Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 1 *Cattleman's Day (1993-2014)*

Article 382

2000

Effect of level of surface-spoiled silage on the nutritive value of corn silage-based rations

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Abstract

Twelve ruminally cannulated crossbred steers were used to determine the effects of level of surface-spoiled silages on dry matter (DM) intake and nutrient digestibilities of corn silage-based rations. Irrigated corn was harvested at the 80% milkline stage of maturity and ensiled in 3-ft-deep, pilot-scale, bunker silos and a 9-ft-diameter AgBag®. After 90 days, the bunkers were sealed with a single sheet of polyethylene, and this silage was designated "spoiled"?. The silage in the AgBag was designated "normal"?. The four rations contained 90% silage and 10% supplement (DM basis). The silages in the rations were: A) 100% normal; B) 75% normal: 25% spoiled; C) 50% normal: 50% spoiled; and D) 25% normal: 75% spoiled. Dry matter intake decreased in a linear manner as the proportion of spoiled silage increased from 0 to 75%. Steers consuming the normal silage ration had higher DM, OM, CP, NDF, and ADF digestibilities than those fed the three rations that contained spoiled silage. The addition of spoiled silage also had negative associative effects on nutrient digestibilities, and the integrity of the forage mat in the rumen was destroyed partially by even the lowest level of surface spoilage.

Keywords

Cattlemen's Day, 2000; Kansas Agricultural Experiment Station contribution; no. 00-287-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 850; Beef; Corn silage; Surface spoilage; Nutritive value

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EFFECT OF LEVEL OF SURFACE-SPOILED SILAGE ON THE NUTRITIVE VALUE OF CORN SILAGE-BASED RATIONS

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Summary

Twelve ruminally cannulated crossbred steers were used to determine the effects of level of surface-spoiled silages on dry matter (DM) intake and nutrient digestibilities of corn silage-based rations. Irrigated corn was harvested at the 80% milkline stage of maturity and ensiled in 3-ft-deep, pilot-scale, bunker silos and a 9-ft-diameter AgBag®. After 90 days, the bunkers were sealed with a single sheet of polyethylene, and this silage was designated "spoiled". The silage in the AgBag was designated "normal". The four rations contained 90% silage and 10% supplement (DM basis). The silages in the rations were: A) 100% normal; B) 75% normal: 25% spoiled; C) 50% normal: 50% spoiled; and D) 25% normal: 75% spoiled. Dry matter intake decreased in a linear manner as the proportion of spoiled silage increased from 0 to 75%. Steers consuming the normal silage ration had higher DM, OM, CP, NDF, and ADF digestibilities than those fed the three rations that contained spoiled silage. The addition of spoiled silage also had negative associative effects on nutrient digestibilities, and the integrity of the forage mat in the rumen was destroyed partially by even the lowest level of surface spoilage.

(Key Words: Corn Silage, Surface Spoilage, Nutritive Value.)

Introduction

Whole-plant corn silage is a major source of energy in most rations for growing beef cattle and lactating dairy cattle in North America. Two silage management practices, which are in the control of cattle producers but often poorly implemented or overlooked entirely, are effective sealing of the exposed surface in bunker, trench, or drive-over pile silos and discarding spoiled silage. The objective of this study was to determine the effect of including three levels of "surface-spoiled silage" on the nutritive value of whole-plant corn silage-based rations.

Experimental Procedures

Twelve crossbred steers fitted with ruminal cannulas were used in the study. A single source of irrigated corn (Pioneer 3394) was harvested at the 80% milkline stage of maturity and chopped to a 10 mm particle length. Three pilot-scale bunker silos, which were approximately 3 feet deep, and a 30-ft section of a 9-ft-diameter AgBag® were filled with alternating loads of chopped forage. After 90 days, the bunkers were sealed with single sheets of 0.6 mil polyethylene, and these silages were designated "spoiled". The silage in the AgBag was designated as "normal". The four experimental rations contained 90% silage and 10% supplement (dry basis). The silages in the rations were: A) 100% normal, B) 75% normal:25% spoiled; C) 50% normal:50% spoiled, and D) 25% normal:75% spoiled. The rations were fed once daily at 7:00 a.m., and the amount fed was adjusted so that 5 to 10% of the as-fed ration was in the feed bunk at the end of each 24-h period.

Results and Discussion

The pHs and chemical compositions of the whole-plant corn silages fed are shown in Table 1. The composition of the spoiled silage is reported for each of the two distinct visual layers, designated as the original top 18 inches and bottom 18 inches and for a

composite of the two layers after they were mixed. The mixture represents the spoiled silage as it was actually fed in rations B, C, and D. With ash content as the internal marker, the estimated proportions of the original top 18-inch and bottom 18-inch spoilage layers in the spoiled composite silage were 23.8 and 76.2%, respectively. The normal corn silage had higher DM and OM contents and slightly lower starch and CP contents than the spoiled composite silage. The normal corn silage also had low NDF and ADF percentages, which reflect the high proportion of grain in the ensiled crop. The high ash and fiber contents of the spoiled composite silage are associated with poor preservation efficiency and very high OM losses during the aerobic, fermentation, and storage phases.

The original top 18-inch layer was visually quite typical of an unsealed layer of silage that has undergone several months of exposure to air and rainfall. It had a foul odor; was black in color; and had a slimy, "mud-like" texture. Its extensive deterioration during the 90-day storage also was reflected in very high values for pH, ash, and fiber. This slimy layer comprised 5.4, 10.7, and 16.0 % of the DM in rations B, C, and D, respectively. The original bottom 18-inch layer had an aroma and appearance usually associated with wet, high-acid, corn silage – a bright yellow to orange color, a low pH, and a very strong acetic acid smell.

The original depth of the packed, whole-plant corn in the bunker silos was about 36 inches; however, the final depth of the spoiled silage was only about 22 inches, with about 7 in. in the top layer and 15 in. in the bottom (Figure 1). This settling of the ensiled crop that occurred during the 90 days when the bunker silos remained unsealed – approximately 14 inches – is typical of settling depths observed in unsealed bunker, trench, or drive-over pile silages.

The addition of spoiled silage decreased CP digestibility in a linear manner, and surface spoilage had large negative associative effects on DM intake and DM, OM, NDF, and ADF digestibilities (Table 2). When the ruminal contents were evacuated, the spoiled silage had partially or totally destroyed the integrity of the forage mat in the rumen. These results clearly indicate that feeding surface-spoiled silage has greater negative impacts on the nutritive value of corn silage-based rations than were expected.

Table 1. pH and Chemical Compositions of the Whole-Plant Corn Silages Fed in the Metabolism Trial

Silage	pH	DM	OM	Starch	CP	NDF	ADF
		% ---------- % of the DM - - - - - - - - - -					
Normal	3.90	38.0	94.7	22.3	6.9	42.6	23.4
Spoiled top layer, composite of the original top 36 inches	4.79	26.4	90.9	24.3	9.9	48.9	31.0
Spoilage Layers							
Original top 0-18 inches (Slimy layer)	8.22	19.1	80.0	2.7	17.7	57.6	48.3
Original top 18-36 inches (acidic layer)	3.67	27.6	94.3	26.1	6.7	48.5	25.5

Table 2. Effect of the Level of Spoiled Silage on Nutrient Digestibilities for Steers Fed the Four Whole-Plant Corn Rations

	Ration			
Item % Spoiled silage (% Slimy layer)	0 (0)	25 (5.4)	50 (10.7)	75 (16.0)
DM intake, lb/day	17.5[a]	16.2[b]	15.3[b,c]	14.7[c]
DM intake, % of body weight	2.36[a]	2.22[a,b]	2.10[b,c]	2.04[c]
		Digestibility, %		
DM	74.4[a]	68.9[b]	67.2[b]	66.0[b]
OM	75.6[a]	70.6[b]	69.0[b]	67.8[b]
Starch	94.6	95.0	93.3	95.3
CP	74.6[a]	70.5[b]	68.0[b,c]	62.8[c]
NDF	63.2[x]	56.0[x,y]	52.5[y]	52.8[y]
ADF	56.1[a]	46.2[b]	41.3[b]	40.5[b]

[a,b,c]Means within a row with no common superscript differ (P<.05).

[x,y]Means within a row with no common superscript differ (P<.10).

Figure 1. Surface-Spoiled Silage with a Slimy Layer of 7 Inches (Top) and an Acidic Layer of 15 Inches (Bottom).