EFFECT OF DIFFERENT PROTEIN LEVELS ON GROWTH PERFORMANCE, CARCASS TRAIT, DIGESTIBILITY AND SOME BLOOD BIEOCHEMICAL PARAMETERS IN AWASSI LAMBS

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ABSTRACT

Twenty one Awassi lambs (4 month old and 23.59 ± 031 kg body weight) were used to investigate the effect of different levels of protein on growth, carcass traits, body composition, digestibility and some blood parameters. The lambs were divided equally and randomly and penned individually into three treatment groups, and fed ad lib on low protein (129.1 T_1) medium protein (140.6 T_2) and high protein (151.1 T_3, g/kg DM). After 72 days of fattening, 5 lambs from each treatment were chosen randomly and slaughtered. The result showed that lambs fed on T_3 diet had significantly (P<0.05) higher daily gain (210.83 g), better feed efficiency (4.8 kg/kg), higher dressing percentage (51.67 %), and rib eye area muscle (12.05 cm^2) than those fed in T_2 and T_3, as well as digestibility coefficient of dry matter, organic matter, crude protein, and total digestible nutrient (TDN) was also numerically higher in group fed (151.1 g/kg DM) as compared with lambs received low or medium level of protein. It could be concluded that the high dietary protein level produce the better performance, carcass traits and nutrient digestion of lambs.

Keywords: protein, growth, trait, lambs, body composition , organic matter .

تأثير مستويات مختلفة من البروتين في اداء النمو, صفات الذبيحة, معامل الهظم و بعض الصفات الكيموحيوية للدم للحملان العواسية

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المستخلص

تم استخدام واحد و عشرون حمل عواسي بعمر 4 اشهر ووزن 23.59 ± 0.31 كغم, لدراسة تأثير مستويات مختلفة من البروتين في اداء النمو و صفات الذبيحة و تركيب الجسم و معامل الهضم وبعض صفات الدم الكيموحيوية. تم توزيع الحملان بصورة متساوية و عشوائية الى ثلاثة مجاميع لتتغذى على مستوى واطىء (129.1), متوسط (140.6) و عالي (151.1 غم/ كغم/ مادة جافة) وتم ايواءها بصورة فردية و كانت تقدم لها عليقة المركزة بصورة حرة. بعد مرور 72 يوم من التسمين, تم ذبح 5 حملان من كل مجموعة. تشير النتائج الى تفوق معنوى للحملان المغذاة على مستوى عالي من البروتين في معدل الزيادة الوزنية اليومية (210.83 غم). و كفاءة تحويل غذائي اعلى (4.8 كغم/ كغم) واعلى نسبة تصافي (51.67 %) ومساحة العضلة العينية (12.05 سم^2) مقارنة بالحملان التي غذيت على مستوى متوسط و واطئ من البروتين . كما تبين بأن الحملان المغذاة على مستوى اعلى من البروتين قد تفوقت على نظيراتها المغذاة على مستوى واطىء او متوسط في معامل هضم المادة الجافة, المادة العضوية, البروتين الخام, و مجموع المواد القابلة للهظم ولكن الاختلافات لم تكن معنوية. ويمكن الاستنتاج بأن اعلى مستوى من البروتين قد ادى الى زيادة اداء النمو و صفات الذبيحة و هظم المواد الغذائية.

الكلمات المفتاحية: البروتين, النمو, صفات, حملان.

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INTRODUCTION

Animal meat production efficiency can be defined as the return of salable product per unit feed input (5). In the Middle East including Iraq, 80% of the production cost of red meat from fattening lambs is attributed to feed cost (11). It is known that a number of factors affect growth performance, the quality and quantity of the carcass, as well as productivity in sheep farming, which dietary energy and protein levels and their interaction are probably considered the most important (10). Also, the amount of tissue deposited in the carcass components is largely determined by the level of protein intake and the energy available for retention in muscle (4). Studies were conducted to determine the optimum dietary crude protein (CP) level for lambs. The NRC (23) recommended 14.5% CP for weaned lambs for maximum growth rate, but Andrews and Orskov (1) indicated that maximum weight gain occurred at 17 % dietary CP. Although feeding lambs with 18% CP diet is common practice, it was observed that lambs feed 16 and 18 % CP diet had higher body weight gain and dry matter intake than lambs fed 10, 12 and 14 % CP diet, and there were no difference between lambs fed 16 and 18 % CP (10). Since the increasing cost of protein and environmental pollution due to emission of ammonia into the atmosphere from degradation of urea in extra demands the determination of optimum levels of dietary protein for animal to avoid unnecessary loss of nitrogen, optimize production and minimize costs of feed and risk of environmental pollution. Therefore the aim of this study was to investigate the effect of different dietary crude protein levels on performance, digestibility and some biochemical parameters of Awassi lambs.

MATERIALS AND METHODS

The present study was carried out at animal farm, College of Agricultural Engineering Sciences, University of Duhok, where 21 weaned Awassi ram lambs (4 month) with an average live body weight of 23.59± 0.31 kg were used. After an adaptation period of 10 days, the lambs were randomly and equally allocated and individually penned (1 ×2 m) into three treatment groups to receive ad libitum concentrate containing different level of crude protein namely 129.1 (T1), 140.6 (T2) and 151.1 (T3) g/kg/DM (Table 1). The offered concentrate was weighed daily, and the refusal was collected and weighed before morning feeding. Clean water was available constantly.

Table1. Ingredient and chemical composition of the diet

Ingredient %	T_1	T_2	T_3
Barley	60	57	53
Corn	17	17	17
Wheat bran	8	8	8
Wheat straw	3	3	3
Soybean meal	7	10	14
Urea	0.15	0.15	0.1
Oil	2.85	2.85	2.9
Salt	1	1	1
Mineral & Vitamin	0.5	0.5	0.5
Limestone	0.5	0.5	0.5
Total	100	100	100
Chemical composition[1] g/kg DM			
Dry matter	911	911.3	911.6
Organic matter	975	973.4	971.4
Ash	25	26.6	28.6
Crude protein	129.1	140.6	151.1
Ether Extract	41	41.3	42.3
Crude fiber	62.4	62.0	61.3
Nitrogen Free Extract [2]	653.5	640.8	627.5
Metabolizable Energy [3]	12.26	12.24	12.21

T_1= Treatment 1 (Low protein)
T_2= Treatment 2 (Medium protein)
T_3= Treatment 3 (High protein)
Chemical composition[1] (AOAC, 2007)
NFE[2]= 1000 - (water + Ash + CP + EE + CF).
ME[3] MJ/kg DM, (MAFF, 1975).
[(CP*0.012) + (EE*0.031) + (CF*0,005) + (NFE*0.014)]

Following 72 days of fattening, five lambs from each group were chosen randomly and slaughtered. Feed was withdrawal over might and lambs were slaughtered according to muslim (Halal) way by severing the throat and major blood vessels in the neck. Immediately after skinning was completed, non- carcass components such as head, skin, feet, liver, spleen, heart, lung with trachea and testes were weighed. Dressed carcass was weighed within 1 h. The gastro- intestinal tract was weighed, and then emptied of their content, washed and re-weighed to facilitate calculation of empty body weight by subtracting the weight of gut content from slaughter weight. Also weight of

omental, mesenteric and cardiac fat was recorded.

Carcass measurements

After chilling the carcass at 4^{o} c for 24h, cold carcass was weighed and kidney and pelvic fat was weighed separately. The carcass was split along the vertebral column into two halves, using an electrical saw. The right half was separated into eight whole sale cuts. The cross-sectional area of L.dorsi muscle between 12 and 13 ribs was traced of the cutting and the area was subsequently measured by digital planimeter. Fat thickness over the midpoint of L. dorsi muscle was measured by using Caliper device.

Physical dissection

All whole cuts of the right half carcass were dissected completely into lean, fat and bone. The three components were weighed separately to determine their percentage. Non-carcass fat is the sum of the omental, mesenteric, pelvic, kidney and cardiac fat. Carcass fat including subcutaneous and intramuscular fat was separated from each cut and weighed.

Apparent digestibility

To measure digestibility, 3 lambs from each group were placed in individual pens (1×2 m) at the end of last week of experiment. Total fecal output was determined for 7- days. Feces from each animal were weighed daily and a sample (10%) was taken and frozen, and later was analyzed according to AOAC (2).

Statistical analyses

The experiment was designed by complete randomized design CRD. Data was analyzed statistically using general linear model procedures within SAS (30). Duncan (8) multiple range test was used to test differences between treatments.

RESULTS AND DISCUSSION

Growth performance

Data related to growth performance in term of initial, final and daily gain in weight of Awassi lambs maintained on three different protein levels are demonstrated (Table 2). It appears that lambs fed high levels of protein (T_3) had significantly ($P\leq0.05$) highest in weight gain (210.83 g), more dry matter intake (882.06 g) and better ($P\leq0.05$) efficient of feed conversion (4.18) than lamb fed low (T_1) and medium (T_2) protein level. Such increases in body gain could be due to the animals deposit more protein in their body during early growth, which indicates that they can utilize rations with higher protein levels (26). Increased efficiency of FCR was a result of increased intake above maintenance and possibly increased organic matter digestibility (22). Or may be this result is due to the highest bioavailability of nutrient by balanced energy and protein levels on the treatments (13). This finding is in accordance with those reported in sheep (10, 29), as well as in goat (2, 22, 13, 27).

Table 2. Effect of different protein level on animal performance

Trait	Over all mean	T_1 Low protein 129.1 g/kg DM	T_2 Medium protein 140.6 g/kg DM	T_3 High protein 151.1 g/kg DM
Initial wt./ kg	23.59 ± 0.31	23.66 ± 0.59	23.50 ± 0.59	23.62 ± 0.56
Final Wt./ kg	35.87 ± 0.89	32.12 ^{b} ± 0.40	36.70 ^{a} ± 1.12	38.80 ^{a} ± 1.03
Total gain/ kg	12.28 ± 0.87	8.46 ^{b} ± 0.95	13.20 ^{a} ± 0.88	15.18 ^{a} ± 0.60
Daily gain/ g	170.55 ± 12.13	117.50 ^{b} ± 13.28	183.33 ^{a} ± 12.22	210.83 ^{a} ± 8.44
Total DMI/ kg	61.19 ± 2.00	58.19 ± 1.24	61.87 ± 5.39	63.51 ± 2.77
Daily DMI/ g	849.88 ± 27.80	808.19± 17.36	859.38 ± 74.94	882.06 ± 38.52
FCR kg/kg	5.41 ± 0.47	7.23 ^{a} ± 0.79	4.81 ^{b} ± 0.62	4.18 ^{b} ± 0.08

Carcass traits

In the present study, results related to carcass traits of feeding Awassi lambs under three different protein levels are summarized in Table 3. It appears that lambs received high protein level had significantly ($P\leq0.05$) heaviest slaughter weight (38.80 Kg), carcass weight (20.02 kg), dressing percentage based on slaughter weight (51.67 kg) and empty body weight (57.11 kg) than those fed low (T_1) and medium (T_2) protein levels. Such increase could be due to higher growth rate attained by lambs maintained on high level of protein as a result of lambs responding well to the level of crude protein. Or such result could be attributed to higher slaughter weight (19) as a result of higher muscle mass (16), which contribute to observed gain in lean mass (32). Similar finding was noticed in sheep (33), in goat (6), and in cattle (9 and 18).

Table 3. Effect of different protein level on carcass trait

Trait	Over all mean	T_1 Low protein 129.1 g/kg DM	T_2 Medium protein 140.6 g/kg DM	T_3 High protein 151.1 g/kg DM
Slaughter weight/ kg	35.87 ± 0.89	32.12 ^{b} ± 0.40	36.70 ^{a} ± 1.12	38.80 ^{a} ± 1.03
Hot carcass weight kg	17.50 ± 0.58	15.02 ^{c} ± 0.38	17.46 ^{b} ± 0.45	20.02 ^{a} ± 0.37
Cold carcass weight kg	17.29 ± 0.57	14.85 ^{c} ± 0.39	17.27 ^{b} ± 0.47	19.76 ^{a} ± 0.30
Shrinkage percentage	1.18 ± 0.13	1.16 ± 0.12	1.10 ± 0.27	1.29 ± 0.29
Dressing % (slaughter wt.)	48.68 ± 0.68	46.76 ^{b} ± 0.75	47.61 ^{b} ± 0.43	51.67 ^{a} ± 0.87
Dressing % (EBW wt.)	53.68 ± 0.74	51.48 ^{b} ± 0.62	52.44 ^{b} ± 0.51	57.11 ^{a} ± 0.74
Rib eye area cm^2	10.60 ± 0.38	9.05 ^{c} ± 0.43	10.71 ^{b} ± 0.32	12.05 ^{a} ± 0.33
Fat thickness mm	0.15 ± 0.007	0.14 ± 0.01	0.14 ± 0.01	0.17 ± 0.003

Values of $^{a, b, c}$ on the same row with different letters are significant different (P≤0.05).

Carcass composition

Carcass side of Awassi lambs fed diet of different protein levels are demonstrates in Table 4. The proportion of separable tissue indicates that lambs fed high protein levels in T_3 are numerically leaner and fatter compared to those fed low or medium level of protein. Moreover, the higher ratio of lean to fat and lean to bone was also recorded in T_3 compared with T_2 and T_1. These results agree with those found in sheep and goats (7, 13, 20, 24, 28).

Table 4. Effect of different protein level on carcass composition

Trait	Over all mean	T_1 Low protein 129.1 g/kg DM	T_2 Medium protein 140.6 g/kg DM	T_3 High protein 151.1 g/kg DM
Lean	57.48 ± 0.77	56.94 ± 0.65	57.65 ± 1.29	57.85 ± 2.03
Fat	20.72 ± 0.95	20.16 ±1.41	20.92 ± 1.55	21.07 ± 2.23
Bone	21.82 ± 0.54	22.88 ± 1.07	21.41 ± 0.98	21.18 ± 0.77
Lean : fat ratio	2.88 ± 0.16	2.87 ± 0.19	2.84 ± 0.28	2.93 ± 0.42
Lean : bone ratio	2.66 ± 0.07	2.53 ± 0.08	2.71 ± 0.14	2.74 ± 0.13

Values of $^{a, b, c}$ on the same row with different letters are significant different (P≤0.05).

Carcass and non-carcass fat

One of the most variable tissues in the carcass its fat, the proportion and location of fat in the body are important in meat animal (34). Data related to the weight of total fat, weight of carcass fat and weight of non-carcass fat are shows in Table 5. It appear that the amount of the fat deposited in the lambs fed high protein level in (T_3) is higher (1.58 kg) than other two group fed medium (1.47 kg) or low (1.21 kg), while the relative contribution of carcass and non-carcass fat to the total body fat was very little and statistically did not significant.

Table 5. Effect of different protein level on carcass and non- carcass fat

Trait	Over all mean	T_1 Low protein 129.1 g/kg DM	T_2 Medium protein 140.6 g/kg DM	T_3 High protein 151.1 g/kg DM
Wt. carcass fat/ kg	1.42 ± 0.09	1.21 ± 0.09	1.47 ± 0.14	1.58 ± 0.19
Wt. non- carcass fat/ kg	0.91 ± 0.04	0.79 ± 0.02	0.95± 0.09	0.99 ± 0.05
Wt. fat tail/ kg	2.32 ± 0.15	1.97 ± 0.04	2.41 ± 0.31	2.58 ± 0.31
Total body fat/ kg	4.65 ± 0.24	3.97 ± 0.11	4.84 ± 0.43	5.14 ± 0.48
Non- carcass fat %	19.92 ± 0.91	19.96 ± 0.95	19.85 ± 1.67	19.96 ± 2.24
Carcass fat %	30.39 ± 1.03	30.24 ± 1.59	30.53 ± 1.80	30.39 ± 2.33
Fat tail %	49.68 ± 1.20	49.79 ± 0.83	49.61 ± 3.28	49.64 ± 1.94

Apparent digestibility

It seems from the results show in Table 6, that dry matter digestibility (74.58, 79.76 and 79.56 %), organic matter digestibility (78.33, 82.21 and 82.14 %) and crude protein digestibility (62.47, 68.99 and 70.74 %) of the three dietary crude protein levels in T_1, T_2 and T_3 respectively, were not different significantly, but their values was increased by increasing protein levels. The higher crude protein digestibility for the lambs that fed 151g/kg DM in T_3 could be attributed to the highest CP level resulted in an increase the population growth and total activity of rumen

microbes and fermentation (31). These results agree with those found by other workers (6, 14, 25). Similarly total digestible nutrient (TDN) of T_1, T_2 and T_3 averaged respectively 72.24, 75.59 and 75.47 %, and the differences among them did not significant. Also it was noticed that the effect of level of protein on the apparent digestibility of fiber as well as either extract lacked significance. Similar result was obtained by other investigation (3, 25).

Table 6. Effect of different protein level on apparent digestibility

Digestibility Coefficient %	Over all mean	T_1 Low protein 129.1 g/kg DM	T_2 Medium protein 140.6 g/kg DM	T_3 High protein 151.1 g/kg DM
Dry matter	**77.97 ± 2.14**	**74.58 ± 2.05**	**79.76 ± 4.25**	**79.57 ± 4.92**
Organic matter	**80.89 ± 1.74**	**78.33 ± 1.59**	**82.21 ± 3.54**	**82.14 ± 4.05**
Crude protein	**67.40 ± 3.35**	**62.47 ± 2.91**	**68.99 ± 6.82**	**70.74 ± 7.80**
Crude fiber	**30.61 ± 3.20**	**32.19 ± 5.75**	**29.72 ± 4.43**	**29.91 ± 8.27**
Ether extract	**68.41 ± 1.91**	**67.89 ± 1.52**	**68.87 ± 3.75**	**68.45 ± 5.23**
Nitrogen free extract	**88.45 ± 1.54**	**85.54 ± 1.06**	**89.97 ± 3.57**	**89.85 ± 2.90**
TDN	**74.43 ± 1.63**	**72.24 ± 1.53**	**75.59 ± 3.27**	**75.47 ± 3.91**

Values of [a, b, c] on the same row with different letters are significant different (P≤0.05)

Blood parameters

The results related to concentrations of serum biochemical (glucose, total protein, albumin, globulin, cholesterol, triglyceride and urea) of Awassi lambs fed three different protein levels are shows in Table 7. It seems that no significant effects was observed in all parameters. However, blood urea increased by increasing protein level but the increase was not significant. Similar results have been reported by other researchers (12, 15, 21, 29, 34, 35).

Table 7. Effect of different protein level on blood parameters

Items	Over all mean	T_1 Low protein 129.1 g/kg DM	T_2 Medium protein 140.6 g/kg DM	T_3 High protein 151.1 g/kg DM
Glucose mg/dl	**66.00 ± 1.65**	**65.00 ± 3.01**	**66.40 ± 2.82**	**66.60 ± 3.37**
Total protein g/dl	**5.74 ± 0.12**	**5.82 ± 0.21**	**5.66 ± 0.14**	**5.76 ± 0.28**
Albumin g/dl	**2.38 ± 0.07**	**2.38 ± 0.12**	**2.30 ± 0.11**	**2.48 ± 0.15**
Globulin g/dl	**3.36 ± 0.15**	**3.44 ± 0.32**	**3.36 ± 0.05**	**3.28 ± 0.38**
Cholesterol mg/dl	**58.33 ± 2.35**	**57.00 ± 3.72**	**59.40 ± 5.64**	**58.60 ± 3.41**
Triglyceride mg/dl	**34.40 ± 2.63**	**33.80 ± 3.72**	**34.60 ± 2.46**	**34.80 ± 7.27**
Urea mg/dl	**14.33 ± 0.73**	**12.80 ± 0.48**	**14.80 ± 1.68**	**15.40 ± 1.288**

CONCLUSION

It could be concluded that Awassi lambs can be finished on diet containing 151.1 g/kg DM to achieve better performance, carcass traits and digestion of nutrient.

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