Changes in Chemical Composition and Digestion Kinetics of Stockpiled Kura Clover in Late Fall

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Mehmet Akif Karsli, research assistant,
James R. Russell, professor of animal science,
Iowa State University
Kenneth Albrecht, professor of agronomy,
Robert A. Zemerchick, research assistant, and
Ed. J. Bures, research associate,
University of Wisconsin

Summary

Stockpiled kura clover samples harvested on three different winter dates were used to determine changes in chemical composition and N digestion kinetics. Kura clover was harvested from four different plots at 14 d intervals and analyzed for neutral detergent fiber (NDF), acid detergent fiber (ADF), crude protein (CP), acid detergent insoluble nitrogen (ADIN), and in vitro digestible dry matter (IVDMD), and in situ digestion kinetics of N. Crude protein concentrations decreased, but ADIN concentrations increased with later date of harvest. Digestible N pool-size and the rate of digestion was the lowest in third-harvest kura clover. Although the proportion of protein that is soluble or non-digestible increased, proportion of protein that is potentially digestible decreased with maturity.

Introduction

The use of low quality forages such as corn crop residues to feed beef cattle is more economical than hay feeding. However, low quality forages are usually inadequate in CP concentrations resulting in low dry matter intake, digestibility and weight gains. Protein supplementation of corn crop residues is necessary to improve dry matter intake, digestibility of the diet and weight gains. Legumes have been shown to be a good protein supplement for beef cattle. Although legume forage may be supplemented as hay, a more economical way to supplement animals grazing low quality forages is to integrate corn stalk grazing with grazing of a stockpiled legume species.

Kura clover has been shown to grow as cover crop when planted with corn and may provide adequate growth for grazing after corn harvest. Kura clover is a very persistent legume and can grow the following year without seeding. Similar to other legumes, kura clover could provide CP for beef cattle grazing corn crop residue if kura clover is incorporated into the system as a cover crop. However, there is limited information regarding the changes in nutritive value of kura clover caused by weathering in late fall and early winter.

The objective of this study was to determine the nutritive value of stockpiled kura clover in late fall.

Materials and Methods

Over three years, kura clover was established in 4 plots at the University of Wisconsin's Lancester Research Station. In spring 1997, one-third of the area in each of the plots was treated with glyphosphate and planted with corn using no tillage. After grain harvest, kura clover was sampled from amongst the corn crop residue and from the area adjacent to the corn plots at 14 day intervals starting on October 10, 1997. All samples were oven-dried and analyzed for dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent insoluble nitrogen (ADIN), and in vitro digestible dry matter (IVDMD). Another three samples were collected from same plot at each date to determine the N degradation kinetics.

To determine the kinetics of nitrogen degradation in the rumen, approximately 3 grams of each forage sample were placed in 10 x12 cm Dacron bags with a mean pore size of 50 μm. Duplicate bags of each forage sample attached to weighted rings were placed in the rumens of two fistulated steers grazing smooth bromegrass to incubate for 0 to 48 h. Bags were placed in the rumen at staggered times to allow all bags to be withdrawn simultaneously. Bags were washed in cold water and dried at 60°C for 48 h. Crude protein concentrations of incubated samples were analyzed by Kjeldahl analysis. The kinetic parameters associated with the disappearance of nitrogen that is potentially digestible, the rate of digestion, and discrete lag times for nitrogen digestion were determined by fitting recovery data to a model using nonlinear regression analysis.

Forage nitrogen was divided into three fractions as follows: 1) the soluble nitrogen fraction determines as nitrogen loss during the washing process, 2) the potentially digestible nitrogen fraction determined as the differences between initial nitrogen content after washing and the amounts of nitrogen recovered after a 48-hour incubation, and 3) the indigestible nitrogen fraction determined as the amount of N residue recovered in bags after 48 h incubation. The percentage of escape protein in forages were determined from samples incubated 12 hours.

Results and Discussion

On October 10, yields of stockpiled kura clover were 950 and 2,544 lb/acre from within and adjacent to the corn crop residues. Nutritional quality of this forage was high with concentrations of in vitro digestible dry matter and crude protein at 76.2 and 22.6%, respectively (Table 1). Thus, kura clover would seem to be an effective supplement for cows grazing corn crop residue.

As kura clover weathered over 28 days, concentrations of acid detergent insoluble nitrogen increased and crude protein concentrations decreased. Although weathering has

been found to increase neutral detergent fiber and acid detergent fiber in forages during winter, the concentrations of neutral detergent fiber and acid detergent fiber in kura clover did not change during weathering over 4 weeks. The lack of change may have been caused by the lack of stem structure in kura clover. Similarly, there was little change in in vitro digestible dry matter concentrations of kura clover over 4 weeks of weathering.

Table 1. Changes in chemical composition of kura clover with weathering.

	Harvest[a]		
Item	H1	H2	H3
NDF, %	25.4	26.4	26.7
ADF, %	20.2	20.4	19.8
CP, %	22.6	20.4	18.5
ADIN-N, % of total CP	4.08	4.15	6.08
IVDMD, %	76.2	80.2	77.8

[a]H1= first-harvest, H2=second-harvest, H3=third-harvest.

In situ digestion measurements revealed that kura clover has a highly soluble nitrogen similar to other legumes. Potentially digestible protein, measured as the pool-size, ranged from 93.3 to 97.6% of total protein (Table 2). Proportion of protein that was potentially digestible decreased as kura clover weathered. Similarly, the time required for initiation of protein degradation (lag time) increased, and the rate of ruminal protein degradation decreased as kura clover weathered.

Table 2. Changes in ruminal digestion kinetics of nitrogen in kura clover with weathering.

	Harvest[a]		
Item	H1	H2	H3
Pool-size, % of total CP	97.6	95.5	93.3
k, h^{-1}	.59	.70	.52
Lag, h	.82	2.05	1.41

[a]H1= first-harvest, H2=second-harvest, H3=third-harvest.

As kura clover weathered, the proportion of total protein that was removed during the water procedure (soluble protein) or was non-digestible increased and the proportion of protein that was insoluble but potentially digestible decreased (Table 3). However, none of these effects were extreme over the 28-day sampling period. The average proportion of protein that escaped ruminal degradation was 31.3% of total protein and was not affected by weathering over 28 days.

Table 3. Changes in proportions of total N in kura clover with weathering

	Harvest[a]		
Item	H1	H2	H3
Readily digestible, % of total CP	42.1	47.9	46.3
Potentially digestible, % of total CP	56.9	50.2	50.1
Non-digestible, % of total CP	1.25	1.82	3.50
Escape protein, % of total CP	32.4	29.1	32.4

[a]H1= first-harvest, H2=second-harvest, H3=third-harvest.

Implications

Like other legume species, stockpiled kura clover is high in CP and highly digestible. Therefore, stockpiled kura clover may be used as a protein supplement for ruminants grazing low quality forages. Unlike the high decrease in nutritive value that occurred during the weathering of berseem clover, the nutritive value of kura clover did not change greatly over 4 weeks.

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