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Effect of mass medication with antibiotics at feedlot entry on the health and growth rate of cattle destined for the Australian domestic market

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Objective To examine the effectiveness of mass medication with long acting antibiotics at feedlot entry on lot-fed Australian domestic cattle during a period of high risk for bovine respiratory disease (BRD).

Design Systematic allocation at feedlot entry of tilmicosin, long acting oxytetracycline or no antibiotic treatment, to cattle lot fed for the Australian domestic market. Comparisons of growth rate, disease occurrence and mortality were made between the groups at the conclusion of the feeding period.

Results Cattle medicated with tilmicosin at 10 mg/kg body weight on entry to the feedlot grew 0.08 kg/d faster than cattle medicated with oxytetracycline at 20 mg/kg body weight and non-medicated cattle. There was no significant difference in growth rate between oxytetracycline medicated cattle and cattle not medicated with antibiotic at feedlot entry. Cattle medicated with tilmicosin at feedlot entry had 8 fewer cases of disease per 100 animals compared with cattle not medicated with antibiotic at feedlot entry. There was no significant difference in disease occurrence between oxytetracycline medicated cattle and those not medicated with antibiotic at feedlot entry.

Conclusion Mass medication with tilmicosin at feedlot entry of cattle destined for the Australian domestic market may be used to reduce disease occurrence and increase growth rate during periods of high risk for BRD.

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BRD Bovine respiratory disease

Surveys of Australian feedlots in 1991 and 2001 have shown that BRD is the most important disease of feedlot cattle in Australia.^{1,2} A large number of North American studies have assessed the effectiveness of the mass administration of injectable antimicrobials on the occurrence of BRD. A reduction in the occurrence of BRD has been found in response to administration to all cattle at feedlot entry of benzathine penicillin,³ oxytetracycline,⁴⁻⁶ sulfadimethoxine⁴ and tilmicosin.⁷⁻⁹ In addition to a reduction in the occurrence of BRD, cattle mass medicated with tilmicosin have also shown improved growth rate.⁸⁻¹⁰ Meta-analysis has shown that parenteral mass medication with long-acting oxytetracycline or tilmicosin on feedlot arrival can significantly reduce the occurrence of BRD in feedlot cattle.¹¹ However, the authors also concluded that data on the effects of mass medication on mortality rate and growth rate were unreliable. Furthermore, variable results from mass medication are consistent with the multifactorial nature of BRD.¹² The purpose of this study was to evaluate the effectiveness of mass medication at feedlot entry using oxytetracycline or tilmicosin in reducing losses from BRD in the form of morbidity, mortality and growth rate, on an Australian feedlot during a period of high risk for BRD.

Materials and methods

Location and timing

The study was done in a commercial feedlot in southern Queensland of 7000 head capacity during autumn 2001. The previous decade of feedlot data showed autumn to be the period of highest risk for BRD.

Animals

Six hundred and thirty mixed breed beef cattle weighing approximately 302 kg were purchased through saleyards within a 500 km radius of the feedlot. Time from arrival at the feedlot to entry processing varied from 1 to 4 days. The cattle were systematically allocated to treatments sequentially as they were processed through the crush at feedlot entry. The treatments were: oxytetracycline 200 mg/mL (Bivatop®; Boehringer Ingelheim, North Ryde, Sydney) at 20 mg/kg body weight by subcutaneous injection; tilmicosin 300 mg/mL (Micotil®; Elanco Animal Health, West Ryde, Sydney) at 10 mg/kg body weight by subcutaneous injection; and no antibiotic treatment. At feedlot entry, all animals were vaccinated against clostridial diseases, a macrocyclic lactone anthelmintic drench and a hormonal growth promotant were administered, and individually numbered ear-tags were applied. The medications were recorded against individual animal ear-tag numbers using a code so that feedlot staff were unaware of which medication group cattle were allocated to. The different treatments were distributed across three pens, each pen having 210 animals, and each pen containing approximately equal numbers of animals from each treatment group. There were 211 cattle medicated with tilmicosin at feedlot entry, 210 medicated with oxytetracycline at feedlot entry and 209 not medicated with antibiotic. The cattle were fed commercial feedlot diets for the duration of the trial, which was approximately 73 days. The trial concluded with the slaughter of the cattle.

Measurements

The occurrence of all diseases and deaths, the number of days on feed and average daily gain were recorded. Disease occurrence was a measure of all cattle identified as requiring treatment by the feedlot animal health staff in consultation with the feedlot veterinarian. A diagnosis of BRD was based on the absence of clinical signs referable to systems other than the respiratory system, and two or more of the clinical signs of dyspnoea, nasal and/or oral discharge, lethargy and inappetence. The number of days on feed at the time of initial treatment for BRD was noted on the treatment records. Average daily gain was calculated from individual feedlot entry weight, after at least 24 h access to feed and water, and individual exit weight at the conclusion of the feeding period within 1 week of slaughter.

Statistical analysis

The occurrence of disease and mortality were categorical binomial data and were analysed with a chi square goodness of fit test. The other measurements were normally distributed and were analysed with analysis of variance. The growth rate data do not include cattle that died during the trial but the mortality and treatment data include all cattle entered in the trial. The analysis was done with Statistix version 7 (Analytical Software, PO Box 12185, Tallahassee, Florida 32317).

Results

There was no significant difference in entry weights between cattle medicated with oxytetracycline, cattle medicated with tilmicosin and cattle not medicated with antibiotic (302 kg, 303 kg and 302 kg respectively, $P = 0.64$).

Table 1. Comparison of occurrence of disease and growth rate in cattle medicated at feedlot entry with either oxytetracycline, tilmicosin or no antibiotic.

Variable	Entry medication		
	No antibiotic	Oxytetracycline (20 mg/kg)	Tilmicosin (10 mg/kg)
No. at feedlot entry	209	210	211
No. at completion of feeding period	205	206	208
Feeding period (days)	73 ± 0.9	74 ± 1	73 ± 1
No. cases of disease (cases per 100 animals)	19 (9.1 ± 0.02) ^A	15 (7.1 ± 0.02) ^A	3 (1.4 ± 0.008) ^B
No. initial cases of BRD (cases per 100 animals)	19 (9.1 ± 0.02) ^A	13 (6.2 ± 0.02) ^A	2 (1.0 ± 0.007) ^B
Mean days on feed at initial time of treatment for BRD	31.5 ± 3.2	30.8 ± 2.5	37.5 ± 16.5
Mortality (deaths per 100 animals)	4 (1.9 ± 0.009)	4 (1.9 ± 0.009)	3 (1.4 ± 0.008)
Average daily gain (kg/animal/d)	1.59 ± 0.03 ^A	1.59 ± 0.03 ^A	1.67 ± 0.03 ^B

Values with different superscripts differ significantly ($P < 0.05$).

Values in parentheses are mean ± SE.

The comparisons between the groups are presented in Table 1.

Cattle mass medicated with tilmicosin had significantly fewer treatments for all illnesses ($P = 0.0004$) and BRD specifically ($P = 0.0001$), compared with cattle not given antibiotic at feedlot entry and compared with cattle mass medicated with oxytetracycline ($P = 0.004$). There was no significant difference in treatments for all diseases ($P = 0.47$) and treatments for BRD ($P = 0.26$) between oxytetracycline treated cattle and cattle not given antibiotic at feedlot entry. The mean number of days on feed at which cattle were initially treated for BRD was numerically higher for cattle mass medicated with tilmicosin but this was not statistically significant ($P = 0.78$). Mortality rates between the groups did not differ significantly ($P = 0.91$).

The cattle treated with tilmicosin at feedlot entry had a significantly higher mean daily body weight gain than cattle not medicated with antibiotic at feedlot entry ($P = 0.03$) and cattle medicated with oxytetracycline at feedlot entry ($P = 0.05$). There was no significant difference in weight gain between cattle medicated with oxytetracycline and the non-medicated group.

Cattle that were not identified as showing clinical signs of disease warranting treatment by the feedlot staff had a significantly higher growth rate than cattle that were treated (1.64 kg/animal/d versus 1.18 kg/animal/d, $P < 0.001$).

In summary, cattle medicated with tilmicosin at feedlot entry had a growth rate advantage of 0.08 kg/animal/d and an occurrence of disease that was lower by 8 cases per 100 animals compared with animals not medicated with an antibiotic at feedlot entry.

Discussion

It is unclear why mass medication with tilmicosin was associated with significant improvements in health and growth while mass medication with oxytetracycline was not. Contrary to the findings of North American laboratories, negligible resistance to oxytetracycline or tilmicosin has been recorded with isolates of *Mannheimia haemolytica* and *Pasteurella multocida* from cases of BRD in Australia.¹²



Much of the pathology of BRD is due to respiratory tract inflammation.¹³⁻¹⁵ The severity of the disease can therefore be reduced by the administration of agents that reduce inflammation.^{15,16} Tilmicosin appears to induce apoptosis in pulmonary neutrophils leading to a reduction in leukotriene B4 synthesis, thereby reducing further amplification of the inflammatory injury of BRD.¹⁷ This may partly explain the difference between the response to mass medication with the two antibiotics. Conversely, meta-analysis of ten randomised controlled field trials indicates that parenteral mass medication with tilmicosin or long acting oxytetracycline on feedlot arrival significantly reduces BRD morbidity rates in cattle.¹¹ An advantage to mass medication of cattle at feedlot entry with tilmicosin compared with other antibiotics may be explained by cattle having pulmonary inflammation on arrival at the feedlot. However, the mean number of days on feed at the time of first treatment for BRD in this study is not consistent with the widespread occurrence of pre-existing pulmonary inflammation in the cattle.

The effectiveness of mass medication with tilmicosin at feedlot entry may be related to the tissue distribution of the antibiotic and its ability to inhibit colonisation of the airways with increased numbers of respiratory bacteria. Tilmicosin administered as a single injection at 10 mg/kg body weight maintains concentrations above the minimum inhibitory concentration for *M haemolytica* in alveolar macrophages for 14 days after administration and in peripheral neutrophils for 10 days after administration.¹⁸ Further, medication with tilmicosin decreases the number of *M haemolytica* in the nasopharynx.¹⁹ Mass medication with tilmicosin at feedlot entry was proposed to reduce the incidence of acute respiratory tract disease for several days after feedlot arrival, which is the period of greatest susceptibility to potential respiratory pathogens.¹⁹ However, it is difficult to interpret the positive effect in this trial in which there is a mean of approximately 30 days on feed at the time of first treatment for BRD. Further research may elucidate the mechanisms by which medication with tilmicosin at feedlot entry exerts a positive effect over several weeks.

The variable results from mass medication trials are not surprising considering the outcome measured is a complex affected by a large number of factors, some of which are specific to country, production system, region, feedlot or time of year.¹² Further research into responses to antibiotic mass medication of cattle over a range of feedlot entry weights under a variety of Australian feedlot production systems is warranted. These data show a significant improvement in health and performance in response to the administration of tilmicosin at feedlot entry in cattle at high risk for BRD. Detailed economic analysis has not been provided due to many of the inputs being commercial in confidence and

constantly changing. However, feedlot advisers can use the production data from this trial to assess the profitability of mass medication under current costs and returns. Further, under the economic conditions current during this trial, the production benefits from mass medication with tilmicosin resulted in a profit.

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The efficacy of dantrolene sodium in controlling exertional rhabdomyolysis in the Thoroughbred racehorse

A study to investigate the efficacy of oral dantrolene sodium in controlling exertional rhabdomyolysis (ER) involving 77 Thoroughbred racehorses. Following 2 days box rest horses were treated on two occasions 1 week apart. For the first treatment each horse was randomly selected to receive either 800 mg dantrolene sodium or a colour matched placebo orally 1 hour before exercise. This was followed by a crossover to the other treatment on the second occasion.

Concentrations of serum creatine kinase (CK) before exercise were compared with those 6 hours after exercise and the increase used as an indicator of the degree of ER.

The results confirmed that oral dantrolene sodium given 1 hour before exercise had a statistically significant effect on reducing plasma CK concentrations and preventing clinical ER in susceptible horses, suggesting that the drug may be of use in the management of this disease in the Thoroughbred racehorse.

Edwards JGT et al. *Equine Vet J* 2003;35:707-711.