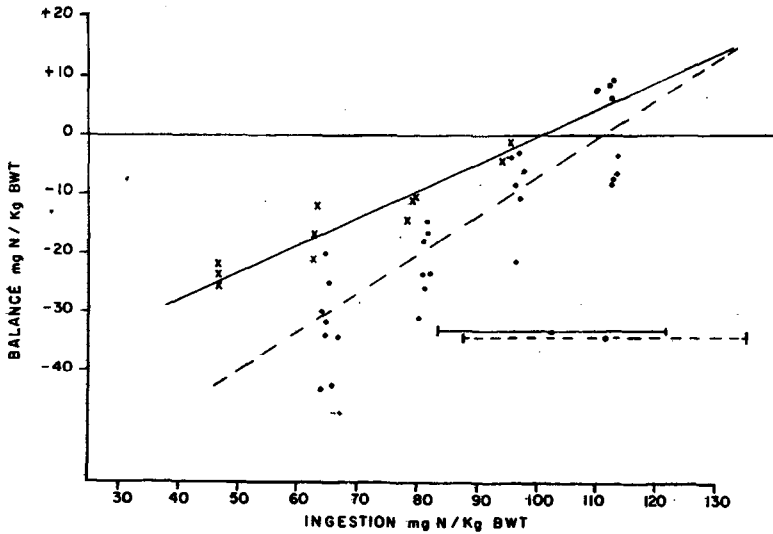


FIGURE 1

Nitrogen ingestion and balance of a Mexican rural diet (---) and of a milk diet (—)

PR_{α} around 161 mg N/kg body weight; the experimentally-found values were considerably lower, suggesting that lysine was not as limiting in the Mexican rural diet as it could be predicted using the 1973 FAO/WHO Provisional Pattern.

It is interesting to compare the nitrogen requirements obtained with the two diets in the three subjects who participated in both studies.

The similarity of requirements of S.R. and U.R. for both diets is striking; ADF utilized milk protein with similar efficiency than the other two subjects, but showed much less efficiency of utilization of the rural-diet protein; no special characteristics could be identified in this subject to explain the phenomenon except that, being a native of Malinalco, he moved to Mexico City where he stayed for several months, changing his diet. The new diet was rich in meat, eggs and milk; back home he maintained a diet providing an average of 47g protein, including 20 g of animal pro-

tein as beef, pork, milk, cheese and eggs. Interpretation of these findings is difficult.

True Digestibility, Biological Value and NPU

Table 7 shows the true digestibility, biological value and NPU for the rural diet on each subject; the respective values for the milk diet are presented in Table 8, while the NPU for both diets is illustrated in Figure 2.

For the rural diet, the mean NPU showed a slight tendency to increase as nitrogen intakes approached the requirement level; on the average, there was a correlation coefficient of 0.94 between NPU and protein intake, but taking all the individual values, correlation was very poor with an $r = 0.38$; actually, the NPU for 0.4 and 0.7 g of protein intake/kg body weight was statistically different ($t = 3.22$, $P = 0.006$). There was, however, a significant increase in true digestibility as intakes approached the requirement level; a comparison of values at 0.4 with those at the 0.7 level showed a $t = 3.91$ which is significant at $P < 0.002$. On the average, digestibility and intake had a correlation coefficient of 0.99; using all the individual values, the correlation was still high with an $r = 0.62$.

The unexpected raise in NPU with increased protein intake, due to an increase in digestibility is difficult to explain, but a similar phenomenon was observed by Yañez *et al.* with a Chilean mixed diet (16).

In the case of the milk protein diet, the NPU decreased as protein intake increased with a correlation coefficient of -0.89 and -0.66 when the averages or the individual values were used, respectively. The mean NPU at 0.6 g and 0.3 g protein intake/kg body weight were not significantly different ($t = 1.38$, $P = 0.13$); the digestibility of this diet was similar at different levels of protein intake, but the biological value decreased as the protein intake increased, with a correlation coefficient of -0.89 .

Body Composition

The gross estimators of body composition used in this study detect significant changes throughout the experiment.

TABLE 7

TRUE DIGESTIBILITY, BIOLOGICAL VALUE AND NET PROTEIN UTILIZACION (NPU) OF THE MEXICAN RURAL DIET PROTEIN AT DIFFERENT LEVELS OF INTAKE

Code	Protein intake	True digestibility, %				Biological value				NPU			
		0.4	0.5	0.6	0.7	0.4	0.5	0.6	0.7	0.4	0.5	0.6	0.7
ADF		62	70	—	80	87	71	—	55	56	50	—	50
AF		70	84	86	86	91	61	56	62	63	52	49	53
JS		79	83	—	97	40	41	—	61	32	34	—	59
IG		85	77	86	93	66	70	71	84	56	54	62	78
AR		70	93	94	90	54	52	65	68	38	48	61	61
SR		63	79	82	81	76	69	67	76	48	55	55	61
UR		81	76	79	83	65	79	86	66	53	60	67	55
ER		74	71	77	87	63	63	56	50	46	45	43	43
Mean		73.0	79.1	84.0	87.1	67.7	63.3	66.8	65.2	49.0	49.7	56.1	57.5
SD		7.77	7.02	5.56	5.55	15.69	11.26	10.18	10.25	9.55	7.22	8.17	9.62

TABLE 8

TRUE DIGESTIBILITY, BIOLOGICAL VALUE AND NET PROTEIN UTILIZATION (NPU) OF MILK PROTEIN
AT DIFFERENT LEVELS OF INTAKE

Code	Protein intake	True digestibility, %				Biological value				NPU			
		0.3	0.4	0.5	0.6	0.3	0.4	0.5	0.6	0.3	0.4	0.5	0.6
SR	90	79	83	85	78	78	75	70	70	62	62	59	
ADF	82	88	97	—	86	82	59	—	71	72	58	—	
UR	93	83	87	96	91	92	74	70	85	77	64	68	
Mean	88.3	83.3	89.0	90.5	85.0	84.0	69.3	70.0	75.3	70.3	61.3	63.5	
SD	4.64	3.68	5.89	5.5	5.35	5.89	7.31	0.0	6.84	6.23	2.49	4.50	

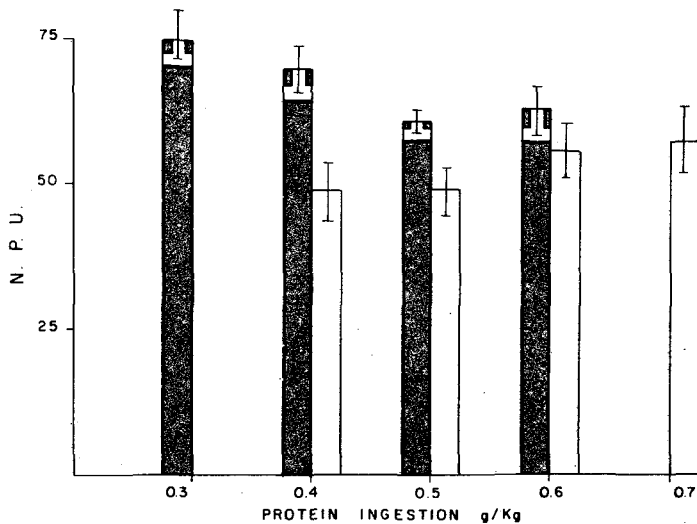




FIGURE 2

Protein ingestion and NPU of a Mexican rural diet () and of a milk diet ()

Chemical Laboratory Tests

All values in all subjects were normal and remained normal throughout the whole study.

CONCLUSIONS

In summary, the protein requirements for the Mexican rural diet, in the conditions of this experiment, distributed around a mean of 112 mg of nitrogen (0.70 g of protein)/kg body weight; according to Rand's method 3, the necessary intake to cover the needs of 97.50/o of the population would be 136 mg N (0.85 g of protein)/kg body weight. The digestibility and consequently the NPU of this diet, increased as the protein intake was raised from 0.4 to 0.7 g.

Several aspects deserve further study: other model diets

should be tried; the effect of intestinal parasites should be investigated; the increase in digestibility with protein intake needs more documentation and testing of the possible mechanisms involved.

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RESUMEN

REQUERIMIENTOS PROTEINICOS DE HOMBRES JOVENES ADULTOS ALIMENTADOS CON UNA DIETA RURAL MEXICANA

Se llevó a cabo un estudio para determinar los requerimientos proteínicos de varones adultos jóvenes, alimentados con un modelo de dieta rural mexicana. Se utilizó la técnica de balance de nitrógeno con niveles múltiples de ingestión en ocho sujetos; tres de ellos fueron también estudiados con una dieta a base de productos lácteos. El promedio de los requerimientos para las dietas rural y láctea fue 112 y 103 mg de N/kg de peso corporal, respectivamente. La cantidad de nitrógeno necesaria para cubrir los requerimientos del 97.5% de la población, calculada conforme al método 3 de Rand, Scrimshaw y Young fue de 136 mg de N/kg de peso corporal para la dieta rural y de 122 mg de N/kg de peso corporal para la dieta láctea. Es interesante el aumento de la utilización proteínica neta (NPU) y de digestibilidad observado con la dieta rural, cuando la ingestión proteínica se aproxima a niveles de requerimientos.

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