Effect of the Frequency of Corn Supplementation on a High Quality Alfalfa Hay Utilization by Cattle

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Story in Brief

Two trials were conducted to study the effect of frequency of corn supplementation on utilization of high quality alfalfa hay. In Trial I, eight ruminally cannulated steers in a replicated 4 x 4 Latin square were given ad libitum access to chopped alfalfa hay with no supplement (CONT) or with a cracked corn supplement fed at one of three frequencies: 0.5 % of body weight (BW) every day (24); 1.0% of BW every other day (48) or 1.5% of BW every third day (72). Total organic matter intake was greater when corn was fed every day than when corn was fed less frequently. Feeding cracked corn significantly increased organic matter digestibility and the ruminal concentration of butyrate and decreased the acetate to propionate ratio of ruminal fluid. In Trial 2, 60 Holstein heifers (440 lb) were stratified by weight and assigned to the same four treatments with the exception that hay was not chopped. After 90 d on trial, feeding supplemental corn increased average daily gain (ADG), and ADG decreased linearly as time interval between supplement feedings increased.

Key Words: Feeding Frequency, Supplementation, Alfalfa Hay, Cattle

Introduction

Supplementation of high quality forages with grain often increases daily gains (Wagner et al., 1984; Horn and McCollum, 1987), organic matter intake (Elizalde et al., 1999), and digestibility of organic matter (Norton et al., 1982). The objective of this research was to examine the effect of frequency (every 24, 48 or 72 h) of feeding the same amount of supplement on ruminal parameters, digestibility and average daily gain (ADG) by cattle fed alfalfa hay.

Materials and Methods

Trial I.

Animals and Diets. Eight ruminally cannulated crossbreed steers (Hereford x Angus, 1070 lb) were assigned to two 4 x 4 Latin squares. Steers were weighed at the beginning and end of each 18-d period. Steers were housed in individual indoor 3 x 4 m pens for 9 d each period. On d 10, they were moved to individual metabolism stalls for a 3-d adaptation and a 6-d collection period. The treatments included: chopped alfalfa hay ad libitum and a mineral vitamin premix (CONT), chopped alfalfa hay plus 0.5% of body weight (BW) cracked corn every day (24), chopped alfalfa hay plus 1.0% BW cracked corn every second day (48), or chopped alfalfa hay plus 1.5% BW as cracked corn every third day (72). Animals were fed each morning at 0800 and had continuous access to chopped alfalfa hay and water.

Sample Collection and Preparation. Intakes of hay and corn were recorded daily and refused hay was weighed back. Total urine and feces were collected each day of the collection period.

Feces were weighed and a subsample was analyzed for dry matter, organic matter (OM), acid detergent fiber (ADF), neutral detergent fiber (NDF), starch and fecal nitrogen. At 0 h of d 16, 17 and 18, before being fed, CoEDTA was dosed to determine liquid passage rate. During this 3-d period, ruminal samples were collected each day to determine marker concentrations, pH, and fermentation profiles for volatile fatty acids (VFA) at 3, 6, 9, 15 and 24 h after feeding.

Laboratory and Statistical Analysis. Dry matter, ash, crude protein, ADF and NDF were determined in feeds and fecal samples. Concentrations of Co and volatile fatty acids (VFA) were determined from rumen samples. Period, animal, and treatment were included as class variables with statistical analyses by the GLM procedure of SAS (SAS Inst. Inc., Cary, NC). Least squares means and comparison among them (PDIFF option) were used. Linear and quadratic effects of supplemental interval (24, 48 and 72) were tested using contrast statements.

Trial II.

Animals and Diets. Sixty Holstein heifers (440 lb; 14 mo old) and eight cannulated heifers were stratified by weight and assigned to the same four treatments with the exception that hay was not chopped. Animals were fed in a dry lot at INIA La Estanzuela Research Station, Colonia, Uruguay for 110 d (20 d for adaptation and 90 d for measurements). Round alfalfa bales (730 lb) were offered ad libitum with a salt premix. Animals were sorted each morning at 0800 and those receiving supplemental corn were fed individually. Animals were weighed every 14 d with intake of corn DM being adjusted at this time.

Sample Collection and Preparation. Starting on d 60, animals were fed chromic oxide for 12 d with fecal samples being collected the final 3 d. On d 80, blood samples were taken for three consecutive days.

Statistical Analysis. Analysis was for a randomized complete block design using Proc GLM of SAS. Same contrast as explained for Trial 1 was carried out.

Results and Discussion

Trial I.

Intake. Total organic matter intake was greater ($P<.05$) for steers fed more frequently (at 24-h intervals) than at 48 and 72-h intervals (Table 1). Feeding supplement more frequently (24) tended to increase OM intake compared with to CONT ($P=.058$). Intake of organic matter, hay organic matter and digestible organic matter decreased linearly ($P<.02$, $P<.01$, $P<.08$, respectively) as hours of feeding supplement increased. However, digestibility of organic matter increased as the time interval between feeding supplements increased. To calculate how much of this increase was caused by an increased percentage of the diet being corn grain, we calculated the amount of digestible OM that would be provided by the added corn assuming the corn had an OM digestibility of 90%. Intake of digestible OM from hay was calculated by difference, and OM of hay was calculated. These estimates suggest that hay digestibility was not markedly changed by supplemental corn though hay digestibility tended to be depressed with more frequent feeding of corn grain. Consequently, the increases in OM digestibility with less

frequent feeding of corn grain can be ascribed primarily to the higher percentage of corn in the total diet consumed by steers consuming corn less frequently.

Table 1. Average organic matter intakes and digestibility for the four treatments (CONT=only alfalfa hay; 24= alfalfa hay + .5% BW as corn every day; 48=alfalfa hay + 1.0 BW as corn every 2-d; 72 = alfalfa hay + 1.5% BW as corn every other 3 d)

	Treatments				Contrasts[1]	
Intake and digestion	CONT	24	48	72	1	2
OM total intake (lb)	27.93[ab]	30.87[a]	27.79[b]	26.89[b]	ns	L**
OM hay intake (lb)	27.93[a]	25.39[a]	22.30[b]	20.92[b]	***	L***
Digestibility OM (%)	68.89[a]	71.69[b]	73.90[b]	75.31[b]	***	L**
Digestible OM intake (lb)	19.25[a]	22.14[b]	20.50[ab]	20.22[ab]	**	L *
Hay digestibility (%) assuming corn is 90 % digestible	68.89	68.18	70.32	70.56	ns	ns

[1]Contrast 1=CONT vs corn treatments; Contrast 2=linear and quadratic effects only for corn treatments

[a,b]Different letter within row P<.05;*P<.10; ** P<.05; *** P<.01

Ruminal VFA. Averaged across time intervals, feeding corn increased butyrate concentrations (P<.01); butyrate concentration increased linearly with frequency of feeding (P<.05). The ratio acetate/propionate was decreased by feeding corn (P<.05), but concentrations of other VFA were not affected either by feeding corn or by the frequency that it was fed (Table 2).

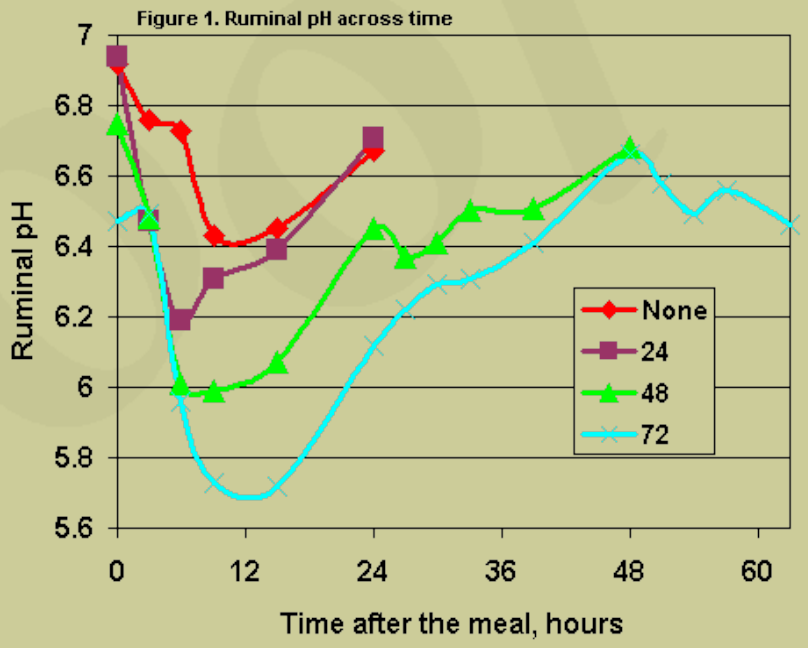
Table 2. VFA concentrations and Co-Edta dilution rate for the four treatments (CONT=only alfalfa hay; 24= alfalfa hay + .5% BW as corn every day; 48=alfalfa hay + 1.0 BW as corn every 2-d; 72 = alfalfa hay + 1.5% BW as corn every other 3 d)

	Treatments				Contrasts[1]	
VFA	CONT	24	48	72	1	2
Acetate mmol/liter	84.67	81.78	82.26	80.08	ns	ns
Propionate mmol/liter	18.59	19.16	19.62	19.59	ns	ns
Butyrate mmol/liter	7.63[a]	8.97[ab]	9.16[ab]	10.64[b]	***	L**
Total mmol/liter	116.87	115.88	116.93	116.41	ns	ns
Acetate/Propionate	4.54[a]	4.37[ab]	4.24[ab]	4.11[b]	**	ns
Co-EDTA dilution rate	8.45[ab]	9.05[a]	5.56[b]	6.73[ab]	ns	ns

[1]Contrast 1=CONT vs corn treatments; Contrast 2=linear and quadratic effects only for corn treatments

[a,b]Different letter within row P<.05;*P<.10; ** P<.05; *** P<.01

Ruminal pH. Ruminally pH was numerically lowered following intake of larger but less frequent meals and remained lower for more hours with feeding at 72-h interval (Figure 1).



Trial II. Averaged across the 90-d trial, supplemental corn increased ADG (P<.01) of Holstein heifers. Rate of gain decreased linearly (P<.01) as time intervals between meals was increased.

Table 3. Average daily gain (lb) in Holstein Heifers for the four treatments (CONT=only alfalfa hay; 24= alfalfa hay + .5% BW as corn every day; 48=alfalfa hay + 1.0 BW as corn every 2-d; 72 = alfalfa hay + 1.5% BW as corn every other 3 d))

	Treatments				Contrasts[1]	
	CONT	24	48	72	1	2
Average daily gain (lb)	1.06[c]	1.70[a]	1.65[a]	1.37[b]	**	L**

[1]Contrast 1=CONT vs corn treatments; Contrast 2=linear and quadratic effects only for corn treatments

[a,b,c]Different letter within row P<.05;*P<.10; ** P<.05; *** P<.01

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