Prevention of Bloat in Pastured Cattle - Using Monensin Sodium Controlled Release Capsules (CRC)

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Abstract

Bloat in cattle grazing legume pastures can depress production and cause death. Development of controlled release capsules (CRC) containing monensin for prevention of bloat is described. Early studies were based on CRC devices delivered 170 mg monensin/day in beef cattle. Significant liveweight gains and reduction in both bloat and death were found. In dairy cows, devices which delivered 300 mg monensin/day reduced bloat and increased milk and protein yields. Inclusion of silicone glycol in the monensin CRC showed some benefits both *in vitro* and *in vivo* although a study on highly bloat susceptible dairy cows failed to show a difference.

Keywords: beef, bloat, capsule, dairy, monensin

Introduction

Bloat is a rumen metabolic disease of cattle associated with either the grazing of temperate legume and grass pastures or the feeding of high levels of grain. Onset is typically unpredictable and rapid. On pasture, production of carbon dioxide and methane in the reticulorumen results in foam which is stabilized by leaf protein. Increased abdominal pressure may cause a loss of productivity and in severe cases lead to death from heart failure and asphyxia.

Polyether antibiotics, such as monensin sodium, are known to change the fermentation pattern in the rumen (Potter *et al,* 1974) causing an increased production of propionic acid and a decrease in formation of the gases implicated in bloat.

Laby (1978, Australian Patent No. 35908/78) proposed that delivery of a controlled dose of an anti-bloat agent into the rumen, from a variable geometry device, could be used to prevent bloat in grazing cattle. Early work focused on the delivery of surface active agents (Laby, 1973). Since, extensive development of controlled release capsules (CRC) has taken place in Australia. Studies described here show the development of the monensin CRC technology for prevention of bloat and to increase the productivity, of beef and dairy cattle. The inclusion of silicone glycol, a potent agent for reducing surface tension, could improve the bloat prevention capacity of the monensin CRC. Studies to test this hypothesis are described.

Materials and Methods

A series of experiments were carried out in beef cattle between 1983 and 1985 (A) and in dairy cows in 1988 (B) to determine the effectiveness of the monensin CRC for prevention of bloat. In 1994 and 1995 *in vitro* and *in vivo* experiments in dairy cows using modified monensin CRC devices, containing silicone glycol, were made (C).

A. Prevention of bloat in beef cattle

Fifteen trials investigated the effect of administering monensin CRCs (delivering 170 mg monensin/day for 150 days) on the incidence and severity of bloat and on weight gain. A total of 1472 cattle were included, half of which were treated with monensin CRCs and half were left untreated. Cattle were grazed on pastures containing variable amounts of lucerne (Medicago sativa) and white clover (Trifolium repens). Bloat scoring was done on a 0-4 scale (0- no bloat, 4- animal recumbent, markedly bloated and terminal). Cattle were weighed at the beginning and end of the trial. Data from all trials were pooled for statistical analysis.

B. Prevention of bloat in dairy cows

A pilot study at AgResearch Ruakura (New Zealand) in 1988 demonstrated the potential of monensin CRCs for reducing bloat and improving milk yield. Six further field studies were undertaken in the same year. A total of 368 cows were included; half were treated with monensin CRCs (delivering 300 mg monensin/day for 100 days) and the other half were left untreated. Bloat scoring and milk production was measured. Results from all trials were pooled for statistical analysis.

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C. Bloat prevention using monensin and silicone glycol

(i) In vitro study 1994

Monensin CRC core matrix material containing either 12 or 24% silicone glycol (dimethyl polysiloxone with polyoxyalkylene; Basildon BC 403, Abingdon, UK) was dissolved in 0.2 M phosphoric acid. Clover leaf cytoplasmic protein was dissolved in 0.2 M sodium bicarbonate solution. Both solutions were maintained at 0°C. Mixtures were made to give different combinations of plant protein and core material at pH 6.0 and then placed in a water bath at 40°C. This resulted in the release of carbon dioxide and production of unstable foam. Foam height and collapse time were measured.

(ii) Pilot dairy cow study 1994

Standard monensin CRCs and others containing 10% silicone glycol (delivering 300 mg monensin/day and 75 mg silicone glycol/day) were used to treat a herd of 230 lactating Friesian dairy cows grazing white clover and annual rye-grass *(Lolium rigidum)* pasture. Half the herd was dosed at random with each type of device. Numbers of animals dying from bloat and requiring treatment by stabbing the rumen were noted.

(iii) Dairy cow study 1995

Thirty cows at AgResearch Ruakura (New Zealand), which had been bred for 20 years for high susceptibility to bloat, were allocated to one of three treatment groups, either untreated (6 cows), treated with monensin CRC (12 cows) or treated with monensin CRCs containing 10% simethicone glycol (12 cows). While grazing either white clover/rye-grass or red clover *(Trifolium pratense)* bloat scoring was carried out for 15 half-day periods and after a break of 3 weeks, for a further 13 half-days.

Results

Results of the three series of trials with monensin CRCs during the period between 1983 to 1995 are as follows:

A. Prevention of bloat in beef cattle

Results of 15 trials with a mean duration of 94 days were pooled and statistically analysed. (Table 1)

Table 1. Effect of monensin CRC in beef steers on weight gain, mean bloat score per animal and number of animals dying from bloat.

Treatment	Liveweight at treatment kg	Ave Daily Gain kg	Mean Bloat Score	No of Bloat Deaths
Untreated control	294.4	1.16	2.89	17
Monensin CRC	299.0	1.25***	1.21*	3**

Differences between treated groups statistically significant *(P< 0.1), ** (P<0.01) and ***(P<0.001)

Treatment with monensin CRCs resulted in faster growth of cattle. In 12 out of the 15 trials there was a reduction in the incidence of bloat in comparison to the untreated control groups and when the data was pooled there was a significant reduction overall. There was a significant reduction in the number of cattle that died from bloat.

B. Prevention of bloat in dairy cows

Results of 6 field studies in lactating dairy cows were previously reported (Lowe *et al* 1991). A summary of the results are shown in Table 2. Treatment with monensin CRCs significantly reduced bloat and increased milk protein yields.

Table 2. Effect of monensin CRC on milk, fat and protein yields (kg/cow/day) and mean daily bloat scores of dairy cows.

Treatment	Milk Yield kg/day	Fat Yield kg/day	Protein Yield kg/day	Mean Daily Bloat Score
Untreated Control	17.7	0.76	0.55	0.62
Monensin CRC	18.8**	0.77	0.58**	0.31*

Differences between treatment groups statistically significant *(P<0.05), **(P<0.025)

C. Bloat prevention using monensin and silicone glycol

(i) In vitro study 1994

Carbon dioxide released from the mixtures resulted in production of foam. Core material from both the monensin CRC device with and without silicone glycol reduced the amount of foam produced and time for the foam to collapse (Table 3).

Table 3. The effect of CRC core matrix on *in vitro* foam production in media containing clover leaf protein.

Treatment	Foam Height mm	Collapse Time sec
Control blank	20	510
Monensin CRC	6	180
Monensin CRC + 12% silicone	3	20*
Monensin CRC + 24% silicone	5	120*

*Collapse time of 120 sec corresponds to effective cessation of carbon dioxide emission; almost nil foam persistence.

The addition of silicone glycol at 12 and 24% in the core matrix greatly reduced foam production and foam was non-persistent.

(ii) Pilot dairy cow study 1994

CRC devices containing monensin and silicone glycol were significantly (P<0.01) better than monensin alone in preventing bloat deaths and in reducing the number of cows that had to be stabbed to reduce gas pressure (Table 4).

Table 4. Pilot study on the effects of monensin CRC and monensin CRC + silicone glycol on bloat in dairy cows.

Treatment	No. Of Animals	No. of Bloat Deaths	No. of Cows Treated by Stabbing
Monensin CRC	115	8	4
Monensin CRC + silicone glycol	115	0**	00**

Difference between treatment groups statistically significant **P<0.01

(iii) Dairy cow study 1995

Serious bloat occurred in 14 of the 28 mornings of the trial. All bloat scores were relatively low because cows with a bloat score approaching 1.5 were removed from the pasture and treated with paraffin oil according to animal welfare procedures. Groups treated with monensin CRC and monensin CRC containing silicone glycol had significantly lower bloat scores than the untreated control group whether assessed over 14 days or on the final 6 days (Table 5). There was no significant difference in bloat score between the two CRC treatment groups.

Table 5. Bloat score means from all 14 days when bloat was recorded and from the final 6 days of scoring.

No. of Bloat Score Days	Untreated Control	Monensin CRC	Monensin CRC + silicone glycol
All 14	1.04***	0.12	0.19
Final 6	1.08***	0.15	0.20

***Significantly different (P<0.001) between control and other two treatments.

Discussion

There are marked production advantages in terms of animal growth and milk yields, from cattle grazing legume pastures (Moate *et al* 1992). Unfortunate consequences are the possible losses in animal productivity and death of valuable livestock from bloat.

Control of bloat on the farm is practiced by drenching with materials such as pluronics, terics, emulsified tallow and paraffin oil, spraying of pastures with tallow or paraffin oil, feeding of anti-foaming agents in the bail at milking, in water and in lick blocks, and flank application of anti-foaming agents. Although labour intensive, daily drenching with bloat control agents is effective and practical in the dairy farming situation. Beef cattle which graze much larger areas of pasture present logistic difficulties in the treatment of bloat. Removal from dangerous pastures is often the only possibility.

Many surveys have been made to determine the extent of bloat deaths in Australia, Canada, New Zealand and USA in both beef and dairy cattle. For example, in the New England area of Australia in the period of 1961 to 1966 death losses in beef cattle ranged from 0.27% to 3% (Wolfe 1968), while in New Zealand, between 1963 and 1987, a mean of 0.71% of all dairy cows (Morris *et al* 1991) died annually from bloat. Occasionally death rates up to 16% in cows and 48% in heifers (Carruthers *et al* 1987) have occurred.

There is much published work which supports the usefulness of monensin in reducing bloat in both pastured and lot-fed cattle (Sakauchi and Hoshimo 1981, Bartley *et al* 1983, Katz *et al* 1986, Johnson *et al* 1991). Effects of monensin on rumen protozoan and bacterial populations have been studied widely. Monensin reduces the populations of Gram positive bacteria with a resulting increase in the population of monensin-resistant bacteria which produce more propionic acid and less carbon dioxide and methane (Strobel *et al* 1989). Treatment of cattle with monensin CRC devices over the last 13 years has demonstrated that bloat deaths can be reduced and animal production improved by reduction in severity of clinical cases of bloat and from direct effects of monensin on efficiency of rumen metabolism.

In 1944 (Quinn *et al*) a new method for the treatment of bloat in cattle by either using an oral drench or by direct injection into the rumen a solution of polymerized methyl silicone, was reported. Use of silicone liquids, although still favoured for the treatment of flatulence in humans, are no longer widely used for the treatment of bloat in cattle.

Silicone glycol was chosen for inclusion in the monensin CRC because of its solubility in water. An *in vitro* and a pilot study in dairy cows showed that treatment of bloat could be improved by inclusion of silicone glycol but results from Ruakura, in highly bloat susceptible cows, did not support the earlier findings. Unpredictability of onset and severity of bloat often makes this type of experimental work unrewarding. The need to treat clinical cases of bloat with extra treatment may have masked differences between treatments. It is possible that the difference in response to CRC devices with and without silicone glycol can only be shown during more severe bloat situations.

In spite of more than 50 years of scientific study bloat is still a serious problem in cattle grazing legume pastures. Monensin CRCs, although not providing total prevention, reduces the incidence and death from bloat, and improves animal production, both directly and indirectly. Improvement in the efficacy of monensin CRCs by inclusion of active materials, including silicone, which suppress gas production and reduce stability of foam in the rumen of cattle is promising.

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Abstract

Detection of Calves Persistently Infected With Bovine Pestivirus in a Sample of Dairy Calves in South-eastern Queensland

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Objective
To determine the proportion and incidence of calves persistently infected with bovine pestivirus in calves (n = 1521) supplied to the Tick Fever Research Centre and to assess the test regime to detect calves persistently infected with bovine pestivirus.

Design
Calves, 1 to 6 weeks old, selected for use in the production of tick fever vaccine were collected from 21 properties in 56 separate groups between October, 1990 and December, 1996. Each group was examined for the presence of calves persistently infected with bovine pestivirus.

Procedure
All calves were routinely tested for antibody to bovine pestivirus and bovine pestivirus antigen using a serum neutralisation test and an antigen-capture ELISA, respectively. Pooled lymphocyte samples from calves were also monitored for bovine pestivirus by inoculation of sheep. Whole herd testing was carried out in eight herds, using a serum neutralisation test as a screen test followed by an antigen-capture ELISA of cattle with a serum neutralisation test titre of less than 32.

Results
Fourteen of the 1521 calves tested (0.9%), were detected as persistently infected and the incidence ranged from 0.0 to 3.0% per year over 6 years. Persistently infected calves were found in 13 of the 59 groups and originated from 7 of the 21 herds used. In whole herd testing on the properties of origin, cattle persistently infected with bovine pestivirus were detected in four of the eight herds tested.

Conclusions
The proportion of calves persistently infected with bovine pestivirus is similar to that in other countries and indicates that bovine pestivirus could be a significant cause of economic loss in Australian cattle herds. In detecting calves persistently infected with bovine pestivirus, the combination of sheep inoculation, paired antigen-capture ELISA and serum neutralisation tests appeared to be highly sensitive and specific.