Digestive-tract strongyle fecal egg counts in cattle, sheep and goats of São Tomé Island in relation to local climate, season and breeding management

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Key words

Cattle - Sheep - Goat - Strongylidae - Digestive system - São Tomé.

Summary

Individual fecal sampling was performed in 84 cattle. Fecal samples were pooled in each of the 51 sheep farms and 64 goat farms. Sampling was performed in adult hosts in four climatic zones (subarid, subhumid, humid and very humid) during the 1994 dry season, and 1993 and 1995 rainy seasons of São Tomé. Strongyle fecal egg counts, expressed in eggs per gram of feces (EPG), were measured. Climate affected cattle EPGs only. Extensive husbandry was associated with low EPGs in cattle, perhaps because of the low stocking rate and use of anthelmintics. On the other hand, high EPGs were observed in goats. No influential factor could be related to sheep EPGs.

■ INTRODUCTION

The life history of digestive-tract strongyle nematodes in ruminants involves a free-living phase, whose success depends on climatic conditions, and a parasitic development phase during which female nematodes pass eggs in the feces. The number of eggs recovered from feces (eggs per gram) is a gross indicator of intensity of infection in goats (2) and sheep and goats (3). It is well documented that EPG strongly depends on the ruminant species (6), climate (10), and breeding management (2).

The island of São Tomé, which is located in the gulf of Guinea, has several interesting features regarding ruminant species (introduced recently or not), breeding management (more or less extensive), and climate (variable on a local scale). Cattle were reintroduced in recent years from Europe and were disseminated in 1992 from one state farm to individual farmers in various sites on the island. They remained in limited numbers (fewer than 500), crossed with remnant zebu cattle, and they are now regularly treated with anthelmintics. Sheep and goats are distributed in different sites on the island, but their breeding management is different: sheep (fewer than 800) are better cared for than goats (several thousands) which live freely in most cases. The majority of sheep are imported from several European countries. Goats are of southern Europe breeds (their importation ceased about twenty years ago) and local West African Dwarf. The prevailing parasites are helminths. Goat necropsies performed in this study revealed *Haemonchus contortus* and *Oesophagostomum columbianum* as the dominant species. According to Brito-Gutteres, cattle carry *Haemonchus santomei* (1). The climate, although of equatorial type corresponding to the tropical rain forest zone, is variable due to altitude: from under 1500 mm to over 3000 mm rainfall is recorded per year in areas where domestic ruminants are bred. Very few publications are available on the digestive-tract strongyle infection of adult ruminants in the tropical rain forest zone. Moreover, the data were never treated as standard epidemiological data, and the relative importance of risk factors has not been evaluated accurately. The aim of the present work was to relate strongyle infection (assessed by fecal egg counts) in adult domestic ruminants to local climate, season and breeding management in the island of São Tomé.

■ MATERIALS AND METHODS

Sampled animals and sites

The studied animals were all adults. As breeding occurred throughout the year in all the sites, the influence of periparturient rise on fecal egg counts (6) was not taken into account. Twenty-two sites distributed in the island were investigated (figure 1). Climatic divisions, based on rainfall per year, were as follows: subarid (< 1500 mm), subhumid (1500-2000 mm), humid

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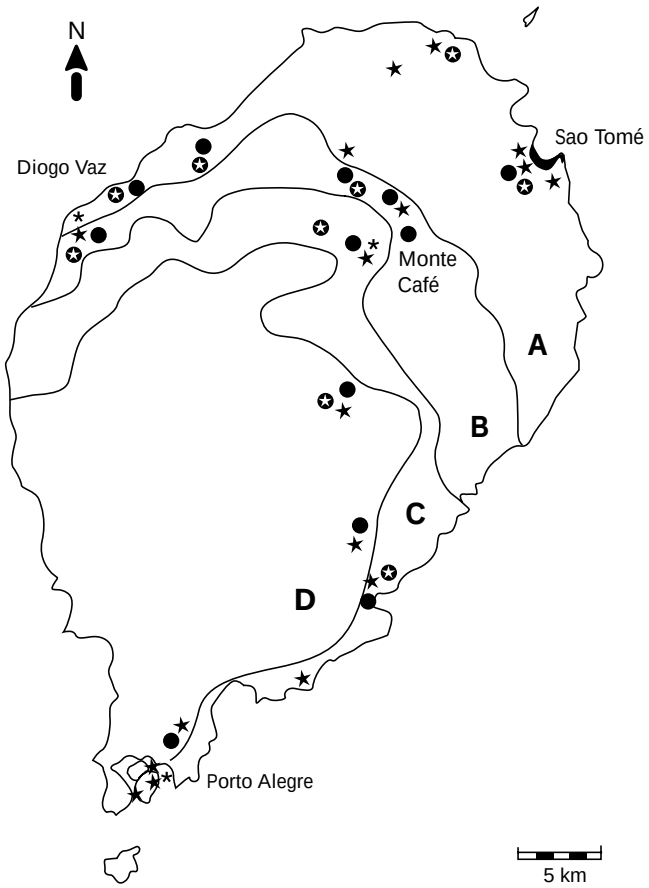

Figure 1: *Sampling sites in São Tomé for cattle (●), sheep (✪) and goats (★) in the four climatic areas (A = arid and subarid; B = subhumid; C = humid; D = very humid).*

(2000-3000 mm), and very humid (> 3000 mm). Sample characteristics are presented in table I. In the extensive system, ruminants were grazed permanently on pastures, whereas in the so-called intensive breeding management they were kept indoors at night. Goats were also in some farms grazed individually (tethered with a rope) and moved regularly to new grazing areas, which might be considered as the most intensive management type.

Parasitological techniques

Fecal samples of three to five small ruminants were pooled per farm. Cattle samples were individual, so that for each farm cattle EPGs were estimated on several individual values in order to increase the accuracy of estimation, which is low in low infection. Feces were examined using the classical McMaster technique with sodium chloride as floatation liquid; fecal egg counts (FEC) were assessed (1 egg seen corresponded to 100 eggs per gram of feces). *H. santomei* was identified as *H. placei* based on data presented by Brito-Gutteres (1).

Statistical analyses

FEC means and confidence intervals (CI; P = 0.95) were calculated using bootstrap resampling (2000 repeats) with the Simstat program (13) as their distribution did not follow a normal distribution. The epidemiological study was of the cross-sectional type as ruminants were sampled without beforehand considering parasite infection or exposure to environmental factors (mostly breeding management). In this type of study, only the odds ratio (OR) can be calculated as follows: a*d/b*c (a: infected and exposed to the factor; b: not infected but exposed to the factor; c: infected and not exposed to the factor; d: not infected and not

Table I

Climate, season and breeding management in relation to eggs per gram (EPG) in feces of digestive-tract strongyles in cattle, sheep and goats of São Tomé

	Cattle			Sheep			Goats		
	EPG	**CI***	**PFS****	**EPG**	**CI**	**PFS**	**EPG**	**CI**	**PFS**
Climate in the area									
Subarid	33	5-70	21	950	626-1387	23	1607	630-2828	19
Subhumid	127	65-203	28	933	408-1531	13	513	371-600	7
Humid	114	45-180	21	448	220-720	10	675	442-965	26
Very humid	93	40-150	14	258	40-500	5	1605	325-3520	12
Season									
Rainy season 1993	40	12-72	35	777	452-1152	25	1354	563-2632	19
Dry season 1994	191	124-260	30	778	492-1176	23	494	327-689	37
Rainy season 1995	44	16-76	19	882	150-1700	3	2317	845-4259	22
Breeding management									
Extensive	76	48-105	77	804	561-1089	49	1515	861-2388	57
Kept indoors during the night	300	190-410	7	400	-	2	659	220-1360	5
Grazed individually and moved regularly to new grazing area	-	-	-	-	-	-	262	131-412	16

* Confidence interval at 95% based on 2000 resamplings; ** Number of pooled fecal samples; - = Does not exist in the host species

exposed to the factor). OR increases when factor influence on infection prevalence is high. OR calculation, significance (Mantel-Haenzel test) and confidence interval (Cornfield limits) (P = 0.95) were performed according to Kleinbaum *et al.* (11). Logistic regression (9) was also used when EPG was coded into binary values (lower *vs.* higher than median); the Wald chi-square test was used to select significant environmental variables.

■ RESULTS

Prevalence of infection and fecal egg counts

The prevalence was 43 ± 11%, 86 ± 10% and 90 ± 8% in cattle, sheep and goats, respectively. Goats (EPG = 1207; CI 95% = 691-1820) had a higher EPG than sheep (EPG = 785; CI 95% = 501-987), mainly because a few goats were exceptionally highly infected. EPG was low in cattle (EPG = 95; bootstrap CI 95% = 67-125) (table I).

Univariate analysis of parasitic risk

The climate in the area did not seem to influence the infection intensity as assessed from EPGs (table II). Fluctuations recorded in table I did not lead to clear conclusions either. The highest cattle EPG was recorded during the dry season (table I). Extensive breeding management was associated with low EPG in cattle and high EPG in goats. No significant associations were found regarding sheep EPGs.

Multivariate analysis of parasitic risk

Logistic regression analysis was performed to determine which factors were independently associated with an increased or a reduced risk of digestive-tract strongyle high EPG (table III). The conclusions were substantially the same as those drawn from univariate analysis, except that local climate was found to modify the risk in cattle.

Table II

Univariate analysis of selected risk and reducing factors for digestive-tract strongyle egg excretion in ruminants of São Tomé

Factor	Cattle	Sheep	Goats
Climate in the area (4 climates from subarid to very humid)	NS	NS	NS
Season (dry *vs.* rainy)	7.6*(2.3-22.8)** (0.01)***	NS	NS
Extensive *vs.* non-extensive breeding management	0.11 (0.0-0.97) (0.02)	-	4.5 (1.4-15.1) (0.01)

* Odds ratio
** 95% confidence interval, Cornfield estimate
*** Probability obtained with Mantel-Haenzel test

Table III

Multivariate analysis of selected risk and reducing factors for digestive-tract strongyle egg excretion in ruminants of São Tomé

Factor	Cattle	Sheep	Goats
Climate in the area	3.9* (0.01)**	NS	NS
Season (dry *vs.* rainy)	6.2 (0.001)	NS	NS
Extensive *vs.* non-extensive breeding management	0.13 (0.02)	-	8.5 (0.04)

* Odds ratio
** Probability obtained using logistic regression and Wald statistics

■ DISCUSSION

Factors influencing transmission and incidence of digestive-tract strongyle infection are well known. In areas with a short dry season, herbage infectivity occurs all the year round (12) and a very similar situation occurs probably in São Tomé. This could account for the limited differences recorded between seasons in small ruminants. The higher EPG of cattle during the dry season remains unexplained; it might be related with the modification of helminthic fauna (presence of species with higher prolificity).

The influence of local climate is fairly limited. All tropical rain forest areas are propitious for infection transmission (6), as rainfall over 1000 mm is largely sufficient for the development of infective larvae and even heavier rainfall will not induce better development. Similarly, there was no significant difference in cattle infection between several areas of Ethiopia located at various altitudes (7), or between two locations that had large but different rainfall in Zaire (4). The unfavorable effects of subaridity (poorer development of eggs into infective larvae?) or of too much humidity (larvae migrating into the soil and poor availability of these larvae for actual infection?) are not surprising, but they should occur in cattle (present results) and in small ruminant infections (where, conversely, no difference was evidenced). The behavior or requirements of larvae of cattle nematode species might differ from that of small ruminant nematode species, which could account for the observed differences between small ruminant and cattle infections.

Husbandry practices may profoundly modify the patterns of worm infection as shown in Nigeria (6). Intensively managed herds with high stocking rates and limited grazing areas are expected to be more infected than those grazing larger areas of pastures, which is the case in cattle (8). Conversely, intensive grazing results in lower infection in goats, which had been previously recorded under temperate climate (2). This is only an apparent contradiction with cattle data. Intensively grazed goats are the best cared for: they are moved to uninfected areas regularly (where they are tethered with a rope), whereas extensively bred goats are rather feral compared to domesticated goats. No conclusion could be drawn on sheep management and infection, as the sheep investigated were nearly all managed extensively.

Host species and age play a role in infection with digestive-tract strongyles. In Uganda cattle, infection is much higher in one-year-old calves than in over three-year-old cattle (14). Adult

animals, which were furthermore submitted to anthelmintic treatments, were sampled, which could explain the low infection recorded in the cattle of São Tomé. Infection prevalence in small ruminants was not much different from that recorded in similar zones (5, 6). Goats were slightly more infected than sheep as previously observed in Mozambique (15), but in contrast with findings in Zaire (5); breeding management could explain these discrepancies.

In the future, it would be interesting to identify the species of digestive-tract strongyles other than *Haemonchus* spp., probably the most prolific species, as this knowledge could help to interpret the fecal egg counts that were taken as an index of infection intensity.

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Résumé

Neto-Padre L., Afonso-Roque M.M., Fazendeiro I., Refega S., Cabaret J. Excrétion des œufs de strongles de l'appareil digestif chez les bovins, les ovins et les chèvres de l'île de São Tomé en fonction du climat local, de la saison et du mode d'élevage

Des échantillons fécaux individuels ont été prélevés chez 84 bovins. Des collectes d'échantillons groupés par ferme ont été réalisées dans 51 fermes ovines et 64 fermes caprines. La période d'échantillonnage correspond à la saison sèche de 1994 et aux saisons humides de 1993 et 1995 à São Tomé. Les hôtes adultes ont été prélevés au sein de quatre zones climatiques : subaride, subhumide, humide et très humide. Les excrétions d'œufs de strongles, exprimées en œufs par gramme de fèces (opg) ont été mesurées. Le climat de la zone a joué un rôle uniquement sur les opg des bovins. L'élevage extensif a été associé à des opg faibles chez les bovins (peut-être en raison de la faible charge à l'hectare et de l'utilisation d'anthelminthiques). En revanche, des opg élevés ont été observés chez les chèvres. Aucun paramètre n'a pu être relié aux opg des ovins.

Mots-clés : Bovin - Ovin - Caprin - Strongylidae - Appareil digestif - São Tomé.

Resumen

Neto-Padre L., Afonso-Roque M.M., Fazendeiro I., Refega S., Cabaret J. Excreción de huevos de estróngilos del aparato digestivo de los bovinos, de los ovinos y de las cabras de la isla de San Tomé en función del clima local, de la estación y del tipo de crianza

Se tomaron muestras fecales individuales en 84 bovinos. Se llevaron a cabo colectas de muestras en grupo por finca, en 51 fincas de ovinos y en 64 fincas de caprinos. El período de muestreo corresponde a la estación seca de 1994 y a las estaciones húmedas de 1993 y de 1995 en San Tomé. Los huéspedes adultos fueron escogidos en cuatro zonas climáticas: sub árida, sub húmeda, húmeda y muy húmeda. Se midieron las excreciones de huevos de estróngilos, expresadas en huevos por gramo de heces (opg). El clima de la zona jugó un papel únicamente sobre las opg de los bovinos. La cría extensiva se asoció a opg bajas en los bovinos (quizás debido a la baja carga por hectárea y a la utilización de antihelmínticos). Por otro lado, en las cabras, se observaron opg altas. No se pudo relacionar ningún parámetro a las opg de los ovinos.

Palabras clave: Ganado bovino - Ovino - Caprino - Strongylidae - Sistema digestivo - São Tomé.