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## Abstract

Twelve ruminally cannulated crossbred steers were used to determine the effect of level of surface spoilage in corn silage-based rations on dry matter (DM) intake and nutrient digestibilities. Irrigated corn was harvested at the 80% milkline stage of maturity and ensiled in pilot-scale bunker silos, which were 3 ft in depth, 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), and the proportions of silage 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, organic manner, crude protein, neutral detergent fiber, and acid detergent fiber digestibilities than those fed the three rations that contained spoiled silage. The addition of surface-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 spoiled silage.; Dairy Day, 2000, Kansas State University, Manhattan, KS, 2000;



## Keywords

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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 effect of level of surface spoilage in corn silage-based rations on dry matter (DM) intake and nutrient digestibilities. Irrigated corn was harvested at the 80% milkline stage of maturity and ensiled in pilot-scale bunker silos, which were 3 ft in depth, 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), and the proportions of silage 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, organic manner, crude protein, neutral detergent fiber, and acid detergent fiber digestibilities than those fed the three rations that contained spoiled silage. The addition of surface-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 spoiled silage.

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

## Introduction

A silage management practice sometimes overlooked by dairy producers is the discarding of spoiled silage. Because sealing bunker, trench, and drive-over pile silos with a polyethylene sheet is not 100% effective, aerobic spoilage occurs to some degree in virtually all sealed silos. 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.

## 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 ft in depth, 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 (on a DM basis), and the proportions of silage 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 0700, and the amount fed was adjusted so that approximately 10% of the as-fed ration was in the feed bunk at the end of each 24-hr period.

## Results and Discussion

The pH and chemical composition 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, which represents the spoiled silage as it was actually fed in rations with 25%, 50%, or 75% spoilage. 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, and its extensive deterioration during the 90-day storage also was reflected in very high pH, ash, and fiber values. The "slime" layer comprised 5.4, 10.7, and 16.0 % of the DM in rations with 25%, 50%, or 75% spoilage, 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 and 15 inches in the top and bottom depths, respectively (Figure 1). This settling of the ensiled crop that occurred during the 90 days 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 surface-spoiled silage had large negative associative effects on feed intake and DM, OM, NDF, and ADF digestibilities (Table 2), and the first increment of spoilage had the greatest negative impact. Examination of ruminal contents showed that the spoiled silage also had partially or totally destroyed the integrity of the "forage mat" in the rumen. The results clearly showed that surface spoilage reduced the nutritive value of corn silage-based rations more than was expected.

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

**Table 1. pH and Chemical Composition 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 (slime 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 |

DM = dry matter, OM = organic matter, CP = crude protein, NDF = neutral detergent fiber, ADF = acid detergent fiber.

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

| | Ration | | | |
|---|---|---|---|---|
| % Spoiled silage | 0 | 25 | 50 | 75 |
| Item (% Slimy layer) | (0) | (5.4) | (10.7) | (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[b] | 2.10[b,c] | 2.04[c] |
| | ---------- Digestibility, % ---------- | | | |
| Dry matter | 74.4[a] | 68.9[b] | 67.2[b] | 66.0[b] |
| Organic matter | 75.6[a] | 70.6[b] | 69.0[b] | 67.8[b] |
| Crude protein | 74.6[a] | 70.5[b] | 68.0[b,c] | 62.8[c] |
| Neutral detergent fiber | 63.2[x] | 56.0[y] | 52.5[y] | 52.3[y] |
| Acid detergent fiber | 56.1[a] | 46.2[b] | 41.3[c] | 40.5[c] |

[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).