Influence of Postpartum Nutrition of Primiparous Beef Cows on Insulin Like Growth Factor-I and Insulin in Plasma and Follicular Fluid

I. Rubio, R.P. Wettemann, F.J. White and L.S. Spicer

Story in Brief

Effects of nutrition on insulin-like growth factor-I (IGF-I) and insulin in plasma and dominant follicles (DF) were evaluated at 56±9 d postpartum in anovulatory primiparous Angus x Hereford cows. Body condition score (BCS=1 emaciated, 9=obese) at calving was 4.8±0.2. Twenty-eight cows were blocked based on BCS and randomly assigned to one of two nutritional treatments at calving: moderate (M), 2.27 kg of a 40% supplement CP per day and ad libitum hay; or high (H), *ad libitum* access to a 50 % concentrate diet and hay. Estrus was monitored with electronic mount detectors (HeatWatch) and blood samples were collected twice a week starting at 30 d postpartum. Ovarian follicles were evaluated daily by ultrasonography commencing at 42 d postpartum. Body condition score at aspiration of the DF was greater for H (4.8±0.2) than M (4.3±0.3) cows and postpartum interval to luteal activity was longer for M cows (95±24) than for H (80±11d). Maximum size of DF was not influenced by nutritional treatment (13.2±1.6 mm). Concentrations of IGF-I in FF were greater for H (34.0±10.7 ng/ml) than M (23.6±8.5 ng/ml) cows. Plasma concentrations of IGF-I prior to aspiration were greater in H (33.6±11.7 ng/ml) than in M (18.6±8.2 ng/ml) cows. Concentrations of insulin in FF were greater for H (1.59±0.22) than M (0.97±0.17 ng/ml). Concentrations of progesterone, androstenedione, and estradiol in FF were not influenced by treatment. Postpartum interval to luteal activity increased in cows with lower body condition score at calving.

Key Words: Postpartum Beef Cows, Follicle, Ovary

Introduction

Nutrient intake and body energy reserves are major regulators of ovarian function in beef cows (Richards et al., 1989; Wettemann and Bossis, 2000). The interval from calving to first estrus is longer for heifers fed low energy diet compared with heifers fed high energy diet (Spitzer et al., 1995; Ciccioli et al., 2003). Body condition score is an indicator of the nutritionally status of cow and increased BCS is required for the resumption of estrous cycles in nutritionally induced anovulatory heifers (Bossis et al., 2000). Cows calving with thin BCS (<4) have longer intervals to first estrus (Spitzer et al., 1995; Lents et al., 2000). Metabolic hormones may exert a direct effect on the ovary. Greater nutrient intake increases plasma concentrations of insulin like growth factor-I (IGF-I), insulin and leptin in cows (Ciccioli et al., 2003; Lents et al., 2005). The objectives of this study were to evaluate the effects of nutrition on IGF-I, insulin and steroid hormones in dominant follicles and on IGF-I and insulin in plasma, at 55 d post partum in anovulatory primiparous cows.

Material and Methods

Twenty-eight cows were blocked based on body condition score (BCS=1 emaciated, 9=obese) at calving and randomly assigned to one of two nutritional treatments: moderate (M), 2.27 kg of a 40% CP supplement per day and ad libitum hay; or high (H), *ad libitum* access to a 50 %

concentrate diet and hay. Estrus was monitored with electronic mount detectors (HeatWatch) and blood samples were collected twice a week starting at 30 d postpartum. Ovarian follicles were evaluated daily by ultrasonography commencing at 42 d postpartum. When growth of DF plateaued (<0.8 mm in 24 h), follicular fluid (FF) was obtained by transvaginal ultrasound-guided follicular aspiration. Data was analyzed as a completely randomized block design with a 2 x 2 factorial treatment structure, using a generalized mixed model (PROC MIXED; SAS Inst., Inc., Cary, NC). The model included the effect of BCS at calving and treatment as main effects, and the first order interaction. Pearson correlations were calculated among all the variables (PROC CORR, SAS Inst., Inc., Cary, NC).

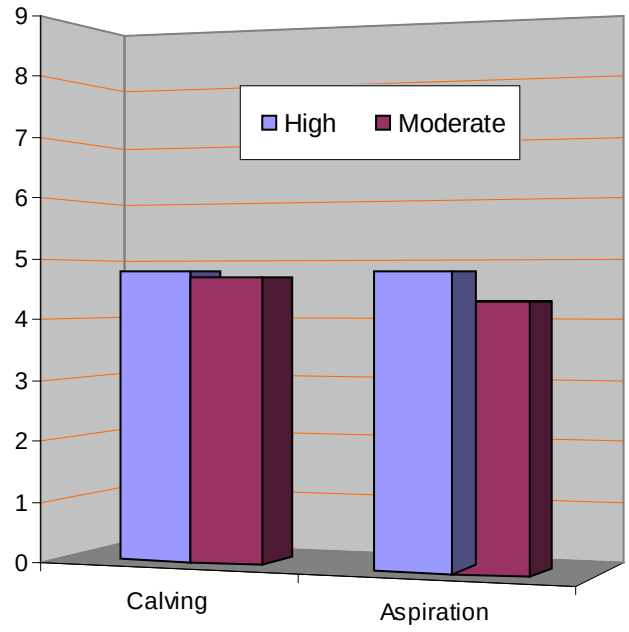
Results and Discussion

Days at follicular aspiration of the dominant follicular was similar for both treatments (H, 56.6 days and M, 55.3 days). Maximum size of DF was not influenced by nutritional treatment (P>0.10, 13.2±1.6 mm), this is in contrast with Ciccioli et al (2003), where they found an increase in DF size in H primiparous cows at the time of the first estrus.

Weights prepartum and at early postpartum were similar in High and Moderate cows, however, at aspiration (56 days postpartum) H cows weighed more that M cows (P<0.05).

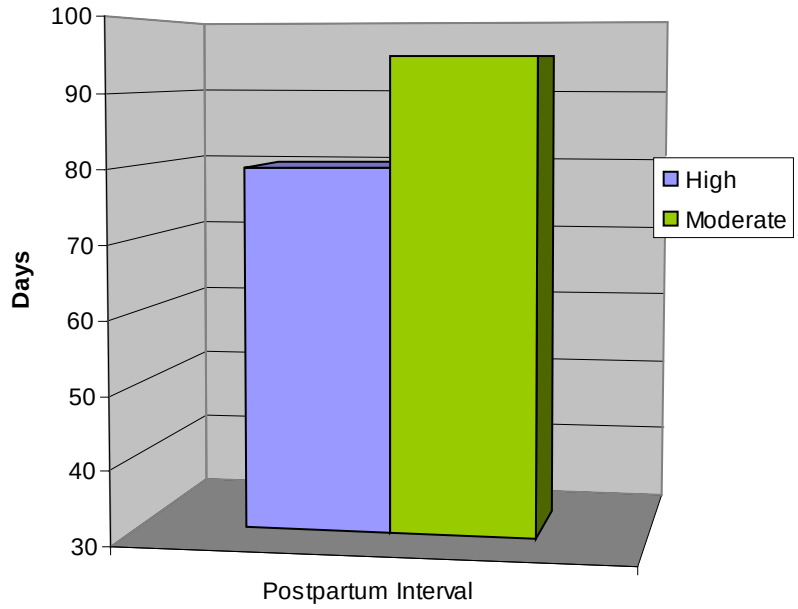
Body condition score was similar in both treatments (H and M) at calving, however, body condition score at aspiration of the DF was greater (P<0.01) for H (4.8±0.2) than M (4.3±0.3) cows (Figure 1).

Figure 1. Effect of postpartum nutrition beef cows on BCS at follicular aspiration



Postpartum interval to luteal activity was longer (P<0.05) for M cows (95±24) than for H (80±11d) (Figure 2). Postpartum interval to luteal activity was negatively correlated (P<0.01) with BCS at aspiration (56 days postpartum).

Figure 2. Effect of postpartum nutrition of beef cows on postpartum interval to estrus and luteal activity



Plasma concentrations of IGF-I prior to aspiration were greater (P<0.01) in H (33.6±11.7 ng/ml) than in M (18.6±8.2 ng/ml) cows (Figure 3). Concentrations of IGF-I in FF were also greater (P<0.01) for H (34.0±10.7 ng/ml) than M (23.6±8.5 ng/ml) cows (Figure 4). This is similar with previous studies in which IGF-I in plasma were directly related to nutrient intake in primiparous cows (Lalman et al., 2000) and in heifers (Yelich et al., 1996).

Figure 3. IGF-I in plasma prior to and the time of follicular aspiration

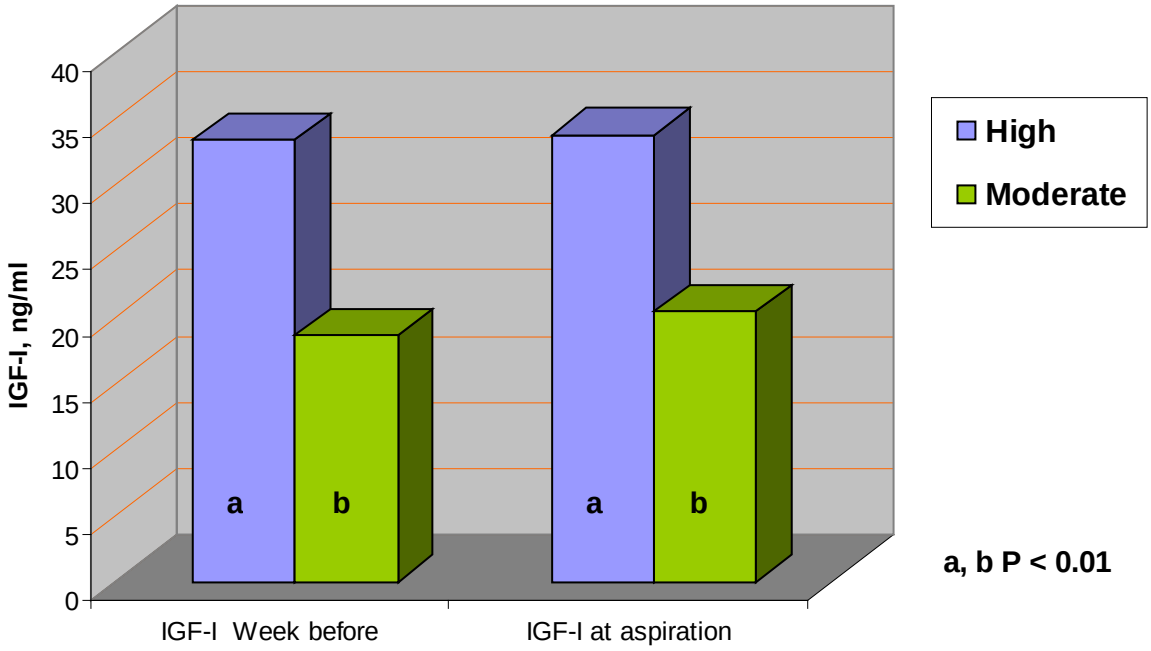
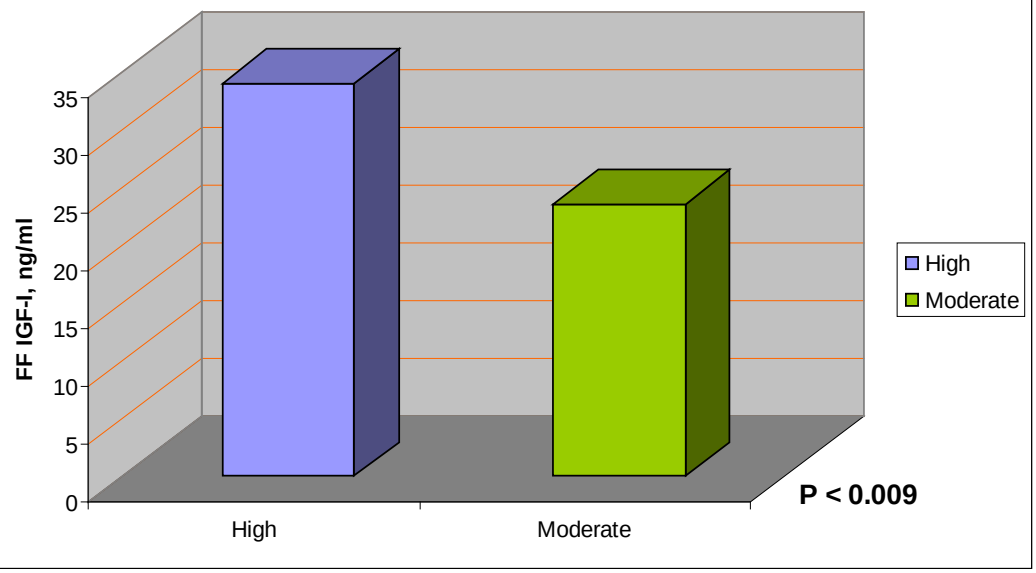
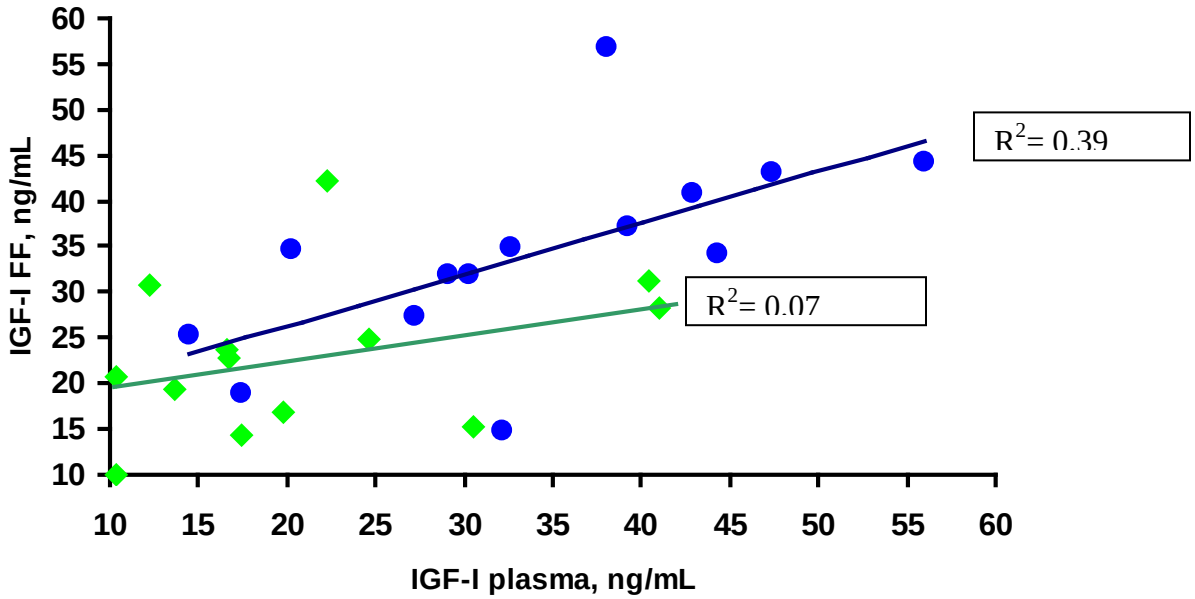


Figure 4. Effect of postpartum nutrition of beef cows on IGF-I in follicular fluid



There was a positive relationship between concentration of IGF-I in plasma and in follicular fluid in High cows (R^2=0.39, P=0.02) but in Moderate cows the relationship was not significant (R^2=0.07, P=35) (Figure 5)

Figure 5: Relationship between IGF-I in plasma and FF



Similarly to IGF-I, concentrations of insulin in FF were greater (P<0.05) for H (1.59±0.22) than M (0.97±0.17 ng/ml) and H cows had greater (P<0.01) insulin in plasma (1.61 0.17) than M (0.97±0.17 ng/ml). This is in agreement with previous studies (Lalman et al., 2000) in primiparous beef cows.

Concentrations of progesterone, androstenedione, and estradiol in FF were not influenced (P>0.10) by treatment, on the contrary White et al (2003) found differences in androstenedione concentrations in FF in mature beef cows, and this could account for the differences in both studies.

BCS at aspiration was positively correlated with FF IGF-I (r=0.45, P<0.05), similarly plasma IGF-I was positively correlated with FF IGF-I (r=0.61; P<0.01). Similarly Bishop et al.(1994) found that BCS and IGF-I were positively correlated in postpartum beef cows and in primiparous

beef cows (Lalman et al., 2000). Moreover, Ciccioli et al. (2003), found differences in IGF-I concentrations, between H and M in cows calving at BCS=5.

Implications

Increased postpartum nutrient intake of primiparous beef cows increased BCS and increased concentrations of IGF-I and insulin in FF and plasma at 56 d postpartum. The nutritionally induced increased in concentrations of IGF-I and insulin could have directly and/or indirectly reduced the postpartum length without affecting size of DF or concentrations of steroid hormones. Cow with lower BCS at 56 days postpartum had longer postpartum interval.

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Authors

Rubio, I. – Grad Assistant
Wettemann, R.P. -Regents Professor
White, F.J.- Grad Assistant
Spicer L. J.- Professor