Efficacy of a Preservative Product (ZeniPro) for Wet Distiller's Grains

Final Report to Kemin Americas, Inc.

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James K. Drackley
University of Illinois

Purpose: To evaluate the efficacy of a commercial product (ZeniPro) to prevent mold growth and spoilage of wet distiller's grains, and so prevent decreases in feed intake and milk production by lactating cows under summer heat conditions.

Personnel:

James K. Drackley, Principal investigator
Michael F. Hutjens, co-investigator
Ignacio Ipharraguerre, graduate research assistant
Elizabeth French, undergraduate research assistant

Procedures: A continuous design with 24 second or greater lactation Holstein cows past peak production was used. Cows were housed in a tie stall barn with artificial ventilation, and were allowed to exercise in a dirt lot for 2 hours daily (approximately 0800 to 1000 h). Cows were moved into the barn on Tuesday July 8, 2003. A load (about 2 Tons wet) of untreated distillers grains was delivered from Badger State Ethanol on July 9. The diet containing the untreated distillers was fed to all cows starting on July 9 to adapt cows to the barn and diet. On July 15, 3 Tons of each of untreated and treated distillers grains were delivered. Cows were allocated to diets containing treated or untreated distillers starting on July 16. Cows were fed the diets for 27 days, at which time the batch of treated distillers was deemed visually to not be suitable to feed any longer. The project was ended on August 10, 2004.

The distillers grains were placed in piles on tarps. Piles were covered with a tarp when rain threatened. A second batch of untreated distillers grains was delivered on July 25, and was fed beginning on July 28. Temperature of each pile was recorded daily (in the morning, same time each day) using a forage sampling thermometer. Samples of each pile were every other day (three times weekly) for analysis by Dairyland Labs.

Diets were fed twice daily as total mixed rations (TMR). Diet composition is shown in Table 1. Daily feed offered and refused were measured daily for calculation of dry matter intake (DMI). Samples of feed refusals were collected daily and frozen for later drying to accurately determine DMI. Milk yield was measured and recorded at each milking, and daily milk yield was the sum of p.m. and a.m. milk weights. Samples of milk were obtained from two consecutive milkings weekly (Tuesday p.m. and Wednesday a.m.). Milk samples were composited into daily samples according to milk yields at each milking and sent to Dairy Lab Services (Dubuque, IA) for analysis. Cows were weighed weekly and body condition scores were assigned (1 to 5 scale where 1 = thin and 5 = fat). Feeds were sampled weekly and rations adjusted for DM content. Samples were frozen for later analysis by Dairyland Labs. Environmental temperatures were obtained from the Illinois Water Survey, an official National Weather Service weather recording station for the Urbana area.

Data were analyzed statistically by using the PROC MIXED procedure of SAS as a completely randomized design, with repeated measures as appropriate. The statistical model contained the effects of diet (treated or untreated wet distillers grains), time, and the interaction of diet and time. Cow was considered a random effect.

Results:

Cow performance. Results are compiled in Table 4. There were no differences in mean DMI, milk yield, fat-corrected milk (FCM) yield, or milk component contents and yields. Milk urea nitrogen (MUN) was significantly greater for cows fed the treated distillers' grains, but we are unable to explain this finding based on any measurements made. Milk somatic cell count (SCC), body weight (BW), and body condition scores also did not differ between groups.

Most variables summarized in Table 4 were affected by time (i.e., week) but the interaction of dilstillers' grains treatment and time did not approach statistical significance for any variable. This is interpreted to indicate that although environmental factors may have impacted performance of cows, those factors affected both treatments similarly so that the patterns of change over time were similar between treatment groups. These patterns are shown in Figures 1-10. Although the dietary treatment by time interaction did not approach statistical significance, it appears that the cows fed the treated distillers' grains had slightly lower DMI after introducing that diet, suggesting some sort of adaptation period to the preservative.

Daily environmental temperatures are plotted in Figure 4 (page 8). Temperature alone does not seem to fully explain the variability in DMI and milk yield, suggesting that actual degree of heat stress (a factor of both termperature and humidity) was not reflected by the termperature data. The large drops in milk yield between days 15 and 19 in particular were associated with a period of very hot and humid conditions. Barn temperatures and relative humidities were not able to be measured, so the actual degree of heat stress on the cows is unable to be determined.

Cows fed the untreated distillers' grains appeared to become more variable in DMI by day 6 to 7 of feeding, although we were unable to detect this statistically by examining the standard deviations of DMI given the number of cows used. When the new batch of untreated grains began to be fed, DMI appeared to become less variable, before starting to increase again; by this time, however, the treated grains also seemed to be causing more variable DMI as well.

Analytical results of treated and untreated distillers'grains. Chemical and microbiological results from repeated sampling of the distillers' grains samples are plotted in Figures 11-27. For untreated batch 1, clumps of mold (pink and white with dark spots) became evident on the untreated pile on the 6th day after arrival, but not on the treated grains. This continued to worsen, and by the 12th day the appearance of the untreated pile was so bad that it was decided to switch to the fresh batch of untreated grains out of concerns for potential toxins. However, the analytical results show that there was no discernable difference between treated and untreated in any chemical or microbiological parameter, with the exception of the fermentation and acid profiles. Treated grains had slightly higher crude protein (CP) contents. The propionic acid content of the treated grains was greater than the untreated grains as expected. Pile temperatures and pH did not differ between treated and untreated batch 1.

The two batches of untreated distillers' grains appeared to be different in some way, as evidenced by the much lower pH and higher lactic acid content for the second batch. Total acid content also was greater for batch 2 of the untreated distillers' grains and increased between days 19 and 21. Propionic acid increased sharply in this second batch after day 21 of the experiment. We have no explanation for these differences, as piles were handled similarly and weather conditions were generally similar during the feeding of each batch. Consequently, the difference appears to be in the processing and/or origin of the source material in the second batch.

Despite obvious differences in visual appearance of the untreated and treated distillers' grains with time (see digital photos sent under separate cover), there were no clear differences in analytically determined measures of yeast or mold counts or measurements of mycotoxins present. There were occasional spikes in these values for both treated and untreated distillers' grains, which likely are associated with small pockets of mold or yeast growth that happened to be sampled or not.

The employees doing the feeding at the research unit noted obvious differences in consistency between the untreated and treated distillers' grains. The treated grains did not clump and harden but remained free-flowing, thus being much more easily handled and incorporated uniformly into the TMR.

Conclusions: No difference in cow performance was noted between untreated and ZeniPro-treated wet distillers' grains. However, one batch of treated distillers' grains was able to be fed for as long as two batches of untreated grains, based on visual appraisal of changes in quality. Unfortunately, chemical measurements did not provide objective support for these visual differences. Handling characteristics were markedly mproved by the ZeniPro treatment.

Our experiment was conducted with small batches placed in piles, which may present different physical and aerobic conditions compared with large (e.g., semi-load or rail-car quantity) batches placed in piles or bags. It also would be of interest to determine the effects of ZeniPro with lower dry matter (e.g., 30-35% DM) distillers' grains.

Table 1. Ingredient composition of the experimental diets.

Ingredient	Treatments[1] Control	Treated
	----------(% of DM)--------	
Alfalfa silage	18.00	18.00
Alfalfa hay	6.00	6.00
Corn silage	26.00	26.00
Wet distiller's grains		
Control	14.00	……
Treated	……	14.00
Ground shelled corn	20.00	20.00
Soybean meal, 48% CP	9.00	9.00
Soybean hulls	4.40	4.40
Sodium bicarbonate	1.00	1.00
Limestone	0.90	0.90
Dicalcium phosphate	0.20	0.20
Sodium chloride	0.20	0.20
Mineral and vitamin mix[2]	0.20	0.20
Magnesium oxide	0.10	0.10

[1]Control = Untreated wet distiller's grains, Treated = treated wet distiller's grains.
[2]Contained 5.0% Mg, 7.5% K, 10.0% S, 3.0% Zn, 3.0% Mn, 2.0% Fe, 0.5% Cu, 0.025% I, 0.015% Se, 0.004% Co, 2200 IU of vitamin A/g, 660 IU of vitamin D_3/g, and 22 IU of vitamin E/g.

Table 2. Chemical composition of forages and wet distiller's grains (WDG).

	Ingredients			WDG[1]		
	Alfalfa silage	Alfalfa hay	Corn silage	Untreated batch 1	Untreated batch 2	Treated
	(% of DM)					
DM	40.6	86.1	44.8	51.6	52.4	51.5
CP	20.7	17.7	8.2	27.7	29.0	28.4
NDF	48.0	49.7	39.4	33.7	29.3	32.7
ADF	41.6	41.5	22.3	16.8	15.2	17.2
pH	ND[2]	ND	ND	4.28	3.96	4.42
Lactic acid	ND	ND	ND	1.14	2.01	1.10
Acetic acid	ND	ND	ND	0.25	0.28	0.33
Propionic acid	ND	ND	ND	0.10	0.11	0.47
Butyric acid	ND	ND	ND	0.01	0.01	0.01
Isobutyric acid	ND	ND	ND	0.01	0.01	0.01
Total acids	ND	ND	ND	1.48	2.38	1.90
Ethanol	ND	ND	ND	0.01	0.01	0.01
Ammonia-N	ND	ND	ND	5.15	5.25	5.03

[1]Untreated batch 1 was fed from 7/15/2003 to 7/27/2003 (n = 5; 3 samples/week), Untreated batch 2 was fed from 7/28/2003 to 8/10/2003 (n = 9; 3 samples/week), Treated was fed from 7/15/2003 to 8/10/2003 (n = 13; 3 samples/week).

[2]Not determined.

Table 3. Chemical composition of the experimental diets.

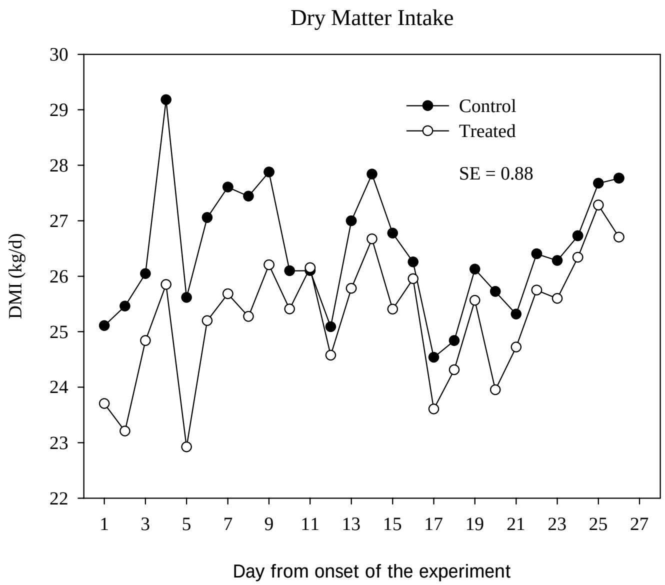
Item	Treatments[1]	
	Control	Treated
	-----------(% of DM)-----------	
DM	55.8	55.4
CP	18.0	17.7
NDF	33.3	34.3
ADF	20.7	23.0

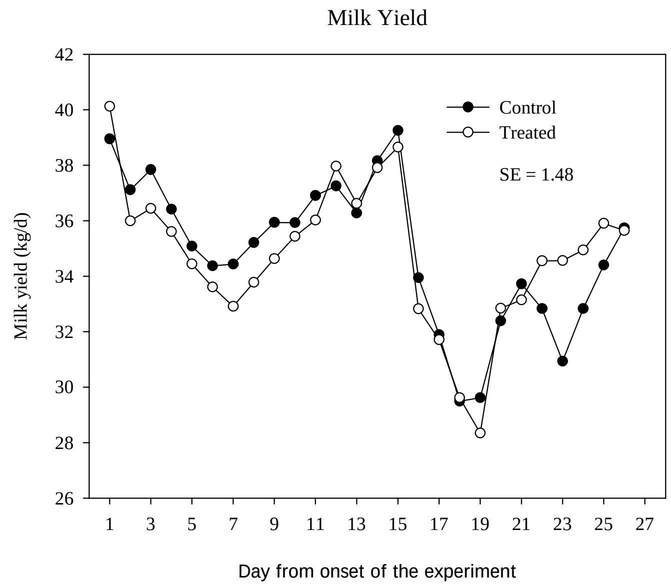
[1]Control = Untreated wet distiller's grains, Treated = treated wet distiller's grains.

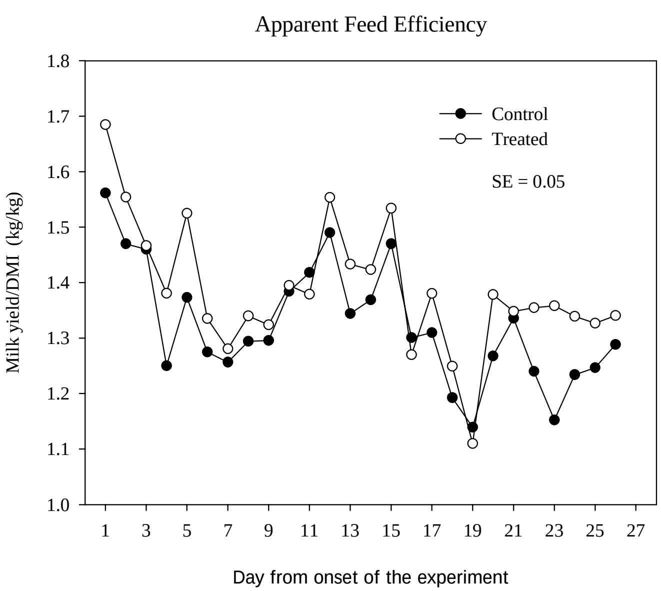
Table 4. Least square means for DMI, milk production, milk composition, BW, and BCS of lactating dairy cows fed the experimental diets.

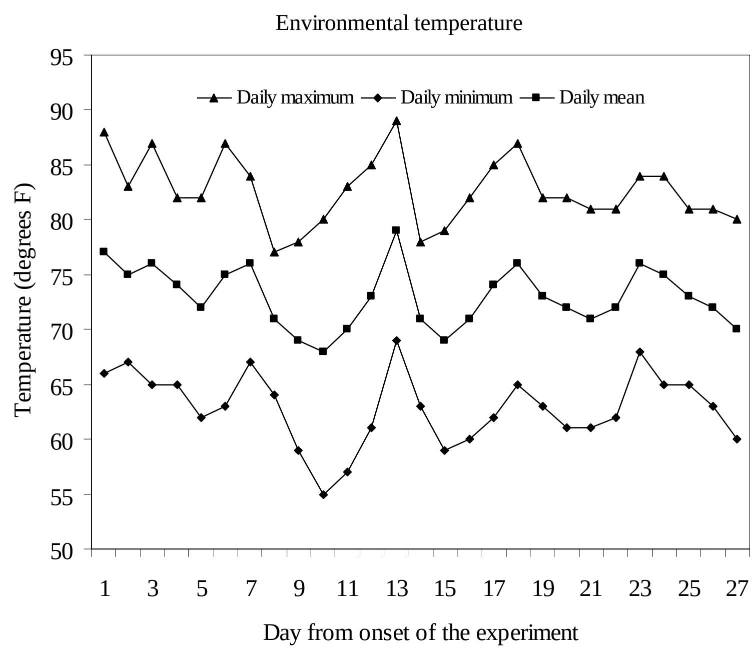
	Treatments[1]			Effect, *P* <		
Item	Control	Treated	SEM	WDG	Week	WDG x Week
DMI, kg/d	26.5	25.3	0.7	0.27	0.0003	0.24
Milk yield, kg/d	34.8	34.8	1.2	0.96	0.0001	0.38
3.5% FCM,[2]kg/d	39.6	38.2	1.4	0.46	0.0001	0.16
Apparent efficiency						
Milk/DMI	1.32	1.38	0.03	0.19	0.0001	0.24
FCM/DMI	1.51	1.55	0.05	0.57	0.0001	0.41
Fat						
%	3.95	3.82	0.15	0.53	0.0001	0.33
kg/d	1.46	1.38	0.06	0.41	0.0001	0.21
Protein						
%	2.99	3.05	0.07	0.48	0.01	0.70
kg/d	1.10	1.11	0.04	0.86	0.01	0.46
MUN[3], mg/dl	11.4	14.0	0.7	0.01	0.03	0.83
Lactose						
%	4.64	4.78	0.09	0.30	0.60	0.44
kg/d	1.71	1.74	0.07	0.80	0.0007	0.40
SNF						
%	5.55	5.69	0.10	0.30	0.59	0.44
kg/d	2.05	2.07	0.07	0.86	0.0003	0.37
SCC, 10^4 cells/ml	339	454	980			
SCC, log10	2.10	2.18	0.19	0.75	0.04	0.21
BW	685	674	20.4	0.70	0.0001	0.62
BCS[4]	2.87	2.88	0.05	0.88	0.006	0.71

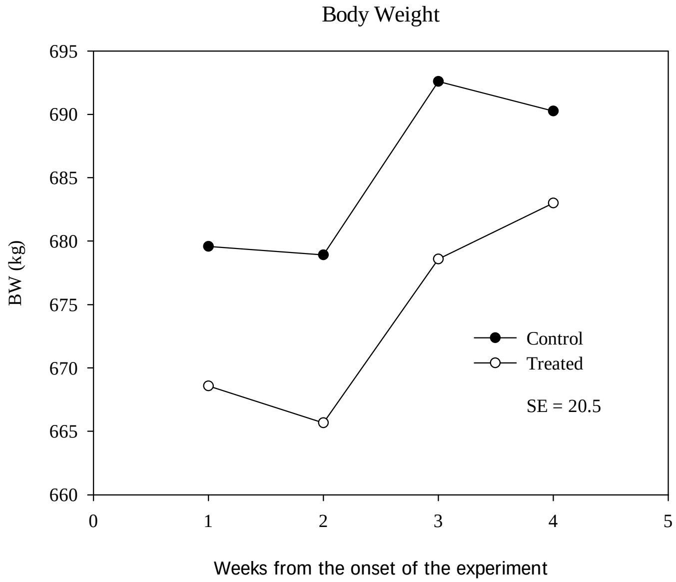
[1]Control = Untreated wet distiller's grains, Treated = treated wet distiller's grains.
[2]3.5% FCM = 0.4324(kilograms of milk) + 16.216(kilograms of fat).
[3]Milk urea nitrogen.
[4]Body condition score on a 5.00 scale in quarter point increments where 1=thin and 5=fat.


Dry Matter Intake
DMI (kg/d)
Control
Treated
SE = 0.88
Day from onset of the experiment

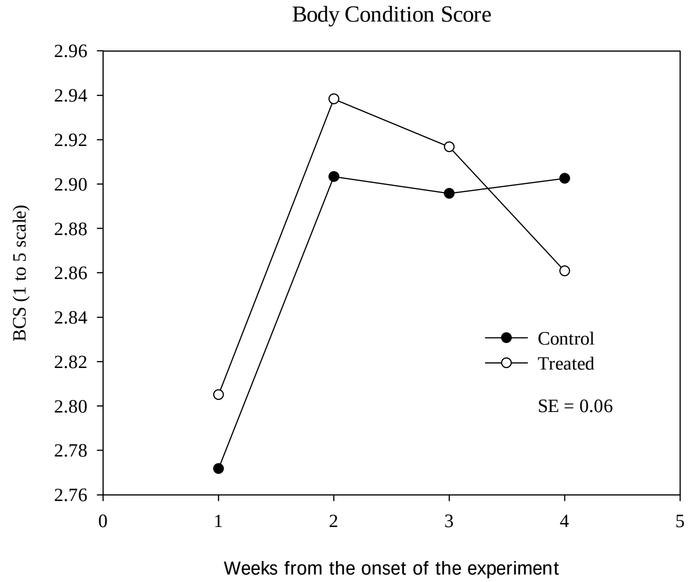

Milk Yield
Milk yield (kg/d)
Control
Treated
SE = 1.48
Day from onset of the experiment


Apparent Feed Efficiency
Milk yield/DMI (kg/kg)
Control
Treated
SE = 0.05
Day from onset of the experiment

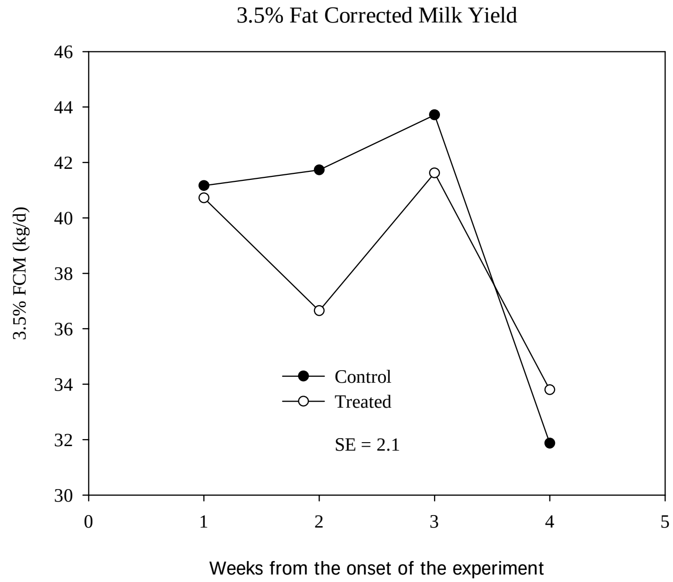

Environmental temperature
Daily maximum
Daily minimum
Daily mean
Temperature (degrees F)
Day from onset of the experiment



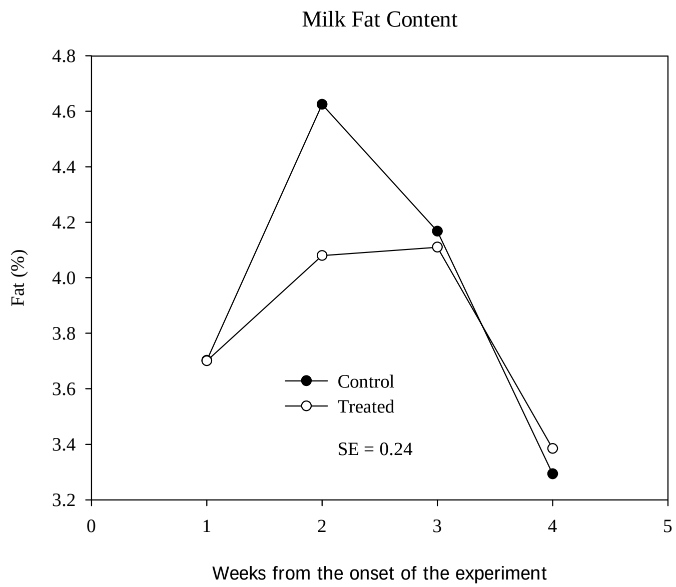
Body Weight
BW (kg)
695
690
685
680
675
670
665
660
0
1
2
3
4
5
Control
Treated
SE = 20.5
Weeks from the onset of the experiment

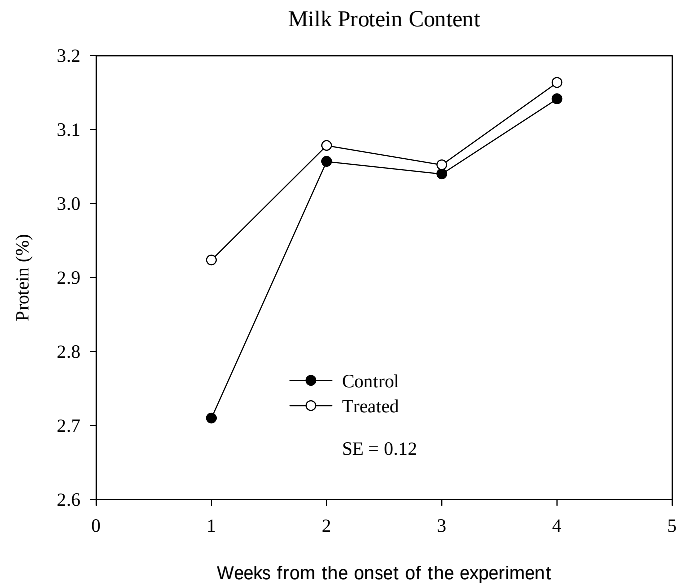


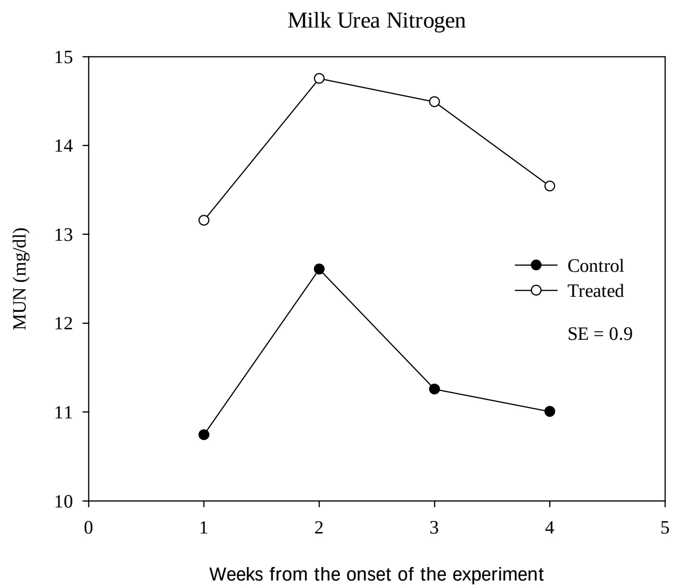
Body Condition Score
BCS (1 to 5 scale)
2.96
2.94
2.92
2.90
2.88
2.86
2.84
2.82
2.80
2.78
2.76
0
1
2
3
4
5
Control
Treated
SE = 0.06
Weeks from the onset of the experiment

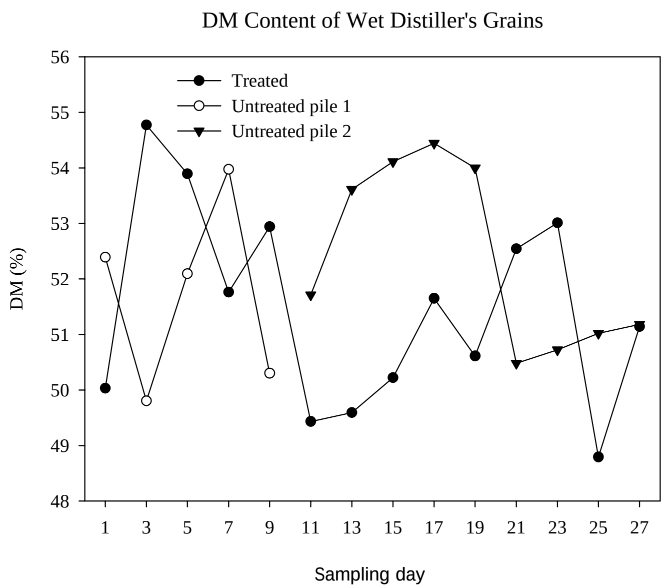


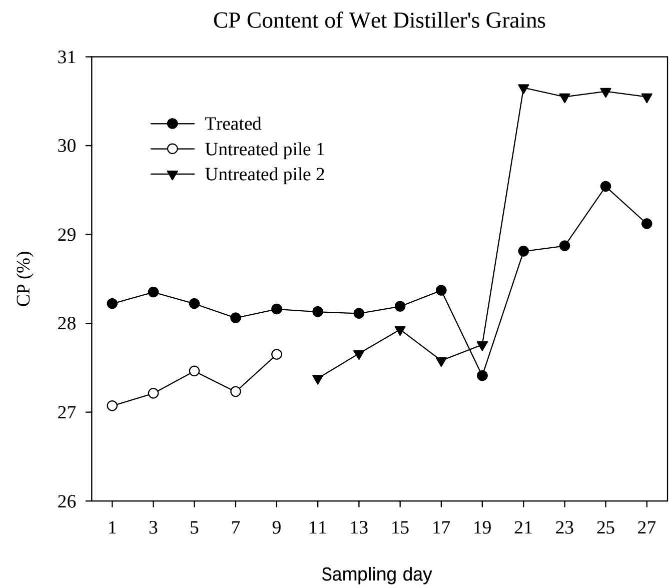
3.5% Fat Corrected Milk Yield
3.5% FCM (kg/d)
46
44
42
40
38
36
34
32
30
0
1
2
3
4
5
Control
Treated
SE = 2.1
Weeks from the onset of the experiment

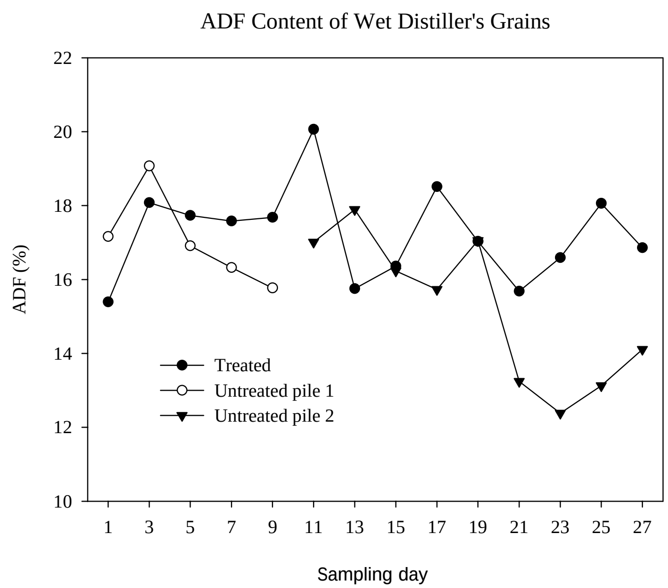

Milk Fat Content
Fat (%)
Control
Treated
SE = 0.24
Weeks from the onset of the experiment

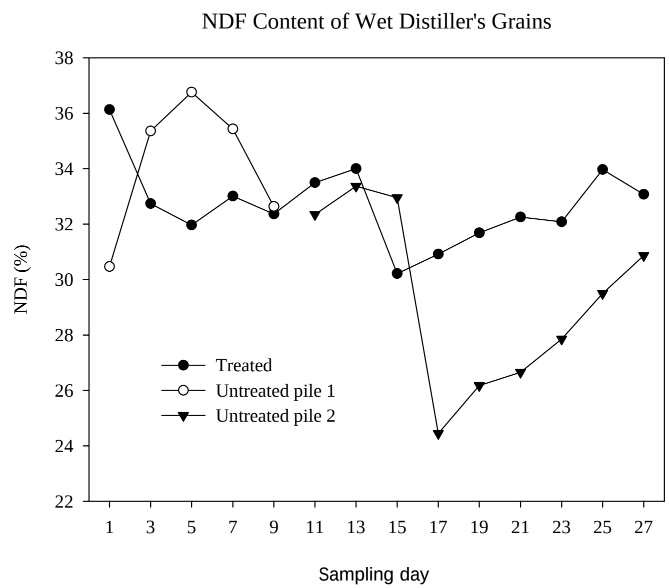

Milk Protein Content
Protein (%)
Control
Treated
SE = 0.12
Weeks from the onset of the experiment

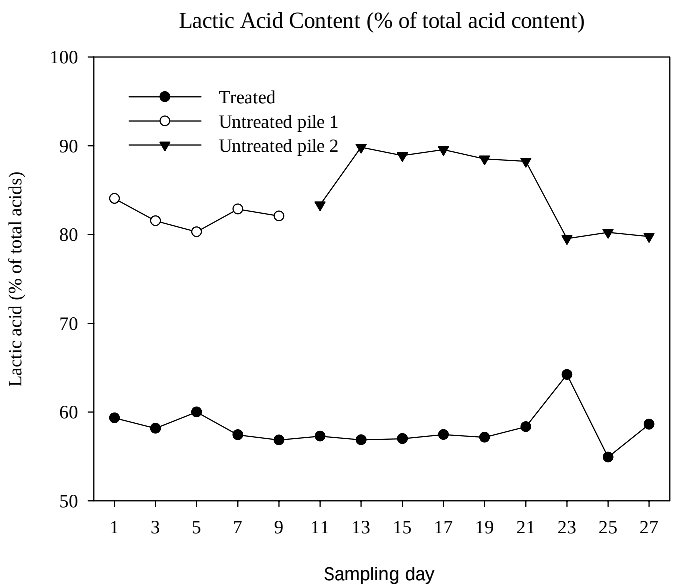

Milk Urea Nitrogen
MUN (mg/dl)
Control
Treated
SE = 0.9
Weeks from the onset of the experiment

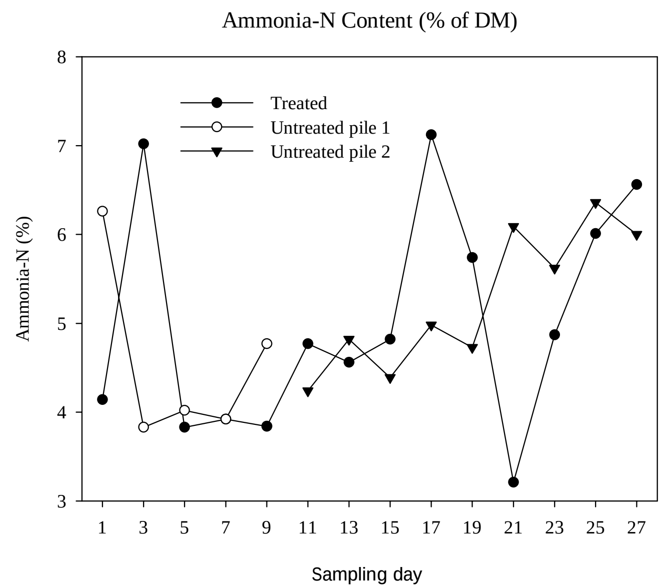

DM Content of Wet Distiller's Grains
DM (%)
Sampling day
Treated
Untreated pile 1
Untreated pile 2

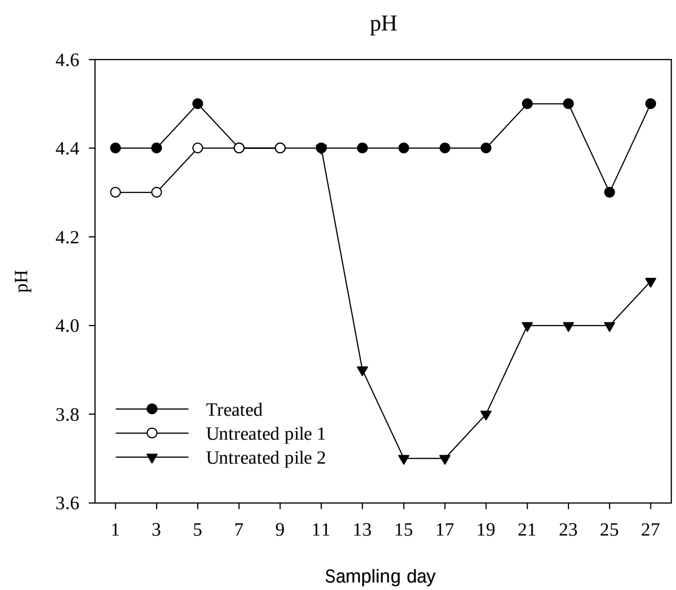

CP Content of Wet Distiller's Grains
CP (%)
Sampling day
Treated
Untreated pile 1
Untreated pile 2


ADF Content of Wet Distiller's Grains
ADF (%)
Sampling day
Treated
Untreated pile 1
Untreated pile 2

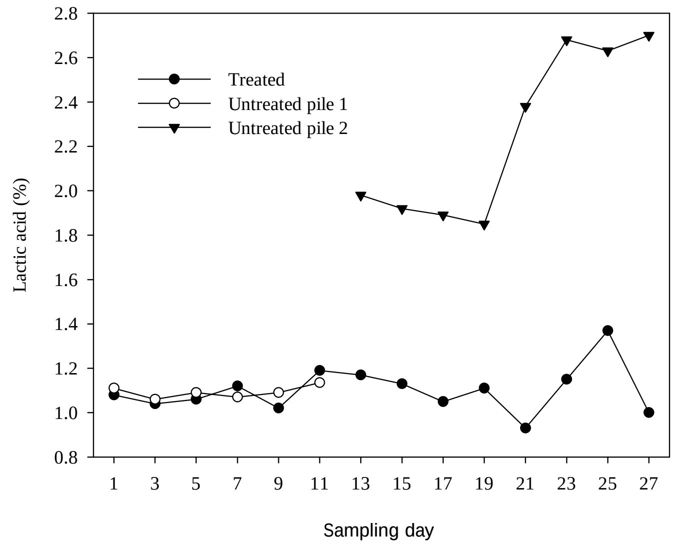

NDF Content of Wet Distiller's Grains
NDF (%)
Sampling day
Treated
Untreated pile 1
Untreated pile 2


Lactic Acid Content (% of total acid content)
Lactic acid (% of total acids)
Treated
Untreated pile 1
Untreated pile 2
Sampling day

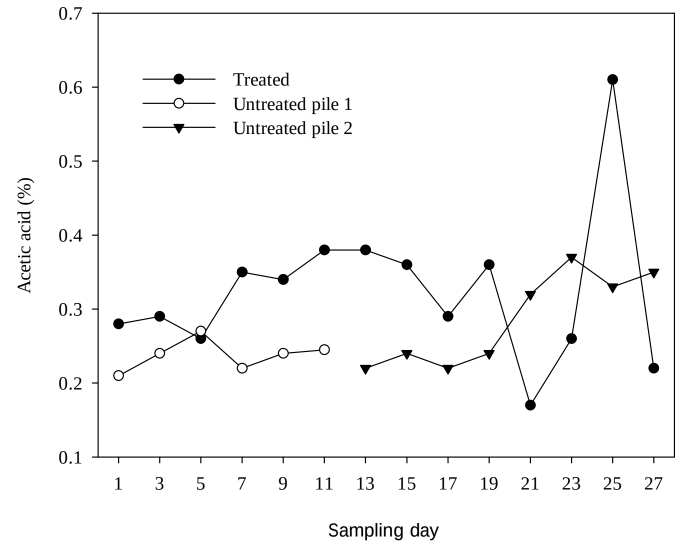

Ammonia-N Content (% of DM)
Ammonia-N (%)
Treated
Untreated pile 1
Untreated pile 2
Sampling day


pH
pH
Treated
Untreated pile 1
Untreated pile 2
Sampling day

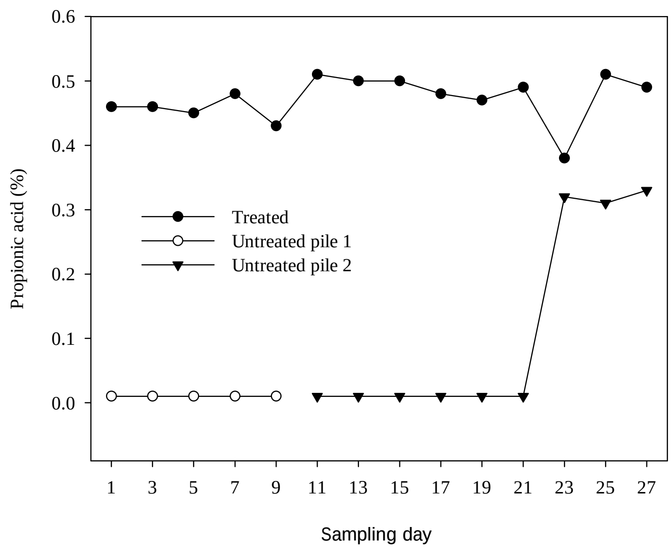
Lactic Acid Content (% of DM)



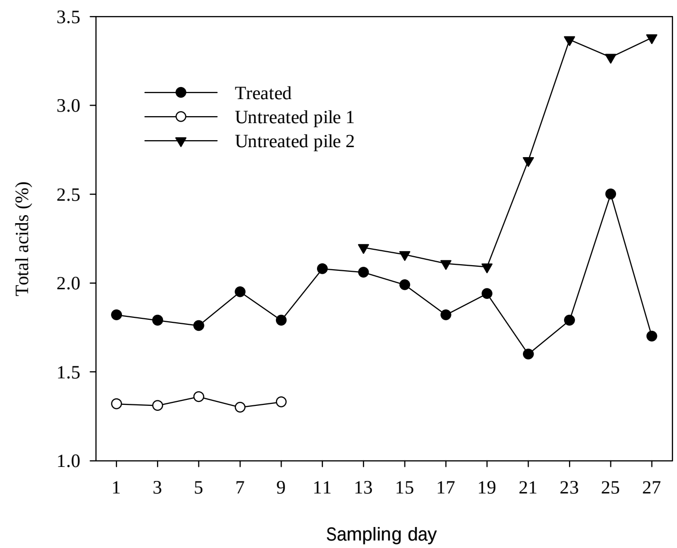
Acetic Acid Content (% of DM)

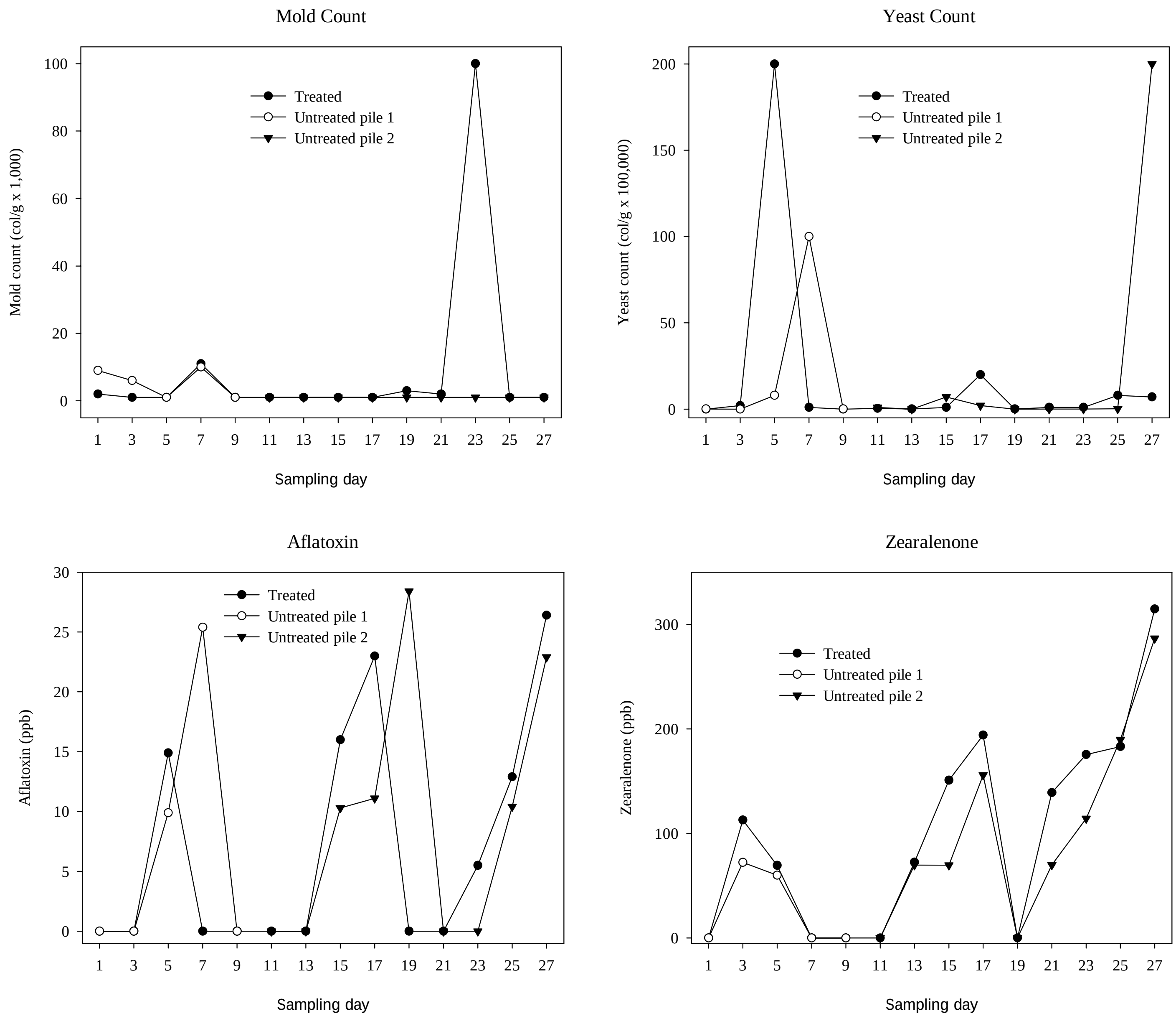


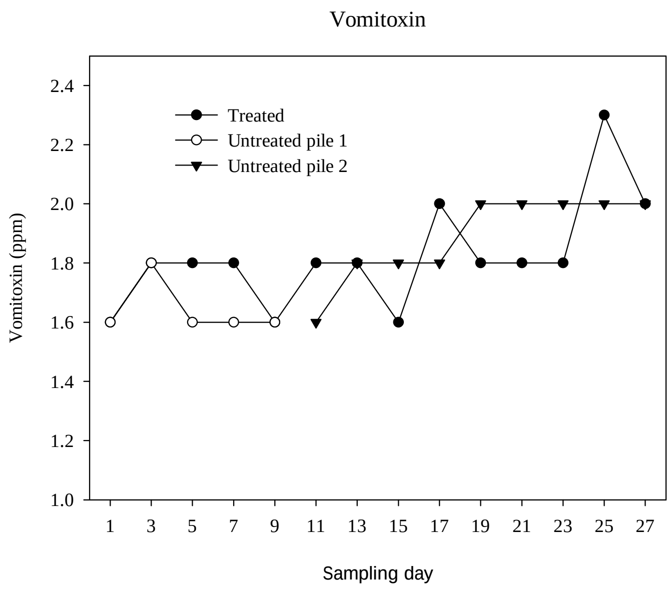
Propionic Acid Content (% of DM)

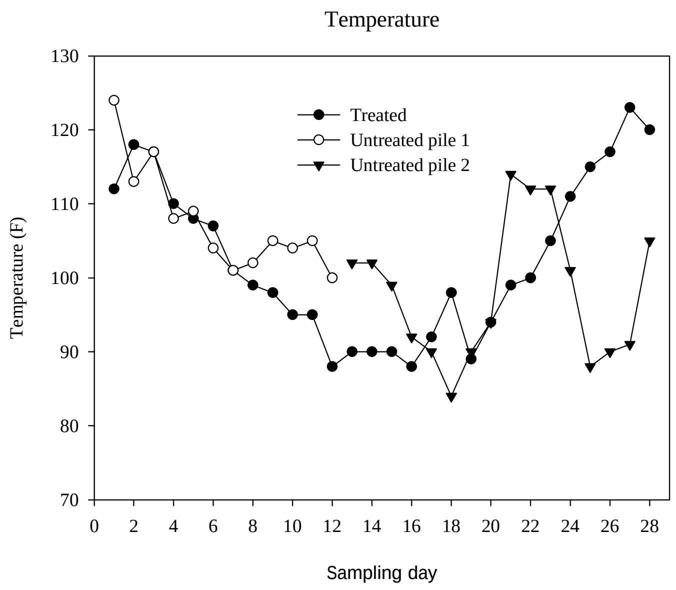


Total Acid Content (% of DM)




Mold Count
Treated
Untreated pile 1
Untreated pile 2
Mold count (col/g x 1,000)
Sampling day
Yeast Count
Treated
Untreated pile 1
Untreated pile 2
Yeast count (col/g x 100,000)
Sampling day
Aflatoxin
Treated
Untreated pile 1
Untreated pile 2
Aflatoxin (ppb)
Sampling day
Zearalenone
Treated
Untreated pile 1
Untreated pile 2
Zearalenone (ppb)
Sampling day


Vomitoxin
Treated
Untreated pile 1
Untreated pile 2
Vomitoxin (ppm)
Sampling day


Temperature
Treated
Untreated pile 1
Untreated pile 2
Temperature (F)
Sampling day