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Effect of Atriplex Consumption on Growth Performance and Secondary Hair Follicle Activity of Cashmere Goats

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Abstract: This experiment was conducted to study the effect of feeding different levels of two species of *Atriplex canescens* and *Atriplex lentiformis* replacing with Alfalfa on feed intake, body weight gain and secondary hair follicle activity of Raeini cashmere goats. A complete randomized design was used with 7 experimental treatments 1, 2, 3, 4 with 100% Alfalfa (control) and 20, 40 and 60 % *Atriplex canescens* and treatments 5, 6 and 7 with 20, 40 and 60 % *Atriplex lentiformis* respectively. Forty nine female Raeini goats of 18 months of age with an average initial body weight of 19.8±2.3 Kg were used for 180 days. Daily feed intake and weight gain was measured during experimental period. At the end of experimental period skin biopsies were taken from the right mid side region of goats. Skin samples were fixed in buffered formalin, dehydrated in series of ethanols, blocked in paraffin, sectioned with microtome and stained with Sacpic method. Active secondary follicle percentage was measured from the sectioned skinned samples. Results indicated that levels of two species of Atriplex had significant ($p<0.05$) effect on feed intake and daily weight gain. Maximum feed intake and daily weight gain were found in control group (940±36.60 and 23.9 g d^{-1}) respectively. Minimum feed intake was 615±77.09 g d^{-1} in treatment group 7 and minimum daily weight gain was -12.42 g d^{-1} in treatment group 4. Significant ($p<0.05$) difference was found in active secondary follicle percentage between treatment groups. Active secondary follicle percentage was 91.21±0.20, 88.25±0.64, 86.74±1.23, 87.38±1.09, 86.19±1.34, 86.59±0.50 and 85.65±1.44 treatment groups 1, 2, 3, 4, 5, 6 and 7, respectively. In an overall of conclusion, from the stand point of body weight gain 20% *Atriplex canescens* or 20- 40% *Atriplex lentiformis* could be replaced with Alfalfa but in relation to fibre production the replacement rate for any Atriplex species should not exceed 20%.

Key words: Raeini goat, hair follicle, *Atriplex*, daily weight gain

INTRODUCTION

The goat is an ideal animal for keeping in harsh arid areas of the world. It has ability to survive under such conditions and produce milk, meat and high quality fibre (Mahgoub *et al*., 2005). Traditionally goats are indeed important especially in Iran for milk and fibre (Rafat and Shodja, 2004). Fibre producing goat produce three different fibre types namely hair, mohair and cashmere. The hair follicles of goats are grouped in clusters. Within these clusters are primary and secondary follicles. Primary follicles are producing guard hairs, while secondary follicles are producing undercoat or cashmere (Norton, 1991). In Iran there are about 5 millions Cashmere goats out of a total of 26 millions goat heads which produce approximately 1500 metric tons of raw cashmere (Rafat and Shodja, 2004). In Iranian province of Kerman there are about 2 millions heads white Raeini Cashmere goats which totally produce approximately 700 metric tons of raw cashmere (Ansari-Renani, 2004) . In arid region of Iran in order to prevent the expanding of desert and dedesertation attempts has been made to cultivate different plants including *Atriplex Canescens* (*AC*) and *Atriplex Lentiformis* (*AL*). These plants are resistant to salinity and dry lands and at the same time the growth and development of these species in ranges could be useful in preventing soil erosion and helps to increase forage production.

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Several research on effect of nutrition on wool and Cashmere growth indicated that good nutrition has been positive effect on yield, however its lead to increasing fibre diameter and so reduced quality of fibres (Harries *et al*., 1990; Kloren *et al*., 1993; Sumner and Bigham, 1993; Restall *et al*., 1994). In another studies by Cottle (1988), Zarafroz (1998) and Rafat and Shodja (2004) follicle activity were affected by the levels of energy and protein in diets. Because when follicles were inactive, fibre shedding or moulting occurs. There was a little information on effects of nutrition on cashmere production and quality, thus the aims of this study were:

- Investigation of the effect of two species of *AC* and *AL* replacing with Alfalfa on feed intake and body weight gain of goats.
- Determination of optimal replacing level of two species of atriplex with Alfalfa in order to prevent follicle shutdown and moulting.

MATERIALS AND METHODS

Experimental design and management of animals: This experiment was carried out in Bardsir station that located about 70 km far from Kerman. Forty nine Raeini female Cashmere goats with average initial body weight of 19.8±2.3 Kg and 18 months old were used for 180 days from September to march 2002. A complete randomized design was used with 7 treatments and 7 replicates. Animals were randomly divided into 7 groups and each groups included 7 animals and after adaptation period with experimental diets, were fed ad libitum by experimental rations. Experimental roughage diet ingredients included 100% Alfalfa (control), 20% *AC* and 80% Alfalfa, 40% *AC* and 60% Alfalfa, 60% *AC* and 40% Alfalfa, 20% *AL* and 80% Alfalfa, 40% *AL* and 60% Alfalfa and 60% *AL* and 40% Alfalfa (Table 1). In all of experimental treatments, 100 g barley grain per day per animals was used. The goats were weighted weekly during experimental period; feed intake and daily weight gain were recorded for each group.

Histological measurements: At the end of experimental period skin biopsies was sampled at March. A sit just forward of the mid side on the right of the goat was clipped and sprayed liberally with a 2% lidocain an aesthetic spray. A trephine with 0.8 cm diameter was used to make an incision to the connective tissue beneath the skin. The skin section was raised with forceps and a hand-held scalpel blade used to cut parallel to the skin surface through the connective tissue, removing the skin section. Skin sections were placed in glass scintillation vials containing 10% buffered formalin (Maddocks and Jackson, 1988). After at least 7 days in the buffered formalin, samples were transferred in Animal Science Research Institute of Karaj and Islamic Azad University-Shabestar Branch laboratory. Skin histological stage included: Fixation, dehydration, blocking, section with microtome, staining and microscopic investigation.

After fixation, skin samples dehydrated through a series of graded ethanols and cleaned in Histoclear using a citadel tissue processor and for blocking used leuk hardet. Sections were cut in the transverse plan at 8 μm using a rotary microtome (Ansari-Renani *et al*., 2007). Approximately 60 sections were cut per sample, but only every fifth section was retained. Before staining, all sections were deparaffinised and special tetrachrome stain "sacpic" (Auber, 1952) was used to demonstrate follicular tissue components.

Analysis of the slides was performed on a light microscope. Three hundred follicles per slides were identified to derive estimates of secondary follicle activity. Skin section was collected and used due to the high quality of the sections.

Statistical analysis: All data obtained from the trials were subjected to the analysis system (SAS, 1996) according to a completely randomized deign. Means were separated by Duncan's Multiple Rang Test. The level of significance was determined at $p<0.05$.

Table 1: Nutrients composition of experimental forage/diets

Treatment or forages	DM (%)	DE (Kcal Kg^{-1})	CP (%)	EE (%)	ADF (%)	NDF (%)	Na (%)	K (%)	Ca (%)	P	S ppm	Cu ppm
AC	96.2	1420	9.8	6.01	43.75	60.41	1.56	2.3	1.32	0.10	2239	6.14
AL	96.6	2000	10.4	7.05	24.53	42.21	2.1	1.72	1.83	0.09	2183	6.7
100% Alfalfa (control)	95.2	2300	13.1	5.46	33.2	51.4	0.3	0.22	0.8	0.04	2734	8.7
20% *AC* and 80% Alfalfa	95.5	2130	12.6	5.5	34.2	52.3	0.55	0.65	0.9	0.05	2630	8
40% *AC* and 60% Alfalfa	95.5	1940	12	5.6	36.5	54.2	0.8	1.05	1.05	0.06	2540	7.6
60% *AC* and 40% Alfalfa	95.7	1770	11.5	5.7	38.8	55.5	1.1	1.4	1.13	0.08	2390	7
20% *AL* and 80% Alfalfa	95.5	2240	12.8	5.5	31	48.8	0.7	0.55	1.1	0.05	2610	8.1
40% *AL* and 60% Alfalfa	95	2190	12.4	6	29	47.5	1	0.8	1.25	0.06	2503	8
60% *AL* and 40% Alfalfa	96	2120	11.9	6.2	28	45.3	1.4	1.1	1.4	0.07	2398	7.5

AC= Atriplex canescens, AL= Atriplex lentiformis, DM= Dry Matter, DE= Digestible Energy, CP= Crude Protein, EE= Ether Extract, ADF= Acid Detergent Fiber, NDF= Neutral Detergent Fiber

Table 2: Mean (±SE) feed intake (gr d^{-1}), body weight gain (gr d^{-1}), active and inactive secondary follicle (%) in experimental treatments

Treatment Number	Treatment	Feed intake (gr d^{-1})	Body weight gain (gr d^{-1})	Active secondary follicle (%)	Inactive secondary follicle (%)
1	100% Alfalfa (control)	63.66±940[a]	23.9[a]	91.21±0.20[a]	8.79±0.20[b]
2	20% *AC* and 80% Alfalfa	52.15±806[ab]	0.47[bcd]	0.64±88.25[b]	0.64±11.75[a]
3	40% *AC* and 60% Alfalfa	66.22±681[b]	-6.18[cd]	1.23±86.74[b]	1.23±13.26[a]
4	60% *AC* and 40% Alfalfa	60.98±684[b]	-12.42[d]	1.09±87.48[b]	1.09±12.61[a]
5	20% *AL* and 80% Alfalfa	82.07±743[ab]	15.32[ab]	1.34±86.19[b]	1.34±13.08[a]
6	40% *AL* and 60% Alfalfa	69.81±688[ab]	6.82[abc]	0.50±86.59[b]	0.50±13.41[a]
7	60% *AL* and 40% Alfalfa	77.09±615[b]	1.76[bcd]	1.44±85.65[b]	1.44±14.35[a]

AC= Atriplex canescens, AL= Atriplex lentiformis, a, b, c, d : Means within same column with differing superscript are significantly different

RESULTS AND DISCUSSION

Table 2 showed means comparisons of feed intake, daily weight gain, active and in active secondary follicle percentage in treatments.

Feed intake: Results indicated that levels of two species of Atriplex had significant ($p<0.05$) effect on feed intake. Maximum feed intake was found in control group 940±36.60 g d^{-1}. Minimum feed intake was 615±77.09 g d^{-1} in treatment group 7. Several factors such as body size, breed, physiological condition, age, sex, health, environmental temperature, animal activity, dry matter contents of diet, Neutral Detergent Fibre (NDF), energy, protein, individual and social behaviors, passage rate, feed form, palatability, particle size, feeding system, stress and est. can influenced dry matter intake (Van Soest, 1994; Fisher, 2002; Forbes, 2003). Because of many benefits of Alfalfa that mentioned above its consumption by animal was preferred. Since the NDF in Alfalfa is lower than that of atriplex species, thus intake level of Alfalfa is higher than that of them, because increasing NDF content in diets limit their consumption by animals (NRC, 1981; Van Soest, 1994; Givens *et al*., 2000). Also low level of atriplex species intake could be due to antinutritional components of these forages (Van Soest, 1994; Aslani, 2004). On the other hand the selenium content of AC is very high (up to 1500 ppm) and so that its acceptability for animals could be very low (Aslani, 2004).

Zarafroz (1998) indicated that increasing levels of dietary energy and protein in Varamini sheep increased feed intake and reported that increasing level of dietary protein influenced ruminal fermentation and resulted increased propionic acid to total volatile fatty acid ratio and improved energy utilization efficiency in animal. Ebne-Abbasi *et al.* (2005) showed that feed intake in Qezel lambs affected by levels of dietary energy and protein (increasing levels of dietary energy and protein increased feed intake). Kloren *et al.* (1993) shown that changing levels of nutrition from maintenance to 2.3×maintenance increased feed intake in Australian Cashmere goat. Taghizadeh *et al.* (2005) indicated that using isoenergetic diets with different Rumen Undegredable Protein (RUP) not influenced feed intake in Raeini goats. Feed intake in current study was similar to that of Kloren *et al.* (1993), Zarafroz (1998) and Ebne-Abbasi *et al.* (2005) and in contrast with Mahgoub *et al.* (2005) and Taghizadeh *et al.* (2005).

Live weight changes: Results indicated that levels of two species of Atriplex had significant ($p<0.05$) effect on daily weight gain. Maximum daily weight gain were found in control group 23.9 g d^{-1}. Minimum daily weight gain was -12.42 g d^{-1} in treatment group 4. Heritability of weight gain in goats was 0.29 and therefore 0.71 were influenced by environmental factors (Pattie and Restall, 1991). The body weight gain in animals affected by nutritive value of feed stuffs. The energy and protein contents are important quality index of diets in animal nutrition (Mc Donald *et al*., 1995). Since, the energy and protein content of Alfalfa was higher than that of Atriplex species (Emami-Meabodi *et al*., 1996; NRC, 1981). Its can be concluded that the difference in body weight gain between treatments in relation to different energy and protein levels of excremental diets. Ivey *et al.* (2000) shown that increasing levels of energy and protein in diet resulted to increasing body weight gain in Spanish goats. Gholami *et al.* (2005) shown that the level of dietary energy in Raeini kids influenced daily weight gain, although this trait no affected by dietary protein. Mahgoub *et al.* (2005) indicated that there was a significant increase in daily weight gain pattern with increasing metabolizable energy density in Omani goats. Kloren *et al.* (1993) reported that there were significant differences between feeding levels for dry matter intake and shown that live weight gain increased significantly with increasing feed intake. Perito *et al.* (2000) in study on Boer crossbred and Spanish goat reported that, diets with high protein concentration may support greater live weight gain than diets with low protein content. Also the results of current study in line with Kloren *et al.* (1993), Ivey *et al.* (2000) and Perito *et al.* (2000).

Additionally its seem that reason why using Atriplex resulted to decrease in body weight gain could be due to high content of antinutritional components in these forages specially in *AC* (Aslani, 2004).

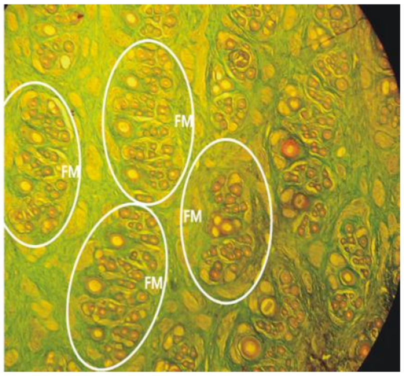

Fig. 1: Photomicrograph showing a cross section of skin taken from the midside of the an Raeini cashmere goat at the end of experiment. Feature labeled is as follow: FM, follicle mass or follicle group

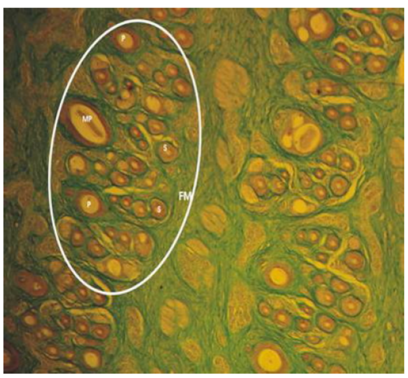

Fig. 2: Photomicrograph showing a cross section of skin taken from the midside of the an Raeini cashmere goat at the end of experiment. Features labeled are as follows: FM, follicle mass or follicle group; MP, medium primary follicle or central primary follicle; P, lateral primary follicle; S, secondary follicle

Secondary follicle activity: Data variance analysis resulted that significant ($p<0.05$) difference was found in active secondary follicle percentage between treatment groups (Table 2 and Fig. 1-3). Maximum active and minimum inactive secondary follicle percentage were found in control group (91.21±0.20 and 8.79±0.20, respectively) and minimum active and maximum inactive secondary follicle percentage were found in group 7 (85.65±1.44 and 14.35±1.44, respectively).

Several studies indicated that the level of feeding and nutrients affected follicle activity and fibre growth (Hynd *et al*., 1997; Hynd and Masters, 2002; White *et al*., 1994). If a restriction in feed intake is sufficiently severe, some follicles cease fibre production and enter a resting

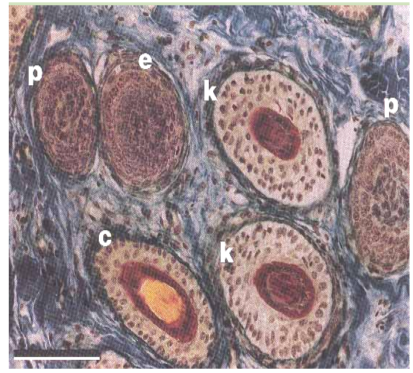

Fig. 3: Photomicrograph showing a cross section of skin taken from the midside of the an Raeini cashmere goat at the end of experiment. Features labeled are as follows: e and p inactive secondary follicles without fibre; k, inactive secondary follicle in disappearance state of fibre; c, follicle entering in resting (telogen) stage

or "shutdown" phase. This phenomenon occurs in autumn in Mediterranean environments, when nutrient supply is poor (Hynd and Masters, 2002). There is also a strong correlation between stocking rate and incidence of shutdown. Both these lines of evidence suggest that shutdown is largely nutritional in origin (Hynd *et al*., 1997). Hynd and Masters (2002) indicated that increasing RUP, provided protein in small intestine and dietary high level of energy improve wool growth. In other research Zarafroz (1998) shown that follicle activity affected by level of dietary energy and protein in Varamini sheep. Secondary follicle activity is present research was similar that to Zarafroz (1998).

CONCLUSION

In an overall of conclusion, from the stand point of body weight gain 20% *AC* or 20-40% *AL* could be replaced with Alfalfa but in relation to fibre production the replacement rate for any Atriplex species should not exceed 20%.

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