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EFFECT OF RECOMBINANT BOVINE SOMATOTROPIN TREATMENT ON HEMATOLOGICAL AND SERUM BIOCHEMICAL VARIABLES OF YOUNG KAMORI GOAT

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ABSTRACT

The present study was carried out on sixteen young goats of Kamori breed having age 9-10 weeks and weighing 14-15 kg body weight (BW). After an adaptation period of two weeks, goats were housed in the outerdoor pens (4 animals/pen) under ambient temperature and lighting. The animals were randomly divided into two groups, C and rbST. The animals in rbST group received intramuscular injection of rbST fortnightly, at the dose rate of 1 mg/kg. BW and those in C were kept as control. The experiment lasted for a period of 22 weeks. Animals were fed adlibitum the total mixed ration as a basal diet composed of roughages and concentrates (60:40), twice a day at 08:00 am and 05:00 pm and water was provided ad libitum. The hematological analysis of blood sampled on week 10 of experiment showed an increase ($P < 0.05$) in red blood cells (RBC) count and hemoglobin concentration in rbST treated goats than that of untreated goats, however, no significant effect ($P< 0.05$) of rbST was observed on hematological parameters in the blood of goats sampled on week 22 of the experiment. The serum total protein and glucose concentrations increased ($P< 0.05$) and the total lipid concentration decreased in goats of rbST group than that of control, however, no significant change ($P< 0.05$) was found in these variables on week 22 of the experiment. The serum IGF-I concentrations increased in the blood of rbST treated on week 10 and 22 of the experiment. The serum T_3 concentration increased ($P< 0.05$) in rbST group than that of control on week 10 of trial but did not differ ($P< 0.05$) between the groups on week 22 of the trial. While the serum T_4 concentration was not different ($P< 0.05$) between the group, on week 10 and 22 of the experiment. In conclusion, the present study reveals that rbST treatment stimulated eryhthropoises and increased serum concentrations of IGF-I and T_3 in the blood of goats sampled on week 10.

Keywords: bovine somatotropin, goat, recombinant, thyroid, IGF-I

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INTRODUCTION

Pakistan is an agro-based country and possesses some important species of ruminant livestock such as cows, buffaloes, sheep and goats. Kamori goat is one of the important goat breeds of Sindh province of Pakistan, which is used for both milk and meat purpose and commonly known as poor man's cow. The goat meat is most popular in the Middle East, Africa and South Asia including Pakistan. Currently, 629 thousand tons of mutton is being produced from goats. Generally, meat is considered as valuable food for human providing many essential nutrients such as proteins, vitamins (vitamins A, B12 and E), fat (such as Omega-3 fatty acids) and minerals (Fe, Zn, Se) which are of prime importance for the growth of human body (Schonfeldt and Gibson, 2008). Despite considerable increase in milk and meat production in Pakistan, average meat protein availability per capita is 17 g as compared to 27 g/day minimum daily allowance requirements as recommended by WHO. The shortage in protein requirement is because of increasing human population at the rate of 3% annually (Bilal ., 2006). Moreover, a lot of goats are slaughtered on the occasion of Eid-al-ada. This exerts a lot of pressure on the meat industry to produce large quantities of qualitative, healthier and lean meat. One of the strategies to achieve an increase in meat production could be proper management and enhanced growth performance of young Kamori goats through the use of growth promoter like recombinant bovine somatotropin (rbST).

The rbST, an analogue of growth hormone, is synthesized and manufactured by using recombinant DNA (rDNA) technology, which is widely used as galactopoietic in lactating animals and as growth promoter in young and growing animals. The treatment of animals with exogenous rbST improves feed efficiency, increases growth rate and alters carcass characteristics (Eisemann *et al*., 1989; Govoni *et al*., 2004; Mellado *et al*., 2012). The rbST has shown a considerable shift in the partitioning of nutrients towards an increase in protein and decrease in fat deposits (Fabry *et al*., 1991; Rumsey *et al*., 1996). Nour-El-Din *et al*. (2009) reported an increase in total protein concentration and decrease in triglycerides and cholesterol concentrations in the blood serum of lambs treated with rbST compared to those of untreated. The rbST has also been shown to affect the concentrations of certain hormone in the blood. It is believed that rbST-induced growth performance, at least in part, is mediated by elevating circulating hormonal levels of insulin and insulin-like growth factor (IGF-I) (Holzer *et al*., 2000; Cook *et al*., 2013). Variable effects on hemotology have been shown in response to rbST treatment. The rbST treatment produced no effect on hematological variables in primparous and multiparous lactating cows (Azza *et al*., 2010) and buffaloes (Khaliq and Rahman, 2010). Eppard *et al*. (1997) reported a decrease in RBC count during rbST treatment. Nour-El-Din *et al*. (2009) did not observe any change in hemotological parameters in lambs injected with biweekly rbST at the dose rate of approximately 3.5 mg/kg. BW. However, the previous studies vary in many regards, for example, species, breed, age, sex, physiological and nutritional status of animals, dose of the rbST and duration of the experiment. Most of the studies have evaluated short term effect of rbST. Moreover, most of the studies have been conducted on cattle and sheep and very little research has been conducted on goats to evaluate the effects of rbST as growth promoter. The blood biochemical and hematological

variables are the important indices of animal health. The current study was therefore, conducted to evaluate the effects of rbST treatment on blood biochemical and hematological variables of young Kamori goats.

MATERIALS AND METHODS

Sixteen young goats of Kamori breed having age 9-10 weeks and weighing 14-15 kg were used in the present study. The current study was carried out at livestock experimental station, Department of Livestock Management, Sindh Agriculture University Tandojam. After an adaptation period of minimum two weeks, goats were housed in the outerdoor pens with cemented floors, in groups of 4 per pen, under ambient temperature and lighting. The animals were randomly divided into two groups, C and rbST. The animals in rbST group received intramuscular injection of rbST (Boostin-S, LG Life Sciences, Korea) fortnightly, at the dose rate of 1 mg/kg. BW and those in C were kept as control. The experiment lasted for a period of 22 weeks. Animals were fed total mixed ration (TMR) as a basal diet composed of roughages and concentrates with the ratio of 60:40. The concentrates were composed of cotton seed cake, crushed maize, wheat bran, moong Kutta and rice polish. The diet was chemically composed of crude protein 16%, total digestible nutrients (TDN) 68%, crude fiber 18.5%, calcium 1.05% and phosphate 0.6%. Goats were fed ad libitum twice a day at 08:00 am and 05:00 pm and water was provided ad libitum.

Blood samples of goats were taken on week 10 and 22 by jugular vein puncture. The portion of fresh blood samples were immediately collected in heparinised tubes for haematological analysis. Another portion of blood samples were collected without any anticoagulant and centrifuged at 3000 rpm for 20 min and the serum was collected and then stored at –20 °C for later analysis. Serum biochemical concentrations such as total protein, total lipids and glucose were analyzed using commercial enzymatic colorimetric kits (Merk, Germany). Serum insulin-like growth factor (IGF-1) concentration was determined using a commercial kit (IGF-1- ELISA, Biosource, Europe SA, B-1400 Nivelles, Belgium) and serum triiodothyronine (T3) and tetraiodothyronine (T4) concentrations were determined by using commercial kits (Abbott Laboratories, Abbot Park 60064 IL, USA). Data presented as (Mean ± SEM) were determined by Student's t test using statistical software SPSS 12.0 (StatSoft, Tulsa, OK, USA). Significance was considered at $P< 0.05$.

RESULTS

The heamotological indices of goats before the commencement of experiment were within normal ranges and did not vary significantly ($P> 0.05$) between the groups (Table 1). The hematological analysis of blood sampled on week 10 of experiment showed a significant increase ($P< 0.05$) in red blood cells (RBC) and hemoglobin concentrations in rbST treated goats as compared to that of untreated goats, however, no significant effect ($P> 0.05$) of rbST was observed on hematological parameters in the blood of goats sampled on week 22 of the experiment.

Table 1. Effect of rbST treatment on the haemotological indices of goats

Items	Groups		P-Value
	Control (C)	rbST	
Week 0			
Hemoglobin (g/dL)	10.47 ± 1.55	10.19 ± 1.32	0.724
RBC (x10^6/uL)	5.71 ± 0.72	5.78 ± 0.74	0.694
WBC (x10^3/µL)	9.91 ± 2.00	10.32 ± 3.76	0.562
Platelets (x10^3/µL)	146.1±101	148.6 ± 65.82	0.774
Week 10			
Hemoglobin (g/dL)	10.55 ± 0.44	12.04 ± 0.28	0.031
RBC (x10^6/uL)	5.71 ± 0.39	8.65 ± 0.82	0.048
WBC (x10^3/µL)	9.98 ± 2.96	10.21 ± 2.05	0.764
Platelets (x10^3/µL)	146.57 ± 73.54	146.32 ± 75.93	0.733
Week 22			
Hemoglobin (g/dL)	10.28 ± 1.29	10.37 ± 1.40	0.638
RBC (x10^6/uL)	5.68 ± 0.76	5.73 ± 0.73	0.861
WBC (x10^3/µL)	10.28 ± 3.71	10.19 ± 2.01	0.764
Platelets (x10^3/µL)	147.33 ± 63.78	147.18 ± 75.82	0.733

Goats in rbST group were treated with recombinant bovine somatotropin @ 1.0 mg/kg. BW where as animals in group C were kept as control. Values are mean±SE

Table 2 shows the serum concentrations of total proteins, total lipids and glucose of goats. The results showed that the serum biochemical variables were not different ($P > 0.05$) between the groups before the start of trial (week 0). Analysis of blood sampled on week 10 of experiment showed that the serum total protein and glucose concentrations increased ($P < 0.05$) and the total lipids concentration decreased in goats of rbST group as compared to control, however, no significant change ($P > 0.05$) was found in these variables on week 22 of the experiment.

The concentrations of insulin-like growth factor-I (IGF-I), T_3 and T_4 in serum of goats are shown in Table 3. The results revealed that the serum concentrations of IGF-I, T_3 and T_4 of goats were not significantly different ($P > 0.05$) between the groups before the commencement of experiment (week 0). Analysis of blood sampled on week 10 and 22 of experiment showed that the serum IGF-I concentrations significantly ($P < 0.05$) increased in goats of rbST group as compared to control. Analysis of thyroid hormones in the serum of goats revealed an increase in T_3 concentration in rbST group compared with control on week 10 of trial but did not differ ($P > 0.05$) on week 22 of the trial. Whereas T_4 concentrations in serum of goats were not different ($P > 0.05$) between the group on week 10 and 22 of the experiment.

Table 2. Effect of rbST treatment on the concentrations of total proteins, total lipid and glucose in serum of goats

Items	Groups		P-Value
	Control (C)	rbST	
Week 0			
Glucose (mg/dl)	43.2 ± 15.05	46 ± 13.56	0.785
Total protein (mg/dl)	6.44 ± 0.54	6.25 ± 0.75	0.881
Total lipids (mg/dl)	528 ± 59.62	533.7 ± 40.24	0.792
Week 10			
Glucose (mg/dl)	42.86 ± 15.49	51.17 ± 15.70	0.045
Total protein (mg/dl)	6.58 ± 0.54	7.32 ± 0.53	0.038
Total lipids (mg/dl)	516.65 ± 57.03	451.73 ± 53.34	0.001
Week 22			
Glucose (mg/dl)	45.2 ± 14.23	47 ± 15.56	0.741
Total protein (mg/dl)	6.18 ± 0.43	6.38 ± 0.68	0.830
Total lipids (mg/dl)	531 ± 51.63	537 ± 60.43	0.628

Goats in rbST group were treated with recombinant bovine somatotropin @ 1.0 mg/kg. BW where as animals in group C were kept as control. Values are mean±SE

Table 3. Effect of rbST treatment on the concentrations of insulin-like growth factor-I (IGF-I), T_3 and T_4 in serum of goats

Items	Groups		P-Value
	Control (C)	rbST	
Week 0			
IGF-I (ng/mL)	47.03 ± 13.05	45.93 ± 10.88	0.678
T_3 (nmol/L)	2.86 ± 0.63	2.78 ± 0.69	0.381
T_4 (nmol/L)	91.50 ± 12.44	77.28 ± 26.58	0.711
Week 10			
IGF-I (ng/mL)	47.28 ± 14.93	51.42 ± 11.20	0.048
T_3 (nmol/L)	2.66 ± 0.75	3.08 ± 0.58	0.034
T_4 (nmol/L)	78.18 ± 12.44	74.76 ± 26.58	0.528
Week 22			
IGF-I (ng/mL)	45.71 ± 13.83	50.25 ± 11.20	0.036
T_3 (nmol/L)	2.51 ± 0.61	2.47 ± 0.73	0.754
T_4 (nmol/L)	73.22 ± 15.17	77.86 ± 23.43	0.528

Goats in rbST group were treated with recombinant bovine somatotropin @ 1.0 mg/kg. BW where as animals in group C were kept as control. Values are mean±SE

DISCUSSION

The use of rbST as a growth promoter in young animals has been shown to improve growth performance (Nour-El-Din *et. al*., 2009) but its effects on hematological and biochemical indices have not been much studied particularly in goats. Goats are predominantly found in South Asian regions including Pakistan which supply milk, meat and other byproducts as an important source of animal protein. It is of prime importance to take measures to enhance their growth rates and maintain health in order to fulfill the protein requirement of

animal origin for ever growing population of the country. Hemotological and biochemical parameters are important indices of animal health. The present study evaluated the hemotological effects of rbST treatment in kids.

In the current study, the rbST treatment increased RBC count and hemoglobin concentration in the blood of goats sampled on week 10 of the treatment than those of untreated goats; however, the RBC count in blood of goats sampled on week 22 was not different between the groups. Moreover, the increase in RBC count and hemoglobin concentration was within normal range. Consistent with our results, previous studies have shown an increase in RBC and hemoglobin levels of buffalo calves treated with rbST at the dose rate of 1 mg/kg. BW for 10 weeks. In contradiction to our results, Eppard *et al.* (1997) observed that rbST treatment decreased RBC count in cattle. While other researchers reported no significant change in RBC count in the blood of heifers (Prado *et al*., 2003), primparous as well as multiparous lactating cows (Azza *et al.,* 2010) and buffaloes (Khaliq and Rahman, 2010). Moreover, lambs receiving rbST injections at the dose of 3.5 mg/kg. BW, fortnightly, did not show any change in RBC count than that of control lambs (Nour-El-Din *et. al.,* 2009). The dose used in their experiment was higher than the dose we used in the present study. The discrepancies in the effect of rbST treatment on RBC count suggest that effects of rbST depend on species, physiological status of the animal, dose and duration of the treatment. Previous studies have shown an improvement in growth performance of animals treated with rbST (Gavidia *et. al.,* 2001) and the stimulation of erythropoiesis during growth is necessary to ensure proportionality between erythrocyte mass and body mass (Kurtz *et. al.,* 1988). This suggests that the rbST-induced growth might reach at its maximum in two weeks and the rapid increase in tissue mass might not received proper oxygen (tissue hypoxia) which might stimulated the release of erythropoietin and ultimately resulted in increased erythropoiesis (RBC production). The increasing demand of oxygen to the tissue is also evident from the higher serum T_3 concentration in rbST treated goats. This suggests that the treatment of animals with rbST at growing stage increases thyroid status and stimulate the conversion of inactive thyroid hormone (T_4) to the active form (T_3) and thereby increase the basal metabolic rate and ultimately the growth of the animal. Our results are in agreement with Holzer (2000) who found the tendency to increase in plasma T_3 concentration of bulls treated with rbST than those of untreated. Moreover, the rbST might have direct effect on hemopoietic stem cells. Furthermore, the rbST-induced erythropoiesis might be mediated by IGF-I as in the present study, we found elevated serum IGF-I concentration in rbST treated kids. Previous studies have also shown an elevation in serum IGF-1 concentration of cattle treated with rbST (Burton *et al.,* 1991; Cooke *et al*., 2013) and the IGF-I has been shown to stimulate erythropoiesis either directly or through release of erythropoietin (Kurtz *et al.,* 1988).

In the current study, the serum glucose and total protein concentrations increased while the serum total lipid concentration decreased in rbST treated kids compared to that of untreated. Consistent with our findings, Nour-El-Din *et al*. (2009) and McLaughkin *et al*. (1991) reported an increase in the serum glucose and total protein concentrations and decrease in the serum total lipid concentration in rbST treated lambs than that of control. The rbST treatment has

been shown to stimulate glucose metabolism in cows (Gulay *et al*., 2004), which may be due to decreased peripheral oxidation of glucose, increased rates of gluconeogensis in the liver (Cohick *et al*., 1989; Bauman *et al*., 1993). The increase in serum total proteins in rbST treated goats may be due to increase in protein synthesis rate to cope with increasing growth rate of animals as rbST has been shown to increase nitrogen (N) retention and carcass protein content in cattle (Wagner *et al.*, 1988; Moseley *et al*., 1990). Similarly, the reduction in serum total lipid in rbST treated goats may be due to decreased fat absorption as evidenced by decreased carcass fat content in the cattle (Wagner *et al*., 1988; Moseley *et al*., 1990).

CONCLUSION

In conclusion, the present study reveals that rbST treatment stimulated eryhthropoises and increased serum concentrations of IGF-I and T_3 in the blood of goats sampled on week 10. The erythropoietic effect and elevation in serum T_3 concentrations were not found in the blood of goats sampled on week 20, however, the serum IGF-I concentrations were found higher. It could be suggested from our results that the rbST induced-growth in the young goats may be partly associated with both IGF-I and T_3 at the early stage of life and at the later stage of life, rbST treatment produces growth through the stimulation of IGF-I.

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