

EFFECTS OF A NEW CELLULASE DERIVED FROM *ACREMONIUM* ON SILAGE FERMENTATION

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ABSTRACT

Alfalfa (*Medicago sativa* L) and timothy (*Phleum pratense* L) were ensiled in laboratory silos to evaluate the effect of cellulase derived from *Acremonium* (0, 0.005, 0.01, and 0.02% to alfalfa and 0, 0.006, 0.012, and 0.024% to timothy) on silage fermentation. In alfalfa, the addition of cellulase inhibited the production of butyric acid, and as the percentage of cellulase increased, the concentration of ammonia decreased and the content of lactic acid increased.

The dry matter recovery significantly decreased with the addition of cellulase. The quality of timothy silage also increased due to the absence of butyric acid. The quality of silage and dry matter recovery were the highest with 0.006% and 0.012% additions of cellulase, but low with 0.024% addition of the cellulase.

KEYWORDS

Silage, cellulase, NDF, alfalfa, timothy

INTRODUCTION

Cellulase may be used as a silage additive to stimulate silage fermentation by producing lactic acid bacteria with adequate amounts of water-soluble carbohydrate (WSC) resulting from the hydrolysis of cellulose (McDonald *et al.*, 1991). The addition of cellulase derived from *Trichoderma viride* to forage at the time of ensiling has improved silage fermentation in several previous studies (McDonald *et al.*, 1991, No *et al.*, 1985). The objective of this study was to evaluate the effects of the addition of new cellulase derived from *Acremonium* on silage fermentations of alfalfa and timothy.

MATERIALS AND METHODS

Alfalfa (cv. Euver, 21.3% DM, 16.5% CP, 8.0% WSC, and 49.4% NDF) and timothy (cv. Hokusen, 21.5% DM, 8.4% CP, 8.4% WSC, and 68.0% NDF) were ensiled in laboratory silos. Four levels of the cellulase (Meiji Seika Ltd.; 0, 0.005, 0.01, and 0.02% to alfalfa and 0, 0.006, 0.012, and 0.024% to timothy) were added to each forage. The silos were opened after 50 d and the fermentation characteristics were examined.

RESULTS AND DISCUSSION

The characteristics and NDF contents of the silages are shown in Table 1. In alfalfa silage, pH and NH₃-N levels were decreased as the cellulase levels were increased. When no cellulase was added, butyric acid contents were high, but when the cellulase was added, butyric acid was not detected.

When none or up to 0.012% of cellulase was added to the timothy silages, pH and acetic acid contents were decreased; lactic acid contents were increased; and the fermentation qualities were improved as the level of the cellulase addition was increased. When 0.024% of the cellulase was added, the silage quality became lower than the silage with 0.012% of the cellulase. Dry matter recoveries of alfalfa silages significantly decreased, but there were no significant differences among timothy silages. No *et al.* (1985) reported that as adding levels of cellulase were increased, dry matter recoveries decreased as well. This agrees with the results reported by Ataku *et al.* (1993). In this study, the results may suggest that lactic acid fermentation is improved with addition of the cellulase which degrades NDF i.e. more sugars become available for the fermentation. It may be concluded that adequate level of the cellulase addition is from 0.005 to 0.01%, and excessive addition of the cellulase causes negative results in the fermentation.

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Table 1Fermentation characteristics and NDF contents of the silages at 50 d post-ensiling¹

	Cellulase Addition (%)	pH	Acids(% FM ²)				NH ³ -N (%N)	DM Recovery (%)	NDF (%DM)
			Lactic	Acetic	Butyric	Total ³			
Alfalfa	0	4.79 ^{Cc}	0.96 ^{Aa}	0.28 ^A	0.47 ^B	1.37 ^{Aa}	13.2 ^{Bc}	93.2 ^B	50.6 ^b
	0.005	4.46 ^{BCb}	1.01 ^{Aa}	0.84 ^B	0 ^A	1.95 ^{ABb}	10.5A ^b	86.3 ^A	49.4 ^b
	0.010	4.18 ^{ABa}	1.66 ^{ABb}	0.91 ^B	0 ^A	2.63 ^{BCb}	10.2 ^{Ab}	84.7 ^A	48.6 ^{ab}
	0.020	4.03 ^{Aa}	1.94 ^{Bb}	0.84 ^B	0 ^A	2.84 ^{Cb}	8.8 ^{Aa}	87.5 ^A	46.6 ^a
	SE ⁴	0.05	0.084	0.053	0.042	0.076	0.27	0.49	0.50
Timothy	0	5.14 ^{Bc}	0.32 ^A	0.37 ^B	0.69 ^B	1.92 ^{Aa}	25.2 ^{Bc}	83.0	68.0 ^A
	0.006	3.84 ^{Ab}	1.35 ^B	0.15 ^A	0 ^A	1.52 ^{Aa}	8.1 ^{Ab}	86.7	61.2 ^B
	0.012	3.49 ^{Aa}	2.51 ^C	0.19 ^A	0 ^A	2.74 ^{Bb}	5.5 ^{Aa}	87.0	59.1 ^B
	0.024	3.91 ^{Ab}	1.07 ^B	0.88 ^C	0 ^A	2.00 ^{ABa}	5.4 ^{Aa}	83.3	58.5 ^B
	SE ⁴	0.048	0.079	0.010	0	0.086	0.43	0.86	0.50

¹ Each value is the mean of two silos.² Fresh matter.³ Lactic acid + acetic acid + propionic acid + butyric acid + valeric acid + caproic acid.⁴ Standard error.^{A,B,C} Different superscripts within a same forage and row significantly differ (P < 0.01).^{a,b,c} Different superscripts within a same forage and row significantly differ (P < 0.05).