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High-quality meadow regrowth is limiting in escape protein. Milk is an important source of metabolizable protein however, milk intake in late lactation may not be sufficient to maximize growth of nursing calves.

Summary

Forty spring-born calves grazing subirrigated meadow regrowth were assigned to two weaning and two supplementation treatments in the fall of 1995 and 1996. Weaning treatments were: 1) weaning September 1; or 2) nursing during the trial. Supplementation treatments were 1) no supplemental undegraded intake protein (escape protein); or 2) supplemental undegraded intake protein. No treatment interactions were detected indicating weaning and supplementation affects were independent. Nursing calves had higher weight gains (2.1 versus 1.3 lb/day) and lower forage intakes (5.2 versus 6.5 lb/day) than weaned calves. Supplemental undegraded intake protein increased weight gains of calves (1.94 versus 1.45 lb/day). We concluded subirrigated meadow forage was limiting in metabolizable protein and milk was an important source of metabolizable protein.

Introduction

For the nursing calf, milk represents an important source of nutrients. Milk bypasses rumen fermentation by the esophageal groove reflex and is digested and absorbed in the abomasum and small intestine. Because of this reflex, milk protein represents an important contribution to the metabolizable protein supply for the nursing calf. Nursing calves have higher relative protein requirements than more mature animals.

Generally, when cattle graze cool-season grasses, ruminal ammonia concentrations do not limit microbial growth and fermentation. However, because of the degradable nature of the protein in these grasses, large amounts of nitrogen can be lost as ammonia before reaching the duodenum. Therefore, it is possible for metabolizable protein to be limiting in forages which have relatively high crude protein contents, especially if relative requirements are high.

Numerous studies have evaluated

the effects of early weaning on cow and calf performance. However, these studies generally involved feeding early weaned calves large amounts of concentrates or grains, rather than leaving calves in a grazing setting. Few studies have evaluated the effect of early weaning on calf performance, where calves graze high-quality forages after weaning. Effects of supplemental, undegraded intake protein on forage intake and performance of the weaned and nursing calves grazing high-quality forage are not well-defined. Supplying undegraded intake protein in the form of milk or in a supplement may increase performance of calves grazing meadow regrowth if metabolizable protein is deficient in those forages. Our objectives were to evaluate the effects of milk intake and supplemental undegraded intake protein on calf performance and forage intake while grazing subirrigated meadow regrowth in the Nebraska Sandhills.

Procedure

The study was conducted at the University of Nebraska-Lincoln Gudmundsen Sandhills Laboratory. Forty spring-born crossbred calves were assigned in each year to two weaning and two supplementation treatments during the fall of 1995 and of 1996. Because the calves did not readily consume supplements until mid-October, 1995, the trial lasted from October 17 to November 18. In 1996, however, the calves readily consumed supplements from the outset and the trial lasted from September 5 to November 4. Each year, calves grazed subirrigated meadow regrowth after July haying. Weaning treatments were: 1) weaning before the trial began (September 1); and 2) nursing throughout the trial. Supplementation treatments were: 1) no supplementation; or 2) supplemental undegraded intake protein. Supplement composition is listed in Table 1. Weaned calves receiving supplement were individually fed 2.0 lb of supplement daily; nursing calves received 1.1 lb supplement daily.

Calves were gathered each day at 7:30 a.m. and individually fed their supplements. In order to prevent nursing by weaned calves, the subirrigated meadow pasture was split in 1995 into two pastures; nursing calves grazed on one side, and weaned calves on the other. Each day, following supplementation, nursing and weaned calves rotated pastures. Over the course of the trial, each group of calves grazed each side a similar number of days. In 1996, nursing and weaned calves were pastured together and observed for cross nursing. No nursing by weaned calves was observed in either year. Milk intake by nursing calves was determined by weigh-suckle-weigh on November 4, 1995 and October 18, 1996.

Table 1. Composition of supplement fed to weaned and nursing calves (dry matter basis).

Ingredient	% of DM
Sulfite liquor treated soybean meal	80.0
Feather meal	20.0
	% of OM
Crude protein	57.3
In vitro organic matter disappearance	79.5
Undegraded intake protein, % crude protein[a]	78.8

[a]Determined using ammonia release procedure.

Fecal output was determined on steer calves during October of each year. Each steer calf was dosed with a chromium-releasing Captec bolus. Fecal output was calculated by dividing the amount of chromium released by the Captec bolus by the chromium concentration in the feces. Forage intake was calculated by dividing fecal output by indigestibility of the subirrigated meadow diet.

Forage diet samples were collected with three esophageally fistulated cows and three ruminally fistulated nursing calves. Extrusa samples were analyzed for DM, OM, CP, NDF, ADF, IVOMD and protein degradability

Results

Year effects were significant for initial weight and average daily gain ($P = 0.06$ and 0.04, respectively). Initial weights averaged 478.3 and 423.9 lb in 1995 and 1996, respectively. These weights were higher in 1995 because of the difficulties in getting calves to consume supplements, which caused the trial to start later than anticipated. Average daily gains averaged 1.52 and 1.87 lb day^{-1} in 1995 and 1996, respectively, and again were likely influenced by the starting date of the trial.

Calves and cows selected diets which were similar in quality. Diets collected with ruminally cannulated calves averaged 12.5% CP and 54.8% IVOMD (Table 2). While grazing meadow regrowth, calves tended to select diets higher in undegraded intake protein than cows (Table 2).

No supplementation by weaning management interactions were detected for initial weight, final weight or average daily gain. No supplementation by weaning management interactions were detected for forage intake, total intake, forage intake as a percentage of body weight or total intake as a percentage of body weight. Therefore only main effects will be presented and discussed.

Nursing calves had higher average daily gains and higher final weights ($P < .01$) compared to weaned calves (Table 3). Due to the magnitude of this response, it is apparent that milk was an important source of nutrients for the growing calf. Nursing calves gained

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Table 2. Crude protein (CP), undegraded intake protein (UIP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and in vitro organic matter digestibility (IVOMD) of diet samples collected from cows and calves grazing subirrigated meadow regrowth in 1995 and 1996.

		% of organic matter				
Date	Type	CP	UIP	NDF	ADF	IVOMD
27 Oct., 1995	Cow	10.0	1.94	84.4	57.2	53.1
27 Oct., 1995	Calf	10.9	2.45	83.9	55.9	50.1
3 Nov., 1995	Calf	11.5	2.21	76.3	53.0	56.1
15 Oct., 1996	Cow	11.1	1.78	76.5	53.2	55.7
15 Oct., 1996	Calf	11.2	2.72	88.8	63.0	56.7
16 Oct., 1996	Calf	16.2	3.09	94.4	69.8	56.3

Table 3. Effect of weaning and supplementation on ADG and intake.

	Main effects[a]					
	Weaning management			Supplementation		
	Weaned	Nursing	P-value	Non-supplemented	Supple-mented	P value
Initial weight (lb)	432	470	.2072	457	446	.7560
Final weight (lb)	490	569	.0099	524	535	.6847
ADG (lb/day)	1.3	2.1	.0009	1.5	1.9	.0306
Forage intake (lb/day)	6.5	5.2	.0090	6.0	5.7	.3257
Total intake (forage + supplement, lb/day)	7.50	5.74	.0040	6.00	7.26	.0111
Forage intake (% body weight)	1.29	0.89	.0074	1.17	1.02	.0927
Total intake (forage + supplement, % body weight)	1.48	0.99	.0048	1.17	1.30	.1388

[a]All supplement by weaning management interactions were nonsignificant at P>0.15.

0.79 lb/day more than weaned calves over a 60 day grazing period, resulting in over 44 lb of body weight gain per calf. Lactation effects on weight and body condition score changes in the cow were not investigated. Previous research at Gudmundsen Sandhills Laboratory indicated lactating two-year-old cows will maintain weight and body condition while grazing meadow regrowth (1996 Nebraska Beef Report, pp. 3-5), however body condition increased when cows were dry.

Calves receiving undegraded intake protein supplementation had higher (P = 0.03) weight gains compared to nonsupplemented calves (Table 3). Weaned and nursing calves responded to supplemental undegraded intake protein in a similar fashion, indicating the undegraded intake protein was likely first limiting for both weaned and nursing calves.

Forage intake and total intake, when expressed either as a percentage of body weight or as an amount, were higher (P<.01) for weaned compared to nursing steers (Table 4). Although weaned calves compensated for lack of milk intake by increasing forage intake, this compensation was not enough to increase weight gains to levels of nursing calves, indicating the importance of milk for the growing calf.

No differences were found in forage intake for supplemented or non-supplemented steers. Intake of forage and supplement were higher (P < .01) for supplemented steers. Forage intake, as a percentage of body weight, tended to be higher for nonsupplemented steers (P=.09). Total intake, expressed as a percentage of body weight, tended to be higher for supplemented calves (P=0.14).

Milk consumption averaged 12.8 and 14.5 lb milk/day for supplemented and nonsupplemented calves, respectively. Assuming milk contains 3.4% protein, these milk intakes would supply 0.43 and .46 lb metabolizable protein, respectively. For the nursing calves not receiving the undegraded intake protein supplement, this represents over 50% of the metabolizable protein supply. However, based on the supplementation performance responses, milk may not supply adequate metabolizable protein to meet the requirements for the level of daily gain by the calves that other nutrients in the grazed forage would support.

Commonly accepted practices of creep feeding cereal grains to nursing calves may not correct metabolizable protein deficiencies in high quality forages. Creep feeding small amounts of protein supplements high in undegraded intake protein may increase weight gains in nursing and weaned calves grazing high-quality forages.

We concluded that high-quality forages, such as subirrigated meadow regrowth, may be limiting in metabolizable protein for growing calves. Even though milk represents an important source of metabolizable protein, milk intake in late lactation may not be high enough to support the level of growth that would be supported by the energy consumed.

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