Spoilage of Wet Distillers Grains Plus Solubles and Feed Value

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Summary

Performance of growing or finishing steers fed wet distillers grains plus solubles (WDGS) from a silo bag (nonspoiled) or bunker (spoiled) was studied. Spoiled WDGS lost DM, as well as decreased in fat, NDF, and CP. Even though DM was lost, and composition of the spoiled WDGS changed, the spoiled WDGS had no effect on finishing cattle performance, but it did affect DMI of the growing steers consuming high forage diets.

Introduction

The top of a WDGS pile starts spoiling in a few days. Since WDGS is delivered in semitruck load quantities, it is often impractical for smaller livestock operations that cannot utilize large quantities of WDGS within a few days to purchase WDGS. The most common method of storage is in a bunker, which leaves the WDGS exposed to oxygen, causing the WDGS to spoil. Previous research illustrated WDGS decreased in fat and increased in NDF, CP, pH, and ash during the spoilage process (*2011 Nebraska Beef Cattle Report,* p. 18), indicating WDGS is losing feeding value. Most producers don't separate the spoiled from the unspoiled WDGS, so this could affect cattle performance. Therefore, the objective of these two studies was to determine the effects of spoiled WDGS on 1) feedlot performance and 2) growing performance.

Procedure

Experiment 1

A 130 day finishing experiment was conducted using 60 individually fed steers (878 ± 15.3 lb). Five days prior to the start of the experiment, steers were limit fed to minimize variation in initial BW, then weighed for three consecutive days. Animal served as the experimental unit (20 steers per treatment).

The three treatments included a dry-rolled corn based diet (control) and two diets containing 40% WDGS replacing DRC (Table 1). The WDGS was split equally between semi load into either an uncovered bunker (spoiled WDGS) or into a silo bag and stored anaerobically (nonspoiled WDGS). Storage was initiated on June 2, 2010, 38 days prior to experiment (started July 10, 2010) to allow for spoilage. WDGS from the same semi load was also placed into barrels for 140 days to mimic the WDGS being stored in the bunker. The spoiled and nonspoiled layers were measured and analyzed for ash. A relationship was found between percentage spoiled and the % ash (combining both spoiled and nonspoiled ash content) in the barrels. A regression equation was then used (% spoilage = (0.1002 * % ash of bunker WDGS) + 0.0639) to calculate the amount of spoilage in the bunker. Feed refusals were weighed and sampled twice per week. They were then analyzed for DM and used to calculate accurate DMI for each steer.

Samples of WDGS (from both storage methods) were collected daily after allowing the WDGS to mix alone in the truck prior to diet mixing to ensure accurate sampling occurred throughout. Daily samples of WDGS were composited by week for nutrient analysis. Weekly composites were analyzed for DM, ash, fat, NDF, CP, and pH. An overall composite of the bagged and bunkered WDGS was analyzed for mycotoxins (Romer Labs; Union, Mo.).

All steers were slaughtered on day 130 at Greater Omaha (Omaha, Neb). Carcass characteristics consisting of hot carcass weight (HCW), liver abscesses, USDA marbling score, 12th rib fat thickness, and LM area were collected. For USDA calculated YG, KPH fat was assumed to be 2.5%. Hot carcass weights were used to calculate adjusted final BW by dividing HCW by a common dressing percentage (63%). Yield grade was calculated using the equation: USDA YG = 2.5 + 2.5(12th rib fat thickness, in) – 0.32(LM area, in²) + 0.2(KPH fat, %) + 0.0038 (HCW, lb). Steer performance and carcass characteristics were analyzed using the Mixed procedure of SAS (SAS Inst., Inc., Cary, N.C.).

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Table 1. Dietary treatments (% of diet DM) fed to finishing steers evaluating spoilage of stored wet distillers grains plus solubles for Experiment 1.

Ingredient	Control	Spoiled	Nonspoiled
Dry-rolled Corn	82.5	47.5	47.5
WDGS, Bag[1]	—	—	40.0
WDGS, Bunker[2]	—	40.0	—
Alfalfa Hay	7.5	7.5	7.5
Supplement[3]	5.0	5.0	5.0

[1]Bagged wet distillers grains plus solubles stored anaerobically to minimize spoilage (nonspoiled).
[2]Bunker wet distillers grains plus solubles that was allowed to have more spoilage occurring during storage prior to and during feeding (Spoiled).
[3]Formulated to contain 59% fine ground corn, 30% limestone, 6% salt, 2.50% tallow, 0.32% thiamine, 1% vitamin pre-mix, 0.38% Rumensin-80, 0.19% Tylan-40.

Experiment 2

An 84 day growing experiment was conducted using 60 individually fed steers (730 ± 0.46 lb). Steers were limit fed for five days and then weighed three consecutive days to obtain initial BW. Animal served as the experimental unit, and there were 15 steers per treatment. The four treatments were designed as a 2x2 factorial. Similar to Experiment 1, WDGS was stored in a bunker (spoiled) or silo bag (nonspoiled). The other factor was WDGS stored either way was fed at 15% or 40% (Table 2). The treatments with 15% WDGS were formulated to meet the protein needs of the steers. The 40% inclusion treatments were formulated to meet the protein needs of steers and provide additional energy. The WDGS was purchased from an ethanol plant and split equally within semi load into either an uncovered bunker (spoiled WDGS) or into a silo bag and stored anaerobically (nonspoiled WDGS). Storage was initiated five months prior to starting the experiment (March 24, 2011) to allow for spoilage to start occurring throughout the winter months. Feed refusals were weighed and sampled twice per week and analyzed for DM to calculate accurate DMI for each steer.

Sampling, compositing, and analyses are described in Experiment 1. Weighing and statistical analyses were as described in Experiment 1, also.

Table 2. Dietary treatments fed to growing steers where 15 or 40% wet distillers grains were fed that had spoiled (Bunker) or not (Bag) for Experiment 2.

Ingredient[1]	15% Bunker[3]	40% Bunker[4]	15% Bag[3]	40% Bag[4]
WDGS, Bag	—	—	15.0	40.0
WDGS, Bunker	15.0	40.0	—	—
CRP Hay[2]	81.0	57.0	81.0	57.0
Supplement	4.0	3.0	4.0	3.0

[1]Inclusion on a DM basis.
[2]Low quality grass hay with a 48% TDN, 72.7% NDF, and 5.3% CP.
[3]Supplement formulated to contain 28.5% fine ground corn, 23.0% limestone, 37.5% urea, 7.5% salt, 1.88% tallow, 1.25% trace minerals, 0.38% vitamin pre-mix.
[4]Supplement formulated to contain 44.67% fine ground corn, 40.67% limestone, 10.0 salt, 2.5% tallow, 1.67% trace minerals, 0.50% vitamin pre-mix.

Table 3. Weekly nutrient composition of spoiled and nonspoiled WDGS in Experiment 1.

Nutrient	Bunker	Bagged	Calculated Loss[1]
DM, %	35.2	33.4	12.3
Ash, %	6.4	5.6	—
Fat, %	14.1	14.8	16.0
NDF, %	33.3	31.7	8.0
CP,%	30.8	30.8	12.2
pH	4.8	4.2	—

[1]Calculated using (1-((ash initial/ash final)*(nutrient final/nutrient initial).

Table 4. Performance and carcass characteristics for steers fed wet distillers grains that had spoilage or not compared to a corn control diet in Experiment 1.

Variable	Control	Nonspoiled[4]	Spoiled[5]	SEM	*P*-Values
Initial BW, lb	871	885	879	15.3	0.81
Final BW, lb[1]	1211[a]	1269[b]	1291[b]	22.5	0.04
DMI, lb/day	22.36	21.73	22.42	0.48	0.54
ADG, lb	2.61[a]	2.95[b]	3.18[b]	0.14	0.02
F:G[2]	8.54[a]	7.39[b]	7.13[b]	0.34	0.01
HCW, lb	763[a]	800[b]	814[b]	14.2	0.04
LM Area, in[2]	12.5	13.1	12.8	0.3	0.35
Fat, in	0.46	0.47	0.48	0.03	0.86
Marbling[3]	522.5	526.5	505.7	14.6	0.57
YG	3.03	3.01	3.16	0.13	0.67

[1]Final BW was calculated by taking HCW*0.63 dressing percentage.
[2]Analyzed as G:F, the reciprocal of F:G.
[3]Marbling score 400 = slight (Select); 500 = small (Choice-); 600 = modest marbling (Choice).
[4]WDGS stored in a silo bag.
[5]WDGS stored in a bunker.
[a, b, c]Means with different superscripts within a row are different ($P < 0.05$).

Results

Experiment 1

Steers fed the spoiled treatment (bunkered WDGS) consumed WDGS that contained 7% spoilage on average. No measurable amounts of mycotoxins in either spoiled or nonspoiled WDGS were detected. Nutrient analysis of the spoiled and nonspoiled WDGS indicated spoiled WDGS was 0.7% lower in fat content throughout the feeding period compared to the nonspoiled WDGS. Spoiled WDGS was higher in DM, ash, NDF, pH, and no change in CP was observed throughout the 130 day feeding period. Ash was used as a marker to calculate the overall loss of DM of the spoiled WDGS from the day (June 2, 2010) it was stored in the bunker (Table 3). The calculated loss indicated spoiled WDGS lost 12.3% DM. Also, the spoiled WDGS lost 16% fat, 8% NDF, and 12.3% CP. It is evident that the spoiled WDGS changed in composition compared to the initial WDGS purchased on June 2 because 16% fat was lost compared to 12.3% DM; however, there was no effect on performance (Table 4).

Despite nutrient losses, feeding the control, nonspoiled WDGS, or spoiled WDGS treatments did not affect DMI (Table 4). No differences in ADG, final BW, or F:G were observed between nonspoiled and spoiled WDGS. However, both WDGS treatments were greater ($P \leq 0.04$) in ADG, final BW, and lower in F:G compared to the control. Even though the spoiled

Table 5. Weekly nutrient composition of spoiled and nonspoiled WDGS in Experiment 2.

Nutrient	Spoiled[2]	Nonspoiled[3]	Calculated Loss[1]
DM, %	37.0	35.1	6.0
Ash, %	5.8	5.2	—
Fat, %	12.8	11.2	-2.6
NDF, %	35.1	34.9	10.3
CP,%	35.2	33.1	4.9
pH	4.8	4.0	—

[1]Calculated using (1-((ash initial/ash final)*(nutrient final/nutrient initial).
[2]WDGS stored in the bunker.
[3]WDGS stored in the silo bag.
Negative losses indicate an increase in that nutrient.

Table 6. Performance characteristics of growing steers Experiment 2.

	15%		40%		*P*-value		
Variable	S[1]	NS[2]	S[1]	NS[2]	Interaction	Level	Source
Initial BW, lb	730	730	730	729	0.94	1.0	1.0
Ending BW, lb	785	793	831	835	0.83	<0.01	0.56
DMI, lb	15.0	16.5	17.6	19.1	0.94	<0.01	<0.01
ADG, lb	0.66	0.75	1.20	1.26	0.71	<0.01	0.13
F:G	24.4	23.0	14.9	15.3	0.42	<0.01	0.67

[1]WDGS stored in the bunker (spoiled).
[2]WDGS stored in the silo bag (nonspoiled).

WDGS changed in composition from the initiation of the trial to the end; it is evident that the spoilage occurring when WDGS was stored in a bunker had no effect on the performance of finishing steers.

Experiment 2

Steers receiving the spoiled treatments consumed WDGS that contained 7% spoilage on average. Mycotoxins were not observed in either spoiled or nonspoiled WDGS. Nutrient analysis of the spoiled and nonspoiled WDGS indicated spoiled WDGS were higher in fat content throughout the feeding period compared to the nonspoiled WDGS. Spoiled WDGS were higher in DM, ash, NDF, pH, and CP throughout the 84 day feeding period. Ash was used as a marker to calculate the overall loss of DM from the spoiled WDGS from the day (October 26, 2010) it was stored in the bunker (Table 5). There was a 6.0% DM loss for the spoiled WDGS. Also, the spoiled WDGS lost 10.3% NDF and 4.9% CP. The spoiled WDGS increased 2.6% fat, indicating that the fat was becoming more concentrated in the spoiled layer due to other nutrient losses. The effects of spoilage of WDGS on performance were different in the growing experiment compared to the finishing experiment (Table 6).

There was no interaction (Table 6) between level of WDGS (15% or 40%) and source of WDGS (bag or bunk). The diets containing 40% WDGS performed better in ending BW, DMI, ADG, and F:G ($P < 0.01$) compared with steers fed 15% WDGS. Feeding spoiled WDGS decreased DMI ($P < 0.01$) across both levels of dietary WDGS compared to nonspoiled WDGS. The diets containing spoiled WDGS had statistically similar ending BW, ADG, and F:G compared to diets with nonspoiled WDGS. Numerically, the steers fed 15% spoiled WDGS in the diet had lower ending BW, lower ADG ($P = 0.14$ for main effect of ADG between source of WDGS), and greater F:G than nonspoiled WDGS. There were no differences for ending BW, ADG, or F:G between the 40% spoiled and 40% nonspoiled diets. Therefore, there was no overall effect of source (spoiled or nonspoiled) on ending BW, ADG, or F:G. However, spoiled WDGS did affect intakes of growing steers.

In conclusion, the spoilage process that occurs when WDGS is stored in a bunker causes a loss of DM and nutrients, with decreases in % fat and small increases in ash content (i.e., lower OM). However, feeding spoiled WDGS did not affect finishing performance. Feeding spoiled WDGS to growing steers did decrease DMI, but had little impact on ADG and no effect on F:G.

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