Agricultural Experiment Station U. S. Department of Agriculture

Department of Animal and Range Sciences

CLAYTON LIVESTOCK RESEARCH CENTER

PROGRESS REPORT

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Effects of Supplemental Whole Shelled Corn on Forage Intake and Digestion by Steers Grazing Native Rangeland

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Introduction. Intake of digestible energy by stocker cattle grazing native rangeland can be improved by providing supplemental protein or grain (Krysl et al., 1989). Supplemental grain, however, has potentially negative effects on forage intake and digestion (Sanson et al., 1990). These negative effects may be mediated through depressed ruminal pH or changes in ruminal microorganisms caused by fermentation of grain starch in the rumen. The extent of decrease in forage intake caused by supplemental grain is often called the substitution ratio, which tends to be greater with forages of moderate to high digestibility (Horn and McCollum, 1987).

Supplemental grain might be one economical means of improving performance of stocker cattle grazing blue grama rangeland in New Mexico, but little is known about the effects of such a practice on forage intake and digestion. To answer some of these questions, we conducted an experiment with mature beef steers fed varying levels of whole shelled corn (WSC) while grazing native rangeland during Summer, 1988.

Methods. Sixteen ruminally cannulated beef steers [British breed crosses; avg body weight (BW) = 1,119 lb] grazed a 618-acre pasture of native rangeland adjacent to the Clayton Livestock Research Center for a period starting 2 weeks before the experiment began on July 11 and continuing through August 9, 1988. Average standing biomass of forage was estimated from hand-clipped plots to be 892 lbs/acre. Precipitation was 1.72 and 1.76 inches during July and August, which represents 68.3 and 72% of the 29-year average for these two months in the Clayton area.

Steers were assigned randomly to one of four treatments (four steers/treatment), including no supplement or supplemental WSC at .2, .4 or .6% of BW. Supplemental WSC was fed individually to steers at about 9:00 am daily throughout the time that the steers were on pasture. Two 8-day sampling periods (July 11 to 19 and August 1 to 9) were conducted. Three steers (not supplemented) fitted with esophageal cannulas were used to collect samples of grazed forage during the two sampling periods. Fecal output was estimated by dosing ruminally cannulated steers with chromic oxide, while forage intake was estimated from fecal output and indigestible acid detergent fiber (IADF; ash-free basis) in forage and feces (corrected for IADF in WSC). Nylon bags containing dried esophageally collected forage also were incubated in the rumen of each steer during each period to estimate in situ ruminal organic matter (OM) disappearance.

Results. Chemical composition of forage collected from esophageally fistulated steers during mid-July and early August is shown in Table 1. Forage contained slightly more crude protein and less fiber and lignin during July than in August, reflecting effects of advancing forage maturity in August. Crude protein levels would generally be adequate during both months for 600 to 700 lb, medium-frame steer calves consuming forage at 2 to 2.5% of BW and gaining up to 2 lbs/day (NRC, 1984). However, when corrected for presumably unavailable nitrogen (available crude protein; Table 1), crude protein levels would be marginal for gain above .5 lb/day.

Table 1. Chemical composition of forage collected from beef steers grazing native rangeland.[a]

Item	Sampling period	
	Mid-July	Early August
	%	
Organic matter	87.4	88.6
Crude protein	11.6	9.3
Available crude protein	10.3	7.8
Neutral detergent fiber	78.7	83.0
Acid detergent fiber	41.1	42.0
Acid detergent lignin	4.8	5.5

[a]All values except organic matter are expressed as a percentage of organic matter.

Forage OM intake (Table 2) declined (P=.02) as level of WSC increased above .2% of BW, but total OM intake (forage + supplement) remained fairly constant across treatments. The .2% of BW level of WSC appeared to be somewhat stimulatory to forage intake, perhaps reflecting greater synthesis of microbial protein in the rumen and greater flow of protein to the small intestine with this treatment.

In situ OM disappearance was depressed by the two higher levels of WSC after 24 (P=.07) and 96 h (P=.01) of incubation. This depression in digestion did not appear to be related to changes in ruminal pH (data not shown), and may reflect altered ruminal microbial populations (less fiber-digesting bacteria and more starch-digesting bacteria) with greater levels of WSC. As with forage OM intake, the .2% level of WSC was slightly stimulatory to disappearance of OM from bags incubated in the rumen.

Table 2. Effects of increasing levels of whole shelled corn on forage organic matter (OM) intake and in situ OM disappearance by beef steers grazing native rangeland.

Item	Whole shelled corn level, % of body weight			
	0	.2	.4	.6
Steer weight, lbs	1,111	1,106	1,117	1,142
Forage OM intake,				
% of body weight[a]	2.76	2.95	2.26	1.98
Total OM intake,				
% of body weight	2.76	3.14	2.65	2.57
In situ OM				
disappearance, %				
24 h incubation[b]	38.9	48.1	35.0	34.7
48 h incubation	56.0	62.2	52.3	51.9
72 h incubation	67.9	75.6	66.7	66.0
96 h incubation[c]	73.5	77.0	68.1	66.4

[a]Linear decrease (P=.02).
[b]Linear decrease (P=.07).
[c]Linear decrease (P=.01).

Present data are generally in agreement with results of other studies referenced above in which harvested roughages were fed to beef cattle supplemented with grain. A low level of WSC stimulated forage OM intake and digestion slightly, but levels of WSC beyond .2% of BW appeared to affect forage intake and digestion negatively. Low levels of grain supplements might be one means to improve performance of stocker cattle grazing native rangeland, particularly if effective self-limiting supplements could be developed.

References.

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IN AN UPCOMING PROGRESS REPORT, FORAGE CHEMICAL COMPOSITION AND INTAKE DATA FROM GRAZING CATTLE EXPERIMENTS CONDUCTED AT THE CLAYTON LIVESTOCK RESEARCH CENTER DURING 1986, 1987 AND 1988 WILL BE COMPILED.

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