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Summary

Wet corn byproducts were mixed with straw and stored in 55 gallon barrels for 56 days to simulate bunker storage. The spoilage process caused a decrease in fat content and an increase in pH, NDF, ash, and CP. Covering with plastic or distillers solubles reduced the amount of spoilage and the change in nutrient composition.

Introduction

Mixing wet distillers grains plus solubles (WDGS) or distillers solubles (DS) with straw allows storage in bunkers (*2008 Nebraska Beef Cattle Report*, pp. 23-25; *2010 Nebraska Beef Cattle Report*, pp. 21-25). When the surface of WDGS is exposed to air it will spoil. As previous research shows, spoilage process will result in loss of DM at the surface of the bunker (*2010 Nebraska Beef Cattle Report*, pp. 21-25). To minimize the amount of spoilage to surfaces exposed to oxygen, several cover treatments may be applied.

Along with a loss of DM, nutrient composition of stored mixes may change during spoilage. In most cases, producers feed the spoiled material along with the unspoiled. The purpose of this experiment was to determine the nutritional composition of the spoiled feed fractions and how different covers affect these nutritional changes.

Procedure

Storage

To simulate bunker storage, 55 gallon barrels were packed with one of two mixes: 70% WDGS and 30% straw mixture or 60% DS and 40% straw (both on a DM basis). Barrels were filled to approximately the same weight (300 lb) and packed to similar heights. All barrels (except DS: straw open-outside) were stored inside the Animal Science building at the University of Nebraska–Lincoln in a temperature-controlled room. Table 1 describes the barrel covers that were assigned randomly to barrels with two replications per treatment.

Table 1. Cover treatments.

WDGS: Straw	
Open	Barrels were left uncovered.
Open + H_2O	Uncovered with water added at a rate of 0.6 in weekly to mimic average Nebraska precipitation.
Plastic	Six mil plastic covering the surface of the mixture, weighed down with sand, and the edges sealed with tape. This treatment would be comparable to plastic and tires in a bunker setting.
Salt	Salt was sprinkled over the surface of the mixture at a rate of 1 lb/ft^2.
Distillers solubles (DS)	DS were poured over the surface of the mixture to make a 3-inch layer (45 lb as-is).
DS + Salt	DS and salt added at rates previously discussed and mixed together before application.
DS + Salt + H_2O	DS and salt added at rates previously discussed and water added at 0.6 inch weekly.
DS: Straw	
Open, inside	Barrels left uncovered and stored inside.
Open, outside	Barrels left uncovered and stored outside at the University of Nebraska Feedlot near Mead, Neb., and exposed to any rainfall.

Opening Barrels

After 56 days of storage, each barrel was opened by carefully removing the solubles layer (if applied), the spoiled portion, and then the nonspoiled portion. When salt was used as a cover,

Figure 1. Picture of a portion of the spoiled material removed from an open barrel. Layers of moisture loss, mold, and decomposition can be seen.

Table 2. WDGS: Straw nutrient composition and losses.

		Open	Open + H_2O	Plastic	Salt	DS[4]	DS + Salt	DS + Salt + H_2O
DM %[1]	**SP[2]**	44.0	25.3	39.0	43.6	37.4	39.3	32.3
	N[3]	36.3	33.7	41.2	39.4	39.3	38.0	34.2
pH	**SP**	8.1	7.6	7.2	8.5	6.5	5.4	6.0
	N	4.1	4.5	3.9	4.0	3.9	4.1	4.0
Fat %	**SP**	4.9	6.0	7.2	4.1	10.0	7.4	9.5
	N	10.6	10.5	10.1	10.2	10.1	10.5	9.4
NDF %	**SP**	52.9	55.3	49.3	50.5	38.1	35.2	41.7
	N	42.2	43.0	45.4	48.3	44.3	40.9	43.7
Ash %	**SP**	12.0	14.2	12.0	19.1	13.9	20.0	17.7
	N	8.1	8.7	8.2	8.3	8.8	11.0	11.4
CP %	**SP**	28.7	25.9	29.3	24.0	29.9	25.6	26.1
	N	27.6	27.9	25.7	25.5	23.7	25.5	24.7
DM loss, %		3.4	3.4	0	.82	0.07	0	0
Spoilage, %		3.9	3.9	0.61	3.8	2.0	2.1	1.5

[1]140°F forced air oven DM%
[2]Spoiled material
[3]Nonspoiled material
[4]Distillers solubles

Table 3. DS: straw nutrient composition (DM) and losses.

		Open-Inside	Open-Outside
DM, %[1]	**SP[2]**	41.3	43.2
	N[3]	44.5	41.5
pH	**SP**	7.5	7.0
	N	4.0	4.1
Fat, %	**SP**	5.9	7.1
	N	13.2	13.0
NDF, %	**SP**	46.2	43.8
	N	35.1	36.5
Ash, %	**SP**	19.0	18.3
	N	12.1	11.8
CP, %	**SP**	23.2	22.3
	N	18.2	19.4
DM loss, %		2.7	1.8
Spoilage, %		4.9	3.9

[1]140°F forced air oven DM%
[2]Spoiled material
[3]Nonspoiled material

it was collected and analyzed as part of the spoiled layer. As in previous research, it was assumed that all of the spoilage occurred from the top down as it was exposed to the air. The spoilage was determined by appearance and texture as seen in Figure 1. As each layer was removed, representative samples were collected and used for analysis. Subsamples were dried in 140°F forced air oven for 48 hours to obtain DM. Additional samples were freeze-dried and ground through a Wiley Mill (1 mm screen) and analyzed for pH, fat, neutral detergent fiber (NDF), ash, and CP, and reported on a DM basis.

The nonspoiled material was assumed to be unchanged and, therefore, equivalent to the starting mix. Data were analyzed using the mixed procedures of SAS using barrel as the experimental unit.

Results

Interactions ($P < 0.01$) resulted between the cover treatment and spoilage layer for pH, fat, NDF, ash, and CP with the WDGS: Straw mixture and CP for the DS: Straw mixture (Tables 2 and 3). Overall, there was a decrease in fat and increases in pH, NDF, ash, and CP. The most important of these to consider is the loss of fat content. The greatest loss of fat resulted when salt was used as a cover or when barrels were left uncovered. Fat decreased from 10.2 to 4.1% DM and 10.6 to 4.9% DM, respectively. The microbes that are causing the spoilage utilize fat in the distillers products as an energy source. Therefore, the used fat is lost for the animals' use when it is time to feed. Using DS as a cover resulted in no change in fat content for the spoiled fraction. The other treatments were intermediate in terms of fat loss in the spoilage process.

The spoilage process also caused the pH of the mixture to increase from its initial pH of about 4.0 to a final pH of 8.5 with a salt cover, and 6.0 with the DS + Salt + H_20. The NDF content (% of DM) generally increased as spoilage occurred. The greatest change occurred in the open barrels with or without water added, with a 12.3 and 10.6 percentage unit increase in NDF, respectively. A 2.2% increase was the smallest change recorded with the salt covering, but it must be noted that the salt covering was not separated from the spoiled material. When separating the DS layer from the spoiled layer, not all of the DS could be removed; therefore, some was collected in the spoiled layer. This may be the reason that the spoiled portions of the barrels covered with DS resulted in a decreased NDF content.

The results for ash content of the mixtures showed the largest increase with the salt covering, but again the salt was included in the spoiled material. The CP content generally increased with each cover. This is due to the microbes utilizing the fat and soluble carbohydrates, thus increasing the ash and CP contents.

From previous research focusing on shrinkage and DM loss, covers like plastic and DS minimized the air contact and were found to be the best covers, resulting in the smallest amount of spoilage (Tables 2 and 3). The mixes left uncovered (open) resulted in the greatest amount of spoilage. This is closely associated with the difference in nutritional composition. The plastic and DS covers allowed for the least amount of air to reach the surface of the mix, and resulted in the least amount of spoilage.

In conclusion, the loss of fat and increase in ash and NDF reduce available energy in spoiled feed. The spoiled feed is not as nutrient dense as nonspoiled material.

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