Acid Preservation of Alfalfa Hay for Dairy Cows

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Story in Brief

Since high quality forage is essential in a dairy ration, it is improtant to study new methods of preserving hay. In this trial, the effect of a commercial organic acid preservative on nutirent content and feeding value of alfalfa hay was evaluated.

Alfalfa hay from a common field was baled at about 20 percent moisture for a control, and at about 28 percent moisture with addition of 0.1 percent organic acid based hay preservative. In a feeding trial with lactating cows, the control hay supported higher milk production than the hay to which the preservative had been added. Milk fat and non-fat solids content was similar for both groups. Digestibility of dry matter, organic matter and crude protein was slightly higher in rations containing the control hay.

The commercial hay preservative used for this trial was not entirely effective in preventing molding in hay baled at high moisture content. It apparently was not effective in maintaining quality equal to that of hay baled at lower moisture content without a preservative.

Introduction

Alfalfa hay plays a major role in many dairy feeding programs in Oklahoma. Therefore, harvesting of hay with sufficiently high quality to sustain a high level of milk production is important.

A relatively new approach to hay harvesting involves adding a small amount of organic acid to the hay at the time of baling. This permits baling at higher moisture content than would otherwise be recommended and in some instances would reduce nutrient loss due to shattering of leaves in handling. Information is very limited regarding the effect of adding organic acids on the available nutrient content of stored hay, and on its comparative feeding value for lactating cows.

Research workers have found hay quality inversely related to moisture content at baling and to temperature attained during storage. Increase in microbial activity and heating in storage result in increased losses of dry matter, sugars, fats and hemicellulose. High temperature during hay curing also favors a chemical reaction in which sugars and amino acids react to form indigestible compounds. The principal dark-colored nitrogenous compound

resulting from this reaction accumulates in the lignin fraction of the cell wall material.

The addition of 2.1 percent acetic:propionic (57:40) acids or 1.1 percent ammonium isobutyrate to a grass-clover mixture containing 35 to 50 percent moisture was found to be reasonably effective in preventing heating and molding in loose stacks. Propionic acid at 1.5 percent was not effective in inhibiting mold under the same conditions. Other workers have observed a higher percent of total nitrogen in the relatively indigestible fraction (ADF-N) in alfalfa hay baled at 25 to 37 percent moisture with the addition of 0.05 percent propionic acid based mold inhibitor than in hay baled at 16 to 19 percent moisture.

Addition of either anhydrous ammonia or propionic acid at a rate of one percent to alfalfa hay baled at 32 percent moisture has been found effective in preventing heating in storage and development of mold. Smaller amounts of propionic acid were not as beneficial in preventing heating of the hay or a decrease in *in vitro* dry matter digestibility. One researcher found the quality and digestibility of alfalfa hay baled at about 29 or 26 percent moisture, with the addition of 0.1 percent commercial mold inhibitor containing 20 percent propionic acid, equal to that of hay baled at 11 or 16 percent moisture.

No reliable data have been reported on the merits of adding organic acid preservatives to hay at baling for feeding to dairy cows.

The purpose of this trial was to evaluate the effect of adding an organic acid product to hay at baling on its nutrient content and feeding value for lactating cows.

Materials and Methods

Hay from a common field was baled under two different conditions as follows: a) control, baled at an average moisture content of about 20 percent, and b) acid treated hay, baled at about 28 percent moisture with additon of 0.1 percent commercial acid product. This product, containing 20 percent propionic acid, was applied with a CO_2 pressure spray unit as the hay moved into the "throat" of the baler.

Twenty lactating cows (14 Holsteins and six Ayrshires) were used in a switchback feeding trial with two treatments. Comparison periods were six weeks in duration, with data from the last five weeks used for analysis, and the first week of each period allowed for change-over from one hay to another. Cows started the first comparison period seven to ten weeks after calving.

The experimental rations consisted of a concentrate mixture and alfalfa hay (50:50 ratio) fed in sufficient quantity to meet NRC requirements based on size, age, milk production, and fat percentage. Allowances were reduced by five percent at the start of the second and third periods to minimize weight changes.

Milk production was recorded twice daily with samples from four consecutive milkings each week composited for analysis of total solids and fat percentage. Body weights were recorded on three consecutive days at the beginning of the trial and during the last week of each comparison period. Digestibility of ration components was determined during the fifth week of each period by using chromic oxide as an indicator.

Results and Discussion

The commercial acid product was not completely effective in controlling mold growth in the hay baled at an average moisture content of about 28 percent. The control hay was judged to be slightly higher in quality on the basis of chemical composition after storage (Table 1). In the months after harvest, protein content of the control hay tended to be slightly higher and acid detergent fiber lower than in the acid-treated hay. Around 12 percent of the protein was present in lignified nitrogen form, which is a measure of the amount of protein expected to be relatively indigestible. The amount of protein in this form in the two hays did not differ greatly, indicating little or no difference in heat damage.

Intakes of grain and hay were similar, in keeping with the plan for a 50:50 concentrate to hay ration (Table 2). The control hay supported higher milk production than the other hay. Milk fat and non-fat solids percentages in the two groups were similar. Weight changes were minimal in both treatment groups.

There was very little difference between groups in the digestibility of ration components (Table 3). Digestibility values for the total ration were lower than desired for rations fed to lactating dairy cows. The alfalfa hay available for the experiment was in a more advanced stage of maturity than desired. Nevertheless, digestibility values for the rations were in agreement with the production data, indicating that the control hay was of higher quality than that baled at higher moisture content with the preservative added.

Table 1. Composition of hay

Item	Month			
	June (windrow)	July	August	September
	(percent, dry basis)			
Crude protein				
Control	16.4	16.4	17.0	15.4
Treated	16.9	15.8	15.0	16.6
Acid Detergent fiber				
Control	38.0	38.4	36.0	42.5
Treated	36.8	44.0	44.4	42.6

Table 2. Responses of cows to experimental rations

Item	Control	Acid-treated
Feed DM intake		
Grain, lb/day	16.3	16.3
Alfalfa hay, lb/day	16.3	16.5
Milk production		
Yield, lb/day	37.0	35.9
Fat test, percent	3.67	3.69
Non-fat solids, percent	8.58	8.54
SCM, lb/day	34.3	33.4
Weight change, lb/6 wk	6.3	10.9

Table 3. Digestibility of ration components

Component	Hay group	
	Control	Acid-treated
	(percent)	
Dry matter	56.4	55.6
Protein	64.2	63.7
Organic matter	60.1	59.2
Acid detergent fiber	21.9	25.2

The commercial acid product used in this trial was not effective in preserving hay quality. The ultimate goal in using hay preservatives would be to harvest hay at high moisture content and maintain quality equal to that obtained in hay baled under ideal conditions. No improvement in feeding value due solely to addition of a preservative should be expected in such a comparison. The economic advantage that could result from using an effective hay preservative would be in preventing weather damage by earlier baling in some cases, or in preventing the leaf loss occurring when hay is too dry at baling.

In additional work now in progress, it has been demonstrated that another hay preservative, different from the one used in the trial described in this report, is effective in preserving hay baled at high moisture content.