CORN MOISTURE, FERMENTATION AND LAMB PERFORMANCE AND DIGESTIBILITY

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Story in Brief

Ground corn was reconstituted with water to five levels of moisture (20, 25, 30, 35, and 40 percent) and allowed to ferment for 90 days prior to feeding. Similar levels of water were added to dry ground corn at feeding time. The 10 diets containing (dry matter basis) 80 percent corn and 20 percent supplement were fed to 60 growing lambs (77 lb) in individual pens for 21 days and gain, feed intake and feed efficiency were measured. To measure digestibility, intake was restricted to 90 percent of ad libitum and total feces were collected for 6 days. Moisture level of the reconstituted or wetted grain did not affect dry matter intake; however, gain tended to decrease with the addition of water. Feed efficiency was highest with the lower levels of water. Dry matter and organic matter digestibilities were not affected greatly by addition of water though starch digestibility increased linearly with water addition and digestibilities of acid detergent fiber and ash decreased as moisture level increased. Protein digestibility also tended to decrease as moisture level increased. Gains and feed efficiencies favored fermented over wetted grain, but digestibilities of organic matter and acid detergent fiber were greater for wetted than reconstituted grain.

Introduction

Harvest and storage of corn in the high moisture (HMC) form is a low cost method of preserving corn relative to drying and subsequent grinding or steam flaking. Usually, HMC is harvested at moisture levels from 22 to 35 percent. The value of HMC varies with moisture level (Gill et al., 1982), but why feeding value differs with moisture content is unknown. Moisture level alone could alter rate of eating, saliva addition and rate of ruminal digestion, but fermentation may be important as well. The fermentation process causes physical and chemical changes in the kernel structure (Aguirre et al., 1983). The objective of this experiment was to determine the influence of moisture level of non-fermented or fermented corn grain on performance and digestibility by growing lambs. The fermented grain was reconstituted rather than harvested at various stages of maturity to remove effects of changing chemical composition of the grain.

Materials and Methods

Two procedures for addition of water to corn were used. One was to add water a minimum of 60 days prior to feeding, whereas the other procedure was to add moisture at feeding time. In each case corn had water added to obtain five different final levels of moisture (20, 25, 30, 35, and 40 percent). For fermentation, reconstituted grain was

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packed in plastic bags which were evacuated with a vacuum pump and held at 102 F for a minimum of 60 days prior to feeding. The diets (Table 1) on a dry matter basis consisted of 80 percent corn grain and 20 percent supplement. The supplement contained the roughage (cottonseed hulls) plus non-protein nitrogen as the only source of supplemental protein. The ten treatments were randomly allocated to 60 growing wethers weighing a mean of 77 lb. Lambs were in individual pens. Feed intakes and weight gains were measured over a 21-day period following 7 days of adaptation to diets.

To determine the effect of fermentation and moisture content of grain on digestibility of dry matter (DM), organic matter (OM), starch, protein and acid detergent fiber (ADF), 30 of the lambs selected at random were equipped with bags for collection of feces and feces were collected for 6 days. Performance and digestibility data were analyzed statistically as a completely randomized design.

Table 1. Diet composition.

Ingredient	Percent[a]
Corn	80
Supplement:	
Cottonseed hulls	15.25
Molasses	1.69
Urea	.92
Limestone	.76
Salt, trace mineralized	.46
Chromic oxide	.46
Dicalcium phosphate	.23
Ammonium chloride	.23

[a]Vitamins A and D added.

Results and Discussion

Water addition did not affect daily feed intake (Table 2). However, daily gain tended to decrease and efficiency of feed use declined as the level of moisture in the corn increased. This may be a result of a reduced chewing and reduced saliva addition with wetter grain. Digestibility of total DM and OM was not changed with addition of moisture. However, digestibility of some components changed with moisture level. Starch digestibility increased with addition of water while digestibility of acid detergent fiber and ash decreased. Protein digestibility also tended to decrease with moisture addition.

The decrease in fiber digestion may be explained by a lower cellulolytic activity in the rumen or large intestine, due to more acid conditions with more extensive fermentation of starch.

The effects of fermentation on performance and digestibility are summarized in Table 3. Feed intake, daily gain and efficiency of feed use were higher for fermented corn than for non-fermented grain. One of the frequently reported problems with HMC is reduced feed intake. As this was not observed in this study or several other studies (Thornton

Table 2. Grain moisture content and animal performance.

Item	Moisture Content 20	25	30	35	40
Daily feed, lb.	2.7	2.7	2.5	2.6	2.6
Average daily gain, lb.	.48[a]	.47[ab]	.38[c]	.39[b]	.38[c]
Feed/Gain	5.7[b]	5.9[b]	7.1[ab]	7.5[a]	7.4[a]
Digestibility, percent					
Dry matter	73.0	73.1	74.4	75.1	73.3
Organic matter	74.2[b]	74.5[b]	75.7[ab]	76.3[ab]	75.0[a]
Starch	97.5[b]	97.7[b]	98.2[ab]	99.1[ab]	99.2[a]
Protein	66.8	64.8	63.4	64.9	64.6
ADF	31.9[a]	24.5[b]	26.6[b]	24.8[b]	23.8[b]
Ash	43.9[a]	35.9[b]	40.0[ab]	40.5[ab]	38.9[ab]

[abc]Means in a row with different superscript differ (P.05).

Table 3. Fermentation and animal performance.

Item	Fermented	Non-Fermented
Daily feed intake, lb	2.8[a]	2.5[b]
Average daily gain, lb	.46[a]	.39[b]
Feed/Gain	6.2[a]	7.1[b]
Digestibility, percent		
Dry matter	72.4[b]	75.3[a]
Organic matter	73.6[b]	76.7[a]
Starch	98.4	98.3
Protein	64.7	65.2
ADF	23.6[b]	29.1[a]
Ash	43.1[a]	35.9[b]

[ab]Means in a row with different superscript differ (P<.05).

et al., 1977; Gill et al., 1982), factors associated with fermentation in addition to moisture level are probably involved and need to be examined. Based on the above studies, protein solubility or urea level alone does not appear to cause reduction of feed intake with HMC. As discussed in another paper in this publication (Aguirre et al., 1984), depressed ruminal fiber digestion may be responsible for reduced feed intake with wetter HMC under feedlot conditions.

Greater intake of the fermented grain in this study could be due to differences in palatability or texture of the fermented grain or may be due to growth of yeasts or molds in the wetted grain. Grain was

replaced each day, but some heating was noted. Digestibilities of DM and OM were higher for non-fermented corn. These differences are due primarily to higher digestibility of acid detergent fiber for the non-fermented grain since starch and protein digestion were not altered by fermentation. Further study of ruminal fiber digestion with fermented versus non-fermented grain and feed intake limitation with HMC is needed.

Literature Cited

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