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The Influence of Supplementation with Urea–Molasses Blocks on Weight Gain and Nematode Parasitism of Dairy Calves in Central Kenya

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ABSTRACT

The effect of feeding urea–molasses blocks (UMB) on the growth and gastrointestinal nematode parasitism of dairy weaner calves grazing on the same pasture was investigated on a farm in Thika District, central Kenya. Twenty-six female calves, with an average age of 9 months, were initially treated orally with albendazole (10 mg/kg body weight) and assigned into two groups: animals in group I were fed urea–molasses blocks (UMB) prepared using a cold process and those in group II were the controls. The UMB were given in the evening, when the animals returned from grazing, and were consumed during the night at a rate of 550 g/head per day. Supplementation was undertaken on three occasions for three consecutive months, between July and August 1999, and between January and March and July and September 2000. The body weights of the calves and the faecal egg counts were measured monthly and larval cultures were performed on positive faecal samples from each group. Significant differences ($p < 0.05$) were found in the cumulative weight gains of the two groups of calves from September onwards. The UMB group averaged ($\pm$SD) 311.2 $\pm$ 14.9 g/day over the study period, while the control group averaged 235.7 $\pm$ 23.5 g/day; the UMB group also reached breeding weight earlier ($p < 0.05$) than the control group. There was no significant difference ($p > 0.05$) in the faecal egg counts between the groups, the predominant genera of gastrointestinal nematodes in faecal cultures being *Haemonchus* spp. and *Trichostrongylus* spp. Other nematodes were *Cooperia* spp., *Bunostomum* spp. and *Oesophagostomum* spp.

Keywords: blocks, cattle, calves, *Cooperia*, *Haemonchus*, live weight, molasses, supplement, urea

Abbreviations: ABZ, albendazole; epg, eggs per gram of faeces; FEC, faecal egg counts; GI, gastrointestinal; UMB, urea–molasses blocks

INTRODUCTION

Gastrointestinal (GI) helminth parasites, and especially haemonchosis, represent a major constaint to cattle production in the arid and semi-arid lands of Kenya (Omara-Opyene, 1985; Waruiru *et al.*, 1993). These areas are characterized by wide fluctuations throughout the year in the nutrients available from the pastures on which cattle mainly depend on for their feed supply. Working in central Turkana, Njanja (1991) observed that GI nematodes were the most important helminths in ruminants, with clinical helminthosis occuring in the late dry season when the animals were also under nutritional stress.

Cattle in the arid and semi-arid lands often rely on low-protein, straw-based diets, which leads to low levels of production, including a low calving percentage, low birth weight, high calf mortality, low weaning weight, stunted body size, late sexual maturity and reduced milk production (Abate *et al*., 1985). Production is likely to be even lower in animals suffering from GI parasitism (Sykes, 1994). Alternative nutritional practices need to be developed to increase the productivity of cattle and these should include feed supplementation by the use of multinutrient blocks containing fermentable nitrogen and other microbial growth factors, which enhance the digestibility of crop residues and straw by affecting the ruminal functions (Leng *et al*., 1991). In these areas, the use of low-cost supplements, such as urea–molasses blocks (UMB), should enhance the animals' ability to utilize the available diet and assist them to withstand infection, resulting in a substantial increase in productivity. The positive effects on the production of meat and/or milk of providing such supplements for ruminants fed on unbalanced roughages have been well documented (Sansoucy *et al*., 1988; Leng *et al*., 1991). This on-farm study was undertaken to determine the effects of UMB supplementation on the productivity of grazing calves in central Kenya.

MATERIALS AND METHODS

Study area

The study was conducted between June 1999 and August 2000 on a dairy farm (Iganjo) in Ruiru Division of Thika District, central Kenya, about 40 km northeast of Nairobi. The area is semi-arid and lies at an altitude of 1500 m above sea level. The district has a bimodal annual rainfall that varies from 500 mm in dry years to 1500 mm in wet years. The long rains occur between March and May, and the short rains between October and December. The mean annual temperature is about 20°C, the coldest months being June, July and August, and the hottest months being February, March and April. The relative humidity ranges from 57% in February to 74% in July (Anonymous, 1997). The vegetation on the farm consists of natural pasture, which is dominated by *Themeda triandra*, *Cynodon dactylon* and *Pennisetum clandestinum*. The soils are shallow, well-drained and composed of clay with a lot of murram. Their water-holding capacity is low and the vegetation dries up quickly during the dry season (Jaetzold and Schmidt, 1983). Problems related to GI parasites have been reported and anthelmintics are regularly used (Waruiru *et al*., 1993, 1997).

Feed block manufacture

The UMB consisted of 10% fertilizer-grade urea (46% N), 12% cement (as a binding material), 25% sugar cane molasses, 4% common salt, 4% mineral premix (NaCl, Ca, P, Mg, Fe, Cu, Mn, Zn, S, Co, I, Se and Mo), 35% maize germ (as a bulking product) and 10% water. The UMB were prepared by a cold process using a concrete mixer (Sansoucy, 1986; Avilla *et al*., 1993) as follows. Initially, half the water (5 parts) was thoroughly mixed with the urea until the urea granules dissolved. The cement and most of the remaining water (3 parts) was added and mixed. Then, the molasses, salt, mineral premix and the remaining water (2 parts) were added to the mixture and mixed in. Thereafter, the maize germ was added in repeated small quantities and thoroughly mixed in until the mixture was even and without lumps. The complete multinutrient mixture was poured into a mould (a 5 L plastic basin). The mixture was left in the basin for a day and the block was then taken out by turning the basin over and knocking the bottom and sides, and left to dry for 2 weeks in the open air (Bain, 1999).

Feed analysis

Proximate analysis of the UMB and grass hay was done to determine the dry matter, crude protein, crude fibre, ash and ether extract using the procedure outlined by McDonald and colleagues (1987). The chemical composition of the feeds is shown in Table I.

TABLE I
Chemical composition (%DM) of the dietary urea–molasses block (UMB) and grass hay offered to the calves during the study

Component	UMB	Hay
Dry matter	88.56	90.16
Crude protein	39.08	6.71
Crude fibre	11.35	62.35
Ash	34.61	7.71
Ether extract	1.42	2.44

Study design

In June 1999, 26 weaner crossbred-Friesian female calves, aged between 7 and 10 months, were weighed, treated orally with albendazole (ABZ) (Valbazan, Novartis East Africa Ltd, Nairobi, Kenya; 10 mg/kg), and maintained as a group. The calves (mean weight of 138 kg; range 126–142 kg) were allocated on the basis of their weight to two similar groups of 13 animals each. Group I (UMB group) were fed UMB on three occasions for three consecutive months: July to September 1999 (dry cold season), January to March 2000 (dry hot season) and July to September 2000. This was preceded by an adaptation period, with the blocks being fed to the group for 2 weeks in June 1999. All the blocks were weighed daily during the adaptation period and during the first 14 days of each supplementation period. Each block weighed 5 kg and it was calculated that 1.8 blocks were required to provide an average intake of 2.8 g/kg body weight, equivalent to about 700 g/head per day (Sansoucy, 1986). Fifteen blocks were put out initially and were replaced as they were consumed. The animals had unrestricted access to the blocks while they were housed each night. The calves in Group II (control group) did not receive the UMB blocks, but both groups of calves were provided with mineral salt (Maclik Super, Cooper Kenya Ltd, Nairobi) during the adaptation and throughout the study period. All the calves grazed together during the day but were housed separately at night for the supplementary feeding. Owing to drought, hay was offered from January 2000 to the animals, each group receiving similar amounts. The animals were observed daily as part of the normal management practices on the study farm and were examined thoroughly at each sampling. Individual body weights were recorded for each animal before the study commenced and then at monthly intervals until the end of the study.

Rectal faecal samples were collected at the start of the study and at monthly intervals thereafter. A modified McMaster technique was used to determine the number of nematode worm eggs per gram (epg) of faeces (MAFF, 1986). Group-bulked faeces were cultured and the infective larvae were identified and expressed as the percentages of the genera (MAFF, 1986).

Rainfall

Rainfall data were recorded on the farm (Figure 1). Over the study period, the highest rainfall occurred in November and December 1999 (short rains) and rainfall was unusually low through January to August 2000, when only sporadic low falls of rain were recorded; wet days being > 5 days in each of these months. The recorded rainfall was below the expected long-term average for the study area.

Statistical analysis

The differences in live weight gain and faecal egg counts (FEC) between the groups were analysed by repeated measures analysis of variance, using the general linear model procedure of the SAS package (SAS Institute Inc., 1989–1996). The FEC data required logarithmic transformation ($\log_{10}(\text{count} + 50)$) to stabilize the variance within the groups. Geometric group means were calculated.

RESULTS

Most of the faecal samples taken from the naturally infected calves before treatment with ABZ contained low numbers of strongylid-type eggs. A few of the samples also contained small numbers of eggs of *Nematodirus* spp., *Trichuris* spp. and *Monezia* spp. The monthly geometric mean faecal egg counts for the two groups are given in Figure

1. The initial oral administration of ABZ was effective in reducing the existing nematode infections, as evidenced by the reduction in FEC to zero in July. Thereafter, the GI nematode infection showed two peaks, which were directly related to the pattern of rainfall. There was a sharp rise in FEC in November–January, during the short rains. This was followed by an equally sharp drop, which, apart from a small transient rise in counts in April, was maintained until the end of the observations. There was no significant difference ($p > 0.05$) in FEC between the UMB and control groups, although, after August, the mean FEC for the UMB group was consistently lower than that of the control group (Figure 1).

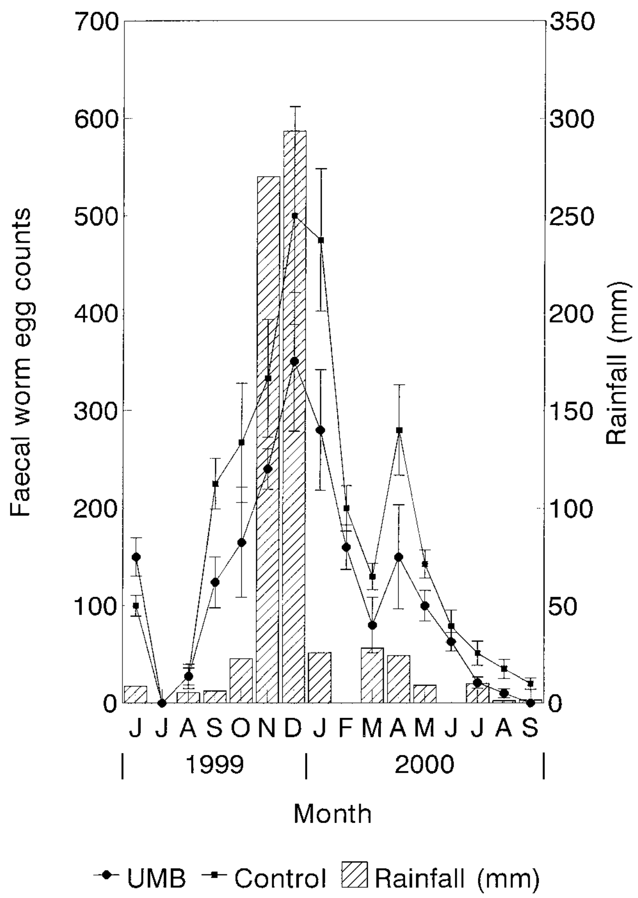

Figure 1. Geometric mean strongyle eggs per gram of faeces for the UMB and control groups of calves during June 1999–September 2000 and total monthly rainfall figures

The strongylid-type larvae derived from the cultures were predominantly those of *Haemonchus* spp. (mean 59%), and *Trichostrongylus* spp. (mean 28%), with small proportions of larvae of *Cooperia* spp., *Bunostomum* spp. and *Oesophagostomum* spp. (mean 6%, 2% and 5%, respectively). There was no significant difference ($p > 0.05$) in the generic composition of the larvae from the UMB and control groups.

The mean daily consumption of blocks by the UMB group during the adaptation period (June) was 370 g. The average daily consumption of blocks by the same group during the three phases of supplementation was 390 g (July), 640 g (January) and 800 g (July), an average consumption rate of 550 g, 78.6% of the 700 g intended. No adverse reactions associated with feeding UMB were observed.

All the calves showed similar weight gains up to August 1999 (Figure 2). Thereafter, the UMB group gained significantly ($p < 0.05$) more weight than the control group. Overall, the calves in the UMB group gained an average ($\pm$SD) of 140$\pm$9.2 kg

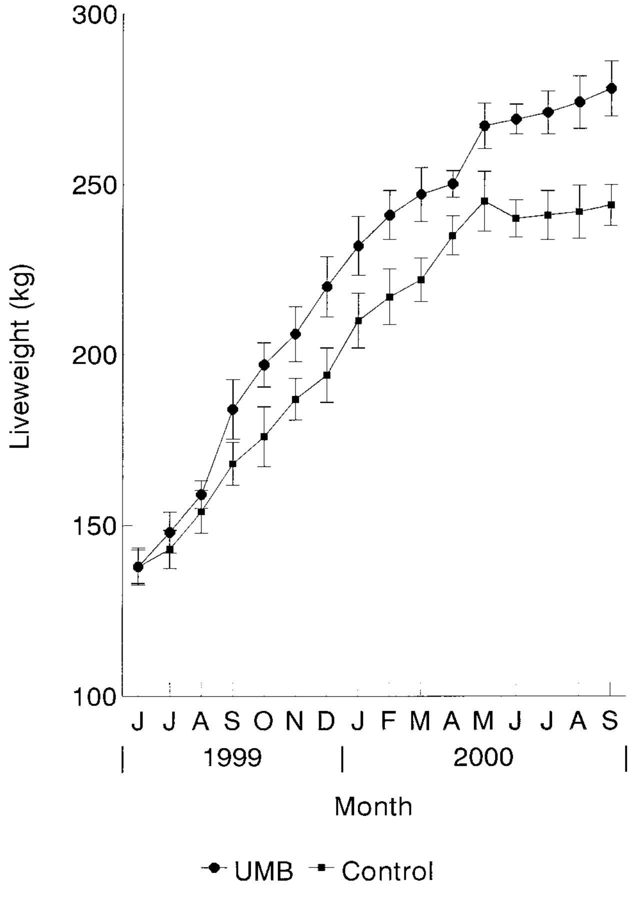

Figure 2. Mean ($\pm$SD) live weight of UMB and control groups of calves during June 1999–September 2000

(311.2 ± 14.9 g/day), while the control group gained an average of 106 ± 6.9 kg (235.7 ± 23.5 g/day) over the study period. Calves in the control group were in poor bodily condition from April onwards, while those in the UMB group looked healthier, their skin appearance improved and so did their bodily condition. In January, 8 of 13 UMB heifers ($p < 0.05$) were mated compared to only 3 in the control group.

DISCUSSION

The faecal egg output showed a clear seasonal pattern in both groups. During the short rains, the environmental conditions were ideal for the development and transmission of infective larvae on herbage. It was during this period that FEC values began to rise, reaching their highest peak between December and January. The small peak recorded in April was due to larvae picked up in March, as hypobiosis does not seem to play an important role in the epidemiology of *Haemonchus* spp. in the study area (Waruiru *et al.*, 2002). The FEC indicated low to moderate worm burdens, consistent with subclinical parasitism throughout the study, as previously reported by Waruiru and colleagues (1997).

Although the FEC in the UMB group was consistently lower, it was not significantly different from that in the control group. This was in agreement with the general consensus from various studies that supplementation of the basal diet with additional protein does not appear to influence the initial establishment of nematode infections, although the pathophysiological consequences are generally more severe in animals that are not supplemented (Coop and Holmes, 1996).

McBeath and colleagues (1979) observed that the intake of feed blocks may vary according to the amount of grazing and supplementary feed available and also suggested that animals should be accustomed to block feeding. The 2-week adaptation period allowed in this study was appropriate, as the consumption rate of 78.6% led to a significant increase in the growth rate and no cases of urea toxicity were recorded. In this study, the UMB was offered in a block form for the animals to lick rather than being chopped into pieces before feeding, which may lead to consumption of toxic doses of urea, as was reported recently in sheep (Tibbo *et al.*, 1998).

The UMB group had greater weight gains than the control group. Ricca and Combellas (1993) showed that such blocks had a positive effect on the growth of animals when sufficient forage or grazing was available, for example at the beginning of the dry season, but that they had no effect when the basal diet was limited in quantity. Urea supplementation of sheep fed a low-quality roughage diet is known to reduce the level of infection and debilitating effects of GI nematode infections (Knox and Steel, 1996). This response is partly due to the stimulatory effect of urea on feed intake, counteracting the depressive effect of the parasites on appetite (Kyriazakis *et al.*, 1998). Multinutrient blocks can, therefore, assist cattle to overcome the detrimental effects of GI nematode parasitism (Saadullah, 1991). This effect may be attributed to a greater intake of the basal diet owing to increased digestibility, arising from the effect of enhanced ammonia nitrogen levels in the rumen on microbial fermentation, causing an increased availability of post-ruminal microbial protein (Knox and Steel, 1996).

Other microbial factors are also provided at the same time, particularly the sulphur and trace elements contained in molasses (Hendratno *et al.*, 1991).

Supplementation also had some benefits in reproduction, as the UMB group reached breeding weight 1–3 months earlier than the control group. The decision of the cattle owner to have the heifers mated was based on the general condition of the animals. Current recommendations for the management of dairy heifers encourage farmers to breed heifers when they reach the optimal weight rather than at a specific age, such as 15 months (Foley *et al.*, 1973). As reproduction rates are low in the arid and semi-arid lands, it appears that one of the most beneficial effects of multinutrient blocks might be an improvement in the reproductive aspects of the herd. In this context, adding phosphorus to the blocks would probably be useful (Sansoucy, 1995).

In conclusion, the use of UMB should be considered as an integral part of husbandry practice in Kenyan farms, as elsewhere in Africa (Sansoucy *et al.*, 1988), in order to reduce the debilitating effects of GI nematode parasitism and minimize the requirements for anthelmintic chemotherapy (Coop and Holmes, 1996).

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