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AN ABATTOIR SURVEY OF GASTROINTESTINAL NEMATODE INFECTIONS IN CATTLE IN THE CENTRAL HIGHLANDS OF KENYA

R.M. WARUIRU[1*], P. NANSEN[3], N.C. KYVSGAARD[3], S.M. THAMSBORG[3], W.K. MUNYUA[1], J.M. GATHUMA[2] AND H.O. BØGH[3]
[1]Department of Veterinary Pathology and Microbiology, [2]Department of Public Health, Pharmacology and Toxicology, University of Nairobi, PO Box 29053, Nairobi, Kenya; [3]Danish Centre for Experimental Parasitology, Department of Veterinary Microbiology, Royal Veterinary and Agricultural University, Bulowsvej, DK-1870 Frederiksberg C, Denmark
*Correspondence

ABSTRACT

Waruiru, R.M., Nansen, P., Kyvsgaard, N.C., Thamsborg, S.M., Munyua, W.K., Gathuma, J.M. and Bøgh, H.O., 1998. An abattoir survey of gastrointestinal nematode infections in cattle in the Central Highlands of Kenya. *Veterinary Research Communications*, **22(5)**, 325–334

The gastrointestinal tracts of 672 crossbred cattle were obtained from various abattoirs in Kiambu District, Kenya from August 1992 to July 1993, and examined for the presence of gastrointestinal nematodes. Eight nematode species were found in 583 (86.8%) of the animals. The nematodes were, in order of prevalence: *Haemonchus placei* (67.0%), *Cooperia pectinata* (53.0%), *Cooperia punctata* (41.7%), *Oesophagostomum radiatum* (38.4%), *Trichostrongylus axei* (24.3%), *Nematodirus helvetianus* (19.6%), *Trichuris globulosa* (9.7%) and *Strongyloides papillosus* (3.6%). The intensity of the nematode infection was moderate; the mean burden being less than 7000 worms. *H. placei* accounted, on average, for 52.3% of the total burden. The total burden was least during the dry seasons and increased gradually during the rainy seasons. Adult *H. placei* persisted in the host throughout the year and there was no indication of hypobiosis. The heaviest gastrointestinal worm burdens were detected in 1.5- to 3-year-old animals. These findings are discussed with regard to their relevance for strategic control of gastrointestinal nematodes in cattle.

Keywords: age, cattle, hypobiosis, prevalence, season, trichostrongyles

Abbreviations: epg, eggs per gram of faeces

INTRODUCTION

It is generally believed that, of all the intestinal parasites of cattle, the gastrointestinal nematodes have the most serious economic consequences. This is based on the overall numbers of worms, numbers of genera and species present, general levels of pathogenicity and widespread distribution (Gibbs and Herd, 1986; Rickard and Zimmerman, 1992). The most common nematodes present in cattle on pasture in the tropics include *Haemonchus placei*, *Trichostrongylus axei*, *Cooperia* spp. (*C. pectinata*, *C. punctata* and *C. oncophora*) and *Oesophagostomum radiatum* (Winks *et al.*, 1983; Chiejina, 1994). Of these, *H. placei* and *O. radiatum* are recognized as being the most pathogenic and economically important parasites of cattle in the tropics (Roberts *et al.*, 1951; Waruiru *et al.*, 1993; Chiejina, 1994).

The marked variation in the transmission patterns of the gastrointestinal nematodes is dependent on the particular climate in the geographic location in which they occur. Therefore, epidemiological data should be developed for each geographic area. Such data do not exist for most of Kenya, which has a variety of geographic regions, each with defined environmental conditions. Thus, to develop strategic preventive measures against nematodosis, it is necessary to have a fairly precise knowledge of the seasonal epidemiology of nematode infections in each area (Arambulo and Moran, 1981; Thys and Vercruysse, 1990). Gastrointestinal nematode infections of cattle have been investigated in various climatic environments in Kenya (Omara-Opyene, 1985; Gatongi *et al.*, 1987; Maingi and Gichigi, 1992) and much of the information on epidemiology is based on estimating worm burdens from faecal egg counts (Carles, 1992). In cattle, however, the egg production of nematodes was found to depend heavily on the season (Kaufmann and Pfister, 1990). During the dry season, when conditions are unfavourable for the development of infective larvae, faecal egg production is reduced. It is therefore more reliable to quantify worm burdens by post-mortem examinations, particularly during the dry season (Fritsche *et al.*, 1993).

This paper describes results obtained from 672 post-mortem analyses of cattle in Kiambu District, central Kenya, with special emphasis on the seasonal epidemiology of gastrointestinal nematode infections.

MATERIALS AND METHODS

Study area

The survey was conducted in Kiambu District, in the highlands of central Kenya. The area is a dissected plateau, drained by many rivers and streams, lying between 1500 m and 3200 m above sea level. The district has an annual bimodal rainfall of 600–2500 mm. The long rains occur between March and May, and the short rains between October and December. The mean monthly minimum temperature varies from 10°C to 15°C and the mean maximum temperature from 20°C to 25°C. The meteorological data for the area were obtained courtesy of the Director, Meteorological Department, Nairobi.

Owing to the high population density, most of the district has been cleared of natural vegetation to give way to farming practices. Most of the residents are smallholder mixed farmers, for whom the livestock enterprise is mainly milk production. The cattle population mostly comprises *Bos taurus* or *Bos taurus* crosses, which are well adapted to the moderate climate of the area (Gitau *et al.*, 1994).

The control of helminth parasites is largely based on the use of anthelmintics and pasture management is rarely practised. Drenching is normally done at irregular intervals, without following the epidemiology of the parasites. The most common practice is to treat animals, especially young cattle, at intervals of approximately 3 months (Kinoti *et al.*, 1994). Supplementary feeding is not often practised in the study area.

Animals

The investigation was conducted on crossbred cattle slaughtered at various abattoirs and slaughter slabs located throughout Kiambu District. The animals to be examined were procured locally and it was envisaged that their worm burdens would reflect the general pattern of worm population in animals of the area surveyed. A total of 672 gastrointestinal tracts were analysed from freshly slaughtered animals between August 1992 and July 1993. Fourteen gastrointestinal tracts were collected each week, being taken at random from the animals presented for slaughtering during the visits. Age (by number of teeth) and origin (with the help of the cattle owners and butchers) were determined prior to slaughter. The ages of the animals ranged from 13 months to more than 4 years (average age 57 months). There were 390 female and 282 male animals.

Parasitological examination

At slaughter, the gastrointestinal tracts were removed and the abomasum was immediately isolated by two ligatures to avoid mixing of the contents. Thereafter, the abomasum was opened along the major curvature and washed. The abomasal contents and washings were then collected in a bucket and passed through a sieve of 200 μm mesh in order to clear the suspension and retain the adult nematodes. The retained contents were resuspended in 5 litres of water, and aliquots of 200 ml were taken while mixing thoroughly. The small intestine and the caecum with the ascending colon were slit along their length and processed separately in the same way as the abomasum.

The recovered samples were examined, a few millilitres at a time, in a Petri dish under a dissecting microscope (magnification $\times 25$). The worms in the two intestinal compartments were counted and collected in 4% formaldehyde for subsequent identification after treatment with 90% lactic acid. Female nematodes were identified to genus level and males to species level (Ministry of Agriculture, Fisheries and Food, 1986). The abomasal mucosa was scraped off and digested in 1% pepsin solution containing 2% concentrated HCl at 39°C for 4–6 h (Herlich, 1956). The larvae in the digested material were counted as described above for the adults. Rectal faecal samples were collected from all the animals for strongylid worm egg counts (epg) using a modified McMaster technique (Thienpont *et al.*, 1979). The remaining faecal material from each collection was pooled and cultured at 27°C for 7–10 days to harvest the third stage (L_3) larvae, which were identified to generic and species levels (Keith, 1953).

Statistical analysis

One-way analysis of variance (ANOVA) was used to examine the differences in worm burdens and faecal strongyle egg counts between age classes, based on a logarithmic transformation similar to that used by Field and colleagues (1960).

RESULTS

Meteorological data

The data for the total rainfall and for the mean maximum and minimum monthly temperatures for the area pertaining to the survey period are shown in Figure 1. The meteorological values for each month accorded with the average values over the previous 20 years.

Parasitological findings

Of the 672 animals investigated, 583 (86.8%) were found to be infected with one or more species of nematode parasites. The prevalence and mean worm burdens of the eight species encountered are listed in Table I. *H. placei*, *C. pectinata*, *C. punctata* and *O. radiatum* were the most common species, followed by *T. axei*, *Nematodirus helvetianus*, *Trichuris globulosa* and *Strongyloides papillosus*, which were generally only found in moderate or low numbers.

The intensity of the nematode infections was moderate in most animals, the overall mean nematode burden being 3353 (range 260–18 300) and the overall mean faecal strongyle egg count being 400 epg. *H. placei*, *Cooperia* spp. and *O. radiatum* accounted, on average, for 52.3%, 28.5% and 6.9% of the total worm burden, respectively.

The seasonal dynamics of the worm burdens and faecal egg output followed a similar pattern (Figure 1). Worm burdens increased with the onset of the short rains in October and reached a peak in November/December. A second peak was observed in May/June, during the long rains, after which time the worm numbers steadily decreased. Faecal egg output was at its lowest during the dry seasons. However, it increased gradually through the rainy seasons to reach peaks in December and May. The relative abundance of *H. placei*, *Cooperia* spp., *O. radiatum* and *T. axei* followed the same trend as that of the total worm burden during the different seasons. *N. helvetianus*, *S. papillosus* and *T. globulosa* occurred only occasionally, in very low numbers, and their populations were apparently not affected by seasonal fluctuations.

Abomasal digestion revealed negligible numbers of developing stages of *H. placei* at any time, the proportion of EL_4 ranging between 0 and 5.8% throughout the year.

The mean and range values of the percentage of the larval population of *H. placei*, *Cooperia* spp., *Oesophagostomum* spp. and *Trichostrongylus* spp. were 56.7% (43–78%), 29.3% (18–39%), 8.4% (6–21%) and 5.6% (1–20%), respectively. *H. placei* ($>65\%$) and *Cooperia* spp. ($>30\%$) were the most prevalent during the rainy seasons.

Age/worm burden relationship

There were 49 animals under 1.5 years, 140 aged 1.5–3 years, 209 aged 3–4 years, and 274 over 4 years examined. Animals younger than 1.5 years had significantly ($p<0.05$) lower burdens than older animals (Figure 2). The highest burdens of nematodes

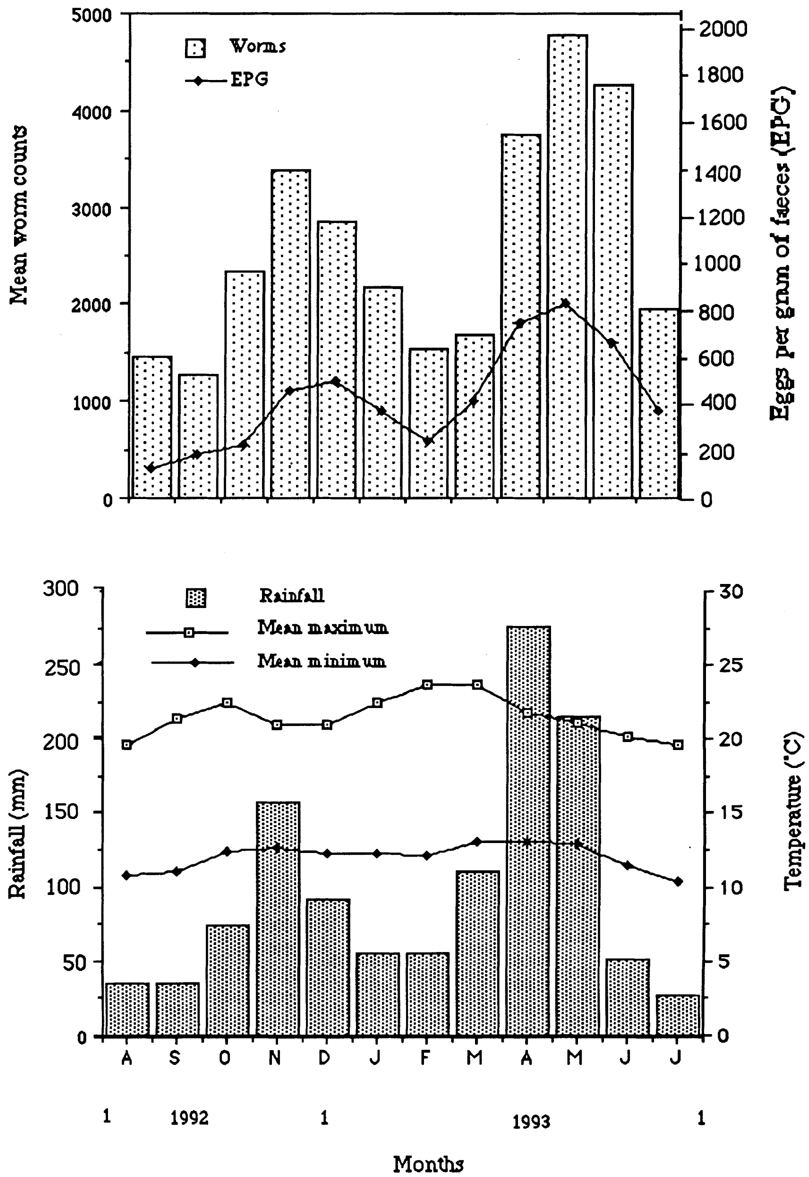

Figure 1. The seasonal patterns of nematode burdens and faecal egg output in cattle, and local climatic data for Kiambu District, Kenya

TABLE I
Spectrum, prevalence and mean burdens of nematodes found in cattle in Kiambu District, Kenya in 672 post-mortem examinations between August 1992 and July 1993

		Worm burden	
Location/species	Prevalence (%)	Mean	Range[a]
Abomasum			
Haemonchus placei	67.0	3378	125–10 375
Trichostrongylus axei	24.3	305	75–1785
Small intestine			
Cooperia pectinata	53.0	1050	150–5515
Cooperia punctata	41.7	779	40–4350
Nematodirus helvetianus	19.6	210	15–1675
Strongyloides papillosus	3.6	81	15–420
Large intestine			
Oesophagostomum radiatum	38.4	445	25–2275
Trichuris globulosa	9.7	175	30–426

[a]Range of positive cases

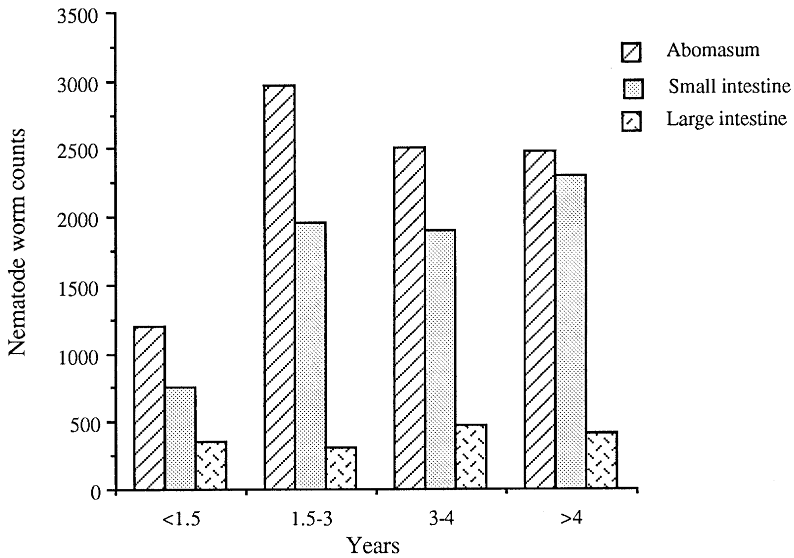

Figure 2. The relationship between gastrointestinal worm burdens and the age of cattle examined in Kiambu District, Kenya

(> 5000) were found in animals of 1.5–3 years of age, but the total number decreased only slightly in older animals. Cattle older than 4 years still carried an average load of more than 4700 nematodes (range 446–6831) and their abomasal load was even higher than in animals of less than 1.5 years.

Cattle older than 1.5 years had significantly ($p < 0.05$) higher *H. placei* burdens, whereas counts of *S. papillosus* were higher in younger animals ($p < 0.05$). Faecal strongyle egg counts were not influenced by age.

DISCUSSION

This paper reports on the results of a study on the seasonal epidemiology of gastrointestinal nematodes found in naturally infected cattle grazing in Kiambu district, central Kenya. With regard to both prevalence and burden, *H. placei* was the most common nematode, as has been reported by others in Kenya (Mango *et al.*, 1974; Omara-Opyene, 1985). A relatively short generation interval probably enables *Haemonchus* spp. to take rapid advantage of favourable climatic conditions (Grant, 1981), as occurred in the present study (Figure 1). The climatic conditions in the study area also seem to be well suited to the development and survival of the free-living stages of the other three species, *Cooperia* spp. and *O. radiatum*. The absence of *Bunostomum* spp. was surprising, considering that the species has been reported in the highlands of Kenya (Round, 1962). Perhaps the distribution of this parasite is focal, affecting only a few farms and localities.

Of the nematode species encountered, *H. placei* and *O. radiatum* are among those which are serious pathogenic parasites of cattle and are therefore of considerable economic importance. The significance of *Haemonchus* spp. and *O. radiatum* is due to the severe trauma and blood loss caused by their migrating and feeding stages (Hutchinson *et al.*, 1980). Roberts and colleagues (1951) observed that egg counts of up to 1000 *H. placei* epg were accompanied by serious signs, while counts of over 500–700 *H. placei* epg reflected a dangerous infection if combined with 300 *Oesophagostomum* and/or *Bunostomum* epg. *Trichostrongylus axei* and *Cooperia* spp are of lower pathogenicity (Anderson *et al.*, 1965) and these parasites appear to have only limited significance in central Kenya (Mango *et al.*, 1974).

The total nematode counts showed a trend which was closely related to rainfall and, generally, animals of all ages were affected by the *Haemonchus–Cooperia* complex, age not having any effect on faecal egg counts. The intensity and prevalence of the *Haemonchus* infections in adult animals were unexpectedly high. Since supplementary feeding is rarely practised, nutritional deficiencies may have interfered with the development of acquired immunity in cattle, as the nutritional state of most of the animals presented for slaughter appeared poor. Malnutrition and concurrent disease may impair host resistance against helminths, resulting in higher worm burdens and/or egg counts (Blackburn *et al.*, 1991). Relatively higher worm burdens and/or egg counts observed in some animals during the wet months (Figure 1) may not have been a result of higher availability of infective larvae on the pasture, but rather of increased susceptibility to infection (Dorny *et al.*, 1995). The present study supports that of

Kaufmann and Pfister (1990) in The Gambia under different climatic conditions and with N'dama cattle. Older animals may be a major source of infection for young stock and further more detailed studies should be undertaken in other areas of Eastern Africa with different climatic conditions. Although clinical helminthosis occurs more often in calves, older animals should also be included in future control strategies.

Persistence of a parasitic nematode infection may be due to the successful survival of the pre-parasitic stages on the pasture and/or of the adults or hypobiotic larvae in the host. The post-mortem and faecal examination results showed that the adults of the various gastrointestinal nematodes were present throughout the year. The numbers of EL_4 of *H. placei* were very low throughout the year. Thus, it appears that, in the area of study, inhibition of *H. placei* L_4 in cattle does not play a significant role in the biology of this nematode. There are conflicting reports on the actual stimuli for hypobiosis in the field. For example, some studies have indicated that, where conditions are favourable for development of the free-living stages, the faculty of hypobiosis is discarded by the parasites (Gupta *et al.*, 1987). By contrast, Ikeme and colleagues (1987) observed that, in spite of the year-round tropical rainfall in Malaysia, there were still significant numbers of hypobiotic larvae of *H. contortus* in goats. Gatongi (1995) observed high levels of inhibition of *Haemonchus* spp. in sheep and goats in a semi-arid area of Kenya during the dry season. It seems, therefore, that the prevailing climatic conditions (medium altitude, bimodal rainfall) in central Kenya are not severe enough to promote selection for seasonally arrested development, as described elsewhere in Africa (Kaufmann and Pfister, 1990; Ndao *et al.*, 1995).

It was concluded that moderate worm infections were found in cattle of all age classes in the area of study. To increase the productivity of cattle, serious efforts should be made to control these subclinical worm infections. Control should be based on epidemiological observations and should not rely on anthelmintics only. Alternative methods of control, such as pasture rotation, breeding for resistance and biological control methods, would reduce the costs for the purchase of anthelmintics and minimize the risk of development of anthelmintic resistance (Waller, 1993; Donald, 1994). The anthelmintic activity of plants like papaya latex (*Carica papaya* Linn.) against gastrointestinal nematodes of ruminants should be investigated, as it has been found to be effective against intestinal nematodes of monogastric animals (Satrija *et al.*, 1994).

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