The Nutritive Value of Range Grasses in Northern Brewster County, Texas

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ABSTRACT

Blue grama, sideoats grama, hairy grama, sprucetop grama, silver bluestem, johnsongrass, sand dropseed, tobosa, and big alkali sacaton were randomly collected from one of five sites in northern Brewster County, Texas. Each grass was analyzed for crude protein (CP) content and amino acid (AA) composition for the determination of biological value (BV) using an amino acid index (AAI). Means were compared by ANOVA and separated using Student Newman Keul's multiple comparisons test. The quadratic response in CP content throughout the year was determined using regression analysis. The mean CP content for all grasses throughout 1991 was described by the equation $y = 0.98 - 0.13x^2 + 1.76x$ ($r^2 = 27\%$; $P < 0.001$). Big alkali sacaton contained the highest CP content in the spring (8.3%) and fall (10%); johnsongrass CP was highest in the summer (13.2%) and sprucetop grama in the winter (5.3%) ($P < 0.05$). The grasses had BVs in the mid-to upper 70s except silver bluestem (2%) and johnsongrass (80%). The low BV of silver bluestem was suggestive of an AA imbalance in the plant due to stress before sampling. Barring any factors that may have inhibited digestion and absorption, range grasses in northern Brewster County contained adequate CP to meet CP requirements of dry gestating beef cattle (500 kg) during the summer, fall, and spring of 1991.

Crude protein (CP) content is commonly used to indicate range grass quality (Rodgers and Box, 1967). Studying range grass quality will provide range managers and wildlife biologists access to a greater data base on which to make judgments concerning provision of supplemental feed for their livestock and game animals. Because the species selected for this study occupy approximately 90% of the rangeland in northern Brewster County Texas (Gould, 1975), assessing their nutritive quality will help to form the basis of a valuable management tool in West Texas.

Analyzing CP content in grasses is important but determining the quality of the protein is equally critical. Protein quality can be estimated from amino acid (AA) composition by the equations of Mitchell and Block (1946). This method establishes an amino acid index (AAI) to compare the amino acid composition of the samples to that of a standard. In many cases whole egg is the standard of choice because it is very high in total protein and those proteins have a digestibility coefficient of 96% (Oser, 1959). The ratio established between the standard and the samples is indicative of the digestibility of the proteins in the sample. The objective of this

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study was to determine the seasonal CP content and quality in nine species of range grasses in northern Brewster County, Texas.

MATERIALS AND METHODS

Sample Collection and Analysis

Samples of blue grama (*B. gracilis*), sideoats grama (*Bouteloua curtipendula*), hairy grama (*B. hirsuta*), sprucetop grama (*B. chondrosioides*), silver bluestem (*Bothriochloa laguroides*), johnsongrass (*Sorghum halepense*), sand dropseed (*S. cryptandrus*), tobosa (*Hilaria mutica*), and big alkali sacaton (*Sporobolus wrightii*) were collected from one of five sites in northern Brewster County, Texas. Sites (about 25 m^2) averaged 1624 m in elevation and consisted primarily of rocky hills or sandy loams of creek levies. All sampled pastures were moderately stocked with cattle (about 17 section^{-1}) and were not irrigated. The same collection sites were used throughout the study. The description, habitat, and abundance of these species is provided by Gould (1975).

Samples from each species were collected by hand to simulate grazing and composited into sealable plastic bags for transportation to the laboratory. The samples were dried at 50°C for 48 h in a forced-air oven and ground to pass through a 1 mm screen using a standard no. 3 Wiley mill. Duplicate 1 g aliquots of ground material were analyzed for Kjeldahl nitrogen using the Kjeltec Digestion System 6/12 and the associated 1002 Distilling unit (Prabin and Co AB, Klippan). The percent CP was calculated as 6.25 x N%.

The AA composition of each species was determined using HPLC by the Biotechnology Support Laboratory at Texas A&M University (TAMU) using the Bidlingmeyer et al. (1984) method. Pre-treatment was conducted at our laboratory and involved delipidization and decolorization of the samples (Bidlingmeyer et al., 1987). The lyophilization pretreatment was done by TAMU.

Statistical Analysis

Analysis of Variance testing of a completely randomized design was used to determine differences in mean CP content and AA composition between species. Means were separated using Student Newman Keuls' multiple comparisons test where significance was declared when $P < 0.05$. Regression analysis was used to determine the trend of the CP content in the grasses relative to the months of the year. The means for each season were determined by averaging the CP content in each grass over the three months in each season.

RESULTS

Crude Protein Content

The amount of CP in the grasses varied throughout the year. The highest levels occurred in the summer and the lowest levels in the winter ($P < 0.05$; Figure 1). These data fit the quadratic equation, $y = 0.98 - 0.13x^2 + 1.76x$ ($r^2 = .27$; $P <$

0.001). The CP content of grass species peaked at different times of the year (Figure 2). The CP content in hairy grama, for example, peaked in April while blue grama peaked in August and sprucetop grama in July. The maximum and minimum CP contents observed were 14.4% in big alkali sacaton and 1.7% in silver bluestem. Comparisons of the CP content between grasses within a season are summarized in Table 1. Overall, big alkali sacaton, johnsongrass, and sprucetop grama contained the highest CP content whereas sand dropseed, hairy grama, and sideoats grama typically contained the lowest.

Table 1. Seasonal crude protein (CP) content and biological value (BV) of range grasses in northern Brewster County, Texas in 1991.

Item	CP (%)				BV, %
	Spring	Summer	Fall	Winter	
Blue grama	5.75ab	5.62b	3.86b	3.28b	77.55
Sideoats grama	4.33b	5.24b	2.88b	2.33b	77.61
Hairy grama	4.66b	6.68b	4.84b	3.06b	78.70
Sprucetop grama	7.34ab	9.24ab	5.71b	5.33a	78.30
Silver bluestem	3.65b	4.84b	3.01b	2.06b	2.00
Johnsongrass	6.62ab	13.17a	8.06ab	3.81b	80.32
Sand dropseed	3.88b	7.80ab	3.77b	3.00b	75.70
Tobosa	4.48b	4.53b	3.91b	3.64b	74.69
Big alkali sacaton	8.34a	11.37ab	10.03a	5.14a	78.25
Standard deviation	1.58	2.89	2.29	1.06	1.64

Within columns, means followed by different letters differ ($P < 0.05$).

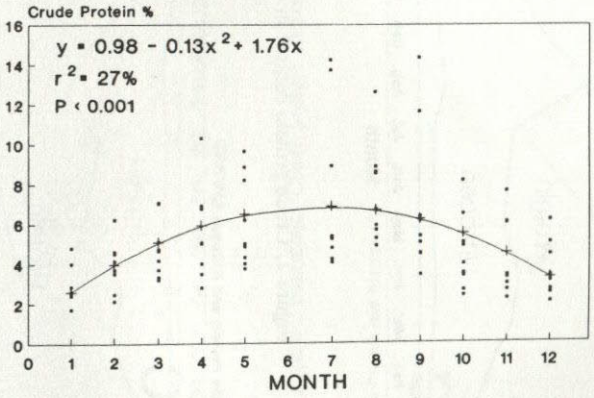


Figure 1. Temporal trends in crude protein (%) for blue grama, sideoats grama, hairy grama, sprucetop grama, silver bluestem, johnsongrass, sand dropseed, tobosa, and big alkali sacaton in northern Brewster County, Texas, 1991.

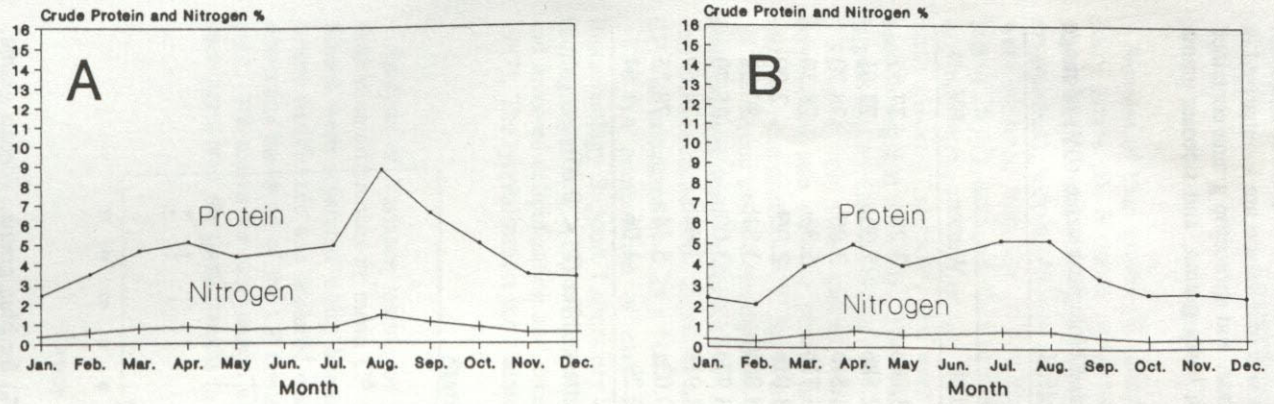
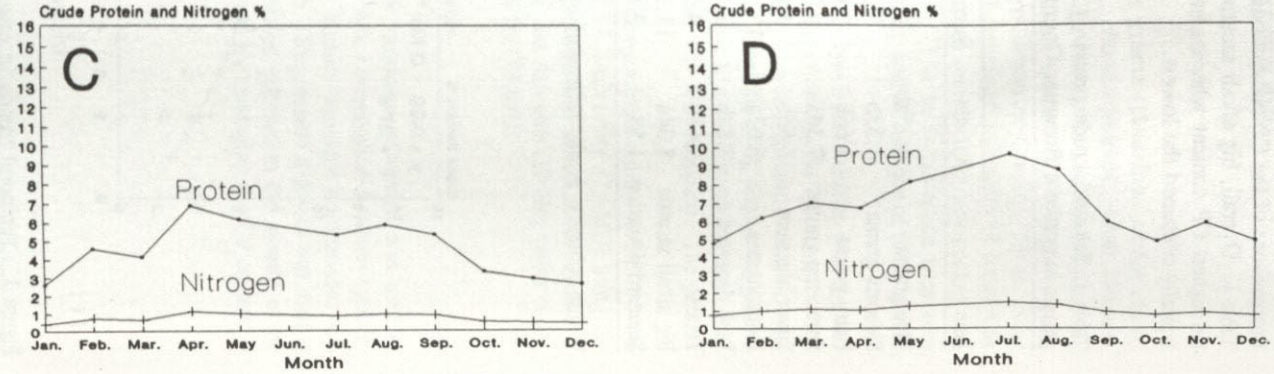
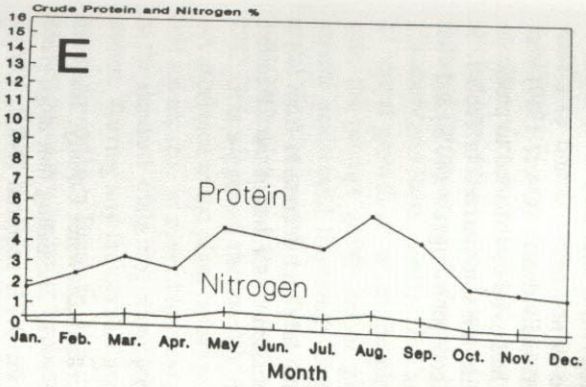


Figure 2. Crude protein content in (A) blue grama, (B) sideoats grama, (C) hairy grama, (D) sprucetop grama.





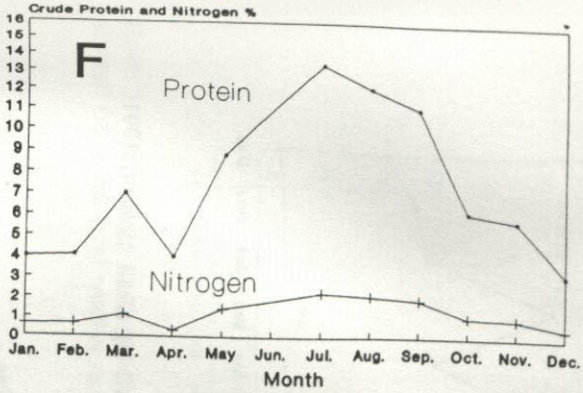
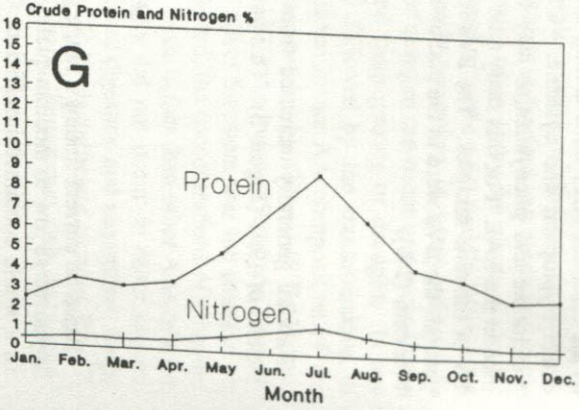
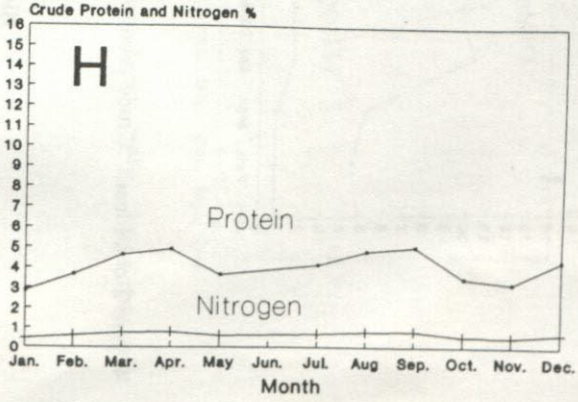


Figure 2 continued. Crude protein content in (E) silver bluestem, (F) johnsongrass, (G) sand dropseed (H) tobosa.





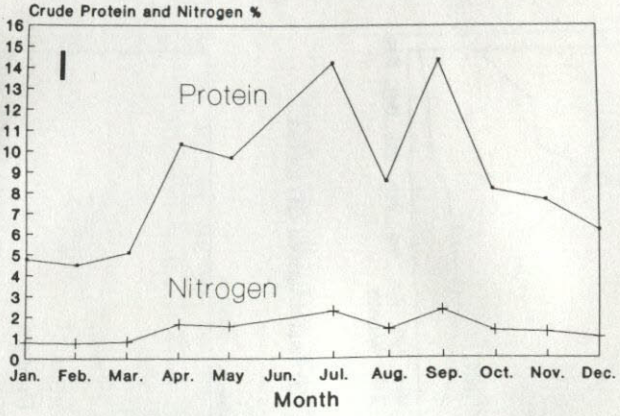


Figure 2 continued. Crude protein content in (I) big alkali sacaton, 1991.

Biological Value

Appreciable concentrations of 16 AAs were present in each of the samples. Nine of the essential AAs were among the 16 measured. Our methods were unable to detect tryptophan and cysteine. Often cysteine is not detected and as a result methionine and phenylalanine may be considered individually (Oser, 1959) when used in the AAI. For this study nine AA indices had to be established to predict the BV of the nine samples. The BVs for each species are summarized in Table 1. In general, the BVs were in the mid to upper 70s except johnsongrass (80%) and silver bluestem (2%).

Rainfall

Rainfall generally increased from January until July and decreased from July to the end of 1991 (Figure 3). This pattern was consistent with that of the CP content.

DISCUSSION

Based on current findings, range grasses in northern Brewster County, Texas were appraised as low to medium quality forages for 1991. Indicating that range grasses as a whole contained insufficient CP to meet the 9.7% required (NRC, 1984) by lactating beef cattle (500 kg) during summer and fall. However, the lower CP requirement of 7% for maintenance of the dry beef cow in early to mid gestation

was potentially met during summer, fall, and spring (Table 1). In winter all nine of the grasses studied were suboptimal in protein content.

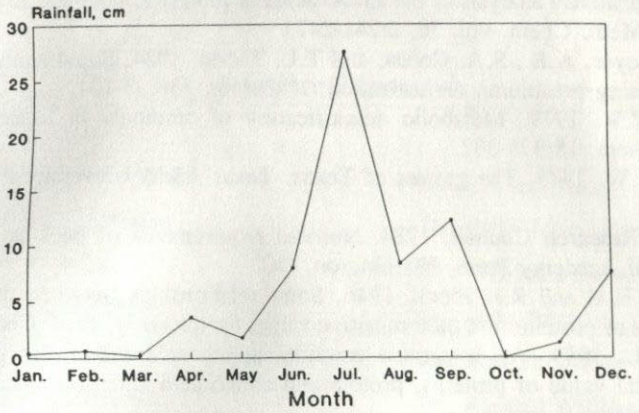


Figure 3. Rainfall in northern Brewster County, Texas, 1991. These data were obtained from the local weather radio station.

Nitrogen Assimilation

Grasses contend with environmental factors such as rainfall, heat, and soil pH which may or may not culminate in adequate microbial populations to facilitate the uptake of soil nitrogen. In general, glutamic acid is the first AA aminated in the presence of certain forms of nitrogen (e.g. nitrate) taken up by the plant. Using N^{15} labeled ammonium, glutamic acid was determined to be the most rapidly labeled AA followed by aspartic acid with N^{15} subsequently appearing in many other AAs (Salisbury and Ross, 1985). The assimilation of nitrogen can occur under conditions of normal growth or when the plant is stressed from grazing or drought. In any case, the prompt amination of glutamic acid followed by the transamination to aspartic acid could transiently cause an imbalance in the AA composition of the plant. Studies regarding these mechanism are provided by Givan, 1979; Runge, 1983; Rajaskhar and Oelmuller, 1987; Pate, 1973; Andrews, 1986; and Stewart 1982. It is suggested the low BV observed for silver bluestem was the result of an AA imbalance in the plant before collection. Indeed, the concentrations of glutamic acid and aspartic in silver bluestem were 3 to 4 times higher than other AAs relative to the standard (data not shown). This anomaly did not occur in other species studied. Barring any factors that may have inhibited digestion and absorption, range grasses in northern Brewster County contained CP levels sufficient to meet the CP requirement of dry gestating beef cattle (500 kg) during the summer, fall, and spring of 1991.

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