EFFECT OF DIFFERENT LEVELS OF DIETARY PROTEIN ON PERFORMANCE, NUTRIENTS UTILIZATION AND METABOLISM OF SOME MINERALS BY LAMBS

A.A. Abou'l Ella[1], S. G. Abdou[1], A. N. Sayed[2] and A. A. Higazy[3]

[1] **Department of Animal Production, Faculty of Agriculture, Al-Azhar University, Assiut Branch**

[2] **Department of Animal and Clinical Nutrition, Faculty of Veterinary Medicine, Assiut University.**

[3] **Department of Animal Production, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt.**

(Received 8/11/2003, accepted 25/8/2004)

SUMMARY

Eighteen male Rahmani lambs (9 months of age and 33.92 kg body weight) were randomly divided into 3 similar groups of 6 lambs each and were used in this study to investigate the effect of different levels of dietary protein on the performance, digestibility of nutrients, nitrogen balance ,blood protein profile as well as rumen fermentation characteristics and balances of calcium, phosphorus and magnesium. Animal of each group were maintained individually on one of three complete diets containing different levels of protein for 3 months. The 3 levels of CP envisaged in the 3 complete rations were 10, 13 and 16% on dry matter basis, designated, respectively, as low (LP), medium (MP) and high protein (HP).The ADG, N-retention and serum total protein were significantly ($P<0.05$) increased when the level of protein increased from low to medium level, while it did not show any further improvement when the level of protein was further increased from medium to high level. There was a highly significant ($P<0.01$) increase in apparent digestibility coefficients of DM, OM, CP, EE, CF and NFE as the level of protein and energy increased. Total bacterial counts, VFAs and ammonia concentrations of rumen were significantly ($P<0.05$) increased as the level of protein and energy increased in the diets. The apparent retention of calcium as amount and percentage of intake were significantly ($P<0.05$) increased with increasing protein level from low to medium, while there was no improvement with the high protein diet. The amounts and percentages of phosphorus and magnesium absorbed and retained were not significantly affected by level of dietary protein. Therefore, medium protein diet showed to be superior in economic feed efficiency compared with high and low protein ones. The overall results indicated that Rahmani lambs need 13% crude protein in their rations during their active growth period and no benefit would accrue by further increasing its level in the ration.

Keywords: dietary protein, performance, nutrient utilization, mineral balance, sheep.

INTRODUCTION

Sheep are important meat-producing animals in Egypt as well as in many parts of the tropic and subtropic regions. Through intensive management, the performance of sheep is improved; with higher growth rates and more desirable carcass composition as compared to those raised under traditional systems. Protein is a costly fraction of the ration and needs to be regulated for judicious utilization. Protein is the principal constituent of the animal body and has to be continuously present in the feed for repair and synthesis process. It is therefore vital for animal maintenance, growth, reproduction and milk production (Harmeyer and Martens, 1980). Protein level in the ration is considered critical for fast growth in sheep, especially during the finishing period on feedlot rations between weaning and marketing (Krishna Mohan *et al.*, 1987). Protein deficiencies in the diet deplete stores in the blood, liver, and muscles, and predispose animal to a variety of serious and even fatal aliments. This deficiency further reduces rumen function and lower the efficiency of feed utilization (Singh and Sengar, 1970). Krishna Mohan *et al.* (1987) found that apparent digestibility coefficients of DM, CP, EE, CF and NFE significantly increased as the level of protein increased in the diet of lamb. The bioavailability of minerals to animals can be affected by a variety of dietary components, one of these components is protein (Greger and Snedeker, 1980). Not only dietary concentrations of protein influence total intake of feed but also have a direct effect on mineral retention (Rosero *et al.*, 1983). A number of reports have suggested an association between protein consumption and incidence of skeletal fracture (Abelow *et al.*, 1992 and Nevitt, 1994). This has generally been ascribed to the fact that a high protein intake increases urinary calcium excretion, resulting in a negative calcium balance and bone lesions (Funaba *et al.*, 1991 and Orwoll, 1992). Brand *et al.* (1999) concluded that high protein intake resulted in skeletal deformities in sheep. Elevated dietary nitrogen has generally been reported to decrease magnesium absorption and retention in ruminants (Martens *et al.*, 1988).

The objectives of this study were to examine the influence of dietary protein concentrations on performance, digestibility of nutrients, nitrogen balance and some biochemical parameters in addition to rumen fluid characteristics and metabolic responses of lambs.

MATERIALS AND METHODS

Animals, experimental design and management:

This study was carried out at the Animal Production Experimental Farm of the Faculty of Agriculture, Al-Azhar University, Assiut Branch. Eighteen male Rahmani lambs (9 months in age with an average body weight 33.92 ±0.06 kg) were randomly divided into 3 similar groups (6 lambs each.) each group was fed on one of the protein levels tested (10 , , 13 and 16% on dry matter basis for 3 months. The experimental animals were kept under the routine veterinary supervision throughout the duration of the experiment. The diets were given twice daily at 9.00 a.m. and 5.00 p.m. and any residues were collected and weighed throughout the experimental period and all animals had free access to clean water. Animals were weighed at the beginning of the experiment and thereafter at two weeks intervals till the end of the experiment to calculate for gain and feed intake. Feed intake was recorded throughout the experimental period. The shrunk live body weight were recorded.

Experimental diets:

The diets were formulated and composed of a concentrate mixture and wheat straw as a roughage. Each animal was offered it's quota of concentrate and roughage mixed altogether (at the rate of 4 % of body weight) making diets of medium protein (MP, 13.04% CP), low protein diet containing 10.06% CP (LP) and high protein 16.00% CP (HP). Formulation and chemical compositions of the experimental diets are presented in Table (1).

Metabolism trials:

At the end of the experiment, three digestibility and nitrogen balance trials were carried out by ordinary method to determine nutrients digestibility, nitrogen balance and nutritive value . The animals were individually placed in metabolism cages. Each trial expanded for 17 days, where the first 10 days were considered as preliminary period and during the subsequent seven days, feces and urine were quantitatively collected.

Samples:

Blood:

Blood samples were taken from all the animals from the jugular vein before feeding at the last day of collection period in a dry, clean and sterile centrifuge tubes. Serum was separated and stored at -20°C until analysis.

Ruminal liquor :-

At the end of the experiment, rumen liquor was collected by a stomach tube from each animal just before feeding in clean and sterile flask by using clean and sterile stomach tube for bacteriological examination immediately after collection. The colony forming units/ml of the rumen liquor was carried out by standard plate techniques (Baily and Scott, 1994). This was filtered and aliquots from the filtrate were used to determine VFAs and ammonia concentrations.

Analytical methods:

Diets were analyzed according to the official methods of AOAC (1990) for DM, CP, EE, CF and ash. Nitrogen free extract was calculated by difference. Nitrogen content of feces and urine samples were estimated according to AOAC (1990) for calculation of nitrogen balance..

Estimations:

Rumen liquor acidity, NH_3 and total volatile fatty acids:

As soon as the rumen fluid samples were obtained, the hydrogen ion concentration was estimated using pH meter. Total volatile fatty acids (TVFAs) and ammonia concentrations were determined by gas-liquid chromatography (Intersmat, IGC 120 FB)

Nutrient digestibility:

Digestion coefficients of the nutrients for the different experimental diets were calculated by using the direct method.

Biochemical parameters:

Total serum protein, albumin and globulin were determined using standard kits supplied by Bio-Merieux (Baines/France).

Statistical analysis:

Statistical analysis of the collected data was carried out according to procedures of completely random design, SAS (1995).

RESULTS AND DISCUSSION

Digestibility of nutrients:

The digestibilities of the different nutrients are shown in Table (2). There were highly significant ($P<0.01$) increases in apparent digestibility coefficients of DM, OM, CP, EE, CF and NFE as the level of protein and energy increased. This low level of protein might be insufficient to achieve optimum microbial digestion of food consumed, and hence the increase in digestibility was maximum when protein level was increased from low to medium level. Similar result was obtained by Etman (1985); Kumar and Narange (1991) and Krishna Mohan *et al.* (1987) who found that the apparent digestibility of DM, CP, EE, CF and NFE increased as the level of protein increased in the diet of sheep and these may be attributed to that low protein may reduce rumen function and lower the efficiency of feed utilization.)

Table (1): Formation and chemical composition (%) of the experimental diets

Ingredients	Experimental diets		
	1	2	3
	Low protein	Medium protein	High protein
Formulation %			
Corn, ground	54.1	45.2	38.0
Soybean meal	6.0	14.0	22.8
Wheat bran	8.0	10.0	8.0
Wheat straw	30.3	29.3	29.8
Limestone, ground	0.90	0.80	0.70
Common salt	0.50	0.50	0.50
Min. mix.*	0.10	0.10	0.10
AD_3E**	0.10	0.10	0.10
Chemical composition (%DM basis)			
Dry matter	89.15	89.14	89.13
Organic matter	94.84	94.48	94.19
Crude protein	10.06	13.04	16.00
Ether extract	2.93	2.78	2.55
Crude fiber	13.76	13.86	14.19
NFE	68.09	64.80	61.45
Ash	5.16	5.52	5.81
Calcium	0.44	0.43	0.43
Phosphorus	0.30	0.35	0.37
Magnesium	0.20	0.23	0.21
TDN***	63.05	63.02	63.06

*Mineral mixture: each 100g contains; 25.6g Na, 1.6g K, 4.6g Ca, 1.8g P, 4g Mg, 300mg Fe, 32mg Mn, 1.5mg Cu, 15mg I, 5mg Zn, 1mg Co and 1mg Se (AGRICO-international company).
**AD_3E, each gram of AD_3E contains 20.000 IU vitamin A, 2000 IU vitamin D and 400 IU vitamin E (AGRICO-international company).
***Calculated according to NRC (1985).

Table (2): Digestion coefficient (%) of nutrients for different experimental groups

Items	Experimental groups		
	1	2	3
	(Low protein)	(Medium protein)	(High protein)
Dry matter	60.39±0.44 [c*]	69.25±0.53 [b]	75.38±1.69 [a]
Organic matter	62.33±0.31 [c]	68.11±0.50 [b]	77.94±0.51 [a]
Crude protein	53.83±0.20 [c]	66.59±0.44 [b]	71.93±0.51 [a]
Ether extract	70.77±0.22 [c]	80.34±1.03 [b]	86.21±0.46 [a]
Crude fiber	35.36±0.59 [c]	46.33±0.70 [b]	51.08±0.53 [a]
Nitrogen free extract	70.71±0.42 [c]	79.75±1.57 [b]	86.04±0.42 [a]
TDN %**	63.093	71.81	76.57
DCP %**	5.415	8.683	11.509

*Figures in the same row having the same superscripts are not significantly different (P>0.01)
** Calculated according to digestibility of values of the experiment.(Feeding values).

Ahmed and Abdellatif (1995) found that digestibility of nutrients increased as dietary CP content was increased from 9.8% to 12.8 or 14.7% in diets of desert sheep. Increase in DM digestibility with increase in protein level was also reported by Veira *et al.* (1980). Increased CP and EE digestibility was reported on high levels of protein (Walker and Cook, 1967). Organic matter and CP digestibility were lowest in Awassi lambs fed the 10% CP diet (Haddad *et al.*, 2001). Regarding the nutritive values of the experimental rations , the results in table (2) indicated that TDN, DCP contents were increased linearly with increased of level of protein and energy in the rations.

Growth rate and feed efficiency:

Data pertaining to growth rate, intake of energy and protein and feed efficiency are shown in Table (3). There was significant ($P<0.05$) difference in the average daily gain (ADG) among experimental groups. The ADG significantly increased ($P<0.05$) when the level of protein increased from low (94.44 g/d) to medium level (130.56g/d). This might be due to the increase in nutrients digestibility for high level of energy and protein. Similar result was found by Ahmed and Abdellatif (1995). It did not show any further improvement when the level of protein further increased from medium to high level (125g/d). This suggested that a level of about 13% in the dry matter of diet is sufficient for Rahmani lambs at that age and stage of growth and that no further benefit is going to accrue by enhancing the protein level in the diet. It was probable that no further improvement in growth was seen when the protein level increased from medium to high level, since this excess protein might be degraded in the rumen as reported by Krishna Mohan *et al.* (1987). The significant increase in urinary-N excretion (Table, 4) with increase in protein level provided evidence for this. Veira *et al.* (1980) observed that the efficiency of protein utilization at higher levels of protein intake (more than 12% CP) could be increased if some dietary protein were protected from degradation in the rumen. In addition, Devendra (1982) and Balakrishna *et al.* (1997) indicated that the increase in growth rate of lambs with increasing protein intake up to certain level and then it declined when the protein content increased beyond 14 or 15%. The intake from DM and TDN increased with increases in from low (946 and 596.87 g/d) to medium level (959 and 688.63g/d), while further increase from medium to high decrease the intake of DM . Iason and Montecont (1993) found no difference in DM intake by lambs fed different levels of protein. The intake of DCP, however, significantly increased ($P<0.05$) with each successive rise in protein level (51.23, 83.27 and 103.58g/d for low, medium and high protein respectively).

Haddad *et al.* (2001) reported that DM and CP intakes significantly ($P<0.05$) increased with increasing levels of protein in the diet of Awassi lambs. The ratio of protein to energy was wider in low protein (10.65) group and this ratio narrowed with increase in level of protein (7.27) and was the narrowest at high level of protein (5.65). There were significant differences ($P<0.05$) in feed efficiency among levels of protein and increased with increased protein and energy level in the diets (9.89, 13.61 and 13.88% for low, medium and high protein, respectively).

The best feed conversion ratio calculated as kg of DM or TDN required for each kg gain in live weight was obtained with medium and high protein groups (7.35, 5.27 and 7.20, 5.51 kg) compared to the low protein group

Table (3): Performance and feed efficiency of rams during experimental period

Items	Experimental groups 1 (Low protein and energy)	2 (Medium protein and energy)	3 (High protein and energy)
Int. body weight (kg)	33.75±0.84	34.00±0.33	34.00±0.74
Fin. Body weight (kg)	42.25±1.29	45.75±0.39	45.25±0.39
Total weight gain (kg)	8.50±1.22 [b*]	11.75±0.58 [a]	11.25±0.84 [a]
Av. Daily gain (g)	94.44±13.61 [b]	130.56±6.41 [a]	125.0±9.35 [a]
Growth rate (%)	25.19	34.56	33.09
Av. Daily feed intake:			
TDMI (g/head)	946±8.05 [a]	959±10.15 [a]	900±12.10 [a]
TDN (g/head)	596.87±18.50 [b]	688.63±15.33 [a]	689.17±20.10 [a]
DCP (g/head)	51.23±6.32 [c]	83.27±8.15 [b]	103.58±10.12 [a]
N.R***	10.65	7.27	5.65
Feed conversion:			
Kg DM / Kg gain	10.02	7.35	7.20
Kg TDN / Kg gain	6.32	5.27	5.51
Kg DCP / Kg gain	0.543	0.638	0.829
Feed efficiency (%)**	9.98±0.75 [b]	13.61±1.50 [a]	13.88±1.25 [a]

***Figures in the same row having the same superscripts are not significantly different (P>0.05)**

** Feed efficiency % = $\frac{1}{\text{Feed consumed per kg gain}} \times 100$ (Krishna Mohan *et al.*, 1987)

***N.R :-The ratio of protein to energy.

Table (4): Nitrogen utilization of the different experimental groups

Items	Experimental groups 1 (Low protein and energy)	2 (Medium protein and energy)	3 (High protein and energy)
Nitrogen intake (g/h/d)	15.23±1.35 [b*]	20.00±1.50 [a]	23.04±1.45 [a]
Fecal nitrogen (g/h/d)	4.80±0.50 [b]	7.76±0.67 [a]	8.03±0.80 [a]
Digested nitrogen (g/h/d)	10.43±0.95 [c]	12.24±1.05 [b]	15.01±1.01 [a]
Urinary nitrogen (g/h/d)	5.98±0.70 [b]	6.43±0.35 [b]	9.13±0.89 [a]
Nitrogen retention (g/h/d)	4.45±0.30 [b]	5.81±0.50 [a]	5.88±0.45 [a]
Productive protein value**	29.22±0.95 [a]	29.05±0.56 [a]	25.52±0.25 [b]
N retention (% of absorbed)	42.66±1.50 [b]	47.47±1.83 [a]	39.17±1.25 [b]

***Figures in the same row having the same superscripts are not significantly different (P>0.05)**

** Protein productive value (PPV) = $\frac{\text{N - retained}}{\text{N - intake}} \times 100$ (Krishna-Mohan et al., 1987)

(10.02, 6.32 kg, respectively). Similar result was obtained by Haddad *et al.* (2001) who observed no difference in feed to gain ratio between 12 , 14 and 16% CP diets except for the diet that contained 10%CP, which had a lower ratio.

The efficiency of feed conversion was higher in high protein ration than low protein ration (Balakrishna *et al.*, 1997 and Scott *et al.*, 1997). On the other hand, DCP conversion ratios were found to be 0.543, 0.638 and 0.829 kg DCP for each kg gain in live weight for low, medium and high protein groups respectively

Nitrogen balance:

The N intake, N-retention, productive protein value (PPV) and N-retention as % of absorbed are presented in Table (4). The N-intake increased significantly (P<0.05) with increasing level of protein in the diet. Fecal and urinary-N losses were positively associated with N-intake.

This is in agreement with the observations of Laughren and Young (1979) ,Santra and Karim (1999); Faicheny (1974) and Ludden *et al.* (2002) who reported that significant increases in urinary-N loss when dietary N-intake increased. N-retention was significantly (P<0.05) increased when the level of protein increased from low to medium, while it did not show any improvement when level of protein increased from medium to high level. Productive protein value (PPV) was high in low and medium protein groups while was lower in high protein group This showed that dietary nitrogen was used most efficiently in low and medium protein groups, while the efficiency was lower in high protein group (Krishna Mohan *et al.*, 1978).The N-retented as % of absorbed significantly (P<0.05) increased when the protein level increased from low to medium, while it decreased at high protein .

Blood proteins profile:

In this study, the total protein concentration of serum was significantly (P<0.05) increased with increasing protein level in the diets from low to medium , while there was no significant difference between medium and high level of protein as shown in Table (5).

Serum albumin and globulin concentrations were significantly (P>0.05) increased when protein level increased from low to medium ,while no significant (P>0.05) difference when was recorded increased from medium to high level .Similar results were found by Rekwot *et al.* (1989), Katunguka-Rwakishaya (1997) and Hoffman *et al.* (2001) who reported that animals fed on high protein diets had significantly higher total protein, albumin and total globulin than those on low protein. Total protein concentration of serum increased in response to the rising level of rumen concentration of ammonia.

Rumen liquor characteristics:

There was no significant differences in the pH of rumen between different experimental groups as shown in Table (6). Total bacterial counts of rumen liquor were significantly (P<0.05) increased as the levels of protein and energy increased in the diets. Total VFAs and ammonia-N concentrations were significantly (P<0.05) increased with further increase in the CP content of the diet. Similar result were reported by Hatfield *et al.* (1998) who found that total VFAs concentration was increased with increasing protein in the diet of sheep from 10 to 18%, while Ludden *et al.* (2002) reported that total VFAs concentrations were not significantly affected by increasing dietary CP of sheep from 13 to 17%. Febel *et al.* (2000) stated that rumen concentration of

Table (5): Protein profile of the different experimental groups

Items	Experimental groups		
	1 (Low protein and energy)	2 (Medium protein and energy)	3 (High protein and energy)
Total protein (g/100ml)	5.07±0.08 [b*]	7.85±0.12 [a]	8.80±0.14 [a]
Albumin (g/100ml)	2.10±0.19 [b]	3.35±0.14 [ab]	4.53±0.07 [a]
Globulin (g/100ml)	2.97±0.24 [b]	4.30±0.11 [a]	4.27±0.09 [a]

***Figures in the same row having the same superscripts are not significantly different (P>0.05).**

Table (6): Rumen characteristics of the different experimental groups

Items	Experimental groups		
	1 (Low protein and energy)	2 (Medium protein and energy)	3 (High protein and energy)
pH of the rumen	5.77±0.14 [a*]	5.93±0.15 [a]	5.91±0.16 [a]
Total bacterial count (/ml)	0.60×10^4 $\pm 0.1 \times 10^3$ [b]	1.08×10^6 $\pm 0.5 \times 10^5$ [a]	1.26×10^6 $\pm 1.0 \times 10^5$ [a]
Total VFA (meq/100 ml R.L)	7.09±0.28 [c]	9.52±0.18 [b]	12.07±0.15 [a]
NH_3-N (meq/100 ml R.L)	15.07±0.10 [c]	20.83±0.31 [b]	26.74±0.31 [a]

***Figures in the same row having the same superscripts are not significantly different (P>0.05).**

Table (7): Calcium balance as affected by treatments expressed as g/head/day.

Items	Experimental groups		
	1 (Low protein and energy)	2 (Medium protein and energy)	3 (High protein and energy)
Calcium (Ca):			
Intake	4.16±0.08 [a*]	4.12±0.15 [a]	3.87±0.10 [a]
Fecal	2.18±0.03 [a]	1.68±0.01 [b]	1.59±0.05 [b]
Urinary	0.09±0.01 [b]	0.15±0.06 [a]	0.18±0.05 [a]
Absorbed	1.98±0.05 [b]	2.44±0.01 [a]	2.28±0.03 [a]
Absorption (%)	47.60±1.20 [b]	59.22±1.13 [a]	58.91±1.28 [a]
Retained	1.89±0.07 [b]	2.29±0.10 [a]	2.10±0.05 [a]
Retention (%) of intake	45.43±1.00 [b]	55.58±1.25 [a]	54.26±1.15 [a]
Retention (%) of absorbed	95.45±1.10 [a]	93.85±1.35 [a]	92.11±1.28 [a]

***Figures in the same row having the same superscripts are not significantly different (P<0.05).**

ammonia increased in response to the rising level of protein in the diet of sheep.

Balance of minerals by lambs :

The balances of calcium, phosphorus and magnesium in the present study are presented in Tables (7, 8 and 9).

Calcium balance:

The average daily fecal excretion of calcium was significantly (P<0.05) higher in lambs fed on low protein diet (2.18 g/d) compared with the groups fed on medium (1.68 g/d) and high (1.59 g/d) level of protein.

Similar result was found by Terashima *et al.* (1975), Yano *et al.* (1976) and Funaba *et al.* (1990) who reported that fecal Ca excretion was decreased in sheep fed high protein ration. For urinary calcium excretion, it was significantly (P<0.05) increased with increasing level of protein. The results agreed with those reported by Huntington *et al.* (1981) and Funaba *et al.* (1990 and 1991) who found that urinary excretion of calcium was increased in animals fed high protein diets. Concerning the amount and percentage of Ca absorbed ، there were significant differences (P<0.05) among the three treatments and the highest values were recorded with medium and high protein diets compared to the low level of protein. Teun *et al.* (1984) stated that low protein supply could adversely affect intestinal Ca absorption. The apparent retention of calcium as amount and percentage of intake were significantly (P<0.05) increased with increasing protein level from low (1.89g/d and 45.43%) to medium (2.29g/d and 55.58%), while there was no improvement with high protein diet (2.10g/d and 54.26%, respectively). The present results are supported by the findings of Braithwaite (1976) and Funaba *et al.* (1990) who reported that high dietary protein increased intestinal calcium absorption and retention by decreasing fecal calcium excretion.

Phosphorus balance:

The amount of phosphorus excreted in urine was very low and ranged from 0.07 to 0.10g with no significant differences among the experimental diets which supported by the findings of Walker and Al-Ali (1987) who stated that urinary excretion of phosphorus was generally low in most domestic animals. The amount and percentage of P absorbed and retained were not significantly affected by level of dietary protein. Similar result was found by Funaba *et al.* (1990) who reported that phosphorus absorption and balance were not significantly affected in sheep fed on high protein ration compared to low one.

Magnesium balance:

The average daily fecal excretion of magnesium was lower compared to calcium and phosphorus. Fecal and urinary excretion were nearly similar in the three balance experiments, which ranged from 0.75 to 0.91g/d for feces and 0.08 to 0.10g/d for urine. Protein and energy levels of the diets did not significantly affect the amount and percentage of Mg absorbed and retained. These results agree with that found by Grace and MacRae (1972) that increasing dietary protein had no effect on urinary Mg excretion, net absorption and Mg balance in sheep.

Economic evaluation:

As presented in Table (10) feed costs of live body gain (L.E) and economic feed efficiency were calculated. Differences in feed cost or economic feed efficiency between lambs were significantly different (P<0.05). However, medium protein diet showed to be superior in economic feed efficiency (52.62%) compared to high (39.44%) and low protein (20.72%) ones.

Table (8): Phosphorus balance as affected by treatments expressed as g/head/day.

Items	Experimental groups		
	1 (Low protein and energy)	2 (Medium protein and energy)	3 (High protein and energy)
Phosphorus (P):			
Intake	2.84±0.10	3.36±0.09	3.33±0.05
Fecal	1.51±0.04	1.90±0.05	1.97±0.03
Urinary	0.10±0.01	0.08±0.00	0.07±0.01
Absorbed	1.33±0.05	1.46±0.01	1.36±0.03
Absorption (%)	46.83±1.05	43.45±1.33	40.84±1.50
Retained	1.23±0.09	1.38±0.03	1.29±0.01
Retention (%) of intake	43.31±0.80	41.07±1.50	38.74±1.10
Retention (%) of absorbed	92.48±1.53	94.52±1.92	94.85±1.83

*There was no significant differences among experimental groups.

Table (9): Magnesium balance as affected by treatments expressed as g/head/day.

Items	Experimental groups		
	1 (Low protein and energy)	2 (Medium protein and energy)	3 (High protein and energy)
Magnesium (Mg):			
Intake	1.89±0.03	2.21±0.04	1.89±0.01
Fecal	0.80±0.02	0.91±0.01	0.75±0.02
Urinary	0.09±0.00	0.10±0.01	0.08±0.01
Absorbed	1.09±0.01	1.30±0.01	1.14±0.03
Absorption (%)	57.67±0.08	58.82±0.10	60.32±0.15
Retained	1.00±0.03	1.20±0.02	1.06±0.06
Retention (%) of intake	52.91±0.70	54.30±0.58	56.08±0.90
Retention (%) of absorbed	91.74±1.10	92.31±1.25	92.98±1.50

*There was no significant differences among experimental groups.

Table (10): Economic evaluation of experimental rams

Items	Experimental groups		
	1 (Low protein and energy)	2 (Medium protein and energy)	3 (High protein and energy)
Feed costs (L.E)	70.41±2.35 ^{b*}	76.99±1.93 ^{ab}	80.68±2.50 ^{a}
Price of body gain (L.E)	85.00±4.02 ^{b}	117.5±3.62 ^{a}	112.5±3.93 ^{a}
Net revenue (L.E)	14.59±1.00 ^{c}	40.51±1.10 ^{a}	31.82±0.95 ^{b}
Economic feed efficiency (%)*	20.72±2.80 ^{c}	52.62±2.58 ^{a}	39.44±3.15 ^{b}

*Figures in the same row having the same superscripts are not significantly different (P< 0.05).

$$\text{*Economic feed efficiency (\%)} = \frac{\text{Net revenue (L.E)}}{\text{Feed costs (L.E)}} \times 100$$

Where, price of 1 ton complete ration for group 1, 2 and 3 = 827 ,669 and 747 LE, respectively.

Price of 1 kg live body weight = 10 LE as the dominant market price of finishing ram lambs at Assiut market in this period.

It could be inferred from the present study that lambs fed on medium protein and energy level had significantly higher body weight gain, better feed efficiency, nutrient digestibility, nitrogen retention ,Calcium and Magnesium balance as well as blood protein profile and fermentation in the rumen characteristics with high economical feed efficiency. It could be concluded that higher level of dietary protein was wasted in feces and urine and that 13% CP was adequate for growing lambs.

REFERENCES

Abelow, B.J.;T.R Holford and K.L. Insogna (1992). Cross-cultural association between dietary animal protein and hip fracture: a hypothesis. Calcified Tissue Int., 50:14-18.

Ahmed, M.M.M. and A.M. Abdellatif (1995). Effect of dietary protein level on thermoregulation, digestion and water economy in desert sheep. Small Rumin. Res., 18(1): 51-56.

Association of Official Analytical Chemists (1990). Official Methods of Analysis. Vol. I.14th ed., AOAC, Arlington, VA.

Baily, W.R. and E.G. Scott (1994) .Diagnostic Microbiology 9th Ed. the C.V. Mosby, Saint Louis.

Balakrishna, G.; G.V Raghaven; T Janardhan Reddy and M.M. Naldu (1997). Effect of feeding different levels of protein on growth and feed efficiency in crossbred lambs. Ind. Vet. J., 74:220-222.

Braithwaite, G.D. (1976). Calcium and phosphorus metabolism in ruminant with special reference to parturient pareses. Rev. of the progress of dairy science. J. Dairy Res., 43:501-520.

Brand, T.S.; Q Jhonson,; F .Frank; , W .Veith; R .Conradie and F.S. Hough, (1999). The influence of dietary crude protein intake on bone and mineral metabolism in sheep. S. Afri. Vet. Ass., 70 (1): 9-13.

Chauhan, J.SA.; M.C. Garg and M.P. Narange (1997). Growth performance in gaddi lambs. Ind. J. Anim.Sci.,67(3):244-245.

Dawa , M. (2003):Effect of energy and protein levels in the diet on intake of lactating Awassi ewes. Egypt. J. Nutritional and Feeds, 6 (special Issue):1333-1347.

Devendra, C. (1982). Strategies other than breeding for the development of small ruminants. Proc. of Workshop held at Brazil.

El-Ashry, M.A; H.M. Khattab; K.E.I. Etman and S.K. Sayed (2003).Effect of two different energy and protein levels on productive and reproductive performances of lactating buffaloes. Egypt. J. Nutritional and Feeds, 6 (special Issue):491-506.

Elliot, R.C. and J.H. Topps (1964). Studies of protein requirements of ruminants. 3.Nitrogen balance trials on Blackhead persion sheep given diets of different energy and protein content. Br. J. Nutr., 18:245-252.

Etman, K.E.I.(1985).The effect of level concentrate feeding and roughage on meat production. Ph .D. Dissertation, Fac. Agric., Zagazig Univ. Faicheny, G.J. (1974). The effect of formaldehyde treatment of a casein supplement on urea excretion and on digesta composition in sheep. Austr. J. Agric. Res., 25:599-612.

Febel, H.; S. Huszar, and I.Z. Harczi (2000). Effects of dietary protein and carbohydrate source on rumen fermentation and nutrient flow in sheep. Acta Vet. Hung., 48 (2): 161-171.

Funaba, M.; H. Nabeta; H. Yano and R. Kawashima (1990). Effect of high energy and/ or high protein diets on calcium and phosphorus metabolism in sheep. Jap. J. Zootech. Sci., 61(2): 162-168.

Funaba, M.; H. Nabeta; H. Yano and R. Kawashima (1991). Effect of a high protein diet on calcium metabolism in sheep. Anim. Sci. and Tech., 62:628-635.

Grace, N.D. and J.C. MacRae (1972). Influence of feeding regimen and protein supplementation on the sites of net absorption of magnesium in sheep. Br. J. Nutr., 27:51-55.

Greger, J.L. and S.M. Snedeker (1980). Effect of dietary protein and phosphorus levels on the utilization of zinc, copper and manganese by adult males. J. Nutr., 110:2243-2253.

Haddad, S.G.;R.E Nasr. and M.M. Muwalla (2001). Optimum dietary crude protein level for finishing Awassi lambs. Small Rumin. Res., 39 (1): 41-46.

Harmeyer, J. and H. Martens (1980). Aspects of urea metabolism in ruminants with reference to the goat. J. Dairy Sci., 63:1707.

Hatfield, P.G.; J.A. Hopkins; W.S. Ramsey and A. Gilmore (1998). Effects of level of protein and type of molasses on digesta kinetics and blood metabolites in sheep. Small Rumin. Res. 28 (2): 161-170.

Hoffman, P.C.; N.M .Esser; L.M .Bauman; S.L .Denzine; M. Engstrom and H. Chester-Jones (2001). Short communication: Effect of dietary protein on growth and nitrogen balance of Holstein heifers. J. Dairy Sci., 84(4): 843-847.

Huntington, G.B.; R.A. Britton and R.L. Prior (1981). Feed intake, rumen fluid volume and turnover, nitrogen and mineral balance and acid-base status of wethers changed from low to high concentrate diets. J. Anim. Sci., 52(6):1376-1381.

Iason, G.R. and A.R .Montecont,. (1993). The effect of dietary protein level during feed restriction on carcass and non carcass components, digestibility and subsequent compensatory growth in lambs. Animal Prod., 56:93-100.

Katunguka-Rwakishaya, E. (1997). The influence of dietary protein on some blood biochemical parameters in Scottish blackface sheep. Vet. Parasitol., 68(3): 227-240.

Krishna Mohan, D.K; K.K.. Krishna Reddy and A.S. Srirama Murthy (1987). Protein requirements of crossbred lambs. Ind. J. Anim. Sci., 50 (10): 1121-1127.

Kumar, S. and M.P. Narange (1991).Effect of different planes of nutrition on the performance of Gaddii male kids using concentrate rations and Kiku grass hay. Ind. J. Anim.Sci.,61 (8):869 – 872.

Laughren, L.C. and A.W. Young. (1979). Duodenal nitrogen flow in response to increasing dietary crude protein in sheep. J. Anim. Sci., 49:211-220.

Ludden, P.A.; T.L. Wechter, and B.W. Hess (2002). Effects of oscillating dietary protein on nutrient digestibility, nitrogen metabolism and gastrointestinal organ mass in sheep. J. Anim. Sci., 80 (11): 3021-3026.

Mckinnon, J.J.; R.D.H. Cohen, S.D.M Jones; B. Loaarveeld and D.A. Christensen (1993).The effect of dietary energy and crude protein concentration on growth and serum insulin – like growth factor-Ii.Cand.J.Anim.SCI.,73:303-313

Martens, H.; G. Heggmann and C. Regier (1988). Studies on the effect of K, Na, NH4, VFAs and CO2 on the absorption of magnesium from the temporarily isolated rumen of heifers. J. Vet. Med. Assoc., 35:73.

Nevitt, M.C. (1994). Epidemiology of osteoporosis. Rheumatic Disease Clinics of North America, 20:535-559.

NRC (1985). Nutrient Requirement of Sheep .6th Ed., National Academy Press, Washington, D.C.

Orwoll, E.S. (1992). The effects of dietary protein insufficiency and excess on skeletal health. Bone, 13:343-350.

Rekwot, P.I.; E.Q. Oyedipe; O.O. Akerejola; A.A. Voh, and P.M. Dawuda (1989). Serum biochemistry of Zebu bulls and their Friesian crosses fed two planes of protein. Br. Vet. J., 145(1): 85-88.

Rosero, O.R.; L.R .McDowell; F.G .Martin; J.H. Conrad and, G.L Ellis

(1983). Nut. Rep. Int., 28:1179. Cited in McDowell, L.R. (1992): Minerals in Animal and Human Nutrition. p: 41. Academic Press, INC, Harcourt Brace Jovanovich, New York, Boston, London.

Safinaz M. Shawket and M.H. Ahmed (2001). The influence of level of energy supplementation on the utilization of salt bush (Atriplex nummularia) by camels. Egypt. J. Nutritional and Feeds, 4 (special Issue):557-565.

Santra, A. and S.A .Karim (1999). Effect of protein levels in creep mixture on nutrient utilization and growth performance of pre-weaner lambs. Small Rumin. Res., 39 (2): 131-136.

SAS (1995). User's Guide: Statistics, V.7.SAS Inst., Inc., Cary, NC.

Scott, D.; N. Loveridge; , L Nicodemo; , W .Buchan; J. Milne.; A Duncan; P. Nicol and S.P. Robins (1997). Effect of diets varying in nitrogen or phosphorus content on indicators of bone growth in lambs. Exp. Phys., 82:193-202.

Singh, S.N. and O.P.S. Sengar (1970). Investigation on milk and meat potentialities of Indian goats. Final Techn. Report Project, Raja Balwaant Singh College, Bichpuri, India.

Singh , J.; M. Singh and A. Kumar (1991).Efficiency of Nutrition of energy and protein for growth in crossbred heifers. Proc. 1st Jnt. Anim. Nut., India 11,296,pp.182.

Singh, N.P.; M. Singh and B.C. Patnayak (1975). Effect of energy and protein levels on nutrient digestibility and wool production.Ind.J.Anim.Sci.,45 (4):277 – 281.

Terashima, Y.; N .Shinozaki; N. Tohrai, and H. Itoh, (1975). Effect of roughage or concentrate feeding on serum mineral and enzyme levels and urinary mineral excretion in sheep. Jap. J. Zootech. Sci., 46:263.

Teun, A.A.; J.C. Wadsworth, and M. Murray (1984). Absorption of Ca and P by growing cattle during protein deficiency. Proc. Of the Nutrition Soc.,Australia, 9:144-147.

Titi, H.H.; , M.J .Tabbaa; , M.G. Amasheh; F. Barakehand and B. Daqamseh, (1999). Comparative performance of Awassi lambs and Black goat kids on different crude protein levels in Jordan. Small Rumin. Res., 37 (2): 131-135.

Veira, D.M.; G.K. Macleod; J.H. Burton and J.B .Stone (1980). J. Anim. Sci., 50:945-951. Cited by Krishna Mohan *et al.*. (1987). Protein requirements of crossbred lambs. Ind. J. Anim. Sci., 50(10): 1121-1127.

Walker, D.M. and S.J. Al-Ali (1987). The endogenous phosphorus excretion of preruminant lambs. Aust. J. Agric. Res., 38(6):1061-1069.

Walker, D.M. and L.J. Cook (1967). Nitrogen balance studies with the milk-fed lambs.4. Effect of different nitrogen and sulpher intakes on live-weight gained wool growth and on nitrogen and sulpher balances. Br. J. Nutrition, 21:237.

Yano, H.; K Miyoshi and R. Kawashima (1976). Relationships between mineral metabolism and rumen fermentation in sheep. Jap. J. Zootech. Sci., 47 (5): 270-276.

مدي تأثير مستويات مختلفة من البروتين علي الأداء والاستفادة من المواد الغذائية والتمثيل الغذائي لبعض العناصر المعدنية في الحملان

علي عبدالله أبوالعلا[١]، صابر جمعة عبده[١]، عبدالباسط نصر سيد[٢]، أمين عبد المبدى حجازى[٣]

١ - قسم الانتاج الحيواني-كلية الزراعة-جامعة الأزهر-فرع أسيوط
٢ - قسم تغذية الحيوان والتغذية الإكلينيكية-كلية الطب البيطري-جامعة أسيوط
٣ - قسم الانتاج الحيواني-كلية الزراعة-جامعة الأزهر- القاهرة

تم استخدام عدد ١٨ من حملان الرحماني مقسمة إلى ثلاث مجموعات (٦ حيوانات / مجموعة) لمدة ثلاثة شهور لدراسة مدي تأثير مستويات مختلفة من البروتين علي الأداء ومعدلات هضم المواد الغذائية وميزان النتروجين وصورة بروتين الدم بالإضافة إلى دلالات التخمر في الكرش والتمثيل الغذائي للكالسيوم والفوسفور والماغنسيوم. غذيت المجموعة الأولى علي مستوي منخفض من البروتين (١٠%) والثانية علي مستوي متوسط (١٣%) من البروتين بينما غذيت الثالثة علي مستوي مرتفع (١٦%). من البروتين وقد خلصت الدراسة إلى النتائج التالية:زاد كل من معدل الزيادة في وزن الجسم وميزان النتروجين وبروتين الدم الكلي زيادة معنوية مع زيادة البروتين في العليقة من المستوي المنخفض إلى المتوسط بينما لم يلاحظ أي تحسن في هذه المعدلات مع زيادة بروتين العليقة إلى المستوي المرتفع. وجود زيادة معنوية عالية في معدلات هضم كل من المادة الجافة والعضوية والبروتين الخام والدهون والألياف ومستخلص خالي النتروجين بالإضافة إلى العد البكتيري وتركيز كل من الأحماض الطيارة والامونيا مع زيادة مستوي البروتين في العليقة. معدل تخزين الكالسيوم في جسم الحيوانات زاد معنويا مع زيادة مستوي بروتين العليقة من المنخفض إلى المتوسط بينما لم تتأثر معنويا معدلات تخزين الفوسفور والماغنسيوم بمستويات البروتين في العليقة. كانت الكفاءة الاقتصادية للعليقة المحتوية علي مستوي متوسط من البروتين أفضل من العلائق المحتوية علي المستوي المنخفض أو المرتفع. استخلص من هذه الدراسة أن حملان الرحماني تحتاج إلى ١٣% من البروتين الخام في علائقها وأن أي زيادة عن هذا المستوي ليس لها أي عائد اقتصادى.