# Prevalence of Bovine Leukemia Virus in Young, Purebred Beef Bulls for Sale in Kansas

David P. Gnad, DVM, MS, DABVP[a]
Jan M. Sargeant, DVM, MS, PhD[b]
Peter J. Chenoweth, DVM, PhD, DACT[a]
Paul H. Walz, DVM, MS, PhD, DACVIM[b,c]

[a]*Department of Clinical Sciences*
[b]*Food Animal Health and Management Center*
*College of Veterinary Medicine*
*Kansas State University*
*Manhattan, KS 66506*

[c]*Current address: Department of Clinical Epidemiology and Biostatistics*
*McMaster University*
*1200 Main Street West*
*Hamilton, Ontario, Canada L8N 3Z5*

**KEY WORDS**: lymphosarcoma, leukemia, bull, bovine leukemia virus

## ABSTRACT

A study was conducted to determine the prevalence of bovine leukemia virus (BLV) in young (less than 2 years of age), purebred beef bulls for sale in the state of Kansas, and to identify geographic differences in BLV prevalence within the state. Serum samples from young, purebred beef bulls submitted to the United States Department of Agriculture for brucellosis testing as part of Kansas state requirements for the sale of breeding cattle identified 2,520 samples that were sent to Kansas State University for analysis. From this population, 775 serum samples were randomly selected and tested for the presence of BLV antibody using an agar immunodiffusion assay. Sixty-six samples were positive for BLV, corresponding to a statewide prevalence of 8.5%. The state was divided into four quadrants and prevalence levels were compared to identify significant differences in BLV prevalence within the state. These differences are critically important to those developing risk assessments as part of a biosecurity program.

*This study was funded by a Dean's Fund Grant from the Kansas State University College of Veterinary Medicine.*

## INTRODUCTION

Bovine leukemia virus (BLV) is a retrovirus that can infect cattle of all ages. The virus infects lymphocytes and produces a lifelong infection.[1] Infection rates are generally low in calves younger than 6 months of age and increase through about 3 years of age.[1] BLV is the causative agent of bovine lymphosarcoma. A low percentage of cows infected with BLV develop lymphosarcoma before slaughter.[2] In 1999, 1.1% of market cow and bull carcasses were condemned at slaughter, and 14.9% of these were condemned because of lymphosarcoma.[3] The number of carcass condemnations because of lymphosarcoma is rising, negatively affecting the beef industry.[4] BLV infection can also cause economic losses due to the inability to ship or sell animals, semen, embryos, and animal by-products to countries free of the disease or involved in eradication programs.

BLV infection can also increase the rate of culling, risk of mortality, and veterinary costs.[5–7] Studies have compared milk production in seropositive dairy cattle versus seronegative dairy cattle, yielding variable results.[6] Data do not exist to evaluate the effect of BLV on milk production and its

subsequent effect on calf weight or on reproductive rates in beef cattle.

If a producer desires to prevent the entrance of BLV into a herd through a biosecurity program, it is critical to have prevalence data for the population of animals from which the imported animals originate. Prevalence of BLV in beef cattle has been published as ranging from 1.2% to 10.3%.[8–10] However, the specific prevalence of BLV in young, purebred beef bulls has not previously been determined. The population used in the present study comprise strictly young, purebred beef bulls that have been raised for sale. There is the potential that this cattle population and the herds from which they originate are managed differently than commercial cattle herds or general beef herds, as documented in previous research.[8–10] This is an important issue to investigate, because differences in management practices can affect herd-level BLV prevalence.[10] Additionally, this population is important to study since the most common category of cattle imported into cow/calf herds is weaned bulls.[11] In 1996, 26.8% of cow/calf operations purchased, leased, or borrowed a new bull for breeding.[11] However, producers who import cattle do not frequently test for pathogens.[12] This may be due to an ignorance of the potential risk of pathogen entry or inaccuracy inherent in interpreting diagnostic tests without accurate prevalence data. Without knowing the sensitivity and specificity of a diagnostic test and the prevalence of disease, it is difficult to interpret a positive or negative result.[13]

This study therefore sought to determine the prevalence of BLV in young, purebred beef bulls in Kansas and to identify geographical differences within the state.

## MATERIALS AND METHODS

### Serum Samples

The United States Department of Agriculture (USDA) receives approximately 300,000 serum samples from the state of Kansas through the Federal Brucellosis Eradication Program (personal oral communication, Don Evans, DVM, MS, USDA, November 2000). These samples come from routine testing of cattle from livestock markets, slaughter facilities, and private farms. All breeding bulls sold in Kansas must be sampled by an accredited veterinarian and tested for *Brucella abortis*. For this study, all serum samples received by the USDA from young (less than 2 years of age), purebred beef bulls for sale in Kansas during 2001 were segregated after brucellosis testing, frozen at –20˚C, and sent to Kansas State University for storage at -80˚C within 3 months of submission.

Individual samples were identified with a sample number. Data were available on breed, age, county of origin, and group number, which was recorded by the submitting veterinarian. The group number identified a group of samples that were received by the USDA by a single veterinarian on a single day.

Seven hundred seventy-five samples were randomly selected from the 2,520 samples using the random number generator in Microsoft Excel (Microsoft). It was determined that random testing of 775 samples would allow the determination of statewide prevalence, with a 2% confidence width at a 95% confidence interval. For these calculations, an assumed prevalence of 10.3% was used, as reported in beef herds.[10]

### Laboratory Methods

Samples were stored at –80˚C until all 2,520 samples from 2001 were received. Groups of 60 were removed from storage three times weekly until all 775 samples were tested. Samples were thawed at room temperature and tested for antibody to BLV using an agar gel immunodiffusion (AGID) assay on the same day as thawing.[14]

### Geographical Stratification

Kansas was divided into north (NH) and south (SH) halves using county lines as the division. Similarly, the state was divided into a western half (WH) and eastern half

**Table 1.** Prevalence of Bovine Leukemia Virus Detected in Blood Samples from Beef Bulls at Livestock Sales in Kansas (2001)

| Region | Total Samples | No. Positive for BLV | Prevalence | 95% Confidence Interval |
|---|---|---|---|---|
| North | 520 | 36 | 6.9%[a] | 4.7%–9.1% |
| South | 255 | 30 | 11.8%[b] | 7.8%–15.8% |
| East | 468 | 53 | 11.3%[c] | 8.4%–14.2% |
| West | 307 | 13 | 4.4%[d] | 2.1%–6.7% |
| Quadrant 1 | –- | –- | 4.7%[b,d] | 2.1%–8.0% |
| Quadrant 2 | –- | –- | 9.1%[b] | 5.6%–12.6% |
| Quadrant 3 | –- | –- | 2.0%[b,e] | 0.1%–10.4% |
| Quadrant 4 | –- | –- | 14.2%[c,f] | 9.4%–19.1% |
| **Total** | **775** | **66** | **8.5%** | **6.5%–10.5%** |

Percentages within region grouping with different superscript letters are significantly different ([a,b]$P < .02$; [c,d]$P < .001$; [e,f]$P < .04$

(EH). The halves were approximately equal in geographic size. The state was also divided into four approximately equally sized quadrants (Q1, Q2, Q3, Q4), using the division lines that were utilized for dividing the state into halves.

**Statistical Analysis**

Statewide, NH, SH, WH, EH, Q1, Q2, Q3, and Q4 prevalences were determined by calculating the proportion of positive samples within the population tested. Prevalence for NH versus SH and WH versus EH were compared using an unweighted logistic regression model, with the outcome corresponding to the presence or absence of BLV antibodies. Prevalence was also compared between quadrants (Q1, Q2, Q3, Q4) using an unweighted logistic regression model. For all analyses, values of $P < .05$ were considered significant. The statistical software Statistix7 (Analytical Software) was used for all statistical analysis.

## RESULTS

A total of 2,520 samples from young, purebred beef bulls were collected by the USDA in Kansas during 2001. Of the 775 samples randomly selected and tested for BLV from this population, 66 samples were positive, resulting in a statewide prevalence of 8.5% (Table 1). The distribution of samples was 520 cattle tested in the NH and 255 samples tested in the SH (Table 1). The difference in BLV prevalence between NH (6.9%) and SH (11.8%) was significant ($P = .02$). In the EH, 53 of 468 samples were positive for BLV and of 307 samples tested in the WH, 13 were positive. Prevalence of BLV was significantly ($P \leq .001$) higher for EH than for WH (Table 1). Quadrants 1 through 4 had prevalence values of 4.7%, 9.1%, 2.0%, and 14.2%, respectively. The difference in BLV prevalence among quadrants was significant, with Q4 significantly ($P \leq .001$) higher than Q1 and Q3 ($P = .04$). BLV prevalence among Q1, Q2, and Q3 were not significantly different.

## DISCUSSION

Results of this study indicate that young, beef bulls purchased in Kansas may be infected with BLV, which could lead to exposure to the virus in a recipient herd. The study population was a randomly selected subset of all young, purebred beef bulls that were sold within Kansas for breeding purposes in 2001. This is an important population to evaluate because young, purebred beef bulls are commonly purchased and introduced into cow/calf herds. However, this population does not represent the entire population of beef cattle within the state and may not be representative of beef bulls in other geographic areas.

The number of samples tested in each quadrant generally reflected the distribution of beef cows in Kansas, but not the total number of bovines.[15] This was expected, given that the feedlot industry is concentrated within certain areas of the state.

There were statistical differences in prevalence between different geographical areas within Kansas. In a previous study, differences in prevalence were identified within the United States.[10] This study identifies prevalence differences within a smaller geographical area, therefore suggesting that broad recommendations for BLV prevalence at the national level may be inaccurate in some areas. Understanding the differences in prevalence will enable a veterinarian to give a more accurate assessment of the level of risk in a biosecurity program. For example, the risk of purchasing a bull that is positive for BLV is higher if the bull is purchased from the eastern part of Kansas than if the bull is purchased from the western part of Kansas.

This study was not designed to identify the cause of prevalence differences. However, insects have been incriminated in transmitting BLV in cattle.[1] There are environmental differences within Kansas that could influence the type or quantity of vectors able to carry BLV. If this is the case, more rigorous vector-control programs could decrease BLV prevalence in these areas. Prolonged physical contact with infected cattle has been implicated as a risk factor for BLV transmission.[1] In Kansas, the western part of the state generally has lower beef cow stocking densities than does the eastern part of the state. This is primarily due to the dryer environment and differing pasture forage. Stocking density could play a role in the ability of BLV to transfer from animal to animal. If so, the higher stocking density could be a factor in the increased prevalence. Additional study is needed to identify risk factors in specific geographical areas for BLV, thus allowing for the potential to mitigate or manage such risks.

Based on results of this study, it is recommended that producers purchasing cattle consider young, purebred beef bulls as a potential risk for BLV exposure. The risk of young, purebred beef bulls being positive for BLV might vary depending on the geographical region from which the bull is being purchased. Beef herds could already contain cattle that are positive for BLV. If this is the case, the addition of another positive animal may increase the exposure rate for negative animals in the herd. Purchasing a BLV-positive bull also increases the likelihood of that bull developing lymphosarcoma. Although the likelihood of a BLV-positive animal developing lymphosarcoma is small, this consideration may be important depending on attitudes of the producer and cost of the bull.[2]

## REFERENCES


1. Hopkins SG, DiGiacomo RF: Natural transmission of bovine leukemia virus in dairy and beef cattle. *Vet Clin North Am: Food Anim Pract* 1997; 13:129–141.
2. Thurmond MC, Holmberg CA, Picanso JP: Antibodies to bovine leukemia virus and presence of malignant lymphoma in slaughtered California dairy cattle. *J Natl Cancer Inst* 1985; 74:711–714.
3. Roeber DL, Mies PD, Smith CD, et al: National market cow and bull beef quality audit, 1999. *J Anim Sci 2001*; 79:658–665.
4. Thurmond MC, Lapuz GR, Farver TB, Mandac GC: Retrospective study of four years of carcass condemnation rates for malignant lymphoma in California dairy cows. *Am J Vet Res* 1985; 46:1387–1391.
5. Chi Junwook, VanLeeuwen JA, Weersink A, Keefe GP, Chi J: Direct production losses and treatment costs from bovine viral diarrhea virus, bovine leucosis virus, *Mycobacterium avium* subspecies *paratuberculosis*, and *Neospora caninum*. *Prev Vet Med* 2002; 55:137–153.
6. Pelzer KD: Economics of bovine leukemia virus infection. *Vet Clin North Am Food Anim Pract* 1997; 13:129–141.
7. Pollari FL, DiGiacomo RF, Evermann JF: Use of survival analysis to compare cull rates between bovine leukemia virus seropositive and seronegative dairy cows. *Am J Vet Res* 1993; 54:1400–1403.
8. Baumgartener LE, Olson C, Miller JM, Maaten MJ: Survey for antibodies to leukemia (C-type) virus in cattle. *JAVMA* 1975; 166:249–251.
9. Burridge MJ, Puhr DM, Hennemann JM: Prevalence of bovine leukemia virus infection in Florida. *JAVMA* 1981; 179:704–707.

10. United States Department of Agriculture: APHIS:VS. R*eference of 1997 Beef Cow-Calf Production Management Practices.* No. N247.198. Fort Collins, CO: Centers for Epidemiology and Animal Health, 1997.

11. United States Department of Agriculture: APHIS:VS. *Part II:* No. N238.797. Fort Collins, CO: Centers for Epidemiology and Animal Health, 1997.

12. Sanderson MW, Gay JM: Veterinary involvement in management practices of beef cow-calf producers. *JAVMA* 1996; 208:488–491.

13. Martin SW, Shoukri M, Thorburn MA: Evaluating the health status of herd based on tests applied to individuals. *Prevent Vet Med* 1992; 14:33–43.

14. Evermann JF, Jackson MK: Laboratory diagnostics tests for retroviral infections in dairy and beef cattle. *Vet Clin North Am Food Anim Pract* 1997; 13:87–103.

15. National Agricultural Statistical Services Web Site: Agricultural statistics database, livestock county data. Available at: http://www.nass.usda.gov:81/ipedb/. Accessed December 5, 2003.