The Use of Medicated Blocks to Control Nematode Parasites of Ruminants

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Summary

Inadequate nutrition and gastrointestinal nematode parasitism are two major constraints to ruminant production in the developing nations of tropical and sub-tropical Asia and the Pacific. In livestock production systems where urea-molasses feed supplement blocks (UMB) have been shown to enhance the utilisation of low quality fibrous feed resources, the inclusion of anthelmintic medication into the blocks at strategic times can provide a solution to the parasite problem. Experimental evidence is presented which demonstrates the prophylactic and therapeutic efficacy of medicated urea-molasses block (MUMB) use in dairy cattle and buffalo in India. Use of MUMB in these systems has resulted in higher growth rates of young stock and increased milk production in lactating adults when compared to animals receiving UMB without medication. Studies in Fiji have shown production benefits in MUMB treated goats equivalent to daily supplementation with protein and regular anthelmintic treatment by conventional methods. Similar studies in Fijian sheep have shown that MUMB treated ewes produced more lambs which grew faster than salvage treated controls. From these studies it was also noted that in young cattle and sheep substantial reduction of parasite load was derived from the nutritional benefits of UMB supplementation alone. It is concluded that the regular use of UMB supplements coupled with strategic prophylactic use of MUMB will increase the productivity of ruminant livestock in areas where low quality fibrous feeds are the predominant feed resource and where nematode parasitism inhibits productivity.

Introduction

Increasing human population in the developing countries of South-East Asia, the Pacific Islands and the Indian sub-continent places an ever-increasing demand on ruminant livestock production systems in those countries to provide more commodities, often with limited options in terms of availability of land and forages. Attempts to increase the productivity of ruminants in these regions generally encounter two principal constraints - nutrition and health. Depending on the particular environment and production system either undernutrition or infectious and/or parasitic disease, and frequently both, interact to limit animal performance. In these countries the forage base is usually of medium to low quality made available by grazing or by cut-and-carry methods. At certain times of the year only poor quality agricultural residues, such as cereal straws, are available. Recent research has shown that substantially improved efficiency of utilisation of this feed base can be achieved by provision of additional nitrogen as urea formulated into a molasses block with additional minerals and small amounts of protein (Leng, 1986; Hendratno et *al.*, 1991).

Gastrointestinal nematode parasitism of ruminant livestock causes significant losses in production in developing countries through mortality and reduced production of meat, milk, fibre and work potential (Beriajaya and Stevenson, 1986; Dorny *et al.*, 1995). It has been shown that in situations where clinical parasitism is affecting production of a proportion of the flock or herd, losses due to sub-clinical parasitism in the remaining animals would also be severe (Barger, 1982) Recent research has been carried out to develop means of controlling nematode parasites through the strategic use of feed supplement blocks containing anthelmintic (medicated blocks) in production systems where the regular use of urea-molassses block (UMB) supplements has proven to be beneficial. This paper reports the results of medicated block development and details the benefits obtained in their use in field applications.

Anthelmintic Delivery by Feed Supplement Blocks

During the past 30 years, attempts at delivery of anthelmintic medication through feed supplement blocks have met with varying levels of success. Blocks containing phenothiazine at sufficient concentration to inhibit the development of parasite eggs to larvae proved successful in reducing nematode parasite levels in intensive livestock rearing systems (Martin, 1986; Beriajaya *et al.*, 1988) but in extensive grazing systems effective control was not demonstrated (Elliott, 1970; Cummins *et al.*, 1978). The inclusion of the benzimidazole anthelmintic fenbendazole (FBZ) into feed blocks in sufficient concentration to give an effective dose from expected normal daily consumption of block proved to successfully control nematode parasites of sheep (McBeath *et al.*, 1979; Bogan and Marriner, 1983) and cattle (Blagbum *et al.*, 1987; Bransby *et al.*, 1992), but adoption of this means of control has been poor due to low requirement for supplementary feeds in the livestock rearing systems where these blocks were promoted (United Kingdom, USA) and the low cost of alternative treatments. Observed variability between individuals in intake of the blocks (Cummins *et al*, 1978) may have also contributed to the low adoption of this technology in extensive grazing systems.

With the emergence of strains of parasitic helminths resistant to anthelmintics and the high cost of developing new compounds for commercial application, considerable research effort has been devoted to seeking methods of increasing the efficacy of available compounds in order to extend their useful commercial life. The observation that prolonged application of low levels of some benzimidazole anthelmintics enhanced their efficacy (Prichard *et al.*, 1978) led to the development of continuous release devices (CRD) for the intraruminal administration of anthelmintics (Anderson *et al.*, 1980). The increase in efficacy is thought to be due to the continued presence of the anthelmintic preventing establishment of incoming larvae, decreasing viability and fecundity of mature worms in the host and having an ovicidal effect on any worm eggs which are produced. Studies by Barton *et al.* (1990), Barger *et al.* (1993) and N. Anderson (unpublished) have demonstrated the effectiveness of this technology in areas where parasite strains are known to be partially resistant to benzimidazole anthelmnitics with no exacerbation of the resistance problem after treatment.

Our research has followed similar pharmacokinetic principles to those applied in CRD applications to develop a UMB containing FBZ for use in livestock production systems where regular consumption of the block occurs. Through the animals consuming their daily low-level dose of FBZ via the feed block, control of parasites can be achieved. Early studies determined that the bioavailability of FBZ was not affected by incorporation into the block formulation, but that dose rates differed between target host species (Knox *et al.*, 1994a; Knox *et al.*, 1995). Field testing of the efficacy of the block formulations has been carried out and the results of these tests are presented below.

Medicated Blocks to Control Parasites.

Indian Dairy Buffalo and Cattle.

i) Efficacy studies

Sanyal and Singh (1993) carried out two experiments to determine the therapeutic and prophylactic efficacy of medicated urea-molasses blocks (MUMB). Firstly, ten 20-24 weeks old worm free calves were divided in to 2 groups of 5 animals and maintained in tick free pens and fed on chaffed *Sorghum* spp. hay, UMB and water *ad Zibitum.* Fifteen days after acclimatization to the specified diet, both groups were experimentally infected with 10,000 live infective *Haemonchus* spp. larvae. After patency of infection, one group was given access to MUMB containing 0.5g FBZ/kg for 15 days while the other had continued access to drug free UMB. Faecal egg counts indicated that within 4 days of being offered MUMB, egg counts declined to zero while the counts in the untreated group remained above 400epg (Fig. 1). At slaughter 45 days after infection no adult worms or larvae could be detected in the abomasum of animals receiving MUMB, while animals in the untreated group had 378 ± 72 (mean + S.D.) worms.

Fig.1 Therapeutic efficacy of MUMB.

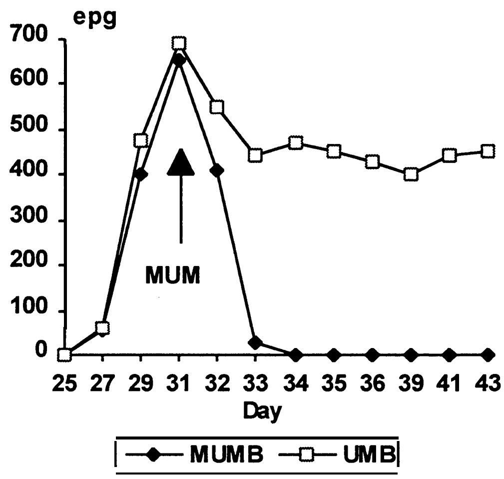
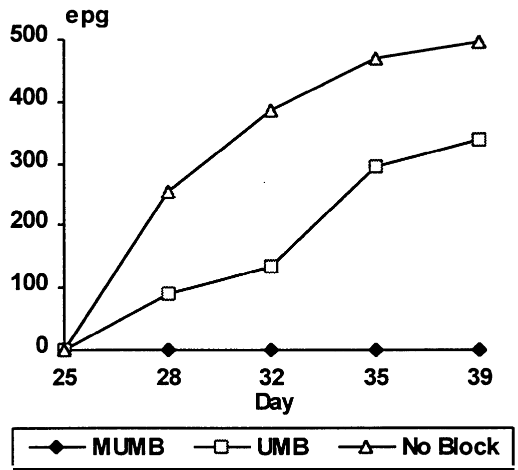


Fig. 2 Prophylactic efficacy of MUMB



In the second experiment fifteen 20-24 week old worm free calves were divided into 3 equal groups and maintained in controlled conditions and fed on chaffed *Sorghum* spp. hay, UMB and water *ad libitum.* After fifteen days acclimatization to the specified diet, one group was allowed access to MUMB and 4 days later were experimentally infected with 1000 infective larvae of *Haemonchus* spp. per day for the following 10 days. MUMB access was continued up to the last day of experimental infection. The same parasite infection schedule was followed for the other groups which were offered UMB or received no blocks. Zero faecal egg counts (Fig. 2) and worm counts demonstrated that MUMB was able to prevent infection in calves undergoing daily parasite challenge. It was also interesting to note that animals receiving UMB showed lower egg counts and worm counts than those animals which received no block, which suggests that the nutritional benefits of the supplement assisted the host to inhibit establishment of infection.

ii) Replacement Heifers

PK. Sanyal, D.K. Singh and M.R. Knox (unpublished) evaluated the benefits of MUMB on an organized farm where cattle are maintained in open barns and fed on green fodder, protein concentrate pellets and UMB. Forty 20-33 month old heifers weighing 165-240 kg were divided into two equal groups and maintained in two different barns. One group had unlimited access to MUMB (0.5g FBZ/kg) in two common places of the barn and the second group had similar access to UMB over a period of 5 months. Faecal egg counts indicated moderate level of infection in the untreated animals while MUMB animals were zero on all occasions after MUMB introduction. MUMB animals gained 18% more weight during the experiment when compared to untreated animals (Table 1). Such an increase in growth rate would enable the MUMB heifers to reach target weight for first service 6 to 7 weeks earlier than those which remained untreated.

Table 1 The effect of MUMB on weitht gain of replacement heifers

Group	Gain/month (kg)	Gain/day (kg)	Net Gain/day (kg)
MUMB	12.02	0.40	0.06
UMB	10.14	0.34	

iii) Lactating cows

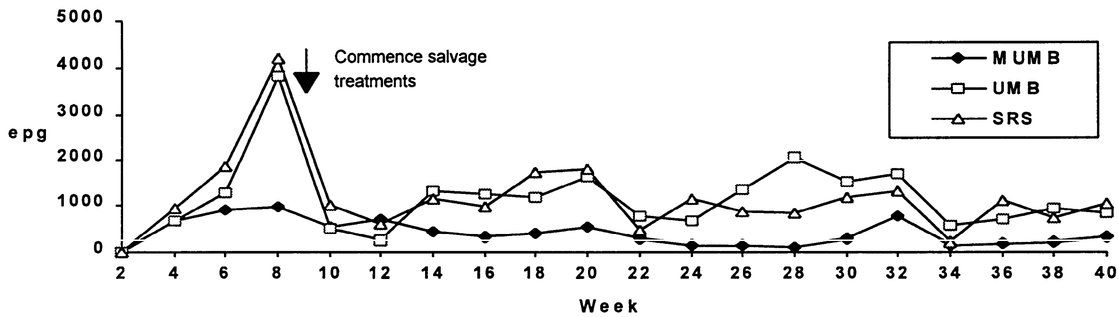
An experiment to test the efficacy of MUMB in adult lactating buffalo was conducted on an organized farm where the animals are tethered in barns and fed on dry and green fodder and UMB (P.K. Sanyal and D.K. Singh, unpublished). Twenty five buffaloes demonstrating low grade subclinical nematodosis were divided into two groups of 13 and 12 animals and maintained in separate rows of the animal shed. One group was offered MUMB (0.5g FBZ/kg) individually in dispensers kept in front of each animal and the other group was offered drug free UMB. Faecal egg counts of MUMB buffaloes declined to zero after MUMB introduction and remained zero throughout the experiment while egg counts of UMB animals remained at low levels (<30epg). Daily lactation records indicated a 13% increase in milk yield in MUMB buffaloes (8.7 litres/day) compared to those buffaloes offered UMB (7.7 litres/day).

Further evaluation of MUMB has been undertaken by the same authors through large scale field trials in Gujarat State. Faecal egg counts were suppressed by MUMB use and farmers indicated that the general health of MUMB treated animals had improved and also estimated that a >5% improvement in milk production had occurred. Detailed lactation records were however, not kept due to the inherent difficulties involved in such recording at the village level but farmers have requested more MUMB be available for purchase which indicates their perception of its effectiveness.

Fiji Goats

An experiment has been carried out to determine the effects of using MUMB in young goats grazing pastures infested with benzimidazole resistant nematode parasites (R. Singh and M.R. Knox, unpublished). Sixty female weaner goats were dosed with an effective anthelmintic then divided into 3 equal groups. One group was given unrestricted access to MUMB (0.75 g FBZ/kg), one group was given similar access to UMB and the final group was given a daily coconut meal/ wheat bran supplement (SRS). From week 8 individual goats were salvage treated with anthelmintic to prevent mortalities if their egg count exceeded 1000 epg. Figure 3 shows that the MUMB group had lower egg

Fig. 3 Faecal egg counts in Figi goats offered MUMB, UMB or SRS

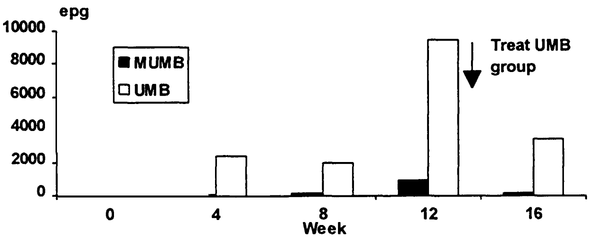


Fiji sheep

i) Periparturient ewes

The effects of MUMB use in periparturient sheep was determined in an experiment carried out in Fiji (Manueli and Knox, unpublished). 60 pregnant adult female sheep (Barbados blackbelly X Wiltshire) were dosed with anthelmintic and divided into two equal groups before allocation to separate 2 hectare pasture plots. One group was given unrestricted access to MUMB (containing 0.75g FBZ /kg) in their night shelter sheds. The other group had similar access toUMB prepared without medication. Faecal egg counts were lower for the MUMB group than the UMB group on all occasions (Fig. 4). It was necessary to treat all animals in the UMB group with anthelmintic in the third month of the trial, whereas it was not necessary to salvage treat any of the ewes in the MUMB group. There was no difference between the groups in ewe liveweights or lamb birth weights but by weaning at 3 months of age the lambs in the MUMB group (17.2 kg) were 2.6kg heavier than those in the UMB group (14.6 kg). After removal of the ewes at weaning the lambs were retained in their treatment groups and the experiment continued for a further 7 months by which time the MUMB lambs had reached the target liveweight of 30kg whereas the UMB lambs were 4.3kg lighter.

Fig 4 Faecal egg counts in sheep offerred MUMB or UMB



ii) Young ewes.

Manueli, Knox and Mohammed (1995) investigated the effects of parasites and nutrition in young Fiji sheep at pasture. Six groups of thirty 1 l-month-old ewes were each placed into 2ha. paddocks. Two groups were allowed unlimited accesss to MUMB (0.75g.kg FBZ), 2 groups had unlimited access to UMB and 2 groups received no supplementation (NB). Animals whose faecal egg count exceeded 3,000 epg were treated with anthelmintic to avoid unnecessary mortality. Faecal egg counts during the experiment were lowest for the MUMB group, highest for the NB group while the UMB group was intermediate. During the experiment it was necessary to salvage treat MUMB, UMB and NB ewes 13, 55 and 92 times, respectively. Larval cultures indicated that *Haemonchus* spp. and *Trichostrongylus* spp. were predominant and *Oesophagostomum* spp. was also present but in low numbers. At mating after 7 months of experimentation the MUMB (10.5kg) and UMB (1 0.0kg) group ewes had gained more weight than the NB (5.8kg) group. Ewe conception rates, lambing percentages and total weight of lambs weaned were increased by MUMB and UMB with the former providing the greatest increase (Table 2).

Table 2 Reproductive performance of young ewes offered MUMB, UMB or no block.

	MUMB	UMB	No Block
Ewes lambing	40	34	22
Lambs born	44	40	24
Total weight born (kg)	144	126	66
Lambs weaned	40	39	20
Total weight weaned (kg)	528	405	222
Average lamb weight (kg)	13.2	10.4	11.1

Discussion

It has been clearly shown that MUMB containing FBZ at 0.5g/kg can satisfactorily clear established infections of *Haemonchus* spp. in calves and that artifical infection can be prevented by offering MUMB to calves during parasite challenge (Sanyal and Singh, 1993). Efficacy of MUMB treatment has also been established in field trials involving young cattle with increased growth rates in treated animals which substantially reduces the time to first service. Similar results after treatment for nematode parasites have been observed in young cattle by de Rond *et al.* (1990) in Sri Lanka with considerable savings in husbandry costs involved with keeping the non-lactating portion of the herd. Milk production increases after MUMB treatment of lactating adult buffaloes and cattle recorded above were of similar magnitude to those achieved by suppressive anthelmintic treatment of buffalo (Sanyal *et al.*, 1993) and cattle (de Rond *et al.*, 1990; Sanyal *et al.*, 1992). In subtropical areas where *Haemonchus* is the predominant parasite species it appears that MUMB may be an appropriate treatment, particularly at times when parasite larvae are seasonally abundant.

Field studies in Fiji have demonstrated that MUMB containing FBZ at 0.75g/kg, as suggested for goats in pharmacokinetic studies (Knox *et al.*, 1995), can effectively control nematode infections in small ruminants. Efficacy of treatment was shown when MUMB were used on a continual basis in young weaner goats and liveweight gain of MUMB animals was equivalent to frequent oral anthelmintic treatment and daily protein supplementation. This result is extremely encouraging since a high degree of efficacy was demonstrated against a strain of parasites known to be substantially resistant to benzimidazole anthelmintic when delivered by conventional methods (D.J.D. Banks, unpublished).

Blocks containing a similar level of anthelmintic (ie. 0.75g FBZ/kg) were also shown to be effective in the field with periparturient sheep and young ewes in Fiji. Results in adult ewes indicated that good control of nematode parasites was obtained using MUMB and lambs of MUMB ewes were heavier at weaning than those from UMB ewes. After weaning into the same treatment groups this weight gain difference continued and the MUMB lambs reached target market weight considerably earlier than those given UMB. Supplementation of young maiden ewes with MUMB gave good control of parasites when compared to animals receiving UMB, which had lower faecal egg counts than those receiving no supplement. MUMB and UMB animals grew faster prior to mating and produced more lambs of greater liveweight than unsupplemented animals, with the MUMB animals showing the better reproductive performance.

From these studies it is also worthy to note that in young calves in India UMB supplementation resulted in lower faecal egg counts and reduced worm burdens compared to unsupplemented animals. Similarly in young sheep in Fiji, UMB supplementation resulted in lower faecal egg counts and increased reproductive performance when compared to unsupplemented animals. These findings demonstrate the practical nutritional benefits of UMB supplements and further support the proposal that such supplements can influence the animal's ability to resist infection as shown by Knox *et al.*(1994b) in pen studies with young Merino sheep.

In order to combat the problem of gastrointestinal parasitism in small ruminants in developing countries, a more integrated approach to control must be employed than that taken in recent times. Recommendations for regular chemotherapy are still being made despite the widespread emergence of strains of nematode parasites resistant to most classes of anthelmintics and the increasing concerns of chemical residues in animal products and the environment. In situations where nutritional deficiencies are likely to exacerbate the detrimental effects of parasitic infection, the use of low cost supplements such as UMB can enhance the animal's ability to utilise the available diet and assist the animal to withstand infection. As Knox and Steel (1995) suggest, such supplements should therefore be considered an integral part of husbandry practice in these areas, in order to reduce the debilitating effects of parasitism and minimise the requirement for anthelmintic chemotherapy. Substitution of MUMB for UMB can then occur for short periods during times when parasite challenge is high or during periods of low host immunocompetence caused by immaturity or physiological stresses such as reproduction. For these reasons it is likely that MUMB will form an integral part of strategic parasite control programs in developing nations where UMB have been shown to offer substantial nutritional benefits.

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