The effect of By-pass protein on quantity and quality traits of Mohair in Iranian Angora (Markhoz) goat

Farzad. Abdollahzadeh[1], Rahman. Ebne Abbasi[2], Shiva. Mafakheri[2] Rahim. Abdulkarimi[1]

[1]Islamic Azad University, Boukan Branch, Boukan, Iran
[2]Department of Animal Science, Agricultural and Natural Resources Research Center, Kurdistan Province, Sanandaj, Iran

ABSTRACT: The effect of dietary varying levels of By-pass protein on fiber production and nutrients digestibility of Markhoz kid goats was studied. Sixteen castrate male Angora goats (about 6 months of age; 20±1.5 kg of initial BW), were assigned randomly to four isocaloric (9/8 MJ/ kg of DM intake) and isonitrogenous (11/9 % Cp of DM) diets differing in their fishmeal (Fm) content in a completely randomized design. The experimental diets were supplemented by 0 Fm (or control), 50 (LFm), 75 (MFm) and 100 g/day (HFm) of Fm as a dietary By-pass protein resource. The inclusion of Fm in Angora goats' diet was associated with a higher greasy and clean fiber, fiber diameter, staple length, medullated and kemp fibers and lower true fiber than control diet. The higher supply of dietary Fm resulted in higher ($P < 0.05$) nutrients (DM, OM, CP and NDF) digestibilities but, no differences were observed among Fm levels. DM intake was highest for goats fed HFm and lowest for those fed control diet, however, differences among treatments were non-significant. Overall results indicated that, enrichment of Angora diets relatively high in concentrate with Fm as a source of By-pass protein improved nutrient digestibility and fleece characteristic of Angora goats. Additionally, the use of By-pass protein resource such as Fm is required for maximum fiber production and 50 g/d of Fm is recommended to feed on such diets.

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Key words: Angora goat, Markhoz goat, By-pass protein, fiber characteristic.

INTRODUCTION

Markhoz goat (Iranian Angora) is the only single coat goat producing shiny fine fibers in Iran. Markhoz goat population in Iran is estimated at 25000 heads in 1996 (Bahmani et al., 2011). The fleece taken from Markhoz goat is called mohair. Mohair production by Angora goats is an important livestock enterprise in some parts of the world (Luo et al, 2004). The nutritional management of the animal can interfere on the mohair production and a poor quality diet will curtail mohair development. Mohair fiber is pure protein thus, Angora goats has a high protein requirement due to their rapid hair growth compared to other ruminant species. It has been shown that fiber production (wool or mohair) can be increased by as much as 20% through the use of rumen by-pass proteins (Shelton,). The kind or quality of protein consumed by ruminants, including the Angora goat, is not considered to be particularly important. Production efficiency would potentially be improved if a significant proportion of these feed proteins could get through the rumen without being degraded. This would be especially true with respect to mohair production if the protein feeds used were made up of high quality protein, rich in limiting amino acids such as methionine. Some protein concentrates (fishmeal, blood meal, meat meal or feather meal) are poorly or slowly digestible and thus have some rumen escape properties. Fishmeal not only has escape value, but is also high in the sulfur containing amino acids and has been shown to be useful to increase fiber production.

Because nutritional variation and especially quality of dietary protein is the most important environmental factor influencing mohair growth of Angora goat (Galbraith, 2000) this experiment have been undertaken to assess the effects feeding different levels of By-pass protein (Fishmeal) on fleece characteristics and diet digestibility of Angora male kid goats.

MATERIAL AND METHODS

Experimental animals and housing

The present experiment was carried out at Agriculture College, Tarbiat Modarres University, Tehran, Iran. Sixteen castrate male Angora goats (about 6 months of age; 20±1.5 kg of initial BW) were purchased from Sanandaj Animal Breeding Research Institute and were arranged in an experiment with a completely randomized design with four replicates per treatment. The animal were randomly assigned to one of four dietary treatments and used in a 90-d study to examine the effect of different levels of by-pass protein (Fm) on diet

digestibility and mohair fiber production. Before initiation of the experiment, animals were allowed to adapt to treatment diets for 2 wk and were de-wormed with an effective anathematic and vaccinated against enterotoxaemia and foot and mouth disease. The goats were weighed before feeding in the morning at 14-d intervals throughout the experimental period and sheared before the beginning and at the end of the trials. They were housed and fed in individual metal-mesh cages and were adapted to human handling and the experimental setting. The floor area in each cage was 90*90 cm, and they were raised 85 cm from the floor. The animals also, had free access to drinking water, limestone and salt at all times. All animals taken into this study received equal management and the kids maintained good health throughout the study.

Feed treatments and diets

The study was designed to determine the effects of supplemental feed on feed intake and fleece characteristics in Angora meal kids. The dietary treatments consisted of three levels of inclusion of Fm in forth diets: 0 Fm (or control diet); 50 (LFm); 75 (MFm) and 100 g/day (HFm) on DM basis. The feed diets were formulated according to the AFRC (1998) guidelines to be isoenergetic (9/8 MJ/ kg of DM intake) and isonitrogenic (CP 11/9 % DM bases) and differed in Fm supplement, which was added to provide diet varying in ruminally undegraded protein. Fm was completely mixed with concentrate and fed at the morning feeding. Each diet was mixed completely and feed sorting by goats was minimal. The metabolizable energy (ME) content of the diets was 9/8 (MJ/kg DM). Ingredient and chemical compositions of the four treatment diets are presented in Table1.

Measurements

At the beginning (d 0) and end (d 90) of the trial all goats were sheared. At the latter clipping, grease mohair weights were recorded and a sample from the mid-side area (10 × 10-cm) of each fleece was meticulously sheared. The samples were bagged separately in moisture proof- plastic bags and taken to the Wool Laboratory for yield, staple length, and proportions of Medullated and Kemp characterized. The sub samples were prepared for measurement with the projection microscope technique in accordance with ASTM, (1991) 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 Hautuer (fiber percent/number) and Barbe (fiber percent/ weight) length.

Data collection and laboratory analyses

Daily feed intake was monitored on individual goats and any refusals were taken into account, weighed and sampled for later analysis. Total fecal collection was carried out for 6 days. Feces were sampled for further analysis. Subsamples of diets, refusal and feces were ground through a 1.0 mm screen then analyzed for DM, CP (N x 6.251, ash, NDF, and ADF as described. Diet samples were analyzed for dry matter (DM) and metabolizable energy (ME) according to AOAC (1984) methods. Crude protein was calculated from Kjeldahl N values as total N x 6.25 (AOAC, 1990). Ether extract was determined using Soxhlet extraction procedure with anhydrous diethyl ether as the non-polar solvent. NDF and ADF were analyzed according to Van Soest et al. (1991). Ash was analyzed by ashing at 550o, 6 h in a furnace. Calcium and phosphorus were measured by using an auto analyzer spectrophotometer (Unico, model S 2100 SUV, serial number 2165168, Japan). Total S was analyzed according to the method of Mottershead (1971). Gross energy was determined with an adiabatic bomb calorimeter (Parr Instrument, Moline, IL) and values for ME were calculated by difference. Ingredients and composition of diets used in the study are given in

Table 1.

Experimental design and statistical analysis

16 castrate male Angora goats (aged 6 months, 20 ± 1/5kg BW) arranged in balanced completely randomized design were used to evaluate the effects of feeding different levels of by-pass protein on fiber characteristics of Markhoz kid goat. The kids were assigned randomly to each of the forth treatments (n= 4 kids per each treatment) and fed with experimental diets for 90 d. The collected data were subjected to statistical analysis using the Duncan procedure of SAS, (1998) (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:

$$\hat{Y}_{ij} = \mu + F_i + \quad _{ij}$$

Where Y is the dependent variable; μ is the overall mean; F is the effect of fishmeal level (i= 50, 70 and 100 g/d) and is the random residual error term.

RESULTS AND DISCUSSION

Intake and nutrient digestibility

Mean values of DM intake and diets digestibility are shown in Table 2. No significant differences was observed in DM intake but, goats fed the HFm diet consumed more DM as compared to goats fed the LFm and control diet. Goats fed the MFm diet were

intermediate (Table 2). Dry matter (DM), organic matter (OM) as well as CP digestibilities were higher ($p<0.05$) for goats fed the Fm containing diets (average = 60.23, 63.57, and 62.6 respectively) as compared with goats fed the control diet (average= 57.2, 58.1 and 57.3, respectively) as shown in Table 2. Neutral detergent fiber (NDF) digestibility showed a similar pattern as that observed for DM or OM (Table 2). As a result, the dietary Fm level did not affect DMI significantly. A possible explanation for the lack of improvement in DM intake is the high consumption of concentrates in this study (avg. = 70% of diet). Beauchemin et al., (1995) and Ferrell et al., (2001) reported that, the effect of dietary undegradable protein levels on DM intake seems to depend on the dietary forage to concentrate ratio, in which no effect from undegradable protein supplements on DMI were observed when they fed feedlot lambs with high concentrate diets.

It is supposed that, Fm containing diets enhances microbial growth and thereby ruminal fermentation as well as provides a higher nutrients digestibility in particular, CP digestibility. The improvement in DM digestibility observed in goats fed the Fm diets is likely to be due to the increased digestibilities of both the NDF and CP.

Fiber production, quantity and quality traits

Influence of diets differing in ratio of Fm on the quantity and quality of fiber produced by Angora goats are listed in Table 3. Feeding of Fm containing diets resulted in decreasing true fiber but, increased greasy and clean fiber, fiber diameter, fiber length (Barbe and Hautuer) staple length and med and kemp fiber than control diet. The higher ($P<0.05$) produced mohair by goats fed Fm containing diets may have reflected enhance of microbial growth and thereby ruminal fermentation as well, provide a reasonable high quality source of amino acids to the intestines. The kind or quality of protein consumed by Angora goat, owing to their rapid hair growth is very important. Production efficiency would potentially be improved if a large proportion of feed proteins could get through the rumen without being degraded. Huston,et al., (1993) reported that, animal byproduct protein concentrates such as fishmeal are effective protein source for goats and may be of greater value than oilseed byproduct meals in stimulating mohair growth because of their comparatively low ruminal protein degradation.

The effects of supplemental feeding on fleece production by Angora goats in some cases are consistent with current results. Several studies with Angora goats have shown that mohair production was increased as the formaldehyde- treated casein (Throckmorton et al., 1982), heat-treated soybean meal (Sahlu et al., 1992), hydrolyzed feather meal (Huston and Shelton, 1968), corn, cottonseed meal, fish meal, and molasses mixture (Huston et al., 1993) and encapsulated Methionine (Bassett et al. (1981) was included in the diet. In contrast, no responses in mohair production were observed when lysine (Sahlu and Fernandez 1992) and encapsulated methionine (Craddock and Bassett 1977) were fed to Angora goat.

CONCLUSION

The quantity and quality of fiber produced by Angora kid goats is markedly influenced by nutrition. Enrichment of Angora diets relatively high in concentrate with fishmeal as a source of By-pass protein improved nutrient digestibility and fleece characteristic of Angora goats. It seems that, beside to basal diet the use of By-pass protein resource such as fishmeal is required for maximum fiber production as well as consumption of 50 g/d of fishmeal is recommended on such diets.

ACKNOWLEDGEMENTS

Project financed by Agricultural and Natural Resources Research Center of Kurdistan Province. Support received from Dr. B, Usefi is fully appreciated.

Table 1. The composition and chemical analysis of the experimental diets varying in by-pass protein content fed to Angora kid goats.

Item	Experimental diets [a]			
Ingredient, DM basis %	Control	LFm	MFm	HFm
Fish meal added(g/d)	-	50	75	100
Alfalfa hay	21	22	22	21
Wheat straw	9	8	8/5	9
Barely grain	55	55	55	55
Wheat bran	5	5/4	4/5	5
Cotton seed meal	5	4/6	5	4
Molasses	1/5	1/5	1/5	1/5
Salt and trace mineral [b]	1/5	1/5	1/5	1/5
Calcium carbonate	1/5	1/5	1/5	1/5

Vitamin premix [c]	0.5	0.5	0.5	0.5
Nutrient				
ME(MJ/kg DM) [d]	9/8	9/8	9/8	9/8
CP, % DM	11/9	11/9	11/9	11/9
NDF	42/3	42/4	42.4	42/3
ADF	29/9	29/7	29/9	29/9

Table 2. Dry matter intake and nutrient digestibility coefficients of diets differing in ratio of fishmeal as by-pass protein source fed to Angora kid goat.

	Experimental diets [a]				
Item	Control	LFm	MFm	HFm	SE [b]
Nutrients digestibility					
DM intake	0.67	0.7	0.75	0.76	0.08
DM	58.2^{b}	58.8^{ab}	60.7^{a}	60.2^{a}	1.2
OM	58.1^{b}	63.2^{ab}	63.3^{ab}	64.1^{a}	1.5
CP	57.3^{b}	60.1^{ab}	63.6^{ab}	64.7^{a}	2.1
NDF	43.3^{b}	45.1^{ab}	47.3^{a}	47.9^{a}	1.4

[a] control, L Fm, M Fm and H Fm contained 0(without fishmeal), 50 (low fishmeal), 75(medium fishmeal) and 100(high fishmeal)g/d of fish meal as by-pass protein source. [b] Standard error

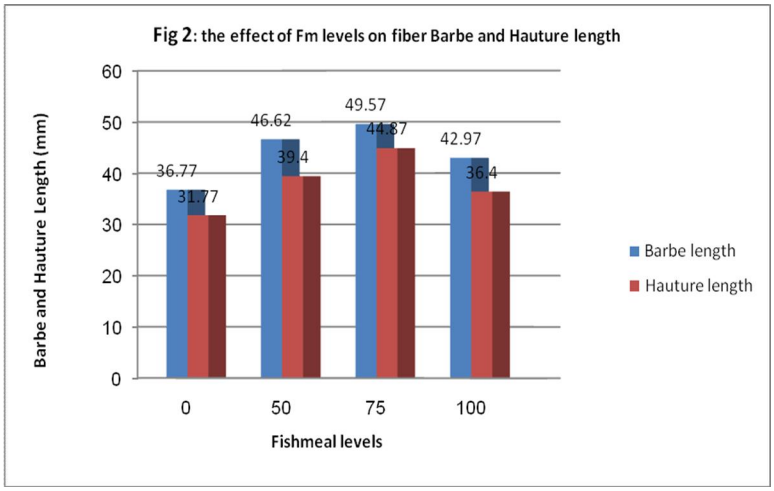
Ca , % DM	0/67	0/65	0/67	0/67
P , % DM	0/31	0/33	0/31	0/31
S, % DM	0/22	0/22	0/22	0/22

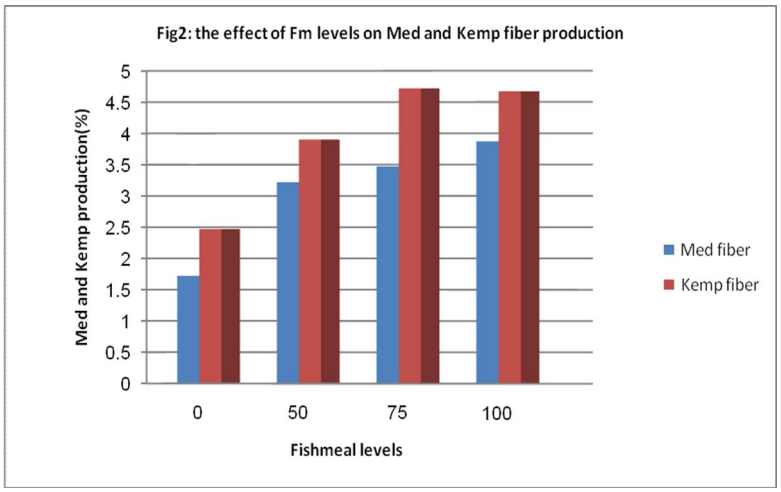
[a] control, L Fm, M Fm and H Fm contained 0(without fishmeal), 50 (low fishmeal), 75(medium fishmeal) and 100(high fishmeal)g/d of fish meal as by-pass protein source.
[b] 94 to 95% NaCl and ³ .2% Mn, .16% ferrous Fe, .14% ferric Fe, .033% Cu, .10% Zn, .007% I, and .005% Co.
[c] Contained 2,200 IU of vitamin A; 1,200 IU of Vitamin D3; 2.2 IU of vitamin E per gram.
[d] ME= Metabolizable energy; calculated according to NRC (1985).

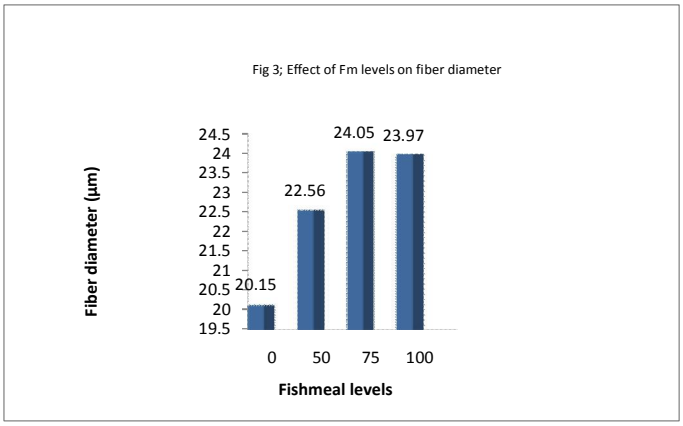
Table 3. Fleece characteristics of Angora goats fed diets differing in ratio of fishmeal as by-pass protein source.

	Experimental diets [a]				
Item	Control	LFm	MFm	HFm	SE [d]
Nutrients digestibility					
Greasy fibers (g)	191^{a}	238.5^{a}	313.2^{b}	302.2^{b}	35.4
Clean fiber, %	76.8^{a}	79.68^{ab}	84.14^{b}	79.13^{ab}	3.39
Fiber diameter (µm)	20.15^{a}	22.56^{ab}	24.05^{b}	23.97^{b}	1.78
Staple length, cm	4.02^{a}	4.9^{b}	5.15^{b}	5.17^{b}	0.33
B Length [b]	36.77^{a}	46.62^{ab}	49.57^{b}	42.97^{ab}	6.38
H Length [c]	31.77^{a}	39.4^{ab}	44.87^{b}	36.4^{ab}	7.04
Med fibers , %	1.72^{a}	3.22^{b}	3.47^{b}	3.87^{b}	0.55
Kemp fibers ,%	2.47a	3.9^{b}	4.72^{b}	4.67^{b}	0.76
True fibers, %	95.8^{a}	92.87^{b}	91.8^{b}	91.45^{b}	1.18

[a] control, L Fm, M Fm and H Fm contained 0(without fishmeal), 50 (low fishmeal), 75(medium fishmeal) and 100(high fishmeal)g/d of fish meal as by-pass protein source. [b] Barbe Length; [c] Hauture Length. . [d] Standard error







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1/5/2012