Effect of Body Condition Score on Plasma Concentrations of IGF-I in Postpartum Beef Cows Treated with Somatotropin

M.J. Prado-Cooper, I. Rubio, M.P. Davis and N.M. Long, M. Anderson, R. Jones, P.Y. Aad, M. Aleman, R. Cueno, M. Giacomini, S. Parr, R. Ross, A. Brown, R.P. Wettemann and L.J. Spicer

Story in Brief

Effect of recombinant bovine somatotropin (bST) on IGF-I concentrations in plasma were characterized in thin or moderate body condition postpartum beef cows. Cows were randomly assigned to four treatment groups in a 2 x 2 factorial: thin (T) or moderate (M) body condition score (BCS; 1= emaciated; 9= obese), and treatment with bST (250 mg of POSILAC, Monsanto) or saline (controls, C) at 33 d after calving. Cows were fed 1.8 kg/d of a 40% CP supplement, and grass hay *ad libitum*. Blood samples were collected twice a week, starting 7 d before and during 14 d after treatment. Cows with moderate BCS had greater concentrations ($P<0.01$) of IGF-I than thin cows before treatment. After treatment there was a BCS x bST treatment effect ($P<0.09$) on plasma IGF-I. Moderate BCS cows treated with bST had the greatest IGF-I concentrations and concentrations of IGF-I were similar for MC, TbST, and TC cows. Greater concentrations of IGF-I in plasma of moderate condition cows treated with bST might improve reproductive performance in postpartum anovulatory beef cattle. Further studies are needed to evaluate the interaction of BCS and bST treatments on ovarian function and reproductive performance in beef cows.

Key Words: Beef Cows, Insulin-Like Growth Factor, Postpartum, Somatotropin.

Introduction

Greater body condition score at calving improves reproductive performance of beef cows (Spicer et al., 1995). Body condition and IGF-I in plasma are positively correlated in postpartum beef cows (Bishop et al., 1994) and nutrient intakes 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. IGF-I is a protein hormone that stimulates ovarian function including increased ovarian cell steroid production. Treatment with bST increases concentrations of IGF-I in plasma of cattle (Bilby et al., 2004). We hypothesized that body condition of postpartum beef cows influences the response to recombinant bovine somatotropin treatment. The objective of this study was to characterize IGF-I concentrations in thin or moderate body condition postpartum beef cows treated with recombinant bovine somatotropin.

Materials and Methods

During gestation (Nov. 2004 to Feb. 2005) Angus x Hereford beef cows (n=16) grazed dormant native pasture and were fed 0.2 kg/d or 1.4 kg/d of a 40% CP supplement so cows would lose body weight and calve in thin BCS (T;< 4.5) or maintain weight and calve with a moderate BCS (M;≥ 4.5). Half of the cows in each group were treated with bST (250 mg, POSILAC, Monsanto), and the other half of the cows received a subcutaneous saline injection at 33 ± 5 d after calving. Treatment with bST consisted of one injection after blood collection on day 0. Body weight and BCS were recorded at treatment, and cows were fed 1.8 kg/day of a 40% CP supplement and prairie hay ad libitum during 5 to 60 d postpartum.

Blood was collected from caudal veins into vacutainer tubes containing EDTA, stored in ice, centrifuged at 4° C within 3 h after collection, and plasma was recovered and stored at -20° C. Plasma concentrations of IGF I were quantified on d -7, -4, 0, 3, 7, 10, and 14 by radioimmunoassay. Plasma concentrations of IGF-I were analyzed as a completely randomized 2 x 2 factorial using the Mixed Model procedure of SAS

(PROC MIXED). The statistical model included BCS, treatment, date, block (radioimmunoassay), and the interactions. Block was considered to be random and all others effects in the model were considered fixed. All interactions among BCS, treatment and date were included in the initial model. Those interactions that were clearly non-significant (P>0.30) were eliminated from the model.

Results and Discussion

There was a BCS x bST treatment effect (P=0.09, Table 1) on IGF-I concentrations in plasma. Cows in moderate body condition treated with bST had the greatest (P<0.01) IGF-I concentrations compared with all other treatments; IGF-I concentrations were similar for the moderate control, thin control or thin bST cows. Moderate bST cows had about twice the concentrations of IGF-I compared with the other treatments. Similarly, Spicer et al. (2002) found that beef cows that calved with BCS≥5 had greater IGF-I in plasma than cows with BCS<5. There was a positive correlation between BCS and IGF-I in plasma (r=0.50; P<0.05) in postpartum beef cows (Bishop et al., 1994), and primiparous beef heifers (Lalman et al., 2000). Moreover dairy cows (Bilby et al., 2004), and Holstein heifers (Radcliff et al., 2004) treated with bST had greater IGF-I in plasma compared with controls. In growing beef cattle, the IGF-I response to bST was greater in well-fed compared with underfed cattle (Rausch et al., 2002). This was likely caused by an increase in growth hormone receptors in the liver (Radcliff et al., 2004). Moderate condition cows may have more growth hormone receptors in the liver than thin cows, and thus a greater increase in IGF-I concentrations in plasma after bST treatment.

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

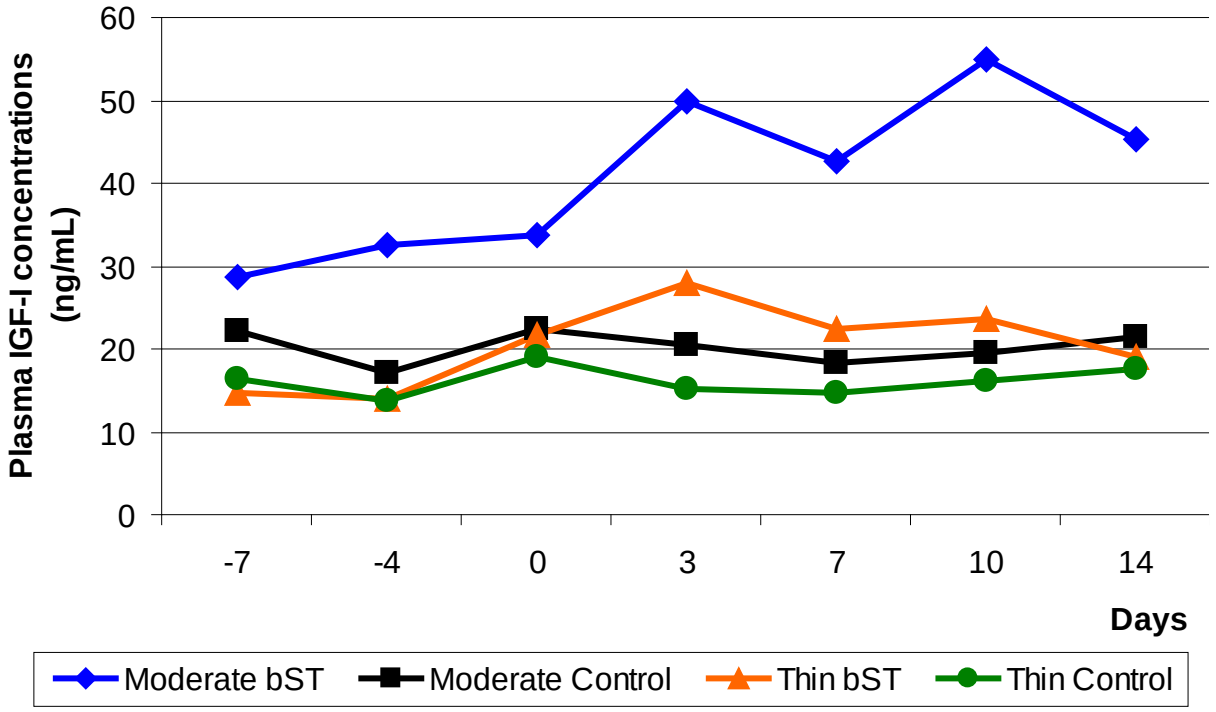
	Body Condition	
Treatment [a]	Thin	Moderate
C	16.1[c]	20.2[c]
bST	20.5[c]	41.1[b]

[a] Four cows per treatment x BCS. SE= 8.6

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

There was a treatment by date effect (P=0.03) on IGF-I in plasma. Concentrations of IGF-I were greater in moderate than thin condition cows before treatment (Figure 1). After bST treatment, plasma concentrations of IGF- I increased in MbST cows but not in thin cows.

Figure 1. Least squares mean concentrations of IGF-I in plasma of thin and moderate BCS cows treated with somatotropin (bST) or controls. The bST injection was administered at day 0



A low dose of bST (250 mg) was sufficient to increase IGF-I in plasma of postpartum beef cows. Gulay et al. (2004) also found that a very low dose of bST (10.2 mg/d) during the transition period of Holstein cows increased plasma IGF-I.

Other factors such as nutrient intake may also affect IGF-I concentrations in plasma. Recently, we (Lents et al., 2005) concluded that nutrient intake had a greater influence on IGF-I in plasma than BCS in pregnant beef cows (2 to 4 mo) and that BCS only accounted for less than 12% of the variation of IGF-I. Further investigation should evaluate the effects of BCS, bST, and nutrient intake on IGF-I concentrations in plasma of postpartum beef cows.

Implications

Bovine somatotropin and greater BCS in postpartum beef cows increase plasma IGF-I concentrations, which might influence ovarian function and reproductive performance. Further investigation of the interactions of BCS, nutrient intake and treatment with bST on plasma concentrations of IGF-I and reproductive function of postpartum beef cows is warranted.

Literature Cited

Bilby T.R. et al. 2004. J. Dairy Sci. 87: 3256-3256.

Bishop D.K. et al. 1994. J. Anim. Sci. 72: 2703.

Bossis I. et al. 1999. J. Anim. Sci. 77:1536.

Gulay M.S. et al. 2004. J. Dairy Sci. 87: 948.

Lalman D.L. et al. 2000. J. Anim. Sci. 78: 530.

Lents C.A. et al. 2005. J. Anim. Sci. 83: 586.

Rausch M.I. et al. 2002. J. Anim. Sci. 80: 94.

Radcliff R.P. et al. 2004. J. Dairy Sci. 87: 3153.

Spicer L.J. et al. 1995. J. Anim. Sci. 73: 1251.

Spicer L.J. et al. 2002. J. Anim. Sci. 80: 716.

Authors

Wettemann, R.P. - Regents Professor

Spicer, L.J. - Professor

Prado, M.J. – Graduate Student

Rubio, I. - Graduate Student

Davis, M.P. - Graduate Student

Long, N.M. - Graduate Student

Aad P.Y. - Graduate Student

Aleman M. - Graduate Student

Cueno R. - Graduate Student

Ross R. - Graduate Student

Brown A. - Graduate Student

Giacomini M. - OSU Student

Parr S. - OSU Student

Anderson M. - Herd Manager, Range Cattle Research Center

Jones R. - Herd Manager Assistant, Range Cattle Research Center