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GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF RAHMANI LAMBS FED DIFFERENT DIETARY PROTEIN LEVELS

(With 7 Table)

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معدل الأداء وصفات الذبيحة في حملان الرحماني المغذاة علي مستويات مختلفة من البروتين

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تم استخدام عدد ١٥ من حملان الرحماني في هذه التجربة لدراسة تأثير مستويات مختلفة من البروتين في العلائق علي الأداء ومعاملات هضم المواد الغذائية وقياسات الدم وصفات سائل الكرش وصفات الذبيحة. قسمت الحيوانات عشوائيا الي ثلاثة مجموعات (٥ حملان / مجموعة). غذيت كل مجموعة علي نسبة من البروتين المختبر (١٢ ، ١٤,٧ ، ١٧%). كانت نسبة البروتين المرتفعة ١٧% والمنخفضة ١٤% و ١٤,٧ % للمقارنة. احتوت كل العلائق علي طاقة هضم واحدة (٣,٢ ميجاكالوري/كجم عليقة). وقد خلصت نتائج التجربة إلي مايلي: وجود اختلافات معنوية بين المجموعات في معدلات كل من استهلاك الأكل والزيادة في وزن الجسم والتحويل الغذائي. زيادة معنوية في معاملات هضم المادة الجافة والبروتين الخام والدهون والألياف ومستخلص خالي النتروجين مع زيادة نسبة البروتين في العلائق. وجود زيادة في البروتين الكلي والالبيومين والجلوبيولين واليوريا في سيرم الدم مع زيادة نسبة البروتين. عدم تأثر الأس الهيدروجيني لسائل الكرش مع وجود زيادة معنوية في تركيز الامونيا والأحماض الدهنية الطيارة في الكرش مع زيادة نسبة البروتين. عدم وجود أي اختلافات معنوية في صفات الذبيحة بين المجموعات المختبرة. نستخلص من هذه التجربة أن زيادة نسبة البروتين في علائق حملان الرحماني عن ١٤,٧ % ليس له أي تأثير علي معدل الأداء وتعتبر النسبة المثلي من البروتين لهذه الحملان.

SUMMARY

Fifteen male Rahmani lambs (8 months in age with an average body weight 30.52 ± 0.21 Kg) were used in this study to evaluate the effect of different protein levels in diets on the performance, nutrient digestibility,

blood parameters, ruminal characteristics and carcass traits in addition to economical benefit. Animals were randomly divided into 3 similar groups (5 lambs each). Each group was fed on one of the protein level tested (12, 14.70 & 17% CP) for 90 days. The medium protein's ration (14.7 %) was considered as control. The two different protein levels as treatments (high protein, HP = 17%, low protein, LP= 12%). All diets contained the same digestible energy (3.20 MCal/kg DE / kg diet). There was significant ($P<0.05$) difference in the feed intake, weight gain and feed conversion between different experimental groups. The apparent digestion coefficients of DM, CP, EE, CF & NFE were significantly ($P<0.05$) increased with increasing dietary protein levels. There was significant ($P<0.05$) increase in the total protein, albumin, globulin and urea as the protein level increased. The levels of protein had no significant effect on the pH of the rumen, while ammonia-N concentration and total volatile fatty acids were significantly ($P<0.05$) increased. There were no significant differences in the carcass characteristics between treated groups. Consequently, it was considered that feeding Rahmani lambs with higher protein level than 14.7% had no advantage for performance and would be cause of economic loss, it can be said that, 14.7% CP was optimal.

***Key words**: Growth, lambs, carcass, protein.*

INTRODUCTION

Sheep are important meat producing animals in many areas 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 (Abou'l Ella *et al.*, 2005). It is well known that the most important factor causing lack of yield and the restriction in lamb meat production is insufficient nutrition. Inadequate protein intake results in lower ammonia in the rumen, thus growth of ruminal bacteria is influenced negatively. Consequently, it resulted in lower feed intake, digestibility and performance. However, the excessive protein intake caused increased feed cost and economical losses. The determination of optimum levels of dietary protein levels are also important in order to prevent environmental pollution due to emission of ammonia into the atmosphere from degradation of excreted urea, to avoid unnecessary losses of nitrogen and minimize costs of feed (Negesse *et al.*, 2001).

Protein requirements suggested by A. R. C. (1980) are smaller than those published by NRC (1985), indicating that additional investigations are necessary on lamb protein requirements, particularly for animals during periods of accelerated growth. Many studies were carried out to determine the optimum dietary crude protein level for lamb. The NRC (1985) recommended 14.5% CP for weaned lambs for maximum growth, but Andrews and Orskov (1970) reported the maximum weight gain occurred at 17% dietary CP. Although feeding lambs with 18% CP diets is common practice, it was reported that lambs fed 16 and 18 % CP diet had higher body gain and dry matter intake than lambs fed 10, 12 and 14% CP diet, and there were no differences between lambs fed 16 and 18% CP (Titi *et al.*, 2000). The aim of the present study was to evaluate the effects of different protein levels in diets on the performance, nutrient digestibility, blood parameters, ruminal characteristics and carcass traits of Rahmani lambs.

MATERIALS and METHODS

Animals:

Fifteen male Rahmani lambs (8 months in age with an average body weight 30.52±0.21 Kg) were randomly divided into 3 similar groups (5 lambs each). Each group was fed on one of the tested protein level (12.0, 14.7 & 17.0 % CP) for 90 days. The diets were given twice daily at 9.00 am and 4.00 pm 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 and each week interval till the end of the experiment to calculate gain and feed intake.

Diets:

The diets were formulated and composed of concentrate mixture and wheat straw as roughage. Each animal was offered it's quota of concentrate and roughage mixed together. The medium protein's ration (MP) was formulated to contain the recommended levels of digestible energy (DE) 3.20 Mcal/kg, crude protein (CP) 14.7 % according to the NRC (1981) for sheep. The two different protein levels as treatments (high protein, HP = 17%, low protein, LP= 12%). All diets contained 3.20 MCal/kg DE/ kg diet (Table, 1).

Table 1: Ingredients and chemical analysis (%) of the experimental rations.

Items	Treatment		
	LP	MP	HP
Ingredients:			
White corn	56.53	46.00	42.80
Soybean meal	10.00	17.30	22.83
Dried fat	5.00	5.00	5.00
Wheat straw	27.00	30.30	28.00
Limestone, ground	0.67	0.60	0.57
Common salt	0.50	0.50	0.50
Premix	0.30	0.30	0.30
Total	100	100	100
Chemical analysis:			
DM	88.93	88.97	88.23
CP	11.98	14.69	16.94
EE	6.14	6.04	6.02
CF	13.57	15.21	14.54
NFE	61.11	56.25	54.76
Ash	7.20	7.81	7.74
Calcium	0.51	0.50	0.51
Phosphorus	0.30	0.31	0.34
DE (kcal/kg diet)	3.21	3.20	3.20

Digestibility trials:

A digestion trial was conducted for 7 days at the end of the experiment to assess the utilization of different dietary nutrients. During this period, animals were fed a fixed weight of ration. Representative feed and fecal samples collected over the period of 7 days were subjected to chemical analysis according to A. O. A. C. (1990). Digestion coefficients of the nutrients for the different experimental diets were calculated by using the direct method.

Blood sample:

Blood samples were taken from all the animals from jugular vein before feeding at the last day of collection period in a dry, clean and sterile centrifuge tubes. Total serum protein, albumin and globulin were determined using standard kits supplied by Bio-Merieux (Baines/france).

At the end of the experiment, rumen liquor was collected by stomach tube from each animal just before feeding in clean and sterile flask, then aliquots from the filtrate was used to determine total volatile fatty acids (VFAS) and ammonia concentrations. As soon as the rumen fluid samples were obtained, pH was immediately measured by pH meter. Total volatile fatty acids and ammonia concentrations were determined by gas-liquid chromatography (Intersmat, IGC 120 FB).

Carcass traits:

At the end of the experiment, 3 animals were selected from each of the treatments and starved for 16 h, while water was available. Live weights at slaughter, dressed carcass, edible organs and body fat weight were recorded.

Economical efficiency:

Economical efficiency was calculated as the ratio between income (price of weight gain) and the cost of feed consumed.

Statistical analysis:

All data were subjected to statistical analysis (SAS, 1990). Duncan's (1955) multiple range test was utilized to detect differences among groups.

RESULTS

The performance of lambs fed on the different experimental diets is presented in Table (2). The diet have high protein gave the similar body weight and weight gain as medium protein, while the low protein diet had the lowest values. The average daily feed intake was affected by the treatments. Feed conversion was better in group fed on high and medium protein diets compared to group fed on low protein diet.

Table 2: Effect of protein levels on the performance of lambs.

Items	Treatment		
	LP	MP	HP
Initial weight (kg)	30.05±1.20	30.55±1.15	29.96±1.01
Final weight (kg)	41.90±1.20 ^{b}	45.89±1.10 ^{a*}	45.66±1.05 ^{a}
Total weight gain (kg)	11.85±0.15 ^{b}	15.34±0.50 ^{a}	15.70±0.30 ^{a}
Av. daily gain (gm)	131.67±6.10 ^{b}	170.44±5.25 ^{a}	174.44±5.82 ^{a}
Av. daily feed intake (gm)	1160±8.15 ^{b}	1202±8.05 ^{a}	1196±7.63 ^{a}
Feed conversion	8.81±0.03 ^{b}	7.05±0.08 ^{a}	6.85±0.05 ^{a}

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

Data in Table (3) revealed that increasing protein level in the diet of lambs improved digestion coefficients of dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE) and nitrogen free-extract (NFE). Highest values of digestible crude protein (DCP) and total digestible nutrients (TDN) were observed with groups fed on the diet containing high protein level compared with medium and lower protein diets.

Table 3: Effect of protein levels on the digestibility and nutritive values.

Items	Treatment		
	LP	MP	HP
Apparent digestibility (%):			
DM	65.12±1.01 ^{c}	70.15±1.20 ^{b*}	76.20±1.10 ^{a}
CP	56.59±0.86 ^{c}	68.01±0.90 ^{b}	73.15±0.73 ^{a}
CF	36.90±1.02 ^{c}	45.10±1.10 ^{b}	52.12±1.08 ^{a}
EE	68.30±1.03 ^{c}	77.05±1.55 ^{b}	84.30±1.90 ^{a}
NFE	69.60±1.56 ^{c}	75.50±1.07 ^{b}	82.13±1.44 ^{a}
Nutritive value:			
DCP	7.09±0.25 ^{c}	10.82±0.50 ^{b}	13.39±0.81 ^{a}
TDN	66.28±1.50 ^{c}	75.32±1.80 ^{b}	82.02±1.93 ^{a}

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

The biochemical parameters of blood of the different experimental groups are shown in Table (4). Total protein of blood, albumin, globulin and urea were increased with increasing protein level from low protein to high protein containing diet.

Table 4: Effect of protein levels on the blood biochemical parameters of lambs.

Items	Treatment		
	LP	MP	HP
Total protein (g/dl)	5.15±0.07 ^{b}	7.90±0.12 ^{a}	8.62±0.10 ^{a}
Albumin (g/dl)	2.56±0.03 ^{b}	3.52±0.10 ^{ab}	4.72±0.07 ^{a}
Globulin (g/dl)	2.59±0.06 ^{b}	4.38±0.05 ^{a}	3.90±0.11 ^{a}
Urea (mg/dl)	28.10±3.10 ^{b}	48.23±4.40 ^{a}	46.11±4.50 ^{a}

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

Table (5) revealed the rumen characteristics of different experimental groups. Total volatile fatty acids and ruminal ammonia nitrogen concentrations were increased in lambs fed on diets containing high protein compared with medium and low protein diets.

Table 5: Effect of protein levels on the ruminal characteristics of lambs.

Items	Treatment		
	LP	MP	HP
pH	5.75±0.09	5.80±0.14	5.76±0.10
Total VFAs (meq/100ml)	6.51±0.10 ^{c}	8.96±0.20 ^{b}	10.12±0.17 ^{a}
NH3-N (meq/100ml)	13.50±0.25 ^{c}	18.70±0.10 ^{b}	23.10±0.31 ^{a}

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

The carcass traits of lambs fed on the experimental diets are shown in Table (6). Protein content had no effect on live weight at slaughter, dressing percentage, weights of internal organs and body fat weight.

Table 6: Effect of protein levels on carcass traits of lamb

Items	Treatment		
	LP	MP	HP
No of lambs	3	3	3
slaughter weight (kg)	39.20±2.10	42.70±2.35	44.10±2.50
Hot carcass weight (kg)	20.82±1.10	22.93±1.25	23.51±1.15
Dressing (%)	53.11±0.05	53.70±0.01	53.31±0.02
Heart (%)	0.38±0.01	0.39±0.03	0.39±0.01
Kidneys (%)	0.28±0.05	0.25±0.01	0.26±0.02
Liver (%)	2.01±0.15	1.80±0.05	1.85±0.10
Lungs (%)	1.40±0.01	1.38±0.04	1.40±0.02
Internal fat (kg)	1.20±0.07	1.24±0.02	1.30±0.05

Economical evaluation:

Economical evaluation of the different experimental groups is presented in Table (7). The groups fed on the medium and high protein diets recorded the highest values in net revenue and economical feed efficiency, while the group fed on low protein diet recorded the lowest value.

Table 7: Economical evaluation of lambs performance in the different experimental groups

Items	Treatment		
	LP	MP	HP
Total feed cost (L.E)	166.00	177.42	185.19
Body weight gain (Kg)	11.85	15.34	15.70
Price of body weight gain (L.E)	177.75	230.10	235.50
Net revenue (L.E)	11.75	52.68	50.31
Economic feed efficiency (%)	7.08	29.69	27.17
Relative econ. feed efficiency (%)	100	419.35	383.76

DISCUSSION

Performance of animals:

There was a significant ($P<0.05$) difference in the feed intake between different experimental groups. The intake was increased with

increasing the level of protein from low protein to medium or high protein. Fluharty and McClure (1997) illustrated increases ($P<0.05$) in dry matter intake when the protein level was increased in lamb rations. There was significant ($P<0.05$) differences in the weight gain between different treated groups. Similar results were reported in other studies (Mahouachi and Atti, 2005). This improvement of growth may be explained by an increase of the total supply of digestible crude protein in high and medium protein levels in comparison with low protein level. However, Fluharty and McClure (1997) found increased average daily gain in growing lambs when they increased the recommended NRC protein requirement by 25%. Increasing the level of dietary protein will change the fermentation process in the rumen causing an increase in total volatile fatty acids production and a rise in the ratio of propionate to volatile total fatty acids. These changes in the rumen will improve the lamb's energy balance allowing the storage of more nitrogen and an increase in body weight (Kabir *et al.*, 2002). Increasing the protein content elevates the amino acid density and their absorption in the small intestine that subsequently improves animal growth (Pittrof *et al.*, 2006). Our result showed non significant difference in the weight gain between medium and high level of protein. Similar result was found by Ahmed and Abdellatif (1995). Consequently, the best feed conversion was obtained with medium and high protein groups compared with low protein group. Similar result was obtained by Manso *et al.* (1998). In this study there was no any further improvement in the growth when the level of protein was increased from medium to high protein level. This suggested that a level of about 14.7% 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). Devendra (1982) and Balakrishina *et al.* (1997) indicated that the increase in growth rate of lambs with increasing protein intake up to a certain level and then it declined when the protein content increased beyond 14 or 15%. On the other hand, Manso *et al.* (1998) observed that diets of higher CP contents were better taken in, presented higher average daily gain and better feed conversion. The authors attributed the increased intake to greater ruminal activity and passage rate.

Digestion coefficient of nutrients:

There was significant ($P<0.05$) increases in the apparent digestion coefficients of DM, CP, EE, CF and NFE as the level of protein increased. Similar results were obtained by Etman (1985); Krishna Mohan et al. (1987) and Kumar and Narange (1991) who found that the apparent digestibility of DM, CP, EE, CF and NFE were increased as the level of protein increased in the diet of sheep and it may be attributed to that low protein may reduce rumen function and lower the efficiency of feed utilization. Dabiri and Thonney (2004) reported that an improvement in CP digestibility by growing lambs as CP levels increased. In addition, CP digestibility levels were higher in lamb fed with higher CP levels (Kaya and Yalcin, 2000; and Dabiri and Thonney, 2004). Regarding the nutritive values of the experimental diets, DCP and TDN contents were increased linearly with increased level of protein. Similar result was obtained with Abou'l Ella *et al.* (2005).

Biochemical parameters:

There was significant ($P<0.05$) increases in the total protein, albumin and globulin as the protein level increased. Similar results were obtained by Katunguka (1997) and Hoffman *et al.* (2001) who found that the animal fed on high protein diets had significantly higher total protein, albumin and globulin than those on low protein. Urea nitrogen was increased significantly ($P<0.05$) by increasing dietary CP. The changes in serum urea levels by increasing dietary CP level are agreed with results of prior studies (Katunguka, 1997; Hatfield *et al.,* 1998; Dabiri and Thonney, 2004; Yurtman *et al.,* 2002 & Keser and Bilalt, 2008). The increase in urea nitrogen concentration that comes from increasing diet protein concentrations, is caused by an increase in rumen ammonia absorption, resulting in greater amounts of ammonia being used in the liver to synthesis urea. Therefore, urea concentration in blood reflects the ingestion of dietary protein (Thomas *et al.,* 1988).

Rumen characteristics:

The levels of protein had no significant effect on the pH of the rumen. Ammonia-N concentration and total volatile fatty acids were significantly ($P<0.05$) increased with the increase in the protein level of the diets. Similar result was obtained by Hatfield *et al.* (1998) who reported that TVFAs concentration was increased with the increasing protein level in the diet of sheep, while Ludden *et al.* (2002) found no significant effect. Febel *et al.* (2000) stated that the rumen concentration of ammonia increased in response to the rising level of protein in the diet of sheep. It is also pointed that rumen ammonia nitrogen and VFAS

levels increased by the dietary increasing CP level (Kaya and Yalcin, 2000). Kaya *et al.* (2009) found no significant difference between lambs groups in case of ruminal fluid pH and VFAS levels, but ammonia nitrogen level increased with the dietary protein levels.

Carcass characteristics:

There were no significant differences in the carcass characteristics between treated groups. These agreed with that found by Rocha *et al.* (2004); Mahouachi and Atti (2005) and Woolley *et al.* (2005) who found no significant effect for protein on carcass characteristics.

It can be concluded that optimum dietary CP level for Rahmani lambs is 14.7% because of feeding lambs with higher protein level than 14.7% had no evident advantages for performance and production.

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