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Abstract

The evaluation of pastures by esophageally fistulated steers requires artificial rumen techniques to determine digestibilities of grasses. To develop a regression curve between data obtained by an artificial rumen and those from a grazing animal, we conducted a series of metabolism studies and artificial rumen trials using native prairie hay from the Flint Hill area cut at three maturity stages.

Keywords

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Effect of Maturity Stage on the Nutritive Value of Native Grass Hay

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The evaluation of pastures by esophageally fistulated steers requires artificial rumen techniques to determine digestibilities of grasses. To develop a regression curve between data obtained by an artificial rumen and those from a grazing animal, we conducted a series of metabolism studies and artificial rumen trials using native prairie hay from the Flint Hill area cut at three maturity stages.

Twelve Angus steers (average weight, 642 lbs.) were fed ad libitum quantities of hays harvested in June, July, and September in a factorially designed experiment. Sodium chloride and water were available free choice. Animals were maintained on each hay 14 days before being put into metabolism crates. Then a 7-day collection period followed a 7-day adjustment interval.

Results and Discussion

Compositions of the three hays are given in table 4. Nutrients that decreased with maturity were crude protein, neutral detergent fiber, ash-free neutral detergent fiber, acid detergent fiber, and calcium. Cellulose and lignin increased with maturity, while hemicellulose, crude fiber, and nitrogen free extractives remained equivocal.

Digestibility coefficients (as %) are presented in table 5. Nutrient digestibilities were generally highest for June hay, lowest for September. With certain exceptions (nitrogen-free extractives, hemicellulose, calcium) September hay was poorer than July hay. Steers maintained a positive nitrogen balance on June and July samples, but not on the September hay.

Calcium and phosphorous balances (table 6) cannot be interpreted as nitrogen balance is because of different metabolic pathways; however, Ca & P balances indicate when additional mineral supplementation is needed. Calcium equilibrium was maintained except on September hay. Excretion was relatively constant so maintenance of equilibrium was related to intake. The steers were in negative phosphorous balance on June and September hays but maintained phosphorous equilibrium on July hay. Phosphorous was below the animals' requirement for all hays, so all should produce a negative phosphorous balance, but that was not the case. The negative phosphorous balances may be partially explained by the differences in Ca:P ratio. Positive phosphorous balance was maintained only with July hay when the Ca:P ratio was 2.75:1. Phosphorous ratios seem to be more important than phosphorous level. An excess of either calcium or phosphorous decreases absorption of the other because insoluble tricalcium phosphate is formed. Other minerals, not evaluated, such as magnesium, manganese, iron, and zinc also interfere with phosphorous absorption.

Average daily dry matter intake was 13.30, 11.83, and 10.07 lbs., on June, July, and September hay, respectively. Animals maintained positive nitrogen balance on June and July hays even though calculated digestible protein values were low (table 6).

Intake is usually lower in cattle confined to metabolism stalls than those penned or in a pasture. Increasing daily intake in stalls likely would not change digestion coefficients.

Table 4 . Nutrient composition (dry matter) of native hay cut in indicated month.

Nutrient	Hay Cut		
	June	July	September
Dry matter, %	94.70	94.83	94.93
Crude protein, %	5.52	4.50	3.43
Crude fiber, %	32.98	36.21	34.69
Ether extract, %	1.99	1.48	1.68
Ash, %	6.46	6.40	7.68
Nitrogen-free extract, %	47.74	46.16	47.43
Neutral detergent fiber, %	79.06	78.12	72.03
Ash free neutral detergent fiber, %	78.02	75.43	71.24
Acid detergent fiber, %	65.00	54.77	54.48
Organic matter, %	88.24	88.33	87.25
*Cellulose, %	47.69	48.23	51.09
*Hemicellulose, %	34.50	33.86	34.66
*Lignin, %	10.78	10.17	12.45
Calcium, %	0.420	0.289	0.359
Phosphorous, %	0.102	0.105	0.090
Ca:P ratio	4.19	2.75	3.98

*Expressed as percent of cell wall.

Table 5. Digestible nutrient content and nutritive value index of native hays cut at three maturity stages.

Constituent	Hay Cut		
	June	July	September
Dry matter, %	62.61	51.84	51.00
Organic matter, %	60.15	50.27	51.53
Crude protein, %	2.44	2.01	1.12
Crude fiber, %	23.60	23.66	21.04
Ether extract, %	.81	.58	.84
Nitrogen free extract, %	33.90	27.08	27.42
TDN, % (as fed)	58.44	51.24	48.72
TDN, % (dry)	61.72	54.04	51.33
Nutritive value index (dry)*	43.48	35.05	28.35

*Standard forage value = 70.00

Table 6. Nitrogen, calcium, and phosphorous balances and nutrient digestibilities of hays fed to steers.

Constituent	Hay Cut		
	June	July	September
Dry matter, %	66.11	54.67	53.73
Organic matter, %	68.17	56.85	59.06
Crude protein, %	44.27	44.60	32.69
Crude fiber, %	71.55	65.34	60.66
Ether extract, %	40.94	39.57	49.73
Nitrogen free extract, %	71.02	58.67	57.82
Digestible energy, %	65.91	56.72	52.04
Neutral detergent fiber, %	71.56	59.05	53.97
Acid detergent fiber, %			
Cellulose, %	71.05	60.59	63.94
Hemicellulose, %	77.23	69.27	69.18
Daily Ca intake, gm.	21.50	15.54	13.60
Daily fecal Ca, gm.	17.40	15.17	15.69
Daily urinary Ca, gm.	.07	.05	.07
Daily Ca balance, gm.	4.07	00.32	-2.16
Daily P intake, gm.	6.05	5.73	3.31
Daily fecal P, gm.	11.56	4.68	3.96
Daily urinary P, gm.	.02	01	.01
Daily P balance, gm.	-5.53	1.07	-0.66
Daily N intake, gm.	52.79	39.97	25.51
Daily fecal N, gm.	27.32	24.65	19.16
Daily N absorbed, gm.	25.47	15.32	6.75
Daily Urinary N, gm.	14.14	7.67	7.01
Daily N retained, gm.	11.24	6.66	-0.26
N retained of absorbed, %	44.10	50.00	Negative