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Effects of wet distillers grains with solubles in diets based on steam-flaked corn containing moderate or high roughage levels on nutrient digestibility in feedlot cattle and in vitro fermentation[1]

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ABSTRACT

Previous research with roughage and wet distillers grains with solubles (WDGS) concentrations in feedlot diets based on steam-flaked corn has not extensively evaluated measurements of digestibility. Two experiments were conducted to evaluate the effects of concentrations of alfalfa hay (AH) and WDGS on apparent total-tract nutrient digestibility by finishing cattle and in vitro fermentation characteristics. In both studies, treatments were arranged in a $2 \times 3 + 1$ *factorial and consisted of diets based on steam-flaked corn including AH (6 or 12% of DM) and WDGS (15, 30, or 45% of DM), and a control diet without WDGS that contained 9% AH. In Exp. 1, 56 beef steers (initial BW =* 395 ± 7 *kg) were used in a randomized complete block design and fed for 28 d. Intakes of DM, OM, NDF, ADF, and CP were greater (*$P \leq 0.048$*) by steers fed 12 versus 6% AH. Increasing the dietary concentration of WDGS increased NDF, ADF, and CP intakes (*$P \leq 0.046$*), and an AH × WDGS interaction (*$P \leq 0.02$*) was detected for starch intake. Digestibility of DM and OM was greater for control steers than for the average of all treatments containing WDGS (*$P < 0.01$*). In Exp. 2, ruminal fluid was collected from 2 ruminally cannulated steers adapted to a 60% concentrate diet to evaluate in vitro total gas and methane production, nutrient disappearance, and VFA concentrations after 24 h of incubation. Total gas production decreased linearly as WDGS increased (*$P = 0.04$*). The control substrate had decreased NDF disappearance versus the average of other treatments (*$P < 0.01$*), and consistent with in vivo total-tract digestibility, in vitro NDF disappearance increased linearly as WDGS increased (*$P < 0.01$*) regardless of AH concentration. The concentration of AH and WDGS in feedlot diets had interactive effects on total-tract digestibility of DM, OM, and starch, but not NDF, in feedlot steers.*

Key words: alfalfa hay, digestibility, wet distillers grains with solubles

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INTRODUCTION

Previous studies with dry-rolled, high-moisture, and steam-flaked corn (**SFC**) as grain sources suggest that type and concentration of roughage can be important in finishing diets containing wet distiller grains with solubles (**WDGS**; Klopfenstein et al., 2008; May et al., 2011; Quinn et al., 2011). May et al. (2011) evaluated 2 dietary concentrations of WDGS (15 or 30% of the DM) and alfalfa hay (**AH**; 7.5, 10.0, or 12.5%; DM basis) plus a non-WDGS control diet that contained 10% AH in SFC-based diets. No WDGS × AH hay interactions were detected, and final shrunk BW, ADG, and DMI did not differ between the 2 WDGS concentrations over the feeding period. Increasing AH concentration tended to increase DMI linearly and resulted in a linear decrease in G:F. Quinn et al. (2011) evaluated a SFC-based control diet with 10% AH and 0% WDGS and diets with either 15 or 30% WDGS (DM basis). Roughage sources in the WDGS diets were AH, coastal bermudagrass hay, or sorghum silage, with all sources included to provide an equivalent percentage of NDF to 7.5% AH. Contrary to the results of May et al. (2011), cattle fed 15% WDGS diets had greater final BW, ADG, and G:F than those fed 30% WDGS. Moreover, using AH as the roughage source resulted in decreased final shrunk BW and ADG compared with bermudagrass hay and sorghum silage, whereas sorghum silage decreased G:F relative to bermudagrass hay. Benton et al. (2015) noted decreased DM, OM, and NDF digestibility as total NDF concentration increased in a 30% WDGS finishing diet with dry-rolled and high-moisture corn. Previous research with roughage and WDGS concentrations in SFC-based feedlot diets has not extensively evaluated measurements of digestibility. Therefore, our objective was to assess the effects of varying concentrations of WDGS and AH in SFC-based diets on apparent nutrient digestibility by feedlot steers. In vitro fermentation measurements were used to further assess the effects of treatments on fermentation characteristics, particularly of the NDF fraction of the diets.

MATERIALS AND METHODS

All procedures involving live animals were approved by the Texas Tech University Animal Care and Use Committee.

Exp. 1

Cattle, Experimental Design, and Treatments. Sixty-five crossbred beef steers were purchased for use in the experiment and shipped from the Texas Panhandle to the Texas Tech University Burnett Center, located near New Deal, Texas. Steers were adapted to facilities for approximately 3 wk and then individually weighed [Silencer Squeeze Chute, Moly Mfg. Inc., Lorraine, KS; with Avery Weigh-Tronix (Fairmont, MN) load cells; readability ± 0.45 kg]. The scale was validated with 454 kg before each use and calibrated as needed. Cattle were given individual ear tags and vaccinated with 2 mL s.c. of a modified-live virus respiratory vaccine containing infectious bovine rhinotracheitis virus, bovine viral diarrhea virus genotype 1, bovine viral diarrhea virus genotype 2, parainfluenza-3, and bovine respiratory syncytial virus (Bovi-Shield Gold 5; Pfizer Animal Health, Exton, PA) and 2 mL s.c. of an inactivated bacterin-toxoid vaccine containing clostridial antigens (Vision 7; Intervet-Schering-Plough Animal Health, De Soto, KS). After processing, cattle were housed in open-lot, soil-surfaced pens with 11 to 12 steers per pen to start an adaptation period to high-concentrate diets. The dietary adaptation period consisted of feeding diets that contained approximately 65, 75, and 85% concentrate for 3, 6, and 9 d, respectively. After approximately 18 d, animals were individually weighed and implanted with an estrogen + trenbolone acetate implant (Revalor-S; 24 mg of estradiol-17 β and 120 mg of trenbolone acetate; Intervet/Schering-Plough Animal Health), after which 56 steers were selected (based on uniformity in BW) for use in the experiment. The steers were then moved to 56 concrete (1 steer per pen), partially slotted-floor pens (2.9 m wide × 5.6 m deep; 2.4 m of linear bunk space). Steers continued to receive the 85% concentrate diet for an additional 4 d, before being steeped up over a 3-d period to the final 90% concentrate, SFC-based diet.

The 56 selected steers (initial BW = 396 ± 36 kg) were used in a randomized complete block design with a 2 × 3 + 1 factorial arrangement of treatments. Factors included 2 concentrations of AH (6 and 12% of DM) and 3 concentrations of WDGS (15, 30, and 45% of DM) plus a control diet based on SFC that contained 0% WDGS and 9% AH in the dietary DM (Table 1). Steers were blocked by BW and assigned randomly to 1 of 8 blocks. Within blocks, steers were assigned randomly to 1 of the following 7 dietary treatments: 0% WDGS (**CON**) diet; diets containing 15% WDGS with 6 or 12% AH; diets containing 30% WDGS with 6 or 12% AH; or diets containing 45% WDGS with 6 or 12% AH. The AH was obtained from a commercial supplier and was prepared in a tub-grinder fitted with 5.1- and 7.6-cm screens, resulting in particles ranging from less than 1 cm in length to a maximum length of approximately 7.5 cm. The WDGS was obtained from a commercial ethanol plant (Quality Distillers Grains LLC, Plainview, TX) and stored in a plastic silage bag. The WDGS used in this experiment was composed of a blend of 70% corn and 30% sorghum as described by Smith et al. (2013). A premix (Table 1) provided monensin and tylosin (Rumensin and Tylan, respectively; 33 and 11 mg/kg, DM basis, respectively; Elanco Animal Health, Indianapolis, IN), along with various vitamins and minerals.

On d 1 of the experiment, all cattle were weighed in the morning before feeding to obtain an individual initial BW, and the experimental diets (Table 1) were offered to allow for ad libitum intake.