Frequency of Feeding Small Grains Range Grass Hay

S. W. Coleman and R. D. Wyatt

Story in Brief

Small grains forage (SGF) was fed at three frequencies to determine its usefulness as a nitrogen (N) supplementation for dormant native grass hay. Twelve steers (265 kg BW) were randomly assigned to one of four treatments (feeding frequency): (1) control - tall native range hay; (2) range hay plus 11.3 kg of green chopped SGF daily; (3) range hay plus 22.7 kg of green chopped SGF on alternate days; and (4) range hay plus 45.4 kg of green chopped SGF every fourth day. After a three-week preliminary period, four consecutive 1-week periods for total collection of feces and urine followed.

The SGF consisted of wheat (immature to soft dough) during the preliminary and first two collection periods and oats (immature to early boot) during the last two collection periods. The addition of SGF to the basal diets significantly increased ($P<.05$) digestibility of dry matter from 36.7 to 43.7 percent and of N from −17.1 to 46.5 percent. However, the interaction between feeding frequency and period for digestibility of N was significant ($P<.05$). The animals were marginal to negative in N balance, even when SGF was fed. Nitrogen balance was also influenced by a significant feeding frequency x period interaction. For both parameters, most of the interaction was due to the control treatment.

In general, digestibility and N-balance increased until period 3 and then decreased the fourth period. Digestibility was less in animals fed every fourth day than in animals fed every day. The data indicate that animals can be fed SGF infrequently and, with adaptation, maintain higher N balance than when they are fed low-protein basal rations such as range hay.

Introduction

Protein deficiency has been shown to be the first limiting nutrient of dry cows grazing dormant native range grass in Oklahoma and also constitutes the greatest part of the cost associated with cow-calf operations. Small grain forages (SGF) are relatively high in crude protein (CP) and are available for grazing when supplemental protein requirements are greatest. In addition, SGF, especially winter wheat, are available for pasture in the Southern and Central Great Plains where native grass range is used for cow-calf production. Though dry, or even lactating, cows do not need forage as high in quality as wheat, limited grazing for supplemental benefits may be profitable. The frequency of grazing has not been determined. This research was begun to determine the influence of frequency of feeding SGF on dietary nitrogen (N) utilization when the basal diet was dormant native range grass hay.

Experimental Procedure

Design

Twelve English crossbred steers were randomly assigned to one of four treatments (feeding frequency): (1) Range hay (control); (2) range hay plus 11.3 kg of SGF each day; (3) range hay plus 22.7 kg of SGF on alternate days; and (4) range hay plus 45.4 kg

---

USDA, Science and Education Administration, Southern Region, in cooperation with Oklahoma Agricultural Experiment Station.

of SGF every fourth day. They were placed in metabolism stalls designed for separation of feces and urine and allowed three weeks for adaptation. Four consecutive 7-day collection periods followed. Within each collection period, timing was arranged so that animals on treatment 4 were fed SGF twice. Feces and urine were collected and processed as described by Coleman and Barth (1974).

Forages

Basal diet consisted of mature tall-grass, native range hay grown on the Southwestern Livestock and Forage Research Station, El Reno, OK. The hay was cut and baled in March. Primary composition was *Andropogon scoparius*, *Andropogon gerardi* and *Andropogon hallii*.

The hay was chopped through a 2.5 cm screen before feeding. Supplementary SGF consisted of two types because of a rapid increase in maturity of wheat forage. During the preliminary period and the first two collection periods, wheat forage was used. During the second collection period, the wheat was so mature that greater than 50 percent was in boot to early dough stage. During the last two collection periods, vegetative material from spring-planted oats was fed. All SGF was chopped with a flail harvester daily at 8 am and fed immediately. Animals fed SGF at 4-day intervals were fed in two equal increments. The amount of green chop offered was determined by observing the amount consumed in 1 hr by animals assigned to daily feeding of SGF.

Daily samples of the wheat forage were collected and dried at 100 C for dry matter (DM) determination. Another sample was collected and dried for three days at 65 C, allowed to air equilibrate, ground to pass a 1-mm screen and stored for chemical analysis. When refusals of wheat exceeded 2.5 kg, samples were taken for DM; otherwise, DM of refusal was assumed to be equal to that of the forage.

Chemical Analysis

All air-dry forage and fecal samples were analyzed for 100 C dry matter, ash and N. Urine was analyzed for N (AOAC, 1970). Acid-detergent fiber, neutral-detergent fiber, permanganate lignin and cellulose were determined according to procedures described by Goering and Van Soest (1970). Total non-structural carbohydrates (TNC) were determined on daily SGF samples (Smith, 1969). Coefficients of digestion were calculated for each nutrient. Also N retention was determined and expressed as a percentage of intake and absorbed N.

Statistical

The data were analyzed with the appropriate analysis of variance for split-plot design. Days between feeding SGF (treatments) were main effects and collection periods were subordinate effects.

Results and Discussion

Chemical composition of dietary components are presented in Table 1. The hay was severely weathered as indicated by low CP and TNC. The wheat and oat green chop varied little among trials, except that CP of the oats was higher than that of wheat. Conversely, TNC of oats was lower than that of wheat.

Overall ration intake and nutrient digestibility are presented in Table 2. Dry matter intake (DMI), whether calculated as actual intake, intake/100 kg of body weight or intake/metabolic body size, was lowest ($P<.05$) for the control. The DMI of steers fed SGF every day was not different from that of steers fed every other day, but DMI was depressed ($P<.05$) for steers fed SGF every fourth day. Digestibility of DM, organic matter (OM) and CP were significantly ($P<.05$) affected by frequency of feeding SGF. Digestibility was lowest for the control treatment. Digestibility of DM, OM and CP declined slightly as the interval between feeding SGF increased. This

Table 1. Nutrient composition of forage.

Nutrient	Range hay	Wheat		Oats	
		Period 1	Period 2	Period 3	Period 4
	%				
Dry matter	87.3	22.5	24.6	16.2	16.4
Organic matter	93.2	91.8	91.0	86.9	88.0
Crude protein	3.3	11.7	14.0	20.2	17.2
Neutral-detergent fiber	75.6	45.8	48.6	46.4	47.3
Acid-detergent fiber	53.9	26.1	26.1	26.5	27.0
Lignin	12.3	3.9	3.9	3.5	3.5
Cellulose	36.9	19.7	20.0	17.6	19.3
Hemicellulose	21.7	19.7	22.5	19.9	20.3
TNC[a]					
Non-hydrolyzed	1.8	10.0	13.3	6.4	7.8
Hydrolyzed[b]	.4	16.9	15.0	7.0	9.9

[a]Total non-structural carbohydrates.
[b]Contains fructosans.

Table 2. Ration intake and nutrient digestibility.

Item	Control	Feeding frequency, days		
		1	2	4
Average weight, kg				
Initial	284	287	290	283
Final	235	276	296	259
Dry matter intake				
kg/day	2.14[a]	5.56[c]	5.26[c]	4.22[b]
kg/100 kg BW[d]/day	.82[a]	1.98[c]	1.80[c]	1.57[b]
g/$W_{kg}^{.75}$/day	33.0[a]	81.1[c]	74.4[c]	63.5[b]
Digestibility, %				
Dry matter	36.7[a]	45.8[c]	44.6[bc]	40.6[ab]
Organic matter	40.5[a]	49.7[b]	48.0[b]	44.5[ab]
Crude protein	−17.1[a]	49.0[c]	48.6[c]	41.7[b]
NDF[d]	46.1	45.6	43.7	41.3
ADF[d]	40.2	36.8	35.6	33.6
Cellulose	58.4	56.1	52.5	52.0
Hemicellulose	61.0	61.9	59.8	56.1
Lignin	9.0	8.6	9.2	4.7

[a,b,c]Values in same row not followed by the same superscript are significantly different ($P<.05$).
[d]BW = body weight; NDF = neutral-detergent fiber; ADF = acid-detergent fiber

Table 3. Nitrogen intake and utilization.

Item	Control	Feeding frequency, days		
		1	2	4
Nitrogen, g/day				
Intake	11.2[e]	71.7[g]	68.7[g]	51.7[f]
Fecal	13.0[e]	36.1[g]	34.5[g]	28.3[f]
Urinary	10.1[e]	38.1[g]	35.3[g]	24.2[f]
MFN[a]	11.2	28.7	27.4	22.2
EUN[b]	7.1	7.4	7.6	7.3
Absorbed	−1.8[e]	35.6[g]	34.2[g]	23.3[f]
Retained	−11.9	−2.6	−1.1	−.8
N retained/N intake, %	- -	−4.5	−4.3	−13.1
N retained/N absorbed, %	- -	−11.5	−13.3	−70.6
Biological value[c]	70.3	51.6	53.5	52.4
Net protein utilization[d]	58.5	46.3	47.8	47.4

[a]Metabolic fecal N = Fecal DM x (3.62 = .13 dry matter digestibility), Swanson, 1977.
[b]Endogenous urinary N = .43 $W_{kg}^{.505}$, Swanson, 1977.
[c]BV = (N intake - (Fecal N-MFN) - (urinary N - EUN))/(N intake - (fecal N - MFN)).
[d]NPU = (N intake - (fecal N - MFN) - (urinary N - EUN))/N intake.
[e,f,g]Values in the same row not followed by the same superscript are significantly different ($P<.05$).

decline may be a reflection of the fact that slightly lower amounts of the dietary DM were furnished by SGF, especially when fed at 4-day intervals. Digestibility of various fiber fractions was not influenced by SGF feeding frequency.

Digestibility of all fractions was affected ($P<.05$) by period. Digestibility of CP, acid-detergent fiber and lignin increased through the third period and then decreased in the fourth. Digestibility of other nutrients were essentially constant through the first three periods and decreased in the fourth. Digestibility of CP, ADF and lignin were influenced by an interaction of feeding frequency and period.

Utilization of N is presented in Table 3. With respect to frequency of feeding SGF, N intake, fecal N, urinary N and absorbed N followed similar patterns. The fact that the animals were in negative N balance regardless of treatment indicates that N intake was inadequate for young growing steers. Deficit N balance amounted to 4-13 percent of intake N or 11-71 percent of absorbed N. The control ration, as expected, resulted in the lowest N status. Nitrogen balance of steers fed SGF daily was not different from that of steers fed SGF every other day. When SGF was fed at 4-day intervals, however, the amount of N consumed, excreted and absorbed decreased. Again, period effects were significant for all parameters of N balance. Nitrogen status increased through period three and then decreased in period four. An interaction ($P<.05$) was observed for fecal, urinary, absorbed and retained N, due primarily to a lack of period effect for the control ration.

When the data were adjusted for endogenous and metabolic N, no significant differences occurred due to feeding frequency and average utilization of dietary N approached 50 percent.

These data indicate that infrequent feeding of SGF may be used to supplement range forage. This technique might become important for limited grazing of brood cows to furnish their supplemental winter protein requirements. Total dietary N intake decreased slightly when SGF was fed at 4-day intervals, but this decrease was accompanied by reduced excretion and resulted in no differences in N retention or utilization.

Literature Cited

A.O.A.C. 1975. Official Methods of Analysis (12th Ed.). Association of Official Agricultural Chemists. Washington, D.C.

Coleman, S. W. and K. M. Barth. 1974. Nutrient digestibility and N-metabolism by cattle fed rations based on urea and corn-silage. J. Anim. Sci. 39:408.

Goering, H. K. and P. J. Van Soest. 1970. Forage Fiber Analysis. USDA Agriculture Handbook No. 379.

Smith, Dale. 1969. Removing and Analyzing total nonstructural carbohydrates from plant tissue. Wisconsin Agric. Exp. Sta. Research Report No. 41 (11 p).

Swanson, E. W. 1977. Factors for computing requirements of protein for maintenance of cattle. J. Dairy Sci. 60:1583.