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Effects of spoilage of wet distillers grains plus solubles when stored in a bunker on nutrient composition and performance of growing and finishing cattle[1]

J. L. Harding, K. M. Rolfe, C. J. Schneider, B. L. Nuttelman, D. B. Burken, W. A. Griffin, PAS, A. L. Shreck, G. E. Erickson,[2] PAS, and T. J. Klopfenstein
Department of Animal Science, University of Nebraska, Lincoln 68583-0908

ABSTRACT

Three experiments evaluated the effect of spoilage of wet distillers grains plus solubles (WDGS) on nutrient composition and cattle performance. In Exp. 1, a 140-d barrel storage study was conducted to simulate bunker storage. An interaction between days of storage and DM, OM, and NDF recovered at the surface in spoiled material was observed. In Exp. 2, a 130-d finishing experiment used 60 individually fed steers fed 3 treatments: a dry-rolled corn–based diet (control) and 2 diets containing 40% WDGS replacing dry-rolled corn. The WDGS was stored in either an uncovered bunker (spoiled) or anaerobically in a silo bag (nonspoiled). Calculations suggest 12% of DM was lost while stored in the bunker. No differences in performance ($P \geq 0.26$) were observed between WDGS treatments. However, both WDGS treatments were greater ($P \leq 0.04$) in ADG, final BW, and G:F than the dry-rolled-corn diet. In Exp. 3, an 84-d growing experiment used 60 individually fed steers in a 2 × 2 factorial. Treatments were spoiled versus nonspoiled WDGS fed at 15 or 40% (DM basis). Calculations suggest that 6.0% of DM was lost while stored in the bunker. Feeding spoiled WDGS decreased DMI ($P < 0.01$) across both levels of dietary WDGS compared with nonspoiled WDGS. Diets containing spoiled WDGS had similar ADG and G:F compared with diets with nonspoiled WDGS ($P \geq 0.16$). Feeding WDGS containing spoilage did not affect performance of finishing steers. Spoilage did decrease DMI but had little effect on ADG and no effect on G:F when fed to growing steers.

Key words: cattle, spoilage, storage, wet distillers grains plus solubles

INTRODUCTION

Distillers grains have been found to have a greater energy value relative to corn, especially wet distillers grains plus solubles (**WDGS**), which is roughly 130% the energy value of corn (Klopfenstein et al., 2008). However, WDGS has a high moisture content with 30 to 35% DM (Buckner et al., 2011), which causes storage and shelf-life issues. Research has shown that once WDGS is stored and exposed to oxygen, spoilage occurs (Christensen et al., 2010). Spoilage occurs within a few days depending on the amount of oxygen exposure and ambient air temperature (Christensen et al., 2010). These shelf-life issues can be avoided if producers keep a fresh supply and use all the WDGS within a few days of delivery. However, milling plants prefer to deliver a semi-load quantity (22.7–27.2 t), which makes it difficult for smaller cattle operations to use all of the WDGS before spoilage starts to occur. Similarly, cow-calf producers may want to use WDGS but only on a seasonal basis. Milling plants have a difficult time accommodating seasonal usage because they produce WDGS consistently throughout the year. Not only do milling plants have to deal with seasonal users of WDGS, but they also have to deal with seasonal

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[2] Corresponding author: gerickson4@unl.edu

changes in the number of cattle in feedlots (NASS, 2012).

Past trends indicate that fewer cattle are fed during the summer months (i.e., July, August, and September) and more cattle on feed from November through June (NASS, 2012). Because of the seasonality of cattle feeding, the price of distillers grains tends to be lower during the summer months because of a decrease in demand. This makes it practical and economical for producers to store large quantities of distillers grains during the summer months for use later during the winter months (Erickson et al., 2008).

Christensen et al. (2010) and Yelden et al. (2011) determined that storing WDGS decreased fat and increased pH, NDF, ash, and CP. Fat decreased from 10.2 to 4.1% DM and 10.6 to 4.9% DM, respectively. These changes in the nutrient composition of WDGS during storage could be affecting cattle performance, especially because most producers do not separate the spoiled material from the nonspoiled material. Therefore, the objectives of this research were to evaluate the effects of spoilage of WDGS on the nutrient profile over time and to determine the effect on performance and carcass characteristics when feeding spoiled WDGS to growing and finishing cattle.

MATERIALS AND METHODS

All animal care and management procedures were approved by the University of Nebraska–Lincoln Institutional Animal Care and Use Committee.

Exp. 1—Barrel Experiment

A barrel storage experiment was conducted over a 140-d period. Fourteen 200-L barrels packed with WDGS were used to mimic bunker storage on a smaller scale. The barrels were filled to approximately the same weight (136 kg) and height. All barrels were stored in a building at ambient temperatures but not precipitation. The barrels were filled and placed in storage on June 2, 2010. Barrels were stored for 7, 14, 28, 56, 84, 112, or 140 d. On each of these days, 2 barrels were weighed and sampled. This process consisted of separating the spoiled and nonspoiled material. The spoilage was determined by appearance and texture, with the spoiled material having a dark-brown appearance and the nonspoiled material having the typical golden appearance. Once the spoiled layer had been separated, the spoiled layer and the remaining unspoiled WDGS were then measured for height and weight and subsampled for chemical analysis.

The spoiled and nonspoiled samples were analyzed for DM, ash, OM, fat, NDF, CP, and pH. Samples were placed in a forced-air oven at 60°C for 48 h to determine DM (Buckner et al., 2011). Ash and OM were determined by placing samples in a muffle furnace for 6 h at 600°C. Ether extract was determined by performing a biphasic lipid extraction procedure described by Bremer (2010). Neutral detergent fiber analysis was conducted using the procedure described by Van Soest et al. (1991) with modifications described by Buckner et al. (2013). Crude protein was determined by using a combustion chamber (TruSpec N Determinator, Leco Corporation, St. Joseph, MI) (AOAC International, 1999; method 990.03). Nutrient analyses for both the spoiled and nonspoiled layers, along with nutrient analysis of the original WDGS sample, were used to determine the nutrient losses. Losses were calculated using the weights and nutrient composition of both the spoiled and nonspoiled layer. In the calculations, the spoiled layer is included in the recovered DM, fat, NDF, CP, and OM, assuming that the spoiled and nonspoiled WDGS would be fed. Therefore, if the spoiled layer were discarded, the loss would be the total of DM loss plus spoilage amount.

Data were analyzed using the mixed procedures of SAS (SAS Institute Inc., Cary, NC). The model included effect of day (7, 14, 28, 56, 84, 112, and 140 d) in storage. Barrel was used as the experimental unit. Contrasts were used to test the linear and quadratic effects of the number of days in storage on nutrient losses. Probabilities less than or equal to α ($P \leq 0.05$) were considered significant.

Exp. 2—Finishing Experiment

A 130-d finishing experiment was conducted using 60 individually fed steers (398 ± 30 kg). Steers were limit fed a common diet at 2.0% of BW for 5 d (Watson et al., 2013) and weighed 3 consecutive days (d −1, 0, and 1) to obtain initial BW (Stock et al., 1983). Steers were stratified by BW based on d −1 and 0 BW and then assigned randomly to treatments. During the initial weighing process, all steers were implanted with Revalor-S (120 mg of trenbolone acetate and 24 mg of estradiol, Merck Animal Health, De Soto, KS). Animals were individually fed 1 of 3 treatments using the electronic Calan gate system (American Calan, Northwood, NH). There were 20 steers per treatment, using steer as the experimental unit.

The 3 treatments included a dry-rolled corn (**DRC**)–based control diet and 2 diets containing 40% WDGS that was stored in either a silo bag or bunker, replacing DRC. All 3 treatments also contained alfalfa at 7.5% of the diet DM and supplement at 5.0% of the diet DM (Table 1).

The WDGS was purchased from one ethanol plant (Abengoa Bioenergy, York, NE) and split equally within semi-load into either an uncovered bunker (spoiled WDGS) at a depth of 37 cm or into a silo bag and stored anaerobically (nonspoiled WDGS). The WDGS was bagged (Kelly Ryan 2W08, Blair, NE) under no pressure. Storage was initiated on June 2, 2010, 38 d before to the start of the experiment (July 10, 2010) to allow for spoilage to occur.

Samples of WDGS (from both storage methods) were collected daily after allowing the WDGS to mix alone in the truck before diet mixing