INFLUENCE OF BODY CONDITION OF BEEF COWS ON PITUITARY AND OVARIAN FUNCTION

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Story in Brief

Nonpregnant Hereford cows were used to determine the effect of body condition on reproductive function. At the beginning of the experiment, body condition score of cows averaged 5±.2 (1= emaciated; 9=obese). From July to November 1, cows were fed to either lose weight and body condition (Thin; body condition score 4 or less; n=22), maintain weight and body condition (Moderate; body condition score 5 to 6; n=24), or gain weight and body condition (Fat; body condition score 6 or greater; n=24). Beginning November 1, each cow received a complete ration to maintain her November weight and body condition. Cows group were slaughtered in December (6 Thin, 8 Moderate, and 8 Fat cows) and the subsequent March (16 cows per group). Before slaughter, cows were synchronized by giving two injections of prostaglandin $F_{2\alpha}$ 11 days apart. Six days after the second prostaglandin injection, cows were treated with 100 ug of GnRH. At slaughter the pituitary, ovaries, and carcass were obtained. Fat cows had heavier dry ovarian and wet corpora lutea weights, greater condition scores, and more carcass energy than Moderate or Thin cows. Pituitary luteinizing hormone content did not differ among groups. However, luteinizing hormone response after gonadotropin releasing hormone differed between Thin versus Moderate and Fat cows. These data suggest that body condition influences ovarian and corpus luteum weight and luteinizing hormone response to GnRH.

(Key Words: Body Condition, Beef Cow, Reproductive Function)

Introduction

Nutrient intake, as reflected in body condition, influences reproductive performance of beef cows. Cows that calve in thin body condition have longer intervals from calving to rebreeding. The relationship between body condition of cows and hormone synthesis and/or secretion remains unclear. Pituitary activity appears to be the limiting factor in initiating follicular activity after calving. Underfeeding cows after calving may reduce luteal function and ovarian responsiveness to luteinizing hormone (LH). Restricting energy to beef cows may influence the release of LH from the anterior pituitary; in contrary, some studies indicate that energy does not influence the concentration of LH in serum. This experiment was designed to determine the influence of body condition (fat reserve) of nonpregnant beef cows on pituitary and ovarian function.

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Materials and Methods

Nonpregnant Hereford cows slaughtered in 1982-83 (n=34) and 1983-84 (n=36) were used to determine the effect of body condition on pituitary and ovarian parameters. Prior to initiating the trial each year, cows were randomly assigned to one of three feeding regimes to alter weight and body condition. From mid-summer to November 1 of each year, cows were fed to either lose weight and body condition (Thin; body condition score 4 or less; n=11), maintain weight and body condition (Maintain; body condition score 5 to 6; n=12), or gain weight and body condition (Fat; body condition 6 or greater; n=12; Table 1). From November 1 until slaughter, cows were weighed and condition scored weekly and each cow received a complete ration (Table 1) so as to maintain weight and body condition. Cows were slaughtered in December (6 Thin, 8 Moderate, and 8 Fat cows) and the subsequent March (16 cows per group).

Prior to slaughter cows were synchronized by giving two injections of prostaglandin $F_{2\alpha}$ 11 days apart. Five days after the second prostaglandin treatment (approximately day two of the estrous cycle), each cow was fitted with a jugular cannula. Six days after the second prostaglandin injection, cows were treated with 100 ug of GnRH (im). Three serum samples were obtained 15 minutes apart prior to GnRH treatment. After GnRH treatment, serum samples were obtained every 15 minutes for 2 hours followed by sampling every 30 minutes for an additional four hours. Concentration of LH in serum was quantified by radioimmunoassay.

On approximately day 5 of the estrous cycle, cows were slaughtered. The pituitary gland was removed and total and anterior pituitary wet weights were determined. The anterior pituitary was frozen on dry ice,

Table 1. Feeding schedule.

	Body Condition		
	Thin	Moderate	Fat
Cows, no	11	12	12
July 1, 1982 to November 1, 1982	wheat straw ad libitum	.5 kg CSM[a]/ head/day + 6.4 kg prairie hay/head/day	2.2 kg CSM/ head/day + prairie hay ad libitum[b]
November 1, 1982	each cow received a complete ration[c] to maintain weight until slaughter		

[a]41% cottonseed meal cube.
[b]During the second year, fat cows received 1.5 kg CSM/hd/da and grazed native range between June 1 and September 1.
[c]Composition of the complete ration: 40% rolled corn, 35% dehydrated alfalfa pellets, 21.7% cottonseed hulls, 3.0% cane molasses, and .3% salt, TM.

stored at -20 C, and LH content was quantified by radioimmunoassay. Dry ovarian, wet corpora lutea, and follicular fluid weights were determined.

Results and Discussion

From mid-summer to November 1, Thin cows lost 176 lbs and about 2 condition scores, Fat cows gained about 176 lbs and 2 condition scores, and Moderate cows maintained weight and body condition. From November 1 until the time of slaughter, all cows maintained their weight and body condition (Table 2). Total carcass energy content differed ($P<.001$) among treatment groups (Table 2). Fat cows had the greatest carcass energy content, followed by Moderate cows. Thin cows had the least amount of carcass energy.

The analysis of reproductive parameters included cows that exhibited ovarian luteal activity as indicated by plasma progesterone equal to or greater than 1 ng/ml at the first or second prostaglandin injection or at the time of GnRH treatment. Therefore, 22 cows in the Thin group, 24 cows in the Moderate group, and 24 cows in the Fat group were included in the analysis.

Fat cows had the heaviest ($P<.001$) dry ovarian tissue weights and Thin cows had the lightest (Table 3). Moderate cows had dry ovarian weights intermediate to the Thin and Fat cows. This suggests that nutrient availability to maintain cell structure and integrity or synthesis and/or secretion of pituitary hormones necessary to maintain ovarian cellular activity may differ in Thin cows. In conjunction, blood flow to the ovary may be different in Thin cows; therefore, altering the amount of nutrients and hormones reaching the ovary in Thin cows.

Table 2. Weights and condition scores of experimental cows.

	Group		
	Thin	Moderate	Fat
November 1st condition score	$3.2\pm.1^{a}$	$5.3\pm.1^{b}$	$6.9\pm.1^{c}$
Condition score at slaughter	$3.4\pm.1^{a}$	$5.3\pm.1^{b}$	$7.1\pm.1^{c}$
November 1st weight (lb)	750 ± 20^{a}	869 ± 20^{b}	1060 ± 23^{c}
Weight at slaughter (lb)	751 ± 20^{a}	869 ± 20^{b}	1066 ± 23^{c}
Carcass energy content (Mcal)	249 ± 6^{a}	430 ± 5^{b}	714 ± 7^{c}

^{abc}Numbers in rows with different superscripts differ ($P<.01$).

Table 3. Ovarian characteristics for thin, moderate, and fat cows.

	Group		
	Thin	Moderate	Fat
Total dry ovarian weight (g)	1.79±.18[a]	2.07±.17[ab]	2.43±.22[b]
Corpus luteum weight (g)	1.02±.37[c]	2.00±.30[d]	1.93±.33[d]

[ab]Numbers in rows with different superscripts differ (P<.001).
[cd]Numbers in rows with different superscripts differ (P<.09).

Cows in Fat or Moderate body condition tended to have heavier (P<.09) corpora lutea than did Thin cows (Table 3). This difference may be caused by reduced amounts of nutrients and/or hormones reaching the ovary or reduced ovarian blood flow in Thin cows. However, it is possible that Thin cows do not respond to prostaglandin the same as Moderate or Fat cows. For instance, if a Thin cow ovulates 24 or 36 hours later than a Moderate or Fat cow the corpus luteum weight would be lighter at slaughter.

Analysis of follicular fluid weight (an indicator of follicle number and size) indicated a treatment by season interaction. In December, Thin cows had less (P<.05) follicular fluid than Moderate or Fat cows (Table 4). However, in March, follicular fluid weights did not differ among groups. Thin cows slaughtered in December lost weight and body condition prior to November 1 then maintained weight and body condition until slaughter. Thin cows slaughtered in March maintained

Table 4. Follicular fliud weights (g) of ovaries from cows slaughtered in December or March.

Group	December	March
Thin	1.83±.35[a]	2.42±.32
Moderate	2.66±.42[ab]	1.84±.30
Fat	3.65±.44[b]	2.51±.44

[ab]Numbers in columns with different superscripts differ (P<.05).

weight and body condition for about four months before slaughter. Loss in weight and body condition followed by a short time of maintaining weight and condition may alter the pituitary-ovarian axis for Thin cows slaughtered in December.

Whole pituitary weight, anterior pituitary weight, and pituitary LH content did not differ among groups (Table 5). However, pituitary responsiveness to GnRH treatment differed ($P<.01$) between cows in Thin versus Moderate and Fat body condition (Figure 1). Greater concentra-

Table 5. Pituitary characteristics of cows with thin, moderate, and fat body condition.

	Group		
	Thin	Moderate	Fat
Whole pituitary weight (g)	2.33±.07	2.40±07	2.54±.08
Anterior pituitary weight (g)	1.96±.07	1.92±.06	2.03±.07
Pituitary LH content (mg)	3.05±.33	2.78±.30	3.66±.36

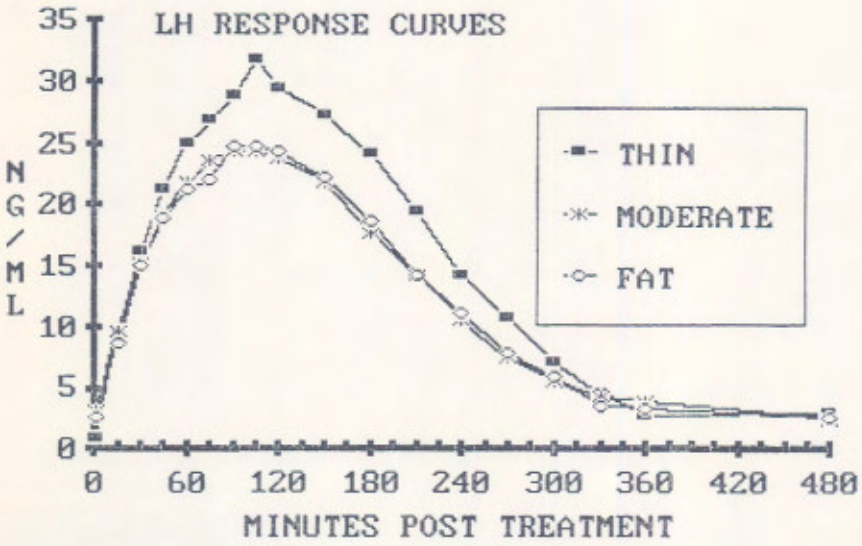

Figure 1. LH response curves after GnRH treatment of cows with thin moderate or fat body condition.

tions of LH after GnRH treatment in Thin cows may be related to greater pituitary stores of LH that are not released in Thin cows until treated with GnRH. This indicates a reduced secretion of GnRH from the hypothalamus of Thin cows. However, because pituitary content of LH was similar for cows in all body conditions, greater serum LH in Thin cows may be a result of release of a similar amount of LH but into a smaller volume of blood.

In conclusion, body condition influenced dry ovarian and wet corpus luteum weight and pituitary response to GnRH. However, body condition did not influence pituitary LH content. Reduced ovarian and corpora lutea weights suggests that those hormones necessary for maintaining ovarian and corpus luteum functions may be altered in Thin cows; therefore, brain centers (hypothalamus) involved with synthesis and/or secretion of releasing hormones may be influenced by body condition.