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PROTEIN REQUIREMENTS FOR MAINTENANCE OF EGYPTIAN SHEEP BREEDS

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SUMMARY

Data of 1467 nitrogen balance trials carried out on native sheep breeds during the period from 1946 to 1996 were collected to quantify the nitrogen requirements for maintenance. Number of N balance trials was 282 for Ossimi, 879 for Rahmany and 306 for Barki sheep. Nitrogen requirements for maintenance were quantified from the relationship between N intake and N balance. Protein requirements for maintenance were 2.26, 1.69 and 1.87 g DCP/KgW$^{0.75}$ for Ossimi, Rahmany and Barki breed, respectively, with an average of 1.89 g DCP/KgW$^{0.75}$ for all sheep breeds.

Protein requirements of maintenance were also experimentally determined applying fasting metabolism, low nitrogen diet and nitrogen balance procedures. The results indicated that protein requirements for maintenance of Ossimi sheep was 2.90 g DCP/KgW$^{0.75}$ using fasting metabolism and 2.57g DCP/KgW$^{0.75}$ using low nitrogen diet but results of nitrogen balance methods indicated that the N requirements for maintenance (g DCP/Kg W$^{0.75}$) was 2.67 as an average of 2.65 by the graphical method, 2.66 by the percentage utilization method, 2.56 by the statistical method, and 2.82 by the factorial method. The different figures of protein requirements of maintenance is related to the differences among experimental procedures. However, the mean value of 1.90 g DCP/Kg W$^{0.75}$ as weighted average could be taken as protein requirements for maintenance of local breeds of sheep in Egypt.

Keywords: Sheep, protein, maintenance, Egypt

INTRODUCTION

The maintenance requirement of protein is comprising a great amount of the daily intake of ruminant rations. The maintenance level of protein is nearly

equal 40-50% of the total protein intake for growing sheep gaining 100g body weight per day or equivalent to the protein needed for ewes producing 1.0 kg milk of 7.1% fat (NRC, 1985). Even though, the maintenance requirements for local animals had not been intensively studied, except few attempts, during the last 50 years.

The objective of the present study was to quantify the protein maintenance requirements for sheep by manipulation of the accumulated data during the period from 1946 to 1996 and to confirm the obtained results by experimental field studies on adult Ossimi sheep.

MATERIALS AND METHODS

Nitrogen requirements for maintenance of sheep were quantified from survey study and experimental field study:

A- Survey study

The study included data collected from the research work in the field of local sheep nutrition in Egypt during the period from 1946 to 1996, through the approved M.Sc and Ph.D. thesis in Cairo, Ain-Shams, Al-Azhar, Alexandria and Assiut Universities. The total number of the collected studies were 87 thesis. Data on Nitrogen balance (body weight, dry matter, N intake, fecal N and urinary N) on individual animals from thesis which containing appendix or from means for Thesis with no attached appendix were sorted for each breed and data base for Ossimi, Rahmany and Barki was performed. Correlations between N balance and N intake were calculated and linear regression were performed after testing the linearity of the relationship for each breed as well as for all breeds. Data were analyzed according to SAS (1984).

B-Experimental field study

Three procedures were applied in the experimental work: 1) fasting metabolism, 2) low N diet and 3) N balance procedures.

1- Fasting metabolism procedure

During 7 days pre-fasting period, four Ossimi rams aged 2-3 years old with an average body weight of 49.50 Kg were fed a basal ration consisted of ground barley grains (*Hordeum vulgare),* IFN 4-00-549 and berseem hay (*Trifolium alexandrinum),* IFN 1-01-340. The basal ration was daily offered at the rate of 3% of the body weight. Roughage: concentrate ratio was 40:60. Vitamin-minerals premix was added as 3 g/kg of ration DM. Drinking water was free choice offered.

During the 14 days fasting period, animals were individually housed in metabolic cages. Individual body weight was daily recorded. Feces and urine were daily collected. Fecal and urinary nitrogen were daily determined

according to standard methods of A.O.A.C. (1984). Metabolic fecal nitrogen and endogenous urinary nitrogen were determined for quantification. of maintenance protein requirement.

2- Low nitrogen diet procedure

During the 15 days pre-experimental period, animals were pen-fed ration consisted of 60% concentrate mixture and 40% berseem hay at the rate of 3% of the body weight. The concentrate mixture composed of 30% undecorticated cotton seed meal (*Gossypium sp.*), IFN 5-01-615 and 70% barley grains. Five days before the experiment, animals were individually housed in metabolic cages and low N diet was gradually introduced to replace 200 g/head/day of the total feed every two days till the daily voluntary feed intake from the experimental diet reached 800-900 gram/head/day. Semi purified low N ration was prepared according to Majumdar (1960) containing; molasses, corn-starch, sugar, fat mixture, lime stone and common salt. The concentrate mixture was added to 1-2 cm chopped sugar cane-baggase. Feed ingredients of the low N diet are shown in Table 1. Low nitrogen diet contained 71.62% DM. the dry matter composition was 93.95% OM, 2.48% CP, 6.31% EE, 25.57% CF, 59.59% NFE and 6.05% ash.

Table 1. Feed ingredients of the low N diet

Feed	% as fed basis
Sugar cane bagasse	53.53
Corn starch	14.00
Sugar	4.53
Fat mixture*	5.76
Molasses solution**	20.18
Lime stone	1.00
Common salt	1.00

* 1:1 sunflower oil and palm oil (w/w)

**Composed of : water 825 g, Molasses 150, Vit. & Min. mix. 25 g/liter solution. Vitamins and minerals mixture consisted of ; Vit A 10,000,000 I.U. , Vit. D_3 , 2,000,000 I.U, Vit. E 20,000 mg, Manganese 120,000 mg, Iron 45,000 mg, Zinc 100,000 mg, selenium 250, mg, Iodine 5,000 mg, cobalt 500 mg and Calcium carbonate AD 3,000 gm.

Daily dry matter intake and body weight were individually recorded. Clean drinking water was freely available at all times. Daily N output was determined according to methods of A.O.A.C. (1984). Nitrogen requirement for maintenance was determined from the MFN and EUN during the last four days of the collection period.

3- Nitrogen balance procedure

Four Ossimi rams aged 2 years old with an average body weight of 38.28 kg in 4x4 Latin square arrangement were fed rations different in crude protein content at the rate of 2% of live body weight to supply 50, 75, 100 and 125 g CP/head/day. The percentage of CP in the experimental rations were 5.98, 9.63, 13.11 and 16.17 for rations 1,2,3, and 4 respectively. Feed ingredients and chemical composition of the experimental rations are presented in Tables 2 and 3.

Animals were individually housed each in a metabolic cage for 21 days as a preliminary period followed by 7 days for feces and urine collection. Initial and final body weights were individually recorded. Drinking water was free choice offered.

The experimental rations were offered once daily at 9.00 a.m. feed residues if any were collected before feeding every day.

Chemical composition of the experimental rations, feces, urine and feed residues were determined according to the standard procedures of the A.O.A.C (1984).

Data collected were statistically analyzed as described by Federer (1955) according to the following model :

$$Y_{ijh} = U + P_i + \lambda_j + T_h + E_{ijh}$$

where U : The population mean

P_i : row effect

λ_j : column effect

T_h : treatment effect

E_{ijh} : experimental error

Nitrogen requirements were quantified using the graphical method, statistical method, nitrogen percentage utilization method and factorial method as described by El-Bedawy *et al.* (1994)

Table 2. Ingredient of the experimental rations.

Ingredient, %	Experimental rations			
	1	2	3	4
Undecorticated CSM	-	-	4	20
Barley grains	27	63	36	33
Molasses	10	-	-	-
Sunflower oil	5	-	-	-
common salt	1	1	1	1
Lime stone	1	1	1	1
Vit-min.premix	1	1	1	1
Berseem hay	-	-	35	24
Rice straw	55	37	25	23
Total	100	100	100	100

Table 3. Chemical composition of the experimental rations.

Item	Experimental rations			
	1	2	3	4
DM	90.50	90.53	90.31	90.17
DM composition, %				
OM	86.33	91.31	89.61	90.55
CP	5.98	9.63	13.11	16.17
EE	6.19	1.58	1.60	1.88
CF	23.24	18.71	26.69	26.51
NFE	50.92	61.39	48.21	45.99
Ash	13.67	8.69	10.39	9.45

RESULTS AND DISCUSSION

A-Survey study

Data of 1467 nitrogen balance trials carried out during the period from 1946 to 1996, including NI, FN, UN, DMI and body weight were collected to quantify the N requirements of maintenance for three local breeds of sheep. Data were sorted for breed as: Ossimi, Rahmany and Barki. Collected data on individual animals represented 79% of the total cases. Number of N balance trials was 282 for Ossimi, 879 for Rahmany and 306 for Barki sheep.

Nitrogen requirements for maintenance were quantified based on the relationship between N intake and N balance. The N intake (NI) was the independent variable (X) and N balance (NB) was the dependent variable (Y) for each breed of sheep and for all. The N requirements were quantified from four regression equations.

Protein maintenance requirements of Ossimi sheep

NB=-3.837+0.374NI (n = 282, r = 0.74)

Mean body weight= 45.49 kg, mean protein digestibility = 61.72%

Nitrogen requirement for maintenance = 585.62 mg $N/KgW^{0.75}$ which is equivalent to 2.28 g $DCP/KgW^{0.75}$ (Fig. 1).

Protein maintenance requirements of Rahmany sheep

NB=-2.137 +0.308 NI (n = 879, r= 0.61)

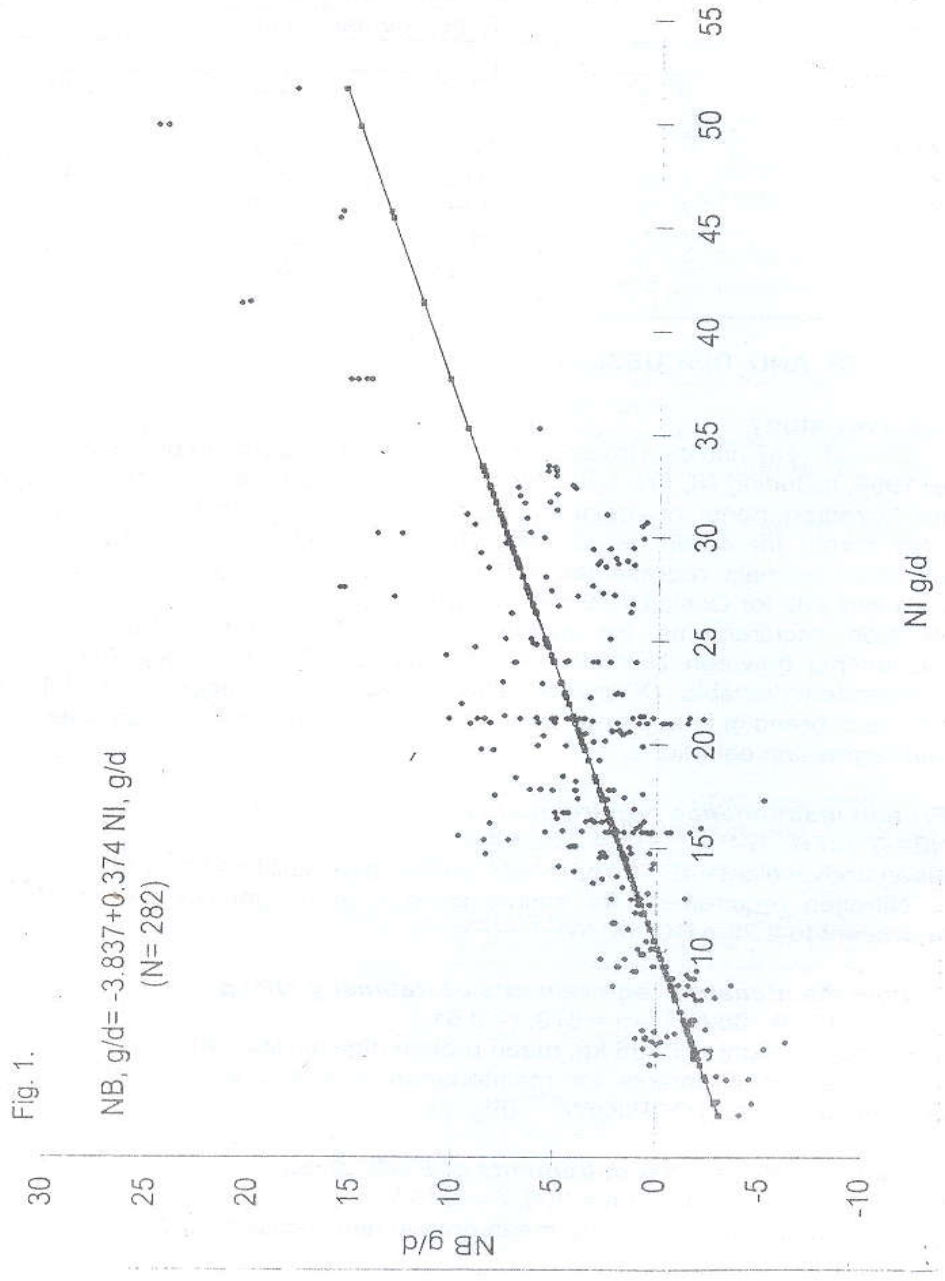
Mean body weight = 42.86 kg, mean protein digestibility = 65.38%

Nitrogen requirements for maintenance is 414.33 mg $N/KgW^{0.75}$ which is equivalent to 1.68 g $DCP/KgW^{0.75}$ (Fig. 2).

Protein maintenance requirements of Barki sheep

NB=-3.746+0.449 NI (n = 306, r = 0.73)

Mean body weight = 41.52 kg, mean protein digestibility = 58.74%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(N= 282)
NB g/d
NI g/d
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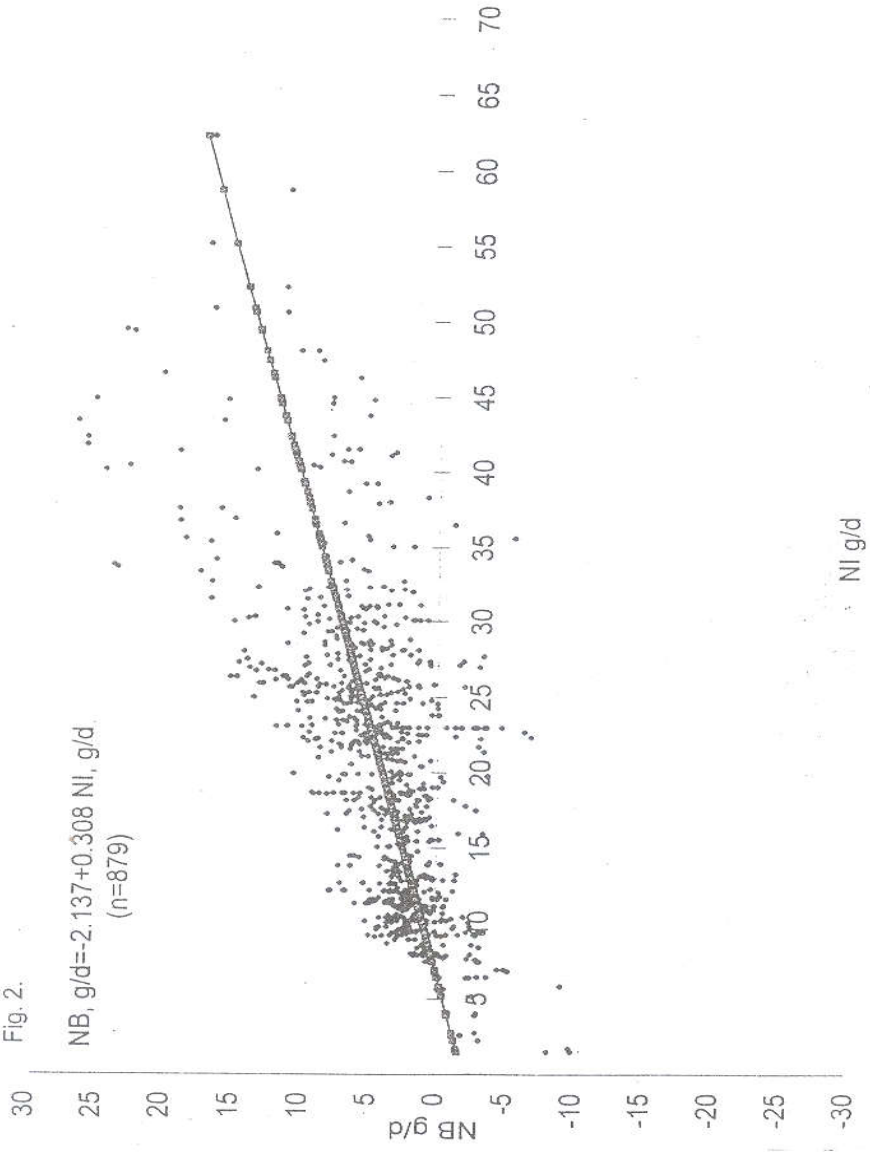
Fig. 1.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(n=879)
NB g/d
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Fig. 2.

Nitrogen requirement for maintenance is 509.78 mg $N/KgW^{0.75}$ which is equivalent to 1.87 g $DCP/KgW^{0.75}$ (Fig. 3).

Protein maintenance requirements of all three breeds:

NB=-2.724+0.339 NI (n = 1467, r= 0.66)

Mean body weight = 43.09 kg, mean protein digestibility = 63.29%

Nitrogen requirement for maintenance is 477.41 mg $N/KgW^{0.75}$ which is equivalent to 1.88 g $DCP/KgW^{0.75}$ (Fig. 4).

B-Experimental field study

Nitrogen requirements for maintenance were quantified using four procedures: fasting metabolism, feeding low N diet and NB data.

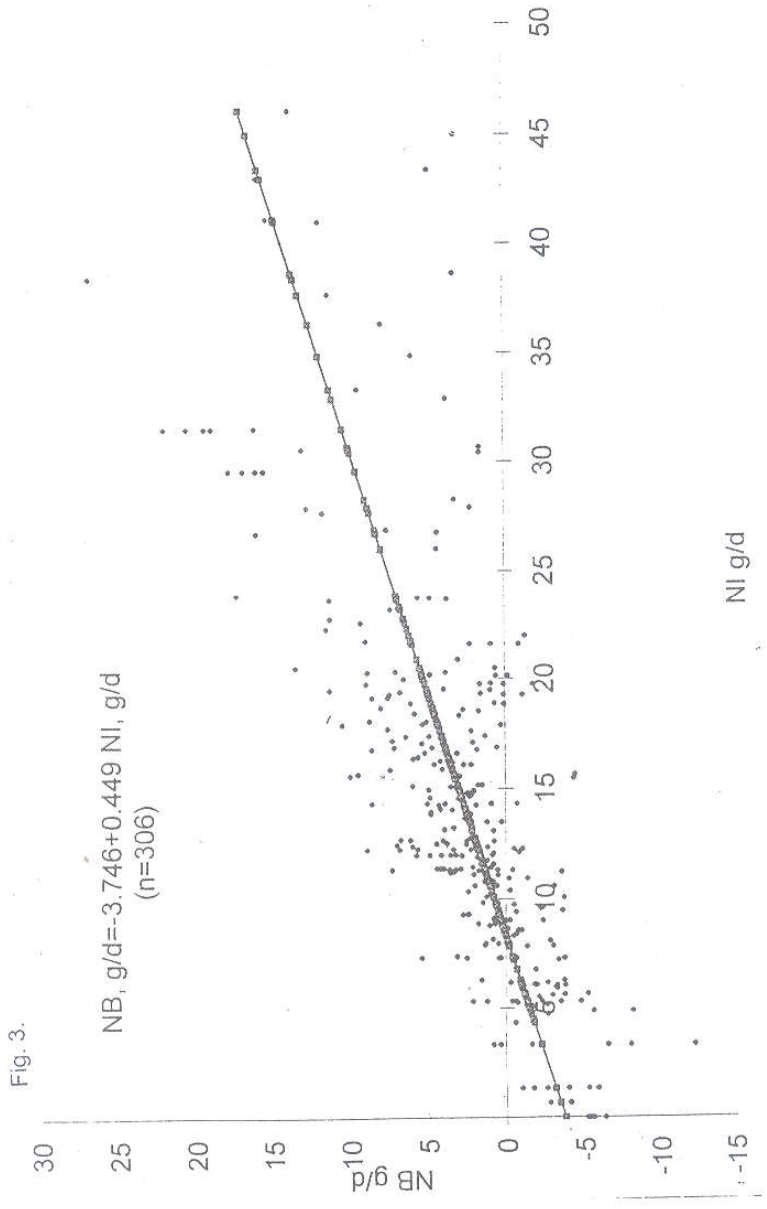
1- Determination of nitrogen requirement for maintenance from fasting trials

During the first 9 days of fasting, sheep lost 5.5 kg. The rate of body weight loss decreased from day 10 to day 14 with an average body weight of 42.60 Kg. This value was an average of the range from 43.25 Kg at day 10 and 41.75 Kg at day 14.

A sharp decline in the fecal nitrogen output from 3.64 g. N at the first day to 0.18 g. N at the 9th day of the fasting period. During the last five days (from day 10 to day 14) of the fasting period, value of FN ranged from 0.20 g. N to 0.13 g. N with an average of 0.17 g. N per head for the Ossimi sheep. This value represented the metabolic fecal nitrogen (MFN). When MFN was expressed as mg/Kg body weight this figure was 4.0 mg N/KgBW.

A sharp decrease in the urinary nitrogen loss from 9.71 g. at the first day of fasting to 4.17 g at the 9th day of fasting period. During the last five days of the fasting period, mean values of the UN were almost constant with a range from 4.08 g to 4.42 g. The average value of EUN was 4.33 g for Ossimi sheep weighing 42.60 Kg (Table 4). This value represented the endogenous urinary nitrogen (EUN). When EUN was expressed as mg/Kg body weight, the figure was 101.5 mg/KgW live body weight, being 259.2 when EUN was expressed as $mg/KgW^{0.75}$

Mean values of fecal and urinary nitrogen during stability period (from day 9- day 14) are presented in Table (5). Fecal nitrogen averaged 4.0 mg/KgW or 10.2 $mg/KgW^{0.75}$. The corresponding value of UN was 101.5 mg N/KgW or 259.2 mg $N/KgW^{0.75}$. The total excreted N during the last five of the fasting period was 269.5 mg $N/KgW^{0.75}$ for Ossimi rams. The MFN was counted 4% of the total N output. Morris and Ray (1939) reported higher value of FN for sheep fasted for 7 days as 33 mg $N/KgW^{0.75}$, while Blaxter (1962) had not consider the value of FN in calculation of N requirements for of fasted sheep.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(n=306)
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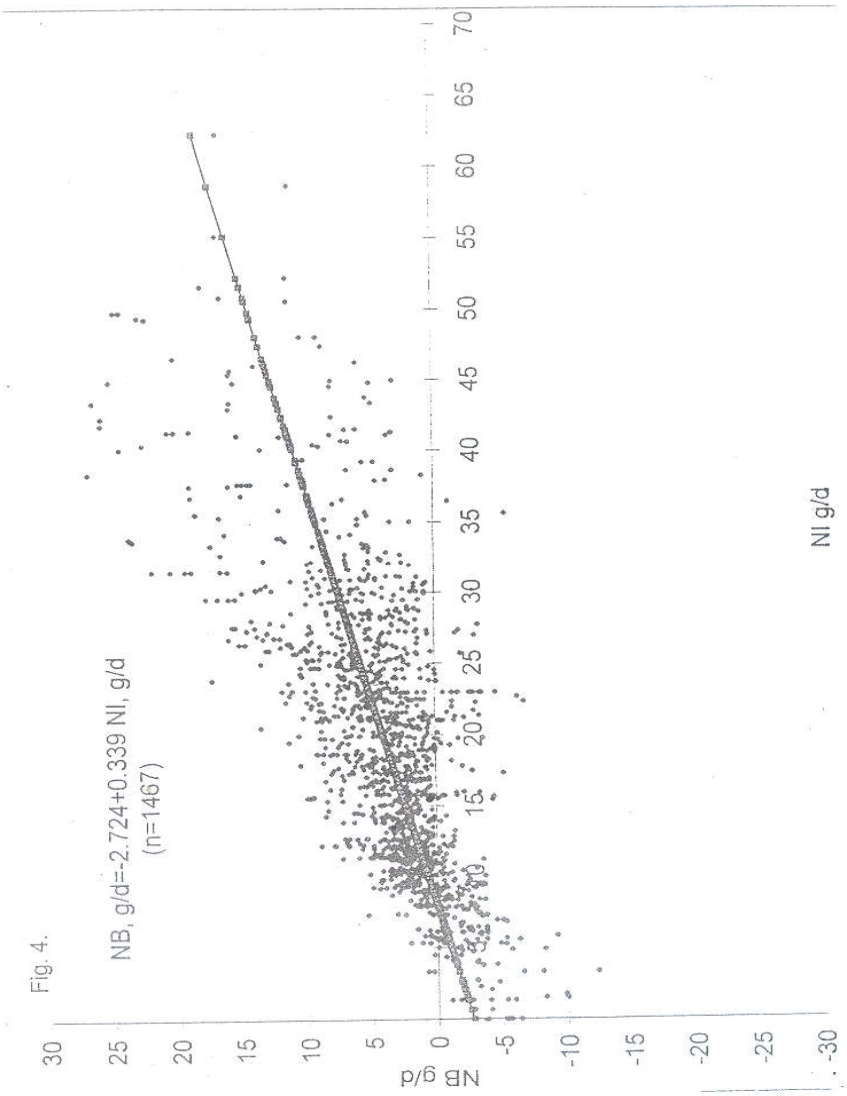
Fig. 3.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NI g/d
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Fig. 4.

Table 4. Body weight, fecal nitrogen and urinary nitrogen of fasted Ossimi sheep

Day	BW, Kg	FN,g/day	UN, g/day
1	49.50	3.64	9.71
2	48.63	2.28	11.92
3	48.50	1.17	9.62
4	47.38	1.08	7.75
5	46.50	0.62	7.91
6	45.75	0.65	6.88
7	45.38	0.40	5.43
8	45.13	0.24	4.96
9	44.00	0.18	4.17
10	43.25	0.20	4.08
11	43.25	0.21	4.40
12	42.63	0.10	4.15
13	42.13	0.21	4.58
14	41.75	0.13	4.42

BW body weight, FN fecal nitrogen, UN urinary nitrogen.

Table 5. Body weight, MFN, EUN and total N out put (Means of the last five days of fasting period).

Item	Mean	SE
Body weight, Kg	42.60	0.89
Metabolic Fecal N (MFN)		
g/day	0.17	0.03
mg/KgW	4.0	0.83
mg/KgW$^{0.75}$	10.2	2.12
Endogenous urinary N (EUN)		
g/day	4.33	0.47
mg/KgW	101.5	12.25
mg/KgW$^{0.75}$	259.2	30.51
Total N output		
g/day	4.50	0.50
mg/KgW	105.5	12.98
mg/KgW$^{0.75}$	269.5	32.43

Protein requirement for maintenance of Ossimi sheep was calculated as g DCP/KgW$^{0.75}$ as follows:

Total N output x 6.25x 100/ 58, being 2.90 g DCP/KgW$^{0.75}$:

where, the biological value of the experimental rations averaged 58% (Table 10).

The DCP requirement for Ossimi sheep was lower than 5.0 g DCP/ $KgW^{0.75}$ found by Morris and Ray (1939) and 4.5 g DCP/ $KgW^{0.75}$ found by Blaxter (1962).

2- Determination of maintenance requirement of nitrogen from low N diet trials

Data of body weight of the experimental sheep during the consecutive 14 days feeding period are given in Table 6. Animals fed low nitrogen ration almost maintained their weight ranging from 38.50 to 39.50 Kg. Data of dry matter intake decreased from 608.8 g/day at the 1st day to 468.2 g/day at the 14th days of the feeding period. There was a fluctuated pattern in fecal nitrogen output during the first five days. During the last four days (from day 11 to day 14) of the experimental period, values of FN ranged from 2.20 g N to 1.89 g N with an average of 2.13 g N per head (Table 7).

Table 6. Body weight, dry matter intake and urinary and fecal nitrogen losses of sheep fed low N diet

Day	Body weight (Kg)	DM intake (g/day)	Urinary N (g/day)	Fecal N (g/day)
1	39.50	608.8	3.22	2.95
2	39.50	608.8	2.47	3.53
3	39.50	565.8	2.53	2.36
4	39.50	501.3	2.05	2.55
5	39.50	497.8	2.31	3.04
6	39.25	510.3	2.25	2.76
7	39.25	513.9	2.10	2.48
8	39.50	503.2	1.70	2.37
9	39.00	483.4	2.15	2.39
10	39.00	508.5	2.33	2.07
11	38.63	496.0	1.68	2.20
12	38.50	461.1	1.76	2.15
13	39.25	457.5	1.40	2.29
14	39.13	468.2	1.49	1.89

Urinary nitrogen loss declined from 3.22 g N at the first day to 2.33 g N at the 10th day of the experimental period. However, during the last four days, UN values were almost constant and ranged from 1.68 g N to 1.49 g N with an average of 1.58 g N for Ossimi sheep weighing 38.88 Kg. This value represented the endogenous urinary nitrogen (EUN)..

The average value of MFN was 4.6 g N/Kg DMI. The MFN value is near from 0.45 g/100 g DMI found by Hutchinson and Morris (1936). However, this value was lower than 0.65 g/100 g DMI found by Sotola (1930) or 0.55 g/100 g DMI found by Hamilton *et al.* (1948) for sheep fed low N diet. The

corresponding value of EUN was 40.5 mg N/KgW or 101.3 mg N/ $KgW^{0.75}$. The EUN values in the present study was comparable to that of 0.093 g/$KgW^{0.75}$ for Rahmany rams found by Abou-Raya *et al.* (1971), and 0.091 g/ $KgW^{0.75}$ found by Miller and Morrison (1939) and 0.086 g/$KgW^{0.75}$ found by Smuts and Marias (1938), but lower than 0.155 g/$KgW^{0.75}$ found by Hutchinson and Morris (1936).The total metabolic nitrogen output during the last four days of the experimental period was 239.1 mg N/$KgW^{0.75}$. (Table 7).

Table 7. Means and standard error of body weight, dry matter intake, metabolic fecal N, endogenous urinary N and total N out put of sheep fed the low N diet

Item	Mean	SE
Body weight, Kg	38.88	1.34
DM intake g/day	470.7	26.75
Metabolic Fecal N		
g/day	2.13	0.14
mg/KgW	55.4	5.29
mg/$KgW^{0.75}$	137.8	12.19
g/100g DMI	0.46	0.03
Endogenous urinary N		
g/day	1.58	0.13
mg/KgW	40.5	1.97
mg/$KgW^{0.75}$	101.3	5.67
Total N output		
g/day	3.72	1.11
mg/KgW	95.9	4.60
mg/$KgW^{0.75}$	239.1	10.02

The maintenance requirement of nitrogen for Ossimi sheep weighing 38.88 Kg and fed low N diet was 239.1 mg N/$KgW^{0.75}$.

Mean of 58% biological value for protein of the experimental rations was considered (Table 10).

The maintenance requirement of DCP for Ossimi sheep is 2.57/$KgW^{0.75}$. The DCP requirement value applying the low N diet procedure is lower than 2.90 g DCP/$KgW^{0.75}$ calculated from the fasting metabolism in the present study but higher than 2.01 g DCP/ $KgW^{0.75}$ found by Salem (1983) for Barki sheep, 1.27 g DCP/ $KgW^{0.75}$ found by Abou-Raya *et al.* (1971) for Rahmany sheep and 1.86 g DCP/$KgW^{0.73}$ found by Yousri (1975), but it was comparable to 2.75 g DCP/ $KgW^{0.75}$ found by Alam and Sarker (1992).

3- Determination of nitrogen requirements for maintenance from NB trials

Data of Nutrient intake and digestibilities (Table 8) showed that the CP intake was 47.24, 74.37, 97.31 and 125.00 g CP/head. The TDN intake was sufficient to cover the maintenance energy requirements. Results also indicated that as the CP intake increased nutrient digestibilities, fecal N, urinary N and N balance values increased.

Table 8. Feed intake, nutrient digestibilites, nutritive value and nitrogen balance for sheep fed the experimental rations

.Item	Experimental rations				±SE	Sign.
	1	2	3	4		
No. of animals	4	4	4	4		
Body weight, Kg.	37.65	38.94	38.63	37.94	0.67	NS
Nutrient digestibilities, %						
DM	62.19^{b}	68.13^{a}	64.61^{b}	64.41^{b}	0.91	*
OM	66.36^{b}	72.01^{a}	67.44^{b}	67.54^{b}	0.99	*
CP	38.53^{c}	62.95^{b}	66.94^{ab}	71.19^{a}	2.22	**
EE	87.23^{a}	66.24^{b}	48.06^{c}	67.81^{b}	3.93	**
CF	56.13	51.84	56.21	49.81	1.98	NS
NFE	71.35^{c}	79.14^{a}	74.31^{bc}	76.22^{ab}	0.87	**
Nutritive value, %						
TDN	64.70^{ab}	66.33^{a}	61.11^{b}	62.04^{b}	1.02	*
DCP	2.36^{a}	6.05^{b}	8.65^{c}	11.52^{d}		**
Intake, g/day						
DM	778.04	775.38	755.64	778.12	24.06	NS
TDN	503.39	514.31	461.77	482.75	17.60	NS
CP	47.24^{a}	74.37^{b}	97.31^{c}	125.44^{d}		**
N Balance , g/day						
N intake	7.58^{a}	11.89^{b}	15.57^{c}	20.07^{d}	0.27	**
Fecal N	4.60^{ac}	4.41^{a}	5.13^{cb}	5.79^{b}	0.19	**
Urinary N	4.22^{a}	6.25^{b}	9.02^{c}	11.20^{d}	0.43	**
N balance	-1.25^{a}	1.23^{b}	1.42^{bc}	3.09^{d}	0.33	**

NS= not significant * P<0.05 ** P<0.01

a,b,c,d Mean with different superscripts in the same row are (P<0.05) different.

Nitrogen requirements for maintenance from Nitrogen balance trials were quantified using 4 methods: Graphical method, Nitrogen percentage utilization method (NPU), Statistical method and factorial method.

I-Graphical method

Data of N balance were plotted against N intake. The cross points (a) and (b) represented the minimum and the maximum N intake at nitrogen equilibrium (NB = 0) for each individual sheep, or the nitrogen maintenance requirement. The average of minimum and the maximum nitrogen

maintenance requirements was 284.5 mg N/KgW or 707.6 mg N/KgW$^{0.75}$ or 4.42 g CP/ KgW$^{0.75}$ or 2.65 g DCP/ KgW$^{0.75}$ (Fig. 5)

II.-Nitrogen percentage utilization method (NPU)

Data of nitrogen balance (mg/KgW) presented in Table (9), were used to quantify the N maintenance requirements for Ossimi sheep by the percentage utilization method according to the following formula:

$$NR = NI \pm \frac{\text{N balance}}{\text{\% N utilization}} \times 100$$

with + or - sign for animal with negative and positive N balance, respectively where, NR= N requirement, NI= N intake

$$\%N \text{ utilization} = \frac{NB(+) - NB(-)}{NI(+) - NI(-)} \times 100$$

The N requirement for the experimental sheep ranged from 220.3 to 412.6 mg N/KgW with an average of 285.3 mg N/KgW or 709.6 mg N/ KgW$^{0.75}$ or 4.44 g CP/ KgW$^{0.75}$ or 2.66 g DCP/ KgW$^{0.75}$.

Table 9. Nitrogen requirements for maintenance of Ossimi sheep calculated by the nitrogen percentage utilization method

Animal No.	Ration	N. Intake mg/KgW	N. balance mg/KgW	N. utilization %	N. requirement mg/KgW
1	R1	182.4	-74.1	-	-
	R2	315.0	0.3	56.1	314.5
	R3	429.3	17.6	37.1	381.9
	R4	536.8	40.0	32.2	412.6
2	R1	204.8	-39.5	-	-
	R2	288.0	3.3	51.4	281.6
	R3	434.9	65.9	45.8	291.0
	R4	562.5	102.0	39.6	304.9
3	R1	206.3	-15.0	-	-
	R2	294.4	50.5	74.4	226.5
	R3	350.3	17.2	22.4	273.5
	R4	499.1	111.32	43.1	240.9
4	R1	209.1	-7.7	-	-
	R2	326.5	73.5	69.2	220.3
	R3	401.8	46.8	28.3	236.4
	R4	521.8	71.2	25.2	239.3
Overall mean					285.3

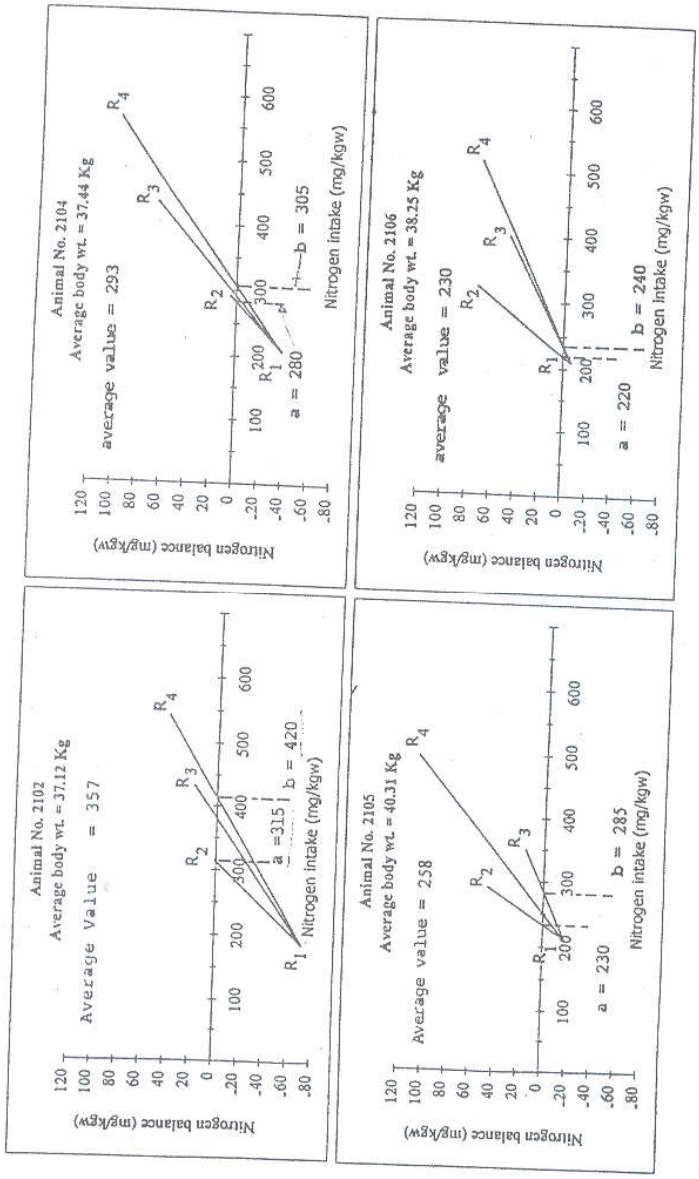

Fig. 5. Nitrogen requirement for maintenance of Ossimi sheep calculated by the graphical method.

III. Statistical method

Regression of Nitrogen balance (mg/KgW) as dependent variable (Y) and N intake (mg/KgW) as independent variable (X) was used to quantify the nitrogen requirement for maintenance of Ossimi sheep. The regression equation was:

$$NB = -87.80 + 0.32\ NI \qquad (r = +0.82)$$

Nitrogen intake needed to maintain nitrogen equilibrium was 274.4 mg N/KgW or 682.5 mg $N/KgW^{0.75}$ or 4.26 g $CP/KgW^{0.75}$ or 2.56 g $DCP/KgW^{0.75}$.

IV. Factorial method

Nitrogen requirement for maintenance was quantified by the factorial method applying the formula:

N requirement = (EUN + MFN)/(BVx TD)

where:

EUN endogenous urinary nitrogen
MFN metabolic fecal N
BV biological value of protein
TD protein true digestibility

Endogenous urinary nitrogen (EUN)

The EUN is the amount of excreted urinary nitrogen at nitrogen intake is zero. The EUN was determined by regressing the urinary N on the apparent digestible N (ADN). The relationship between ADN and UN (mg $N/KgW^{0.75}$) was suggested by Reynolds (1981) that when retained N is zero (at maintenance) N intake equals N output.

NI = FN + ADN
NI = N retained + FN + UN
FN + AND = N retained + FN + UN
at NB = zero
FN + ADN = FN + UN or ADN = UN

The regression equation was :

UN =143.16+0.62 ADN (r= 0.94)

where,

UN and ADN calculated as $mg/KgW^{0.75}$
At ADN = zero,
the EUN was 143 mg $/KgW^{0.75}$

Metabolic fecal nitrogen (MFN)

The MFN is the excreted fecal nitrogen when nitrogen intake equal zero. The MFN was determined by regressing fecal N on N intake as follows:

FN = constant + b x NI
at NI = 0 ,
FN = MFN = constant

The regression equation was:

FN = 93.41 + 0.10 NI (r=0.62)

FN and NI wad calculated as mg N/ KgW

Applying the previous formula, the MFN was 4.6 g N/Kg dry matter intake(DMI).

Biological value of the dietary protein (BV)

The biological value was quantified using the formula suggested by Thomas-Mitchell (1924).

$$BV = \frac{NI-(FN-MFN) - (UN-EUN)}{NI- (FN- MFN)} \times 100$$

The biological value ranged from 40.0 to 72.9% with an average of 58% (Table 10).

Table 10. Nitrogen requirement for maintenance of Ossimi sheep calculated by the factorial method

Ration	Animal No.	Body wt. Kg	NFN g/d	EUN g/d	BV %	TD %	N requirement mg/Kg
R_1	1	35.75	3.32	2.09	53.8	78.7	360.3
	2	37.25	3.46	2.16	72.8	74.7	279.4
	3	40.00	3.72	2.28	70.6	92.7	230.8
	4	37.50	3.49	2.17	72.9	94.0	218.7
R_2	2	40.00	3.72	2.28	54.7	97.2	283.0
	1	37.75	3.51	2.18	59.2	80.9	314.0
	4	37.00	3.44	2.15	69.8	98.5	218.9
	3	41.00	3.81	2.32	70.2	96.9	219.9
R_3	3	40.00	3.72	2.28	53.0	90.1	312.5
	4	40.00	3.72	2.28	54.8	89.3	306.1
	1	37.50	3.49	2.17	43.2	90.8	387.0
	2	37.00	3.44	2.15	55.3	90.3	302.2
R_4	4	38.5	3.58	2.21	47.9	88.6	358.1
	3	40.25	3.74	2.29	58.6	89.3	288.1
	2	35.50	3.30	2.08	51.1	88.3	336.8
	1	37.50	3.49	2.17	40.0	88.8	419.3
Overall mean		38.28	3.56	2.20	58.0	89.3	302.2
±SD		1.71	0.16	0.07	10.50	6.53	60.95

True protein digestibility (TD)

The true digestibility was calculated using the following formula according to (Mitchell, 1924).

$$TD = \frac{NI-(FN-MFN)}{NI} \times 100$$

The true digestibility ranged from 74.7 to 98.5% with an average of 89.3% (Table 10).

The results of N requirement for maintenance applying the factorial method are presented in Table (10). The N requirement ranging between 218.7 and 419.3 mg N, with an average of 302.2 mg N/KgW or 751.7 mg N/ $KgW^{0.75}$ equivalent 4.70 g CP/ $KgW^{0.75}$ or 2.82 g CP/ $KgW^{0.75}$.

The results of N balance of Ossimi sheep fed rations containing varying levels of dietary protein indicated that the N requirements for maintenance (g DCP/Kg $W^{0.75}$) was: 2.65 by the graphical method, 2.66 by the percentage utilization method, by 2.56 by the statistical method, and 2.82 by the factorial method with an average of 2.67.

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الإحتياجات الغذائية من البروتين لسلالات الأغنام المصرية

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جمعت بيانات ١٤٦٧ تجربة ميزان نيتروجين أجريت على سلالات الأغنام المحلية فى الفترة من ١٩٤٦ الى ١٩٩٦ لأستخدامها فى تقويم الإحتياجات الغذائية الحافظة من البروتين وكان توزيعها كما يلى : ٢٨٢ تجربة أجريت على الأغنام الأوسيمى ، ٨٧٩ على الرحمانى و ٣٠٦ على البرقى. قدرت الإحتياجات الغذائية الحافظة من البروتين من هذه التجارب من العلاقة بين المأكول من النيتروجين وميزان النيتروجين، فكانت ٢,٢٦، ٩٦,هو ١,٨٧ جم بروتين خام مهضوم لكل ١ كجم حيز جسم تمثيلى لكل من الأوسيمى والرحمانى والبرقى على الترتيب بمتوسط عام ١,٨٩ جم لكل ١ كجم حيز جسم تمثيلى. كما قدرت الإحتياجات الحافظة من البروتين للأغنام الأوسيمى أيضا تجريبيا باستخدام أساليب مختلفة هى: استخدام التمثيل القاعدى للحيوانات الصائمة، التغذية على علائق منخفضة النيتروجين، ومن نتائج تجارب ميزان النيتروجين باستخدام مستويات متصاعدة من النيتروجين المأكول.

وأوضحت النتائج الإحتياجات الحافظة من البروتين للأغنام الأوسيمى بلغت ٢,٩ جم لكل ١ كجم حيز جسم تمثيلى باستخدام طريقة التمثيل القاعدى، و ٢,٥٧ جم باستخدام طريقة التغذية على علائق منخفضة النيتروجين، بينما كانت ٢,٦٥ جم باستخدام نتائج تجارب ميزان النيتروجين كمتوسط للقيم ٢,٦٥ بالطريقة البيانية، ٢,٦٦ بطريقة نسبة الإستفادة من النيتروجين، ٢,٥٦ بالطريقة الإحصائية و ٢,٨٢ بالطريقة العددية.

ولإختلاف قيم الإحتياجات الحافظة من البروتين ترجع الى الإختلاف بين طرق التقدير، على أنه يمكن أخذ قيمة المتوسط الموزون للنتائج و مقدارها ١,٩٠ جم بروتين خام مهضوم لكل حيز جسم تمثيلى كقيمة تمثل الإحتياجات الغذائية الحافظة من البروتين لسلالات الأغنام المحلية فى مصر.