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Comparison of wet and dry distillers grains plus solubles to corn as an energy source in forage-based diets[1]

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ABSTRACT

Four experiments compared wet or dry distillers grains plus solubles (WDGS or DDGS) to corn as energy sources in forage-based diets. In Exp. 1, 66 individually fed steers (268 kg of initial BW) were fed a 60:40 blend of sorghum silage and alfalfa hay and supplemented at 0, 0.33, 0.67, or 1.0% of BW with either WDGS or DDGS. In Exp. 2, 160 steers (286 kg of initial BW) were fed 25% WDGS or 33.6% dry rolled corn (DRC) in 35% sorghum silage and grass hay diets (DM basis). In Exp. 3, 60 individually fed steers (231 kg of initial BW) were fed DRC at 22.0, 41.0, or 60.0%, or WDGS at 15.0, 25.0, or 35.0% of diet DM in 30% sorghum silage and grass hay diets. In Exp. 4, 120 individually fed steers (282 kg of initial BW) were fed DDGS, WDGS (15 or 30% of diet DM), or DRC (22 or 50% of diet DM) in sorghum silage and grass hay diets. In Exp. 1, 3, and 4, increasing DGS inclusion increased ADG (P < 0.01) in forage-based diets. In Exp. 3, cattle consuming WDGS gained more BW than cattle fed DRC (P < 0.01). Using regression analysis, data from Exp. 2, 3, and 4 were pooled to calculate the energy value of WDGS relative to DRC in forage diets. The energy value of WDGS was 137% and 136% of DRC when fed at 15 and 30% of diet DM, respectively.

Key words: beef, cattle, distillers grains, forage, growing

INTRODUCTION

Expansion of the corn milling industry to make ethanol has led to an increased usage of distillers grains plus solubles (**DGS**) by-products in beef diets. Research explored the benefit of using DGS in finishing diets in place of corn (Bremer et al., 2011). However, the energy value of DGS by-products in high-forage diets is not as well defined. Furthermore, research has shown that dry distillers grains plus solubles (**DDGS**) supplementation in forage-based diets decreases forage DMI (Loy et al., 2007, 2008). Thus, supplementation allows producers to increase carrying capacity of pastures without acquisition of additional land. An experiment compared dry-rolled corn (**DRC**) and DDGS at 2 supplementation levels in forage-based diets, and the energy value of DDGS was 118 to 130% that of DRC (Loy et al., 2008).

In contrast with forage-based diets, energy value of DGS in concentrate diets has been well researched. Prediction equations developed from a meta-analysis of 20 beef cattle finishing experiments suggest greater energy value for wet distillers grains plus solubles (**WDGS**; 130 to 143% the energy value of corn for inclusions of 20 to 40% of diet DM) than DDGS (112% for inclusions of 10 to 40% of diet DM; Bremer et al., 2011). Nuttelman et al. (2011) conducted an experiment directly comparing WDGS and DDGS in concentrate diets. Feeding values calculated from G:F resulted in WDGS and DDGS having 146 and 109% the energy value of corn, respectively, supporting values found by Bremer et al. (2011). Few direct comparisons between wet and dry DGS have been made in forage diets.

The objective of Exp. 1 was to determine differences in cattle performance between WDGS and DDGS. Results from Exp. 1 led to the objectives for Exp. 2, 3, and 4: to compare DRC, DDGS, and WDGS as energy

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sources in forage-based diets and determine the energy value of DGS relative to DRC.

MATERIALS AND METHODS

Four experiments were conducted at the University of Nebraska–Lincoln Agricultural Research and Development Center near Mead, Nebraska, for which animal use procedures were reviewed and approved by the University of Nebraska Institutional Animal Care and Use Committee.

Steers were treated similarly before initiation of each experiment. Crossbred steer calves were purchased from a sale barn in western Nebraska and delivered to the feedlot (approximately 7 mo of age). Upon arrival at the feedlot in October, steers were individually identified and vaccinated for prevention of *Haemophilus somnus* (Somubac; Zoetis Inc., New York, NY) for prevention of bovine viral diarrhea, infectious bovine rhinotracheitis, parainfluenza-3, and bovine respiratory syncytial virus (BoviShield Gold 5; Zoetis Inc.), and given an injectable parasiticide (Dectomax; Zoetis Inc.). Approximately 21 d after arrival, steers were revaccinated with a second dose of viral, bacterial, and clostridial vaccines (BoviShield Gold 5, Ultrabac 7/Somubac; Zoetis Inc.) and for prevention of pinkeye (Piliguard Pinkeye-1; Merck Animal Health, Summit, NJ). At receiving, steers grazed smooth bromegrass pastures (21 d) until revaccination, and then steers grazed cornstalks until experiment initiation. While grazing cornstalks, steers were supplemented with 2.3 kg/steer per d of wet corn gluten feed (Sweet Bran; Cargill Corn Milling, Blair, NE). Before the start of each experiment, steers were penned and limit fed a diet consisting of 47.5% alfalfa hay, 47.5% Sweet Bran, and 5.0% supplement (DM basis) at 2.0% of BW for 5 d (Watson et al., 2013) and then weighed on 2 or 3 consecutive days (Stock et al., 1983). The 2- or 3-d BW were averaged and used as initial BW for performance calculations. Similar weighing conditions (fed a common diet at 2% of BW for 5 d and weighed 2–3 d) were used at the conclusion of each experiment. Steers in Exp. 1, 3, and 4 were individually fed using Calan gates (American Calan Inc., Northwood, NH). Cattle in Exp. 2 were pen fed. Pen fed steers were weighed 2 consecutive days at initiation and end of the experiment, whereas those fed individually were weighed 3 consecutive days.

Orts were collected weekly. A sample of refused feed was taken, and DM was determined using a 60°C forced-air oven for 48 h (AOAC International, 1999; method 4.2.03). To obtain accurate DMI, all feed samples were sampled weekly and analyzed for DM using a 60°C forced-air oven for 48 h (AOAC International, 1999; method 4.2.03). Representative subsamples of dietary ingredients were collected and analyzed for NDF (Van Soest et al., 1991; Mertens et al., 2002), CP, and S (LECO FP-528, LECO Corp., St. Joseph, MI; AOAC International, 1999; method 990.03). Ash was determined using a muffle furnace for 6 h at 600°C (AOAC International, 1999; method 4.1.10), and OM was determined based on ash content. By-products used were analyzed for fat content using the fat procedure described by Bremer et al. (2010), and NDF content was determined using the subsequent sample following fat extraction (Van Soest et al., 1991; Mertens et al., 2002; Buckner et al., 2013).

Table 1. Nutrient composition of dietary ingredients fed to growing steers, Exp. 1 (DM basis)

Nutrient, %	WDGS[1]	DDGS[1]	Alfalfa hay	Sorghum silage
DM	32.7	92.3	87.1	33.9
OM	96.0	95.7	91.4	91.6
CP	30.3	29.7	17.9	7.9
NDF	34.7	28.9	52.4	57.4
Fat	11.5	11.1	—	—
S	0.73	1.06	0.23	0.13

[1]WDGS = wet distillers grains plus solubles; DDGS = dry distillers grains plus solubles.

Exp. 1

A total of 120 crossbred steers (initial BW = 268 kg; SD = 14 kg) were used to evaluate growth performance between different types of DGS. Steers were individually fed for 84 d using Calan gates (American Calan Inc.). The experimental design was a generalized randomized block design with treatments arranged in a 3 × 4 factorial plus a control. This is similar to the experimental design and treatment structure used by Peterson et al. (2015). The experimental design of data reported here was a 2 × 3 factorial plus a control, using 66 steers; these data were collected as part of the full experiment. All steers were fed a control diet consisting of 59.25% sorghum silage, 39.25% alfalfa hay, and 1.5% supplement. The supplement consisted of 72.8% limestone, 19.6% salt, 3.3% tallow, 3.3% trace minerals, and 1.0% vitamin A-D-E. Limestone was provided to ensure a minimum of 1.2:1 ratio of Ca:P. Treatments included DGS supplement at 1 of 3 levels: 0.33, 0.67, or 1.0% of BW/steer per d (DM basis). Control cattle received no DGS supplement (12 steers). The second factor was type of DGS supplemented and included DDGS or WDGS. Supplementation was adjusted to changes in BW using single-day interim BW every 28 d. Nutrient profiles of all ingredients fed are shown in Table 1.

The DGS (Abengoa Bioenergy, York, NE) were fed on top of the base