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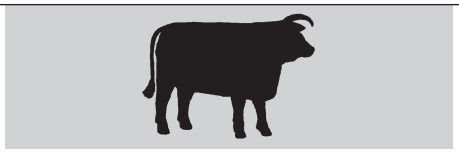

Effect of corn particle size with moderate amounts of wet distillers grains in finishing diets on starch digestibility and steer performance

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ABSTRACT

Five hundred yearling steers (370 ± 30.0 kg, SD) were used to determine the effect of corn particle size in diets containing 35% wet distillers grains plus solubles (WDGS) on steer performance, carcass characteristics, and apparent total-tract starch digestibility (TTSD). Treatments included 45% cracked corn (CON; 2,350 μm) or finely ground corn (FIN; 500 μm) with 35% WDGS and were replicated in 4 pens per treatment with 60 or 64 steers per pen. Fecal samples were collected on d 71 and 72 (F-1) and d 102 and 103 (F-2). Final BW and HCW were heavier ($P \leq 0.01$) for steers finished on CON compared with steers finished on FIN. Whereas G:F was not different ($P = 0.22$) between treatments, DMI and ADG were greater ($P \leq 0.01$) for CON-fed steers than FIN-fed steers. Liver abscess scores were not influenced ($P \geq 0.39$) by treatment. Liver abscess scores tended ($P = 0.10$) to influence ADG over the experiment, with steers having severe liver abscess scores gaining less compared with steers with no or mild liver abscess scores. A treatment × time effect ($P < 0.01$) was observed for TTSD. Whereas TTSD of steers fed CON decreased over time (90.28 and 85.74% for F-1 and F-2, respectively), TTSD of steers finished on FIN did not differ across the 2 sampling dates (97.95 and 97.55% for F-1 and F-2, respectively). Apparent starch digestibility was improved for steers fed finely ground corn with 35% WDGS; however, cattle performance was less compared with steers fed cracked corn with 35% WDGS.

Key words: cattle, corn particle size, distillers grains, liver abscess, starch digestibility

INTRODUCTION

Expansion of the ethanol industry has led to a steady supply of high-quality coproducts, including wet distillers grains plus solubles (**WDGS**) and wet corn gluten feed (**WCGF**). These coproducts have proven to be beneficial replacements for corn in finishing diets through improved ADG and feed efficiency (Klopfenstein et al., 2008). Because corn starch is the primary substrate of alcohol fermentation, both WDGS and WCGF have relatively low concentrations of starch. As a result, coproducts from both the dry and wet milling industries appear to moderate the risk of acidosis in finishing diets (Stock et al., 2000).

Decreasing corn particle size through grain processing is an effective way to increase starch utilization and thus improve performance of the ruminant animal (Owens et al., 1986; Huntington, 1997). However, grinding corn too finely often results in rapid rumen fermentation leading to acidosis. Persistent acidosis often results in decreased animal performance and liver abscesses, causing an economic loss to producers (Brown and Lawrence, 2010).

Adding coproducts at the expense of corn often decreases dietary starch concentrations; therefore, decreasing grain particle size may allow for more complete starch digestion of what starch is present in the diet, potentially improving cattle performance. Research has shown that more extensive

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grain processing when feeding WCGF improves feed efficiency by 10.5% (Macken et al., 2006) to 12.5% (Scott et al., 2003). However, decreasing corn particle size in diets containing WDGS has given more variable results. Corrigan et al. (2009) noted up to 8% improvement in feed efficiency when assessed across multiple WDGS inclusions, whereas Vander Pol et al. (2008) observed a 7% decrease in feed efficiency with decreased particle size in diets containing 30% WDGS. Therefore, the objective of this experiment was to determine whether feeding moderate levels of WDGS would decrease the acidosis risk associated with further grain processing and allow fine grinding of corn to improve starch utilization and, thus, cattle performance.

MATERIALS AND METHODS

Animals and Experimental Design

Procedures and protocols were approved by the Iowa State University Institutional Animal Care and Use Committee (9-13-7630-B).

Six hundred crossbred steers were purchased from a single source and transported to a commercial feedlot (Mogler Stock Farms, Alvord, IA). Upon arrival, steers were housed in a concrete open lot and fed a series of 4 transition diets over 17 d to ensure all steers were prepared for a concentrate-based diet. Five days before the start of the experiment, steers were vaccinated with Bovi-Shield GOLD One Shot (Zoetis, New York, NY), Ultrabac CD (Zoetis), and Somubac (Zoetis) and implanted with Synovex Choice (Zoetis). Steers were treated for internal and external parasites with Dectomax Injectable (Zoetis) and ProMectin B Pour-on (Vedco Inc., St. Joseph, MO). Body weights were also measured on d −5, and 500 steers (370 ± 30.0 kg, SD) were selected to be used in the experiment, blocked by BW, and randomly assigned to 1 of 2 diets: cracked (2,350 μm) corn–based control diet (**CON**) or finely ground (500 μm) corn diet (**FIN**), with both treatments containing 35% WDGS (DM basis; Table 1). Diets were formulated to meet or exceed animal requirements (NRC, 2000).

At the initiation of the experiment, individual BW were collected before feeding. Steers were given a unique visual and electronic ID and sorted into their respective pens within a slotted confinement facility with rubber mats. Each treatment was replicated in 4 pens with 60 or 64 steers per pen, split equally across treatments, to maintain a similar pen density of 2.0 m^2 per steer.

On d 72, interim BW were measured, and steers were reimplanted with Revalor 200 (Merck Animal Health, Millsboro, DE). On d 106, steers were started on ractopamine hydrochloride (Optaflexx, Elanco Animal Health, Greenfield, IN) and fed at a rate of 300 mg per steer per day for the last 21 or 22 d of the experiment. Steers were slaughtered by pen BW blocks on d 127 or 128 at a commercial abattoir (Tyson Foods Inc., Dakota City, NE). Throughout the experiment, 5 steers were removed because of illness, injury, or death, for reasons unrelated to treatment (2 CON and 3 FIN), and data were excluded from analysis. It was assumed that steers were consuming the pen average DMI up until the day of removal or death.

Table 1. Ingredient and nutrient composition of diets[1] (%, DM basis)

Item	CON	FIN
Ingredient		
Cracked corn[2]	45.0	—
Finely ground corn[2]	—	45.0
Wet distillers grains plus solubles[3]	35.2	35.2
Corn silage	10.0	10.0
Corn stalks	6.5	6.5
Liquid supplement[4]	3.3	3.3
Analyzed composition[5]		
CP	18.1	18.2
NDF	29.6	26.8
Starch	36.9	35.2
Ether extract	5.1	4.9

[1]CON = cracked corn diet; FIN = finely ground corn diet.

[2]Cracked corn, 2,350 μm; finely ground corn, 500 μm.

[3]Composite analysis: 35.5% CP, 8.7% ether extract, and 0.62% S (DM basis).

[4]Liquid supplement includes 12.7% Ca, 5.7% salt, 1.6% K, 0.02% P, and 95,000 IU/kg of vitamin A, and monensin sodium provided at 700 mg/kg (DM basis).

[5]Diets were analyzed by Dairyland Laboratories Inc. (Arcadia, WI).

Corn Particle Size

Both sources of corn were processed through a double pair roller mill (Model 12 × 52 Dual Ind, RMS, Harrisburg, SD) at the feedlot. To achieve a 500-μm finely ground corn, the top roller was adjusted to 0.02 cm, and the bottom roller was closed. For the cracked corn, the top rollers were set to minimally process 100% of corn kernels, and the bottom rollers were opened for full flow through. Batches of each corn source were processed back to back to provide uniformity of corn source. After processing, both cracked corn and finely ground corn were stored in bunkers under a covered roof until they were fed.

Samples of both sources of corn were taken 4 times throughout the duration of experiment for determination of corn particle size, which was determined using the method described by American Society of Agricultural and Biological Engineers (ANSI/ASAE, 2008, method ANSI/ASAE S319.4). Samples were shaken