Effect of Parity and Milk Production Potential on Forage Intake of Beef Cows during Lactation

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Story in Brief

Beef cow nutrient requirements increase dramatically during lactation. Two experiments were conducted to evaluate the effects of milk production potential and parity on forage intake in Brangus females during early and late lactation. For both experiments, 12 multiparous cows and 12 first-calf heifers were selected for high and low milk production potential based upon their sire's EPD for milk. All females were individually fed long-stemmed hay harvested from mixed bermudagrass-native prairie pastures. Cottonseed meal was supplemented to ensure adequate protein supply. During early lactation, cows averaged 47 d postpartum and heifers averaged 76 d. During late lactation, cows averaged 149 d postpartum and heifers averaged 178 d. Multiparous cows produced 66 to 84% more milk than first-calf heifers during early and late lactation, respectively. Females selected for high milk production produced 21% more milk than those selected for low milk production during early lactation, however, this effect was not seen during late lactation. Cows consumed more forage dry matter than heifers, at both stages of lactation. When intake was expressed relative to body weight, there was no effect of parity. During early lactation, milk production potential influenced forage intake. Multiparous cows and first-calf heifers consume similar amounts of forage during lactation, when intake is expressed relative to body weight.

Key Words: Forage Intake, Cows, Heifers, Lactation, Milk Production

Introduction

The first-calf beef heifer provides a unique challenge to producers who wish to maintain yearly calving intervals. Compared with older cows, first-calf heifers have increased postpartum intervals that frequently lead to lower pregnancy rates upon rebreeding. Lower reproductive performance in heifers may be caused by a difference in metabolic signals that trigger the initiation of estrous cycles. These metabolic signals are highly sensitive to nutrient intake. Therefore quantifying differences in forage intake and digestibility among cows and heifers may lead to improved management strategies.

Selection for increased milk production based upon sire EPD results in increased milk production, however this increase may be at the cost of body energy stores (Minick et al., 2001) or increased dry matter intake. Our objective was to determine forage dry matter intake in Brangus cows and heifers selected for high or low milk production.

Materials and Methods

Similar to a companion study (Johnson et al., 2002), two experiments were conducted to evaluate the effects of parity and milk production potential (MEPD) on forage intake of beef females during early and late lactation. For both experiments, cows were weighed at the beginning and end of the feeding period and average weight for the feeding period was used to express intake. Body condition scores (scale 1, thin to 9, obese) were determined by two independent evaluators at the beginning of each feeding period and average scores are reported. Expected progeny differences spanned a range of 22 to 24 lb for both experiments (Table 1). Cows averaged 5 yr of age and heifers average 2 yr upon initiation of Exp. 1 (Table 1). Hay and cottonseed meal were similar to our late gestation trial (Johnson et al., 2002). Furthermore feed, refusal, and fecal samples were collected and analyzed similar to Johnson et al. (2002).

Experiment 1. In March 2001, 12 multiparous cows and 12 first-calf heifers were assigned to two feeding periods such that each period was balanced for parity and MEPD. Females in Period 1 averaged 63 d postpartum with a range of 53 d and the females in Period 2 averaged 60 d postpartum with a range of 52 d. Cows averaged 47 d and heifers averaged 76 d postpartum as the heifers were bred to calve earlier than the cows. Cow-calf pairs were penned individually and we assumed that the young calves would consume minimal forage therefore calves were not separated. Therefore, intake data are presented as cow-calf pair intakes. Daily forage offering was determined as 130% of the previous 2-d average intake. Refusal was weighed and subsampled every 2 d and cottonseed meal was fed daily.

Experiment 2. In July 2001, 12 multiparous cows and 12 first-calf heifers were assigned to two feeding periods such that each period was balanced for parity and MEPD. Females in Period 1 averaged 162 d postpartum with a range of 53 d and the females in Period 2 averaged 165 d postpartum with a range of 52 d. Cows averaged 149 d and heifers averaged 178 d postpartum as the heifers were bred to calve earlier than the cows. Because calves were mature enough to consume forage, all pairs were separated and cows were offered hay for two 4-h feeding bouts at 0730 and 1800 h. While separated, calves were offered ad libitum access to water, hay, and a 14% CP creep feed. Intake data are reported for an 8-h feeding period.

Cow-calf pair (Exp. 1) or individual animal (Exp. 2) was treated as the experimental unit. Data were analyzed as a 2 x 2 factorial arrangement using least squares analysis of variance (PROC MIXED; SAS Inst. Inc., Cary, NC). Period was treated as a random effect and the fixed effects of parity, milk production, and the interaction were included in the model. Regression analysis was conducted using multiple regression analysis (PROC REG; SAS Inst. Inc., Cary, NC). Forage DMI was regressed on milk yield (MY), MY^2, MY^3, BW, $BW^{0.75}$, BCS, and parity class and all possible regression equations were evaluated. The best fitting model was determined by evaluating change in R^2 and the Mallows C(p) statistic.

Results and Discussion

Milk Production. Cows selected for high and low MEPD tended to differ in milk yield during early lactation with high MEPD females producing 21% more milk than low MEPD (Table 1). This difference was not observed during late lactation (Table 1). Research has established that selection for sire milk EPD successfully predicts differences in milk yield of the daughters (Minick et al., 2001). Multiparous cows produced 66% and 84% more milk than primiparous heifers during early (Table 1) and late lactation (Table 1), respectively. These data concur with literature that indicates that beef cows do not reach peak milk production until approximately 4-5 yr of age (Clutter and Nielsen, 1987).

Table 1. Least squares means for milk production of cows consuming low-quality forage during early and late lactation						
	High Milk		Low Milk			
Variable	Cows	Heifers	Cows	Heifers	SEM	Effect[a]
Early Lactation (n)	6	6	6	6	--	--
Average sire milk EPD	+9.5	+10.6	-12.5	-12.5	--	--
Age, mo	50	27	71	22	--	--
Milk yield, lb/d	24.9	17.2	23.1	11.7	4.7	P, M
Milk energy, Mcal NE/d	8.5	5.9	7.9	4.0	.73	P, M
Late Lactation (n)	6	6	6	6	--	--
Average sire milk EPD	+9.5	+10.6	-12.5	-12.5	--	--
Age, mo	53	30	74	29	--	--
Milk yield, lb/d	19.1	11.9	19.4	9.0	2.1	P
Milk energy, Mcal NE/d[b]	6.6	4.0	6.6	3.2	.71	P

[a]Effects in the model that are significant at the P<.1 level; P = parity, M = milk production potential, X = interaction

[b]Milk energy estimated via equations from NRC (1996)

Forage Intake. During early lactation high MEPD females consumed 9% more forage dry matter (DM) than low MEPD cows (Table 2). When DM intake was expressed relative to BW, high MEPD consumed 7% more forage than low MEPD. However, during late lactation (Table 2), MEPD class did not influence forage DM intake on either absolute or BW basis. Hatfield et al. (1989) evaluated the relationship between beef cows of varying milk production potential and forage intake during early and late lactation. The cows used in their experiment were F_1 crosses produced from Hereford, Red Poll and Milking Shorthorn sires and Angus dams and were designed to differ in milk production, but maintain similar growth and mature size. They observed a quadratic increase in intake expressed per unit of BW as milk production levels increased. Furthermore, Wagner et al. (1986) used cows with increasing percentage of Simmental, but maintained similar BW, to generate a range in milk production. As proportion of Simmental increased in the cows, so did milk production and forage intake as a percent of BW. The reported literature and our data indicate a positive relationship between forage DM intake and milk production.

Cows consumed more forage DM and organic matter (OM) than primiparous heifers on an absolute basis during early lactation and during late lactation (Table 2). Yet, when expressed per unit of BW both groups consumed similar amounts of forage DM during both stages of lactation. Furthermore, heifers had approximately 6% higher OM digestibility than cows, during both stages of lactation. Yet, the observed increase in OM digestibility did not offset the increased forage OM intake of cows as compared with the primiparous heifers. As a result when total digestible OM intake was calculated, cows consumed approximately 8% more than heifers, at both stages of lactation.

Table 2. Least squares means for forage intake and digestibility of cows consuming low-quality forage during early and late lactation						
	High Milk		Low Milk			
Variable	Cows	Heifers	Cows	Heifers	SEM	Effect[a]
Early Lactation						

Cottonseed meal, lb/d	4.4	4.4	4.4	4.2	--	--
Wt, lb	1208	1010	1225	955	31.2	P
Body condition score	4.3	4.1	4.6	4.2	.23	P
Forage dry matter intake, lb/d	30.4	26.4	29.0	23.3	.79	P, M
Forage dry matter intake, % BW	2.53	2.63	2.36	2.45	.07	M
Total diet organic matter digestibility, %	51.5	55.8	53.2	54.7	1.37	P
Total digestible organic matter intake (TDOMI)	15.8	15.4	15.6	13.4	.53	P
Late Lactation						
Cottonseed meal, lb/d	4.2	4.4	4.2	4.0	--	--
Wt, lb	1188	1027	1230	999	38.5	P
Body condition score	4.3	4.3	4.5	4.2	.18	--
Forage dry matter intake, lb/d	25.7	23.8	26.4	20.7	1.03	P
Forage dry matter intake, % BW	2.18	2.32	2.14	2.08	0.09	--
Total diet organic matter digestibility, %	56.3	58.4	55.8	60.8	2.45	P
Total digestible organic matter intake (TDOMI)	15	14.5	15.2	13.4	.75	P

[a]Effects in the model that are significant at the P<.05 level; P = parity, M = milk production potential, X = interaction

Forage DM intake regression equations for early and late lactation are shown in Tables 3 and 4, respectively. Initial regression analysis indicated minimal benefit in using $BW^{0.75}$ in our models as compared with BW, therefore BW was used for all regressions. During early lactation, BW was the best single variable for predicting forage DM intake (R^2 = 0.6768; Table 6). However during late lactation, milk yield was the best single predictor (R^2 = 0.6366; Table 7). During both stages of lactation, the best two variable equation incorporated milk yield and BW with R^2 = 0.8202 for early and R^2 = 0.7289 for late lactation. Anderson et al. (1983) reported prediction equations for TDN intake that included BW, weight change, and milk yield that had an R^2 of 0.77. They reported little benefit by incorporating BW^x (where x = various exponents to express metabolic BW) as compared with BW. In contrast, Hatfield et al. (1989) found $BW^{0.75}$ better correlated with DM intake than BW. Previous research and the results of our analysis indicate that measures of BW and milk yield can explain significant portions of the variation in DMI during lactation in beef females.

Table 3. Sources of variation for forage dry matter intake (lb/d) of Brangus females during early lactation.

Intercept	Milk[a]	$Milk^2$	BW[b]	BCS[c]	Parity[d]	R^2	C(p)
--Best Single Variable--							
2.864	--	--	0.0191*	--	--	0.6768	12.40
--Best Two Variable--							
0.821	0.7769*	-0.0392*	0.0164*	--	--	0.8202	2.02
--Three Variable--							
4.179*	0.1421*	--	0.0139*	--	0.0582	0.7347	10.59
4.476*	--	--	0.0167*	-0.1461	0.4299	0.6852	15.55
9.297*	0.1812*	--	--	0.2051	1.306*	0.6429	19.80
0.6564	0.7836*	-0.0396*	0.0162*	0.0529	--	0.8204	4.00
0.8163	0.7770*	-0.0081*	0.0164*	--	-0.0016	0.8202	4.02
6.490*	0.7371*	-0.0070*	--	0.4043	1.400	0.7062	15.45
4.4753*	0.1425*	--	0.0146*	-0.1389	0.0391	0.7363	12.43
--Four Variable--							
0.6696	0.7834*	-0.0082*	0.0162*	0.0532	0.0052	0.8204	6.00

[a]Milk yield expressed as kg/d and both linear and quadratic expressions are considered a single variable

[b]Body weight expressed in kg

[c]Body condition score scale 1 to 9

[d]Parity class where multiparous = 1 and primiparous = 0

*Significant in model at P<.1 level

Table 4. Sources of variation for forage dry matter intake (lb/d) of Brangus females during late lactation.

Intercept	Milk[a]	$Milk^2$	BW[b]	BCS[c]	Parity[d]	R^2	C(p)
--Best Single Variable--							
4.478*	1.612*	-0.0836*	--	--	--	0.6366	21.26
--Best Two Variable--							
1.234	1.353*	-0.0733*	0.0088*	--	--	0.7289	12.29
--Three Variable--							
2.111	0.3296*	--	0.0140*	--	-0.8550	0.6160	25.48
3.770	--	--	0.119*	0.2096	0.6229	0.4721	41.02
1.188	0.4781*	--	--	1.576*	-0.4397	0.6270	24.29
-0.494	1.332*	-0.0677*	0.0053	0.7762	--	0.7613	11.78
-2.196	1.660*	0.0844*	0.0141*	--	-1.404*	0.7862	9.09
-1.917	1.660*	-0.0762*	--	1.410*	-0.8349	0.7640	11.49
-1.326	0.4502*	--	0.0097*	1.146*	-1.124	0.6862	19.89
--Four Variable--							
-4.759*	1.675*	-0.0791*	0.0105*	0.9460*	-1.591*	0.8333	6.00

[a]Milk yield expressed as kg/d and both linear and quadratic expressions are considered a single variable

[b]Body weight expressed in kg

[c]Body condition score scale 1 to 9

[d]Parity class where multiparous = 1 and primiparous = 0

*Significant in model at P<.1 level

Implications

Selecting females within a breed for increased milk production may increase forage intake. This effect is greatest during early lactation, when nutrient requirements are highest for the beef cow. In our study, when intake was expressed relative to body weight, intake was similar between older cows and first-calf heifers. When estimating forage intake, it is important to consider that intake responds positively to milk production level.

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