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Introduction

Optimizing grain processing practices in cattle feeding operations is critical to reaching maximum feed utilization efficiency. An increased degree of grain processing has consistently shown improved dry matter and starch digestibility; however, it exists with conflicting results on improving performance in finishing cattle. These inconsistencies are likely due to diet composition, such as roughage and co-product level, that could offset the effects of reduced particle size on rate of fermentation thus reducing the risk of digestive dysfunction.

Finishing diets are commonly formulated with processed grain to increase utilization of starch and improve animal performance. Processing methods including steam-flaking, grinding, or dry-rolling improve total tract starch digestibility compared with that of whole grain. When dry-rolling corn for finishing cattle, recommendations often suggest that grain be coarsely processed, or cracked to prevent production of an excessive quantity of fine material that could potentially result in an increased rate of fermentation, reduced rumen pH, and digestive disturbances. However, previous research has reported that inclusion of dried distillers grains in finishing diets may influence optimal grain processing method. Grinding corn to a finer particle size when the grain is fed in combination with distillers grains may result in improved total tract starch utilization without causing reduced ruminal pH and digestive disturbances.

The objective of this survey was to provide the feedlot industry with an indication of average particle size distribution from current manufacturing practices of dry processed corn, fecal starch content, and co-product and roughage inclusion levels in Midwestern feedlots.

Key words: dry rolled corn, feedlot, particle size

Experimental Procedures

Feedlots (n = 35) were asked to participate in a survey to evaluate dry-rolled corn processing practices, processed corn particle size distribution, and fecal starch content in finishing cattle. Feedlots were located in the central United States, including Kansas, Nebraska, South Dakota, Minnesota, Colorado, and Iowa. Samples of dry processed corn and finishing diet were collected from each feedlot, along with samples of freshly voided feces collected from 3 pens of finishing cattle with samples collected from 3 animals per pen with a total of 9 samples per feedlot composited. The survey was conducted from November 2013 through March 2014. Sample collection included a dry processed corn sample, diet sample, and fecal samples. Dry processed corn samples were collected from the ground corn storage pile. Grain samples (~17 oz) were typically collected from 3 locations in the pile from approximately 5.9 in. deep. If corn was ground directly into the mixer truck (n = 2), the sample was collected in the mixer truck during loading. Diet samples (~17 oz) were collected across 5 locations in the bunk immediately after feeding. Diet samples (n = 5 per pen) were placed in a 20 quart bucket, hand-mixed, and poured onto a clean concrete surface. Piles were quartered, and 2 aliquots of diet were sub-sampled from 2 opposite quarters, placed in a plastic bag and frozen. Diet samples were analyzed at a commercial lab for moisture, dry matter, crude protein, acid detergent fiber, neutral detergent fiber, fat, calcium, phosphorus, potassium, and magnesium.

Fecal samples were collected from 3 pens of cattle per feedlot which were consuming the finishing diet. Samples were collected from 3 animals per pen, composited, and frozen, for a total of 9 composited samples per feedlot. Cattle were required to be transitioned to a finishing diet for a minimum of 5 days prior to taking fecal samples so fecal starch wasn't influenced by step-up diets. Fecal samples were analyzed for moisture, dry matter, and total starch. Dry processed corn samples were analyzed for particle size distribution.

Formulated diet composition was provided by nutritionists (Table 1; one from each feedyard; n = 32). Dry processed corn was the primary energy source in all operations involved in this survey. In addition, there were other sources of starch, such as earlage, high moisture corn, and corn silage in most of the feedlots surveyed, which compromised the ability to determine any relationship between fecal starch and dry-rolled corn particle size. Co-products were in the form of wet distillers grain, wet corn gluten feed, and modified wet distillers grains. Roughage sources included ground hay (Conservation Reserve Program, brome, prairie, or mixture), corn silage, corn stalks, and wheat straw.

All data were entered and tabulated in a Microsoft Excel spreadsheet. Mean, standard deviation, and minimum and maximum values were calculated using spreadsheet formulas.

Results and Discussion

Average particle size of dry processed corn, including dry-rolled and hammermill-ground corn across all operations (n = 35) was 0.166 ± 0.050 in. with a range of 0.046 to 0.269 in. (Table 2). Dry-rolled corn average particle size (n = 31) was 0.179 ± 0.035

in. with a range of 0.085 to 0.269 in. Hammermill-ground corn (n = 4) average particle size was 0.072 ± 0.046 in. with a range of 0.046 to 0.140 in. Fecal starch content averaged 19.0 ± 6.5% with a range of 7.0 to 36.6%. Diet composition was evaluated for co-product (27.8 ± 13.4%) roughage concentration (8.9 ± 2.0%) and neutral detergent fiber concentration (19.3 ± 4.3%). The nutrient analysis of the diets is shown in Table 3.

Implications

Results from this survey provide the industry with a greater understanding of the degree of processing that is currently practiced and the resulting fecal starch concentration, and diet formulation. Research in the area of dry-rolled corn particle size in finishing feedlot diets and its influence on feedlot performance and carcass characteristics is needed. These results do not directly compare dry-rolled corn particle size and fecal starch concentration, but the combined results suggest that dry-rolled corn particle size may affect total tract starch digestion. Diets formulated with a higher co-product level could include more finely processed grain in the diet. Co-products fed at higher levels could dilute the concentration of rapidly fermentable starch found in finely processed grain, thus achieving greater total tract starch digestion without affecting rumen function.

Table 1. Ingredient use in Midwestern U.S. finishing cattle diets[1]

Item	Number of feedlots	Feedlots, %
Grain		
Corn	32	100
Earlage	8	25
High moisture corn	8	25
By-product		
Wet distillers grains	15	47
Wet corn gluten feed	17	22
Modified wet distillers grains	10	31
Roughage		
Ground hay[2]	20	63
Corn silage	12	38
Corn stalks	7	22
Wheat straw	4	13

[1]Values from 32 feedlots located in the central United States.
[2]Ground hay sources consist of Conservation Reserve Program, brome, prairie, or a mixture of hay source.

Table 2. Dry processed corn particle size of Midwestern U.S. finishing cattle diets[1]

Item	Mean	Standard deviation	Range	
			Minimum	Maximum
Dry-rolled				
Geometric mean diameter (in.)	0.179	0.035	0.085	0.269
Hammermill				
Geometric mean diameter (in.)	0.072	0.046	0.046	0.140
Overall				
Geometric mean diameter (in.)	0.166	0.050	0.046	0.269
Fecal starch, %[2]	19.0	6.5	7.0	36.6

[1]Overall values from 35 feedlots located in the central United States.
[2]Fecal starch values obtained from 34 feedlots.

Table 3. Diet nutrient analysis (% of dry matter) of Midwestern U.S. finishing cattle diets[1]

Item	Mean	Standard deviation	Range	
			Minimum	Maximum
Crude protein, %	14.84	1.91	9.85	19.17
Fat, %	5.08	0.92	2.90	7.48
Phosphorus, %	0.44	0.11	0.25	0.63
Calcium, %	0.86	0.23	0.31	1.38
Potassium, %	0.87	0.12	0.31	1.05
Magnesium, %	0.22	0.04	0.12	0.61
Roughage, %[2]	8.9	2.0	5.3	15.6
By-product, %[2]	27.8	13.4	0.0	51.0
Neutral detergent fiber, %[2]	19.3	4.3	11.2	27.5

[1]Values from 32 feedlots located in the central United States.
[2]Roughage, by-product, and neutral detergent fiber values from 32 feedlots located in the central United States.