Effect of Body Weight Gain and Bovine Somatotropin Treatment on Plasma Concentrations of IGF-I in Postpartum Beef Cows

M.J. Prado-Cooper, M.P. Davis, N.M. Long, I. Rubio, R.P. Wettemann, L.J. Spicer

Story in Brief

Effect of body weight gain and recombinant bovine somatotropin (bST) on insulin like growth factor I (IGF-I) concentrations in plasma were determined during early lactation in postpartum beef cows. Angus x Hereford cows were stratified based on calving date and body condition score (BCS; 1= emaciated; 9= obese), at calving, and randomly assigned to a 2 x 2 factorial: weight gain (WG) of either < 0.4 kg/d (M, n= 18) or ≥ 0.4 kg/d (H, n= 19), and treatment with bST (250 mg of POSILAC®, Monsanto) or saline (controls, C) at 31 and 45 d after calving. Cows were fed a supplement and grass hay. Concentrations of IGF-I, glucose and insulin were quantified in plasma collected twice a week from d 24 until d 59 after calving. Before bST treatment, H had greater ($P<0.05$) concentrations of IGF-I in plasma compared with M cows. After bST treatment, there was a WG x bST x day effect ($P<0.001$) on plasma IGF-I. Concentrations of IGF-I in plasma on d 21 were greater ($P<0.001$) in HbST compared with MbST, MC or HC. After bST treatment, concentrations of glucose in plasma were greater ($P<0.01$) in HbST compared with HC, MC and MbST. Concentrations of insulin on d 17 were greater ($P<0.001$) in H compared with M cows. Weight gain and treatment with bST did not influence the percentage of cows with luteal activity by 60 d after calving. Weight gain of young, lactating beef cows, influenced plasma concentrations of IGF-I after treatment with bST. Further studies are needed to evaluate the effects of weight gain and bST on ovarian function and reproductive performance of beef cows.

Key Words: Beef Cows, Insulin-Like Growth Factor, Postpartum, Somatotropin, Body Weight Change

Introduction

IGF-I is a protein hormone that stimulates body growth, ovarian function, and ovarian follicular steroid production. Nutrient intake and BCS influence concentrations of IGF-I in plasma (Lents et al., 2005). Cows with greater body condition scores and/or on greater nutrient intake have greater concentrations of IGF-I in plasma. Bossis et al. (1999) found greater IGF-I concentrations in plasma of beef heifers fed to maintain BCS compared with nutritionally restricted heifers. Treatment with bST increased concentrations of IGF-I in plasma of cattle (Bilby et al., 2004). We hypothesized that body weight gain of postpartum beef cows influences IGF-I concentrations in plasma after treatment with recombinant bovine somatotropin. The objective of this study was to determine the effects of postpartum weight gain and treatment with bovine somatotropin (bST) on concentrations of IGF-I in plasma during early lactation.

Materials and Methods

Angus x Hereford beef cows (n= 37) were fed to gain either < 0.4 kg/d (M, n= 18) or ≥ 0.4 kg/d (H, n= 19) and half of the cows in each group were treated with bST or saline injection (s.c., 250 mg, POSILAC®, Monsanto), at 31 ± 4 (d 0) and 45 ± 4 d after calving. Body weight and BCS were recorded at -7 and 28 d. During 5 to 60 d post partum, M cows received 1.8 kg/d of a 40% CP supplement and H cows had free access to a high energy supplement (1.61 Mcal NE_m/kg DM, 0.9 Mcal NE_g/kg DM, and 11.1% CP) composed (DM basis) of: rolled corn (39.7%), ground alfalfa pellets (35.5%), cottonseed hulls (22%), cane molasses (2.5%) and salt (0.3%). Cows on both treatments had free choice access to hay (6% CP).

Blood was collected from caudal veins into vacutainer tubes containing EDTA, stored on ice, centrifuged at 4°C within 3 h after collection, and plasma was recovered and stored at -20°C. Plasma concentrations of glucose and IGF I were quantified on d -7, -4, 0, 3, 7, 10, 14, 17, 21, 24 and 28 by a colorimetric procedure and radioimmunoassay, respectively. Plasma concentrations of insulin were quantified on d -7, 0, 3, 7, 14, 17, 21 and 28 by radioimmunoassay. Plasma concentrations of glucose, IGF-I, and insulin were analyzed as a completely randomized 2 x 2 factorial using the Mixed Model procedure of SAS (PROC MIXED). The statistical model included WG, treatment, date, block (day of laboratory analysis), and the interactions. Block was considered to be random and all others effects in the model were considered fixed. All interactions among WG, treatment and date were included in the initial model. Those interactions that were non-significant (P>0.30) were eliminated from the model.

Results and Discussion

Before bST treatment, H had greater (P<0.05) concentrations of IGF-I in plasma compared with M cows (Table 1).

Table 1. Least squares mean BCS and concentrations of IGF-I (ng/mL) in plasma of high and moderate body weight gain cows before treatment with somatotropin (bST) or saline (C)

	Body weight gain	
	High	Moderate
IGF-I (ng/mL) (d -7 to 0)	42.3 ± 3.7 [a]	30.6 ± 3.7 [b]
BCS (d 0)	4.4 ± 0.4	4.7 ± 0.4

[a, b] Means with different letter differ P<0.05

Spicer et al. (2002) found that beef cows that calved with BCS ≥ 5 had greater IGF-I in plasma than cows with BCS < 5. Cows on the H treatment gained 1.4 kg/d while M cows lost 0.2 kg/d. Greater nutrient intake increased concentrations of IGF-I in plasma of beef cows (Richards et al., 1991) and beef heifers (Bossis et al., 1999; Ciccioli et al, 2003), and Lents et al. (2005) found that nutrient intake has a greater influence on IGF-I concentrations in plasma than BCS in gestating beef cows. Increased nutrient intake after calving of primiparous beef cows stimulated secretion of anabolic hormones such as IGF-I and insulin (Ciccioli et al., 2003).

After treatment with bST, there was a WG x bST x day effect (P<0.001), on plasma IGF-I. Concentrations of IGF-I in plasma on d 21 were greater (P<0.001) for cows on H gain treated with bST (HbST, n= 10) compared with all other treatments; IGF-I concentrations were similar for the M gain cows treated with bST (MbST, n= 8), M gain control cows (MC, n= 10) or H gain control cows (HC, n= 9) (Figure 1).

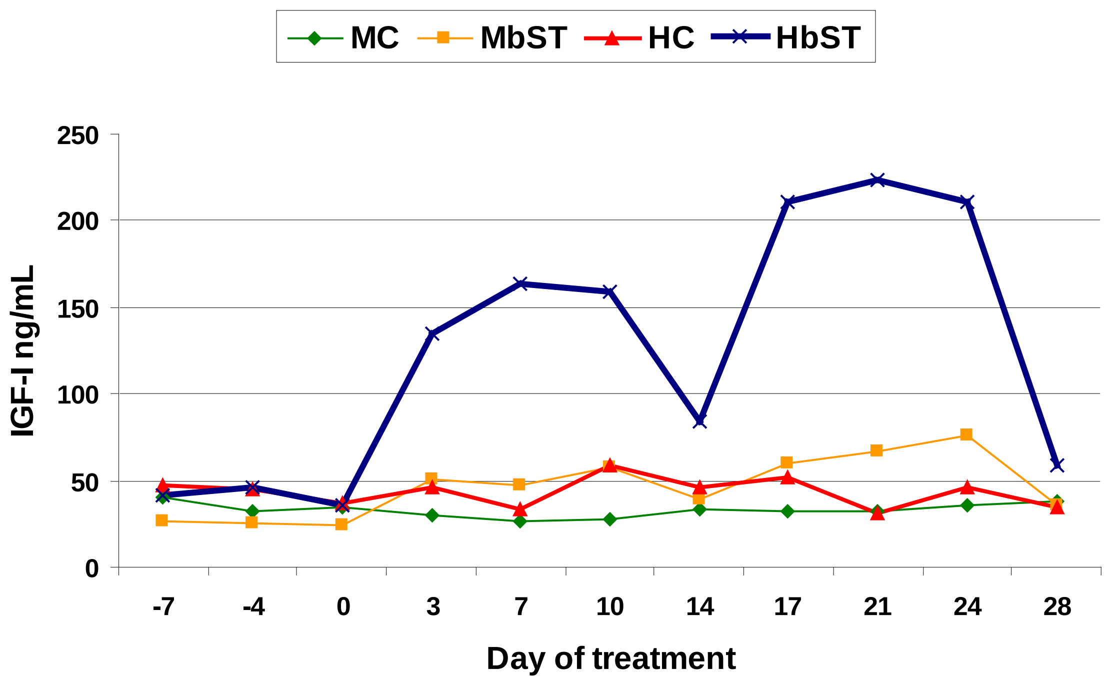

Figure 1. Concentrations of IGF-I in plasma of lactating beef cows on moderate (M) and high (H) gain before and after treatment with bST (d -7 to 28).

Treatment of beef cows (Armstrong et al., 1995), dairy cows (Bilby et al., 2004), and Holstein heifers (Radcliff et al., 2004) with bST resulted in greater concentrations of IGF-I in plasma compared with controls. Moreover, in growing beef cattle, the IGF-I response to bST was greater in well-fed compared with under-fed cattle (Rausch et al., 2002). Holstein heifers fed a high-gain diet had decreased serum GH and greater IGF-I in plasma after bST treatment, compared with heifers on a low-gain diet treated with bST. Decreased nutrient intake decreases the number of growth hormone receptors in the liver (Radcliff et al., 2004) and reduces IGF-I secretion. Cows gaining 0.4 kg/d or more may have more growth hormone receptors in the liver than cows gaining less than 0.4 kg/d of , and treatment of these cows increased IGF-I secretion.

Before bST treatment, H had greater (P= 0.06) concentrations of glucose in plasma compared with M cows (70.0 vs 65.8 mg/dL). Treatment with bST increased concentrations of glucose in plasma (P<0.01) in HbST compared with HC, MC, and MbST (Figure 2). Ciccioli et al. (2003) also found greater plasma glucose and insulin in primiparous beef cows on a high gain after calving compared with those on a moderate gain.

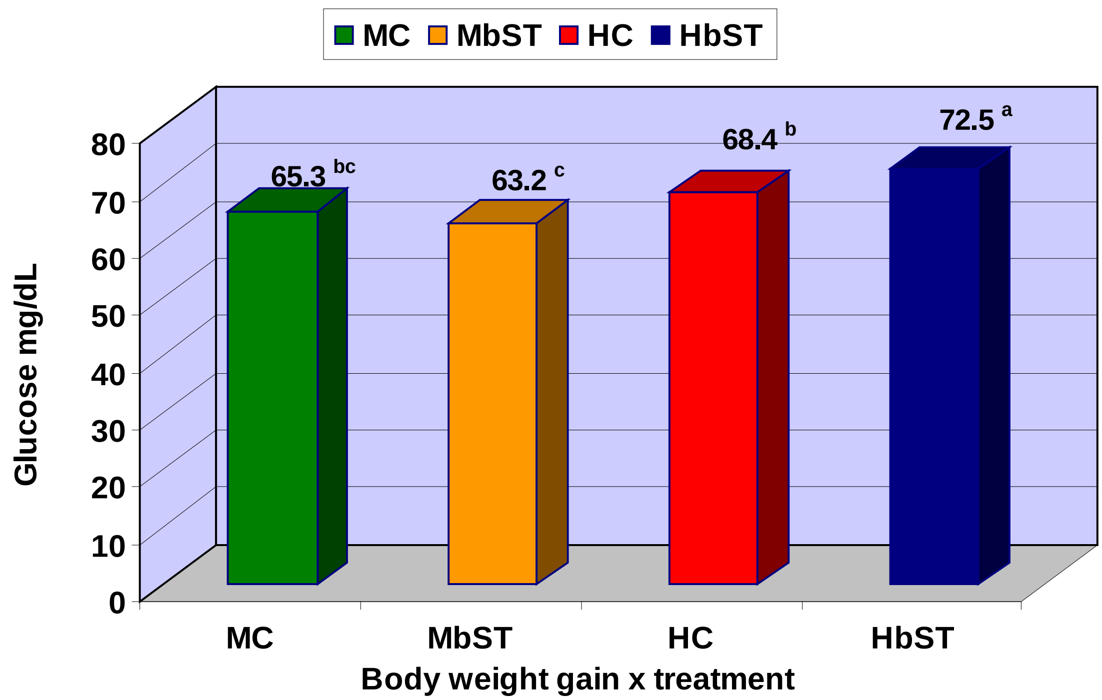

Figure 2. Concentrations of glucose in plasma of lactating beef cows on moderate (M) and high gain (H) after treatment with bST (d3 to 28).

[a,b, c] Means with different letter differ P<0.01

There was a diet x day effect (P<0.001), on plasma insulin. Concentrations of insulin in plasma on d 17 were greater for cows on a H gain compared with M cows (Figure 3).

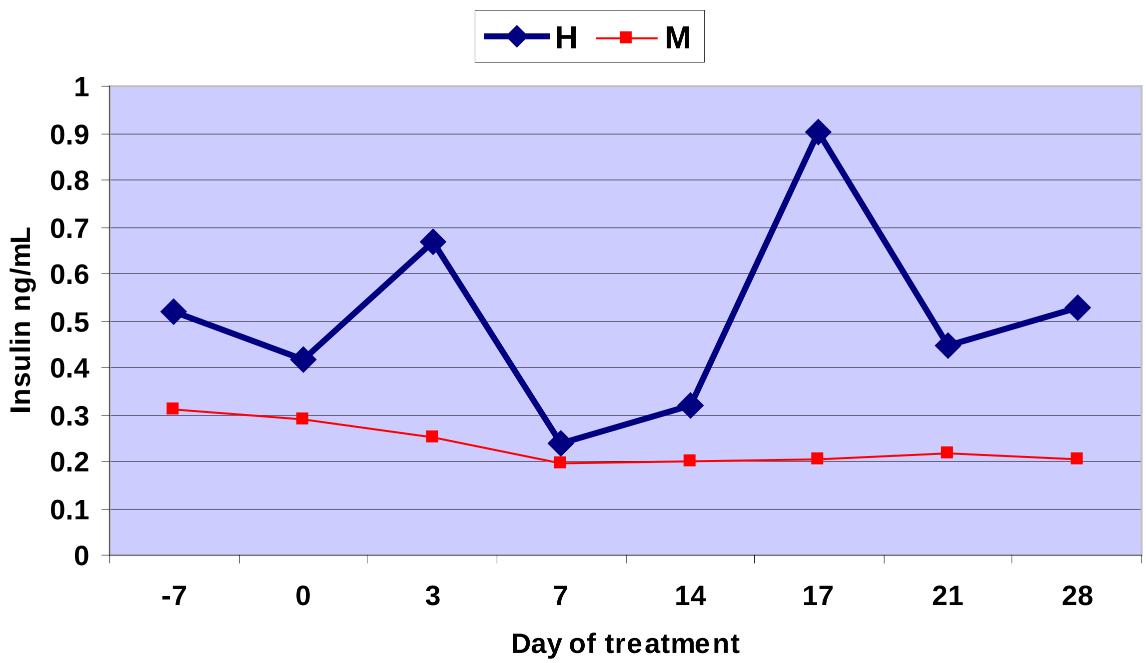

Figure 3. Concentrations of insulin in plasma of lactating beef cows on moderate and high gain before and after treatment with bST (d-7 to 28).

Weight gain and treatment with bST did not influence the percentage of cows with luteal activity by 60 d after calving; based on subsequent calving dates,conception occurred 41 ± 20 d after the last bST injection. Ciccioli et al. (2003) observed a shorted postpartum interval to first estrus in primiparous beef cows that had greater nutrient intake after calving compared with those with a lower nutrient intake. Thatcher et al. (2006) found that the physiological status of dairy cows affects the response to bST treatment combined with AI; a lactating cow treated with bST had increased IGF-I concentrations in plasma and increased pregnancy rate after AI, whereas, although dry cows had greater concentrations of IGF-I after bST treatment, pregnancy rate was decreased. Concentrations of IGF-I in plasma of lactating cows are less than in non lactating cows and this might influence the pregnancy response to bST treatment (Thatcher et al., 2006). There may also be an ideal concentration of IGF-I in plasma in beef cows to improve follicular development and to improve reproductive performance.

Cows gaining 0.4 kg/d or more had greater plasma IGF-I after bST treatment compared with control cows and cows gaining less than 0.4 kg/d. The influence of plasma concentration of IGF-I, glucose and insulin, on reproductive performance requires further investigation.

Implications

Body weight gain and treatment of postpartum beef cows with recombinant bovine somatotropin increased plasma IGF-I concentrations, which might influence ovarian function and reproductive performance. Further investigation of the interactions of nutrient intake and treatment with bST on plasma concentrations of IGF-I and reproductive function of postpartum beef cows is warranted.

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Authors

Wettemann, R.P. - Regents Professor

Spicer, L.J. - Professor

Prado, M.J. – Graduate Student

Davis, M.P. - Graduate Student

Long, N.M. - Graduate Student

Rubio, I. - Graduate Student