EFFECTS OF BODY CONDITION AND OVARIECTOMY ON SECRETION OF LUTEINIZING HORMONE IN BEEF COWS

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Story in Brief

Five nonpregnant, nonlactating, Hereford cows were fed to maintain body weight, body condition, and normal estrous cycles and ten were fed a restricted diet to lose weight and body condition until they became anestrus. Five of the anestrous cows were randomly allotted to be ovariectomized via flank incision and the other five to remain intact. All maintain cows were ovariectomized. Blood was collected frequently for 4 h on days -1, +1, +2, +3, +4, +5 and +10 (day 0 = day of ovariectomy) and luteinizing hormone (LH) was quantified. Concentrations of LH were determined in daily samples collected on days -1 through +10. Concentrations of LH increased in maintain ovariectomized cows when compared with restricted ovariectomized and restricted intact cows, whereas concentrations of LH were similar for restricted ovariectomized and intact cows. The number of LH pulses was similar for maintain and restricted cows. We conclude that secretion of LH is greater, before and after ovariectomy, in cows with moderate body condition compared to secretion in thin cows and the control of LH release from the anterior pituitary is independent of ovarian control in thin anestrous cows.

(Key Words: Beef Cow, Body Condition, Nutrition, LH, Ovariectomy.)

Introduction

Luteinizing hormone (LH) is one of the primary hormones that controls reproduction in farm animals. Anestrus occurs when cows lose weight and have a body condition of about 3.5 (Richards et al., 1986). Nutritional anestrus is probably caused by reduced secretion of LH from the pituitary gland. Increases in both LH pulse frequency and amplitude occur after removal of the ovaries in cows with good body condition. Underfeeding appears to increase the sensitivity of the brain and/or the pituitary to the effects of estradiol in cows.

The objectives of this study were to determine if removal of the ovaries causes an increase in concentrations of LH in nutritionally anestrous beef cows and to examine the relationship between body energy reserves and the secretion of LH in ovariectomized cows.

Materials and Methods

Fifteen nonpregnant, nonlactating, Hereford cows with moderate to good body condition (BCS = 5.2 ±. 3) were used in this study. Two people independently assessed BCS using the system where 1 = emaciated and 9 = obese (Wagner et al., 1985). All cows exhibited normal estrous cycles at the initiation of the study. Five cows were randomly allotted

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to maintain (M) their initial body weight (BW) and BCS and the remaining ten cows were fed a restricted (R) diet (approximately 2 kg of prairie hay per day in a drylot) for approximately 26 wk until they became anestrus (absence of ovarian luteal activity). Within the R group, 5 cows were assigned to be ovariectomized (OVX) and the other 5 cows were left intact (INT). All M cows were ovariectomized.

Body weights and BCS were recorded monthly until R cows became anestrus. Concentrations of progesterone in blood samples were used to determine absence of ovarian luteal activity. All cows were given 2 injections (i.m.) of prostaglandin $F_{2\alpha}$ (25 mg) 11 d apart to synchronize estrus in the cows exhibiting normal cycles. On days 3 to 5 after estrus, cannulae were nonsurgically inserted into jugular veins and cows were confined to metabolism stalls. Two days later, 5 R (R-OVX) and 5 M (M-OVX) cows were ovariectomized through flank incisions. The number and size of all follicles on the surface of the ovary that were 2 mm or greater in diameter were recorded. Follicles were classified as small (< 3.9 mm), medium (4.0 - 7.9 mm) or large (< 8.0 mm). Total and dry ovarian weights, follicular fluid weights and corpora lutea weights were determined.

At 0800 h, on days -1, +1, +2, +3, +4, +5, and +10 (day 0 = day of ovariectomy), blood was collected at 10 min intervals for 4 h. Concentrations of LH in frequent samples were quantified by radioimmunoassays.

Results and Discussion

Restricted cows lost BW and BCS and became anestrus after approximately 26 wk on the restricted diet (Table 1). Body weight and BCS were maintained for M cows and they exhibited normal estrous cycles until ovariectomy. At ovariectomy, R cows were 98 kg lighter and had a 3 unit reduction in BCS ($P<.01$) compared with M cows.

Concentrations of progesterone in the plasma of M cows averaged 2.5 ± .5 ng/ml on the day of ovariectomy (day 5-7 after estrus) and declined to less than 1.0 ng/ml within 72 h after ovariectomy. By contrast, concentrations of progesterone in the blood of R cows averaged .6 ± .1 ng/ml on the day of ovariectomy and averaged less than 1.0 ng/ml throughout the study.

Maintain cows had heavier total ($P<.01$) and dry ($P<.10$) ovarian weights than did R cows (Table 2). There were no CL present on the ovaries from any of the R cows and one M cow that exhibited estrus did not have a CL. These results are in agreement with previous studies

Table 1. Effect of restricted nutrient intake on weight change and body condition score (BCS).

	Body weight (kg)[a]		BCS[a]	
Time	Maintain	Restricted	Maintain	Restricted
Initiation of treatment	453±9	460±6	5.3±.4	5.1±.2
Ovariectomy	438±19[b]	340±6[c]	5.7±.1[b]	2.7±.2[c]

[a]Weight and BCS of 1 cow from each treatment were not available at initiation of the study.

[b,c]Means in the same row within a trait with different superscripts differ ($P<.01$).

Table 2. Ovarian characteristics of cows fed maintenance or restricted diets.

Criteria[a]	Diet		
	Maintenance	Restricted	SEM
Total ovarian weight, g	8.92[b]	5.86[c]	.74
Dry ovarian weight, g	1.24[d]	.92[e]	.13
Dry ovarian weight, %	15.00	16.00	1.00
Corpus luteum weight, g	.87[f]	.00[g]	.29
Follicular fluid weight, g	1.15	.86	.13
No. small follicles (<3.9 mm)	3.90	2.00	.84
No. medium follicles (4.0 to 7.9 mm)	.90	1.10	.33
No. large follicles (>8.0 mm)	.30	.10	.13

[a]Values are a total for both ovaries.
[b,c]Means not having a common superscript differ (P<.01).
[d,e]Means not having a common superscript differ (P<.10).
[f,g]Means not having a common superscript differ (P<.05).

which demonstrated that cows fed diets with reduced energy had lighter ovaries than those fed adequately. Neither follicular fluid weight nor percentage dry ovarian weight were significantly different between M and R cows. However, M cows tended (P<.12) to have more small follicles than R cows. The numbers of medium and large follicles were similar for M and R cows. These results demonstrate that when a cow's body energy reserves are depleted cyclic ovarian function ceases.

Average daily concentrations of LH increased linearly (P<.01) in M cows after ovariectomy; however, R cows did not exhibit an increase in serum LH after their ovaries were removed (Figure 1). Pulse frequency of LH secretion was not influenced by ovariectomy and averaged .89, .71 and .71 ± .26 pulses per 4 h for M-OVX, R-OVX and R-INT cows, respectively. Results from studies using dairy cows indicated that pulse frequency increased by as much as 3-fold within the first four days after ovariectomy. In addition, ovariectomized beef heifers fed a diet low in energy had fewer pulses of LH per 6 h than those fed a diet with adequate energy.

Pulse amplitude of LH was greater for M-OVX than R-INT cows at all times evaluated. Restricted-OVX cows had less LH pulse amplitude on days +2, +4 and +5 after ovariectomy when compared with M-OVX cows. Our results suggest that the brain and pituitary of cows that have adequate body energy reserves and normal estrous cycles prior to ovariectomy are capable of secreting greater quantities of LH once the negative feedback is removed when compared with thin anestrous cows. These results agree with other studies that indicated that when dairy cows in a negative energy balance were ovariectomized 4 d after parturition they had reduced LH pulse frequency and amplitude and reduced mean LH concentrations when compared with cows that were cyclic prior to ovariectomy.

Since ovariectomy did not alter concentrations of LH in R cows, reduced body energy reserves suppress LH secretion by a mechanism which is independent of ovarian steroid or other hormonal feedback. This supports the concept that, although ovarian secretions inhibit LH secretion, reduced nutrient intake has a direct effect on the brain and its related structures.

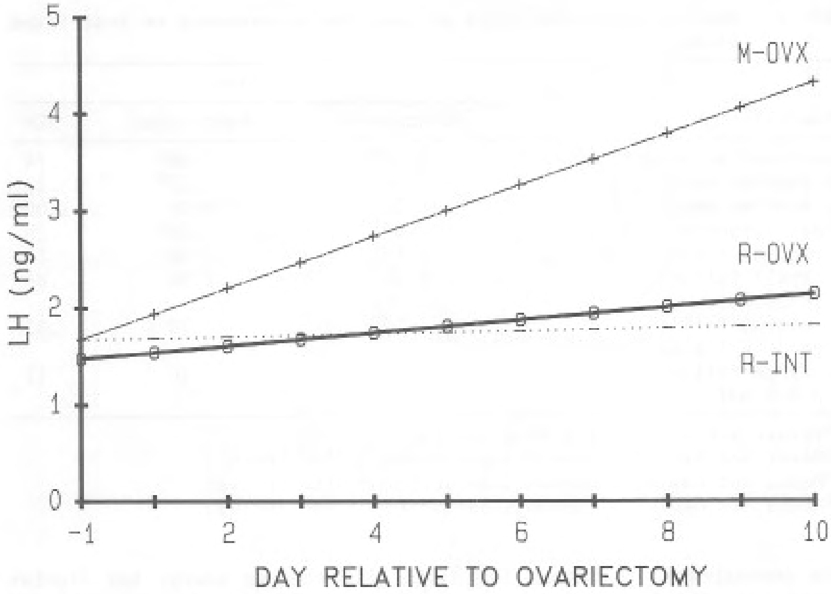

Figure 1. Concentration of LH in daily blood samples from cows fed a maintenance diet and ovariectomized (M-OVX), a restricted diet and OVX (R-OVX), or a restricted diet and left intact (R-INT).

In conclusion, our results suggest that body energy reserves and/or presence or absence of normal estrous cycles prior to ovariectomy alter LH secretion in beef cows. Cows with reduced body energy reserves secrete less LH than those with adequate amounts of body energy reserves. Since ovariectomized thin cows do not have an increase in LH secretion after removal of their ovaries, signals from body energy reserves are independent of the ovary and may directly influence brain and/or pituitary regulation of secretion of LH in beef cows.

Literature Cited

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