Effects of Milk Intake by Calves on Feed Intake and Digestibility[1]

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Story in Brief

Thirty-five 4- to 6-month-old Charolais crossbred calves in drylot and 42 on range nursing Hereford, Hereford x Holstein (Crossbred) and Holstein dams were utilized in two creep intake and digestion trials (drylot) and one forage intake study (range) to determine the influence of level of milk intake on feed intake and digestibility. Calves received free choice creep individually each day in drylot while none was fed on range.

Holstein progeny received more milk and consumed less creep in drylot and less forage cellulose on range than Hereford progeny. No breed differences in cellulose digestibility in drylot were noted. In drylot both creep intake and digestibility decreased as milk intake increased within breed. Similarly, forage cellulose intake decreased as milk intake increased on range. As creep intake increased cellulose digestibility and calf weight within each breed increased.

These results indicate that high levels of milk intake by calves depress the consumption of non-milk nutrients (forage or creep) and may decrease the total efficiency of heavy weaning weights produced by high milk levels.

Introduction

The high correlation between calf weaning weight and milking ability of the dam is well recognized. Previous Oklahoma research indicated that calves of Holstein cows in drylot consumed a lower proportion of total nutrient intake from non-milk sources than calves of Hereford or Hereford x Holstein females. It has been shown that fermentation develops more rapidly in early weaned calves fed concentrates than in milk-fed calves, and that calves receiving dry feed in addition to milk show increased rumen volume and papillary development when com-

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pared to milk fed calves. The purpose of this study was to determine the influence of varying levels of milk intake on cellulose digestibility and creep intake in nursing calves in drylot and on forage intake of nursing calves on range.

Materials and Methods

Thirty-five 4- to 6-month-old Charolais crossbred calves in drylot and 42 on range nursing four-year-old Hereford, Hereford x Holstein (Crossbred) and Holstein cows were utilized. In the drylot phase calves and dams were maintained in drylot from time of calving in December, January and February until weaning at 240 days of age. Cows were allotted to drylot according to sex of calf so that a ratio of three male: two female calves was established within each breed. All drylot calves except two were sired by one charolais bull. Calves received a free choice pelleted creep ration consisting of: Corn, 49.5% ground alfalfa hay, 15.0%; liquid molasses, 5.0%; soybean meal, 17.5% and cottonseed hulls, 13.0%.

Two digestion trials (Trial I in June and Trial II in July) were conducted in drylot. Chromic oxide (10 grams/head/day) was administered with the creep, which was fed daily from 8:00 am to 9:30 am and 4:00 pm to 5:30 pm during trial periods, for five days prior to the collection of fecal grab samples and for five succeeding days during which 100 grams rectal grab samples were taken at the time of each feeding. Grab samples were composited over the 5-day collection period for each calf, dried at 212°F for 48 hr, ground and analyzed for chromic oxide content and cellulose. This procedure allows the calculation of cellulose digestion coefficients in drylot by using the cellulose concentration of feed and feces and the chromic oxide concentration of the feces.

On range, 12 calves each from Hereford and Crossbred dams and 18 from Holstein dams were selected for a forage intake study (Trial III) and maintained with their dams on 86 acres of native tallgrass range in June. Age and sex distribution were equalized when possible. Calves received no creep on range. Chromic oxide administration, collection of fecal grab samples and analytical procedures were identical to those described for drylot with the exception that chromic oxide was administered via gelatin capsules on range. Two three-month-old nursing Angus x Hereford calves fitted with esophageol fistulae were used for collection of forage samples during each of the days when rectal grab samples were taken. Esophageol samples were composited for laboratory dry matter and cellulose digestibility determinations. Cellulose intake on range was calculated using cellulose indigestibility as determined in the laboratory and the chromic oxide concentration of the feces. Cellulose was chosen

to represent a nutrient found in forage on range and in creep in drylot but not in milk.

Milk intake of calves was determined by the calf suckle technique. Milk intake estimates were taken and calf weights obtained one week prior to fecal collections in each drylot trial. On range, milk intake and calf weight were averages of estimates taken one week prior to and two weeks after fecal collection.

Results and Discussion

Data for drylot trials are shown in Table 1. Breed (reflecting milk intake) affected creep intake for the entire creep feeding period. The ratio of creep intake to milk intake for Holstein progeny (0.17:1) was approximately half the ratio found for Hereford progeny (0.33:1) for the total lactation period.

In Trial I Holstein progeny consumed less creep than Crossbred or Hereford progeny. Creep intake and milk intake in Trial II were higher

Table 1. Body Weight, Milk Intake, Creep Intake and Cellulose Digestibility for Drylot Calves (Trials I and II)

Item	Breed of dam		
	Hereford	Hereford x Holstein	Holstein
Trial I			
No. of calves	10	10	10
Weight of calves, lb	426.8	455.4	484
Daily milk intake, lb[1]	12.32[5]	17.16[4]	20.24[4]
Daily creep intake, lb	4.4	4.62	3.52
Lb creep:lb body weight	0.010	0.010	0.007
Lb creep:lb milk	0.40	0.29	0.20
Cellulose digestibility (%)	55.8	57.2	49.4
Trial II			
No. of calves	10	10	15
Weight of calves, lb	464.2	501.6	530.2
Daily milk intake, lb[1]	12.98[6]	18.26[5]	28.16[4]
Daily creep intake, lb	8.14[4]	5.94[5]	5.72[5]
Lb creep:lb body weight	0.170	0.120	0.110
Lb creep:lb milk	0.71	0.36	0.23
Cellulose digestibility (%)	57.2	49.1	54.1
Total lactation period			
Total creep intake, lb[2]	902[4]	796[4,5]	737[5]
Daily creep intake, lb[2]	5.06[4]	5.06[4]	4.18[5]
Daily milk intake, lb[3]	14.74[6]	19.8[5]	21.8[4]
Lb creep:lb milk	0.33	0.26	0.17

[1] Milk production estimates taken one week prior to digestibility trials.
[2] March 1 until weaning.
[3] Average of seven monthly estimates.
[4,5,6] Values on same line with same superscript letters do not differ significantly ($P<.05$).

than in Trial I, reflecting the increase in size of the calves during the month between trials. Hereford progeny had the smallest increase in milk consumption, but the largest increase in creep intake between Trials I and II. Hereford progeny in Trial II consumed more creep per day than Holstein or Crossbred progeny.

Little breed influence on cellulose digestibility was detected in Trial I or Trial II. Milk intake was negatively correlated with cellulose digestibility and creep intake (Table 2) in both drylot trials. Creep intake was positively correlated with cellulose digestibility and calf weight$^{0.75}$ (metabolic size) in both drylot trials except among Hereford progeny in Trial II.

Range calves in Trial II corresponded closely in weight and age to drylot calves in Trial I. Range intake results (Table 3) show that forage dry matter intake on range was less than creep dry matter intake in drylot. However, since range forage contained approximately 45% dry matter at the time of Trial III, range calves consumed a similar amount of non-milk material as drylot calves in Trial I.

Breed tended to affect forage cellulose intake. Holstein progeny received the most milk, but consumed the least forage while Hereford progeny received the least milk and consumed the most forage, in agreement with drylot creep intake trends. Correlation coefficients between cellulose intake and milk intake (Table 4) were negative and low within each breed of calf. Cellulose intake was positively correlated with calf weight$^{0.75}$ (metabolic size) within Crossbred progeny and Holstein progeny, but not within Hereford progeny. As in drylot, the larger (and

Table 2. Correlation Coefficients Between Creep Intake, Milk Intake, Cellulose Digestibility and Calf Weight$^{0.75}$ Within Breed In Drylot[1]

Breed of Dam	Creep intake: milk intake	Cellulose digestibility: milk intake	Creep intake: creep digestibility	Creep intake: weight$^{0.75}$
Trial I				
Hereford (10)[2]	—0.14	—0.24	0.94[3]	0.61[5]
Crossbred (10)	—0.15	—0.02	0.70[3]	0.91[3]
Holstein (15)	—0.29	—0.13	0.86[3]	0.85[3]
Trial II				
Hereford (10)[2]	—0.55[5]	—0.23	0.19	0.42
Crossbred (10)	—0.35	—0.06	0.69[4]	0.84[3]
Holstein (15)	—0.56	—0.50[5]	0.51[4]	0.51[4]

[1] Creep intake during 5-day fecal collection period; milk intake and body weight measured one week prior to fecal collection period.
[2] Numbers in parenthesis represent the number of animals.
[3] Significantly different from zero ($P<.01$).
[4] Significantly different from zero ($P<.05$).
[5] Significantly different from zero ($P<.10$).

Table 3. Body Weight, Milk Intake and Forage Intake for Range Calves (Trial III)

Item	Breed of dam		
	Hereford	Hereford x Holstein	Holstein
No. of calves	12	12	18
Weight of calves, lb	371.8	457.6	486.2
Daily milk intake, lb[1]	14.3[4]	22.44[3]	26.18[5]
Forage cellulose intake, lb	.80	.70	.62
Forage dry matter intake, lb[2]	2.86	2.51	2.20
Forage dry matter intake: milk intake[2]	0.20	0.11	0.08
Lb dry matter: lb body weight	0.008	0.005	0.004

[1] Average of two 24-hour estimates taken one week prior to and two weeks after forage cellulose intake was measured.
[2] Based on forage containing 28% cellulose (dry matter basis).
[3,4]Means on the same line with the same superscript letter do not differ significantly ($P<.05$).

Table 4. Correlation Coefficients Between Forage Cellulose Intake, Calf Weight$^{0.75}$ and Milk Intake on Range[1]

Breed of dam	Cellulose intake: milk intake	Cellulose intake: weight$^{0.75}$
Hereford (12)[2]	—0.26	—0.09
Crossbred (12)	—0.30	0.60[4]
Holstein (18)	—0.09	0.79[3]

[1] Milk intake measured one week prior to and two weeks after fecal collections.
[2] Numbers in parenthesis represent the number of animals.
[3] Significantly different from zero ($P<.01$).
[4] Significantly different from zero ($P<.05$).

older) calves within each breed consumed more forage cellulose than smaller calves even though the largest breed of calf (Holstein progeny) consumed less cellulose than the smallest (Hereford progeny).

Results and Discussion

These results suggest that non-milk nutrient intake, non-milk nutrient digestibility, milk intake and calf weight (reflecting age) are all interrelated. The positive correlations between creep intake and digestibility and the negative correlations between milk intake and cellulose digestibility are in agreement with results of research showing greater ruminal development in calves receiving dry feed with milk than in calves receiving little or no dry feed. The high correlation between non-milk feed intake (on range and in drylot) and calf weight probably reflects the influence of calf age on creep and forage intake. Milk intake did not vary greatly within breed and differences in weight were more a function of age than milk intake within each breed.

The trend for drylot calves with higher milk intakes to consume less creep has also been noted previously. Results presented herein suggest that the same depression of non-milk feed intake at high levels of milk intake also holds true for calves grazing range forage. The lower proportion of non-milk:milk nutrients in the diet of dairy crossbred progeny may reduce the overall efficiency of heavier weaning weights produced by increased milk production on range. Previous Oklahoma research with Charolais crossbred calves of Hereford, Hereford x Holstein and Holstein dams in drylot showed that Hereford progeny was more efficient in converting digestible energy of milk and creep to weaning weight than Hereford x Holstein or Holstein progeny.

Effects of Two Milk Intake Levels on Performance of Two Calf Types

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Story in Brief

The effect of two levels of milk intake on the performance of calves of two growth potentials was determined. This was accomplished by breeding Hereford cows to Angus bulls and Holstein cows to Charolais bulls, followed by reciprocal cross-fostering of about one-half of the calves.

The high level of milk consumption (24 lb/day, produced by Holsteins) resulted an additional 105 and 126 lb of weaning weight in Angus x Hereford and Charolais x Holstein calves, respectively. Increasing the level of milk consumption from 10-12 to 24 lb/day resulted in a reduction in apparent efficiency of conversion of milk to calf gain of 63 and 72% in Angus x Hereford and Charolais x Holstein calves, respectively.

Relative forage intake was reduced 30 and 49% in Angus x Hereford and Charolais x Holstein calves, respectively, at high levels of milk

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