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GRAZING ENDOPHYTE INFESTED TALL FESCUE AND CHANGES IN BOVINE BLOOD COMPONENTS AND GAIN

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Abstract

Tall fescue (*Festuca arundinacea*) is utilized on more than 15 million ha of pasture in the eastern USA and over 80% of the plants in this area are infested with the endophyte *Neotyphodium coenophialum*. Tall fescue toxicosis results from consumption of the infested (E+) grass host and is an important problem that causes considerable economic loss to producers. However, the agronomic attributes of tall fescue make it an attractive forage because of its ability to withstand cool temperatures, drought, poor soil conditions and intensive defoliation. There is need to understand mechanisms of animal physiology that are affected by the alkaloids produced by the endophyte/grass association. Blood serum samples were collected from steers (*Bos taurus*) grazing either E+ or endophyte free (E-) tall fescue in spring and summer during three consecutive years and were related to animal performance. Consistent and significant changes associated with E+ tall fescue were noted for daily gain, prolactin, albumin/globulin ratio, alanine aminotransferase, cholesterol, creatinine, globulin, total bilirubin, total serum protein, copper, red blood cells, mean corpuscular volume, mean corpuscular hemoglobin, and eosinophils. Thus, repeatable changes that occur in serum biochemical and blood cellular values of cattle grazing E+ tall fescue were identified and will aid in understanding

the pathogenesis of the toxicosis.

Keywords: *Festuca* toxicosis, *Neotyphodium coenophialum*, Prolactin, Animal performance

Introduction

Tall fescue benefits from association with the endophytic fungus *N. coenophialum* because of alkaloids produced by the fungus/host plant combination. The alkaloids are biologically active compounds that suppress consumption of E+ tall fescue by both mammals and insects, while enhancing stress and drought tolerance of the host plant. Tall fescue toxicosis is a costly endemic problem for cattle in eastern USA that results in reduced weight gain, milk production and fertility (Cheeke, 1995). The alkaloids associated with E+ tall fescue are known to affect vascular tissues (Oliver et al., 1998) and blood components (Oliver et al., 2000). This report details changes that occurred in average daily gain (ADG) and blood serum components of cattle that consumed either E+ or E- tall fescue during a 3-year grazing study.

Material and Methods

Angus and Angus/Hereford crossbred steers, about 1 yr old and weighing 318 kg, were used each year at Knoxville (35°49'N, 83°59'W). Animals grazed ‘Kentucky 31' tall fescue from mid-March to mid-August. The E+ and E- 1.2-ha tall fescue pastures were verified annually for E+ status from 50 tillers ha^{-1} by PAS-ELISA (Gwinn et al., 1991). Eight steers were allotted to each treatment each year. Pasture was the only source of feed, with free choice minerals, water and shade available. Cattle were placed on triplicate test pastures one month prior to the first blood sample collection. Steers were observed daily and weighed every 21 d during grazing seasons of 125 d. At each weigh time,

whole blood samples were obtained by jugular puncture. Forage availability in each pasture was monitored every 21 d from ten 50 ´ 300 cm strips ha^{-1} cut at a 5-cm stubble height. There were 7 bleeding dates in 1996, 5 in 1997 (due to a summer drought) and 8 in 1998. Whole blood samples for complete blood counts were placed in tubes containing ethylenediaminetetra-acetic acid (EDTA) to prevent coagulation. Samples were chilled immediately after collection. Blood analytes and hormone concentrations were determined in serum. Smears of blood samples were made for differential blood cellular quantification, and complete blood counts were done with the Abbott Cell Dyn 3500™. Serum mineral analyses were done by Inductively Coupled Plasma Emission Spectroscopy. Data are presented as least squares means ± SEM (standard error of the mean). The Proc Mixed of SAS (1997) was used to compare serum biochemical/blood cellular values among steers on E- and E+ pastures. Steer, treatment, month, year and pasture were treated as class variables. The final model for each analysis included treatment, year, treatment X year, month /year and treatment X month /year as independent (fixed) variables. Pasture was included in the model as a random effect.

Results and Discussion

Forage availability ranged between 800 and 1200 kg dry matter ha^{-1}; thus forage was vegetative throughout and never limiting. Steers grazing E+ had an ADG of 437 g d^{-1} (Table 1). As expected, ADG of steers grazing E- was higher and averaged 676 g d^{-1}. Prolactin levels also reflected the considerable decrease typical of steers grazing E+ during spring and summer. Most serum analyte values of cattle that grazed either E- or E+ tall fescue were within the established normal range. However, certain alterations were noted each year between cattle grazing E+ or E- for albumin/globulin ratio, alanine aminotransferase, cholesterol, creatinine, globulin, total bilirubin and total serum protein. In contrast, albumin, alkaline phosphatase, aspartate, estradiol, gamma glutamyl

transferase, glucose, lactic dehydrogenase and urea nitrogen were not significantly different and within reference range. Exposure of animals to the endophyte had minimal effects on serum mineral concentrations, as reported by Bond et al. (1984). However, serum copper was below the 0.6 ppm level that indicates deficiency for cattle grazing E+ tall fescue (Dennis et al., 1998) and significantly lower in E+ than in E- cattle. Other minerals (Ca, Fe, K, Mg, Na, total P, Zn) were not different between the two steer groups. Many other blood components were not different between the two treatment groups: hemoglobin, hematocrit, mean corpuscular hemoglobin concentration , platelets, mean platelet volume, white blood cells, polymorphonuclear-leukocytes, lymphocytes, monocytes, basophils. Even though red blood cells, mean corpuscular volume, mean corpuscular hemoglobin, and eosinophils were significantly different, the values for both treatments fell within reference range.

Tall fescue toxicosis of herbivores continues to be a significant economic burden for producers who rely on tall fescue pastures. The condition is complex, and there still is minimal understanding of the effects of the associated alkaloids on grazing animals. The presence of *N. coenophialum* in tall fescue plants is important for persistence, and tolerance to stress and climatic occurrences. Future approaches to reducing the tall fescue toxicosis problem must consider the negative effects of the alkaloids on animal physiology as well the positive effects on the host plants.

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Table 1 - Least squares means and SEM of animal responses, blood serum analytes and hemogram constituents for steers grazing E- and E+ tall fescue for three grazing seasons (20 bleeding dates) in triplicate pastures.

	Units	E-	E+	SEM	P>F [†]	Reference range
Gain (ADG)	$g\ d^{-1}$	676	437	41	0.054	- - -
Prolactin	$ng\ ml^{-1}$	214	13.2	57	0.012	- - -
Albumin	$g\ dL^{-1}$	3.58	3.71	0.05	0.051	3.0 - 3.55[‡]
Albumin / Globulin	- - -	1.10	1.32	0.04	0.001	0.84 - 0.94[‡]
Alanine aminotransferase	$U\ L^{-1}$	37.8	31.3	1.8	0.010	11 - 40[‡]
Cholesterol	$mg\ dL^{-1}$	107	91	4.2	0.006	80 - 120[‡]
Creatinine	$mg\ dL^{-1}$	1.38	1.58	0.04	0.001	1.0 - 2.0[‡]
Globulin	$g\ dL^{-1}$	3.37	2.97	0.07	0.001	3.0 - 3.48[‡]
Total bilirubin	$mg\ dL^{-1}$	1.63	1.74	0.04	0.042	0.01 - 0.5[‡]
Total protein	$g\ dL^{-1}$	6.93	6.68	0.08	0.037	6.74 - 7.46[‡]
Copper	$mg\ L^{-1}$	0.72	0.59	0.03	0.006	0.72 ± 0.02[§]
Red blood cells	$M\ \mu L^{-1}$	8.33	8.83	0.15	0.015	5 - 10[‡]
Mean corpuscular volume	fL	41.4	39.5	0.46	0.004	40 - 60[‡]
Mean corpuscular hemoglobin	pg	15.1	14.3	0.18	0.002	11 - 17[‡]
Eosinophils	$k\ \mu L^{-1}$	0.68	0.48	0.06	0.024	0.0 – 2.4[‡]

[†] NS = not significantly different
[‡] Kaneko et al. 1997. Clinical Biochemistry of Domestic Animals. 5th ed. Academic Press. pp. 890-894.
[§] Duncan et al. 1994. Veterinary Laboratory Medicine: Clinical Pathology. 3rd ed. Iowa State Univ. Press, Ames, IA.