GASTROINTESTINAL NEMATODOSIS IN GOATS KEPT UNDER THE TETHERING, STALL-FEEDING AND PASTORAL MANAGEMENT SYSTEMS IN TWO ECOCLIMATIC AREAS IN MOROGORO DISTRICT, TANZANIA.

L.J.M. Kusiluka[1], D.M. Kambarage[1], L.J.S Harrison[2], C.J. Daborn[2] and R.W. Matthewman[3]. [1]Department of Veterinary Medicine and Public Health, P.O. Box 3021, Morogoro, Tanzania. [2]Centre for Tropical Veterinary Medicine, Easter Bush, Roslin Midlothian, Scotland EH25 9RG. [3]Natural Resource Institute, Central Avenue, Chatham Maritime, Kent ME4 4TB, UK.

SUMMARY

A field study was conducted to monitor the prevalence and seasonal changes in nematode egg counts in goats kept under the tethering, stall-feeding and pastoral systems in Mgeta (tropical highland) and Mlali (semi-arid) Divisions of Morogoro District, Tanzania. Of the 869 goats examined, 67.7% (588) were infected with nematodes. The prevalence of nematodosis and median nematode egg counts were significantly higher ($P < 0.05$) in stall-fed than in tethered or pastoral goats. In addition, Norwegian Landrace x Small East African crossbred goats had a significantly higher prevalence and median nematode egg count compared to tethered or pastoral indigenous Small East African goats ($P < 0.05$). The prevalence of nematodosis and median egg counts during the long rainy season were significantly higher ($P < 0.05$) compared to the dry and short rainy seasons. Overall, the prevalence of nematodosis and median egg counts in the tropical highland and semi-arid ecoclimatic zones were comparable. The nematode egg count in all the management systems was low (< 500), indicating that subclinical nematodosis was the most common form of the disease. *Haemonchus* spp. (88.2%), *Oesophagostomum* spp. (71.6%) and *Trichostrongylus* spp (62.2%) were the most prevalent nematodes, while *Bunostomum* spp. (6.7%) and *Strongyloides* spp. (5.4%) were least prevalent.

INTRODUCTION

Nematodosis is a major cause of mortality and high economic loss in traditional small ruminant farming systems in Tanzania (Ngomuo *et al.*, 1994). The most important species of gastrointestinal nematodes that affect goats in the country are *Haemonchus contortus*, *Oesphagostomum columbianum* and *Trichostrongylus colubriformis* (Connor, 1985; Njau, 1987). Of these, *Haemonchus contortus* is the most common and important species associated with heavy mortalities and high economic losses in small ruminants in Tanzania (Njombe, 1986; Connor *et al.*, 1990) and other sub-Saharan countries (Lutu, 1983; Muimo, 1989; Asanji, 1988).

The epidemiology of gastrointestinal nematodosis is

influenced by both management systems and climatic factors (Lutu, 1983); with rainfall being the major factor in tropical countries (Okon and Enyenihi, 1977; Ogunsusi, 1979; Hansen and Perry, 1994; Ngomuo *et al.*, 1994). Whereas tethering has been associated with increases in nematode worm burdens (Hendy *et al.*, 1989; Fakae, 1990, Connor *et al.*, 1990), extensive grazing has been found to preclude a build-up of heavy worm burdens (ILCA, 1979).

Little information is available on the epidemiology of gastrointestinal nematodes in various breeds of goats kept under different management systems in Tanzania. The epidemiology of gastrointestinal nematodes may well vary throughout the country because of the diversity of agro-ecological and ecoclimatic conditions. In order to devise effective helminth control programmes, a thorough knowledge of the epidemiology of helminthosis is required. This study was therefore designed to establish the epidemiology of gastrointestinal nematodosis in indigenous and crossbred goats kept under the tethering, stall-feeding and pastoral systems management systems in the tropical highland (Mgeta) and semi-arid (Mlali) ecoclimatic zones in Morogoro District.

MATERIALS AND METHODS

Study area and manage-ment systems

The study was carried out in Mgeta and Mlali Divisions of Morogoro District, Tanzania. Mgeta has a tropical highland climate (temperature of 9-21 ^{o}C and relative humidity of 75-94%), and Mlali has a semi-arid climate (temperature of 15-35 ^{o}C and relative humidity of 46-71%). In both divisions, the long rainy season extends from late February or early March to late May or early June, while the dry season extends from late June or early July to October. The short rains often occur between November and January.

Thirty-four small-holder goat herds (with 1-20 goats) in the tropical highland area (28 herds with indigenous Small East African goats (tethering system) and 6 with Norwegian Landrace x Small East African crossbred dairy goats (stall-feeding system) were screened for nematodes. Small East African goats in 32 small-holder herds (tethering system) and two large herds (with more than 100 goats) and one herd of Toggenburg x Small East African crossbred goats (57 animals) in the semi-arid area (pastoral system) were also included in the study.

Indigenous goats in the tropical highland area were tethered throughout the year in communal grazing areas including harvested crop fields. In most cases, tethering sites were changed daily and shifting of tethering sites in a day depended on farmer's decision or availability of time. Tethering ropes were about 3.5-5.0 metres long and sometimes the grazing

areas between tethered animals overlapped. At night, animals in this group were kept in brick or wooden houses and in most houses manure was left to accumulate for use in crop fields. The houses were cleaned infrequently (about 4 or more weeks) except in few cases where animals were kept in one part of the family house. These animals received little or no veterinary attention.

Norwegian Landrace x Small East African crossbred dairy goats (stall fed) were kept in wooden houses with slatted floors and the manure was infrequently removed. Kids were housed separately from adults. Pasture or fodder was cut from communal grazing areas or small cultivated plots and brought to the animals in stalls. Occasionally, these animals were dewormed.

Small-holder farmers in the semi-arid area tethered the goats in the communal grazing areas during the rainy season and herded or left the animals on free range during the dry season. Tethering practices were similar to those in the tropical highland area. Most goats in this group were housed in one room of the family house and cleaned regularly. These animals received no veterinary attention. In the large pastoral herds, goats were herded throughout the year in communal areas and at night they were confined in open bomas which were not cleaned. Only clinically sick animals were treated. Crosses of Toggenburg and Small East African goats, owned by a Roman Catholic Mission community, were herded in open areas close to residential premises between 8.00 a.m. and 12.00 noon and confined in two one-hactare paddocks thereafter. At night the animals were housed in a wooden house with slatted floor which was cleaned regularly. These animals were also occasionally supplemented with concentrates and regularly dewormed.

Monitoring protocol and parasitological procedures

The general health status of the study goats was assessed using the method described by Agyemang *et al.* (1991). Goats were identified using eartags, aged by dentition (Jindal, 1984) and grouped as kids (< 1 year), yearlings (1-2 years) and adults (> 2 years). About 5 gram of faeces were then taken from the rectum of each goat and examined for nematode eggs using modified McMaster technique as described by the Ministry of Agriculture, Fisheries and Food, MAFF (1986). Egg counts were graded according to Agyemang *et al.* (1991) as low (≤500), medium (>500-1000) and high (>1000). A total of 189 faecal samples which had nematode eggs were cultured for recovery of infective nematode larvae as described by Urquhart and Sewell (1992).

Data analysis

Statistical analysis of data was carried out using Minitab For Windows Release 9.2 statistical package (Minitab Inc., 1993). Differences in the prevalence of

nematodosis between breeds, age-groups, management systems and seasons were compared by the χ^2 test. Differences in the nematode egg counts between breeds, age-groups, management systems and seasons were analysed by the Kruskal-Wallis test for more than two groups and the Mann-Whitney test for any two groups.

RESULTS

The prevalence of nematodosis and, median and ranges of nematode egg counts in goats kept under the different management systems are indicated in Table 1. Out of the 869 goats screened in the three management systems in the two ecoclimatic areas, 67.7% (588) were infected with nematodes. Sixty five percent, 79.0% and 67.2% of tethered, stall-fed and pastoral goats respectively were infected with nematodes. The prevalence of nematodosis in tropical highland and semi-arid zones were comparable ($P > 0.05$). However, in the tropical highland area, crosses of Norwegian Landrace and Small East African goats had a significantly higher prevalence of nematodosis (79.0%) compared to the indigenous (Small East African) goats (59.0%). Similarly, the median nematode egg count (400) of the crossbred animals was significantly higher than that of indigenous goats ($P < 0.05$). The prevalence of nematodosis and median EPG in Toggenburg x Small East African crossbred goats were significantly lower than in animals in other management systems ($P < 0.05$). It was also observed that the prevalences of the disease in both adults and yearlings in all management systems were significantly higher ($P < 0.05$) than that of kids (data not shown).

It was further observed that the majority of the infected animals in all the management systems were excreting ≤ 500 eggs per gram of faeces (Figure 1). The prevalences and median egg counts in animals in the two ecoclimatic zones were found to be significantly higher ($P < 0.05$) during the long rainy season compared to the dry- and short rainy seasons (Figure 2).

Infective nematode larvae were recovered from 85.7 % (162) of the total faecal samples cultured. In these samples, *Haemonchus* spp (88.2%), *Trichostrongylus* spp (71.6%) and *Oesophagostomum* spp (62.2%) were the most prevalent nematodes encountered, whereas *Bunostomum* spp. and *Strongyloides* spp. were recovered from 6.7% and 5.4% of the animals respectively.

DISCUSSION

The observations in this study that more than 65% of the goats examined in all the management systems were excreting nematode eggs and that the prevalences were comparable between the tropical highland and semi-arid zones indicate that helminthosis is widespread in the study area. The genera of nematodes encountered in this study have also been reported by other workers in sub-Saharan countries (Assoku, 1981;

Asanji and Williams, 1987; Okon, 1988; Ndarathi *et al.*, 1989; Zinsstag *et al.*, 1991) and in Tanzania (Connor, 1985; Njau, 1987; Ngomuo *et al.*, 1994). Mixed infections were common as also observed by Connor *et al.* (1990).

The finding that yearlings and adult goats had higher prevalences of the disease than kids is in contrast with the observations of other reports (Assoku, 1981; Connor, 1985; Asanji, 1988). The low prevalence of nematodosis in kids observed in this study may be due to the practice of confining kids near homesteads, which was a common practice in all the management systems. Adults goats were sent to graze in communal areas and were exposed to more widely contaminated areas. Hence, chances of ingesting infective nematode larvae were higher in adults compared to kids. On the other hand, the low prevalence of nematodosis in kids born to stall-fed goats may be due to the fact that they were housed separately from adults and were thus less exposed to contaminated environments.

The high prevalence and intensity of nematodosis in stall-fed Norwegian Landrace x Small East African crossbred goats compared to indigenous animals may be related to breed susceptibility variations to nematode infections (Shavulimo *et al.*, 1988). However, it is also possible that the high environmental contamination (due to infrequent cleaning of animal houses) may have contributed to the high prevalence of the parasites in the stall-feeding system (Restrepo and Preston, 1989). On the other hand anthelmintic treatment which was carried out regularly in Toggenburg x Small East African crossbred goats may have contributed to the low prevalence of nematodosis and median EPG in these animals (Hansen and Perry, 1994).

The majority of infected animals in all management systems were excreting ≤ 500 EPG which may be indicating that subclinical nematodosis is the commonest form of infection in the study areas. This may be attributed to the relatively low stocking densities especially with the extensive management system and age-related resistance to nematodosis (Van Veen, 1973; ILCA, 1979). In addition, the practice of tethering goats on fresh land each day may have prevented animals from acquiring higher nematode burdens.

Rainfall is an important factor influencing the epidemiology of helminth infections in the tropics (Ogunsusi, 1979; Vasudevan and Basuthakur, 1986). This is supported by the observation in this study that higher prevalences and median nematode egg counts were encountered during the rainy season compared to the dry season. However, microclimate of the faecal pellets under grass cover and overcrowding of goats at water points may also be responsible for the survival and continued transmission of infective nematodes during the dry period

(Chiejina *et al.*, 1989). This probably contributed to all year round infections in animals in the study area.

It may thus be concluded that subclinical nematodosis is widespread among goats in all the management systems and that worm burdens show a seasonal pattern in both the tropical and semi-arid ecoclimatic zones. This calls for disease intervention after carrying out a cost-benefit analysis of possible control strategies.

ACKNOWLEDGEMENTS

We are grateful to goat owners in Mgeta and Mlali Divisions for allowing us to use their animals. The technical assistance of Mr D. Mabagala, P. Mkuchu and A. Kitime is highly appreciated as is the advice on statistical analysis given by Dr G. Scott of the Centre for Tropical Veterinary Medicine, Scotland.

REFERENCES

Agyemang, K., Rawlings, P., Clifford, D., Bojang, N. and Tamba, A. (1991) Productivity and health parameters of small ruminants in villages of the Gambia. Bull. Anim. Hlth. Prod. Afri., 39: 129-135.

Asanji, M. F. (1988) Haemonchosis in sheep and goats in Sierra Leone. J. Helminthol., 62: 243-249.

Asanji, M.F. and Williams, M.O. (1987) Variables affecting the populations dynamics of gastrointestinal helminth parasites of small ruminants in Sierra Leone. Bull. of Anim. Hlth. Prod. Afri., 35: 308-313.

Assoku, R.K.G. (1981) Studies on parasitic helminths of sheep and goats in Ghana. Bull. of Anim. Hlth. Prod. Afri., 29: 1-10.

Chiejina, S.N., Fakae, B.B. and Eze, B.O. (1989) Development and survival of free-living stages of gastrointestinal nematodes of sheep and goats on pastures in the Nigerian derived savanna. Vet. Res. Communic., 13: 103-112.

Connor, R.J. (1985) Helminthiasis in goats: Observations on the epidemiology and control of gastrointestinal nematode infections. Report on Work Conducted by the Veterinary Investigation Centre, Mtwara, Southern Tanzania. ODA, London, pp.159-175.

Connor, R.J., Munyucku, A.P., Mackyao, E.and Halliwell, R.W. (1990) Helminthosis in goats in southern Tanzania: investigations on epidemiology and control. Trop. Anim. Hlth. Prod., 22: 1-6.

Fakae, B.B. (1990) The epidemiology of heiminthosis in small ruminants under the traditional husbandry system in Eastern Nigeria. Vet. Res. Communic., 14:381-391.

Hansen, J. and Perry, B. (1994) The Epidemiology, Diagnosis and Control of Helminth Parasites of Ruminants. ILRAD, Nairobi, 169 pp.

Hendy, C.R.C., Mpepo, F., Kamtande, K., Notley, J.R. and Kitosi, K. (1989) The influence of season and related factors on breeding of female liveweights and reproductive performance, the offspring growth and survival of goats under traditional management in Southern Tanzania. Paper presented to the 7th Small Ruminant Collaborative Research Support Programme Scientific Workshop, 22-25 February, Nairobi, Kenya, pp. 1-17.

ILCA. (1979) Small Ruminant Production in the Humid Tropics. ILCA Systems Study 3. ILCA, Addis Ababa, pp. 40-76.

Jindal, S.K. (1984) Goat Production. Cosmos Publications. New Delhi. pp. 10-15.

Lutu, W.Z. (1983) Internal parasitism in milk goats in Kenya. Trop. Anim. Hlth. Prod., 16: 153-157.

MAFF. (1986) Manual of Veterinary Parasitological Techniques. Reference Book 418. Ministry of Agriculture, Fisheries and Food. Her Majesty's Stationary Office, London. 160 pp.

Minitab Inc. (1993) Minitab For Windows Release 9.2. State College, Philadelphia.

Muimo, R. (1989) Strongyle infections of goats on commercial farms in Zambia. In: R.Trevor Wilson and Azeb Melaku (Editors), Proceedings of a Conference on African Small Ruminant Research and Development, Bamenda, pp. 393-402.

Ndarathi, C.M., Waghela, S. and Semenye, P.P. (1989) Helminthiasis in Maasai Ranches. Bull. Anim. Hlth. Prod. Afri., 37: 205-208.

Ngomuo, A.J., Kassuku, A.A. and Boa, M.E. (1994) The prevalence of gastrointestinal nematode infection at SUA and their susceptibility to the commercially available levamisole preparations. Paper presented at the 12th Tanzania Veterinary Association Scientific Conference, 29 November - 3 December, Arusha, 22 pp.

Njau, B.C. (1987) Gastrointestinal nematodes of small ruminants at Kingo'ri in Northern Tanzania. Bull. Anim. Hlth. Prod. Afri., 35: 298-303.

Njombe, A.P. (1986) Small Ruminant Production in Tanzania. In: K.O. Adeniji and J.A. Kategile (Editors), Proceedings of the Workshop on the Improvement of Small Ruminants in Eastern and Southern Africa, Nairobi, pp. 343-351.

Okon, E.D. (1988) Gastro-Intestinal Parasites: Causes and control measures to bring increased productivity. In: K.O. Adeniji (Editor), Proceedings of the Workshop on the Improvement of Small Ruminants in West and Central Africa, 21-25 November, Ibadan, pp. 191-200.

Okon, E.D. and Enyenihi, U.K. (1977) Development and survival of *Haemonchus contortus* larvae on pastures in Ibadan. Trop. Anim. Hlth. Prod., 9: 7-10.

Ogunsusi, R. A. (1979) Pasture infectivity with trichostrongylid larvae in the northern Guinea Savanna of Nigeria. Res. Vet. Sci., 26: 320-323.

Restrepo, J.L. and Preston, T.R. (1989) Parasites and nutrition as constraints to goat production in the Latin American humid tropics. In: R.T. Wilson and A. Melaku (Editors), Proceedings of a Conference on African Small Ruminant Research and Development, 18-25 January, Bamenda, pp. 105-113.

Shavulimo, R.S., Rurangirwa, F., Ruvuma, F., James, A.D., Ellis, P.R. and McGuire, T. (1988) Genetic resistance to gastrointestinal nematodes, with special reference to *Haemonchus contortus*, in three breeds of goats in Kenya. Bull. Anim. Hlth. Prod. Afri., 36: 233-241.

Urquhart, H.R.U. and Sewell, M.M.H. (1992) Helminthological Techniques. Department of Veterinary Clinical Studies. University of Edinburgh. pp. 1-7.

Van Veen, S. T.J. (1973) Small ruminant health problems in Nigeria with emphasis on helminthiasis. Nig. Vet. J., 2: 26-31.

Vasudevan, B. and Basuthakur, A.K. (1986) Control and epizootiology of *Haemonchus* sheep reared under tropical environment in India: A field study. Ind. J. Anim. Sci., 56: 987-900.

Zinsstag, J., Kaufmann, H., Fritsche, T. and Ndao, M. (1991) ITC/University of Berne Helminthiasis Project. Fourth Progress Report. 53 pp.

Table 1. Prevalences, medians and ranges of nematode egg counts in goats in Morogoro district in relation to ecoclimatic zones, breeds and management systems.

Comparison variable	Comparison group	No. Examined	No. infected	Percent infected	Median EPG	EPG range
Ecoclimatic zone	Tropical highland	246	169	68.7	200	100-10,800
	Semi-arid	623	419	67.3	200	100-25,700
Breeds	SEA	731	496	67.9	200	100-25700
	CN	81	64	79.0	400	100-10,800
	CT	57	28	49.1	100	100-14,700
Management System	Tethering	231	150	64.9	200	100-8,500
	Stall-feeding	81	64	79.0	250	100-9,700
	Pastoral	557	374	67.2	200	100-25,700

Key: SEA=Small East African goats; CN=Norwegian Landrace x Small East African goats; CT=Toggenburg x Small East African goats; EPG = Eggs per gram of faeces.

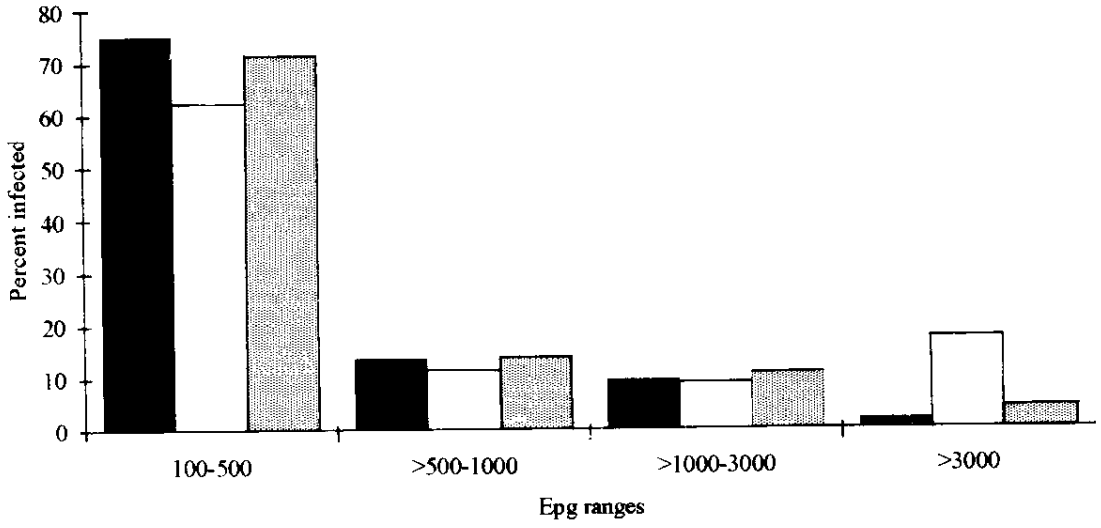

Figure 1. Percentages of goats under tethering (■), stall-feeding (□) and pastoral (□) management systems excreting various ranges of nematode eggs.

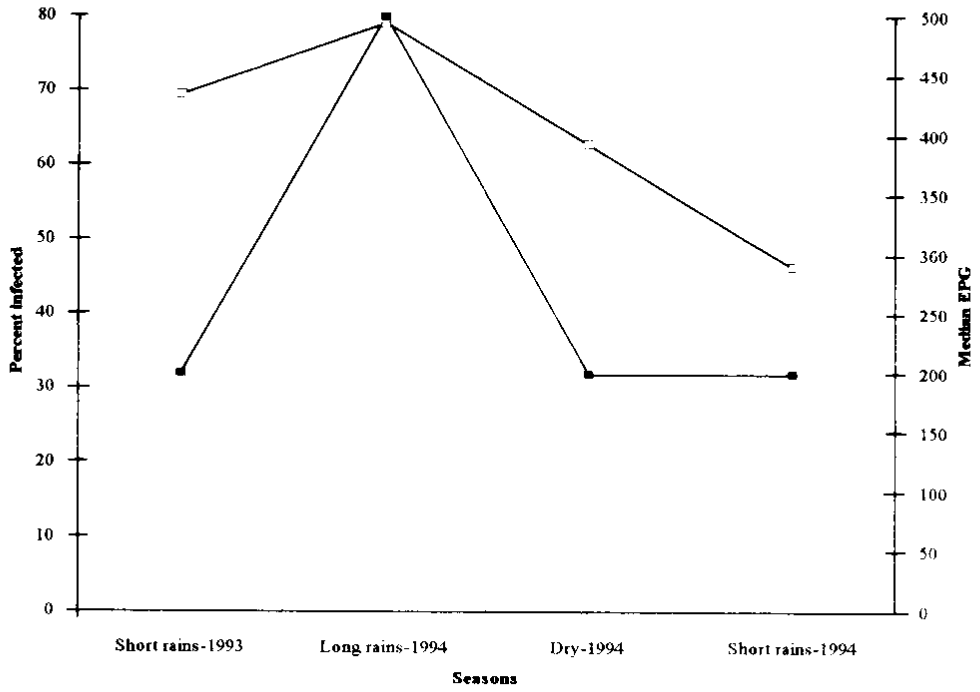

Figure 2. Seasonal variation in the prevalence of nematodosis (□) and median nematode egg counts (■) of goats in Morogoro District during the short rains 1993 (Nov 1993-Jan 1994), long rains 1994 (Mar-May 1994), dry season (Jun-Oct 1994) and short rains of 1994 (Nov-Dec 1994).