Impact of Increasing Level of Milk Production on Cow-Calf Performance in Nebraska Sandhills

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Summary with Implications

In a 2-yr study, data were collected on 118 crossbred cow-calf pairs from March- and May-calving herds. On approximately 30, 60, 90, 120, and 210 d postpartum, individual cow 24-h milk yield was estimated through weigh-suckle-weigh techniques. Cow body weight (BW) and body condition score (BCS) were collected weekly through breeding. Calf BW was recorded at each milking. Individual cow milk area under the curve (AUC) values were calculated and data were analyzed using linear regression analysis. Results from this study illustrate that increasing total milk produced throughout the lactation period had minimal influence on the cow production parameters assessed in the Nebraska Sandhills forage environment. However, the lack of differences found in this study may be due to years of selecting for low milk production genetics and the cowherd may not represent the US average for milk production.

Introduction

Genetic selection and cow-calf management practices must be tailored to each unique environment to optimize forage resource utilization and animal productivity. Increased efforts to improve output-related traits, such as calf weaning weight, have been observed in the last 30 years. With increased selection for calf growth by increasing dam milk production, mixed results have been observed, which may be due to differences in calf forage intake. This may be due to the value of the added milk production not being fully captured due to environmental conditions. Previous research has shown offspring from high-milking cows have decreased postweaning growth and feed efficiency, due to increased maintenance requirements. Therefore, the objective of this study was to evaluate the effects of increasing total milk yield on cow BW, cow BCS, cow reproductive performance, calf BW, and calf gain in beef cattle grazing Nebraska Sandhills native range.

Procedure

In a 2-yr study, data were collected on 118 crossbred mature cow-calf pairs from March- and May-calving herds. At the initiation of the study, cows were selected at ~30 d post-calving based on initial milk production estimated using a traditional weigh-suckle-weigh technique to include a range of cows with low to high milk production. Cows and calves were separated at 1000 h, paired and allowed to nurse at 1630 h, then separated again until the following morning at 0700 h. Beginning at 0700 h, calves were weighed, paired with their dam and allowed to nurse, then weighed again. Milk production was estimated by calf pre- and post-suckle body weight difference and extrapolated to 24-h yield based on duration of separation. Cows were stratified by cow age, body weight (BW), body condition score (BCS), calving date, calf sex, calf age, and calf birth BW. At approximately d 60, 90, 120, and 210 postpartum, milk production was measured using a modified weigh-suckle-weigh technique utilizing a milking machine. The day prior to milking, cows and calves were separated before 1000 h, paired and allowed to nurse at 1630 h, then separated again for approximately 14 h until machine milked. Each cow received an intramuscular injection of oxytocin (20 IU; Vedo Inc., St. Joseph, MO) 10 min prior to milking to facilitate milk letdown. Milking began at 0630 h the following day and was completed using a portable milking machine (Porta-Milker, Coburn Company Inc., Whitewater, WI) until machine pressure could not extract any additional fluid. Milk weight, time of last separation, and time of milking initiation were recorded for calculation of 24-h milk yield. The 24-h milk yield and days in milk at each timepoint were used to calculate area under the curve (AUC) for each cow, which was a representation of cumulative milk production throughout the lactation period.

Cow body weight (BW) and body condition score (BCS; 1 = emaciated, 9 = obese) were collected prior to calving, weekly from the onset of the study through the breeding season, and at weaning. Body condition score was determined visually and through palpation by a trained technician. All cows were bred via natural service (1:15 bull:cow) during a 45-d breeding season. Pregnancy diagnosis was conducted via transrectal palpation by a local veterinarian ~90 d following bull removal.

Calf BW was recorded at birth and on all days the cows were milked (~ d 30, 60, 90, 120, and weaning). All March-born steers were implanted at weaning (year 1: Component TE-IS, Elanco, Greenfield, IN; year 2: Synovex Choice, Zoetis). May-born steers were implanted with 25.7 mg estradiol (Compudose, Elanco) at weaning.

Post-weaning steer management differed by season of calving. March-born calves were weaned November 1 and May-born calves were weaned December 1. All calves were fed ad libitum meadow hay and 1 lb/d dry distillers grain for 2 wk. March steers were then transported 90 miles to the West Central Research and Extension Center (WCREC) in North Platte, NE. Following a 2 wk acclimation period, steers were placed in a GrowSafe feeding system (GrowSafe Systems Ltd., Airdrie, AB, Canada). A 2-d average weight was recorded 10 d after GrowSafe entry and considered the initial feedlot entry BW. Approximately 100 d before slaughter, steers were implanted with Synovex Plus (Zoetis).

May-born steers were backgrounded over winter to gain either 1 or 2 lb/d, then grazed upland native range from May to September. In May, steers were implanted with Component ES (Zoetis). In September,

Table 1. Twenty-four-hour milk yield for March- and May-calving cows throughout lactation

	2020		2021	
Item	March	May	March	May
24-hr milk yield, lb				
d 30	15.16	18.30	14.30	20.64
d 60	9.75	13.44	12.19	15.77
d 90	12.76	12.10	14.26	15.05
d 120	10.52	8.25	13.75	8.95
d 210	4.64	5.59	7.28	8.01

Table 2. Regression coefficients and odds ratios used to evaluate the influence of increasing total milk produced during the entire lactation period on cow body weight and reproductive performance

Measurement	Estimate	SEM	*P*-value
Body weight, lb			
Pre-calving	-0.044	0.044	0.37
Pre-breeding	-0.088	0.066	0.17
Breeding	-0.110	0.066	0.09
Weaning	-0.088	0.066	0.13
Pregnancy rate, % (odds ratio)[2]	0.990		0.58
Cycling[1], % (odds ratio)	0.990		0.53

[1]Cycling before the start of the breeding season; evaluated by weekly serum progesterone concentration.

[2]The odds ratio is the odds of being pregnant with milking 2,277 lbs of milk over the lactation period over the odds of being pregnant at 2,255 lb of milk.

steers were shipped to WCREC and managed similarly to the March-born steers in the GrowSafe feeding system. Upon feedlot entry, all May steers were implanted with Component TE-200 (Elanco). A common finishing diet of 48% dry rolled corn, 40% corn gluten feed, 7% prairie hay, and 5% supplement was fed throughout both herd's finishing periods. Average daily gain (ADG) feedlot performance were recorded for all steers.

All analyses were performed using SAS 9.4 PROC GLIMMIX (SAS, Cary, NC). A similar initial model was used to analyze both the cow and progeny performance data. To account for differences in calving season (March or May) and differences among years, a SEASONYR term was determined. To account for differences in birth date within calving season, days within calving season was determined (CDATE). The initial model included the fixed effects of calf gender (CALFSEX; Heifer, Steer), cow age (COWAGE; 4, 5, 6), linear Milk AUC (MILKAUC), and linear and quadratic CDATE and the random effect of SEASONYR and residual error. For the behavior data, which was measured both early and late in the year, an additional fixed effect of time (TIME; Early, Late) and the random effect of SEASONYR was replaced by Cowid(SEASONYR), to account for the repeated measurements on the same experimental unit. In order to account for the differences between seasons and between years, the error term used for testing the MILKAUC effect was the Cowid(SEASONYR) random effect. All other effects were tested over the residual. Non-significant terms ($P > 0.05$) were dropped to produce the final model. A normal distribution was assumed for all measures, except for cow pregnancy rate and cycling rate where a binomial distribution was assumed. Binomial data was evaluated using the odds and odds ratio. Odds (*0*) are the probability (p) of the event occurring over the event not occurring ($1-p$). Odds ratio is the ratio of the odds for two different levels. Significance was determined at $P < 0.05$ and tendency was determined at $0.05 < P < 0.10$.

Results

Means for 24-h milk production at each timepoint during the lactation period are shown in Table 1 for March-calving and May-calving cows. Milk yield values ranged from 14.30–20.64 lb at 30 d postpartum and 4.64–8.01 lb at weaning (~210 d postpartum).

Cow BW was not influenced by milk AUC (Table 2) at pre-calve ($P = 0.37$), pre-breed ($P = 0.17$), or weaning ($P = 0.13$). At breeding, cow BW tended ($P = 0.09$) to be negatively associated with total milk production with a 0.11 lb decrease in BW for every 1 lb increase in total milk produced. Increased milk produced did not influence BCS at pre-calve ($P = 0.97$), pre-breed ($P = 0.48$), or breed ($P = 0.55$). At weaning, BCS decreased ($P = 0.02$) by 0.0006 points for every 1 lb increase in milk AUC. In this study, the odds of cows becoming pregnant were not influenced ($P = 0.58$; Table 2) by increasing milk production. The odds of cows cycling before the start of the breeding season were not influenced ($P = 0.53$) by milk production.

Calf pre-weaning BW was positively associated with increased total milk production at day 30, 60, 90, and 120 ($P < 0.01$; Table 3) of age. A positive association was also observed between milk AUC and calf BW at weaning ($P < 0.01$) with a 0.11 lb increase in weight for every 1 lb increase in total milk production. As expected with the increased calf BW, ADG from birth to 30 d ($P < 0.01$), 30 to 60 d ($P = 0.04$), and 60 to 90 d ($P < 0.01$) were positively influenced by increasing milk production. However, d 120 to weaning calf ADG tended ($P = 0.09$) to be positively associated with increasing milk AUC, illustrating the decreasing impact that milk production has on calf gain as forage consumption increases. In addition, steer ADG in the finishing phase was not associated ($P = 0.63$) with total milk produced by the dam.

Conclusion

In summary, increasing total milk produced throughout the lactation period had minimal influence on the cow production parameters assessed in this study in the Nebraska Sandhills forage environment. In general, BW, BCS, and reproductive productivity were maintained regardless of total milk produced during the lactation period. This suggests that the genetic potential for milk in the current study's cowherd is effectively supported by the environmental forage quality conditions, which is illustrated in Table 1 by signifi-

Table 3. Regression coefficients used to evaluate the influence of increasing total milk produced during the entire lactation period on calf body weight and average daily gain

Measurement	Estimate	SEM	*P*-value
Body weight, lb			
Birth	-0.0044	0.0044	0.28
d 30	0.0396	0.011	< 0.01
d 60	0.0528	0.011	< 0.01
d 90	0.0748	0.0154	< 0.01
d 120	0.088	0.0176	< 0.01
d 210 (weaning)	0.110	0.022	< 0.01
Average daily gain, lb/d			
Birth to d 30	0.0022	< 0.001	< 0.01
d 30 to 60	< 0.001	< 0.001	0.04
d 60 to 90	< 0.001	< 0.001	< 0.01
d 90 to 120	< 0.001	< 0.001	0.01
d 120 to 210	< 0.001	< 0.001	0.09
Feedlot performance			
Average daily gain, lb/d	0.00022	0.00044	0.63

cantly lower overall milk production than industry average. Although the data indicate milk production increases pre-weaning calf growth, this relationship weakens after 120 d, which may be due to the increase in forage intake and reliance on forage to meet requirements of the growing calf. Further examination of post-weaning calf efficiency will provide understanding of how of dam milk yield selection impacts the overall beef production system.

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