Indian Journal of Animal Sciences **68** (3) : 209-211, March 1998

An outbreak of haemonchosis associated with anthelmintic resistance on a sheep farm in Kenya

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Received: 21 April 1997 ; Accepted : 9 September 1997

ABSTRACT

An outbreak of haemonchosis associated with anthelmintic resistance was recorded in a flock of 150 Dorper sheep. Closantel (CLO) @ 5 mg kg^{-1} body weight and ivermectin (IVM) @ 0.2 mg kg^{-1} body weight were 100% effective against *Haemonchus contortus* while fenbendazole (FBZ) and albendazole (ALB) reduced faecal egg counts by 27.5 and 38.0%, respectively. Levamisole (LEV) showed an efficacy of 92.3%. At double the recommended dose (10 mg kg^{-1}), percentage reduction in faecal egg counts of sheep treated with FBZ and ALB varied between 69.9 and 75.7% and worm counts between 38.3 and 42.0%, respectively, confirming *Haemonchus contortus* resistance to these anthelmintics. These data indicate that worm control strategies based on CLO or IVM could provide effective control of benzimidazole-resistant strains of *H. contortus* on Kenyan farms.

Key words : Anthelmintic resistance, Benzimidazoles, Haemonchosis, Kenya, Sheep

Resistance to phenothiazine in a strain of *Haemonchus contortus* was first reported by Drudge *et al.* (1954). Since then *H. contortus* resistant to a number of anthelmintics have been described in grazing animals (Prichard 1994). In Kenya, strains of the parasite resistant to benzimidazoles (BZs) and levamisole (LEV) in sheep and goats were recorded (Ndarathi 1992, Maingi 1993, Waruiru 1994).

The present communication describes an outbreak of haemonchosis associated with the presence of anthelmintic resistance in sheep.

MATERIALS AND METHODS

Clinical parasitic gastroenteritis due to haemonchosis was diagnosed in the last week of August 1995 in a flock of 150 Dorper sheep reared on a private farm in Nairobi, Kenya. The clinical signs of haemonchosis observed included anaemia, rapid weight loss, weakness, emaciation, submandibular oedema and prostration. Deaths were also observed despite the flock having been treated monthly with either fenbendazole, albendazole or levamisole. The characteristic abomasal lesions and recovery of adult *H. contortus* parasites from the abomasum of the carcasses confirmed the disease.

The sheep flock had been dewormed with thiabendazole (TBZ), TBZ plus rafoxanide combination, fenbendazole and LEV plus oxyclozanide combination at one time or another during the previous 5 years.

When treatment failed to alleviate the deteriorating condition of the flock, 50 infected weaner lambs, aged 6-8 months were separated and their faecal samples subjected to an egg count. Based on the result of the faecal examination, the lambs were randomly divided into 5 treatment groups to compare the faecal egg count reduction abilities of the drugs: fenbendazole, 5.0 mg kg^{-1} orally; albendazole, 5.0 mg kg^{-1} orally; levamisole, 7.5 mg kg^{-1} orally; ivermectin, 0.2 mg kg^{-1} subcutaneously (s.c.); closantel, 5.0 mg kg^{-1} orally. On the same day, infected sheep in the remaining 100 animals of the flock were treated with IVM (0.2 mg kg^{-1} s.c.) and because of the severity of the condition the 2 flocks were maintained indoors, separately, on lucerne hay and concentrates. Water and mineral salt were provided *ad lib.* Ten days later, faecal samples of animals of each experimental groups were examined again for worm eggs and clinical signs.

Controlled anthelmintic test

Lambs (42), 6-8 months, rendered parasite-free by subcutaneous IVM treatment 6 weeks earlier and reared in pens with concrete floors, were each infected once with 5 000 infective larvae (L_3) of the *H. contortus* isolate from the farm. Twenty-one days after infection, the lambs were weighed, their faeces sampled, and assigned to one of the 6 treatment groups each consisting of 7 lambs. The sheep in group 1 were treated with FBZ, 10 mg kg^{-1} body weight, those in group 2 with ALB, 10 mg kg^{-1} body weight and those in group 3

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Table 1. Faecal egg and worm counts, mortality and general health of naturally infected crossbred lambs following treatment[1], and the efficacy of benzimidazole and non-benzimidazole anthelmintics against an isolate of *Haemonchus contortus* in artificially infected sheep in Kenya[2]

Treatment (mg kg^{-1})	Geometric mean faecal egg count (range)		FECR%	Worm count post-treatment	Mortality	Worm reduction (WR%)
	Pre-treatment	Post-treatment				
A[1]: Fenbendazole, 5	7333 (3)[b]	5317 (4)	27.5	2498	3	-
B[2]: Fenbendazole, 10	2615 (2200-3800)	722 (200-2200)	69.9	2106 (874-3293)	--	38.8
A: Albendazole, 5	7800 (4)	4836 (3)	38.0	3745	2	--
B: Albendazole, 10	2650 (1700-4000)	590 (100-1600)	75.7	1978 (516-3450)	--	42.0
A: Levamisole, 7.5	7668 (2)	590 (0)	92.3	--	0	--
B : Levamisole, 7.5	2790 (1400-3600)	24 (200-900)	99.4	27 (0-168)	--	99.2
A : Ivermectin[a], 0.2	7566 (4)	0 (0)	100	--	0	-- 100
B : Ivermectin, 0.2	2520 (1200-3600)	2	100	2	--	100
A : Closantel, 5	6895 (3)	23 (0)	99.7	--	0	--
B : Closantel, 5	2548 (1600-3900)	0	100	0	--	100
B : Control	2519 (1900-2800)	2307 (900-3600)	--	3413 (1976-4210)	--	--

[a]Drugs given subcutaneously; all other drugs given orally, [b]figures in parenthesis indicate submandibular oedema.

with LEV, 7.5 mg kg^{-1} body weight. Sheep in groups 4 and 5 were treated with IVM, 0.2 mg kg^{-1} and CLO, 5.0 mg kg^{-1} body weight respectively. Animals in group 6 served as untreated controls. Ten days after treatment, all the lambs were sampled for faeces then slaughtered prior to worm recovery from the abomasal contents and mucosal digests.

Parasitological techniques

In all trials, faecal egg count (FEC) were done by a modified McMaster technique detecting a minimum of 50 egg per gram (epg) (Thienpont *et al.* 1979). Larval cultures were made on pooled faecal samples (50-100 g) collected before (day 0) and 10 days after treatment. At slaughter, the abomasum was removed intact. The worms present in 2 sub-samples of 20% alequots of abomasal contents and mucosal digests of each animal were then counted (MAFF 1986).

Anthelmintic efficacy

The data on epg and worm counts for each animal were transformed according to the expression $y = \log_{10}$ (count + 20) to calculate geometric means. The efficacy of each anthelmintic was determined by calculation of the percentage faecal egg count reduction (FECR; Presidente 1985). The FECR were corrected for change that occurred in the control group by the equation :

$FECR\% = (1 - T2/T1 \times C1/C2) \times 100$

where, T and C are the geometric means for the treated and control groups, and 1 and 2 designate the counts before and after treatment respectively.

The worm count reduction (WR%) after slaughter was calculated from counts of adult and immature stages of *H. contortus* using the following formula :

$WR\% = (C-T)/T \times 100$

where, C and T are the geometric mean counts from untreated and treated groups respectively (Presidente 1985).

RESULTS AND DISCUSSION

FBZ and ALB treatments reduced epg by 27.5%, and 38.0% respectively (Table 1). LEV treatment produced 92.3% reduction in epg, while CLO and IVM treatments produced over 99.0% reduction in epg. The pooled co-proculture of each group for positive epg identified *H. contortus* as the predominant nematode with an occurrence rate of 95.3% in the flock. The occurrence rate of *Trichostrongylus* spp. was 2.8% and of *Oesophagostomum* spp. 1.9%.

Submandibular oedema was observed in 4 and in 3 lambs in the FBZ- and ALB- treated groups respectively. Lambs receiving CLO and IVM did not show submandibular oedema and their health also improved. Within 10 days of treatment, 2- 3 lambs died within each of the FBZ- and ALB-treated groups and worm counts ranged between 2 498 and 3 745. The occurrence rate of *H. contortus* was 94.9%, *T colubriformis* 3.4% and *Oesophagostomum* 1.7%. Predominant postmortem lesions were haemorrhagic gastritis, oedema and anaemia.

There were 69.9, 75.7 and 99.1% reductions in the mean FEC of sheep 10 days after treatment with FBZ, ALB and LEV respectively (Table 2). The corresponding reduction in worm counts on these treated groups on postmortem

examination were 38.3, 42.0 and 99.2%. of IVM and CLO, reduction FEC and worm counts was 100% (Table 2).

On the basis of FECR, *H. contortus* had developed resistance to BZs (FBZ and ALB) but not to CLO and IVM. The recovery of worms from animals that died due to haemonchosis and results of the controlled slaughter trial also confirmed that the parasites had developed resistance. In the slaughter trial, FBZ and ALB treatments depressed egg output by > 65%, but reduced worm burdens by < 45%. These results confirm previous observations on the effect of BZs on BZ-resistant strains, i.e, a temporary suppression of worm egg counts without a corresponding worm loss (Hotson *et al.* 1970, LeJambre *et al.* 1979). A reduction of > 90% in epg in LEV-treated sheep did not suggest resistance of the parasite to this drug though its continuous use may cause the development of resistance (Herd *et al.* 1985); as LEV has caused in Kenya (Wanyangu *et al.* 1996).

CLO and IVM proved to be very effective against this isolate of *H. contortus* and since these drugs had not been used on the farm, resistance against them was not expected. The prolonged activity of CLO (Hall *et al.* 1981) and parenteral IVM (McKenna 1986), which could prevent the establishment of incoming larvae, could additionally reduce the rate of reinfection and pasture contamination and increase the intervals between treatment (Dash 1986). However, an isolate of *H. contortus* resistant to CLO and IVM have been described on a sheep and goat farm in Kenya (Mwamachi *et al.* 1995). It is therefore important that farmers are informed through veterinary extension officers, to alternate the use of CLO or IVM with unrelated compounds after a given period of time. This would avoid generation of resistant strains, especially *H. contortus*, hence losses in livestock production (Ndarathi 1992).

ACKNOWLEDGEMENTS

This study was supported by a grant from the Agricultural Research Fund (grant NO. ARF/LSKP/RC-USAID/1132/1) under the auspices of Kenya Agricultural Research Institute (KARI) and the author is most grateful.

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