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Nutritive Value Of Grazed Old World Bluestem And Tall Grass Prairie Across The Calendar Year

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Story in Brief

Monthly forage samples were collected from Old World bluestem and tall grass prairie by fistulated steers over 5 yr to estimate nutritive value changes in degradable and undegradable intake protein, crude protein, and forage digestibility. Crude protein and *in vitro* organic matter digestibility were highest in the early spring and decreased into the fall and winter. Degradable intake protein remained relatively constant throughout the calendar year when expressed as a percentage of crude protein. The ratio of degradable intake protein supply to requirement, based on digestibility, supports observed responses to summer and winter protein supplementation on these forages. Additionally, these values provide needed information about forage nutritive values used to evaluate possible supplementation strategies utilizing the beef cattle NRC, 1996.

Key Words: Forage, Degradable Intake Protein, Digestibility, Old World Bluestem, Tall Grass Prairie.

Introduction

Protein requirements of cattle are partitioned into degradable intake protein (DIP) and undegradable intake protein (NRC, 1996). Due to the fact that forage provides the major portion of grazing cattle diets, it is imperative to understand the protein and energy relationships of the forage throughout the year. Accurate estimates of the DIP content of forages, and an understanding of how DIP may vary over the course of a grazing season are essential for evaluating supplement strategies. To evaluate monthly changes in DIP, UIP, and forage digestibility for Old World bluestem and native tallgrass prairie, historical data from 1993, 1994, and 1995 were combined with 1998 and 1999 data to produce a calendar of forage quality over time.

Materials and Methods

Forage samples from tall grass prairie (n=114) and Old World bluestem (N=121) pastures near Stillwater, OK, were collected during the course of several independent trials by steers fitted with either ruminal or esophageal fistulae. Crude protein (CP) and *in vitro* organic matter digestibility (IVOMD) were determined. Degradable intake protein (DIP) was determined by measuring nitrogen disappearance during a 48-h incubation in a solution containing the proteolytic enzyme from *Streptomyces griseus*. Data were plotted by month, and equations were fitted without intercepts to allow for different intercept estimates for each forage species. The highest mean values of CP, DIP and IVOMD occurred in April, so April was considered to be x=1, May to be x= 2 and so on. When Jan was considered x=1, values for Feb and Mar were over-estimated and those for Apr and May were underestimated. Initial equations included the linear, quadratic and cubic terms nested within forage species. The cubic term was removed if it was not significant (P>.10). Linear contrasts were used to test for differences in the estimates of intercept and slope terms between the two forages species. Predicted crude protein and DIP levels were multiplied to estimate DIP concentration in forage. The NRC (NRC, 1996) predicts DIP requirements for microbial protein production ranges from 9% to 13% of TDN. In order to evaluate the adequacy of DIP concentrations, we assumed three ratios DIP/TDN: 9, 11 and

13%. DIP concentration was then divided by DIP required to arrive at a ratio representing the "DIP balance" of each forage species in each month.

Results and Discussion

***Crude Protein*.** Forage type affected the response in crude protein content of early spring and early summer months (Table 1). Additionally, crude protein content of both forages exhibited a cubic change over the course of a year (Table 2).

Digestibility. Forage digestibility values were similar for both forage types (Table 1) and therefore only one equation was established for both forage types. There was a significant cubic change in forage digestibility over the calendar year (Table 2).

Degradable Intake Protein. Degradable intake protein was affected by forage species (Table 1) and changed cubically, but with different slope, through year (Table 2). However, DIP and predicted DIP had a fairly narrow range (Tables 1 and 3). It may therefore be possible to use an average value for DIP for all months and predict DIP supply relatively closely.

***DIP:TDN Ratio*:** Utilizing a ratio that puts DIP and energy into one common term allows us to evaluate these interrelated nutrients that must be closely balanced for optimal animal performance. By plotting DIP:TDN using multiple microbial efficiency values, deficiencies in either DIP or energy can be observed. Using this simple ratio reveals that during the early spring and mid-summer values seem to be balanced for Old World bluestem (Figure 1) and tall grass native range (Figure 2), possibly indicating that energy supplement could be helpful. After that, available energy of forage is higher than DIP supply, so protein supplementation is required to improve ruminal fermentation. In contrast, energy supplementation could result in a negative effect, decreasing fiber digestion and feed intake. In accordance with these results, it is interesting that supplementation programs usually begin when DIP:TDN ratios are the lowest in the year (Nov). It would appear that both energy and DIP could be used at different times during the year to improve nutrient balance in both forages. Overall these values should assist in supplementation strategies that attempt to match forage nutritive value with the addition of energy or DIP.

Literature Cited

NRC. 1996. Nutrient Requirements of Beef Cattle (7th Ed.) National Academy Press, Washington, DC.

SAS. 1996. SAS® System for Fixed Models. SAS Inst. Inc., Cary, NC.

Table 1. Observed nutritive value of two forages across years.

	Old World Bluestem			Tallgrass prairie		
Month	CP	DIP	IVOMD	CP	DIP	IVOMD
Apr	18.5	76.5	74.4	17.1	70.8	76.3
May	19.6	64.1	78.0	17.5	63.5	79.5
Jun	14.9	56.8	75.9	12.5	59.3	75.1
Jul	14.6	54.9	76.8	10.6	56.3	74.5
Aug	10.9	57.3	74.0	10.9	59.1	74.1
Sep	12.8	53.0	68.0	17.4	62.0	76.4
Oct	10.6	65.2	70.1	10.3	62.5	70.6
Nov	9.7	64.1	65.8	8.6	55.1	65.5

Dec	6.4	65.6	63.5	5.8	57.1	64.1
Jan	6.6	66.2	64.0	6.7	58.4	64.1
Feb	6.0	63.9	66.0	6.4	59.1	61.5
Mar	10.4	67.2	65.8	8.9	63.3	64.0

Table 2. Regression equations for CP, DIP and IVOMD for grazed Old World bluestem and tallgrass prairie.

Forage species	Regression equations	R^2	s.e.d[a]
OWB[b]	$CP= 20.98 – 1.215 X – 0.221 X^2 + .02 X^3$	.57	.33
(n=121)	$DIP= 88.796 – 17.135X + 2.706 X^2 - 0.12 X^3$	.45	.55
	$IVOMD= 73.18 + 3.613 X – 0.94 X^2 + .048 X^3$	.42	.41
TPG[b]	$CP= 18.859 – 1.595 X – 0.031 X^2 + .007 X^3$	.59	.26
(n=114)	$DIP= 73.831 – 5.849X + 0.62 X^2 - 0.018 X^3$	.17	.66
	$IVOMD= 73.18+3.613 X – 0.94 X^2 + .048 X^3$	.42	.41

[a]Standard error deviation.

[b]OWB=Old World Bluestem, TGP= Tallgrass prairie, CP= Crude protein, DIP=degradable intake protein and IVOMD= in vitro organic matter digestibility. X=Month, where X=1 is April , X=2 is May,etc.

Table 3. Predicted nutritive value of two forages across years.

	Old World bluestem				Tallgrass prairie			
Month	CP	DIP	IVOMD	Ratio[a]	CP	DIP	IVOMD	Ratio[a]
Apr	19.6	74.3	75.9	1.76	17.2	68.6	75.9	1.40
May	17.8	64.4	77.0	1.36	15.6	64.5	77.0	1.18
Jun	15.9	58.5	76.9	1.10	14.0	61.4	76.9	1.01
Jul	13.9	58.9	75.7	.93	12.4	59.2	75.7	.88
Aug	11.9	55.8	73.7	.82	11.0	57.8	73.7	.78
Sep	10.1	57.5	71.4	.73	9.7	57.2	71.4	.70
Oct	8.5	60.3	68.9	.68	8.6	57.1	68.9	.64
Nov	7.4	63.5	66.5	.64	7.7	57.5	66.5	.60
Dec	6.7	66.3	64.5	.62	7.1	58.3	64.5	.58
Jan	6.7	68.1	63.3	.65	6.8	59.3	63.3	.58

Feb	7.5	68.0	63.1	.71	6.9	60.6	63.1	.60
Mar	9.1	65.5	64.1	.81	7.4	61.8	64.1	.65

aDIP supplied : DIP required= (CP*DIP%)/(IVOMD*11.0%)

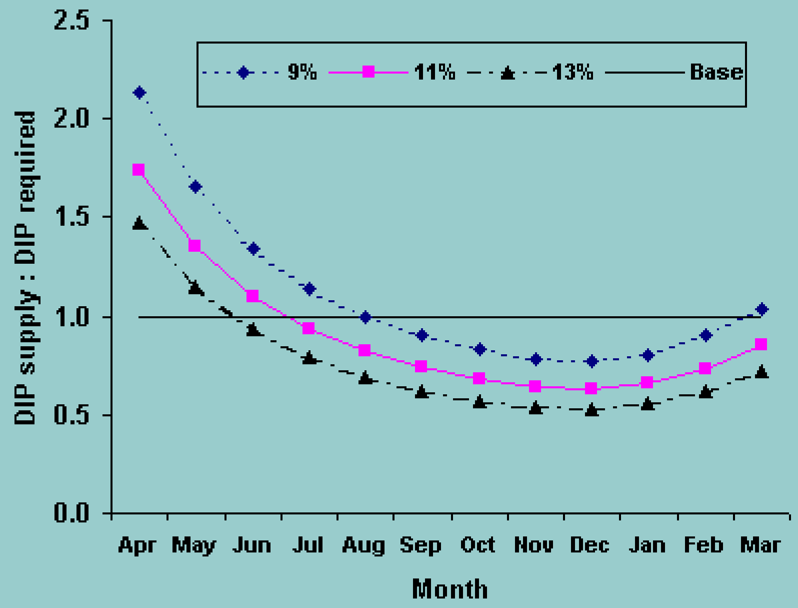
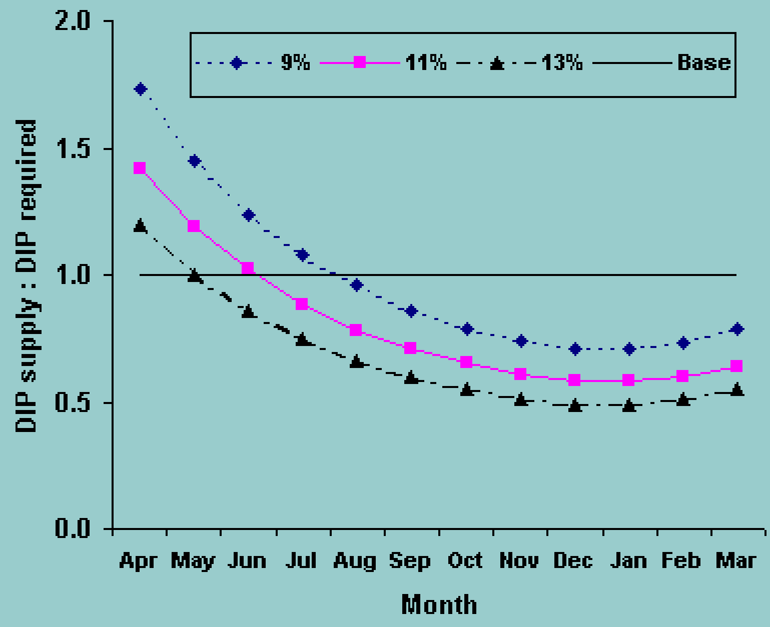


Figure 1.

Ratio of DIP supply to DIP required of grazed Old World bluestem at three microbial efficiencies across the year.



Excess DIP respect to available energy

Figure 2. Ratio of DIP supply to DIP required of grazed tallgrass prairie at three microbial efficiencies across the year.

Deficiency of DIP respect to available energy

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