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A survey of phytoestrogenic activity in Kansas Flint Hills pastures

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A SURVEY OF PHYTOESTROGENIC ACTIVITY IN KANSAS FLINT HILLS PASTURES¹

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Summary

The botanical composition and basal cover of three Kansas Flint Hills pastures located in Butler and Chase counties was surveyed to estimate the incidence of plant species that contain appreciable levels of estrogenic activity. Many-flowered scurfpea and Ladino clover were the only plant species classified as high in estrogenic activity. Although significant estrogenic activity existed in specific species, the willingness of livestock to consume those species is unclear.

(Key Words: Flint Hills Pastures, Phytoestrogen, Buller Steer Syndrome.)

Introduction

Incidence of the buller steer syndrome in feedlots is typically less than 4%, but can occasionally reach 10%. However, several Kansas feedlot managers have observed individual pen bulling rates as high as 30% in steers previously grazed on Kansas Flint Hills native pastures. Factors such as social hierarchy, aggressive behavior, seasonality, entry weights, stress, pheromones, and growth promoting implants have been suggested as factors contributing to the occurrence of the buller steer syndrome. More recently, plant estrogens have been impli-

cated as an additional factor that might increase bulling activity or reduce the efficacy of growth-promoting implants.

More than 40 plant species have been shown to contain estrogenic activity. Estrogenic activity is widespread among many legumes, including subterranean (*Trifolium subterranean*), white (*Trifolium repens*), and red (*Trifolium pratense*) clovers, as well as alfalfa. Many leguminous plants, such as purple prairieclover, Illinois bundleflower, catsclaw sensitive briar, showy partridgepea, and many-flowered scurfpea, naturally inhabit Flint Hills native-grass pastures. Moreover, introduced species such as Korean lespedeza, which was extensively air-seeded during the 1950's, may be present (Owensby, personal communication, 1999). However, it is not known if plant species found in Flint Hills pastures contain estrogenic activity in appreciable concentrations or if they are consumed in sufficient quantities to elicit bulling activity. Consequently, during July we determined the phytoestrogenic activity in a variety of pasture plants, as well as in alfalfa collected at a commercial feedlot.

Experimental Procedures

Botanical composition and basal cover estimates from three pastures in the Flint Hills were determined in July, 1999, using a

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modification of the step-point system outlined by Owensby (1973). Individual plant species were collected over three sampling periods during the latter stages of intensive-early grazing (early to mid-July). All forage samples were frozen and shipped overnight to a University of Missouri laboratory for phytoestrogen analyses.

The bioassay (Welshons et al., 1990; J. Vet Diagn Invest. 2:268) measures estrogen-stimulated growth of MCF-7 cells in tissue culture. It is both specific in that it detects only estrogens and inclusive, detecting all estrogenic compounds. The assay is exceptionally sensitive, requires minimal sample preparation, and allows a large number of feed/forage samples to be screened.

Results and Discussion

Table 1 illustrates the plant species composition of the three Flint Hills pastures. Major warm season perennial grass such as big bluestem, little bluestem, indiangrass and switchgrass, represented about 70% of the the plant species counted in pastures A and B, with leguminous plants and forbs repre-

sented 7 to 12%. Pasture C contained more cool season grasses, forbs and sedges.

Estrogenic activity varied dramatically among the species assayed. Table 2 shows the results of the bioassay expressed in zearalenone equivalents, which is the amount of zearalenone required to give the observed response. The highest estrogenic activity was found in Ladino clover and many-flowered scurfpea (*Psoralea tenuiflora* Pursh). Intermediate levels of activity were found in alfalfa, black medic, and Korean lespedeza. Because Korean lespedeza is an introduced species, its presence is variable and depends upon the original seeding. Low levels of activity were found in roundhead lespedeza, wood sorrel, and yellow sweet clover. Only traces of activity were found in the grasses.

Native and introduced legumes comprised only 3 to 4% of the plant species in the three pastures we studied. This raises questions regarding their potential contribution to the buller steer syndrome. Collecting samples throughout the grazing season and measuring actual plant selection by animals will answer that question.

Table 1. Plant Species Composition of Three Flint Hills Pastures (1999)

	Pasture		
	A	B	C
	----- Count (Percentage)-----		
Major warm season ^a	72.24%	70.27%	58.74%
Minor warm season ^b	12.07%	12.41%	10.72%
Cool season ^c	2.24%	0.86%	7.15%
Misc. grass ^d	2.41%	0.86%	1.94%
Forbs ^e	3.28%	5.78%	8.39%
Native Legume ^f	4.14%	2.99%	3.26%
Sedge	3.62%	6.84%	9.79%
Total	100%	100%	100%

^aBig blue, little blue, indian, switch. ^bBuffalo, grama, sideoats. ^cAnnual, fescue, Brome, Poa. ^dPanic, dropseed. ^eAnnual, field pussytoe, ragweed, aster, oxalis, yarrow, Goldenrod, daisy fleabane, milkweed, dandelion, many-flowered scurfpea, wood sorrel, western yarrow, western ragweed, showy partridge pea, purple prairie coneflower, Illinois bundleflower, catsclaw sensitive briar, California loosestrife. ^fBlack medic, Korean lespedeza, iron weed, leadplant, ladino clover, roundhead lespedeza.

Table 2. Zearalenone equivalent of Kansas Flint Hills Native Plant Species

Plant Species	Zearalenone Equivalent, ppm dry basis			
	No. of Samples	Ranges ^a	Average	Range
Ladino clover	5	high	10.9624	2.032 - 36.239
Many-flowered scurfpea	2	high	43.6929	39.39 - 47.9958
Alfalfa hay	6	medium	7.5120	3.103 - 13.051
Black medic	9	medium	5.0318	1.037 - 15.429
Korean lespedeza	13	medium	8.4032	0.8063 - 27.558
Blue wild indigo	1	low	3.2650	3.265
Roundhead lespedeza	3	low	1.2004	0.4266 - 2.355
Wood sorrel (oxalis)	1	low	1.9690	1.969
Yellow sweet clover	1	low	1.0140	1.014
California loosestrife	1	< 1 ppm	0.0412	0.0412
Catsclaw sensitive briar	9	< 1 ppm	0.0513	0.0133 - 0.145
Grazed grass	8	< 1 ppm	0.1063	0.0274 - 0.2602
Illinois bundleflower	3	< 1 ppm	0.2454	0.225 - 0.7363
Leadplant	11	< 1 ppm	0.2766	0.0831 - 0.595
Non-grazed grass	2	< 1 ppm	0.0186	0.0212 - 0.01602
Purple prairie clover	4	< 1 ppm	0.0771	0.0311 - 0.121
Sedge	1	< 1 ppm	0.1780	0.178
Showy partridge pea	1	< 1 ppm	0.7039	0.7309
Ungrazed grass	2	< 1 ppm	0.0120	0.01089 - 0.0131
Western ragweed	3	< 1 ppm	0.7760	0.293 - 1.041
Western yarrow	3	< 1 ppm	0.1077	0.0596 - 0.174

^aHigh = ≥ 10 ppm; medium = ≥ 5 and < 10 ppm; low = $\geq$ and < 5 ppm.