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Research Article

COMPARATIVE EFFICACY OF BETA-AGONISTS ON DRESSING PERCENTAGE, EMPTY GI TRACT WEIGHT AND PROTEIN CONTENT OF SKELETAL MUSCLES IN GOATS

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ABSTRACT
Twenty four growing male kids of Barbari and Black bengal breeds are used in comparative study for determining the efficacy of beta-agonists – clenbuterol, salbutamol and terbutaline on dressing percentage, weight of the empty GI tract, weight and protein content of soleus, semitendinosus and gastrocnemius muscles. The repartitioning agents were fed to the respective groups for 6 weeks period and the animals were slaughtered 72 hours after the end of the trial. The treatment exhibits 1.52 – 4.86% higher dressing percentage than the control group, though statistically not significant. The empty GI tract weight was not affected by treatment. Non significant increase in weight of gastrocnemius muscle by 15% and 22% was observed in terbutaline and clenbuterol group. The protein content of soleus muscle with exception of clenbuterol group and of semitendinosus and gastrocnemius muscles was significantly increased.

Key Words: *Beta-agonists, Goat, Repartitioning agents, Dressing percentage, Muscle protein.*

INTRODUCTION
A major objective of animal production is to develop feasible strategies to enhance lean deposition and reducing the fat accretion in meat animals. Advances in knowledge in this area have offered a variety of growth regulators/ approaches to achieve such objectives. Since the steroids are banned as anabolic agents, considerable attention has focused on the use of beta-agonists since early 1980s to improve carcass quality in livestock. Beta-agonists are physiological analogues of adrenaline, in addition to their regular role in veterinary medicine as bronchodilatory and tocolytic agents, they have been used to increase lean meat to fat ratio and improve feed conversion efficiency (Moloney and Beermann, 1996). The repartitioning activity of beta-agonists has been reported in cattle (Weber *et al.*, 2013), sheep (Nourozi *et al.*, 2005), pigs (Warriss *et al.*, 1990) and poultry (Kim *et al.*, 1994). But very little information is available on goats which contributes major part of meat industry in India. The present experiment deals with the comparative efficacy of beta-agonists on dressing percentage, empty GI tract weight, weight of skeletal muscles and protein content of skeletal muscles.

MATERIALS AND METHODS
Twenty fourfarm bred male kids of Barbari and Black Bengal breeds of about 6 months old were selected and divided equally and randomly into four groups, namely salbutamol group, terbutaline group and clenbuterol group along with control group. Animals were maintained under standard managemental conditions in well ventilated asbestos roofed shed with concrete flooring. All the animals under trial were offered standard ration as per Kearl (1982) with concentrate and roughage (Oat hay, *Avina sativa*) in the ratio of 50:50 on the basis of dry matter requirement. *Ad libidum* water was offered to the animals twice a day. All the animals were adapted to the experimental ration one month before the experiment and were fed individually. Based on the availability and reported action salbutamol, terbutaline and clenbuterol were chosen and administered *per os* to the respective groups @ 0.3 mg/ Kg B.wt/ day for 6 weeks. Control group received no drug. During the period under trail no other drug was administered to these animals.The animals under trial were slaughtered 72 hrs after the end of the treatment period in the

institutional abattoir. Dressing percentage, weights of the empty GI tract, and soleus, semitendinosus and gastrocnemius muscles were measured. The protein content of the above said muscle tissue homogenate was estimated by lowry method using bovine serum albumin as reference standard. The data obtained were analyzed statistically according to Snedecor and Cochron (1994).

RESULTS AND DISCUSSION

The mean dressing percentage for the control and treatment groups are presented in the table 1. It is evident from the results that though the beta-agonist treatment exhibit 1.52 to 4.86% higher dressing percentage over the control group, it was statistically not significant. This may be attributed to smaller sample size. However, Moloney*et al.* (1994) observed in steers that inclusion of beta-agonist at various levels in the diet resulted in 3.7%, 8.7% and 9.3% increase ($P<0.01$) in dressing percentage in treatment groups. Baker *et al.,* (1984) and Nourozi *et al.,* (2005) also reported similar findings in the lambs.Avendano-Reyes *et al.* (2006) observed carcass yield in steers was increased by feeding beta agonists.

The weight of empty GI tract for the control and treatment groups are presented in the table 1. In view to elucidate the effect of repartitioning agents on the visceral organs, the weight of empty GI tract was studied. The results indicated that treatment did not affect empty GI tract weight. This may be due to lack of required number of specific receptors in the GI smooth muscles. The smooth muscles of gut, liver and kidneys did not increase in size in response to anabolic action of beta-agonists as reported by Reeds *et al.,* (1986).

The weights of soleus, semitendinosus and gastrocnemius muscles are given in table 2. The results indicated that there was no significant difference in the weight of each muscle between groups. However, though the gastrocnemius muscle increased in weight by 15% and 22% for terbutaline and clenbuterol groups respectively the differences were not statistically significant. However, Beermann *et al.,* (1986) reported in lambs fed with cimaterol a 25-30% increase in weight of several muscles compared to control group. Kim *et al.,* (1987) observed similar findings that 40% increase in weight of gastrocnemius muscle in treated lambs. The hypertrophic effect of beta-agonist is selective to fiber types (Kim and Sainz, 1992) and the type-II fiber is more responsive, with type-I fiber usually unaffected or affected to a lesser extent than type-II fibers (Yang and McElligott, 1989).

The mean protein content of soleus, semitendinosus and gastrocnemius muscle tissue homogenate are shown in the table 2. As evident from the results, protein content in the soleus was increased significantly ($P<0.05$) in salbutamol and terbutaline groups over the control group but in clenbuterol group it was insignificant. Likewise for the semitendinosus and gastrocnemius, in all the treated groups the protein content was significantly higher ($P<0.05$) over the control group. However, in all the three muscles between groups no significant differences were found. Beermann *et al.,* (1987) also reported that 30% increase in protein in the muscles of lambs treated with cimaterol. The increase in muscle protein content may be due to reduced protein degradation rate or by increased protein synthesis rate. Unless otherwise the activities of enzymes involved in these pathways are not studied, it is difficult to conclude that which pathway is most involved in protein accretion in the muscle.

Table 1: Dressing percentage and empty GI tract weight in control and treatment groups

Group	Dressing percentage	Empty GI tract weight (kg)
Control	41.95 ±2.75	1.40 ± 0.30
Salbutamol	43.47 ±3.85	1.40 ± 0.35
Terbutaline	45.03 ±0.52	1.53 ±0.31
Clenbuterol	46.81 ±0.43	1.36 ± 0.18

Table 2: Weight of skeletal muscles and Protein content in muscles in control and treatment groups

Group	Weight of skeletal muscles (gm)			Protein content in muscles (mg/gm of tissue)		
	Soleus	***Gastrocnemius***	***Semitendinosus***	***Soleus***	***Gastrocnemius***	***Semitendinosus***
Control	1.70 ± 0.58	35.79 ± 16.17	37.04 ± 5.88	97.33 ± 7.68[a]	86.00 ± 4.61[a]	87.33 ±12.23[a]
Salbutamol	1.33 ± 0.28	34.66 ± 12.11	36.38 ± 4.39	128.66 ± 6.35[b]	114.67 ± 12.34[b]	118.67 ± 3.52[b]
Terbutaline	1.64 ± 0.38	41.49 ± 13.61	37.15 ± 8.28	128.00 ±4.61[b]	113.00 ± 0.58[b]	123.00 ± 6.35[b]
Clenbuterol	1.96 ± 0.39	43.67 ± 07.85	37.77 ± 4.13	109.33 ± 10.41[ab]	131.33 ± 9.82[b]	110.67 ± 8.74[b]

Means with the same superscripts do not differ significantly :P<0.05 in the rows

Conclusion

This study supports the favorable effect of repartitioning agents on the protein accretion in the goats as well and compared the efficacy of various beta-agonists. To confirm the above findings, studies with large number of experimental animals are needed. It is also suggested that studies on the effect of beta-agonists on meat quality and safety considerations along with its mechanism of action at molecular level are desirable before their advocacy.

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