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Growth, haematological and biochemical responses of growing lambs injected with growth hormone and supplemented with calcium soaps of fatty acids

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Abstract

Physiological and productive responses to recombinant bovine somatotropin (rbST) injection and calcium soap of fatty acids (CSFA) supplementation were studied in post-weaning male Rahmani lambs. Male lambs (n = 20) of similar initial body weight (27.9 kg) and age (162 d) were divided randomly into four equal groups. The first was fed the injected with 100 mg of rbST biweekly; the third (basal diet and served as control; the second (GH) was CSFA) was supplemented with 50 g/d of CSFA and the fourth (GH + CSFA) was injected with 100 mg of rbST biweekly plus 50 g/d of CSFA. Treatments increased the average daily gain and final body weight. Concentration of insulin-like growth factor-1 (IGF-1) in lambs treated with (GH) and (GH + CSFA) was higher than that of CSFA and control groups. Haematological parameters (RBC, WBC, and haemoglobin concentrations) did not change. Animals injected with rbST had higher serum total protein than other treated groups and controls. Control lambs showed the least serum albumin concentration. Injection of rbST and supplementation of CSFA increased serum glucose in treated lambs compared to controls. Serum urea concentration was not affected by injection of GH, while CSFA supplementation decreased serum urea concentration compared to the control. Serum triglycerides concentration decreased in rbST-injected lambs than other treatment groups. Lambs supplemented with CSFA only or combined with rbST had higher concentration of serum cholesterol than control or rbST-injected lambs. The results of the present study suggest that rbST and CSFA may increase the average daily gain and improve the physiological status of growing lambs.

Keywords: rbST, CSFA, average daily gain, IGF-1, cholesterol
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Introduction

Exogenously administered somatotropin is one biotechnology tool that increases growth rate, improves feed efficiency, and increases the proportion of lean to fat tissue in the carcasses of lambs (Mclaughlin *et al*., 1991. Growth hormone exerts some of its actions on skeletal muscles growth via IGF-1, thus the concentration of IGF-1 in blood is generally increased by somatotropin treatment (Vestergaard *et al*., 2003; Govoni *et al*., 2004). Commercial products based on calcium soaps of fatty acids (CSFA) are widely used in dairy rations, while these products are less used for growing steers or growing lambs diets (El-Bedawy *et al*., 2004). Bypass fats are hydrolyzed to their polyunsaturated fatty acids and glycerol, a precursor for glucose (Morsy, 2008). Moreover, Moallem *et al*. (1997) reported that plasma urea concentrations were decreased in high producing dairy cows fed calcium soaps of fatty acids, reflecting the better utilization of amino acids as reviewed by Etherton & Bauman (1998). The objectives of this study were to determine the separate and combined mechanisms by which rbST administration and calcium soap of fatty acids affect growth rate, serum IGF-1 concentration, haematological parameters as well as serum biochemical parameters in growing Rahmani lambs.

Materials and Methods

Twenty weaned crossbred lambs (initial live weight 27.9 ± 1.8 kg) of 162 ± 5 days of age were assigned randomly to four equal treatment groups, five animals each. Groups were balanced for mean age and body weight. Animals were offered berseem hay *ad libitum* and commercial concentrate mix containing at least 140 g crude protein/kg. Animals had free access to fresh drinking water. Animals were housed in shaded barns in separate groups. The first group was fed the basal diet and received no further treatment and

served as a control. The second group was fed the basal diet plus 50 g/head/day of protected fat (calcium soaps of fatty acids; CSFA; Megafat, Alfa Chemical Co, Alexandria, Egypt). The third group was fed the basal diet plus biweekly injections of 100 mg/head of sustained release formulation of recombinant bovine somatotropin (rbST; Somatec, Elanco-Eli Lilly export, S.A. Geneva). The fourth group was fed the basal diet plus 50 g/head/day of CSFA and received an injection of 100 mg/head/14 days of rbST.

Lambs were weighed biweekly in the mornings before access to feed and water. Blood was collected by jugular vein puncture one week after each rbST injection. Blood samples were immediately collected in heparinised tubes for fresh haematological blood analysis. Remaining blood was centrifuged at 3000 rpm for 20 min and serum was harvested and stored at –20 °C for later analysis. Concentrations of serum insulin-like growth factor (IGF-1) were determined using a commercial kit (IGF-1- ELISA, Biosource, Europe SA, B-1400 Nivelles, Belgium). Serum concentrations of total protein, albumin, glucose, urea and cholesterol were determined using commercial enzymatic colorimetric kits (Diamond Diagnostics, Egypt). Serum triglyceride concentrations were determined using Commercial kit (BioSystems S.A. Costa Brava 30, Barcelona, Spain). Globulin concentrations were calculated as the difference between total protein and albumin. Data was analyzed by the general linear model (GLM) procedure using SAS statistical package (SAS, 1999). The model included rbST and CSFA as main effects and their interaction. Duncan's Multiple Range Test was used to test variations between means.

Results

Initial age and weight of lambs were similar among treatment groups. Mean final weights were 41.5, 46, 48 and 47 kg in control, GH, CSFA and GH plus CSFA lambs, respectively (Table 1). Average daily gain increased ($P < 0.05$) in all groups. Serum concentrations of insulin-like growth factor-1 (IGF-1) in lambs treated with GH and GH + CSFA were higher ($P < 0.01$) than those receiving the CSFA and the controls (Figure 1).

Table 1 Effect of growth hormone (GH) and calcium soaps of fatty acids (CSFA) on body weight and average daily gain of growing lambs (mean ± s.e.)

Variable	Groups			
	Control	GH	CSFA	GH + CSFA
Initial weight (kg)	27.8 ± 1.3	28.5 ± 1.8	27.65 ± 2.5	27.66 ± 2.5
Final weight (kg)	41.5^{b} ± 3.3	46.0^{a} ± 1.2	48.0^{a} ± 3.4	47.0^{a} ± 2.5
Average daily gain (g/d)	80.9^{b} ± 19.7	103.2^{a} ± 14.0	119.7^{a} ± 15.6	113.8^{a} ± 20.7

$^{a, b, c}$ Means with different superscripts within rows differ ($P < 0.05$).

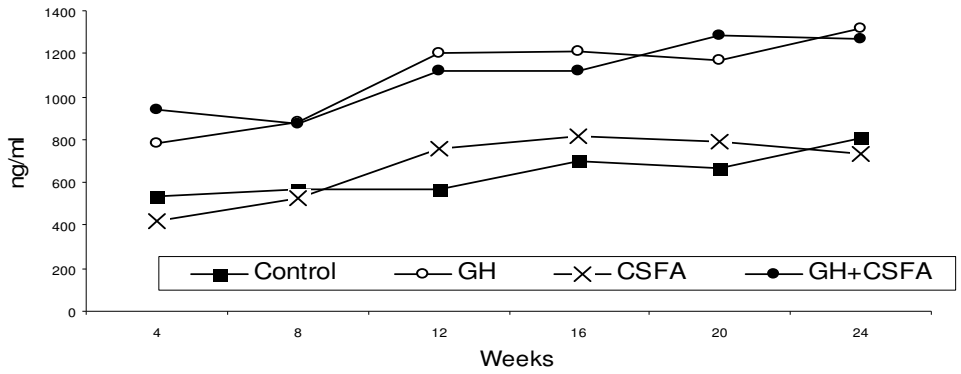

Figure 1 Effect of growth hormone (GH) injection and calcium soaps of fatty acids (CSFA) supplementation on insulin-like growth factor-1 (IGF-1) concentrations in growing lambs.

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Table 2 Effect of growth hormone (GH) injection and calcium soaps of fatty acids (CSFA) supplementation on blood haematological parameters of growing lambs (means ± s.e.)

Parameter	Groups			
	Control	GH	CSFA	GH + CSFA
RBCs (x 10^6/mL)	13.70 ± 0.37	14.21 ± 0.22	13.79 ± 0.34	13.82 ± 0.32
WBCs (x 10^3/mL)	16.65 ± 0.31	16.33 ± 0.53	16.87 ± 0.30	16.47 ± 0.31
PCV %	32.81 ± 0.44	32.82 ± 0.40	32.75 ± 0.32	32.40 ± 0.41
Hb (g/100 mL)	10.45 ± 0.18	10.60 ± 0.14	10.58 ± 0.11	10.63 ± 0.19

Table 3 Effect of growth hormone (GH) and calcium soaps of fatty acids (CSFA) on serum biochemical parameters of growing lambs (mean ± s.e.)

Parameter	Groups			
	Control	GH	CSFA	GH + CSFA
Total protein (g/100 mL)*	6.69^b ± 0.06	7.30^a ± 0.05	6.58^b ± 0.04	6.58^b ± 0.06
Albumin (g/100 mL)*	3.12^c ± 0.06	3.26^b ± 0.03	3.54^a ± 0.04	3.33^b ± 0.05
Globulin (g/100 mL)*	3.57^b ± 0.05	4.03^a ± 0.05	3.04^d ± 0.05	3.25^c ± 0.05
Glucose (mg/100 mL)*	54.0^b ± 1.49	60.9^a ± 1.70	63.6^a ± 1.26	62.7^a ± 1.19
Urea (mg/100 mL)**	53.4^a ± 1.41	54.0^a ± 1.03	37.8^b ± 0.79	39.9^b ± 0.70
Triglycerides (mg/100 mL)**	53.0^a ± 1.50	26.8^b ± 1.12	57.5^a ± 1.45	57.7^a ± 1.39
Cholesterol (mg/100 mL)*	14.7^b ± 0.86^b	12.6^b ± 0.78	24.8^a ± 1.42	24.8^a ± 1.61

Means with different superscripts within rows differ: * at P <0.05; ** at P <0.01.

Haemoglobin concentrations (Hb), red blood cells count (RBCs), white blood cells count (WBCs), and packed cells volume (PCV) did not differ among treatment groups and the control (Table 2). Serum total protein in the GH group was higher (P <0.05) than the other groups (Table 3). The Control had lower (P <0.05) serum albumin concentrations than the treated groups. Moreover, CSFA group alone had higher (P <0.05) albumin concentrations than the GH or GH + CSFA groups. However, serum globulin concentration was extremely variable among all groups; and the GH group had the highest concentration of serum globulin. Glucose concentrations were increased (P <0.05) by GH injection and CSFA supplementation. Serum urea concentrations were not affected by the CH injection, while CSFA supplementation decreased (P <0.01) serum urea concentrations compared to the control. On the other hand, serum triglycerides concentrations were lower (P <0.01) in GH lambs than in the remaining groups. Lambs supplemented with CSFA only or combined with GH had higher (P <0.05) concentration of serum cholesterol than the control or GH lambs.

Discussion

Average daily gain of growing lambs was improved by treatment with GH and CSFA either alone or combined. The current findings are in agreement with those reported by McLaughlin *et al.* (1991) and Beermann et al. (1990) who reported 16 – 18% increase in growth rates of growing lambs treated with rbST. However, growth performance of Pelibuey lambs was not influenced by the inclusion of different levels of calcium soaps of tallow in diets (Salinas *et al*., 2006). Moreover, treatment with GH alone or combined with CSFA increased serum concentrations of IGF-I similar to Govoni *et al*. (2004) and Godferson *et al*. (1990) who reported that administrations of exogenous forms of GH increased serum IGF-I in Herford calves and growing wethers, respectively. No marked changes were found in haematological parameters in the current study, which is consistent with previous results reported by Sallam *et al*. (2005).

In the current study GH-treated lambs had elevated serum total protein, albumin, globulin, and glucose concentrations compared to controls. Serum urea and cholesterol concentrations were not affected by GH injections, while serum triglycerides concentrations were decreased. The present results are in part similar to those reported by McLaughlin *et al*. (1991) where lambs treated with rbST had greater serum glucose and

albumin concentrations than controls while urea concentrations were decreased in rbST-treated lambs. GH dramatically reduced fatty acids synthesis in adipose tissue and decreased adipocytes hypertrophy (Dunshea *et al.*, 1992). This may illustrate the cause of reduction in serum triglycerides concentration in lambs treated with rbST. However, the current results showed that CSFA increased serum cholesterol. Fat supplementation markedly increases lipoprotein cholesterol export by the intestine, the major site of de novo cholesterol synthesis in ruminants (Noble, 1981). Similar data were reported by Espinoza *et al*. (1997) where cholesterol was elevated in Pelibuey ewes fed CSFA. Further, CSFA supplementation alone or combined with GH decreased serum concentrations of urea which is consistent with previous findings by Moallem *et al*. (1997) and Metwally *et al*. (2006) in dairy cows fed protected fats. This decrease in urea may be explained by improved efficiency of amino acids utilization and increased protein accretion.

In conclusion, injection of rbST and supplementation of CSFA improved average daily gain and serum IGF-1 of growing Rahmani lambs. CSFA-supplementation decreased serum urea concentration indicative of increased protein utilization, while rbST-injection decreased serum cholesterol and triglycerides concentrations. Therefore, GH injections either alone or combined with protected fats can be used to improve growth performance in growing lambs.

References

Beermann, D.H., Hogue, D.E., Fishell, V.K., Aronica, S., Dickson, H.W. & Schricker, B.R., 1990. Exogenous human growth hormone-releasing factor and ovine somatotropin improve growth performance and composition of gain in lambs. J. Anim. Sci. 68, 4122-4133.

Dunshea, F.R., Harris, D.M., Bauman, D.E., Boyd, R.D. & Bell, A.W., 1992. Effect of porcine somatotropin on in vivo glucose kinetics and lipogenesis in growing pigs. J. Anim. Sci. 70, 141-151.

El-Bedawy, T.M, Ahmed, S.M, Salem, M.A.I. & Omer, H.A.A., 2004. Effect of dietary protected fat and voughage level on digestion, rumen metabolism and plasma lipids of growing-finishing lambs. Egyptian J. Anim. Prod. 41, 219-236 (suppl.).

Espinoza, J.L., Ramirez-Godinez, J.A., Simental, S.S., Jimenez, J., Ramirez, R., Palacios, A. & De Lun, R., 1997. Effect of calcium soaps of fatty acids on serum hormones and lipid metabolites in Pelibuey ewes. Small Rumin. Res. 26, 61-68.

Etherton, T.D. & Bauman, D.E., 1998. Biology of somatotropin in growth and lactation of domestic animals. Physiol. Rev. 78, 745-761.

Godfredson, J.A., Wheaton, J.E., Crooker, B.A., Wong, E.A., Campbell, R.M. & Mowles, T.F., 1990. Growth performance and carcass composition of lambs infused for 28 days with a growth hormone-releasing factor analogue. J. Anim. Sci. 68, 3624-3632.

Govoni, K.E., Hoagland, T.A. & Zinn, S.A., 2004. The ontogeny of the somatotropic axis in Hereford calves from birth to one year of age and its responses to administration of exogenous bovine somatotropin. J. Anim. Sci. 82, 1646-1655.

McLaughlin, C.L., Rogan, G.J., Buonomo, F.C., Cole, W.J., Hartnell, G.F., Hudson, S., Kasser, T.R., Miller, M.A. & Baile, C.A., 1991. Finishing lamb performance responses to bovine and porcine somatotropin administered by alzet pumps. J. Anim. Sci. 69, 4039-4048.

Metwally, A.M., Abdel-Raouf, E.M., Shitta, A.A. & El-Diahy, Y.M., 2006. Effect of fat supplementation on productive and reproductive performance of lactating Friesian cows during early lactation. J. Agric. Sci., Mansoura Univ. 31, 159-174.

Moallem, U., Kaim, M., Folman, Y. & Sklan, D., 1997. Effect of calcium soaps of fatty acids of administration of somatotropin in early lactation of productive and reproductive performance of high producing dairy cows. J. Dairy Sci. 80, 2127-2136.

Morsy, A.S., 2008. Reproduction and production performance of ewes fed diets supplemented with calcium soaps of fatty acids. MSc thesis, Faculty of Agric., Alex. Univ., Egypt.

Salinas, J., Ramírez, R.G., Domínguez, M.M., Reyes-Bernal, N., Trinidad-Lárraga, N. & Montaño, M.F., 2006. Effect of calcium soaps of tallow on growth performance and carcass characteristics of Pelibuey lambs. Small Rumin. Res. 66, 135-139.

Sallam, S.M.A., Nasser, M.E.A. & Yousef, M.I., 2005. Effect of recombinant bovine somatotropin on sheep milk production, composition and some hemato-biochemical components. Small Rumin. Res. 56, 165-171.

SAS, 1999. SAS/STAT User's Guide. Version 8.2. SAS Institute, Inc., Cary, N.C., USA.