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The XIX International Grassland Congress took place in São Pedro, São Paulo, Brazil from February 11 through February 21, 2001.
Proceedings published by Fundacao de Estudos Agrarios Luiz de Queiroz

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ID#09-04

EFFECT OF LEVEL OF SURFACE SPOILAGE ON THE NUTRITIVE VALUE OF MAIZE SILAGE DIETS

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Abstract

This study determined the effect of surface spoilage in the diet on feed intake and nutrient digestibilities using growing steers fed whole-plant maize silage-based diets. A bunker silo, 0.9 m in depth, and a 2.7 m diameter AgBag were filled with alternating loads of chopped forage. After 90 days, the bunker was sealed with a sheet of polyethylene, and this silage was designated “spoiled”. The silage in the AgBag was designated “normal”. The four diets contained 90% silage and 10% supplement (dry matter basis), and the proportions of silage in the diets were A) 100% normal, B) 75% normal: 25% spoiled; C) 50% normal: 50% spoiled; and D) 25% normal: 75% spoiled. Feed intake decreased linearly as the proportion of spoiled silage increased from 0 to 75%. Steers consuming the normal silage diet had the highest nutrient digestibilities. Spoiled silage also had negative associative effects on nutrient digestibilities, and the integrity of the forage mat in the rumen was partially destroyed.

Keywords: silage, top spoilage, nutritive value

Introduction

Whole-plant maize silage is a major source of energy in most lactating dairy cattle and growing beef cattle diets in North America. An important silage management practice, which is in the control of cattle producers and that is often poorly implemented or overlooked entirely, is the discarding spoiled silage. Plastic sheeting was first used to protect the surface of small "clamp" silos from air and rain or snow in Europe in the 1950s (Shukking, 1976). By the 1960s, sheets were usually made from polyethylene and ultra-violet stabilizers to prevent the material from disintegrating in sunlight. The great benefits of plastic sheeting were that air movement in and out of the silo could be reduced and surface waste could be minimized as a result. But sealing with a polyethylene sheet weighted with old tires is not 100 percent effective, and aerobic spoilage occurs to some degree in virtually all sealed silos (Bolsen et al., 1993). 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 maize silage-based diets.

Material and Methods

Twelve crossbred steers, fitted with ruminal cannulas, were used in the study. A single source of irrigated maize (Pioneer 3394) was harvested at the 80% milkline stage of maturity and chopped to a 10 mm particle length. Three pilot-scale bunker silos, 0.9 m deep, and a 6.0 m section of a 2.7 m 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 diets contained 90% silage and 10% supplement (on a DM basis), and the proportions of silage in the diets were: A) 100% normal, B) 75% normal:25% spoiled; C) 50% normal:50% spoiled, and D) 25% normal:75% spoiled. The diets were fed once daily at 0700, and the amount fed was adjusted so that approximately 10% of the as-fed diet 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 maize silages fed in the metabolism trial 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 45 cm and bottom 45 cm, and for a composite of the two layers after they were mixed, which represents the spoiled silage as it was actually fed in rations B, C, and D. With ash content as the internal marker, the estimated proportion of the original top 45 cm and bottom 45 cm spoilage layers in the spoiled composite silage was 23.8 and 76.2%, respectively. The normal maize silage had higher DM and OM contents and slightly lower starch and CP contents than the spoiled composite silage. The normal maize 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 composite silage are associated with poor preservation efficiency and large OM losses during the aerobic, fermentation, and storage phases.

The original top 45 cm 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 was also reflected in very high pH, ash, and fiber values. The original bottom 45 cm layer had an aroma and appearance usually associated with wet, high-acid maize silage, e.g., a bright yellow to orange color, a low pH, and a very strong acetic acid smell.

The original depth of the packed, whole-plant maize in the bunker silos was about 90cm; however, the final depth of the spoiled silage was only about 55 cm, with about 20 and 35 cm in the top and bottom depths, respectively. This settling of the ensiled crop that occurred during the 90 days the bunker silo was unsealed, e.g., approximately 35 cm, is typical of settling depths observed in unsealed bunker, trench, or drive-over pile silos.

The addition of 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 The spoiled silage also partially or totally destroyed the integrity of the "forage mat" in the rumen. The results clearly indicated that feeding surface spoilage had greater negative impacts on the nutritive value of maize silage-based diets than were expected.

Future research should focus on the effect of feeding this surface spoilage on livestock performance and on the potential hazards on the health of livestock.

References

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Table 1 - pH and chemical composition of the whole-plant maize 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 90 cm	4.79	26.4	90.9	24.3	9.9	48.9	31.0
Spoilage layers							
Original top 0 – 45 cm (slime layer)	8.22	19.1	80.0	2.7	17.7	57.6	48.3
Original top 45 – 90 cm (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 maize silage diets

	Diet			
Item	A	B	C	D
DM intake, kg/day	7.95[a]	7.35[b]	6.95[b,c]	6.66[c]
DM intake, % of body weight	2.36[a]	2.22[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	63.0[x]	56.0[y]	52.5[y]	52.3[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).