COMPARATIVE CHARACTERISTICS DURING WILTING FOR FORAGE HARVESTED BY MACERATION VS. A CONVENTIONAL ROLLER-CONDITIONER

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ABSTRACT

Two studies were conducted to monitor forage nutrient and microbial changes during wilting of alfalfa (*Medicago sativa* L.) forage in response to varying degrees of maceration at harvest. Early bloom alfalfa forage was harvested with either a roller conditioner (Control) or a macerator, with four degrees of maceration (Light, Light plus, Moderate and Severe) imposed. Macerated forage reached an 80% dry matter 10-27 hours sooner than roller-conditioned forage, the most rapid drying rates being associated with the more severely macerated treatments. Total bacteria and lactic acid bacteria populations tended ($P < 0.07$ and $P < 0.08$, respectively) to increase with maceration. Macerated forage, when exposed to precipitation, had lower ($P < 0.05$) crude protein and higher ($P < 0.05$) fiber concentration than roller-conditioned forage. Macerated forage, exposed to 2 cm precipitation during wilting without precipitation reached 80% DM sooner than conventionally cut alfalfa exposed to no precipitation.

KEYWORDS

Alfalfa, maceration, precipitation, drying time, bacteria, nutrient profile

INTRODUCTION

Conventional methods of forage harvest with a cutting equipment utilising rollers or crimpers may require 2-8 days of field drying to reach an 80% DM under typical prairie drying conditions. A long drying period will result in quality loss due to leaching, plant respiration or undesirable microbial growth. Longitudinal splitting and crushing of the plant stem by running cut plant material through a series of serrated steel rollers rotating at differential speeds can reduce the drying time required for alfalfa forage (Shinners et al. 1987). Savoie et al. (1992) revealed a 111% faster drying rate when forage was harvested with a mower macerator relative to that with a mower conditioner in Eastern Canada.

These studies were conducted to monitor the effect of degree of maceration at the time of harvest on microbial population and nutrient profile during wilting and to estimate probable nutrient losses due to precipitation for forage exposed to varying degrees of maceration at cutting.

MATERIALS AND METHODS

A 2 ha field having a relatively uniform stand of vegetative, first cut alfalfa, *Medicago sativa* L., was divided into two blocks. Within each block, five 100 m length swaths of alfalfa were cut, into five swaths, each swath assigned to one of 5 harvest methods. The 5 harvest methods included a John Deere mower-conditioner (**mower-conditioner**); and 4 degrees of maceration using a pull type macerator prototype built by the Prairie Agricultural Machinery Institute in Portage la Prairie, MB. The four degrees of maceration imposed included: **light** - using a 1-cm roller spacing and 750/1000 rpm roller speed; **light-plus** - using a 0.75-cm roller spacing and 750/1000 rpm roller speed; **moderate** - using a 0.75-cm roller spacing and 750/1500 rpm roller speed; and severe - for which rollers were set as close together as possible and 750/1500 rpm roller speed.

One-quarter each swath was exposed to one of 2 precipitation treatments. Two cm water were hand sprinkled on the swath at either 3 h (**P-3h**) and 24 h (**P-24h**) after cutting, respectively. The remainder of the swath was not exposed (**0-P**) to precipitation for the duration of the wilting trial. Swaths were sampled 3 times daily for the duration of the wilting trial. At each sampling time, 3 samples per swath were collect for 0-P, and 1 sample per swath was collected for each of P-3h and P-24h from the time of exposure to precipitation to the time forage material achieved 80% DM. Samples taken from 0-P were collected aseptically, with one portion of each sample being submitted to the lab immediately for microbial assessment, and the remainder being placed into storage (-20 °C) for determination of dry matter, crude protein, soluble nitrogen, neutral detergent fiber and glucosamine, used as an indicator of degree of fungal growth on the cut plant material. Samples collected from P-3h and P-24h were stored (-20 °C) until analysis for the same

A randomized complete block design, using general linear (GLM) model procedures of the Statistical Analysis System (SAS) was used to compare harvest methods under condition with no precipitation. A factorial design, with 3 harvest methods and 3 precipitation treatments was used to determine potential losses for macerated vs conventionally harvested forage that is exposed to precipitation.

RESULTS AND DISCUSSIONS

Forage moisture at time of cutting ranged from 72.3% to 75.2%. Harvest treatments resulting in the most severe maceration of alfalfa, Severe, Moderate and Light-Plus, achieved 80% DM by 9 h; forage subjected to Light maceration required 18 h to achieve 80% DM; and roller conditioned forage required more than 51 h. These results are in accordance previous observations of Shinners et al. (1987), and Savoie et al. (1992) that macerated alfalfa forage dried 2-3 time faster than that of conventionally harvested forage.

Lactic acid and total bacteria populations tended to be greater ($P < 0.08$ and $P < 0.07$, respectively) with maceration. Elevated lactic acid bacteria can impact the fermentation at ensiling, and may also influence microbial succession during hay storage. Under ideal drying conditions, forage quality was not reduced when subjected to maceration as opposed to roller conditioning (Table 1).

Application of 2 cm water, to simulate precipitation, at either 3 h or 24 h post cutting to macerated forage still resulted in more rapid water loss than was observed for roller conditioned forage not subjected to precipitation (Table 2). Precipitation did not result in reduced forage quality for alfalfa forage subjected to a roller conditioner (Table 2). Quality of macerated forage subjected to precipitation shortly after cutting also was not adversely affected. Macerated forage, approaching dryness at the time that it is exposed to precipitation did result in a higher NDF concentration relative to forage not subjected to precipitation. Soluble nitrogen, soluble carbohydrate and glucosamine concentrations of macerated forage at the end of the wilting phase were not adversely affected by precipitation.

REFERENCES

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Table 1

Effect of degree of maceration on forage drying rate, microbial population and nutrient profile, n=6.

	Treatment				
		Degree of maceration			
	Roller conditioner	Light	Light plus	Moderate	Severe
Initial moisture, %	75.2	74.6	73.7	72.3	75.1
Time tož80% DM, h	51 +	18	9.8	9.0	9.0
Microbial profile, L_{10} g^{-1} DM					
Lactic acid bacteria	2.57 (0.21)	NA	3.49 (0.20)	3.83 (0.21)	3.60 (0.20)
Total bacteria	3.22 (0.10)	NA	3.71 (0.09)	3.76 (0.10)	3.65 (0.09)
Glucosamine, mg g^{-1} DM					
At cutting	1.20 (0.08)	1.36 (0.08)	1.34 (0.09)	1.63 (0.13)	1.41 (0.10)
At 80% DM	1.32 (0.15)	1.23 (0.14)	1.33 (0.15)	1.51 (0.30)	1.25 (0.19)
NDF, % DM					
At cutting	35.7 (1.32)	34.7 (1.32)	36.7 (1.47)	38.4 (1.97)	36.9 (1.60)
At 80% DM	34.5 (0.87)	35.1 (0.78)	34.9 (0.87)	36.7 (1.35)	38.1 (1.10)
CP, % DM					
At cutting	20.8 (0.35)	20.3 (0.35)	19.8 (0.43)	19.3(0.53)	19.4 (0.43)
At 80% DM	19.5 (0.55)	19.7 (0.49)	19.3 (0.55)	18.6 (0.86)	18.1 (0.70)
Soluble N, % total N					
At cutting	36.9 (1.87)	34.7 (1.87)	34.1 (2.80)	36.6 (2.80)	37.3 (2.28)
At 80% DM	35.6 (1.14)	33.9 (1.02)	32.4 (1.25)	33.9 (1.77)	33.9 (1.45)

NA - Microbial counts were not conducted on these samples.

Table 2

Effect of precipitation on drying rate and nutrient profile of forage harvested with (O-P), or without 2 cm precipitation at 3 h (P-3h) or 24 h (P-24h) after cutting[z].

	Treatment								
	Roller conditioner			Moderate maceration			Severe maceration		
	O-P	P-3h	P-24h	O-P	P-3h	P-24h	O-P	P-3h	P-24h
Time to 80% DM, h	51	52.5	54	9	16.5	49.5	9	25.5	30
NDF, % DM[a]	34.7 (1.56)	33.8 (2.21)	32.2 (2.21)	36.7 (2.21)	40.7 (2.21)	41.6 (2.21)	38.0 (1.87)	40.0 (2.21)	41.2 (2.21)
CP, % DM[a]	19.5 (0.36)	20.6 (0.52)	20.1 (0.52)	18.6 (0.52)	19.0 (0.52)	17.9 (0.52)	18.2 (0.44)	18.0 (0.52)	18.0 (0.52)
Soluble N, % total N	35.7 (0.89)	34.8 (1.25)	34.3 (1.25)	33.9 (1.25)	33.5 (1.25)	30.9 (1.25)	33.8 (1.07)	28.6 (2.22)	29.2 (1.25)
Soluble carbohydrate, mg/g DM[b]	124.1 (4.58)	117.2 (5.41)	110.2 (5.41)	134.0 (5.41)	123.3 (5.41)	125.3 (5.41)	122.1 (4.57)	124.7 (5.41)	125.5 (5.41)
Glucosamine, mg/g DM	1.36 (0.11)	1.35 (0.16)	1.26 (0.16)	1.37 (0.28)	1.45 (0.16)	1.87 (0.16)	1.28 (0.13)	1.24 (0.16)	1.24 (0.16)

[z] Lsmeans (standard error) n=6 for O-P and n=2 for P-3h and P-24h.
[a] Means for the roller conditioner treatment are significantly different from that of the macerated treatments, $P < 0.05$.
[b] Means for the roller conditioner and moderate maceration treatments are significantly different from that of the severe maceration treatment, $P < 0.05$.