PEER REVIEWED

# Case Report – Mastitis in Beef Bulls on a Feeding Test

**Emmanuel Rollin**[1], *DVM;* **Stephen C. Nickerson**[2], *PhD;* **Doug Ensley**[1], *DVM, MS;*
**Roy D. Berghaus**[1], *DVM, PhD, DACVPM (Epidemiology)*
[1]*Food Animal Health and Management Program, College of Veterinary Medicine, University of Georgia, Athens, GA 30602*
[2]*Department of Animal and Dairy Science, College of Agricultural and Environmental Sciences, University of Georgia, Athens, GA 30602*
*Dr. Ensley is currently with Fort Dodge Animal Health, Overland Park, KS 66210*
*Address correspondence to Dr. Rollin: emmanuelrollin@gmail.com*

**Abstract**

This case study describes an outbreak of mastitis in beef bulls in Georgia in the summer of 2007, and the observed effects of mastitis on measures of growth. Twenty-one of 97 bulls at a bull test station were found to have enlarged mammary glands with expressible fluid and purulent material. Bacteriologic culture of the exudates revealed numerous environmental pathogens. Treatment was attempted with intramammary infusion of chlorhexidine diacetate and intramammary antimicrobials, but did not result in clinical cure. Affected and unaffected bulls did not differ in average daily gain or weight per day of age. Reproductive consequences of mastitis could not be evaluated.

**Keywords:** bovine, bull, mastitis

**Résumé**

Cette étude de cas décrit une flambée de mammite dans des taureaux de boucherie de la Géorgie lors de l'été 2007 et les effets de la mammite sur les paramètres de croissance. Un total de 27 taureaux sur 97 à un poste d'évaluation des taureaux avaient des glandes mammaires élargies avec suintement de fluide et de matières purulentes. La culture bactériologique des exsudats a permis de déceler plusieurs pathogènes environnementaux. On a tenté un traitement avec une infusion intramammaire de diacétate de chlorhexidine et des antimicrobiens intramammaires mais sans obtenir de guérison. Les animaux atteints et les animaux sains ne différaient pas en termes de gain moyen quotidien ou de poids par jour d'âge. Il n'a pas été possible d'évaluer les conséquences reproductives de la mammite.

## Case Description

In July 2007, 101 purebred bulls between seven and 10 months of age and representing 10 beef breeds entered a bull test station in Calhoun, Georgia. The purpose of the program was to test and record weight gain under standardized management conditions. Bulls were weighed every 28 days for 112 days, and average daily gain (ADG) and weight per day of age (WDA) were calculated and used to compare growth performance of bulls within the same breed.

Bulls came from 31 different sources and were required to have a valid health certificate to enter the test. Vaccination with the following was required at least three weeks prior to entry: a multivalent infectious bovine rhinotracheitis virus, bovine viral diarrhea virus, parainfluenza-3 virus, bovine respiratory syncytial virus vaccine; a bacterin containing 5 *Leptospira* serovars; a 7-way clostridial bacterin-toxoid; a *Pasteurella multocida* bacterin; and a *Histophilus somni* bacterin. There were no specifications for type or brand of vaccine to be used. At arrival, bulls were tested for BVD persistent infection by ear notch immunohistochemistry; all were negative.

Bulls were housed as groups of six to 14 animals in 10 grass paddocks. Each two-acre paddock had a 30 ft by 30 ft (9.14 m x 9.14 m) permanent shade structure, and adjacent paddocks shared a water trough. Bulls were fed free-choice Coastal Bermuda grass hay from round bale feeders, and free-choice grain mix from a self-feeder. Fly control during the program was achieved with monthly application of moxidectin pour-on,[a] a generic ivermectin pour-on product, or a synthetic pyrethroid pour-on.[b] Fly control was considered adequate throughout the season by bull test employees, and by the investigators during their two visits. There was historic drought in this area of Georgia during the test period. During the day, the animals commonly lounged under the shade structures. These areas were generally muddy due to urine and fecal contamination. Nursing behavior between bulls was not observed by bull test employees during the feeding period.

The first case of mastitis was noticed on July 19 when an employee observed swelling on the cranial

aspect of the scrotum of one bull. Closer physical examination revealed a swollen mammary gland with purulent fluid expressible from the teat orifice. Employees observed the next case on August 23, and four more cases on September 25. At this time, the herd veterinarian was consulted, and samples of the exudate from two bulls were collected for bacteriological culture. These samples were submitted to a veterinary diagnostic laboratory, and yielded a positive culture of *Arcanobacterium pyogenes* and *Acinetobacter lwoffii*. The herd veterinarian then recommended treating the affected mammary glands of the two cultured bulls, as well as any other current or new cases, with a dry-cow intramammary antibiotic (cephapirin benzathine[c]). At this point, the herd veterinarian consulted with members of the University of Georgia Department of Animal and Dairy Science and the University of Georgia College of Veterinary Medicine for further work-up.

## Clinical Findings

The investigators examined a subsample of 58 bulls from pens with known cases of mastitis on October 18, 2007. These animals were examined because they were a suspected case or were housed in a pen with a suspected case; time constraints prevented examination of all animals. Fourteen of the 58 animals (24%) were found to have mastitis in one or more quarters. The working case definition was an enlarged mammary gland or the presence of serous fluid or purulent exudate that could be expressed from the teat orifice. The affected glands were swollen from 1.18 inches to 3.94 inches (3 cm to 10 cm) in diameter, and exudate ranging from clear fluid to thick purulent exudate could be expressed from affected teats. One to four glands per bull were affected. Secretions from teats were aseptically collected for bacteriologic culture, plated onto trypticase soy agar with 5% ovine blood, and identified to the species level. The majority of bulls examined had epidermal crusts in the inguinal region and on the teats. No other clinical signs were noted in affected or unaffected bulls.

The two bulls originally examined by the referring veterinarian (*Arcanobacterium pyogenes* and *Acinetobacter lwoffii* were cultured) and treated with intramammary cephapirin, were treated on October 18 by flushing the affected teats with 2% chlorhexidine diacetate solution[d] and leaving 2-5 mL of solution in the gland.[5] This represented an extra-label use of chlorhexidine, therefore a pre-harvest withdrawal time of 120 days was prescribed.

Cultures of 19 teat exudates sampled from 14 bulls on October 18 yielded the following bacteria: *Arcanobacterium pyogenes* (10 samples), coagulase-negative *Staphylococcus* spp (one sample), coliform bacteria (two samples), *Streptococcus* spp and *Staphylococcus* spp (one sample), and no growth (five samples). Cultures of teat scabs were positive for coagulase-negative *Staphylococcus* spp.

The investigators returned to the bull test station on November 12, 2007 to follow up bulls treated with chlorhexidine and cephapirin, and to examine all the animals. Three bulls had died from unrelated causes since the beginning of the test, and one bull passed through the chute before it could be examined, therefore a total of 97 bulls were examined during this visit. Twenty-one of the 97 animals (21%) were diagnosed with mastitis on that day, including those that had been diagnosed previously. Once again, secretions from teats found to fit the case definition were aseptically collected for bacteriologic culture. Affected bulls came from seven different pens, with no apparent spatial clustering.

Cultures of 26 teat exudates sampled from 21 bulls on November 12 yielded the following bacteria: *Arcanobacterium pyogenes* (15 samples), coagulase-negative *Staphylococcus* spp (two samples), *Staphylococcus aureus* (two samples), coliform bacteria (two samples), *Streptococcus* spp (two samples), and no growth (three samples). Examination of the two bulls treated with intramammary chlorhexidine diacetate during the initial visit showed no change in size of the affected glands, but the exudates were much thicker, and bacteriologic cultures from both bulls yielded no growth. The referring veterinarian's initial treatment of other bulls with dry-cow intramammary antibiotics alone did not resolve clinical signs, and subsequent cultures showed that bacteriologic cure was not achieved following the use of intramammary cephapirin.

Samples of hay and grain were taken on November 12, and submitted to a commercial laboratory[e] for analysis of zearalenone concentrations. Both samples were found to contain less than the detectable limit of 100 parts per billion.

Employees of the bull test station monitored the bulls after the second visit by the investigators. No new cases or progression of existing cases of mastitis were reported to the investigators. The investigators were not able to re-examine the bulls after the second visit to the bull test station. It is not known whether the cases of mastitis completely resolved.

## Outcome

At the end of the test period, mean ADG of affected bulls was not statistically different from that of unaffected bulls (4.23 lb/day vs 4.11 lb/day [1.92 kg/day vs 1.87 kg/day]; t-test $P$=0.337). Mean WDA for affected bulls was numerically greater, but not statistically different, than that for unaffected bulls (3.50 lb/day vs 3.39 lb/day [1.59 kg/day vs 1.54 kg/day]; t-test $P$=0.054).

Breeding soundness examinations were not a routine part of this bull test, and thus were not performed on these animals. Seventy bulls, including 18 that had been diagnosed with mastitis, met the requirements for the sale and were sold at an auction at the end of the test period. Bulls not in the top two-thirds of their breed for ADG or WDA were not eligible for the sale, nor were bulls with lameness or aggressive behavior. Mean sale price for bulls diagnosed with mastitis was similar to the sale price of unaffected bulls ($1,977.78 vs $1,761.54, respectively; t-test $P$=0.268).

## Clinical Relevance

Mastitis in individual bulls has been described in the literature,[2] but an outbreak among several bulls housed in close proximity to one another has not previously been reported. Although no significant differences in weight gain were recorded between affected and unaffected bulls, it is conceivable that a localized inflammatory process such as mastitis could have a negative impact on performance. Because of the proximity of the teats to the testicles, it is possible that mastitis may have effects on developing spermatozoa. The lesions did not appear painful to affected bulls, but pain in this area may decrease the willingness of bulls to mount females, and thus reduce their value as a breeding animal.

The root cause of this mastitis epidemic is still unresolved, but one hypothesis is that it may have been related to increased susceptibility of the mammary gland to invasion by opportunistic environmental pathogens. The normal mammary gland in male animals does not contain substrates for microbial growth, but under some hormonal signals, the gland could secrete milk proteins that could enable bacteria to reproduce within the gland.[6]

Research in male rats has shown that exposure to certain phytoestrogens can alter the development of mammary tissue in pubertal animals and induce secretion of material into alveolar lumena.[6,7] It is possible that these bulls were exposed to phytoestrogens in feed either before or during the feeding test, thereby inducing secretion of material by the gland. This secretion could facilitate colonization by opportunistic environmental bacteria and lead to an inflammatory response within the mammary gland. Zearalenone is a phytoestrogen occasionally found in animal feed in high enough levels to cause hormonal disruption, especially in sows.[3] Little data exists on the effects of zearalenone in cattle, especially in pubertal bulls. Even though the level of zearalenone in sampled feed was low, the sample did not represent what was fed to the bulls before mastitis was detected. A historical sample of feed would have been more diagnostic, but was not available. The summer heat and the presence of mud under the shade structures likely exposed the teat orifice to environmental bacteria.

Although fly control was thought to be adequate, flies could not be discounted as vectors of opportunistic pathogens. Flies have been implicated as vectors of "summer mastitis" in dairy heifers.[1] *Arcanobacterium pyogenes* has often been cultured from cases of summer mastitis and these microorganisms were also recovered from many of the bulls described in this report. Evidence of fly irritation was found on teats of several bulls examined by investigators. This irritation could increase the likelihood of bacterial colonization of teat skin, the teat canal, and subsequently the mammary tissue.

All bacteria recovered from the exudates were common environmental bacteria or bacteria commonly found on the skin of cattle. *Acinetobacter lwoffii* is a ubiquitous bacterium commonly found on the skin of healthy humans and in the environment, and has been implicated in bacteremia associated with immunosuppression in humans.[4] This bacterium has not previously been associated with mastitis in cattle. Culture-negative exudate samples could have been due to gram negative infections in which the inciting organism was no longer present but inflammation remained, or due to organisms, such as *Mycoplasma* spp, that cannot be cultured on blood agar.

Although not statistically significant, bulls with mastitis had numerically higher mean weight gains and sale prices than unaffected bulls. This observation could be consistent with a hypothesis of phytoestrogen contamination in the feed, where bulls that consume more feed will gain more weight, but also consume a higher total dose of phytoestrogens.

The value of these bulls lies in their breeding potential. Because breeding soundness examinations were not performed, we were unable to evaluate whether mammary infections had any effect on sperm quality. Another concern is the spread of *A. pyogenes* mastitis from bulls to nearby beef cows and heifers. This could occur by transmission of microbes via horn flies from teats of bulls to teats of cows and heifers in adjacent pastures, or while in close proximity during the breeding season. *A. pyogenes* intramammary infection is refractory to all antibiotics available to treat mastitis, and once these microorganisms establish intramammary infections in cows and heifers, affected glands become permanently nonfunctional and the growth rate of the suckling calf is diminished.

## Conclusions

Twenty-one of 97 bulls at a test station developed mastitis during the summer months. Several bacteria were cultured from the mammary gland exudates, but

treatment was ineffective. The contributing causes of the mastitis was not clearly defined.

## Endnotes

[a]Cydectin, Fort Dodge Animal Health, Overland Park, KS
[b]Cylence, Bayer Animal Health, Shawnee Mission, KS
[c]Cefa-Dri, Fort Dodge Animal Health, Overland Park, KS
[d]Nolvasan Solution, Fort Dodge Animal Health, Overland Park, KS
[e]Trilogy Analytical Laboratory, Washington, MO

## References


1. Chirico J, Jonsson P, Kjellberg S, Thomas G: Summer mastitis experimentally induced by *Hydrotoea irritans* exposed to bacteria. *Medical and Vet Entomology* 11:187-192, 1997.
2. Crosfield P: Mastitis in bull. *Vet Rec* 62:533, 1950.
3. Deen J, Dee S, Morrison RB, Radostits O: Health and production management in swine herds, in Radostits OM (ed): *Herd Health: Food Animal Production Medicine*, ed 3. Philadelphia, WB Saunders, 2001, pp 635-764.
4. Ku SC, Hsueh PR, Yang PC, Luh KT: Clinical and microbiological characteristics of bacteremia caused by *Acinetobacter lwoffii*. *Eur J Clin Microbiol Infect Dis* 19:501-505, 2000.
5. Middleton JR, Fox LK: Technical note: Therapeutic cessation of lactation of *Staphylococcus aureus*-infected mammary quarters. *J Dairy Sci* 84:1976-1978, 2001.
6. Wang XJ, Bartolucci-Page E, Fenton SE, You L: Altered mammary gland development in male rats exposed to genistein and methoxychlor. *Toxicol Sci* 91:93-103, 2006.
7. You L, Sar M, Bartolucci EJ, McIntyre BS, Sriperumbudur R: Modulation of mammary gland development in prepubertal male rats exposed to genistein and methoxychlor. *Toxicol Sci* 66:216-225, 2002.

## DESCRIPTION

CEFTIFLEX™ (ceftiofur sodium sterile powder) contains the sodium salt of ceftiofur, which is a broad-spectrum cephalosporin antibiotic active against gram-positive and gram-negative bacteria, including lactamase-producing strains. Like other cephalosporins, ceftiofuris bactericidal in vitro, resulting from inhibition of cell wall synthesis. Each mL of the reconstituted drug contains ceftiofur sodium equivalent to 50 mg ceftiofur. The pH was adjusted with sodium hydroxide and monobasic potassium phosphate.

## INDICATIONS

**Cattle:** CEFTIFLEX™ (ceftiofur sodium sterile powder) is indicated for treatment of bovine respiratory disease (shipping fever, pneumonia) associated with *Mannheimia haemolytica, Pasteurella multocida* and *Histophilus somni.* Ceftiofur Sodium Sterile Powder is also indicated for treatment of acute bovine interdigital necrobacillosis (foot rot, pododermatitis) associated with *Fusobacterium necrophorum* and *Bacteroides melaninogenicus.*

## DOSAGE AND ADMINISTRATION

**Cattle:** Administer to cattle by intramuscular or subcutaneous injection at the dosage of 0.5 to 1.0 mg ceftiofur per pound (1.1 to 2.2 mg/kg) of body weight (1-2 mL reconstituted sterile solution per 100 lbs body weight). Treatment should be repeated at 24-hour intervals for a total of three consecutive days. Additional treatments may be given on days four and five for animals that do not show a satisfactory response (not recovered) after the initial three treatments. Selection of dosage (0.5 to 1.0 mg/lb) should be based on the practitioner's judgment of severity of disease (i.e., for respiratory disease, extent of elevated body temperature, depressed physical appearance, increased respiratory rate, coughing and or loss of appetite; and for foot rot, extent of swelling, lesion and severity of lameness).

## CONTRAINDICATIONS

As with all drugs, the use of CEFTIFLEX™ (ceftiofur sodium sterile powder) is contraindicated in animals previously found to be hypersensitive to the drug.

## WARNINGS

NOT FOR HUMAN USE. KEEP OUT OF REACH OF CHILDREN.
Penicillins and cephalosporins can cause allergic reactions in sensitized individuals. Topical exposures to such antimicrobials, including ceftiofur, may elicit mild to severe allergic reactions in some individuals. Repeated or prolonged exposure may lead to sensitization. Avoid direct contact of the product with the skin, eyes, mouth and clothing. Persons with a known hypersensitivity to penicillin or cephalosporins should avoid exposure to this product. In case of accidental eye exposure, flush with water for 15 minutes. In case of accidental skin exposure, wash with soap and water. Remove contaminated clothing. If allergic reaction occurs (e.g., skin rash, hives, difficult breathing), seek medical attention. The material safety data sheet contains more detailed occupational safety information. To obtain a material safety data sheet (MSDS), please call 1-909-392-8900. To report any adverse event, please call 1-909-392-8900.

## PRECAUTIONS

The effects of CEFTIFLEX™ (ceftiofur sodium sterile powder) on the reproductive performance, pregnancy and lactation of cattle, swine, sheep and goats have not been determined.

**Cattle:** Following subcutaneous administration of ceftiofur sodium in the neck, small areas of discoloration at the site may persist beyond five days, potentially resulting in trim loss of edible tissues at slaughter. As with any parenteral injection, localized post-injection bacterial infections may result in abscess formation. Attention to hygienic procedures can minimize their occurrence.

## RESIDUE WARNINGS

**Cattle:** When used according to label indications, dosage and routes of administration, treated cattle must not be slaughtered for 4 days following the last treatment. When used according to label indications, dosage and routes of administration, a milk discard time is not required. Use of dosages in excess of those indicated or by unapproved routes of administration, such as intramammary, may result in illegal residues in edible tissues and/or in milk.

## ADVERSE REACTIONS

The use of CEFTIFLEX™ (ceftiofur sodium sterile powder) may result in some sign of immediate and transient local pain to the animal.

## STORAGE CONDITIONS

Store unreconstituted product at controlled room temperature 20° to 25° C (68° to 77° F) [see USP]. Store reconstituted product either in a refrigerator 2° to 8° C (36° to 46° F) for up to 7 days or at controlled room temperature 20° to 25° C (68° to 77° F) [see USP] for up to 12 hours. Protect from light. Color may vary from off-white to a tan color. Color does not affect potency.

## ONE-TIME SALVAGE PROCEDURE FOR RECONSTITUTED PRODUCT

At the end of the 7-day refrigeration or 12-hour room temperature storage period following reconstitution, any remaining reconstituted product may be frozen for up to 8 weeks without loss in potency or other chemical properties. This is a one-time-only salvage procedure for the remaining product. To use this salvaged product at any time during the 8-week storage period, hold the vial under warm running water, gently swirling the container to accelerate thawing, or allow the frozen material to thaw at room temperature. Rapid freezing or thawing may result in vial breakage. Any product not used immediately upon thawing should be discarded.

MED-PHARMEX™
ANIMAL HEALTH

PO BOX 110254 • Carrollton, TX 75011-0254
phone 800.587.4306 • www.med-pharmexanimalhealth.com

# ZERO MILK WITHDRAWAL.

Introducing CEFTIFLEX™ (ceftiofur sodium sterile powder) from Med-Pharmex™. With zero milk withdrawal, it's the new choice in antibiotic therapy that gives your clients the flexibility to manage challenges like foot rot and respiratory disease without sacrificing productivity.

**For more information about CEFTIFLEX, talk to your animal health supplier or visit www.med-pharmexanimalhealth.com.**