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Effects of Different Dietary Energy and Protein Levels at Fixed Slaughter Weight on Performance and Carcass Characteristics of Arabi Fattening lambs

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Abstract

Forty eight Arabi fattening lambs with similar initial weight (18.72 ± 0.604 Kg) and age (90 ± 5 day) from a flock of Arabi sheep of Ramin Agricultural and Natural Resources University werer andomly allocated to six dietary treatments in a 2 × 3 factorial experiment using completely randomized design. The treatments included low (EL=2.4 Mcal/KgDM ME), medium (EM=2.6 Mcal/KgDM ME) and high (EH=2.8 Mcal/KgDM ME) levels of dietary energy in combination with low (PL=16% cp) and high (PH=18% cp) levels of dietary protein. The body weight (BW), average daily gain (ADG), average daily feed (ADF) and feed conversion ratio (FCR) of lambs were measured two weeks interval until the end of experiment. Carcass components were recorded at the end of trial. The ADG of lambs in EH, EM and EL treatments were respectively 271, 244 and 206 g/d and differences between them were significant ($p<0.05$). The same trend was found for feed efficiency. The ADG was also significantly greater ($p<0.05$) for lambs fed diets containing 18% protein than for lambs fed diets containing 16% protein (254 vs. 216 g/d). The FCR also had the same trend (4/47 vs. 5/37). The differences for other traits for dietary containing different Energy and Protein levels was not significant. The interactions between protein and energy treatment levels were not significant for none of traits. In general, with increasing level of energy the performance of lambs particularly for ADG and FCR was improved for either of protein levels. The lowest ADG (150 g/d) and worst FCR (6/36) was belong to the treatment containing the lowest energy and protein levels and differences between them and other treatments were significant ($p<0.05$).

Keywords: Dietary energy and protein levels; Performance; Carcass traits; Fattening lambs

Introduction

Many studies have been conducted to determine the effects of varying protein and energy levels in the diet on performance in lambs [1-9]. In general, average daily gain increased and feed efficiency was improved as protein and energy levels in the diet were increased. Most studies are in agreement that feed intake increased with increasing protein levels and decreased with increasing energy levels [10]. Several works on the effect of energy levels in the diet on lamb performance and carcass measurements has been conducted [5,6,9,11-14]. Most researchers were in agreement that increasing energy levels in the diet usually resulting greater gain and fat deposition. The same trend of fat deposition results was found by previous experiments with the Arabi lambs in similar condition and environment [15,16]. For this reason this trial designed to find a solution for this disadvantage despite high growth rate of lambs in previous studies. It was hypothesized that fat deposition/carcass composition may change less in fixed slaughter weight compared with above mentioned studies.

Compared with energy, less work has been carried out to study the effect of dietary protein levels on lamb carcass composition [9,17,18]. In general daily gain are increased by increasing protein level which part of this superiority are due to more by- pass protein [19], but such changes was not found for fat deposition. Adjusting protein and energy levels in the diet in order to produce high quality lamb carcass more efficiently and economically could be very beneficial to the lamb producer [10]. It may also be possible to alter body composition by varying protein and energy levels in the diet [10]. Altering the diet to produce more efficient, leaner, faster growing lambs would be beneficial to the producer and make lamb more acceptable to the consumer [17].

The present study was conducted the effects of different levels protein and energy and to determine their interaction at fixed slaughter weight on performance and carcass traits of Arabi fattening lambs.

Material and Method

Animal and management: Forty eight male lambs with similar conditions (18.72 ± 0.604 Kg body weight and 90 ± 5 days of age) from autumn lambing of Arabi sheep flock of the Ramin Agricultural and Natural Resources University were used in this study. The fattening lambs were randomly allocated to six dietary treatments in a 2 × 3 factorial experiment. The treatments included low (EL=2.4 Mcal/kgDM ME), medium (EM=2.6 Mcal/kgDM ME) and high (EH=2.8 Mcal/kgDM ME) levels of dietary energy in combination with low (PL=16% cp) and high (PH=18% cp) levels of dietary protein. Ingredient of the diets is presented in Table 1.

The animals were treated against ecto and endo parasites. At the end of the adaptation period, the lambs were individually weighted and grouped according to live weight into six equal groups of an average 18.75 Kg each. Each group was penned separately. The pen were provided with feed and water troughs, in addition to salt-lick blocks.

The lambs were fed ad libitum and were weighted bi-weekly. Kilograms of feed offered per pen were recorded. Refused feed was removed each week, weighted and discarded. The BW, ADG, ADF and FCR of lambs were measured two weeks interval until the end of experiment.

Carcass traits: When the lambs approached weights of 36 Kg, three

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Ingredient	P_L			P_H		
	E_L	E_M	E_H	E_L	E_M	E_H
Corn	10	10	16.5	6	13	18
Alfalfa hay	3	2.5	2	5	3	3
Sugar beet pulp	10	7	5	13.5	8	4
Barley	25	33	40.2	23	28	38.3
Pith	22	22	15	23	22	15
Bran wheat	4	8	7	10	10	6
Salt	0.9	0.5	0.5	1	0.2	0.5
Supplement (v + m)	1	1	1	1	0.8	1
straw	7	2	-	-	-	-
Limestone	1	1	0.5	1	0.5	0.4
Urea	1.1	1	0.8	1.5	1.5	1.4
Bicarbonate sodium	1	-	0.5	1	-	0.4
Soybean meal	14	12	11	14	13	12
Total	100	100	100	100	100	100

Table 1: Ingredients of experimental diets (DM basis).

lambs for each treatment were slaughtered. The lambs were held 18 hr without feed and slaughtered. After dressing and storing for 24h at 3°c, carcasses were weighted according to guidelines of Iranian standard and industrial research institute and sectioned into two symmetric halves. The right half was divided into the cuts: neck + proximal thoracic limb + steaks + brisket, lumbar + abdominal region, proximal pelvic limb, and weights of each cut were recorded. The weights of carcass meat, bone and fat were measured separately.

Statistical analysis: Differences between dietary treatments were analyzed as a factorial design using the general linear models (GLM) procedures SAS® [20]. The model included the effect of energy level, protein level and the interaction term energy × protein level.

Results and Discussion

The effects of protein levels

Least squares means and standard errors for the effect of dietary protein level on performance and carcass characteristics are presented in Table 2. With the exception of average daily gain, dietary protein level in the diet did not significantly affect any of the performance and carcass characteristics studied. Lambs fed the diets containing 18% protein had final body weight greater than did lambs fed the diets containing 16% protein. Average daily gain was significantly greater ($p<0.05$) for lambs fed diets containing 18% protein than for lambs fed diets containing 16% protein. Most works are in agreement that average daily gain increases with increasing protein levels [1-4,9,19-22]. Total feed conversion ratio (4.47 vs. 5.37) of fattening lambs fed the diets containing 18% protein were significantly lower than lambs fed diets containing 16% protein. In Hinds et al. [2]; Huston and Shelton [23] and Ebrahimi, et al. [9] have reported improved feed efficiencies with increasing protein levels. Average daily feed amounts of the lambs fed diets containing 16% protein were no significantly lower than other groups. This is not in agreement with work by Andrews and 0rskov [4] and Craddock, et al. [17], while results of present study are similar to research by Fiems, et al. [18] and Dabiri and Tonney [8]. It is known that low dietary protein levels may reduce animal performance [8,22,23].

No significant differences in carcass composition or quality characteristics were noted due to protein levels. Slaughter weight, hot carcass weight and dressing percentage were slightly influenced by the protein level. The higher hot carcass weight of the PH group was mainly a result of the influence of the protein on live weight at slaughter as mentioned in Table 2, and to a smaller extent the result of the influence of the protein level on the dressing percentage. In Reid et al. [24] stated that diet has very little effect on carcass composition when lambs are slaughtered at a constant weight.

Variable	P_L	P_H
Performance:		
Initial weight (kg)	18.75 ± 0.473[a]	18.71 ± 0.475[a]
Average daily feed (g/day)	1160 ± 40	1134 ± 110
Average daily gain (g)	216 ± 13[b]	254 ± 12[a]
Feed conversion ratio	5.37 ± 0.208[a]	4.47 ± 0.203[b]
Final weight (kg)	35.48 ± 0.724[a]	36.12 ± 0.875[a]
Carcass traits:		
Slaughter weight (kg)	33.66 ± 0.54[a]	34.37 ± 0.482[a]
Hot carcass weight (kg)	16.34 ± 0.349[a]	17.14 ± 0.281[a]
cold carcass weight (kg)	15.67 ± 0.277[a]	15.78 ± 0.185[a]
Dressing percentage	48.59 ± 0.901[a]	49.94 ± 0.908[a]
Meat%	51.36 ± 1.075[a]	52.39 ± 0.914[a]
Fat%	25.03 ± 1.236[a]	24.52 ± 0.934[a]
Bone%	24.92 ± 0.625[a]	25.31 ± 0.917[a]

Table 2: Influence of dietary protein level on performance and carcass characteristics. [a,b]Means in row with different superscripts different significantly ($p<0.05$).

The effects of energy levels

The effect of the different energy levels on performance and carcass characteristics were shown Table 3. With the exception of average daily gain and feed efficiency, energy level in the diet did not significantly affect any of the performance and carcass characteristics studied. The carcass result, particularly fat is agree with Reid et al. [24] who stated that diet has very little effect on carcass composition when lambs are slaughtered at a constant weight. Energy was however an important factor affecting feed intake and feed conversion ratio. Average daily feed were non- significantly greater for the lambs fed the diet containing low energy level than did other groups. As per Montgomery and Baumgardt [25], Noble et al. [12], Glimp [5] and Craddock, et al. [17] also found that lambs fed higher energy levels in the diet consumed less the total feed. Feed conversion ratio were significantly lower for lambs fed diet containing high energy level than for lambs fed diet containing medium and low energy levels. These results agree with those of and Craddock, et al. [17], Fiems, et al. [18], Mohamed [26], Ahmed [10] and Ebrahimi, et al. [9], who reported that feed intake and feed conversion ratio decreased as energy levels in the diet increased. In agreement with results of Fiems et al. [19]; Ahmed [10] and Ebrahimi,

et al. [9], average daily gain of fattening lambs fed the diet containing high energy level were significantly greater ($p<0.05$) than other groups.

The energy level had no significant influence on final weight, but lambs fed the diets containing high energy level had greater final weight than did fattening lambs fed the diets containing two level of energy. This is in agreement with study by Fiems, et al. [18] and Ahmed [10].

No significant differences of the energy level on the carcass composition or quality characteristics were found. The obtained results in this study are in agreement with work by Craddock, et al. [17]. Hot carcass weight, dressing percentage and meat percentage were greater but not significantly so in lamb group fed high energy level in their diets than those in other treatment groups. However there was an influence of energy on the proportion of fat in the carcass while the proportion of meat in the carcass only tended to be influence by energy [18].

The interactions of protein × energy

The interactions of the protein × energy levels on performance fattening lambs were shown in Table 4. The interactions between protein and energy treatment levels were not significant for none of traits. In general, with increasing level of energy the performance of lambs particularly for ADG and FCR was improved for either of protein levels. The lowest ADG (150 g/d) and worst FCR (6/36) was belong to the treatment containing the lowest energy and protein levels and differences between them and other treatments were significant ($p<0.05$) (Table 4).

In compatible with the result of Reid et al. [23] who stated that diet has very little effect on carcass composition when lambs are slaughtered at a constant weight, carcass results/fat in this study was not affected by treatments, but was non- significantly higher in lambs had highest energy and protein compared with lambs had lowest energy and protein levels (data was not shown). It looks like that both protein levels was enough for optimum growth performance of lambs and probably energy levels was the only factor for changing performance of lambs in this experiment. The same result was obtained by Ebrahimi, et al. [9]. As per Dabiri and Tonney [8] in an experiment on growth of lambs after weaning similar to this experiment with diets containing high energy level resulted that the performance of lambs was superior for both levels of protein 15 and 17% compared with 13% protein level [27].

Variable	E_L	E_M	E_H
Live traits:			
Initial weight (kg)	19.06 ± .609^a	18.84 ± 0.627^a	18.78 ± 0.518^a
Average daily feed (g/day)	1205 ± 90^a	1180 ± 30^a	1091 ± 100^a
Average daily gain (g)	206 ± 11^c	244 ± 17^b	271 ± 9^a
Feed conversion ratio	5.86 ± 0.302^c	4.84 ± 0.366^b	4.03 ± 0.177^a
Final weight (kg)	35.44 ± 1.079^a	35.37 ± 0.925^a	37.55 ± 0.839^a
Carcass traits:			
Slaughter weight (kg)	34.68 ± 0.498^a	33.72 ± 0.819^a	33.63 ± 0.531^a
Hot carcass weight (kg)	16.47 ± 0.426^a	16.70 ± 0.479^a	17.07 ± 0.363^a
cold carcass weight (kg)	15.45 ± 0.195^a	15.97 ± 0.349^a	15.75 ± 0.285^a
Dressing percentage	47.47 ± 0.975^a	49.55 ± 0.974^a	50.78 ± 1.087^a
Meat%	51.64 ± 1.49^a	53.01 ± 0.754^a	53.36 ± 1.83^a
Fat%	24.65 ± 0.816^a	24.72 ± 1.464^a	26.45 ± 1.861^a
Bone%	25.74 ± 0.705^a	25.11 ± 0.732^a	24.49 ± 0.461^a

Table 3: Influence of dietary energy level on performance and carcass characteristics. $^{a\text{-}c}$Means in row with different superscripts different significantly ($p<0.05$).

Variable		P_L			P_H		SE
	E_L	E_M	E_H	E_L	E_M	E_H	
Average daily feed (g/day)	960	1110	1270	1030	1180	1200	98
Average daily gain (g)	150^d	210^c	300^a	182^c	260^b	320^a	15
Feed conversion ratio	6.36^a	5.30^{ab}	4.30^{bc}	5.65^a	4.53^{bc}	3.75^c	0.397
Final weight (kg)	33.98^c	35.54^{bc}	36.96^{ab}	34.54^{bc}	36.20^{ab}	38.14^a	1.34

Table 4: Effect of interactions of protein × energy on performance and carcass traits. $^{a\text{-}c}$Means in row with different superscripts different significantly ($p<0.05$).

Conclusion

Lambs fed diets containing both 16 and 18% protein levels with highest energy level (2.8 Mcal/kgDM) gained faster and required less feed per (gr) of gain compared with other groups. Thus, it is recommended that, using of diets containing 16% protein and high energy level would be useful for performance and carcass characteristics of fattening lambs in similar conditions.

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