ARTICLE

Efficacy of a feed-additive antibacterial combination for improving feedlot cattle performance and health

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Abstract

The effectiveness of a feed-additive antimicrobial combination for improving feedlot performance and health was tested using 4325 high-risk feeder calves randomly allocated to a control group or an experimental group. The experimental group received the conventional ration plus a feed additive containing 700 mg per head/day of chlortetracycline and sulfamethazine from arrival at the feedlot to day 56 of the feeding period. The inclusion of the feed additive to the ration significantly improved average daily gain for days 0–28 ($P = 0.0163$) and 0–56 ($P = 0.0001$), and the feed conversion for days 0–28 ($P = 0.0061$) and 0–56 ($P = 0.0004$). Additionally, the use of the feed additive significantly reduced the rate of bovine respiratory disease morbidity for days 0–28 ($P = 0.0014$) and 0–56 ($P = 0.0001$), the rate of relapses and mortality for days 0–56 ($P = 0.0151$ and $P = 0.0209$, respectively), and the rate of animals diagnosed with chronic respiratory disease for days 0–28 and 0–56 ($P = 0.0009$ and $P = 0.0002$, respectively). Performance and health improvements produced by the use of the feed additive were cost-effective.

Résumé

L'efficacité d'un additif alimentaire antibactérien combiné pour améliorer la performance et la santé des bovins en parc d'engraissement

Cette étude évalue l'efficacité d'un additif alimentaire combiné afin d'améliorer la performance et la santé des bovins en parc d'engraissement. Quatre mille trois cent vingt-cinq veaux, considérés à haut risque, ont été répartis de façon aléatoire dans un groupe témoin ou dans un groupe expérimental. Les animaux du groupe expérimental ont reçu un additif alimentaire combiné de chlortétracycline-sulfaméthazine, 700 mg/animal/jour, dans leur ration alimentaire du jour 1 au jour 56 de leur séjour en parc d'engraissement. L'additif alimentaire présent dans la ration du groupe expérimental améliore de façon significative le gain moyen de poids corporel quotidien pour les périodes de 0 à 28 jours ($P = 0,0163$) et de 0 à 56 jours ($P = 0,0001$) ainsi que la conversion alimentaire pour les périodes de 0 à 28 jours ($P = 0,0061$) et de 0 à 56 jours ($P = 0,0004$). De plus, l'utilisation de l'additif alimentaire a réduit de façon significative le taux de morbidité pour les maladies respiratoires bovines pour les périodes de 0 à 28 jours ($P = 0,0014$) et de 0 à 56 jours ($P = 0,0001$); les taux de rechute et de mortalité pour la période de 0 à 56 jours (respectivement de $P = 0,0151$ et de $P = 0,0209$) et le taux d'animaux atteints d'une maladie respiratoire chronique pour les périodes de 0 à 28 et de 0 à 56 jours (respectivement de $P = 0,0009$ et de $P = 0,0002$). En conclusion, l'ajout de cet additif alimentaire a accru la performance et amélioré la santé des animaux et présente un bon rapport coût/bénéfice.

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Introduction

Newly arrived, feedlot cattle are prone to respiratory diseases induced by the stresses inherent in the weaning, shipping, processing, and commingling of animals of various sources. The clinical syndrome defined as bovine respiratory disease (BRD) continues to be the most economically significant health problem in calves entering feedlots in North America, especially during the months of September, October, November, and December. Although feedlots have become considerably more sophisticated in managing health problems, the expected BRD morbidity and mortality rates range from 15% to 45% and 1% to 5%, respectively (1). Pneumonia, particularly that caused by *Pasteurella haemolytica,* results in significant mortality and annual economic losses to the industry estimated in excess of $1 billion (2). Other organisms, such as infectious bovine rhinotracheitis (IBR), bovine viral diarrhea (BVD), parainfluenza-3 (PI_3), and bovine respiratory syncytial (BRS) viruses, *Haemophilus somnus,* and *P. multocida,* also play a significant role in producing disease in these animals and complicating the multifactorial nature of this complex, thus making it difficult to prevent and treat (3).

The epidemiological patterns of BRD morbidity have been reviewed (1,4,5), and the indications are that,

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while morbidity is at its peak during the first 2 to 3 wk after arrival, there are 2 waves of mortality that extend for approximately 2 mo. In western Canada, "shipping fever," or fibrinous pneumonia, is the most common clinical and necropsy diagnosis representing the first wave of mortality, while mortality due to *H. somnus*, which occurs later, today represents the higher mortality risk (6).

There is considerable interest in developing programs that combine existing vaccines against specific respiratory pathogens and strategic medication, given either orally or parenterally, that would reduce and, eventually, totally control BRD-related morbidity and mortality, while improving performance. It was speculated that, by extending the period of use of a feed-additive antibacterial combination from 28 to 56 d, it would be possible to further improve health and, therefore, performance in a cost-effective manner.

Materials and methods

Animals

Four thousand three hundred and twenty-five, newly weaned, cross-bred calves of both sexes, weighing an average of 260 kg, were used in this trial. Calves with these characteristics are considered at high risk for bovine respiratory disease (1). While some calves were sourced directly from ranches, approximately 80% of the animals utilized were purchased through the auction market system and entered the feedlot between October 22 and November 20, 1992.

Animals on arrival were separated by sex, classified by body weight in three categories: light, standard, and heavy (<200 kg, 200–250 kg, and >250 kg, respectively), and then, within each category, randomly allocated to 2 pens. By this procedure, heifer and steer pens contained animals of the 3 body weight categories, and therefore, extensive mixing of source groups occurred. Each pair of pens was filled within a maximum of 3 d and randomly allocated to 1 of the 2 treatments. Each pen in this study should be considered an "epidemiological unit."

Within 24 h of arrival at the feedlot, calves were processed following a standardized protocol, which included individual identification with a number and a color-coded, permanent ear tag. This protocol consisted of an implant (Compudose, Elanco, London, Ontario); 3 mL, IM, of vitamins A-D injectable (rogar/STB, Pointe Claire/Dorval, Quebec); 1 mL/50 kg BW, SC, of an parasiticide (Ivomec Merck Agvet, Pointe Claire/Dorval, Quebec); 2 mL, IM, of a modified live IBR-PI_3 vaccine (Coopers MLV IBR-PI_3, Coopers, Ajax, Ontario); 4 mL, SC, of an 8-way clostridial vaccine (Tasvax-8, Coopers, Ajax, Ontario); and 2 mL, IM, of an *H. somnus* vaccine (Somnustar, Biostar, Saskatoon, Saskatchewan). The calves were taken to their designated home pen after being processed.

Housing and feeding

The calves were housed in 20 pens with a capacity for 195 to 235, typical of feedlots in western Canada. They were fed twice daily with a series of starter rations, consisting of silage (corn, alfalfa, and barley), rolled grain (barley or wheat), and supplement. The two groups, control and experimental, were both fed a pelleted concentrate, topdressed over the silage at a rate of 0.7 kg per head per day, once daily, for the trial period. The concentrate fed to the experimental group contained an antimicrobial feed additive (Aureo S-700 G, Cyanamid Canada Inc., Guelph, Ontario) that provided 350 mg chlortetracycline and 350 mg sulfamethazine per head per day. To ensure total consumption of the pelleted concentrate, the dry matter intake was adjusted biweekly according to Hutcheson and Cole (7). The calves were also fed long cut hay in the bunk for the initial 3 wk until consumption of silage was consistent. After the 56-d trial period, the cattle were conditioned to a high concentrate ration, containing an ionophore (Posistac, Pfizer, Pointe Claire/Dorval, Quebec) and an antibiotic (Tylan, Elanco, London, Ontario). This ration was fed until the cattle were marketed. Cattle were shipped to slaughter on a pen basis without any sorting.

Experimental design

The 2 treatments involved were the conventional ration, given to the control group, and the conventional ration containing the feed additive, given to the experimental group. The control group had 2164 head, housed in 10 pens, and the experimental group had 2161 head, housed in 10 pens. Pens were filled in October (6 control and 6 experimental) and November (4 control and 4 experimental).

Both performance and health parameters were measured. The performance parameters were average daily gain (ADG) and feed conversion (FC) at days 28 and 56 and "close-out" (when all animals from a given pen were shipped to slaughter); feed cost per 100 lb. of body weight gain (feed cost per centiweight (CWT) gain) and total cost per 100 lb. of body weight gain (total cost per CWT gain) at close-out. The health parameters were BRD morbidity and relapses, mortality (total, and due to BRD, hemophilosis, nonspecific lameness, and other causes), animals that presented symptoms of a chronic disease or "chronics" (total, due to respiratory causes, and lameness), and medicine cost, per pen and per head, at days 28, 56, and close-out.

Definitions

The following definitions were used to evaluate morbidity, relapses and chronic cases:

Morbidity: each pen was checked once or twice daily by experienced observers for "sick" cattle. The experimental status of each pen was unknown to the pencheckers. Calves considered "sick" were moved out of the pen into the hospital facility. A diagnosis of BRD was made by the feedlot veterinarian if the individual's rectal temperature was ≥40.5°C and there were no clinical signs referable to organ systems other than the respiratory tract. After treatment animals were returned to their home pen.

Relapses were defined as animals, returned to the home pen following initial treatment for BRD, that were subsequently selected as "sick" by the pencheckers, and again fulfilled the above criteria for a diagnosis of BRD.

Chronics were defined as calves that failed to respond to the standard treatment protocol. Chronic calves were sent to a "chronics" pen following unsuccessful therapy for

Table 1. Effect of treatment on performance parameters

	Control	Experimental	SE	*P*-value
Animals placed	2164	2161		
Animals slaughtered	2075	2108		
Weight (kg) day 0	259.2	260.5	8.88	0.8998
Weight (kg) at close-out	503.7	504.6	4.11	0.8647
Days on feed	206.6	203.2	4.82	0.5586
ADG (kg) 0–28 days	1.01[b]	1.22[a]	0.07	0.0163
ADG (kg) 29–56 days	0.65[b]	0.88[a]	0.08	0.0268
ADG (kg) 0–56	0.83[b]	1.05[a]	0.03	0.0001
ADG (kg) 0–close-out	1.16[c]	1.20[d]	0.02	0.0770
Feed conversion 0–28 d	4.81[b]	4.10[a]	0.20	0.0061
Feed conversion 29–56 d	12.69[b]	7.98[a]	2.16	0.0836
Feed conversion 0–56 d	7.28[b]	6.02[a]	0.24	0.0004
Feed conversion 0–close-out	6.67[d]	6.38[c]	0.14	0.0987

[a,b]Least-squares means in the same row with different superscripts differ ($P < 0.05$)
[c,d]Least-squares means in the same row with different superscripts differ ($P < 0.1$)
SE: Standard error of the least-squares mean
ADG: average daily gain
Control animals received conventional ration
Experimental animals received conventional ration containing 350 mg chlortetracycline and 350 mg sulfamethazine per head per day for the first 56 d after arrival at the feedlot

a third relapse. These animals were included in the analysis of performance and health of each treatment group.

BRD mortality cases were defined by the presence of pneumonia at postmortem.

***Haemophilus somnus* mortality** cases were defined by the presence of gross lesions of encephalitis or myocarditis at postmortem.

Lameness rate was calculated by classifying an animal as lame when it had a limb that was so stiff or sore that it impaired the calves' normal movement.

Mortality due to lameness included lame animals that died without other symptoms or lesions at post mortem, and those that were euthanized because they were unable to rise.

Mortality due to other causes included deaths due to causes not listed above, such as bloat, fractures, etc.

Treatment regime

Calves placed on therapy were treated initially with tilmicosin (Micotil, Elanco, London, Ontario), 1 mL/30 kg BW, SC. Relapses were treated with oxytetracycline (Oxymicine LP, Langford, Guelph, Ontario), 3 mL/45 kg BW, IM or trimethoprim/sulphadoxine (Trivetrin, Coopers, Ajax, Ontario), 3 mL/45 kg BW, IM.

Necropsies

Every animal that died during the study was subjected to necropsy by the feedlot veterinarian. All internal organs in the throracic and abdominal cavities, together with the brain and abnormal joints or limbs suspected of being affected, were visually examined.

Statistical analysis

A regression analysis of variance (ANOVA) was utilized to study the effects of treatment, sex, date of arrival, and their interactions on performance and economic parameters. The General Linear Models procedure of the Statistical Analysis System (8) was used for these analyses. A least-squares analysis (9) was used to obtain the least-squares estimates of differences between treatments for comparison purposes.

A logistic regression model using Generalized Estimated Equations (10) was utilized to study the effects of treatment, sex, date of arrival, and their interactions on health parameters. A Statistical Analysis System (8) macro (11) was used to fit this model, using a correction for clustering (12). The predicted values of the rate of a parameter, based on the fit of the model, were used to show the differences between treatments for comparison purposes.

Results

Performance parameters

The number of animals placed and shipped to slaughter, the initial and final weights, the days on feed, and the effects of treatment on ADG and FC are shown in Table 1.

The effect of sex was significant for weight at close-out ($P = 0.0001$), with males weighing more than females (532.6 vs 475.8 kg, respectively), despite no statistical differences at arrival (females 250.6 kg vs males 269.1 kg); for ADG at close-out ($P = 0.0001$) with males having better ADG than females (1.30 vs 1.06 kg); for FC at close-out ($P = 0.0001$), with males having better FC than females (5.36 vs 7.68).

The effect of date of arrival was significant for ADG for days 0 to 28 ($P = 0.0050$), days 0 to 56 ($P = 0.0071$), and days 0 to close-out ($P = 0.0807$), with animals placed in October gaining more weight in the first 56 d than those placed in November (1.26 vs 0.97 kg for 0 to 28 d; 0.99 vs 0.89 kg for 0 to 56 d, respectively).

Table 2. Effect of treatment on the rate of health parameters for the period 0 to 28 days

	Control	Experimental	SE	*P*-value
BRD morbidity rate	24.82[b]	18.80[a]	1.63	0.0014
Relapses (1×) rate	2.22[d]	1.43[c]	0.48	0.0512
Relapses (2×) rate	0.89	0.82	0.17	0.7642
Total chronics rate	2.61[b]	1.03[a]	0.44	0.0009
Chronics respiratory rate	1.92[b]	0.70[a]	0.39	0.0080
Lameness rate	0.50[b]	0.23[a]	0.15	0.0477
Total mortality rate	0.77	0.54	0.14	0.2501
BRD mortality rate	0.41	0.33	0.09	0.5755
HS mortality rate	0.10	0.13	0.06	0.7039
Mortality rate due to lameness	0.23	0.06	0.06	0.2041
Mortality rate due to other causes	0.11	0.05	0.04	0.5485

[a,b]Rates of health parameters in the same row with different superscripts differ ($P < 0.05$)
[c,d]Rates of health parameters in the same row with different superscripts differ ($P < 0.1$)
SE: Standard error of the least-squares mean
BRD: bovine respiratory disease
Relapses (1×): First relapse, represents the second time that an animal is medicated against the same disease
Relapses (2×): Second relapse, represents the third time that an animal is medicated against the same disease
HS: *Haemophilus somnus*
Control animals received conventional ration
Experimental animals received conventional ration containing 350 mg chlortetracycline and 350 mg sulfamethazine per head per day for the first 56 d after arrival at the feedlot

The effect of date of arrival was significant for FC for days 0 to 28 ($P = 0.0001$) and 0 to 56 ($P = 0.0020$), with animals placed in October again having better FC than those placed in November (3.73 vs 5.18 for 0 to 28 d; and 6.06 vs 7.24 for 0 to 56 d, respectively).

No interactions were observed among treatment, sex, and date of arrival for any of these parameters.

Health parameters

Days 0 to 28 — The effects of treatment on these parameters are recorded in Table 2. Sex showed a significant effect on the rate of relapses ($P = 0.0015$) and total chronics ($P = 0.0340$), and a trend toward affecting the rate of BRD disease ($P = 0.0629$), chronics due to respiratory causes ($P = 0.0949$), and lameness ($P = 0.0751$), with females having, in all cases, lower rates than males.

There was a significant effect of date of arrival on the rate of BRD morbidity ($P = 0.0002$) and relapses ($P = 0.0012$), with higher rates in animals arriving in October, and on the rate of lameness ($P = 0.0006$), with higher rates in those arriving in November.

No interactions were observed among treatment, sex, and date of arrival on any of these parameters.

Days 0 to 56 — The effects of treatment on these parameters are provided in Table 3. Sex showed a significant effect on the rate of BRD morbidity ($P = 0.0375$), relapses ($P = 0.0012$), total chronics ($P = 0.0009$), chronics due to respiratory causes ($P = 0.0050$), and chronics due to lameness ($P = 0.0151$), with females showing lower rates than males for all these parameters.

There was a significant effect of date of arrival on the rate of BRD morbidity ($P = 0.0001$) and relapses ($P = 0.0071$), with animals placed in October having higher rates than those placed in November.

No interactions were observed among treatment, sex, and date of arrival on any of these parameters.

Morbidity and mortality from day 0 to close-out — The effects of treatment on these parameters are given in Table 4. There was a significant effect of sex on total morbidity ($P = 0.0349$), on the rate of mortality due to lameness ($P = 0.0488$), and on the rate of mortality due to other causes ($P = 0.0271$), with females showing lower rates than males.

There were significant effects ($P = 0.0001$) of date of arrival on morbidity rates and morbidity rates due to respiratory disease, and on the rate of mortality due to other causes ($P = 0.0477$). For all of these parameters, animals placed in October had higher rates than those placed in November.

No interactions were observed among treatment, sex and date of arrival on any of these parameters.

Economic parameters

The effects of treatment in these parameters are shown in Table 5. There were significant effects of sex and date of arrival in all parameters analyzed for the periods days 0 to 28 and days 0 to 56. In all cases, females and animals placed in November had the lowest costs, nevertheless, no interactions between treatment and sex or treatment and date of arrival were observed.

When the period day 0 to closeout was analyzed, the statistical differences in medical costs due to sex had disappeared. On the other hand, the higher total medical cost for the October placement remained statistical significant ($P = 0.0186$, \$9017 vs \$6176 for October and November, respectively).

No interactions were observed among treatment, sex, and date of arrival on any of these parameters.

Table 3. Effects of treatment on the rate of health parameters for the period 0 to 56 days

	Control	Experimental	SE	*P*-value
BRD morbidity rate	26.64[b]	19.32[a]	1.76	0.0001
Relapses (1×) rate	3.12[b]	1.62[a]	0.59	0.0151
Relapses (2×) rate	1.22	1.00	0.21	0.4839
Total chronics rate	3.24[b]	1.37[a]	0.06	0.0002
Chronics respiratory rate	2.14[b]	0.87[a]	0.42	0.0032
Lameness rate	1.10[b]	0.51[a]	0.15	0.0080
Total mortality rate	1.88[b]	1.00[a]	0.25	0.0209
BRD mortality rate	1.02	0.53	0.16	0.1141
HS mortality rate	0.20	0.28	0.07	0.5029
Mortality rate due to lameness	0.33	0.14	0.11	0.1527
Mortality rate due to other causes	0.25[b]	0.04[a]	0.06	0.0444

[a,b]Rates of health parameters in the same row with different superscripts differ ($P < 0.05$)
SE: Standard error of the least-squares mean
BRD: bovine respiratory disease
Relapses (1×): First relapse, represents the second time that an animal is medicated against the same disease
Relapses (2×): Second relapse, represents the third time that an animal is medicated against the same disease
HS: *Haemophilus somnus*
Control animals received conventional ration
Experimental animals received conventional ration containing 350 mg chlortetracycline and 350 mg sulfamethazine per head per day for the first 56 d after arrival at the feedlot

Discussion

Bovine respiratory disease is a major cause of economic loss in feedlot calves. While morbidity and mortality rates of 15% to 45% and 1% to 5%, respectively, have been reported (1), considerable variability exists in morbidity and mortality among feedlots and among years for the same feedlot. In general, calves like those used in the present study, i.e., purchased through the auction system, are stressed and more prone to BRD than are calves purchased directly from their farm of origin (13).

Field trials on prophylactic strategic medication for bovine respiratory disease have been criticized for their inadequate randomization and lack of validated results (14). Also, it has been suggested that the measurement of morbidity is very crude due to unsophisticated diagnostic technology and to the lack of a method for determining cause-specific morbidity. In our study, we applied a strict randomization and precise definitions, so clinical signs observed by the pencheckers were confirmed by the feedlot veterinarian only when an elevated temperature was recorded.

Epidemiological curves for morbidity and mortality due to BRD have been shown to peak in the first 3 wk after the cattle arrive, followed by a reduction in the rates 4 to 5 wk postarrival, which is maintained throughout the rest of the feeding period (15). We found that the rate of BRD morbidity was higher during the first 28 d, usually considered the "adaptation period," but declined later. The inclusion of the feed-additive antimicrobial reduced the BRD morbidity rate in the first 28 d by 25%, relapses by 33%, total chronics by 60%, and medical costs per head by 30% for controls and experimental animals, respectively. Morbidity rates due to BRD dropped significantly for the period 29 to 56 d, and this disease pattern mirrored the epidemic curves described by Kelly (15) and Harland *et al* (16). Nevertheless, the use of the feed additive maintained its beneficial effects during the entire period it was fed. It was also observed that the cost of treatment of steers entering the feedlot in October was higher than the cost of treatment of females placed in October, or that of steers and females placed in November. While the higher medical cost of October-placed calves is commonly recognized, we have no explanation for the higher medical costs of October-placed males.

The lack of power and specificity of crude mortality were partially addressed by the use of different categories to classify mortality. Comparison between Tables 2 and 3 shows that the rates of total and BRD mortality were slightly higher in the day 29 to 56 period than in the day 0 to 28 period. The experimental animals were less affected than were the control animals and, by the end of the 56 d, had approximately 1/2 of the total mortality of the untreated group (1.0% vs 1.88%, for the experimental and control groups, respectively). The onset of mortality commenced at day 10 in the controls and on day 15 in the experimental animals (data not shown). After the end of the medication period (day 57 onwards), total morbidity and mortality rates were not different between groups, and no adverse effects of medication on the incidence of any disease were observed (data not shown).

In western Canada, the evidence is increasing that respiratory and myocardial infection due to *H. somnus* has become the most important mortality risk. Evidence suggests that mortality due to *H. somnus* occurs later in the feeding period than mortality due to BRD (17). The data generated in this study only partially confirms these observations. While mortality due to *H. somnus* was only about 1/3 of that due to BRD, its rate was higher in the second 4 wk after placement. In our trial, lameness was considered a separate morbid entity

Table 4. Effects of treatment on the rate of morbidity and mortality for the period 0 day to close-out

	Control	Experimental	SE	*P*-value
Total morbidity rate	33.66[b]	23.29[a]	2.07	0.0001
Respiratory	29.42[b]	21.21[a]	1.74	0.0001
Lameness	3.98[b]	2.04[a]	0.26	0.0271
Total mortality rate	3.71[b]	2.46[a]	0.40	0.0151
BRD mortality rate	1.33[d]	0.69[c]	0.28	0.0703
HS mortality rate	0.32	0.31	0.08	0.9920
Mortality rate due to lameness	0.54	0.27	0.15	0.1362
Mortality rate due to other causes	1.19	1.01	0.21	0.5029

[a,b]Rates of health parameters in the same row with different superscripts differ ($P < 0.05$)
[c,d]Rates of health parameters in the same row with different superscripts differ ($P < 0.1$)
SE: Standard error of the least-squares mean
BRD: bovine respiratory disease
HS: *Haemophilus somnus*
Control animals received conventional ration
Experimental animals received conventional ration containing 350 mg chlortetracycline and 350 mg sulfamethazine per head per day for the first 56 d after arrival at the feedlot

Table 5. Effect of treatment on economic parameters

	Control	Experimental	SE	*P*-value
Period 0 to 28 days				
Medicine cost, $	6755[b]	4805[a]	673	0.0258
Medicine cost/head, $	3.13[b]	2.25[a]	0.29	0.0194
Period 0 to 56 days				
Medicine cost, $	7476[b]	5018[a]	733	0.0118
Medicine cost/head, $	3.51[b]	2.35[a]	0.32	0.0075
Period 0 to close-out				
Medicine cost day 0–end, $	8731[b]	6462[a]	815	0.0326
Medicine cost/head day 0–end, $	4.21[b]	3.10[a]	0.30	0.0224
Feed cost/CWT gain, $	48.39	47.65	0.83	0.4618
Total cost/CTW gain, $	60.18	58.84	1.00	0.2711

[a,b]Least-squares means in the same row with different superscripts differ ($P < 0.05$)
SE: Standard error of the least-squares mean
CTW: 100 lb of body weight
Control animals received conventional ration
Experimental animals received conventional ration containing 350 mg chlortetracycline and 350 mg sulfamethazine per head per day for the first 56 d after arrival at the feedlot

of unknown origin, and no attempts were made to further determine the cause of death in those animals. If *H. somnus* was involved in some of these cases, the rates of *H. somnus* morbidity and mortality were underestimated.

For the periods 0 to 28 d and 0 to 56 d, cattle started on the feed additive outperformed controls in ADG and FC. While both groups had identical initial weights cattle fed the feed additive were 5.5 kg heavier at 28 d and 11.6 kg heavier at 56 d than were the control animals, with approximately 20% better feed conversion. These data support the observation that antimicrobial medication on arrival helps to maintain weight gain and feed conversion in periods of stress (18). The reasons for these effects are unknown, but it has been speculated that subclinical or other unidentified disease in unmedicated animals could decrease feed intake and, consequently, ADG and FC. This positive effect of the feed additive on ADG and FC was carried through until close-out. Results also showed that steers had better ADG and FC and, therefore, cost less per CWT gain than females, and that animals placed in October had better ADG and FC than did those placed in late November. The reason for the latest observation might be related to the extremely cold December experienced in western Canada in 1992. Animals placed in October were over the adaptation period when the cold arrived, while those placed in November were still in the midst of it. When all expenses incurred during the trial, expressed as total cost per 100 lb. of body weight gain, were analyzed, the extended use of the feed-additive antimicrobial produced actual savings of $7.20 per head.

The consistent and very early occurrence of BRD at the feedlot emphasizes that preventive and control efforts should be put in place, at the latest, at the time of arrival. Although antimicrobial feed additives have been used since the 1950s, their efficacy in the prevention and control of BRD is frequently questioned. It has been suggested in the literature that parenteral prophylactic medication at arrival in high-risk cattle would be better than feed added antibiotics (14). The data generated in this study, however, support the use of a chlortetracycline and sulfamethazine combination for 56 d after arrival as a very cost-effective management program. A 150 d withdrawal time is built into the program and concerns about a reduced response to therapeutic treatment have not been substantiated in our trial. In conclusion, the use of this antimicrobial feed-additive for 56 d is a sound management tool for reducing disease in feedlot cattle with favorable impact on both weight gain and feed efficiency. CVJ

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