

Epidemiological studies on the gastrointestinal parasitic infection of lambs in the Guinea and Transitional Savanna regions of Ghana

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Abstract

The *Eimeria* oocyst and strongylate nematode egg outputs from 40 Djallonke lambs, 20 each in Pong-Tamale in the Guinea Savanna and Ejura in the Transitional Savanna zones of Ghana, were followed for 18 months. The modified McMaster technique was used to determine the level of worm egg and oocyst outputs. The earliest time for the appearance of oocysts of lambs in the Transitional Savanna region was 16 days after birth and peaked in the first month. In the Guinea Savanna region the period of oocyst appearance ranged from 26-41 days after birth, but oocyst output rose gradually and reached a mean of 21,929 oocyst per gram (opg) of faeces in December, 4 months after birth. The species of *Eimeria* oocysts encountered by the lambs in both areas were *Eimeria ivinoidalis*, *E. ahsata*, *E. bakuensis*, *E. granulosa*, *E. faurei*, *E. intricata*, *E. pallida*, *E. parva*, *E. crandallis* and *E. marsica*. There were differences in the prevalence and composition of *Eimeria* species in the different zones; *E. marsica* was absent in lambs in the Guinea Savanna region and *E. ovinoidalis* dominated in lambs in the Transitional Savanna region but placed seventh in the Guinea Savanna region. Strongylate nematode eggs were seen 43-60 days in lambs in the Guinea Savanna, and showed a relatively lower worm egg output between the 3rd and 4th month after birth, followed by fluctuating counts which peaked at 18,409 egg per gram about a year old. Worm egg counts in lambs in the Transitional Savanna zone peaked 2 months after birth and peaked again after 1 year of age. Strongylate nematode worms encountered included *Strongyloides papillosus*, *Haemonchus* spp., *Trichostrongylus* spp., *Oesophagostomum* spp., *Cooperia* spp., *Bunostomum* spp. and *Ostertagia*-like spp. as revealed by larval culture. Herbage L_s in the Transitional Savanna reached 2998 kg⁻¹ DM of grass during the period of high rainfall in September with strongylate nematode worm egg counts following the pattern of rainfall.

(Original Scientific Paper accepted 5 Apr 04.)

Introduction

The importance of control of gastrointestinal parasites in the development of the livestock industry cannot be overemphasised. Allonby & Urquhart (1975) were of the opinion that any livestock project without parasite control is doomed to failure. Tuah & Baah (1985) have observed the major role of endoparasites in the mortality of lambs in Ghana. This demands the institution of effective control of parasites depending on the adequate knowledge of their biology (Agyei, 1986) and is, therefore, fundamental to the design of effective parasite control programmes. Studies on the prevalence of gastrointestinal parasites particularly

helminths have been carried out (Edwards & Wilson, 1958; Assoku, 1981; Agyei, 1991a) but little is known yet of the role of *Eimeria* infections and their concurrence with helminths in the epidemiology of gastrointestinal infections. Studies by Agyei (1998, 2003) in both the Forest and Coastal Savanna zones, have shown the dominance of *Eimeria* parasites over helminths in the early part of the lamb's life. Mason (1977) reported the concurrence of both helminth and *Eimeria* infections but drenched the animals with levamisole and, therefore, curtailed the output of helminth ova. This paper reports the concurrence of these parasites and their relative dominance in lambs in the two different agro-ecological areas.

Materials and methods

Sites

The studies were carried out simultaneously at two sites, from Aug 1990 to Jan 1998 in Pong-Tamale in the Guinea Savanna zone, and from Jul 1996 to Dec 1997 in Ejura in the Transitional Savanna zone. Pong-Tamale is about 32 km from Tamale, the capital of the Northern Region of Ghana and situated on longitude 0° 45' W and latitude 9° 40' N. Ejura is 104 km from Kumasi, the capital of the Ashanti Region, and lies on longitude 1° 28' W and latitude 7° 28' N. Climatic data for both Pong-Tamale and Ejura were recorded by the Meteorological Services Department, Accra.

Animals

Forty Djallonke lambs; 20 each from the Animal Production Department (APD) farms at Pong-Tamale and Ejura were involved. Lambs varied in age from 1 day to 2 weeks. No dewormers and anticoccidials were given to the animals during the period of the study. All lambs were allowed to follow their dams and grazed naturally. The management of the lambs at both stations was similar, and animals were allowed grazing on sown pastures during the day and returned in the evenings to be housed. Mineral licks and water were supplied *ad lib* throughout the period of the study.

Death of lambs was recorded and postmortem examinations carried out to ascertain the cause of death.

Faeces sampling and worm egg counts

All the lambs were sampled daily after birth for 1 week and, thereafter, samples were collected weekly at Pong Tamale and fortnightly at Ejura. Faecal egg counts were made as described in the modified McMaster technique (MAFF, 1986). Briefly, about 3 g of faeces were emulsified in 42 ml of water and the solution passed through a wire mesh with 0.15 mm aperture into a bowl. The solution was agitated and a Clayton-Lane test-tube was filled to the 15.5 ml mark and centrifuged at 1500 rpm for 2 min. and the supernatant

discarded. The sediment was thoroughly mixed with saturated salt solution and a sample put in the chambers of the McMaster Counting slide and examined under a microscope.

Faeces from lambs in an area were pooled and cultured for the recovery of infective larvae as described by Agyei (1995). Differential larval counts were made following faecal cultures as described in a chart by MAFF (1986).

Eimeria oocyst counts and differentiation

Oocyst counts were made as described in the modified McMaster technique (MAFF, 1986). *Eimeria* oocysts were recovered and pooled and differentiated after incubation in 2% potassium dichromate solution at room temperature overnight (Nuvor *et al.*, 1998).

Herbage infective larval sampling

Herbage sampling was carried out on two demarcated 0.30 ha plots at Ejura every fortnight. All the sheep on the farm grazed the plots daily. About 500 g of grass samples were collected from each demarcated plot using the double N technique. The grass sample collected was put in a container containing 20 l of water and few drops of detergent added and agitated for at least 5 min. The grass samples were removed and the solution allowed to drain away and the sun-dried sample further dried in an oven at 60 °C. The solution was then passed through a tier of sieves of different mesh sizes and the last sieve having a mesh diameter of 0.38 µ to retain the larvae (Lancaster, 1970). Pasture larvae were washed from the last sieve and collected in a bowl. Saturated magnesium sulphate solution was used to recover the larvae in a centrifugation-floatation procedure and differentiated as described by MAFF (1986).

Analyses

Faecal oocyst and worm egg counts were assessed to determine the time of their appearance in the life of the lambs. The relationship between the rainfall and the number of infective herbage nematode larvae was also assessed using

correlation analysis.

Results

Lambs used for the study were born at Pong-Tamale between late August and early September and at Ejura in early July, 1996. Lambs at Pong-Tamale were of local Djallonke stock while at Ejura they were offsprings of Djallonke ewes brought in from Cote d'Ivoire.

Rainfall

The rainfall pattern in Pong-Tamale was unimodal as shown in Fig. 1a. Rainfall started from May and ended in October, 1997. It peaked in June and September but fell slightly in July. It declined in October and stopped in November. There was no rainfall thereafter until the termination of the study. Though the amount of rainfall was highest in June the number of raindays (Fig. 2a,b) was highest in October. The total amount of rainfall in August 1996 was 356 mm but declined until November. However, there was rainfall in December 1996.

The pattern of rainfall at Ejura was bimodal as shown in Fig. 1b. There was rainfall in January but February was without rainfall. The rains started again in March and peaked in May, fell slightly in July and peaked again in

September 1997. It declined in November, and there was no rainfall in December.

Oocyst counts

In Pong-Tamale oocysts were observed for the first time in lambs born in late August, 31 days after birth (DAB), and in lambs born in September, oocysts appeared in the faeces 41 DAB. Oocyst counts started to rise in October and peaked in

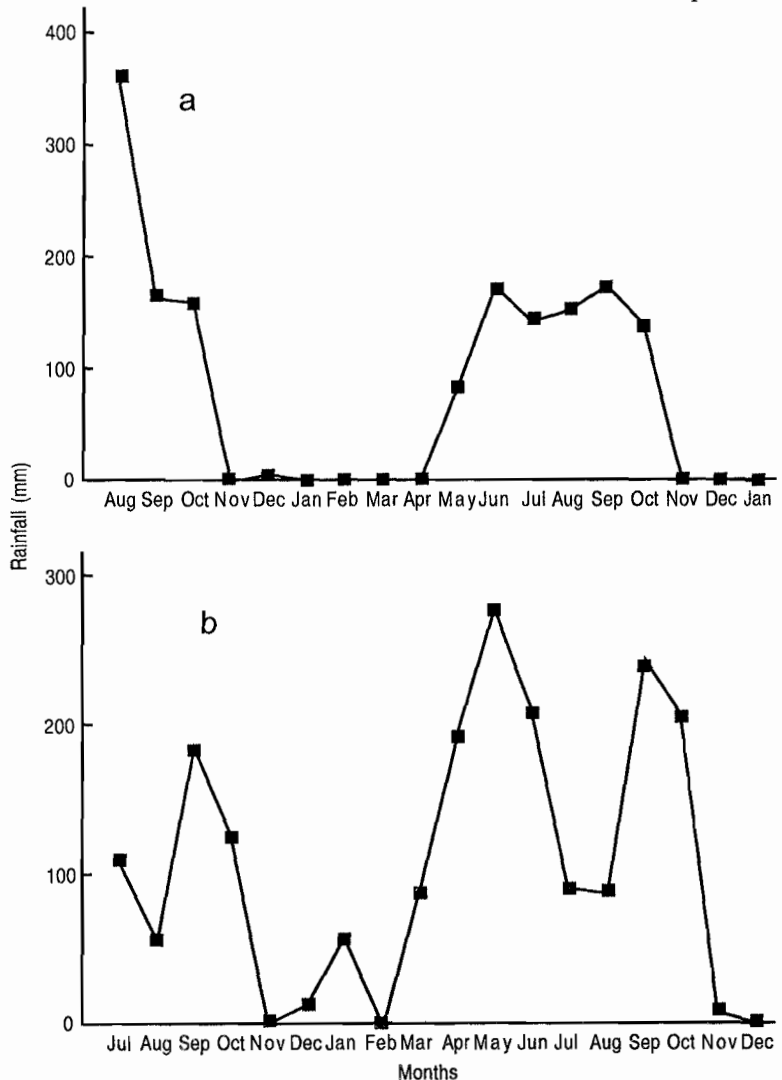


Fig. 1ab. Mean monthly rainfall of (a) Pong-Tamale and (b) Ejura during the study period.

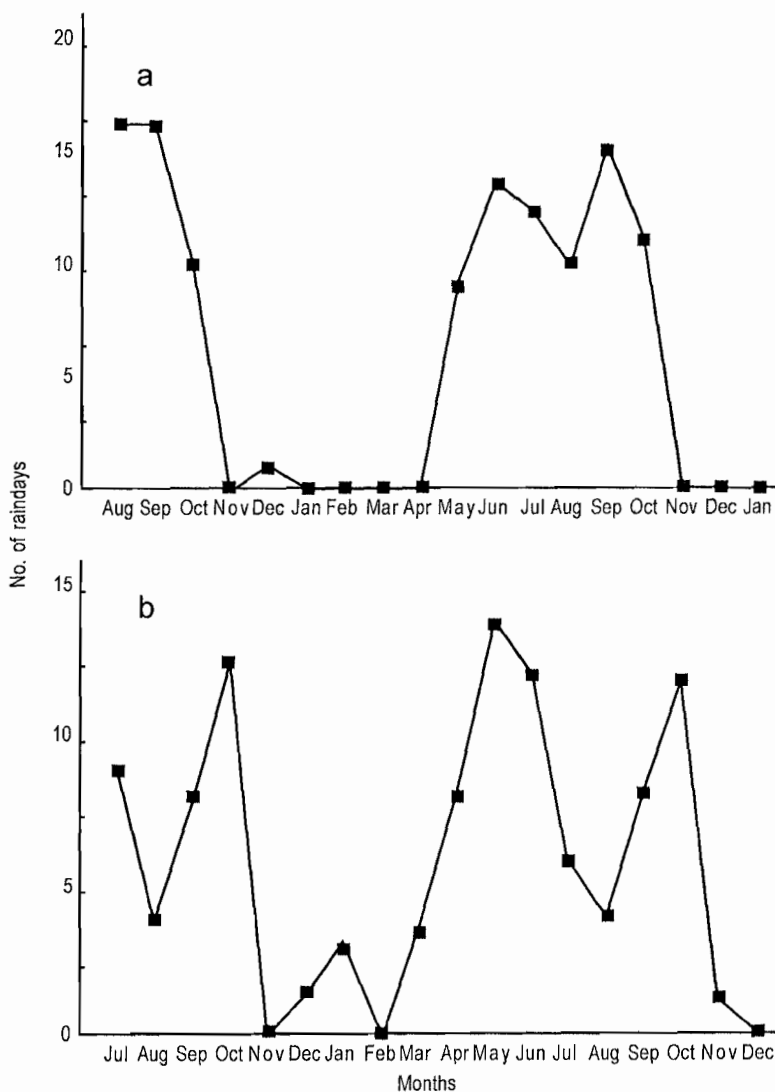


Fig. 2ab. Monthly number of rain days at (a) Pong-Tamale and (b) Ejura during the study period

November at 21,929 opg but was followed by loss of oocyst in the faeces of lambs for 2 consecutive weeks in that month. Oocyst counts thereafter fell and fluctuated until April 1997 and peaked the second time in August (Fig. 3a) and then declined.

At Ejura, oocysts were seen between 16-18 DAB but peaked in the first month (Fig. 3b) with a mean count of 905,375 opg and declined until November, 5 months after birth. Oocyst counts

fluctuated until June 1997, rose rapidly in July and fell considerably in August. Oocyst counts peaked in September the second time at 393,784 opg and, thereafter, fell until the end of the study. Oocyst counts in one of the lambs reached 8,712,00 opg, 2 weeks after birth and died 6 weeks later.

Prevalence of *Eimeria* oocysts

The order of prevalence of species of *Eimeria* oocysts in the lambs at Pong-Tamale (Table 1) was *E. bakuensis* (*ovina*), *E. crandallis*, *E. faurei*, *E. granulosa*, *E. ahsata*, *E. parva*, *E. ovinoidalis*, *E. intricata* and *E. pallida*. In fact both *E. granulosa* and *E. ahsata* were equally dominant. *E. marsica* was absent from lambs in Pong-Tamale.

At Ejura the order of prevalence of *Eimeria* species (Table 2) was *E. ovinoidalis* (*ninkohlyakimovae*), *E. parva*, *E. bakuensis*, *E. granulosa*, *E. pallida*, *E. faurei*, *E. intricata*, *E. marsica*, *E. ahsata* and *E. crandallis*.

Strongylate nematode egg counts

No helminth egg was seen in the lambs in Pong-Tamale until 2 months after birth. Worm eggs were seen towards the end of October. Worm egg counts reached 1697 eggs per gram (epg) in

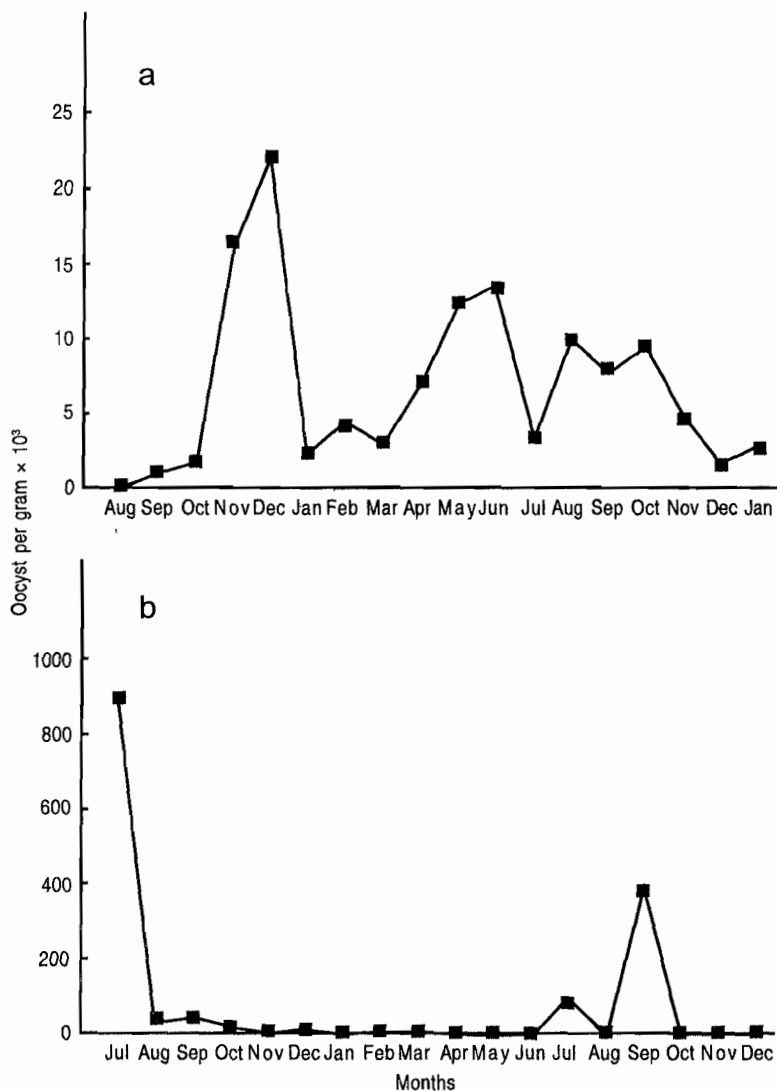


Fig. 3ab. Oocyst counts in lambs in (a) Pong-Tamale and (b) Ejura

December, fell the following January, and fluctuated until April (Fig. 4a) when it started to rise. It peaked in June declined in July and showed a smaller peak in August the following year. It fell the following month but rose again in October and, thereafter, declined until January. *Trichuris* and *Moniezia* eggs were seen transiently.

At Ejura, worm eggs were seen in the last week

of July, and output rose in the second month, fluctuated and rose again in November. Thereafter, it fluctuated until April when counts peaked at 3967 epg and fluctuated again until November when it peaked again at 4350 epg (Fig. 4b), and fell in December.

Moniezia eggs were seen for 2 consecutive months between October and November and were absent until May transiently.

Faecal larval culture

The results related are from samples collected from Ejura. The types of strongylate nematode infective larvae obtained were *Haemonchus* spp., *Trichostrongylus* spp., *Oesophagostomum* spp., *Cooperia* spp., *Bunostomum* spp. and *Ostertagia*-like spp. *Haemonchus* spp. dominated the number of third stage infective larvae (L_3 s) in the pooled faecal cultures.

Herbage infective larvae

The mean monthly total number of L_3 s on pasture is shown in Fig. 5a. The level of L_3 s on pasture was high at 792 kg⁻¹ dry matter (DM) of grass in July at the start of the experiment but dropped in August 1996. It rose in September and was maintained though at a lower level in October. L_3 s were absent on pasture from

TABLE 1
 Mean monthly oocyst counts (per gram of faeces) of *Eimeria* species recovered from lambs at Pong-Tamale during the period of study

<i>Eimeria</i>	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
<i>E. ahsata</i>	0	980	1487	0	7980	314	585	1458	2415	438	1630	1156	1418	604	295	322	15	93
<i>E. bakuensis</i>	5	0	1341	0	287	316	943	2332	3202	594	2377	1589	1857	1279	461	664	28	192
<i>E. granulose</i>	0	110	2036	0	536	526	984	1557	1756	702	1125	1156	1102	691	238	438	8	192
<i>E. faurei</i>	0	147	1228	0	641	104	935	1397	2273	483	1962	1055	1542	957	354	67	26	145
<i>E. intricata</i>	0	232	3264	0	313	210	248	24	129	0	49	289	1418	149	198	27	0	14
<i>E. pallida</i>	0	232	1487	0	352	0	220	668	0	0	0	0	267	94	0	80	3	98
<i>E. parva</i>	415	232	2929	767	5920	218	234	1045	232	0	155	94	236	157	62	80	7	98
<i>E. crandallis</i>	40	0	808	576	339	526	1734	1968	2118	539	1707	1401	1284	470	248	295	17	205
<i>E. ovinoidalis</i>	0	171	1600	386	394	52	998	1700	826	268	737	484	330	306	815	188	4	69

TABLE 2
 Mean total counts of *Eimeria* species recovered from lambs at Ejura during the period of study

<i>Eimeria</i>	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
<i>E. bakuensis</i>	235397	3854	9130	3016	375	1757	120	940	232	245	2194	337	8162	357	63005	264	351	871
<i>E. ahsata</i>	11317	356	1475	591	24	113	14	137	26	10	103	64	255	0	0	33	8	0
<i>E. parva</i>	255768	5637	4672	2532	404	1455	184	1243	100	153	967	451	24214	748	94508	283	476	697
<i>E. pallida</i>	119962	2098	3385	1396	100	785	76	577	48	51	457	289	11217	255	39378	206	109	174
<i>E. granulosa</i>	41013	315	3742	1902	183	843	157	738	84	112	774	219	9327	289	23627	119	304	348
<i>E. faurei</i>	67903	4690	1907	2113	168	697	90	531	58	82	504	155	4667	374	31502	85	47	174
<i>E. intricata</i>	0	144	2248	255	16	55	5	1085	47	0	75	0	1500	0	63005	182	31	174
<i>E. crandallis</i>	0	0	0	662	54	76	29	93	0	0	11	14	1819	34	0	5	5	0
<i>E. ovinoidalis</i>	176548	5500	4926	2882	435	1495	200	1843	333	143	932	295	17273	1122	78757	261	585	1045
<i>E. marsica</i>	0	237	320	408	19	37	16	47	26	20	66	43	1348	221	0	13	24	0

November to February the following year but rose slightly in March through April and May, and peaked at 2998 kg⁻¹ DM of grass in September.

Haemonchus spp. dominated the types of L₃s (Fig. 5b), recovered during the period and was followed by *Trichostrongylus* spp. and *Oesphagostomum venulosum*. The relationship between the monthly mean total number of L₃s/gm on pasture and the monthly total amount of rainfall was highly significant ($P < 0.01$) with a correlation coefficient of 0.62.

Lamb mortality

Four (20%) of the lambs at Ejura had died by the end of the study. At necropsies, *Eimeria* oocysts and strongylate nematode worms were incriminated in the cause of deaths at Pong-Tamale. All the lambs that died between 3-4 months in Ejura showed very high *Eimeria* oocyst counts ranging from 2-9 million o.p.g. prior to their death and, in most of the cases, helminth ova could not be detected in their faeces before death.

Discussion

The precedence of *Eimeria* oocysts in the sequence of appearance of the two parasite species encountered in the life of the lambs in the study confirms previous observations (Mason, 1977; Agyei, 1998; Agyei, 2003). The rapid increase in the output of *Eimeria* oocysts within the first month of birth could be explained on the basis of the life cycle of the parasite. In fact the occurrence of periparturient rise in oocyst counts in ewes (Nuvor *et al.*, 1998) suggests, that it could provide a major source of infection to newborn lambs. The ingestion of a large initial dose of oocysts could result in the release of several millions, provided favourable conditions are present in terms of microclimate and susceptible hosts.

Though there was rainfall (Fig. 1ab) in both areas during and after the birth of the lambs there were differences in the timing of the appearance and magnitude of oocyst peaks in the lambs at

the two different eco-climatic zones. Oocyst output from lambs at Pong-Tamale peaked in December, 4 months after birth (MAB) while it peaked in the same months of birth in lambs at Ejura. The dominance of *Eimeria ovinoidalis*, a very pathogenic species, and *E. parva*, known for its prolificacy in its host, in the lambs (Table 2) could contribute to very high oocyst counts and might be responsible for the deaths. The early attainment of the oocyst peak in the lambs supports the findings that lambs are infected at very early age as observed in a previous study (Agyei, 1998).

The variations in the timing of the initial peaking of oocyst output might have resulted from the differences in the ages of the lambs, the level of environmental contamination and the intensity of operations. It has been observed that oocyst output reduces with age (Pout, 1973), however, the peaking of oocysts a year later in lambs in the Guinea Savanna and Transitional Savanna regions suggests that older animals could serve as sources of infection to susceptible lambs despite the development of resistance. The shedding of oocysts from the older lambs in the Transitional Savanna and the presence of rainfall facilitated sporulation and supports the observations of Amarante & Barbosa (1992) and Catchpole *et al.* (1993) that in the presence of sporulated oocysts there is persistent oocyst output. These differences in oocyst output and level of mortalities encountered at both places could result from the differences in species composition of *Eimeria* parasite and the stocking density in the two areas. Ejura had a higher sheep population.

The strong positive correlation between the amount of rainfall and the level of L₃s on pasture supports previous findings (Agyei, 1997). The high L₃ levels on pasture in September was followed by a correspondingly high faecal worm egg counts in lambs in the Transitional Savanna which supports the observation of Agyei (1991a) and Pandey *et al.* (1994) that faecal worm egg output follows rainfall. The early peaking of worm egg output in lambs in the second month after

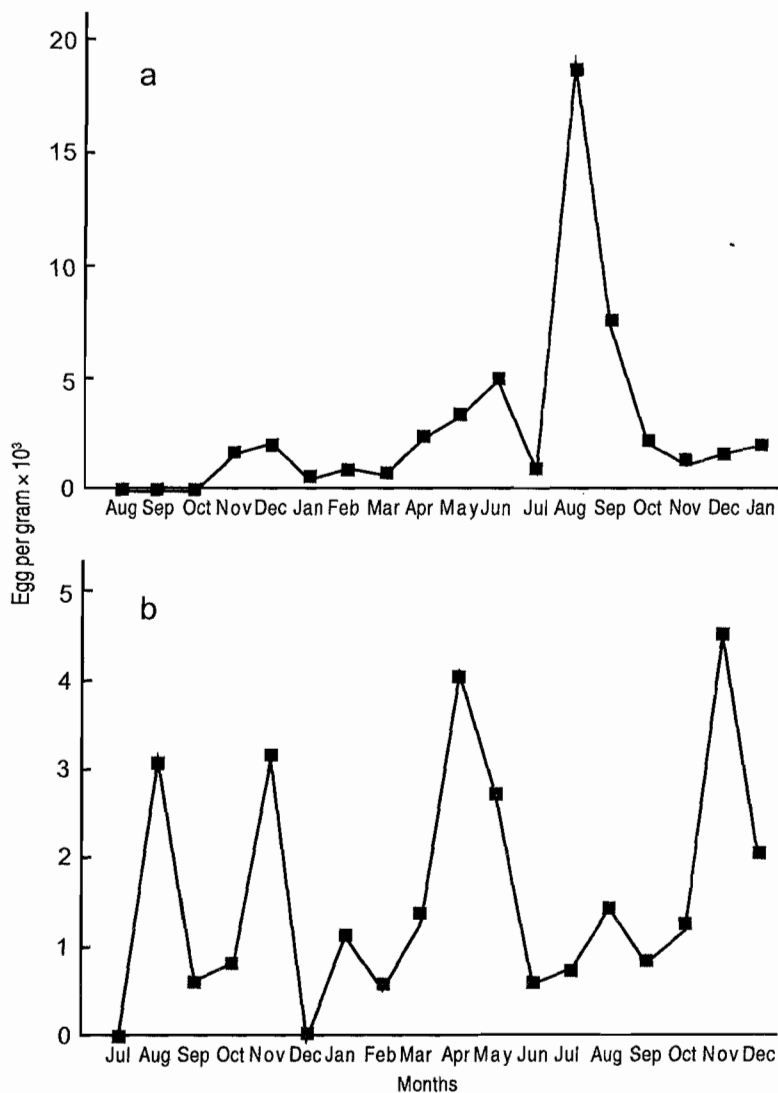


Fig. 4ab. Strongylate nematode egg output in lambs in (a) Pong-Tamale and (b) Ejura

birth contrasts with the results observed in the Guinea Savanna, where worm eggs rose slowly to peak in December, 4 months after birth. The rapid rise in worm egg output in lambs in the Transitional Savanna could result from the level of pasture contamination with L_3 s and the subsequent lowering of the natural resistance of the lambs to worm infection after *Eimeria* attack, and allowing

early establishment of the worms. It could possibly result from lambs nibbling at probably highly contaminated grasses soon after birth. It was observed that worm egg counts fell for 2 months after the initial peak in the lambs during a period of high rainfall.

The dominance of *Haemonchus* spp. in faecal cultures confirms previous report (Agyei, 1991b), and is in line with the generic composition of L_3 s on pasture (Fig. 5b) in this study and could contribute to high worm egg counts. The fluctuating low level of worm egg output in lambs at Pong-Tamale between January and April which is part of the dry season after the initial peak in December is in line with previous observations (Agyei, 1991a; Agyei & Debra Spong, 1999) in southern Ghana, where animals showed very low worm egg counts during the dry season.

The treatment of very young animals whenever they have diarrhoea, which is a common symptom of both infections, with other drugs without considering the coccidials should be reviewed. The result of this study together with that of Agyei (2003) provides the evidence that *Eimeria* infection in lambs could be more serious earlier in the life of the lambs than has been considered in Ghana. The non-administration of these drugs

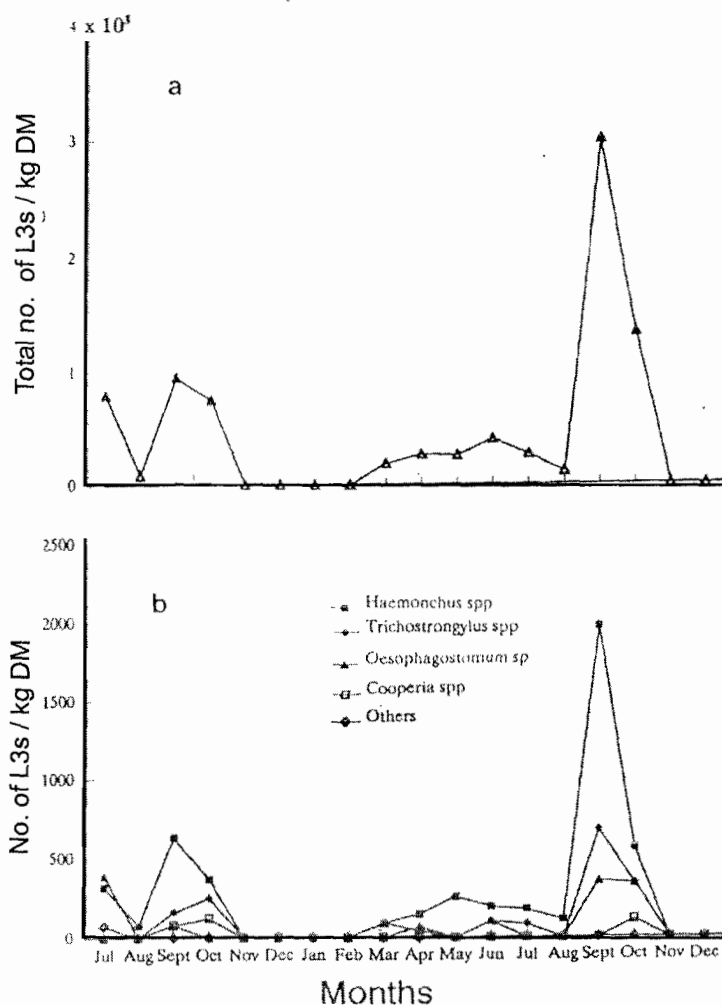


Fig. 5ab. Mean total number (a) and types (b) of L3s recovered from pasture at Ejura

in these experiments with the consequent mortality rate of 80% in lambs, emphasises the need for the control of endoparasitic infections, and provides further evidence of the contribution of *Eimeria* and helminth parasites to lamb mortality.

Acknowledgement

The authors acknowledge the technical assistance of both the staff of the Parasitology Laboratory, Animal Research Institute, Achimota

and the Central Veterinary Laboratory, Pong-Tamale, and the workers of the Animal Production Department farms at Ejura and Pong-Tamale. They also acknowledge the encouragement of Prof. E. O. Otchere, Director, Animal Research Institute, Achimota; and the late Dr A. K. Mosi, Director of APD. They are grateful to the National Agricultural Research Project Secretariat for funding the study.

REFERENCES

- Agyei, A. D. (1986) The need for an integrated approach for the control of livestock parasites in Ghana. *Proc. Gh. Anim. Sci. Symp.* 17, 147-153.
- Agyei, A. D. (1991a) Epidemiological observations on helminth infections of calves in southern Ghana. *Trop. Anim. Hlth Prod.* 23, 134-140.
- Agyei, A. D. (1991b) Observations on the effect of nematode worm burden, and on the time of the day of grazing and on the

liveweight gain performance of West African dwarf sheep. *Ghana Jnl agric. Sci.* 24-27, 53-58.

Agyei, A. D. (1995) An improved method of using sawdust as a faecal culture medium of the production of 3rd stage infective strongylate nematode larvae. *Ghana Jnl agric. Sci.* 28-27, 11-15.

Agyei, A. D. (1998) Observations on the gastrointestinal parasites of sheep in Ghana. *Ann. N. Y. Acad. Sci.* 849, 470-473.

Agyei, A. D. (2003) Epidemiological studies on the gastrointestinal parasitic infection of lambs in the

- Coastal Savanna regions of Ghana. *Trop. Anim. Hlth Prod.* **35**, 207-217.
- Agyei, A. D. & Debra Sapon** (1999) Preliminary study on the persistence of trichostrongyle infection in lambs without larval challenge. *Zariya Vet.* **6**, 1-6.
- Allonby E. W. & Urquhart, G. M.** (1975) The epidemiology and pathogenic significance of haemonchosis in a Metino flock in East Africa. *Vet. Parasitol.* **1**, 29-139.
- Amarante A. F. T. & Barbosa, M. A.** (1992) Species of coccidia occurring in lambs in Sao Paulo, Brazil. *Vet. Parasitol.* **41**, 189-193.
- Assoku, R. K. G.** (1981) Studies on the parasitic helminths of sheep and goats in Ghana. *Bull. Anim. Hlth Prod. Afr.* **29**, 1-10.
- Catchpole, J. Norton, C. C. & Gregory, M. W.** (1993) Immunisation of lambs against coccidiosis. *Vet. Rec.* **132**, 56-59.
- Edwards, E. & Wilson, A. B.** (1958) Observations of nematode infections of sheep and goats in West Africa. *J. Helminthol.* **32**, 195-210.
- Lancaster, M. B.** (1970) The recovery of infective laevae from herbage samples. *J. Helminthol.* **44**, 219-230.
- MAFF** (1986) *Manual of Veterinary Parasitological Laboratory Techniques.* ADAS, HMSO. UK.
- Mason, P.** (1977) Naturally acquired coccidia infection in lambs in Otago. *N. Z. Vet. J.* **25**, 30-33.
- Nuvor, S. V., Agyei, A. D. & Assoku, R. K. G.** (1998) Oocyst counts in crossbred ewes under tree-crop plantation in the Forest zone of Ghana. *Trop. Anim. Hlth Prod.* **30**, 279-286.
- Pandey, V. S., Ndao, M. & Kumar, V.** (1994) Seasonal prevalence of gastrointestinal nematodes in communal land goats from highveld of Zimbabwe. *Vet. Parasitol.* **51**, 241-248.
- Pout, D. D.** (1973) Coccidiosis in lambs 1. Observations on the naturally acquired infections. *Br. vet. J.* **129**, 535-567.
- Tuah, A. K. & Baah, J.** (1985) The reproductive performance, preweaning growth rate and preweaning lamb mortality of a flock of Djallonke sheep in the forest belt of Ghana. *Trop. Anim. Hlth Prod.* **17**, 107-113.