SEASONAL CHANGES IN TESTOSTERONE AND LUTEINIZING HORMONE IN THE SERUM OF MATURE F_2 FINNISH LANDRACE X DORSET RAMS CLASSIFIED AS SEASONAL OR NONSEASONAL

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Story in Brief

Thirty-one mature Finn x Dorset F_2 rams were classified as seasonal or nonseasonal based on the decrease in scrotal circumference from October 1982 to April 1983. Rams with the greatest decreases in scrotal circumference were classified as seasonal. Eight seasonal and seven nonseasonal rams were selected to evaluate changes in serum LH and testosterone during April, July and October of 1983 and January of 1984. Concentrations of LH and testosterone in serum were quantified before and after two infusions of 1 ug of GnRH at an hourly interval. During January, serum testosterone was greater ($P<.05$) before GnRH infusion for nonseasonal rams compared to seasonal rams. The greatest ($P<.05$) concentrations of testosterone in serum were during October for both ram classes. The response of testosterone in serum to infusion of GnRH was similar between ram classes each month except in January when seasonal rams had less testosterone than nonseasonal rams. Both ram classes had the greatest ($P<.05$) serum LH concentrations in April and nonseasonal rams had greater ($P<.05$) serum LH than seasonal rams during October and January. Rams classified as seasonal or nonseasonal based on changes in scrotal circumference have idfferent reproductive endocrine functions.

(Key Words: LH, rams, reproduction, scrotal circumference, season, testosterone)

Introduction

The mature ram is well suited for studying seasonal changes in reproductive activity. Scrotal circumference in the ram can be readily measured, seasonal anatomical changes can be recorded for individual rams, and rams can be classified as seasonal or nonseasonal based on scrotal changes (Ringwall et al., 1985). Seasonal rams have consistent annual cycles in scrotal circumference, while nonseasonal rams have a less conspicuous change in scrotal circumference throughout the year.

Recent investigations have determined the roles of LH, testosterone and gonadotropin releasing hormone (GnRH) in rams. Determination of endocrine changes for seasonal and nonseasonal rams could help clarify the association between observed scrotal circumference change and hormonal changes associated with alterations in daylength. The purpose of this study was to compare reproductive endocrine changes in seasonal and nonseasonal rams during April, July, October, and January.

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Materials and Methods

Thirty-one F_2 Finn x Dorset rams, born during the springs of 1980 and 1981, were maintained under Oklahoma native bermuda pasture conditions until the spring of 1984. Rams were managed and classified as seasonal and nonseasonal (Ringwall et al., 1985). Rams with the greatest (n=8, seasonal) and least (n=7, nonseasonal) change in scrotal circumference between October and April were selected from the original 31 rams. Unequal numbers between ram classes resulted from the death of one ram.

Intravenous catheters were placed in the venae cavae of seasonal and nonseasonal rams in April, July, and October of 1983 and January of 1984. Rams were exposed to natural photoperiods except on the day of blood sampling when they were exposed to continuous light. Rams were isolated from ewes and fed at 0600 h and 1300 h. Blood samples (10 ml) were obtained at 30 min intervals from 0730 h to 1530 h. After a blood sample was taken at 1530 h, 1 ug of GnRH (courtesy of National Hormone and Pituitary Program, Baltimore, Maryland) was infused into the cannulae. Blood samples were obtained at 15 min intervals until 1630 h, then an additional 1 ug of GnRH was infused. Blood samples were obtained every 15 min until 1730 h, then blood samples were taken every 30 min until 2030 h. Blood samples were immediately placed on ice, stored at 4 C for 24 h, centrifuged at 2000 x g for 30 min and serum was frozen until hormones were quantified. Testosterone was quantified by radioimmunoassay in samples obtained at 1130, 1330, 1530, 1600, 1630, 1700, 1730, 1830, 1930 and 2030 h. LH concentrations were quantified by radioimmunoassay in all samples.

One way analysis of variance was used to evaluate the effects of ram class within date or date sampled within ram class on concentrations of LH and testosterone prior to GnRH infusion, the magnitude of LH spikes (serum LH concentration greater than two standard deviations above the mean for the individual ram within a date) and the concentrations of serum LH and testosterone after infusion with GnRH.

Serum LH response to GnRH was calculated as the difference between the LH concentration in the serum sample prior to each infusion of GnRH and the serum sample obtained 15 min post GnRH infusion. Serum testosterone response to GnRH was calculated as the difference between testosterone concentration in the serum sample prior to the first infusion of GnRH and the serum sample obtained 30 min after the second GnRH infusion. The time period selected to evaluate response to GnRH infusion coincided with the periods of maximum response to GnRH. The quick release and decline in LH resulted in two response periods while the slow increase in testosterone produced only one maximum period of serum concentration of testosterone.

Results and Discussion

Seasonal Effects on Concentrations of Testosterone in Serum.

Prior to GnRH infusion, nonseasonal and seasonal rams had similar concentrations of testosterone during April, July and October (table 1). In January, nonseasonal rams had greater testosterone in serum than seasonal rams ($P<.05$). Serum testosterone concentrations were similar before and after GnRH infusion between seasonal and nonseasonal rams except during January, when seasonal rams had reduced ($P<.05$) testosterone concentrations compared to nonseasonal rams.

Table 1. Mean secretory patterns of LH and testosterone in serum during April, July, October and January in nonseasonal (N) and seasonal (S) mature F_2 Finn-Dorset rams.

Hormone (ng/ml)	Ram Class	April	July	October	January
LH concentration					
Mean	N	3.04[a]	1.24	1.45[c]	1.69[c]
	S	1.86[a]	1.03	.72[d]	.74[d]
Spikes/8 h (no)	N	1.88	1.50	2.25	2.38
	S	2.29	1.86	2.57	1.71
Spike magnitude	S	8.92[ac]	5.82	4.51[c]	5.67
	S	5.22[ad]	4.68[a]	2.49[d]	3.41
Testosterone concentration					
Mean	N	3.49	4.20	6.41[a]	4.24[c]
	S	3.28	4.18	5.61[a]	2.53[d]

[a,b]Means with different superscripts within a row are different (P<.05).
[c,d]Means with different superscripts in columns for the same trait are different (P<.05).

Concentrations of testosterone in serum of nonseasonal rams wee similar during April, July and January (table 1) but concentrations were greater in October. Seasonal rams had similar monthly variations in serum testosterone as nonseasonal rams. Seasonal rams responded similarly to GnRH during April, July and October, but the January testosterone response was less than October (table 2, P<.01).

Seasonal effects on concentrations of LH in serum.

Nonseasonal rams had greater (P<.05) concentrations of LH in serum than seasonal rams during October and January (table 1). Nonseasonal rams had greater concentration of LH during spikes than seasonal rams in April (P<.05) and October, but the ram classes had similar concentrations during July and January (table 1). The number of LH spikes was similar for seasonal and nonseasonal rams during each month (table 1).

The increase in LH concentrations in serum following the first infusion of GnRH was similar between ram classes during April (table 2). In July, seasonal rams tended to respond less than nonseasonal rams to GnRH and during October and January seasonal rams had reduced concentrations of LH in the serum after the first infusion of GnRH (table 2, P<.05). The response of LH after the second infusion of GnRH was similar between ram classes for all months (table 2).

The increase in LH following the first minus the second infusion of GnRH was similar between classes of rams during April (table 3). In July, the response in LH concentration in serum following the second infusion of GnRH minus the first was greater for seasonal rams (table 3, P<.05) and a similar trend was observed during October and January.

Table 2. Mean secretory patterns of LH and testosterone in serum in response to GnRH during April, July, October and January in nonseasonal (N) and seasonal (S) mature F_2 Finn-Dorset rams.

Hormone (ng/ml)	Ram Class	April	July	October	January
LH response to GnRH					
1st infusion	N	32.67[a]	22.69	24.14[bc]	23.00[c]
	S	30.40[a]	17.44[a]	13.01[bd]	17.90[d]
2nd infusion	N	32.86[a]	23.54	21.73[b]	23.07
	S	32.11[a]	32.40[a]	20.16[b]	24.00
Testosterone response to GnRH					
2nd infusion	N	6.17	6.89	6.29	5.20
	S	7.16[a]	6.89[a]	7.79[a]	5.73[b]

a,b Means with different superscripts within a row are different (P<.05).
c,d Means with different superscripts in columns for the same trait are different (P<.05).

Table 3. Mean secretory LH in serum after the second GnRH infusion minus the first GnRH infusion during April, July, October and January in nonseasonal (N) and seasonal (S) mature F_2 Finn-Dorset rams.

	Difference in LH Response ng/ml			
Ram Class	April	July	October	January
N	0.19	0.85	-2.41	0.07
S	1.17	14.96[a]	7.15	6.10

[a]P<.05

Seasonal trends were evident within each ram class for serum LH concentrations prior to GnRH infusion. Concentrations of LH were greatest in April (P<.05) followed by a decline in July for both ram classes. Nonseasonal rams reached a minimal concentration of LH in July and LH gradually increased through October and January (table 1). In contrast, concentrations of LH in seasonal rams continued to decline until October and remained at low concentrations in January (table 1).

The magnitudes of the LH spikes for nonseasonal rams were greatest (P<.05) during April and then declined to similar concentrations during July, October and January (table 1). The magnitudes of LH spikes for seasonal rams were greater (P<.05) for April and July than October and January (table 1).

Conclusion

Testosterone concentrations were greatest in October for both ram classes and the main difference in testosterone concentrations between the two classes is that seasonal rams had decreased testosterone concentrations in January. Seasonal rams had an increase in serum LH response to a second GnRH infusion compared to the first GnRH infusion, while nonseasonal rams did not. Results of this study support the concept that changes in scrotal circumference of rams is related to seasonal changes in endocrine function.

Literature Cited

Ringwall, K.A., et al. 1985. Okla. Agr. Exp. Sta. Res. Rep.