

# Bovine Coronavirus Infections in Transported Commingled Beef Calves and Sole-source Ranch Cattle

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## Introduction

Bovine respiratory diseases (BRD) occurring in the feedlot represent the major disease entity during the feeding period. Several bacteria, viruses, and *Mycoplasma* spp are reported as causative agents. Feedlot BRD may occur at various times, although the early disease appearing after arrival and processing often receives the most attention. In addition to bovine herpesvirus-1 (BHV-1), bovine viral diarrhea viruses (BVDV), bovine respiratory syncytial virus (BRSV), bovine parainfluenza-3 virus (PI-3V), bovine coronavirus (BC) infections have been found in BRD cases. Potentially the case can be made for the use of vaccines to control BCV disease. There are no USDA APHIS CVB licensed vaccines for respiratory disease in the US.

The purpose of this study was to: 1) determine the presence of BCV in cattle entering the feedlot from auction markets commingled and shipped to the feedlot and the dynamics of infection over time, and 2) determine the BCV antibody levels in ranch raised (direct from the ranch and not commingled with other cattle) cattle entering the feedlot.

## Materials and Methods

Three groups of cattle were purchased in 2009 from auction markets in Louisiana, Mississippi, and Ohio and shipped to the OSU Sparks facility and held for six months or more. Cattle were vaccinated at entry with a five way modified live virus (MLV) vaccine, and in some studies revaccinated with a MLV vaccine. For each study, Study 1-3, a group of 20-22 calves was selected as sentinels and held in multiple pens with the other cattle in the shipment. A blood sample was collected at entry for serum, and a nasal swab for viral isolation was collected as well. In Study 1 and 2, weekly samples were collected for nasal swabs and lung lavage samples and a blood sample was collected for serum on day 56. For both Study 1 and 2, sick cattle from the entire shipment, including sentinels, were sampled for up to one month post arrival.

For Study 3 the calves were bled for serums on day 150. The nasal swabs were tested for BCV by inoculation on HRT cells (human rectal tumor cell line susceptible to BCV) and MDBK cells. Selected nasal swabs were also tested for BCV by a reverse transcriptase PCR test for BCV. BCV antibodies were assayed by a viral neutralization test in 96-well microtiter (VNT) in HRT cells using a cytopathic BCV strain. Assays for BVDV and BHV-1 were performed using a VNT in MDBK cells.

Calves in a retained ownership program (2001 and 2002) delivered direct from ranches for delivery to a commercial feedlot were bled for serotesting for several viruses.

## Results

In the three 2009 studies at OSU there was evidence of BCV infection both by BCV isolation and seroconversion to BCV. In Study 1, there were 9/22 (41%) of the sentinel calves with viral isolations of BCV in nasal swabs and lung lavages in the day 0 collections, but the calves cleared the infections in the day 8 and day 14 collections. Six of 13 (46.2%) of the sick calves in the first four days were BCV positive in the nasal and lung samples. For the sentinel calves there were 75% that seroconverted to BCV. In Study 2, there were 15/20 (75%) that were positive for BCV in the nasal swabs and 8/20 (40%) in the lung lavages. The calves cleared the BCV infections by day 8. In the sick calves through day 4 there were 4/18 (22.2%) that were BCV positive either in the nasal swab or lung samples. For the sentinel calves there were 95% (19/20) that seroconverted to BCV. In Study 3, 19/20 (95%) were BCV positive in the nasal swabs on day 0, and 90% of the sentinel calves seroconverted to BCV. In Study 1 and 2, BHV-1 and BVDV1 were isolated in selected post arrival samples, and in Study 2 BVDV 1a strains were isolated from nasal swabs or BAL samples collected after vaccination. These BVDV were sequenced as vaccine origin.

There were 159 calves from 18 ranches in 2001 and 156 calves from 17 ranches received into the commercial

feedlot in 2002. There was considerable difference in the BCV antibody levels among the herds with geometric means of 2.6 to 4096. There is quite a diverse population of herds with BCV exposure prior to deliver to auction markets or to the feedlot. Also the level of BCV antibodies indicated that calves' with BCV antibody titers of 16 or below were more likely to be treated for BRD than calves with titers of 32 and above ( $P$ -value = 0.0018).

### **Significance**

These studies confirmed that commingled calves from mixed-source auction market calves may be in-

fectured at day 0, and will in most all cases seroconvert during the initial phase in the feedlot phase, and that the calves will clear the infection in the initial 1-2 week post-arrival period. BCV infections occurred in both healthy and sick calves in the early phase.

Calves direct from the ranch may be either seronegative or with extremely low antibodies, and in other cases have extremely high levels of BCV antibodies. The potential for BCV immunoprophylaxis appears to be best suited for delivery of vaccines at the ranch prior to delivery to the feedlot or to the commingling at auction markets. Efforts are underway to develop a model of viral challenge to measure BCV vaccine efficacy.