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# Seasonal forage quality of rangelands across Kansas

## Abstract

The K-State Research and Extension Forage Task Force surveyed Kansas rangelands during the course of seasonal changes to enable producers and managers to better estimate the feed value of their pasture forage during particular times of the year. Kansas' two distinct rangeland vegetation types, shortgrass and tallgrass prairie, were evaluated. Forage samples were collected monthly from two rangeland sites in each of 10 Kansas counties. Tallgrass vegetation was lowest in acid detergent fiber (ADF) and greatest in crude protein (CP) from May to July, and rapidly increased in ADF and declined in CP the rest of the season. Shortgrass vegetation was also lower in ADF and greater in CP from May to July, but changed less from early summer to the winter than did tallgrass vegetation. Degradable intake protein (DIP) was greatest for tallgrass vegetation in May. Otherwise DIP was similar between tallgrass and shortgrass except in February and March when shortgrass had greater DIP. DIP was greatest in May and June for both vegetation types and gradually declined from June to December. Undegradable intake protein (UIP) values were greater for tallgrass vegetation than for shortgrass vegetation from May through July, but all other months were similar. Seasonal forage quality is different between and within rangeland vegetation types, and identification of dominant vegetation is a key determinant in choosing appropriate animal nutritional management strategies.

## Keywords

Cattlemen's Day, 2002; Kansas Agricultural Experiment Station contribution; no. 02-318-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 890; Beef; Acid detergent fiber (ADF); Degradable intake protein (DIP); Forage quality; Rangelands; Undegradable intake protein (UIP)

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## SEASONAL FORAGE QUALITY OF RANGELANDS ACROSS KANSAS

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### Summary

The K-State Research and Extension Forage Task Force surveyed Kansas rangelands during the course of seasonal changes to enable producers and managers to better estimate the feed value of their pasture forage during particular times of the year. Kansas' two distinct rangeland vegetation types, shortgrass and tallgrass prairie, were evaluated. Forage samples were collected monthly from two rangeland sites in each of 10 Kansas counties. Tallgrass vegetation was lowest in acid detergent fiber (ADF) and greatest in crude protein (CP) from May to July, and rapidly increased in ADF and declined in CP the rest of the season. Shortgrass vegetation was also lower in ADF and greater in CP from May to July, but changed less from early summer to the winter than did tallgrass vegetation. Degradable intake protein (DIP) was greatest for tallgrass vegetation in May. Otherwise DIP was similar between tallgrass and shortgrass except in February and March when shortgrass had greater DIP. DIP was greatest in May and June for both vegetation types and gradually declined from June to December. Undegradable intake protein (UIP) values were greater for tallgrass vegetation than for shortgrass vegetation from May through July, but all other months were similar. Seasonal forage quality is different between and within rangeland vegetation types, and identification of dominant vegetation is a key determinant in

choosing appropriate animal nutritional management strategies.

(Key Words: Acid Detergent Fiber (ADF), Crude Protein (CP), Degradable Intake Protein (DIP), Forage Quality, Rangelands, Undegradable Intake Protein (UIP).)

### Introduction

Forage quality is the predominant plant factor that determines the potential for animal growth and production on grazing lands. Samples from chopped and baled feeds are commonly collected for quality analysis. However, producers rarely sample pastures to determine the quality of available forage during different periods of the year, even though Kansas' land area is approximately 35% rangelands, or about 18 million acres. This information is critical to identify periods when pasture forages are not meeting animal requirements.

Shortgrass prairie and cow/calf systems dominate western rangelands of lower precipitation, while tallgrass prairie and stocker animal production dominate eastern rangelands with greater precipitation. However, many counties in central Kansas have mixed-grass vegetation, and both shortgrass and tallgrass dominated rangelands can be found. Each vegetation type may respond differently to seasonal climatic conditions. Knowing the seasonal changes for vegetation within regions would aid County Extension Agents, consultants, and

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producers by providing dependable information to make more educated decisions on animal management during particular periods of the year.

### Experimental Procedures

Samples were collected by County Agents monthly during the growing season, and bi-monthly during the dormant season, from May of 1997 to October of 1999 from native rangelands at two rangeland locations in each of 10 Kansas counties. Prearranged dates of clipping were determined so that samples from all counties would be collected on the same date. Counties included were Hamilton and Wallace from the west, Clark, Ellis, and Edwards from the central, and Chase, Chautauqua, Clay, Coffey, and Riley from the north and east. Vegetation consisted of mostly short grasses (blue grama, buffalograss, little bluestem, western wheatgrass) in the west and north central, and tall grasses (big bluestem, indiagrass, switchgrass, little bluestem) in the east and south central. Pastures with histories of moderate stocking rates for their respective region were used as sample sites. Ten samples from each collection site were hand clipped, dried, and ground, then sent to a single laboratory for analysis.

Samples were analyzed for ADF and CP. The protein fraction was further analyzed for DIP (the portion available to rumen microbes) and UIP (the portion that escapes to the intestinal tract). Samples were statistically analyzed by grouping the vegetation type (short or tallgrass) of a county for each year and month collected. Unless otherwise noted, significance was based on a level of  $P < 0.05$ .

### Results and Discussion

**Acid Detergent Fiber.** ADF values were much lower in May, June, and July for tallgrass rangelands (36.8, 38.7, and 40.9 %, respectively) than for shortgrass rangelands (45.0, 43.7, and 45.0 %, respectively) (Figure

1). ADF values were similar between the two vegetation types during all other months.

Within tallgrass rangelands, May through September all had lower ADF than October through April. From May through September, a significant increase in ADF concentration also occurred every two months, while ADF significantly increased every sampling period from September to December. Within shortgrass rangelands, ADF values were similar May through August, and ADF was significantly lower May through August than October through April.

Within a forage species, digestibility has a negative relationship with ADF; the greater the ADF value, the less digestible the forage. Thus, tallgrasses and shortgrasses had their greatest digestion potential when late spring and early summer ADF values were lowest.

**Protein.** Tallgrass forage CP reached its greatest levels of 12.3 % and 8.2 % in May and June, statistically greater than any other time period for tallgrass or shortgrass. Similar to tallgrass vegetation, shortgrass CP significantly rose to 7.0 and 6.9 % in May and June, but the rise in CP was less than for tallgrass. April burning of some tallgrass pastures reduced standing dead material and helped to increase average tallgrass CP and decrease ADF in May and June. Shortgrass pastures in western Kansas were not burned. A gradual but significant decline in CP resulted for both vegetation types from July to December (Figure 2).

Degradable intake protein (DIP) is the portion of CP that is utilized by rumen microbes. When energy and protein are well balanced in a diet, DIP is largely incorporated into microbial cells, which become available as a protein source for the animal as the microbes pass out of the rumen and into the intestinal tract. In this study, increases and decreases in CP were paralleled by increases and decreases in DIP (Figure 2). With lower DIP levels in both grass types from July to the following April, energy

needs may not be met in livestock with high gain potential or in those with high energy requirements for maintenance and lactation because DIP may limit both forage intake and fiber digestion of poor-quality forages.

Undegraded by rumen microbes, UIP passes from the rumen unaltered into the remainder of the gastro-intestinal tract. At present, the National Research Council assumes that approximately 80% of the UIP entering the intestines is digested. However, UIP digestibility can vary greatly from this average. No data is available at present to clarify the extent to which UIP from tallgrass and shortgrass is digested in the intestinal tract. In addition, UIP is of nutritional value to cattle only when their protein demands are not sufficiently met by microbial protein (from the DIP) flowing into the intestines. The factors above make the interpretation of UIP's importance challenging. Tallgrass vegetation had much greater UIP than shortgrass vegetation during May, June, and July (4.4, 3.1, and 3.1 % vs. 2.3, 2.4, and 2.6 %, respectively). All other months except December were similar between the two vegetation types. Shortgrass consistently ranged from 2.0-2.8 % UIP through the season.

Protein levels in our study were lower than expected, but forage consumed by

fistulated grazing cattle has been found to be 2-3% higher in CP than forage clipped on Kansas Flint Hills rangeland. Protein levels were also at their greatest and ADF at its lowest in tallgrass vegetation from May until July in this study (Figures. 1 and 2), the period when stocker animals have historically achieved their greatest average daily gains. Animal gains during the early grazing season were similar to gains in the late season 7 out of 10 years on continuously stocked shortgrass pasture. The narrow margin between the lowest and greatest seasonal protein (Figure 2) and ADF (Figure 1) levels on shortgrass range in the current study could have been a factor in the similar response between early and late season gains of previous grazing trials.

Tallgrass prairie is highest in forage quality during the early spring and summer. Quality rapidly declines from July to October. Shortgrass forage quality fluctuated less between seasons. Because seasonal forage quality is quite different between and within rangeland vegetation types throughout Kansas, identification of dominant rangeland vegetation is a key determinant in choosing appropriate nutritional management strategies.

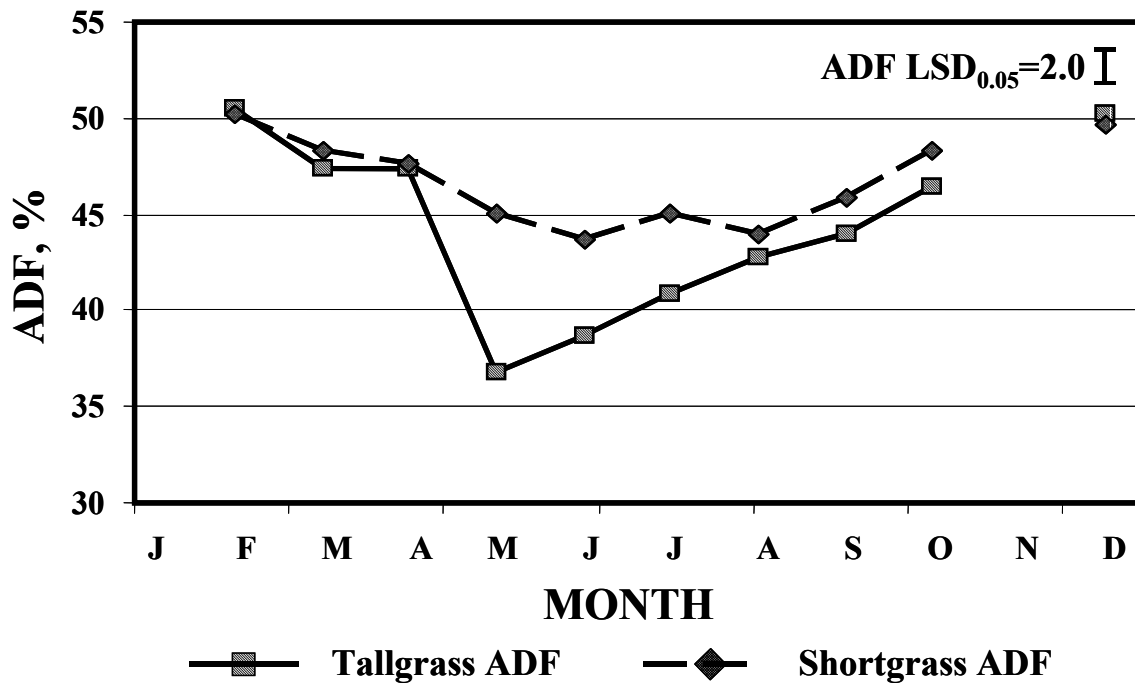


Figure 1. Monthly Acid Detergent Fiber (ADF) Percentage of Kansas Tallgrass and Shortgrass Rangeland Vegetation from Spring of 1997 to Fall of 1999.

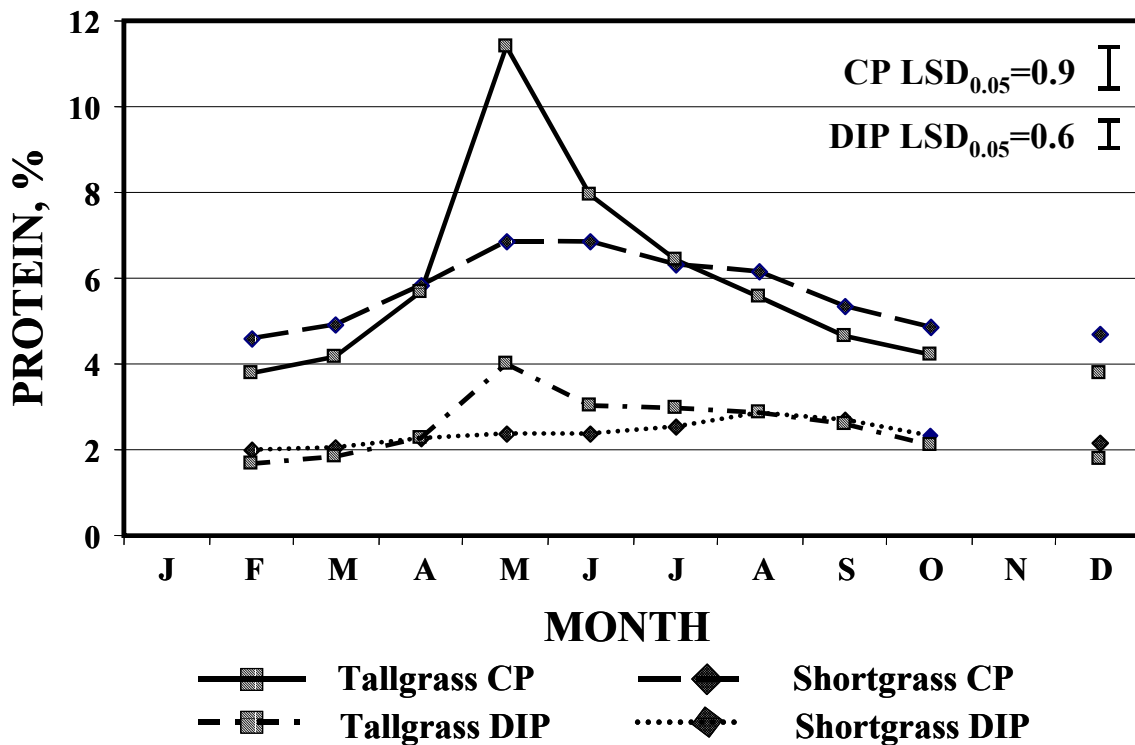


Figure 2. Monthly Crude Protein (CP) and Digestible Intake Protein (DIP) Percentage of Kansas Tallgrass and Shortgrass Rangeland Vegetation from Spring of 1997 to Fall of 1999.