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Research Article

COMPARATIVE EFFICACY OF BETA-AGONISTS ON FEED INTAKE AND CERTAIN BLOOD BIOCHEMICAL CONSTITUENTS IN GROWING KIDS

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ABSTRACT
Twenty four growing male kids of barbari and black bengal breeds were assigned to four groups to investigate the comparative efficacy of beta agonists – clenbuterol, salbutamol and terbutaline on food intake and certain blood biochemical constituents. The treatment was given for 7 weeks period. The treatment had no effect on food intake. Beta-agonists decreased the BUN level and increased the triglyceride level in treated groups. Total cholesterol level significantly increased from day-28 onwards with the exception of terbutaline group. Hypoglycemia was observed only on day-14 in salbutamol and terbutaline group. Activity of creatine kinase was increased from day-21. The sodium and potassium values did not differ significantly except in clenbuterol group on day-14 and day-7 respectively.

Key Words: *Beta-agonist, Goat, Repartitioning agents, Feed Intake, Blood biochemicals.*

INTRODUCTION
Out of many growth promoters which were tried for augmentation of animal production, the beta-agonists nowadays receiving considerable research interest. The repartitioning activity of beta-agonists in improving weight gain, feed efficiency were observed in steers (Wheeler and Koohmarie, 1992), lambs (Nourozi *et al.*, 2005), pigs (Warriss *et al.*, 1990) and broilers (Kim *et al.*, 1994). The beta-adrenergic receptors belong to a family of transmembrane domain proteins that are coupled to stimulatory G-proteins (Mills *et al*., 2003). Beta-agonists cause an increase in body protein which is confined essentially to skeletal muscles (Buttery and Sweet, 1993) and is desirable from meat production point of view. Since India ranks first in the world in goat population and goats contributes major part of meat industry in India, experiments were conducted to elucidate the efficacy of beta-agonists to repartition the nutrients for better growth in goats. Since the member of beta-agonist group vary in their repartitioning activity, three beta-agonists namely salbutamol, terbutaline and clenbuterol were compared for their repartitioning activity in the present study.

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, 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 (composition given in table - 1) 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 starting 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 period. Control group received no drug. During the period under trail no other drug was administered to these animals.
The weekly blood samples were collected from each animal in all the four groups by jugular vein puncture using suitable anticoagulant. The plasma samples were analyzed for blood glucose, total

cholesterol, blood urea nitrogen, triglycerides, creatine kinase, sodium and potassium using standard procedures. The data obtained were analyzed statistically according to Snedecor and Cochron (1994).

RESULTS AND DISCUSSION

The average total dry matter intake (concentrate and roughage) was recorded to range from 278.65 ± 7.52 to 306.37 ± 18.85 gm. The overall daily DMI was recorded as 290.30 ± 21.86, 291.14 ± 23.59, 292.68 ± 19.54 and 283.93 ± 14.20 gm for control, salbutamol, terbutaline and clenbuterol group respectively. The results indicated that initially there was trend of decrease in feed intake in beta-agonist treated kids but with time this difference was decreased, which, however, was not statistically significant. .Between the periods within the group, the DMI was increased with time for all the group even though not significantly and which may be due to increase in their body weight. This was supported by Williams *et al.* (1987) in calves and Walker *et al.* (1989) in pigs who reported that beta-agonist treatment did not affect the DMI significantly. However, Yen *et al.* (1990) and Shukla*et al.* (1998) have reported decreased DMI in ractopamine fed pigs and terbutaline fed kids respectively.

The weekly mean blood glucose was found to be in the range of 47.05 ± 1.05 to 75.20 ± 11.80 mg/ dl. and did not show much difference between control and treatments groups. The results also indicated significant hypoglycaemia on day-14 in salbutamol and terbutaline group but it persisted only for about a week and thereafter the hypoglycaemic action of beta-agonists was not observed till the end of treatment. The beta-agonists have been reported as potent hypoglycemic agent on chronic administration (Carroll *et al.*, 1985) but on acute administration the plasma glucose level show only minor changes (Loubutieres *et al.*, 1971). Similar results have been reported by Sankar De (1997) and Beermann *et al.* (1987) in kids and lambs respectively.

The values of weekly mean total cholesterol concentration for control group ranged from 76.46 ± 3.22 to 86.20 ± 6.07 mg/ dl whereas it was 85.87 ± 11.02 to 114.28 ± 15.17 mg/ dl for salbutamol group, 81.97 ± 10.82 to 111.04 ± 11.73 mg/ dl for terbutaline group and 82.46 ± 8.06 to 112.98 ± 5.78 mg/ dl for clenbuterol group. The results revealed that the control group maintained almost uniform concentration throughout the experiment. Whereas the salbutamol and clenbuterol groups showed significant ($P< 0.01$) difference in total cholesterol level from day-28 to day-42, however it was not observed in terbutaline group. Within the group between periods also only in clenbuterol group significant ($P< 0.05$) difference were noticed. Shukla *et al.* (1998) reported terbutaline treated kids showed almost double the concentration over the control group but salbutamol group did not show any significant difference even though some initial increase in cholesterol was observed. Whereas Heo *et al.* (1990) reported that plasma cholesterol was not affected by clenbuterol in chicks.

As evident from the values in table – 2 upto day-7, the treatment did not have any effect on BUN. But clenbuterol showed its effect ($P< 0.05$) on BUN earlier (day-14) than the salbutamol and terbutaline. However, the maximum effects were observed in all the three treatment groups from day-21 onwards which were significant at 1% level. These differences indicate the increased utilization of plasma nitrogen for the purpose of protein deposition, as the decreased BUN is an indication of increased protein retention (Davis *et al.*, 1970). Reports of Ricks *et al.* (1984) in lambs and Sankar De (1997) in kids have confirmed the above findings. de Almeida *et al.* (2012) and See *et al.* (2004) were also reported reduction in plasma urea concentration in pigs. Thus, the results of this study indicate a positive effect of beta-agonist feeding on protein deposition in the body.

As evident from the triglycerides values presented in the table –2, the treatment showed its effect from day-7 onwards which was significant at $P< 0.05$ and the differences from day-14 onwards till end of the experiment were highly significant. The triglyceride level for the control did not differ much between periods except day-7 and day-14. The differences between treatment groups were not significant except at day-42 when clenbuterol group differed significantly with both salbutamol and terbutaline group. These results may thus indicate probable mobilization of fat leading to leanness of the body. This is in agreement with Kim *et al.* (1987) and Sankar De (1997). Reiter *et al.* (2007) and Halsey *et al.* (2011)

observed in pigs that beta agonists have positive role on reduction in lipogenesis. It is also evident from this study that clenbuterol has more potent lipolytic activity followed by salbutamol and terbutaline.

As evident from the creatine kinase activity in the table - 3, the control did not differ much between periods. But treatment showed its effect from day-21, however it was statistically significant ($P< 0.01$) only on day-42 and the effect was more in salbutamol and clenbuterol compared to the terbutaline group. However, between periods within the treatment group significant differences were observed between day-0 and day-21 with day-42 in case of salbutamol and terbutaline group whereas in clenbuterol group all the three periods differed significantly each other. The increased creatine kinase activity observed in this study was supported by Warriss*et al.* (1990) and Brenner (1988).

Table 1: Composition of ration

Concentrate	60 parts
Crushed maize	15 parts
Groundnut cake	25 parts
Wheat bran	02 parts
Mineral mixture	01 part
Salt	250 g/ 100 kg Conc.
Supplivit-M (Vitamins+Minerals)	
Roughage	
Oat hay	

Table 2: BUN and Triglyceride levels in control and treatment groups

Groups	Day-0	Day-7	Day-14	Day-21	Day-28	Day-35	Day-42
BUN (mg/dl)							
Control	18.49 ±0.61^{AB}	18.05 ±0.29^{AB}	17.78^{a} ±0.63^{A}	18.87^{a} ±1.03^{AB}	19.65^{a} ±1.09^{AB}	18.02^{a} ±0.37^{AB}	19.36^{a} ±0.65^{B}
Salbutamol	18.73 ±0.33^{A}	18.40 ±0.74^{A}	15.55^{ab} ±0.64^{B}	13.92^{bc} ±0.59^{B}	14.10 ±0.86^{B}	14.70^{b} ±0.59^{B}	13.74 ±1.05^{B}
Terbutaline	19.18 ±0.54^{A}	18.31 ±0.93^{AD}	16.06^{ab} ±0.67^{CDE}	14.99^{b} ±0.80^{BCD}	14.52 ±0.18^{BC}	15.03^{b} ±0.26^{BE}	14.08 ±0.47^{C}
Clenbuterol	17.86 ±0.69^{AB}	17.69 ±0.39^{A}	13.18^{b} ±1.10^{BCD}	11.85^{c} ±0.43^{C}	13.27 ±0.19^{CD}	13.03^{c} ±0.26^{CD}	14.08 ±0.47^{D}
Triglycerides (mg/dl)							
Control	27.58 ±1.69^{AB}	30.74^{a} ±2.21^{A}	25.29^{a} ±2.09^{B}	26.15^{a} ±2.58^{AB}	27.01^{a} ±3.12^{AB}	27.58^{a} ±2.93^{AB}	26.72^{a} ±2.62^{AB}
Salbutamol	28.73 ±1.93^{E}	52.58 ±7.40^{ABCD}	47.12 ±2.92^{AC}	61.24 ±3.34^{CD}	53.44 ±4.46^{AB}	59.19 ±1.19^{BD}	62.06^{c} ±3.78^{ABCD}
Terbutaline	30.46 ±4.84^{A}	57.47 ±6.38^{B}	51.14 ±2.19^{B}	56.61 ±1.89^{B}	53.64 ±3.29^{B}	60.53 ±3.39^{D}	63.21^{c} ±3.54^{B}
Clenbuterol	29.02 ±2.58^{E}	47.70 ±5.34^{AEF}	52.29 ±2.98^{AC}	60.63 ±3.09^{BF}	58.91 ±5.82^{ABCD}	65.52 ±3.38^{BCD}	73.51^{b} ±3.71^{D}

Means with the same superscripts (small letters) do not differ significantly: P<0.05 in the rows
Means with the same superscripts (capital letters) do not differ significantly: P<0.05 in the columns

The mean values for the plasma sodium varies from 124.00 ± 1.29 to 142.25 ± 2.49 mEq/L. The sodium values did not differ significantly between groups whereas only in clenbuterol on day-14 significant difference ($P<0.05$) was noticed compared to control group. However, within the group between periods significant differences were noticed in all the groups. Likewise for potassium also, the mean values found

to be ranged from 4.40 ± 0.20 to 5.25 ± 0.27 mEq/L. the values did not differ significantly between group except in clenbuterol group on day -7 significant decrease ($P<0.05$) was noticed compared to control group. Within the group between periods only in terbutaline group significant difference ($P<0.05$) was noticed between day-21 and day-28. The observed differences may be due to stimulation of Na-K pump activity as reported by Toshiro (1973). Also Laurence and Bennett (1994) reported that biochemical pump that shifts potassium into cell is activated by beta-agonists and can cause hypokalemia. However, Shukla *et al.* (1998) and Burr *et al.* (1982) reported that terbutaline and salbutamol in kids and terbutaline in guinea pigs respectively did not affect Na-K level.

Table 3: Creatine kinase activity (IU/L) in control and treatment groups

Groups	Day-0	Day-21	Day-42
Control	11.57	12.41	13.55^{a}
	±1.65	±2.63	±1.94
Salbutamol	11.57	22.07	37.22^{b}
	$±1.73^{A}$	$±2.96^{A}$	$±4.05^{B}$
Terbutaline	10.12	16.44	27.71^{c}
	$±1.34^{A}$	$±3.80^{A}$	$±1.43^{B}$
Clenbuterol	10.43	22.91	35.78^{b}
	$±1.30^{A}$	$±4.49^{B}$	$±1.55^{C}$

Means with the same superscripts (small letters) do not differ significantly: P<0.05 in the rows
Means with the same superscripts (capital letters) do not differ significantly: P<0.05 in the columns

Conclusion

The repartitioning activity of beta-agonists is very well studied in species like cattle, sheep, pigs and poultry. Our study confirmed the repartitioning activity in goats also. This study also indicated better repartitioning of nutrients without additional food intake. The lowered BUN level indicated protein accretion and increased triglyceride level indicated mobilization of fat leading to leanness. In this comparative study, it is also found that clenbuterol has more potent repartitioning activity followed by salbutamol and terbutaline. Thus beta-agonists may be utilized in augmentation of animal growth especially goats which contributes major proportion of meat industry in India.

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