Factors Involved in Udder Edema

Jerome G. E. Vestweber, *D.V.M., Ph.D.*
Falah K. Al-Ani, *B.V.M.S.*
College of Veterinary Medicine
Kansas State University
Manhattan, Kansas 66506

Udder edema is a disorder of the mammary gland characterized by an excessive accumulation of fluid in the intercellular tissue spaces. Pathologically, edema can be classified as either localized or generalized. Udder edema should be thought of as a localized disease because of the factors involved in the development of the disease.

Blood flow to the mammary gland increases dramatically near parturition associated with pending lactation, and anatomical limits in the venous system may restrict drainage from the mamary gland. Cows affected with udder edema have a significant elevation of mammary vein (subcutaneous abdominal) blood pressure at the time of parturition when compared to nonaffected cows. Cows affected with udder edema also have a significant elevation of mammary vein blood pressure at parturition when compared to 2 weeks before parturition and 2 weeks following parturition. Elevation of venous blood pressure apparently is an important factor involved with the development of udder edema.

Statistical analysis of total serum protein, albumin, and globulin values of cows affected with udder edema compared to nonaffected cows revealed no significant differences. Globulin values were significantly decreased in both groups (affected and nonaffected) of cows at parturition when compared to 2 weeks before parturition and 2 weeks following parturition. This suggests that globulin levels decrease in the serum because of colostrum formation, but total serum protein levels are not a factor in udder edema. Edema fluid (EF) from cows affected with udder edema was analyzed for total protein and compared to serum total protein (P). The EF/P ratio was below .5, which suggests that increased vascular permeability is not a factor in udder edema.

Fescue Toxic Syndrome Update

Duane Miksch, *D.V.M., Extension Veterinarian*
University of Kentucky
Princeton, Kentucky 42445

Tall Fescue (*Festuca arundinacea* Schreb.) is presently grown on approximately 35 million acres in the South Central United States. It is a versatile plant used for livestock feed, lawns, turf and conservation purposes. Tall fescue is a long-lived grass that is adapted to a wide range of soil and climatic conditions. It is relatively easy to establish and tolerant of poor grazing management.

Analysis of tall fescue for chemical components which reflect forage quality indicates that tall fescue compares favorably to other transition zone grasses. However, animal performance from grazing tall fescue has been very erratic and frequently less than desired by many lifestock producers.

"Summer syndrome," "summer slump," "fescue toxicity" and "fescue toxicosis" are terms which have been widely used to denote poor animal performance by cattle grazing tall fescue during summer. Characteristic of this condition is reduced feed intake, decreased rate of gain and/or milk production, rough hair coat, rapid breathing, increased body temperature and a generally unthrifty condition. In recent years, this condition has been shown to be associated with an endophytic fungus.

The Endophyte

"Fescue fungus," "endophyte," "fungal endophyte," and "fescue endophyte" have all been used to denote the organism in question. Endo (within) + phyte (plant) means a plant that lives within another plant. In this case, the plant is a fungus (*Epichloe typhina,* recently renamed *Acremonium coenophialum*) that lives within tall fescue. Regardless of terminology used, it is generally accepted that we are all dealing with the same organism which will henceforth be referred to in this paper as the endophyte.

Endophyte and Summer Syndrome - In June 1973, a most unique and important farm visit was made by Dr. Joe Robbins, USDA, Athens, Georgia, to the farm of Mr. A. E. Hays, Mansfield, Georgia. The Hays farm consisted of fescue pastures being grazed by two separate herds of Angus cattle. One herd exhibited nearly all the signs associated with

NOW for CATTLE a Broader Spectrum Anthelmintic...

PANACUR®
(fenbendazole)

...an anthelmintic with the efficacy you expect, the safety you can trust and the economy you demand: Panacur (fenbendazole) Now for Cattle.

EFFICACY
Effectively removes all common gastrointestinal nematodes and lungworms.

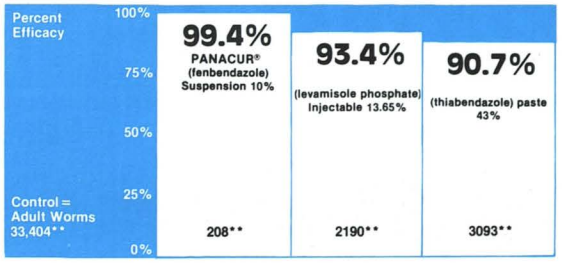
SAFETY
Safe in all beef cattle including breeding stock, pregnant cows and stressed cattle.

CONVENIENCE
Small volume dosage with "no-waste" gun, not only keeps drug cost per treatment low, but makes administration quick and easy. Saves time too!

Available only to Veterinarians

A Study Comparing Efficacy of Three Anthelmintics in Naturally Infected Cattle

Efficacy results, total adult worm burden*



* Data on file at American Hoechst Corporation, Animal Health Division, Somerville, N.J.
** Average number of adult worms recovered per treatment group.

Panacur® (fenbendazole) Cattle Dewormer
Suspension 10% (100 mg/ml)

DIRECTIONS: Determine the proper dose according to estimated body weight. Administer orally.

DOSAGE: Cattle - 5 mg/kg (2.3 mg/lb) for the removal and control of—Lungworm: *(Dictyocaulus viviparus).;* Stomach worms: Barberpole worm *(Haemonchus contortus),* Brown stomach worm *(Ostertagia ostertagi),* Small stomach worm *(Trichostrongylus axei);* Intestinal worms: Hookworm *(Bunostomum phlebotomum),* Thread-necked intestinal worm *(Nematodirus helvetianus),* Small intestinal worms, *(Cooperia punctata & C. oncophora),* Bankrupt worm (Trichostrongylus colubriformis), Nodular worm *(Oesophagostomum radiatum).*

The recommended dose of 5 mg/kg is achieved when 2.3 mL of the drug is given for each 100 lb. body weight.

EXAMPLES:	Dose	Cattle Weight
	2.5 mL	109 lb.
	5.0 mL	217 lb.
	10.0 mL	435 lb.
	15.0 mL	652 lb.
	23.0 mL	1,000 lb.

Under conditions of continued exposure to parasites, retreatment may be needed after 4-6 weeks. There are no known contraindications to the use of the drug in cattle.
WARNING: Cattle must not be slaughtered within 8 days following last treatment. Because a withdrawal time in milk has not been established, do not use in dairy cattle of breeding age.
CAUTION: Consult your veterinarian for assistance in the diagnosis, treatment and control of parasitism.
Sales to licensed veterinarians only.
Keep this and all medication out of the reach of children.

American Hoechst Corporation
Animal Health Division
Somerville, New Jersey 08876

Hoechst

REG TM HOECHST AG

the summer syndrome. The herd in the adjacent fescue pasture was not showing any signs of the summer syndrome. At that time, Mr. Hays had kept the herds separated in their respective pastures for 10 years. After making the original observations at the Hays farm, Dr. Robbins and colleagues, Drs. C. W. Bacon and J. K. Porter, hypothesized that a fungus was involved in the toxic syndrome and they began to examine the plants for fungi.

Most of the research team's efforts were concentrated on external fungi and until they became aware of work by J. C. Neil in New Zealand. Neil, in 1941, published results of his work showing that fescue is subject to infection with an endophyte. Dr. Bacon examined fescue from the toxic areas of the Hays farm in 1976 and found it to be 100% infected with the endophyte while the non-toxic pasture was only 10% infected. Samples of fescue from toxic and non-toxic pastures in Kentucky, Maryland, Missouri, and Virginia were collected and analyzed for the endophyte. Samples from toxic pastures were all infected while non-toxic samples had an infection rate of less than 50%.

Animal Response—Studies with animals consuming fescue containing the endophyte have shown the following animal response: (1) lower feed intake, (2) lower weight gains, (3) lower milk production, (4) higher respiration rate, (5) higher rectal temperature, (6) increased water consumption, (7) rough hair coat, (8) more time spent in shade, (9) excessive salivation, (10) greater urine volume, (11) reduced prolactin level, (12) reduced reproductive performance, and (13) nervousness. Some or all of these responses have also been observed in numerous studies in dairy cattle, beef cattle and sheep consuming endophyte-infected pasture, green chop, hay and/or seed.

Although all of the above responses are important, feed intake, weight gains, milk production and conception are of particular significance. University of Kentucky research conducted by Drs. R. Hemken, J. Boling and colleagues revealed a 39% reduction in forage intake and a 37% decrease in milk production during summer in lactating cows consuming endophyte-infected fescue. In addition, cows consuming endophyte-infected fescue lost weight, while animals consuming non-infected fescue gained weight.

Similar results have been found in grazing studies with beef cattle. Initial grazing studies at Auburn University (C. Hoveland, *et, al*) showed an increase in beef production of 185 pounds per acre with a 0.83 lb increase in average daily gain (ADG) with endophyte-free fescue compared to endophyte-infected fescue. Additional studies at Auburn and University of Kentucky have confirmed these early findings. Workers at the University of Kentucky (N. Gay, et al.) showed ADG for animals grazing fescue containing high levels of endophyte to be 0.81 lbs/day while animals consuming fescue containing low levels of endophyte gained 1.37 lbs/day. More recent studies (J. Boling, et al., 1983, University of Kentucky) showed 0.55 lbs/day increase in ADG of animals grazing low-endophyte KY 31 compared to infected KY31. In the same study, Johnstone (a newly released low-endophyte variety) resulted in a 0.97 lb/day increase in ADG over endophyte-infected KY 31. Animals grazing endophyte-infected fescue showed typical "summer syndrome" symptoms while animals consuming low-endophyte fescue remained healthy. Studies at Auburn University and University of Kentucky have shown increased intake and daily gains and lower body temperatures of steers consuming endophyte-free seed or hay when compared to endophyte-infected seed or hay.

Additional work is needed to determine the endophyte effect on reproductive performance. Preliminary data from Arkansas, using rabbits, showed a significant reduction in reproductive performance when the endophyte was present in the diet. Preliminary work in Kentucky by Gay, *et al.* (1983), using beef cows, showed a 19% increase in conception rate with cows grazing endophyte-free compared to highly infected fescue pastures.

Growth and Development —The endophytic fungus grows *between* the plant cells, overwintering in the perennial parts of the plant. In spring, fungus growth closely parallels tiller growth in fescue. The infected flower panicles produce infected seed. Within the seed, the fungus is located between the scutellum of the embryo and the aleurone layer. The primary method of transmitting the fungus is through the infected seed. The fungal hypha has not been detected in the roots or leaf blades; however, it has been found in leaf tissue but only in areas from the sheathing base to the proximal end of the ligule.

Distribution—Survey results from different states indicate that the majority of the established fescue is infected to some degree with the endophyte. Researchers at the University of Kentucky sampled over 200 fescue fields in 42 different counties during 1981. Ninety-seven percent of the fields were infected with the endophyte. Surveys conducted in Alabama by Auburn University personnel showed 95% of the tall fescue pastures to be heavily infected.

Spread—Preliminary data indicate that the spread of the fungus in fescue fields occurs slowly. Recent results by M. Siegel, *et al.,* in Kentucky with samples taken from adjacent fields established in 1974 indicate limited movement of the fungus across the border from a highly infected field to a field free of the endophyte. Auburn University researchers reported no substantial movement of the endophyte from an infected field to an non-infected field separated only by a fence.

Testing for Endophyte—Until 1981, determination of the presence of the endophyte in fescue was restricted to microscopic examination of pith cells from flowering tillers. This procedure was time consuming and could only be conducted within a short period during the spring when the plants were flowering. In 1981, Drs. M. Johnson, T. Pirone and M. Siegel, Plant Pathologists at UK, adapted a new and rapid technique for detecting the fungus in seed and plant tissue. This technique, ELISA (enzyme-linked immunosorbent assay) is based on a serological identification of the fungus and is extremely sensitive and specific. The

ELISA technique has tremendous potential to help answer a number of questions concerning the endophyte and its relationship to tall fescue.

At present, Auburn University Fescue Toxicity Diagnostic Center is the only commercial laboratory in operation to test seed and/or plant tissue for the endophyte. The function of the facility is to test seed or plant tissue samples submitted by producers to determine levels of infection of the endophyte. The Kentucky laboratory is currently testing seed for certification purposes.

Chemical Constituents and the Endophyte—A cause-effect relationship between the endophyte and a chemical component has not been shown conclusively. The endophyte has been shown through several research studies by Drs. L. Bush, R. C. Buckner, J. Boling and R. Hemken at the University of Kentucky, to be associated with the occurrence of alkaloids in tall fescue. Alkaloids are toxins that appear to be related to the summer syndrome condition. Additional work at UK has also shown a relationship between the endophyte and blood prolactin levels.

Workers at the University of Missouri (Garner, *et al.*) developed an ion-exchange chromotography method in which the chemical constituents of toxic fescue have been separated into a fraction (anion) that produces fescue foot and a fraction (cation) that produces the summer syndrome. The "anion fraction" contains the plant and fungal organic acids, whereas the "cation fraction" contains the plant and fungal alkaloids. Additional studies are needed to isolate a chemical or chemicals responsible for toxicity and to determine the interrelationships between the host plant: endophyte:toxic compound:animal.

Control of the Endophyte

Research from several states has demonstrated that the endophyte is associated with quality problems in tall fescue. Interdisciplinary teams of researchers at different locations are presently engaged in studies attempting to provide answers to many remaining questions concerning the endophyte and tall fescue. Advances have been made in breeding and selection of fungus-free plants. Research has shown that endophyte-free plants can be obtained by heat treatment of infected seed, aging seed and by fungicide treatment of seed. It has also been shown that the negative effects associated with the fungus can be diluted by growing other plants in combination with fescue.

Low Endophyte Varieties—Release of new varieties along with selection within currently available varieties will provide low-endophyte varieties for new plantings. Dr. R. C. Buckner recently released "Johnstone," a new tall fescue variety which contains low alkaloid and low-endophyte. This variety has shown excellent results in grazing and performance trials. In addition, selection within the variety Kenhy has also resulted in low-endophyte seed of this variety. Varieties with low levels of endophyte from other states include A. U. Triumph from Alabama, MO-96 from Missouri and Forager from Indiana. Since these varieties are relatively new, seed supplies are short. Johnstone, for example, is in the process of initial seed multiplication and certified seed is not likely to be available in large quantities until the fall of 1985 or spring of 1986.

Certification—A seed certification program has been implemented by the Kentucky Seed Improvement Association which provides testing, labeling and tagging of seed with low endophyte content. Standards allow 1% endophyte in Foundation Seed, 3% in Registered and 5% in Certified Seed.

Chemical Control—Fungicide treatment of the seed appears to offer tremendous potential for eliminating the endophyte in fescue seed. Researchers at Auburn University and the University of Kentucky have conducted extensive studies using many fungicide seed treatments. Although the initial work in this area was disappointing, most recent work shows considerable promise. An economical fungicide seed treatment (that could be farmer applied on any tall fescue seed to control the endophyte) has been most effective in laboratory and greenhouse tests and is presently being field evaluated. Treatment of plants in the field with systemic fungicides has not been successful with chemicals used to date. Preliminary data suggest the possibility of destroying endophyte-infected stands and replacing them with fungus-free stands, through the use of herbicides and notillage techniques.

Viability of Endophyte in Seed—Research has shown that the fungus dies in seed during storage. Auburn University researchers using on-farm storage conditions showed death of the endophyte in approximately 12 months. Siegel, *et l.* studied endophyte viability in seed stored at different temperatures. Seed stored at -20°C showed viable endophyte after 19 months while seed stored at 21°C showed a disappearance of the endophyte between 7 and 11 months, with no decrease in germination. Additional work is needed to determine effects of environmental factors during storage. Questions remain as to the practical application of using storage as a control measure commercially, especially with alternate control measures becoming available.

It has also been shown that the endophyte can be eliminated from small lots of seeds using hot water and heat treatments. Researchers at Auburn University showed eradication of the endophyte from seed that had been presoaked for 6 hours @ 5°C followed by 10 minutes @ 60°C. Kentucky workers eliminated the endophyte from seed stored at 49°C for 7 days.

Dilution—Sufficient data exist to show that the negative effects on animal performance associated with the endophyte and alkaloids can be diluted substantially by the presence of legumes in the animal diet. Hoveland, *et l.* showed even small amounts of birdsfoot trefoil or ladino clover in endophyte-infected fescue pastures sharply increased steer gains in Alabama. Kentucky workers have shown similar results. Gay, *et al.* showed a benefit of legumes in fungus-free fescue pastures. Cattle grazing

fungus-free Kenhy gained 1.37 pounds per day while cattle grazing fungus-free Kenhy that had been renovated with red clover gained 1.64 pounds per day.

Although many questions remain, the Tall Fescue Research Program in the Fescue Belt has resulted in major breakthroughs. We are possibly nearing discoveries which will answer many of the remaining questions relating to fescue quality and perhaps provide additional solutions. Cooperative interdisciplinary efforts will be required within and among states for this and forthcoming information to be of maximum benefit to livestock producers.

Literature reviewed by Dr. Garry Lacefield, Extension Forage Specialist, University of Kentucky.

The Effect of Unilateral Orchiectomy on Semen Quality in Bulls

Dwight F. Wolfe, *D.V.M., M.S.*
Robert S. Hudson, *D.V.M., M.S.*
Robert L. Carson, *D.V.M., M.S.*
Ram C. Purohit, *BVSc & AH, Ph.D.*
Department of Large Animal Surgery and Medicine
School of Veterinary Medicine
Auburn University
Auburn, Alabama 36849

Introduction

Inflammatory processes within the scrotum of the bull are common clinical occurrences. Numerous pathogenic bacteria, viruses, and fungi as well as trauma and neoplastic diseases may cause orchitis, periorchitis, or epididymitis in bulls. It is difficult to predict the long term effect of conservative (nonsurgical) therapy of these cases. The heat associated with the inflammatory process in one testicle produces degenerative changes in the contralateral testicle.[1] Reversibility of degenerative change depends upon the severity and duration of the insult. Morphologically abnormal sperm can appear in the ejaculate as early as 2 days following the onset of acute inflammation.[2,3] The magnitude of the added insult of scrotal surgery is presently known. One report shows that stallions were aspermic 30 days following the unilateral orchiectomy.[4]

This project was designed to determine: (1) if there was a decline in semen quality following unilateral orchiectomy; (2) the length of time required for semen quality to return to normal following surgery; (3) the magnitude and duration of alterations of normal scrotal thermographic patterns following surgery; and (4) comparison of the degree of surgical insult between bulls operated in winter and summer.

Materials and Methods

Nine mature mixed breed bulls (650 kg average weight) with good semen quality were used. On the day of surgery the bulls were restrained in a squeeze chute, scrotal circumference was recorded and semen was collected by electrojaculation. Semen was evaluated for motility and morphology according to the standards of the Society of Theriogenology.[5]

Each bull was restrained in a closed room and allowed to acclimate to room temperature. Five thermographic views[a] of the scrotum were taken as follows: left anterior (LA); left lateral (LL); posterior anterior (PA); right anterior (RA); and right lateral (RL). The large abdominal girth prevented direct frontal views of the scrotum.[6]

Beginning 2 days following surgery semen was collected and the scrotum thermographed on alternate days for 2 weeks and once weekly for 8 weeks. Mean environmental temperature was recorded for each sampling day.

The bulls were restrained in right lateral recumbency and induced with 10% thiamylal sodium[b] and maintained with halothane[c] inhalation anesthesia. The left rear leg was abducted and the scrotum clipped and disinfected with povidoneiodine[d].

A 15 cm vertical skin incision was made from near the base toward the apex on the lateral surface of the scrotum. The incision was deepened through the skin, tunica dartos, and scrotal fascia leaving the tunica vaginalis parietalis intact. The testicle in the parietal tunic was bluntly dissected from the scrotal fascia and a 12 cm incision was made through the tunica vaginalis parietalis beginning proximally and ending

[a] *Thermovision Model 680, AGA Infrared Systems AB, and AGA Model 101 OR, Infrared Systems AB, Lindingo, Sweden.*

[b] *Surital Veterinary, Parke Davis and Co., Detroit, MI.*

[c] *Fluothane, Ayerst Laboratories, New York, NY.*

[d] *Betadine Surgical Scrub, Purdne Frederick Co., Norwalk, Ct.*