THE EFFECT OF THE RATIO OF DRY ROLLED CORN TO HIGH MOISTURE HARVESTED SORGHUM GRAIN ON THE SITE AND EXTENT OF ORGANIC MATTER DIGESTION IN HEIFERS[1]

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Story in Brief

Dry rolled corn (DRC) and high moisture harvested sorghum grain (HMS) were blended in a variety of ratios (100 percent DRC, 75:25, 50:50, 25:75, 100 percent HMS) to determine the effect of blending on site and extent of organic matter digestion. Five blends were fed (two percent of body weight) in a 5 x 5 Latin square using five Hereford-Angus heifers (693 lb) equipped with ruminal, duodenal and ileal T-type cannulae. Total tract organic matter disgestibility decreased linearly as corn was replaced with high moisture sorghum. Ruminal and large intestinal organic matter disappearance tended to decrease in a linear manner as greater amounts of high moisture sorghum was added to the grain mix. Small intestinal organic matter disappearance was not influenced by altering the ratio of corn to high moisture sorghum. The factors causing depression of ruminal organic matter disappearance may be responsible for decreasing large intestinal and total tract digestion. Based on ruminal, large intestinal and total tract OM digestion it appears that small amounts of high moisture sorghum grain blended with large amounts of dry rolled corn may be more advantageous than the reverse condition.

Introduction

The use of high moisture grains has become more common over the last ten years. High moisture sorghum is typically harvested at 25 to 30 percent moisture and stored in a ground or rolled form to facilitate packing. Blending of dry and high moisture grains does occur, but the specific ratio of dry to high moisture grain is usually determined by the supply of each. Little work has been conducted blending dry coarsely rolled corn and high moisture sorghum grain in a variety of ratios. Even less work has been conducted to determine the effects of such blends on the site and extent of organic matter digestion in feedlot cattle. Therefore, this study was conducted to determine the effect of blending dry coarsely rolled corn and high moisture sorghum grain on the site and extent of organic matter digestion and also to determine if any associative affects occur between DRC and HMS.

Materials and Methods

Five rations, listed in Table 1, were created using coarsely ground corn and commercially obtained HMS (70 percent toluene DM). The ratios

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Table 1. Ration compositions of experimental diets.

Ingredient	A 100% DRC	B 75:25	C 50:50	D 25:75	E 100% HMS
High moisture sorghum grain	---	20.8	41.8	62.7	83.8
Dry corn	83.2	62.6	41.8	20.9	---
Cottonseed hulls	8.0	8.0	8.0	8.0	8.0
Soybean meal	5.2	5.2	5.2	5.2	5.2
Urea	1.0	.87	.76	.65	.53
Supplement					
Dicalcium phosphate	.44	.44	.44	.44	.44
Calcium carbonate	.93	.93	.93	.93	.93
Potassium chloride	.57	.57	.57	.57	.57
Sodium sulfate	.17	.14	.13	.11	.09
Chromic oxide	.20	.20	.20	.20	.20
Trace mineral salt	.25	.25	.25	.25	.25
Vitamin A	2200 IU/kg				

of the grains in each diet, on a dry matter basis were as follows: ration A 100 percent DRC, ration B 75 percent DRC:25 percent HMS, ration C 50 percent DRC:50 percent HMS, ration D 25 percent DRC:75 percent HMS, ration E 100 percent HMS. Analysis of initial grain samples indicated that urea could not be used as the only nitrogen supplement. Therefore, soybean meal was added at equal levels to all diets and urea was used in an attempt to make diets isonitrogenous.

Rations were fed to five Hereford-Angus heifers (693 lb), fitted with ruminal, duodenal and ileal T-type cannulae to allow determination of site and extent of organic matter digestion. Heifers and rations were arranged in a 5 x 5 Latin square and fed twice daily at two percent (DM basis) of initial body weight. Experimental periods lasted 10 days with days 1 through 7 serving for diet adaptation and days 8 through 10 serving for sample collection, performed at 1000, 1400 and 1800 hours. Digesta samples were composited across day and time within each period. Feed samples were ground through a 1 mm screen in a Udy mill using dry ice to facilitate grinding and stored frozen prior to analysis. Digesta samples were dried using a lyophilizer prior to grinding through a 1 mm screen in a Udy mill and analysis. Grain, feed and digesta samples were analyzed for all or part of the following: dry matter, starch (glucose polymers), crude protein and ash. Organic matter digestibility was determined by chromic oxide ratios. Orthogonal polynomials determined if the relationship between organic matter digestion and increasing the percent corn in the ration was linear or not.

Results and Discussion

The chemical composition of the grains and diets used is listed in Table 2. Starch content of the blends tended to reflect the higher starch content of HMS (84.0 percent) versus DRC (78.5 percent). Crude protein content of HMS was slightly higher than that of corn, but does not explain the variation observed in the complete feeds. Ash content of HMS and corn were nearly identical; however, ash content of the

Table 2. Chemical characteristics of grains and feeds.

Item	A 100% DRC	B 75:25	C 50:50	D 25:75	E 100% HMS
Feed					
Starch	66.53	65.69	65.80	66.54	71.05
Crude protein[a]	12.84	13.99	13.37	13.42	12.92
Ash[b]	4.04	4.55	4.40	4.41	4.65
ADF[b]	10.87	8.53	7.80	8.51	8.53
Grain					
Starch	78.54				84.01
Crude protein	9.50				9.82
Ash	1.33				1.32

[a]Quadratic polynomial ($P<.05$).
[b]Quartic polynomial ($P<.05$).

complete feeds showed considerably greater variation. Diet A (100 percent DRC) had the lowest ash value (4.04 percent) while diet E (100 percent HMS) had the greatest ash value (4.65 percent). Diet A (100 percent DRC) had the greatest acid detergent fiber content and diet C (50 percent DRC:50 percent HMS) the lowest, while diets B, D and E were intermediate.

Organic matter (OM) intake (Table 3) tended to increase as greater amounts of HMS were added to the grain mix; however, the difference in intake between the highest and lowest values was only 103 g/day. Ruminal OM disappearance corrected for microbial OM and expressed as a percent of OM intake tended to decrease in a linear manner ($P<.10$) as greater amounts of HMS were added to the grain mix (100 percent DRC 70.2 percent vs 100 percent HMS 64.8 percent). When ruminal OM disappearance was expressed as a percent of total tract digestion and diet A was ignored, values tended to increase with the exclusion of corn (86.5 percent for B vs 89.0 percent for E). Organic matter disappearance in the small intestine was relatively low and constant across all treatments, with the mean value being 34.1 percent of entry. Organic matter disappearance in the small intestine, expressed as a percent of total tract digestion, tended to respond quarticly ($P<.20$). Disappearance of OM through the ileum expressed as a percent of intake showed no trend across diets. However, within diets containing both HMS and corn (B, C and D), increasing amounts of HMS appeared to depress ileal OM disappearance. Ileal OM disapperance (percent of total tract) tended to increase as corn was removed from the grain mix, reflecting a greater importance of pre-ileal digestion as HMS increased in the diets (Figure 1). Large intestinal OM disappearance (percent of entry) tended to decrease linearly ($P<.10$) as corn levels were reduced (100 percent corn 25.7 percent vs. 100 percent HMS 7.9 percent). Total tract OM digestibility decreased ($P<.05$) lineraly as HMS was substituted for corn (100 percent corn 80.0 percent vs. 100 percent HMS 73.0 percent). Ruminal and large intestinal organic matter fermentation tend to reflect the same affects of adding greater amounts of HMS to the grain mix, indicating that the same factors causing reduced ruminal OM digestion may have a similar effect in the large intestine. The small intestine appears to be unaffected by treatment at these levels of intake, with

Table 3. Site and extent of organic matter digestion of DRC-HMS blends.

Item	A 100 % DRC	B 75:25	C 50:50	D 25:75	E 100 % HMS
OM Intake (g/day)	5966	5927	6011	6040	6032
Ruminal disappearance[ac]					
% of Intake (c)	70.2	68.6	69.3	66.2	64.8
% of total tract (c)[a]	88.1	86.5	87.4	88.8	89.0
% of intake (u)[c]	62.8	60.6	61.2	57.6	56.4
% of total tract (u)	78.6	76.5	77.3	77.3	77.5
OM disappearance SI					
% of entry (u)	34.7	40.3	32.0	33.5	32.0
% of total tract (u)[d]	15.7	19.4	15.9	19.0	19.0
OM disappearance Ileal					
% of Intake	72.6	76.4	74.3	71.3	70.7
% of total tract	92.0	95.4	93.2	96.8	96.6
OM disappearance LI					
% of entry[c]	25.7	19.1	21.2	5.9	7.9
% of total tract[b]	8.0	4.6	6.8	3.2	3.4
Total tract OM dig.[b]	80.0	79.6	79.5	74.6	73.0

[a]Ruminal OM disappearance corrected for microbial OM.
[b]Linear polynomial (P<.05).
[c]Linear polynomial (P<.10).
[d]Quartic polynomial (<.20).

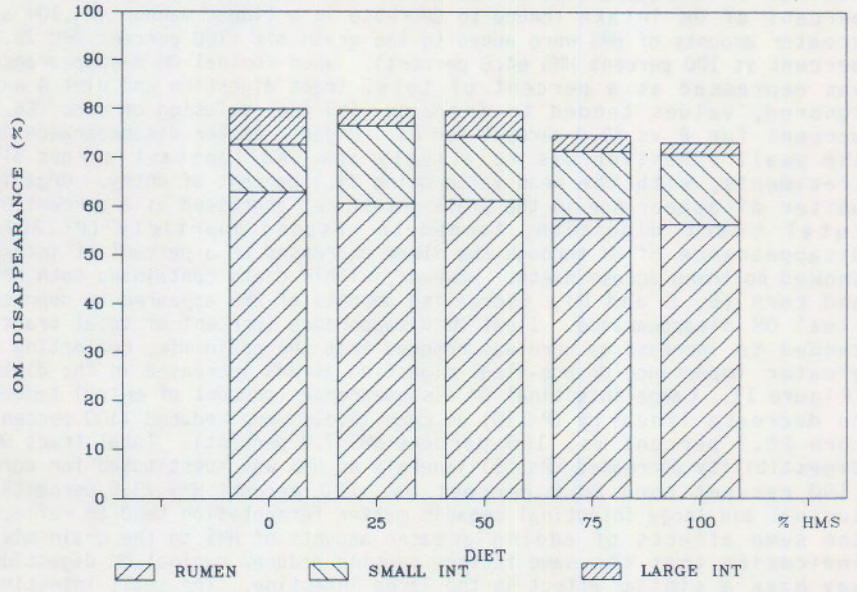

Figure 1. Site and extent of organic matter digestion of DRC-HMS blends (ruminal digestion uncorrected for microbial OM).

disappearance (percent of entry) values being rather low and similar on all diets. Increasing feed intake may increase the importance of small intestinal digestion; however, a large portion of the diet organic matter would be starch and the digestive capacity of the organ may soon be exceeded. Rates of passage were not determined and differences in flow rates may play an important role in creating the trends observed.

Associative effects may have occurred in the small intestine (percent of total tract); however, no associative effects were observed in other segments of the digestive tract, assuming that associative effects of DRC and HMS would result in a non-linear increase or decrease in OM disappearance or digestion. Based on ruminal and total tract OM digestion values, there is some suggestion that high levels of DRC and low levels of HMS may be more advantageous than the reverse condition. Protein may have limited organic matter accessibility within the HMS resulting in decreased total tract digestion. The same differences may or may not be expected with dry rolled and high moisture sorghum blends.

Blends do appear to alter the importance of ruminal and large intestinal fermentation and may cause differences in animal performance.