Global Veterinaria 7 (5): 506-511, 2011
ISSN 1992-6197

Effect of Dietary Metabolizable Energy and Crude Protein on Feed Intake, Carcass Traits and Mohair Production by Markhoz (Iranian Angora) Male Kids

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Abstract: The present work was conducted to find out the effect of different levels of metabolizable energy (ME) and crude protein (CP) on feed intake, carcass traits and fleece characteristic of Markhoz (Iranian Angora) kid goats. Fifty four male kids were used in a completely randomized design with 3×3 factorial experiment and given different diets for 98 d. Results showed that, the effects of dietary ME and CP level on body weight changes, average daily gain (ADG), dry matter intake (DMI) and feed conversion ratio (FCR) were statistically significant ($P<0.05$). The higher supply of dietary energy and protein resulted in heavier ($P < 0.05$) slaughter BW, empty BW, hot carcass weight and higher ($P < 0.03$) dressing percentage than lower dietary nutrient concentrations. Increasing dietary energy and protein increased ($P<0.05$) fiber length and fiber diameter but had little effect on greasy fiber weight, fiber strength and fiber efficiency. In conclusion, it could be said that dietary nutrients concentration has a main role in increasing mohair fiber and particularly meat production by Markhoz kid goats.

Key words: Feed Conversion Ratio · Mohair Fiber · Carcass Traits · Markhoz Kids

INTRODUCTION

Goats provide meat, milk and (or) fiber to a great number of world people and there are many different types of the goats which are used for a variety of purposes [1]. Markhoz goat is well known as a specifically bred for the production of mohair needed by the textile industry. The meat-yield potential as well as milk production by Markhoz goats is not greatly considered. Sahlu [2] reported that, Angora goats are the highest fleece-producing ruminant on a body weight basis and have high nutritional requirements due to their rapid hair growth. A poor quality diet will curtail mohair development. Previous researches indicated that fleece characteristics of Angora goat show important variation according to the age at shearing [3], feed intake [4], dietary energy [5] and protein [6- 8]. In contrast to other livestock species, the effects of nutrition on mohair and particularly carcass traits of Angora goats have received limited research attention. Hence, the need for establishing accurate nutrients (ME and CP) requirements and to evaluate the effects of different levels of dietary energy and protein intakes on mohair and carcass characteristics of male Markhoz kid goats was the main aim of the present study.

MATERIALS AND METHODS

Animals and Management: The current experiment was carried out at the Saqqez Animal Breeding Research Institute, during 2002 to 2003. Fifty four male Markhoz goat kids aged 4 months and weighing 18.19 ± 3kg BW were selected for the feeding trial during 98 days (adaptation: 14 d and experimental period: 84 d). The animals were then allotted randomly to nine treatments. At the beginning of the experiment, all goats were treated with an effective anathematic and vaccinated against enterotoxaemia. Kids were housed in individual metal-mesh cages (1.5×1.0 m) and given ad libitum access to standard completely mixed diets (Table 1) throughout the study. Animals also, had free access to drinking water, limestone and salt at all times. Animal pens were cleaned weekly and the kids weighed monthly on two consecutive days (before morning feeding) for monitoring body weight

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Table 1: Experimental diets differing in ME and CP ratio fed in male goat kids

	Feeding treatments (diets)								
Item	1	2	3	4	5	6	7	8	9
Ingredients (% of DM)									
Alfalfa hay	19.0	36.0	48.0	20.5	30.0	37.0	16.5	22.0	28.00
Wheat straw	44.0	36.5	28.0	35.0	22.0	22.0	26.0	20.0	16.00
Barley grain	35.0	26.0	19.5	43.0	39.5	34.0	56.0	55.0	47.00
Cottonseed meal	0.0	0.0	3.2	0.0	0.0	5.5	0.0	1.0	7.36
Limestone	1.0	1.0	0.8	1.0	1.0	1.0	1.0	1.0	1.00
Salt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.50
Chemical compositions									
ME (Mcal/kg)*	2.1	2.1	2.1	2.3	2.3	2.3	2.5	2.5	2.50
CP (%DM)	8.0	10.0	12.0	8.0	10.0	12.0	8.0	10.0	12.00
NDF (%DM)	51.5	53.3	52.6	45.5	40.0	43.8	37.2	35.1	35.80
ADF (%DM)	22.3	24.6	26.0	20.4	21.3	22.0	17.3	17.3	18.00
Ash (%DM)	9.7	9.4	8.1	8.7	8.6	9.2	8.4	9.2	9.00

*ME= metabolizable energy; calculated according to NRC (1981)

CP, crude protein; NDF, neutral detergent fiber; ADF, acid detergent fiber

gain. All animals taken into this study received equal management and the kids maintained good health throughout the study.

Feeds and Experimental Diets: Nine diets contained different levels of CP (8, 10 and 12 percent) and ME (2.1, 2.3 and 2.5 Mcal/kg DM) were fed to experimental animals for 12 weeks. The diets were prepared according to the NRC, [9] guidelines and offered as total mixed rations twice daily, at 7:00 and 16:00 h, to ensure 10% refusal each day (as-fed basis). Ingredients and chemical compositions of the diets are presented in Table 1. Cottonseed meal and barley grain were used in diet as protein and energy supplements, respectively.

Data Collection and Laboratory Analyses: Daily feed intake was monitored on individual goats and any refusals were taken into account, weighed and sub sampled for later analysis. The diet and refusal sub samples were ground through a 1.0 mm screen then analyzed for DM (using oven drying at 100°C), CP (N × 6.251) and ash (combustion at 550°C for 6 h) according to standard procedures [10]. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) was determined as described by Van Soest [11]. At the end of the experimental period, goats were shorn and greasy fleece weight was determined just after shearing. A fleece sample (10 × 10-cm areas) from the mid side was meticulously sheared and bagged separately in moisture proof- plastic bags and taken to the Wool Laboratory for length (Hauteur and Barbe length items) and diameter analysis. The sub samples were prepared for measurement with the projection microscope technique in accordance with ASTM, [12] short - section procedure to determine fiber diameter, as well was paralleled in fibro liner component of Almeter 100 (Peyer Texlab FDA 200 Siegfried Peyer Ltd. Ch- 8832 Wollerau - Switzerland), to determine the Simi rigid Hauteur and Barbe length. The staple strength of sub sampled fleece was determined using an Agritest Staple Breaker System (Agritest Pty, Sydney, Australia) as the maximum load (Newtons) needed to break a staple.

Carcass Characteristics: At the end of the feeding trial (14d adaptation and 84d experimental period), half of the animals (3 kids/each treatment) were withheld for water and feed after an overnight period and slaughtered (according to Farid, [13] procedures) the next morning after weighing. The abdominal fat was removed and measured then warm carcass weighed immediately after dressing and removal of the offal parts. Over and above, subcutaneous fat thickness was measured by caliper. The carcasses were split sagittally, weighed and taken for cooling in a cold storage chamber (from 2 to 4°C) for 24 hours. The left sides were quartered between the 12th and 13th ribs. At first subcutaneous fat and bone were physically separated from each quarter and the residual (e.g. lean and intramuscular fat) analyzed for moisture, crude protein, ether extract and ash according to AOAC, [10] method.

Experimental Design and Statistical Analysis: 54 male kids (aged 4 months, 18.19 ± 3kg BW) in completely randomized design with a 3 × 3 factorial arrangement were used to evaluate the effects of feeding diets containing different levels of CP and ME. The kids were assigned randomly to each of the nine treatments (n= 6 kids per each treatment) and fed with experimental diets for 98 d. The collected data were subjected to statistical analysis using the PROC GLM procedure of SAS, [14] (SAS Inst. Inc., Cary, NC). Level of significance was α=0.05 and the Duncan test was used to compare differences between treatments. The model used for this analysis was:

$$\hat{Y}_{ijk} = \mu + E_i + P_j + E_j \times P_k + \Sigma e_{jk}$$

Whereas Y is the dependent variable; ì is the overall mean; E is the effect of energy level (i= 2.1, 2.3 and 2.5 Mcal ME /kg DM); P is the effect of protein level (j= 8, 10 and 12 percent of CP); $E_j \times P_k$ is the interaction effect of energy and protein and Σ is the random residual error term.

RESULTS AND DISCUSSION

Feed Intake, BW Changes and Feed Conversion Ratio: Mean values of dry matter intake (DMI), average daily gain (ADG), initial and final body weight (BW) and feed conversion ratio (FCR, i.e., kg feed/kg BW) of animals fed experimental diets are presented in Table 2. The effects of diet was statistically significant (P<0.05) on final BW, ADG and DMI. The average DM intake (p<0.05) as well as ADG (p<0.05) of the goats increased with increasing dietary ME and CP levels. Goats fed diet containing 2.5 Mcal ME and 12% CP showed the highest amounts of ADG (104 g), DMI (864g/d) with lowest FCR (8.67), which was reflected in to the greater (P<0.05) final BW than other diets.

Our observations are supported by some findings [15- 19], which suggested that, DMI in company with ADG of the experimental animals increased linearly as dietary ME or CP level increased. In contrast with current results, others [20, 21] have reported a decrease in DMI when dietary CP was increased.

Average initial BW of the goats was 18.25 kg and the final BW was 25.51 kg (Table 2). Differences in initial BW was not substantial, but final BW affected significantly (p<0.05) by feeding treatments and increased accompanied by increase of dietary ME and CP concentration. These differences are most likely attributable to different in chemical components of the experimental diets and also, varying in amount of DM intake between treatments.

Fleece Characteristics: Influence of diets differing in ratio of ME and CP on mohair fiber characteristics are shown in Table 3. As a result, fiber diameter and fiber length (Hauteur and Barbe length) was affected significantly (P<0.05) by dietary nutrient concentration

Table 2: The interaction and individual effects of diets differing in ME and CP ratio on BW change, ADG, DM intake and FCR in male goat kids

	Feeding treatments (diets)										
Item	1	2	3	4	5	6	7	8	9	SEM	P
Interaction effects of dietary ME and CP levels											
Body weight, (kg)											
Initial	18.43	18.11	18.33	18.77	17.58	18.08	18.53	17.78	18.07	0.14	0.41
Final	23.7^{b}	24.4^{b}	24.7^{ab}	25.4^{ab}	25.8^{ab}	26^{ab}	26.5^{ab}	26.5^{ab}	27.5^{a}	0.18	<0.01
ADG (g/d)	56.3^{b}	68^{ab}	69.6^{ab}	80.3^{ab}	86^{ab}	86.8^{ab}	84.1^{ab}	85.7^{ab}	104^{a}	0.93	0.04
DMI (g/d)	723^{b}	756^{bc}	766^{ab}	789^{ab}	813^{ab}	816^{ab}	845^{a}	862^{a}	864^{a}	0.16	0.02
FCR	12.8	11.1	11	9.8b	9.45	9.4	10.1	10	8.67	0.20	0.05

Individual effects of dietary ME and CP levels

	ME (Mcal/kg)						CP %				
	2.1	2.3	2.5	SEM	P		8	10	12	SEM	P
Final BW(kg)	22.7^{b}	23.2^{ab}	24.3^{a}	0.25	0.001	Final BW (kg)	23.2	23.4	23.6	0.34	0.05
ADG	58.3^{b}	67^{ab}	76.3^{a}	0.18	0.03	ADG	59	68	70	0.12	0.05
DM intake (g/d)	767^{b}	787^{b}	856^{a}	0.35	0.01	DM intake (g/d)	770^{b}	804^{ab}	830^{a}	0.31	0.03
FCR	13.1	11.7	11.2	0.23	0.05	FCR	13^{a}	11.8^{b}	11.85^{ab}	0.12	0.03

ADG, average daily gain; DMI, dry matter intake; FCR, feed conversion ratio

SEM, Standard error of the mean

Means in a row with a different letters (a, b, c) differ (*P* < 0.05)

Table 3: The interaction and individual effects of diets differing in ME and CP ratio on fleece characteristics in male goat kids

	Feeding treatments (diets)										
Item	1	2	3	4	5	6	7	8	9	SEM	P
Interaction effects of dietary ME and CP levels											
Greasy fleece(g)	400.00	441.00	469.00	379.0	625.0	499.0	439.0	439.0	477.0	0.17	0.68
Fiber diameter (µm)	28.50	27.70	29.00	27.0	26.4	30.0	28.0	28.0	29.3	0.19	0.15
H length (mm)	27.50	33.00	24.00	24.8	31.4	32.0	35.8	32.0	32.8	0.68	0.33
B length (mm)	42.48	48.70	48.10	42.1	54.0	53.0	56.8	51.4	56.7	0.17	0.51
Fiber strength	9.00	8.22	7.16	7.8	8.5	7.6	9.0	8.0	7.8	0.21	0.89
Fiber efficiency	84.60	83.00	82.00	82.2	80.4	86.3	83.2	85.7	83.4	0.40	0.36

Individual effect of dietary ME and CP levels

	ME (Mcal/kg)						CP %				
	2.1	2.3	2.5	SEM	P		8	10	12	SEM	P
Greasy fleece (g)	453	493	450	0.30	0.64	Greasy fleece (g)	408	493	492	0.15	0.55
Fiber diameter (µm)	83^{a}	82^{a}	84^{a}	0.16	0.02	Fiber diameter (µm)	27.9^{b}	27.4^{b}	29.4^{a}	0.38	0.04
H length (mm)	31.5^{b}	29.5^{a}	34^{a}	0.46	0.01	H length (mm)	29.4	32	33.2	0.46	0.66
B length (mm)	46.5^{a}	49.7^{a}	55^{a}	0.13	0.02	B length (mm)	37	32	33.2	0.13	0.85
Fiber strength	8.1	8.0	8.	0.44	0.28	Fiber strength	8.7	8.4	7.5	0.44	0.83
Fiber efficiency	28.4	27.8	25.5	0.38	0.08	Fiber efficiency	83.4	83	83.6	0.16	0.61

SEM, Standard error of the mean

Means in a row with a different letters (a, b, c) differ ($P < 0.05$)

Table 4: Carcass characteristics and carcass compositions of Angora male kids given diets differing in ratio ME and CP

	Feeding treatments (diets)										
Item	1	2	3	4	5	6	7	8	9	SEM	P
Slaughter weight, (kg)	23.4^{c}	24.3^{bc}	24.6^{abc}	25.3^{abc}	25.6^{abc}	25.4^{ab}	26.2^{ab}	25.9^{ab}	27.4^{a}	0.62	0.01
Empty BW, (kg)	17.3^{c}	18.5^{bc}	20.3^{bc}	20.8^{abc}	20.3^{abc}	20.8^{ab}	21.9^{ab}	22.4^{ab}	24.6^{a}	0.56	0.03
Hot carcass, (kg)	9.5^{c}	9.95^{bc}	10.2^{bc}	10.7^{bc}	11.2^{abc}	10.8^{abc}	11.1^{ab}	11.5^{ab}	12.4^{a}	0.18	0.02
Dressing percentage	40.1^{b}	40.6^{ab}	41.6^{ab}	41.9^{ab}	43.4^{ab}	40.9^{ab}	41.7^{ab}	42.8^{ab}	45.2^{a}	0.54	0.03
Carcass length, cm	48.3^{b}	47.6^{b}	50^{a}	52.6^{ab}	49.5^{ab}	48.8^{ab}	49.8^{ab}	50.3^{ab}	51.2^{ab}	0.48	0.01
Chemical compositions of carcass components											
Dry matter %	47.2^{ab}	42.6^{b}	43.4^{b}	43.6^{b}	45.6^{ab}	46.2^{ab}	57.1^{a}	51.8^{a}	56.1^{a}	0.55	<0.01
Crude protein, %DM	32.7^{c}	33.7^{c}	35.6^{bc}	36.8^{bc}	37^{bc}	38.7^{bc}	38.5^{bc}	40.79^{b}	42.1^{a}	0.42	<0.01
Fat, %DM	31.8^{b}	31.6^{b}	33.6^{b}	30.3^{b}	38.1^{ab}	36.9^{ab}	42.6^{a}	41.4^{a}	41.5^{a}	0.48	<0.01
Ash, %DM	8.4^{c}	8.6^{c}	11.1^{bc}	12.2^{b}	13.2^{ab}	13.4^{ab}	13.1^{ab}	14.3^{a}	14.4^{a}	0.35	<0.01

SEM, Standard error of the mean

Means in a row with a different letters (a, b, c) differ ($P < 0.05$)

but, differences between treatments for greasy fleece weight, strength fiber and fiber efficiency (e.i. kg fiber/kg live body weight) was not significant. In the mohair production industry, mean fiber diameter is one of the main criteria used in determining the price of mohair [3]. Table 3 shows that, fiber diameter in diets contained highest and lowest level of ME and CP varied as 29.3 versus 28.5 respectively and diet 5 (ME, 2.3 and CP, 10) had lower fiber diameter than other treatments. In general, present results are in agreement with those observed in similar experiments. Both the rate of fiber growth and fiber diameter were increased when the dietary energy [5, 22] or protein [7, 17, 23-25] Angora goats was increased.

Carcass Traits: Effects of dietary treatments on some carcass traits are listed in Table 4. Analysis of these data showed significant differences for empty (digesta-free) BW, hot carcass, dressing percentage and carcass length among treatments. Table 4 also shows the mean values for chemical compositions (dry matter, crude protein, fat and ash) of animal carcasses which was affected significantly ($p<0.05$) by feeding treatments. The higher supply of dietary energy and protein resulted in heavier slaughter BW ($P < 0.01$), empty BW ($P < 0.03$), hot carcass weight ($P < 0.02$) and higher dressing percentage ($P < 0.03$) than lower dietary nutrients concentration. In addition, the animals fed diets containing highest energy and protein presented greater carcass chemical components compared to lowest levels. These data confirm earlier report [17] which suggested that some carcass characteristics improved by dietary energy and protein supplementation.

CONCLUSION

It is concluded that feeding diets differing in energy and protein ratio had dissimilar effects on DM intake, ADG, carcass quality and mohair fiber growth in Markhoz male kid goats. These results might explain the effectiveness of dietary nutrient concentration in increasing mohair fiber and meat production from goat kids. For a fuller understanding of the effect of dietary ME and CP level on Markhoz kid goats, further investigations is needed.

ACKNOWLEDGEMENTS

The authors would like to thank the following for their contribution to this study; the manager (Mr. Ghonchei) of Saqqez Animal Breeding Research Institute for cooperation during experiment, also to Dr. B, Usefi chief of Agricultural and Natural Resources Research Center of Kurdistan Province.

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