Fecal and Urinary Nitrogen Losses

F. Viteri, R. Bressani, G. Arroyave
Institute of Nutrition of Central America and Panama
(I.N.C.A.P.)

1. Introduction

Knowledge of the magnitude of the endogenous losses of fecal and urinary nitrogen is essential for the calculation of protein requirements by the factorial approach. In the present paper data for children are presented on endogenous losses in the feces and urine, that is, under conditions of nitrogen free feeding. In addition we have studied the losses of fecal nitrogen from different dietary protein sources (animal, vegetable and mixed) and various levels of intake. Apparent and true digestibility values were thereby derived and are reported here.

2. Materials and Methods

The studies were conducted in the Unit for Metabolic studies of INCAP. The subjects were boys ranging in chronological age from 23 to 74 months, completely recovered from malnutrition. Criteria for accepting them in the study included: (a) body weight/height above 95% of the 50th percentile of Stuart for the child's height; (b) fully repleted lean body mass as judged by a creatinine-height index above 0.95; (c) absence of any clinical or biochemical evidence of disease. In many children tested, as well as in other fully recovered children, basal oxygen consumption was measured, and found the same as for normal children of the same height.

The diets were quantitatively prepared in the metabolic kitchen and were designed to provide no protein, or variable quantities of the various proteins, but always sufficient amounts of calories and nutrients to meet the subjects' recommended intakes. Fecal and urine specimens were collected for three consecutive days for each determination.

The content of nitrogen in the prepared diets and fecal specimens was determined in the laboratory by direct analyses of representative aliquots, using the Kjeldahl method. "Actual Intake" was computed. That is, losses due to vomiting, refusal, etc, were determined and substracted.

2. Results

A. Endogenous Nitrogen Losses

i) Fecal

The results are based on 67 independent determinations on 12 subjects ranging in age from 23-74 months. The data expressed as mg nitrogen per kilogram of body weight per day gives an average of 24.6 (± SE = 1.0). Since there is a relatively wide range of body weights and ages the dependance of the fecal losses on these variables was investigated. It was found that the fecal nitrogen/kg/d decreases with body weight (regression coefficient = -0.28). One would expect, normally a similar correlation with age. However the regression coefficient obtained between fecal nitrogen and chronological age was much smaller (-0.07). The reason is that since our subjects had previously suffered from malnutrition their biological age did not really match their chronological age. When height-age was used a better negative relationship was observed (N = 66; regression coefficient = -0.34; average = 25.0 ± SE = 0.96).

This fact unveils the error introduced by the WHO/FAO Expert Group when they fixed the losses of fecal nitrogen all along the age scale as 20 mg/kg/d.

The fact that basal calories/kg/d are also inversely correlated with biological age is compatible with a constant relationship between endogenous losses of fecal nitrogen and calories (as used by NRC), and emphasizes the soundness of this concept.

The regression between height-age and endogenous fecal nitrogen per basal calorie was calculated and is shown in Figure 1. It can be seen that, indeed, the ratio of endogenous fecal nitrogen to basal calories is constant with age (regression coefficient = 0.0003) with a value of 0.48 mg nitrogen per basal calorie (S.D. = 0.14; coefficient of variation = 29%). An interesting feature of these data is the large variability observed, which is greater within child than between children.

ii) Urinary

Urinary endogenous nitrogen per kilogram of body weight per day was negatively correlated with body weight (regression coefficient = -0.25) and with height-age (regression coefficient = -0.52). On the other hand, the excretion of urinary nitrogen per basal calorie (see Figure 2) is constant with height-age (regression coefficient = 0.0073) giving an average value of 1.232 mg/b.Cal/day; S.D. = 0.274; coefficient of variation = 22%.

B. Fecal Nitrogen Excretion at various Levels of Protein Intake from different sources

Total fecal nitrogen was measured using the techniques described, in 125 children who were receiving various protein intakes from 18 different sources. These included 4 animal sources, 4 single-vegetable sources, 4 vegetable mixtures, and 6 vegetable mixtures containing powdered milk which contributed from 9 to 18% of the total nitrogen.

Tables I to V present the total fecal nitrogen excreted at various levels of intake for each source, grouped into the four greater categories described above. Regression equations for various nitrogen intake levels were calculated for each protein source and for the total data for each of the four greater categories.

In the case of milk it was found that fecal nitrogen excretion increased rapidly when milk protein intake was greater than 2.75 grams per kilogram per day (440 mg nitrogen/kg/day). Therefore, the linear regression for the animal protein category was calculated taking into consideration only the fecal nitrogen values for milk protein intakes below 440 mg/kg/day.

It is clear that, as expected, fecal nitrogen excretion increases with intake. However, the smallest slope is found for the animal protein category (regression coefficient = 0.07), and the greatest for the single vegetable sources as a whole (regression coefficient = 0.24). Vegetable mixtures have slopes which resemble the latter (regression coefficient = 0.18), the addition of animal protein tending to lower it slightly (regression coefficient = 0.15).

Tables V to XII present the average ± S.E. of total and "exogenous" fecal nitrogen excretion for various intake levels of each protein source. "Exogenous" fecal nitrogen has been calculated by substracting the average endogenous fecal nitrogen to the total fecal nitrogen at the various intake levels. We believe this is justified since it was impractical to determine endogenous fecal nitrogen in each child tested, and since the variability of this parameter was greater within a child than between children.

From these data it is evident that "exogenous" fecal nitrogen from animal sources contributes insignificantly to the total fecal nitrogen at nitrogen intake levels close to the nitrogen requirements. As an average, at 100 mg/kg/d nitrogen intake only 4 mg/kg/d are of exogenous origin. This is 14% of the total expected fecal nitrogen at that level of intake. This is not the case for vegetable proteins as a whole, which at the same level of intake would contribute 36% of the total fecal nitrogen (14/38.6 mg/kg/d).

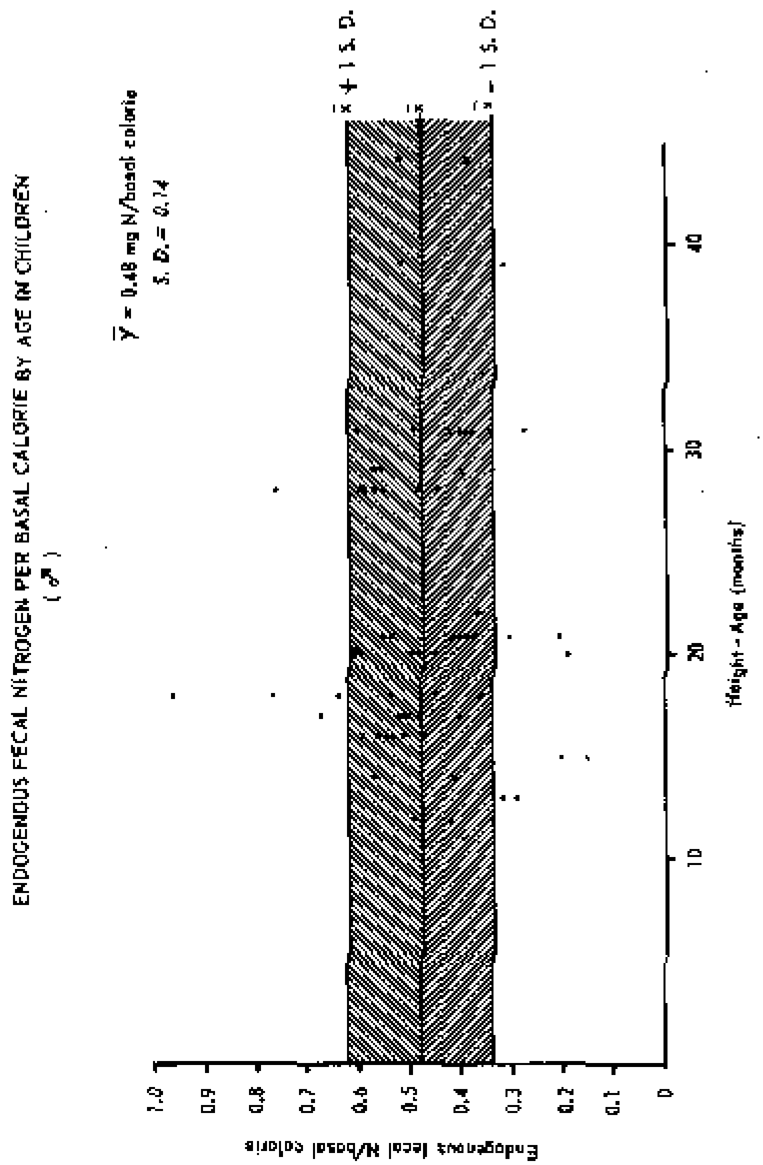
Finally, apparent and "true" digestibility for each source of protein at various intake levels was calculated by the following formula:

$$\text{Apparent digestibility} = \frac{\text{N intake} - \text{Total fecal N}}{\text{N intake}} \times 100$$

$$\text{"True" digestibility} = \frac{\text{N intake} - (\text{Total fecal N} - \text{Endogenous N})}{\text{N intake}} \times 100$$

Results are shown in Tables XIII to XVI. It is evident that animal protein as a group has a high digestibility while vegetable mixtures have the lowest values as a group. The incorporation of animal protein to vegetable mixtures appears to have a beneficial effect. As expected, digestibility is essentially constant for each protein source, independent of intake, with the notable exceptions of lower digestibility for milk fed at high levels (above 3.0 g protein/kg/d), and corn which progressively decreases its digestibility (tested at intakes between 239 and 461 mg of nitrogen/kg/d).

Figure 1



ENDOGENOUS FECAL NITROGEN PER BASAL CALORIE BY AGE IN CHILDREN
(♂)
Ȳ = 0.48 mg N/basal calorie
S.D. = 0.14
x̄ + 1 S.D.
x̄
x̄ − 1 S.D.
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10
20
30
40
Height - Age (months)
Endogenous fecal N/basal calorie

Figure 2

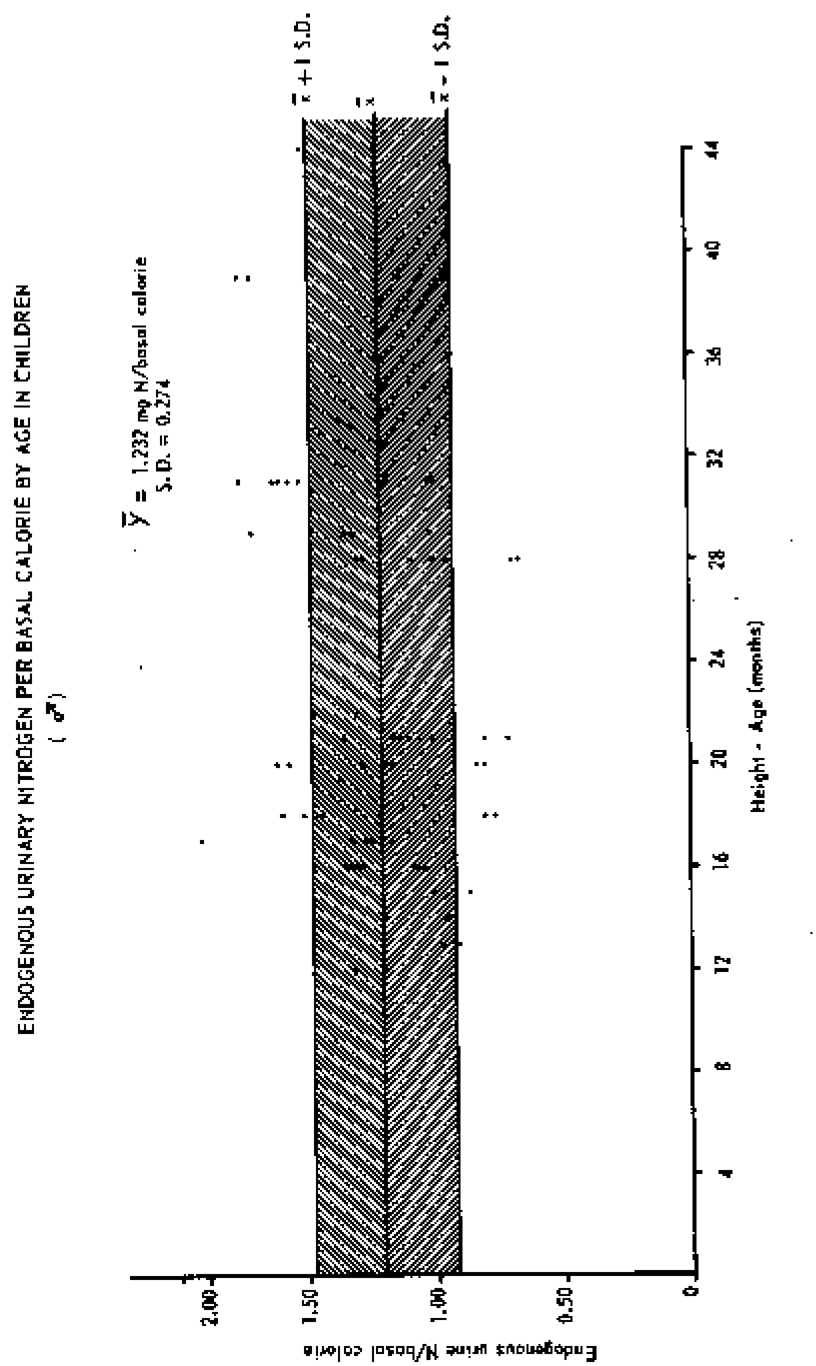

ENDOGENOUS URINARY NITROGEN PER BASAL CALORIE BY AGE IN CHILDREN
(♂)
Ȳ = 1.232 mg N/basal calorie
S. D. = 0.274
x̄ + 1 S.D.
x̄
x̄ - 1 S.D.
Endogenous urine N/basal calorie
2.00
1.50
1.00
0.50
0
4
8
12
16
20
24
28
32
36
40
44
Height - Age (months)

Table I

Fecal Nitrogen at Various Levels of Nitrogen Intake from Animal Sources

Source of Protein	No. of Children	No. of Determinations	Age (m)	Weight (kg)	N. Intake (mg/kg/d)	Regression Equation Against Intake	r
						y = Fecal N.	
						x = N. Intake	
Milk	6	52	20-119	8.8-23.6	154-440	y = 6.8+0.13 x	0.677
Milk	5	15	15-51	8.5-22.7	440-611	y = 208.8+0.57 x	0.776
Egg	7	58	24-39	9.7-14.8	22-404	y = 31.5+0.05 x	0.251
Casein	11	47	17-86	7.6-16.5	80-518	y = 18.5+0.05 x	0.500
FPC	9	79	37-72	11.5-19.8	71-310	y = 18.8+0.05 x	0.400
*All	33	236	17-119	7.6-23.6	22-440	y/?/ = 19.6+0.07 x	0.484

* Milk intake above 440 mg of N/kg/d excluded.

Table II

Fecal Nitrogen at Various Levels of Nitrogen Intake from Single Vegetable Sources

Source of Protein	No. of Children	No. of Determinations	Age (m)	Weight (kg)	N. Intake (mg/kg/d)	Regression Equation Against Intake	r
						y = Fecal N.	
						x = N. Intake	
Corn	8	62	18-74	8.7-16.1	234-478	y = -22.8+0.34 x	0.816
Rice	3	52	26-31	10.0-12.6	282-376	y = 19.9+0.16 x	0.237
Wheat	6	101	17-69	8.1-14.5	253-393	y = 11.6+0.10 x	0.224
Soy	4	38	21-55	9.3-15.5	77-321	y = 19.2+0.11 x	0.761
All	21	253	17-74	8.1-16.1	77-478	y/?/ = 11.96+0.24 x	0.727

Table III

Fecal Nitrogen at Various Levels of Nitrogen Intake from Vegetable Mixtures

Source of Protein	No. of Children	No. of Determinations	Age (m)	Weight (kg)	N. Intake mg/kg/d	Regression Equation Against Intake	r
						y = Fecal N.	
						x = N. Intake	
Inoaparina	9	14	21-56	7.5-14.5	326-632	y = -16.6+0.31 x	0.786
Corn + Beans	13	39	20-71	10.0-17.3	229-378	y = 75.4+0.05 x	0.134
WSB	5	41	20-98	8.3-17.9	75-224	y = 25.7+0.16 x	0.560
Corn + Beans + Incaparina	4	6	26-58	10.1-16.8	236-381	y = -36.1+0.43 x	0.871
All	31	100	20-98	7.5-17.9	75-632	y/?/ = 33.1+0.18 x	0.594

Table IV

Fecal Nitrogen at Various Levels of Nitrogen Intake from Mixed Vegetable and Animal Sources

Source of Protein	No. of Children	No. of Determinations	Age (m)	Weight (kg)	N. Intake mg/kg/d	Regression Equation Against Intake	r
						y = N. Fecal	
						x = N. Intake	
Superamine	5	37	20-44	9.5-15.8	79-249	y = 19.1+0.18 x	0.819
TRL	5	40	21-44	9.5-14.4	72-242 -	y = 18.0+0.17 x	0.725
CSM	5	41	32-67	11.6-19.1	78-256	y = 19.6+0.10 x	0.483
IRL	5	38	26-49	10.2-13.8	68-295	y = 21.9+0.16 x	0.663
CSB	5	36	21-52	8.8-13.9	73-241	y = 18.5+0.17 x	0.684
Corn+Beans+Milk	15	71	20-71	8.2-17.5	229-388	y = 38.1+0.13 x	0.233
All	40	263	20-71	8.2-19.1	72-388	y/?/ = 31.6+0.15 x	0.534

Table V

Total Fecal Nitrogen At Various Levels of Nitrogen Intake from Animal Sources (mg/kg/d)

<table>
<tr><th>Levels of Nitrogen Intake</th><th>Milk x/?/ ± S.D. (N)</th><th>Egg x/?/ ± S.D. (N)</th><th>Casein x/?/ ± S.D. (N)</th><th>Fish Protein Concentrate x/?/ ± S.D. (N)</th></tr>
<tr><td>0-100</td><td></td><td>22.3 ± 3.5 (6)</td><td></td><td>25.2 ± 1.6 (18)</td></tr>
<tr><td>100-150</td><td></td><td>33.7±2.7 (9)</td><td>23.8±5.2 (6)</td><td>25.6±2.1 (20)</td></tr>
<tr><td>150-200</td><td>32.7±2.0 (27)</td><td>44.6±3.5 (20)</td><td></td><td>25.3±1.6 (18)</td></tr>
<tr><td>200-250</td><td></td><td>47.2±3.2 (17)</td><td rowspan="2">26.2±2.9 (5)</td><td></td></tr>
<tr><td>250-300</td><td>36.4±2.6 (11)</td><td></td><td>33.0±2.0 (23)</td></tr>
<tr><td>300-350</td><td rowspan="2">55.5±3.8 (12)</td><td rowspan="2">37.5±7.4 (6)</td><td rowspan="2">45.7±4.8 (6)</td><td></td></tr>
<tr><td>350-400</td><td></td></tr>
<tr><td>400-450</td><td rowspan="2">58.0±5.5 (12)</td><td></td><td>43.0±4.8 (5)</td><td></td></tr>
<tr><td>450-500</td><td></td><td>43.4±2.8 (25)</td><td></td></tr>
<tr><td>500-550</td><td rowspan="2">114.6±11.4 (5)</td><td></td><td></td><td></td></tr>
<tr><td>550-600</td><td></td><td></td><td></td></tr>
</table>

Table VI

Exogenous Fecal Nitrogen at Various Levels of Nitrogen Intake from Animal Sources (mg/kg/d)

<table>
<tr><th>Levels of nitrogen intake</th><th>Milk x/?/ ± S.D. (N)</th><th>Egg x/?/ ± S.D. (N)</th><th>Casein x/?/ ± S.D. (N)</th><th>Fish Protein Concentrate x/?/ ± S.D. (N)</th></tr>
<tr><td>0-100</td><td></td><td>-2.3±3.5 (6)</td><td></td><td>0.6±1.6 (18)</td></tr>
<tr><td>100-150</td><td></td><td>9.1±2.7 (9)</td><td>-0.8±5.2 (6)</td><td>1.0±2.1 (20)</td></tr>
<tr><td>150-200</td><td>7.1±2.0 (27)</td><td>20.0±3.5 (20)</td><td></td><td>0.7±1.6 (18)</td></tr>
<tr><td>200-250</td><td></td><td>22.6±3.2 (17)</td><td rowspan="2">1.6±2.9 (15)</td><td></td></tr>
<tr><td>250-300</td><td>11.8±2.6 (11)</td><td></td><td>8.4±2.0 (23)</td></tr>
<tr><td>300-350</td><td rowspan="2">30.9±3.8 (12)</td><td rowspan="2">12.9±7.4 (6)</td><td rowspan="2">21.1±4.8 (6)</td><td></td></tr>
<tr><td>350-400</td><td></td></tr>
<tr><td>400-450</td><td rowspan="2">33.4±5.5 (12)</td><td></td><td>18.4±4.8 (5)</td><td></td></tr>
<tr><td>450-500</td><td></td><td>18.8±2.8 (25)</td><td></td></tr>
<tr><td>500-550</td><td rowspan="2">90.0±11.4 (5)</td><td></td><td></td><td></td></tr>
<tr><td>550-600</td><td></td><td></td><td></td></tr>
</table>

Table VII

Total Fecal Nitrogen at Various Levels of
Nitrogen Intake from Single Vegetable Sources
(mg/kg/d)

Levels of nitrogen intake	Corn x/?/ ± S.D. (N)	Rice x/?/ ± S.D. (N)	Wheat x/?/ ± S.D. (N)	Soy x/?/ ± S.D. (N)
0-100				27.9±3.8 (9)
100-150				31.1±1.8 (8)
150-200				39.7±4.3 (6)
200-250	53.8±2.4 (16)			46.7±2.4 (7)
250-300		71.6±2.2 (45)	41.6±3.7 (9)	
300-350	86.4±3.2 (26)		45.0±1.2 (74)	54.5±3.2 (8)
350-400		77.8±3.3 (7)	50.3±3.6 (18)	
400-450	131.0±6.7 (20)			
450-500				
500-550				
550-600				

Table VIII

Exogenous Fecal Nitrogen at Various Levels of
Nitrogen Intake from Single Vegetable Sources
(mg/kg/d)

Levels of nitrogen intake	Corn x/?/ ± S.D. (N)	Rice x/?/ ± S.D. (N)	Wheat x/?/ ± S.D. (N)	Soy x/?/ ± S.D. (N)
0-100				3.3 ± 3.8 (9)
100-150				6.5 ± 1.8 (8)
150-200				15.1 ± 4.3 (6)
200-250	29.2 ± 2.4 (16)			22.1 ± 2.4 (7)
250-300		47.0 ± 2.2 (45)	17.0 ± 3.7 (9)	
300-350	61.8 ± 3.2 (26)		20.4 ± 1.2 (74)	29.9 ± 3.2 (8)
350-400		53.2 ± 3.3 (7)	25.7 ± 3.6 (18)	
400-450	106.4 ± 6.7 (20)			
450-500				
500-550				
550-600				

Table IX
Total Fecal Nitrogen at Various Levels of Nitrogen Intake from Vegetable Mixtures (mg/kg/d)

<table>
<tr><th>Levels of nitrogen intake</th><th>Incaparina x/?/ ± S.D. (N)</th><th>Protein 87% Corn, 13% Bean x/?/ ± S.D. (N)</th><th>Wheat Soy Blend x/?/ ± S.D. (N)</th><th>Rural Diet + Incaparina x/?/ ± S.D. (N)</th></tr>
<tr><td>0-100</td><td></td><td></td><td>41.2 ± 3.2 (13)</td><td></td></tr>
<tr><td>100-150</td><td></td><td></td><td>43.8 ± 2.7 (9)</td><td></td></tr>
<tr><td>150-200</td><td></td><td></td><td>51.1 ± 6.2 (10)</td><td></td></tr>
<tr><td>200-250</td><td></td><td>89.0 ± 5.4 (12)</td><td>64.8 ± 4.1 (9)</td><td rowspan="3">91.3 ± 9.0 (6)</td></tr>
<tr><td>250-300</td><td></td><td>89.7 ± 5.3 (12)</td><td></td></tr>
<tr><td>300-350</td><td rowspan="2">117.9 ± 8.9 (9)</td><td>77.8 ± 7.0 (6)</td><td></td></tr>
<tr><td>350-400</td><td>100.0 ± 7.9 (9)</td><td></td><td></td></tr>
<tr><td>400-450</td><td></td><td></td><td></td><td></td></tr>
<tr><td>450-500</td><td></td><td></td><td></td><td></td></tr>
<tr><td>500-550</td><td></td><td></td><td></td><td></td></tr>
<tr><td>550-600</td><td rowspan="2">166.2 ± 13.9 (5)</td><td></td><td></td><td></td></tr>
<tr><td>600-650</td><td></td><td></td><td></td></tr>
</table>

Table X
Exogenous Fecal Nitrogen at Various Levels of Nitrogen Intake from Vegetable Mixtures (mg/kg/d)

<table>
<tr><th>Levels of Nitrogen Intake</th><th>Incaparina x/?/ ± S.D. (N)</th><th>Corn + Beans x/?/ ± S.D. (N)</th><th>Wheat-Soy Blend x/?/ ± S.D. (N)</th><th>Rural Diet + Incaparina x/?/ ± S.D. (N)</th></tr>
<tr><td>0-100</td><td></td><td></td><td>16.6 ± 3.2 (13)</td><td></td></tr>
<tr><td>100-150</td><td></td><td></td><td>19.2 ± 2.7 (9)</td><td></td></tr>
<tr><td>150-200</td><td></td><td></td><td>26.5 ± 6.2 (10)</td><td></td></tr>
<tr><td>200-250</td><td></td><td>64.4± 5.4 (12)</td><td>40.2± 4.1 (9)</td><td rowspan="3">66.7± 9.0 (6)</td></tr>
<tr><td>250-300</td><td></td><td>65.1 ± 5.3 (12)</td><td></td></tr>
<tr><td>300-350</td><td rowspan="2">93.3 ± 8.9 (9)</td><td>53.2 ± 7.0 (6)</td><td></td></tr>
<tr><td>350-400</td><td>75.4 ± 7.9 (9)</td><td></td><td></td></tr>
<tr><td>400-450</td><td></td><td></td><td></td><td></td></tr>
<tr><td>450-500</td><td></td><td></td><td></td><td></td></tr>
<tr><td>500-550</td><td></td><td></td><td></td><td></td></tr>
<tr><td>550-600</td><td rowspan="2">141.6 ± 13.9 (5)</td><td></td><td></td><td></td></tr>
<tr><td>600-650</td><td></td><td></td><td></td></tr>
</table>

Table XI
Total Fecal Nitrogen at Various Levels of Nitrogen Intake
from Mixed Vegetable and Animal Sources
(mg/kg/d)

<table>
<tr><th>Nitrogen intake levels</th><th>Superamine x/?/ ± S.D. (N)</th><th>TRL x/?/ ± S.D. (N)</th><th>CSM x/?/ ± S.D. (N)</th><th>IRL x/?/ ± S.D. (N)</th><th>CSB x/?/ ± S.D. (N)</th><th>Rural Diet + Milk x/?/ ± S.D. (N)</th></tr>
<tr><td>0-100</td><td>32.5 ± 2.3 (8)</td><td>31.2 ± 3.1 (10)</td><td>23.9 ± 2.9 (11)</td><td>33.4 ± 3.5 (10)</td><td>34.0 ± 3.4(7)</td><td></td></tr>
<tr><td>100-150</td><td rowspan="2">44.6 ± 2.2 (17)</td><td>40.4 ± 3.7 (10)</td><td>30.0 ± 4.2 (8)</td><td>47.7 ± 4.2 (10)</td><td>40.1 ± 2.3 (9)</td><td></td></tr>
<tr><td>150-200</td><td>44.8 ± 3.2 (10)</td><td>37.0 ± 3.3 (10)</td><td>47.3 ± 3.8 (10)</td><td>41.1 ± 2.9 (10)</td><td></td></tr>
<tr><td>200-250</td><td>59.6 ± 2.3 (12)</td><td>58.1 ± 2.2 (10)</td><td>42.7 ± 3.8 (12)</td><td rowspan="2">61.2 ± 2.4 (10)</td><td>60.5 ± 3.7 (10)</td><td rowspan="2">66.8 ± 7.4 (10)</td></tr>
<tr><td>250-300</td><td></td><td></td><td></td><td></td></tr>
<tr><td>300-350</td><td></td><td></td><td></td><td></td><td></td><td>83.1 ± 2.7 (41)</td></tr>
<tr><td>350-400</td><td></td><td></td><td></td><td></td><td></td><td>82.8 ± 4.4 (20)</td></tr>
<tr><td>400-450</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>450-500</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>500-550</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>550-600</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>600-650</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Table XII
Exogenous Fecal Nitrogen at Various Levels of Nitrogen Intake
from Mixed Vegetable and Animal Sources
(mg/kg/d)

<table>
<tr><th>Nitrogen intake levels</th><th>Superamine x/?/ ± S.D. (N)</th><th>TRL x/?/ ± S.D. (N)</th><th>CSM x/?/ ± S.D. (N)</th><th>IRL x/?/ ± S.D. (N)</th><th>CSB x/?/ ± S.D. (N)</th><th>Rural Diet + Milk x/?/ ± S.D. (N)</th></tr>
<tr><td>0-100</td><td>7.9 ± 2.3 (8)</td><td>6.6 ± 3.0</td><td>4.3 ± 2.9</td><td>8.8 ± 3.5</td><td>9.4 ± 3.4</td><td></td></tr>
<tr><td>100-150</td><td rowspan="2">20.0 ± 2.2 (17)</td><td>15.8 ± 3.7</td><td>5.4 ± 4.2</td><td>23.1 ± 4.2</td><td>15.5 ± 2.3</td><td></td></tr>
<tr><td>150-200</td><td>20.2 ± 3.2</td><td>12.4 ± 3.3</td><td>22.7 ± 3.8</td><td>16.5 ± 2.9</td><td></td></tr>
<tr><td>200-250</td><td>34.9 ± 2.3</td><td>33.5 ± 2.2</td><td>18.0 ± 3.8</td><td rowspan="2">36.6 ± 2.4</td><td>35.9 ± 3.7</td><td rowspan="2">42.2 ± 7.4</td></tr>
<tr><td>250-300</td><td></td><td></td><td></td><td></td></tr>
<tr><td>300-350</td><td></td><td></td><td></td><td></td><td></td><td>58.5 ± 2.7</td></tr>
<tr><td>350-400</td><td></td><td></td><td></td><td></td><td></td><td>58.2 ± 4.4</td></tr>
<tr><td>400-450</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>450-500</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Table XIII
Apparent and "True" Digestibility of Animal Proteins

N. Intake mg/kg/d x/?/ ± S.D.	Protein Source	Apparent Absorption (%)	"True" Absorption (%)
181.8 ± 2.6	Milk	82.6	96.1
274.7 ± 4.2	Milk	86.7	95.7
347.4 ± 7.4	Milk	84.0	91.1
458.2 ± 6.5	Milk	87.3	92.7
557.0 ± 16.2	Milk	79.4	83.9
54.5 ± 9.7	Egg	59.1	100.0
123.4 ± 2.3	Egg	72.6	92.7
167.0 ± 3.0	Egg	73.3	88.1
223.5 ± 4.1	Egg	78.9	89.9
350.2 ± 16.3	Egg	89.3	96.3
89.3 ± 8.3	Casein	73.3	100.0
258.8 ± 10.3	Casein	89.9	99.4
338.2 ± 16.1	Casein	86.5	93.8
437.0 ± 6.7	Casein	90.2	95.8
469.6 ± 2.6	Casein	90.8	96.0
87.0 ± 2.1	FPC	71.0	99.3
123.8 ± 2.4	FPC	79.3	99.3
160.4 ± 1.9	FPC	84.2	99.6
248.6 ± 5.5	FPC	86.7	96.6

Table XIV
Apparent and "True" Digestibility of Single Vegetable Proteins

N. Intake mg/kg/d x/?/ ± S.D.	Protein Source	Apparent Absorption (%)	"True" Absorption (%)
239.1 ± 0.7	Corn	77.5	87.8
317.2 ± 1.3	Corn	72.8	80.5
461.2 ± 2.7	Corn	71.6	76.9
322.8 ± 2.3	Rice	77.8	85.4
366.7 ± 3.4	Rice	78.8	85.5
274.3 ± 4.4	Wheat	84.8	93.8
331.1 ± 1.5	Wheat	86.4	93.8
364.6 ± 2.5	Wheat	86.2	93.0
82.8 ± 1.6	Soy	66.3	96.1
115.9 ± 3.1	Soy	73.2	94.4
157.2 ± 1.9	Soy	74.7	90.4
239.6 ± 1.0	Soy	80.5	90.8
316.9 ± 1.3	Soy	82.8	90.6

Table XV

Apparent and "True" Digestibility of Vegetable Mixtures

N. Intake mg/kg/d x/?/ ± S.D.	Protein Source	Apparent Absorption (%)	"True" Absorption (%)
430.1 ± 16.0	Incaparina	72.6	78.3
596.2 ± 25.8	Incaparina	72.1	76.2
243.2 ± 2.0	Corn + Beans	63.4	73.5
255.5 ± 1.2	Corn + Beans	64.9	74.6
329.2 ± 6.9	Corn + Beans	76.4	83.8
368.6 ± 2.9	Corn + Beans	72.9	79.5
88.5 ± 1.8	WSB	53.4	81.2
125.6 ± 3.0	WSB	65.1	84.8
167.1 ± 2.4	WSB	69.4	84.1
233.7 ± 3.5	WSB	72.3	82.8
293.2 ± 18.1	Corn + Beans + Incaparina	68.9	77.2

Table XVI

Apparent and "True" Digestibility of Mixed Vegetable and Animal Sources

N. Intake mg/kg/d x/?/ ± S.D.	Protein Source	Apparent Absorption (%)	"True" Absorption (%)
86.5 ± 2.6	Superamine	62.4	90.9
135.5 ± 4.9	Superamine	67.1	85.2
236.2 ± 2.5	Superamine	74.8	85.2
78.0 ± 1.2	TRL	60.0	91.5
125.2 ± 2.6	TRL	67.7	87.4
163.1 ± 1.7	TRL	72.5	87.6
232.8 ± 2.6	TRL	75.0	85.6
86.1 ± 1.8	CSM	66.4	95.0
128.6 ± 4.2	CSM	76.7	95.8
166.8 ± 2.0	CSM	77.8	92.6
243.5 ± 2.4	CSM	82.5	92.6
85.0 ± 2.5	IRL	60.7	89.6
129.6 ± 1.8	IRL	63.2	82.2
162.8 ± 2.0	IRL	70.9	86.0
248.1 ± 7.6	IRL	75.3	85.2
81.8 ± 2.3	CSB	58.4	88.5
124.8 ± 1.5	CSB	67.9	87.6
160.5 ± 3.9	CSB	74.4	89.7
231.9 ± 1.7	CSB	73.9	84.5
273.0 ± 7.8	Corn + Beans + Milk	75.5	84.5
321.8 ± 2.1	Corn + Beans + Milk	74.2	31.8
372.6 ± 2.2	Corn + Beans + Milk	77.8	84.4