INFLUENCE OF FEED AND WATER DEPRIVATION, CALF SEX, AND EARLY WEANING ON BLOOD COMPONENTS AND ESTRADIOL CONCENTRATIONS IN BEEF CALVES

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Story in Brief

Thirty-eight spring born Hereford and Hereford x Angus calves at 7 to 8 months of age were used to determine the effects of feed and water deprivation, calf sex, and early weaning on selected blood components. Four animal types were used: bulls (n=8), steers (n=10), heifers (n=10), and early weaned heifers (n=10). Initial (d 1) and final (d 28) full and shrunk body weights were determined. On d 7, blood samples were taken after 16 h without feed and water (Period 1), at 6 h after feeding (Period 2), and at 24 h after feeding (Period 3). After 16 h of feed and water deprivation, animals lost 6.6% of their body weight on d 0 and 4.2% of their body weight on d 28. During the 28 days, body weight increased 5.2% based on full weights and 7.9% based on shrunk weights. There was an animal type x period interaction for hematocrit. Period influenced plasma urea nitrogen. Animal type did not influence nonesterified fatty acid concentrations, however, they were less in Period 1 than in the other periods. Animal type and period did not influence estradiol concentration. Feed and water deprivation influence blood components, and shrunk weights should be used to accurately evaluate growth rates.

(Key Words: Calves, Blood Components, Estradiol, Body Weight.)

Introduction

The effects of early weaning on early growth rate of calves has been studied (Purvis et al., 1995). Influences of water and feed deprivation on feeder cattle (Harman et al., 1989) and mature beef cows (Wettemann et al., 1995) are known. However, the effects of feed and water deprivation, early weaning, and calf sex on blood components of weaned calves are not established. The objectives of this study were to determine the influence of early weaning, calf sex, and feed and water deprivation on blood components and estradiol concentrations in beef calves.

Materials and Methods

Spring born Hereford and Hereford x Angus calves (n=38) at 7 to 8 months of age were used to determine the effects of early weaning, calf sex, and

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feed and water deprivation on blood components and estradiol concentrations. Four animal types were used: bulls (B, n=8), steers (S, n=10), heifers (H, n=10), and early weaned heifers (EWH, n=10). Bulls, steers, and heifers were weaned from dams two weeks prior to initiation of the study. Early weaned heifers were previously weaned at approximately 75 d of age, grazed native grass pasture throughout the summer, and were of similar age as normal weaned calves. All animals were maintained in a drylot before and during the study and animals were given water and prairie hay ad libitum, and 2 lb/h/d of a 40% crude protein supplement.

Initial (d 1) and final (d 28) full and shrunk weights were determined. At 1700 h on d 0, animals were removed from feed and water. On d 1, after 16 h without feed or water, a shrunk weight was determined. At 0900 h, animals were returned to the pen with feed and water. At 1600 h on d 1, after 7 h of ad libitum feed and water, a full weight was determined. This procedure was repeated on d 28 to obtain final full and shrunk weights.

Blood samples were collected from each animal after 16 h without feed and water (Period 1), at 6 h after feeding (Period 2), and at 24 h after feeding (Period 3) to determine the effects of feed and water deprivation on concentrations of red blood cells, plasma urea nitrogen (PUN), glucose, nonesterified fatty acids (NEFA), and estradiol concentrations. At 1700 h on d 7, animals were removed from feed and water. On d 8, after a 16 h shrink, animals were confined in a squeeze chute and blood samples collected via jugular venipuncture (Period 1). Animals were then returned to feed and water. Six hours after feeding, blood samples were obtained (Period 2) and animals returned to feed and water. On d 9, after 24 h of ad libitum feed and water, a third blood sample was collected from each animal (Period 3). Hematocrits were determined, then blood samples were placed on ice and transported to the lab where plasma was obtained by centrifugation and stored at -20 ^{o}C until analyzed for concentrations of plasma urea nitrogen (PUN), glucose, nonesterified fatty acids (NEFA), and estradiol.

Hematocrit was determined at each of the three sampling periods by centrifugation in microhematocrit tubes. Plasma concentrations of estradiol were determined by radioimmunoassay. Glucose, PUN and NEFA were quantified by colorimetric procedure.

Split-plot analyses of variance were used to determine effects of animal type and sample period on blood components. Animal type (B, S, H, and EWH) was used as the whole plot, while sampling period was used as the sub plot. Means were compared by the protected least significant difference method.

Results and Discussion

Early weaned heifers were lighter (P<.05) at the initial body weight (BW) compared with all other animal types (Table 1). Purvis et al. (1995), suggest that native prairie hay may not be adequate to support similar weight gains of early weaned calves compared with calves still nursing cows. Early weaned heifers were weaned at approximately 75 d of age and placed on summer native range. Although they weighed less at the beginning of the experiment, there was no difference in average daily gain during the study (Table 1). These results would suggest that early weaned and normal weaned calves perform similarly after all calves are removed from cows.

After 16 h of deprivation from feed and water, animals lost 6.6% of their BW on d 1 (initial weight) and 4.2% on d 28 (final weight; Table 2). There was an increase in BW of 5.2% based on full weights, whereas, there was a 7.9% increase based on shrunk weights. When determining weight change using shrunk weights, there was less variance (P<.005) compared with using full weights. Wettemann et al. (1995), suggest that shrunk weights should be used to determine treatment effects on weight gain of cows consuming forage. These data would suggest that shrunk weights should be evaluated to determine changes in BW of weaned calves.

There was an animal type by sampling period interaction for hematocrit (P<.03; Table 3). Hematocrits were greater in B and S after 16 h without feed and water compared with 6 h after eating and drinking. However, withdrawal of feed and water for 16 h did not alter the hematocrit of H and EWH. The increased hematocrit in Period 1 is likely attributable to water loss from the body resulting in reduced plasma volume. After animals were placed back on feed and water, hematocrit values were reduced indicating that plasma volume was increased, probably due to water intake. Hematocrits are also increased following a 19 h shrink period in mature beef cows (Wettemann et al., 1995). These data suggest that B and S respond differently to acute periods of feed and water deprivation as compared to H and EWH.

Animal type did not (P>.10) influence PUN, however sampling period influenced (P<.0001) PUN concentrations (Table 3). There was a 52% increase in PUN after a 16 h of feed and water deprivation (Period 1) as compared with 24 h after continuous feed and water (Period 3). This may be due to an increase in recycling of nitrogen. During time of feed and water deprivation an animal may not consume sufficient nitrogen for synthesis of microbial protein. Nitrogen retention may increase so that nitrogen can be returned to the rumen via the circulatory system for production of microbial protein.

Animal type did not influence NEFA concentrations, however period influenced (P<.0001) NEFA (Table 3). During Period 1, NEFA were greater (P<.05) compared with Periods 2 or 3. NEFA concentrations decreased (P<.05)

linearly from 304 meq/l after a 16 h shrink to 146 meq/l after 24 h with feed and water. An increase in NEFA is likely related to acute mobilization of body fat. In time of feed and water deprivation, body fat may be mobilized to supply energy needed while feed is not available.

Animal type tended (P=.12) to influence glucose concentrations (Table 4), but period did not influence (P=.17) concentrations of glucose. Steers and H had greater (P<.05) glucose concentrations (74.1 and 75.1 mg%) than B or EWH (71.1 and 68.1 mg%).

Concentration of estradiol was not influenced by animal type or sampling period. Our results agree with other researchers (Wolfe et al., 1989). Prepuberal heifers exhibit follicular growth similar to that of mature cows (Evans et al., 1994). However, in prepuberal heifers, maximal estradiol production does not occur until the day of estrus in the first cycle (Del Vecchio et al., 1992). At this prepuberal age (225 ± 3 d), H and EWH may not have follicles capable of producing estradiol. Due to the similar concentrations of estradiol in prepuberal males and females, producers may need to implant heifers not kept for breeding purposes at the same time they implant B or S to enhance growth rates.

In conclusion, to reduce variance calves should be removed from feed and water for 16 h to accurately determine weight gains. Early weaning does not adversely influence weight gains of 7 to 8 month old calves. Feed and water deprivation might influence blood components due to decreased plasma volume, and the possibility that fat mobilization and nitrogen retention may occur. Concentration of estradiol for prepuberal calves are not influenced by sex, and producers may need to implant heifers at the same time they implant bull calves to stimulate growth rates.

Acknowledgments

This experiment was conducted with the assistance of the following students in Animal Science 4803: Kim Brown, Kari Fletcher, Brett Gardner, Brian Grantz, John Honeywell, Laura Hopcus, Brandon Inman, Chad Mueller, Jeffrey Parmley, Dane Schimmel, Scott Schmidt, Larry Smith, Ryan Staerkel and Travis Thedford.

Literature Cited

Evans, A.C.O. et al. 1994. J. Reprod. Fertil. 100:187.
Del Vecchio, R.P. et al. 1992. Theriogenology 38:419.
Harman, B.R. et al. 1989. J. Anim. Sci. 67:311.
Purvis II, H.T. et al. 1995. Okla. Agr. Exp. Sta. Res. Rep. P-943:68.
Wettemann, R.P. et al. 1995.Okla. Agr. Exp. Sta. Res. Rep. P-943:211.

Wolfe, M.W. et al. 1989. Biol. Reprod. 41:626.

Table 1. Influence of animal type on beginning weights and average daily gains (full and shrunk).

Animal Type	No	Beginning shrunk weight, lb	Shrunk ADG, lb/d	Full ADG, lb/d
Bull	8	499.5[a]	1.46	1.28
EWHeifer	10	442.2[b]	1.15	1.04
Heifer	10	496.2[a]	1.35	.97
Steer	10	500.4[a]	1.54	.63
SE		± 16.4	± .16	± .26

[a,b] Means within a column differ (P<.05).

Table 2. Influence of 16 h deprivation of feed and water on body weight (BW).

Item	Day of experiment 1	Day of experiment 28	BW Increase, %[a]
Full BW, lb	518 ± 57	545 ± 62	5.2
Shrunk BW, lb	484 ± 55	522 ± 59	7.9
Difference, lb	34	23	
Shrink, %	6.6	4.2	

[a] BW increase between d 1 and 28 expressed as a percentage of d 1 BW.

Table 3. Nonesterfied fatty acids (NEFA), plasma urea nitrogen (PUN), and hematocrit values for animal type within sampling period.

Item	Sample period	Bull	EW heifer	Heifer	Steer
Hematocrit[1], mg %	1	40.4^{aw}	36.8^{ax}	38.1^{axy}	38.5^{ay}
	2	36.3^{bw}	35.8^{abwx}	37.4^{awy}	36.1^{bwx}
	3	37.8^{bw}	34.5^{bx}	38.8^{awy}	36.7^{bwyz}
SE		±.42	±.36	±.36	±.36
PUN, mg %	1	11.8^{a}	13.9^{a}	10^{a}	13.3^{a}
	2	11.8^{a}	16.9^{b}	13^{b}	14.4^{ab}
	3	7.4^{b}	8.6^{c}	8.2^{c}	8^{c}
SE		±.39	±.34	±.34	±.34
NEFA meq/l	1	270^{a}	333^{a}	322^{a}	289^{a}
	2	192^{b}	223^{b}	202^{b}	193^{b}
	3	129^{c}	165^{c}	148^{c}	141^{c}
SE		±13	±12	± 12	±12

[1] Animal type x period (P<.03).

[a,b,c] Means with different superscripts within a column within an item differ (P<.05).

[w,x,y,z] Means with different superscripts within a row within an item differ (P<.05).

Table 4. Glucose and estradiol concentrations for animal type.

	Animal type				
Item	Bull	EW Heifer	Heifer	Steer	SE
Glucose, mg %	71.1	68.1	74.1	75.1	± 1.29
Estradiol, pg/ml	1.1	1.4	1.4	1.0	± .15