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Effects of concentration and source of wet distillers grains on digestibility of steam-flaked corn-based diets fed to finishing steers[1]

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ABSTRACT

The source and dietary concentration of wet distillers grains may affect the digestibility of beef cattle finishing diets. The objectives of this experiment were to evaluate the effects of graded levels of sorghum+corn-based wet distillers grains plus solubles (NMDGS) and corn-based distillers grains plus solubles (CDGS) on digestibility of steam-flaked-corn-based diets fed to finishing beef steers and to determine potential effects on ammonia emission from feces and urine. Ten beef steers (average BW = 252 kg) were used in a replicated 5 × 5 Latin square design. Steers were fed diets containing increasing concentrations of NMDGS (0, 5, 10, or 15% of DM) or one concentration of CDGS (10% of DM), which replaced steam-flaked corn, cottonseed meal, and urea in a high-concentrate finishing diet. Apparent digestibilities of DM, OM, ash, N, P, ether extract, and NDF were quadratically affected by dietary NMDGS concentration, with lowest values for the 5 and 10% NMDGS diets and highest values for the 0 and 15% NMDGS diets. Digestibilities of DM, OM, ash, N, P, and NDF in the 10% NMDGS diet were not different ($P > 0.10$) from digestibility of the 10% CDGS diet. Digestibilities of CDGS and NMDGS, determined by difference, were not different ($P > 0.10$). In vitro ammonia losses tended ($P < 0.09$) to increase with increased NMDGS in the diet. Results of this study suggest that the digestibilities of NMDGS and CDGS are similar, and, at the concentrations used in this study, wet distillers grains plus solubles have only minor effects on total-tract digestibility of diets based on steam-flaked corn.

Key words: beef cattle, corn, distillers grains, feedlot, sorghum

INTRODUCTION

Distillers grains with solubles (**DGS**), a coproduct of the grain-based bioethanol industry, have become an important feed ingredient used as an energy and CP source in beef cattle finishing diets. To date, most of the DGS production in the United States has occurred in the northern Great Plains and Corn Belt regions; however, production is increasing in the southern Great Plains, where sorghum is frequently used as a grain source in ethanol plants.

Several studies have suggested the feeding value of wet DGS (**WDGS**) is lower in finishing diets based on steam-flaked corn (**SFC**) than in diets based on dry-rolled corn (**DRC**; Cole et al., 2006b; Corrigan et al., 2009a; May et al., 2009). Corrigan et al. (2009a) suggested the optimal level of feeding WDGS in SFC-based diets was approximately 15% of diet DM; however, Vasconcelos et al. (2007) noted a linear decrease in animal

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performance as the concentration of WDGS increased from 5 to 15% of diet DM. The reasons for this lower feeding value are not clear but may be due to energy dilution in SFC-based diets (Cole et al., 2006b). In addition, Vasconcelos et al. (2007) noted that the feeding value of blended WDGS based on sorghum and corn (**NMDGS**) was less than that of corn-based WDGS (**CDGS**). This is possibly due to the higher fiber and lower fat content of the NMDGS compared with the CDGS (Stock et al., 2000) or differences in the quantity or quality of solubles added to the distillers grains at different ethanol plants (Corrigan et al., 2009b).

Most finishing diets in the southern Great Plains region are based on SFC, which has more digestible starch than does DRC, which is typically used in the northern Great Plains. Therefore, research is needed to delineate optimal ways to feed WDGS in SFC-based diets. In addition, gaseous emissions from agriculture are a growing environmental concern. The effects of feeding high-N ingredients, such as WDGS, on gaseous emissions need to be determined.

To that end, 2 experiments were conducted to evaluate the digestibility and ammonia production potential of 2 sources of WDGS in SFC-based diets. The objectives of the studies were to 1) evaluate increasing levels of NMDGS on digestibility of SFC-based diets when fed to feedlot cattle, 2) compare the digestibility of NMDGS and CDGS fed at similar dietary concentrations, and 3) evaluate the in vitro ammonia production potential of feces and urine from cattle fed diets containing NMDGS and CDGS.

MATERIALS AND METHODS

Digestion Study

All procedures were approved by the multi-institution (Texas AgriLife Research, Amarillo; West Texas A&M University, Canyon; and USDA-ARS, Bushland, TX) animal care and use committee. Ten mixed-breed steers (initial BW = 252 ± 15 kg) were selected from a larger group and used in a replicated 5 × 5 Latin square design with 5 dietary treatments. Steers were processed on arrival, which included receiving a uniquely numbered ear tag; vaccination for infectious bovine rhinotracheitis, bovine viral diarrhea, parainfluenza 3, bovine respiratory syncytial virus (Titanium 5, Agri-Labs, Des Moines, IA), and *Clostridium chauvoei-septicum-novyi-sordellii-perfringens* Types C and D (Vision 7 with SPUR bacterin-toxoid, Intervet Schering-Plough, Millsboro DE); and treatment for internal and external parasites (Cydectin, Ft. Dodge Animal Health, Overland Park, KS). Steers were adjusted to the facilities, handling procedures, and a 92% concentrate finishing diet for 45 d before the start of the experiment. Steers were implanted with Revalor S (120 mg of trenbolone acetate + 24 mg of estradiol; Intervet Schering-Plough) at the start of the experiment.

The 5 dietary treatments used were similar to those used by Vasconcelos et al. (2007) and consisted of a standard SFC-based, 92% concentrate (DM basis) finishing diet formulated to contain 13.5% CP (**CON**), 3 diets with 5, 10, or 15% (DM basis) NMDGS replacing SFC, cottonseed meal, and urea (**5NMDG**, **10NMDG**, **15NMDG**, respectively), and a diet with 10% (DM basis) CDGS replacing SFC, cottonseed meal, and urea (**10CDG**; Table 1). To decrease the potential for excess dietary sulfur intake, a separate premix was used in diets containing WDGS in which ground corn replaced the ammonium sulfate used in the control premix (Table 1). Diets were formulated to be isonitrogenous and to meet all nutrient requirements (NRC, 1996); however, concentrations of fat and degradable intake protein (**DIP**) were not held constant. The NMDGS was obtained from a plant in New Mexico and was a composite (DM basis) of 47.1% sorghum centrifuge cake (directly from the centrifuge), 18.4% solubles (syrup), and 34.5% corn dried distillers grains. The CDGS was obtained from a plant in Nebraska and was composed of approximately 65% centrifuge cake and 35% syrup (DM basis). Both NMDGS and CDGS were stored in sealed, plastic, 200-L drums for the duration of the experiment. Samples of each WDGS were taken weekly and immediately frozen. At the conclusion of the study, samples were composited for chemical analyses.

Each period of the Latin square was 3 wk in length. During the first 2 wk of each period calves were individually fed in pens equipped with feeding headgates (American Calan, Northwood, NH) and adapted to the experimental diet. Calves were moved to indoor individual tie stalls (1.16 × 2.38 m) for a 2-d adjustment period followed by a 5-d total urine and partial fecal collection period. Each steer was restrained in the tie stall using a halter attached to a ring that moved freely on a chain spanning the width of each stall. Feed refusals were collected daily before 0730 h and weighed, and a representative subsample was collected and composited for each steer. Steers were fed once daily (at approximately 0730 h) during the collection periods. Feed intake was adjusted daily, if necessary, to hold feed refusals to less than 200 g/d; otherwise, steers had ad libitum access to feed. Feed samples were collected daily before feeding and composited for each steer for the 2 d before and 3 d after the first day of fecal and urine collection. Total urine excretion was collected using a rubber urine pouch attached to the ventral portion of the abdomen via a harness. A constant vacuum was maintained using individual vacuum pumps to allow collection of urine from each steer into a 20-L polypropylene urine-collection reservoir (Nasco Farm & Ranch, Fort Atkinson, WI). During the first 2 d in the tie stalls, urine to be used in the in vitro ammonia emission study was collected twice daily into unacidified containers and immediately frozen for later use. During the last 5 d of collection, urine was collected into reservoirs containing 200 mL of a 30% hydrochloric acid solution to maintain a pH of less than 4.0 to preserve N. Urine mass was recorded