TREATMENT WITH MELATONIN INCREASES PREGNANCY RATE OF BEEF CATTLE

R.P. Wettemann[1], H.A. Tucker[2], K.S. Lusby[3], D.K. Bishop[4], J.V. Yelich[4] and J.A. Vizcarra[4]

Story in Brief

Postpartum Hereford and Angus x Hereford cows were used in two replications to evaluate reproductive performance during and after treatment with melatonin. Cows were fed control vehicle or melatonin daily between 10 to 100 d post partum. Days from calving to conception were reduced in cows fed melatonin by 12 days in year 1 and by 18 days in year 2, compared with controls. Pregnancy rate at the first ovulation during breeding was increased by treatment with melatonin. We conclude that treatment of cows with melatonin from 10 to 100 d post partum increases conception rate at the first ovulation.

(Key Words: Beef Cow, Fertility, Melatonin, Reproduction.)

Introduction

A major reason that beef cows are not pregnant at the end of the breeding season is postpartum anestrus. The anestrous condition is associated with quiescent ovaries without follicular or luteal activity. If nutrient intake is inadequate and body energy reserves are depleted, the interval from calving to the first estrus is extended.

Nutrient intake and body energy reserves are major factors controlling luteinizing hormone (LH) secretion and limiting ovarian function. An agent that influences fat deposition may influence secretion of LH during the postpartum period in cows. Zinn et al. (1987) found that feeding melatonin to thin heifers increased fat deposition. If fat is deposited more rapidly in postpartum cows, the desirable signal to increase LH secretion may occur sooner after parturition.

Chronic treatment of postpartum anestrous beef cows with melatonin that resulted in a continuous one- to two-fold increase in plasma melatonin increased the intervals from calving to first estrus and to first ovulation (Sharpe et al., 1986). Hansen and Hauser (1984) suggested that extended photoperiods may hasten estrus and conception in winter-calving cows. Chronic treatment with melatonin may simulate short days. There is specific binding of melatonin

---

[1]Regents Professor [2]Professor, Michigan State Univ. [3]Professor [4]Graduate Student

in bovine tissues, and binding was maximal in the hypothalamus. Thus melatonin may affect secretion of hypothalamic regulatory peptides.

There are at least three possible mechanisms by which melatonin may affect reproduction in postpartum cows. Melatonin may influence gonadotropin secretion by altering fat metabolism and body energy reserves or melatonin may influence secretion of gonadotropins by altering the effective photoperiod signal. Another possible effect of melatonin may be on other endocrine glands or reproductive tissues by unidentified mechanisms.

The objectives of this experiment were to determine if feeding melatonin to postpartum anestrous cows influenced the intervals from calving to first estrus, onset of ovarian luteal activity and conception.

Materials and Methods

One-hundred-one anestrous Hereford and Angus x Hereford cows were used in two replications (1988 and 1991) to evaluate reproductive performance of range cows during and after treatment with melatonin. Cows were fed during gestation so that they had a body condition score (BCS; 1=emaciated and 9=obese) of 5 at parturition. In 1988, cows calved between February 12 and April 16 and in 1991 cows calved between February 13 and April 9. Cows were cohabited with androgenized cows with chinball markers (1988) after parturition to monitor estrous activity. Weekly plasma samples (on Thursday) were obtained between 15 and 100 d post partum and progesterone was quantified to monitor the onset of ovarian luteal activity. Cows were exposed to fertile bulls until at least 110 d postpartum commencing on May 5, 1988 and March 10, 1991.

After calving, cows were maintained as a group in a single pasture. Supplemental protein was fed individually in a stall barn 7 days a week so that cows gained about .2 kg/d. On day 10 ± 3 post partum, cows were blocked based on BCS at calving, breed and calving data and assigned to receive either the control vehicle (95% ethanol) treatment or melatonin (4 mg/100 kg body weight) added to the supplemental protein each day for 90 days. Cows were fed between 1330 and 1400 h. Cows were weighed and BCS was determined every 2 weeks from parturition until 100 d post partum. On one day during the second week of treatment, blood samples were taken at -.5, 0, .5 and 1 h relative to feeding to assess concentrations of melatonin in plasma.

Hair growth of cows was evaluated in 1991. Melatonin treatment was started between February 25 and April 15 (at 10 ± 3 d post partum) and continued until 100 d post partum (May 23 to July 3). On May 16, an area (approximately 8 x 8 cm) was clipped on the left hip of each cow and the hair was collected and weighed. The area was measured. On June 13 the area was reclipped and the hair was collected and weighed. At this time, 6 cows were off treatment for 3 wk, 20 cows were off treatment for 2 wk and 10 cows were off treatment for 1 wk.

Days from calving to first estrus, days to conception, pregnancy rate and days until the onset of ovarian activity (based on progesterone in plasma) were determined to evaluate reproductive performance. To determine pregnancy rate at first ovulation, first ovulation was determined by progesterone in plasma and day of conception was estimated by subtracting 280 days from the subsequent calving date. The effects of treatment were analyzed by analyses of variance.

Results and Discussion

Cows calved at an average BCS of 5 during 1988 and 1991. Body weight and BCS changes during the postpartum treatment period were not influenced by treatment during 1988. Weights of calves at the end of treatment were not influenced by treatment.

There was a treatment x time effect on concentrations of melatonin in plasma of cows in 1988 (Table 1). Concentrations of melatonin in plasma increased almost threefold within 30 min after consumption of melatonin and were 2.3 fold greater at 1 h after consumption compared with control cows.

The amount of hair on the hip of cows (1991) on May 16 was not influenced by treatment (Table 2). However, cows fed melatonin had greater hair growth ($P<.09$) between May 15 and June 13 than control cows. Hair growth was greater ($P<.06$) for cows calving in February and fed melatonin than for control cows. Melatonin treatment did not influence hair growth of cows calving in March and April.

Days to first estrus (1988) and days to the onset of luteal activity (1988 and 1991) were not influenced by treatment with melatonin (Table 3). Days from calving to conception were reduced ($P<.002$) by feeding melatonin (Table 3). In 1988, cows fed melatonin conceived 12 d sooner after calving than control cows and in 1991 the interval from calving to conception was reduced by 18 d for cows fed melatonin. The decreased interval from calving to

Table 1. Influence of oral melatonin on melatonin (pg/ml) in plasma of cows (1988).

Time of day	Time relative to feeding (h)	Treatment	
		Control	Melatonin
1300	-.5	65	86
1330	0	67	80
1400	.5	67	226
1430	1	106	248

Trt x time ($P<.001$).

Table 2. Influence of feeding melatonin on hair growth in cows.

	Treatment			
	Control	Melatonin	SE	Sign
Cows, no	30	30		
Hair present on 5-16-91, mg/cm2	15.04	15.73	.99	NS
Hair growth between 5-16 and 6-13, mg/cm2	1.83	2.38	.19	.09

Table 3. Reproductive performance of range beef cows fed melatonin.

		Treatment	
Characteristic	Year	Control	Melatonin
Cows, (number)	1988	21	20
	1991	30	30
Days post partum to			
First estrus	1988	63	58
	1991	--	--
Onset of LA[a]	1988	69±4	64±4
	1991	47±3	49±3
Conception[b]	1988	85±6	73±5
	1991	72±5	54±4
Cows pregnant, %	1988	90	95
	1991	87	97
Pregnant at first ovulation,%	1988	77	100
	1991	52	89

[a] Luteal activity
[b] Treatment effect (P<.002).

conception was related to increased pregnancy rate at the first ovulation. In 1988, all treated cows conceived at the first ovulation during exposure to bulls, whereas only 77% of control cows conceived to the first service. In 1991, 89% of treated cows conceived at the first ovulation but only 52% of control cows conceived. In 1988, fertile bulls were not presented at the first ovulation for some cows, whereas cows were exposed to fertile bulls commencing before the first ovulation in 1991. Pregnancy rate during the total breeding season was not significanly altered by melatonin treatment (Table 3).

We conclude that feeding melatonin to postpartum range cows from 10 to 100 days after calving significantly decreases the interval from calving to conception. Since the interval from calving to the onset of luteal activity was not influenced by treatment, the effect of melatonin appears to be by increasing conception rate at the first ovulation.

Literature Cited

Hansen, P.J. and E.R. Hauser. 1984. Theriogenology 22:1.
Sharpe, P.H. et al. 1986. Theriogenology 26:621.
Zinn, S.A. et al. 1988. J. Anim. Sci. 66:21.