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Gastrointestinal parasites of Angora goats in Lesotho: Prevalence and abundance

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ABSTRACT

Angora goat farming is of economic importance in Lesotho as these goats provide cash from the mohair export sales, sales of animals for use in cultural ceremonies and as source of meat. Their production is however constrained by diseases including those caused by gastrointestinal parasites (GIPs). Therefore, this study was conducted to determine whether prevalence and abundance of GIPs of Angora goats are influenced by the district, agro-ecological zone, goat age and sex. Information on GIP prevalence and abundance was collected through a longitudinal study from which 1,795 goat faecal samples were collected from the two districts (Maseru and Quthing) categorized by agro-ecology, age and sex. Nematodes and coccidians were the most prevalent species of parasites, with 79% and 52% of the goats respectively harbouring these GIPs in Maseru and 74% and 36% in Quthing, respectively. Prevalence of these GIPs differed significantly ($P<0.05$) among the agro-ecological zones within each district. Different ages of goats did not differ significantly ($P>0.05$) in nematode prevalence whereas they differed significantly in coccidian prevalence. Male and female goats did not differ in their prevalence and abundance of both nematodes and coccidia. Nematodes were highly prevalent in October but faecal egg counts (FEC) were more in November. Coccidian prevalence and oocyst accumulation were high in winter (July) but dropped drastically thereafter. Therefore, it is important to take into consideration agro-ecological zone, age and month of the year when designing an integrated GIP control programme for Angora goats in Lesotho.

Key words: Agro-ecological zone, gastrointestinal parasites, goat age, Lesotho

RÉSUMÉ

L'élevage de chèvres angora est d'une importance économique capitale au Lesotho car ces chèvres fournissent de l'argent grâce aux ventes à l'exportation de mohair, aux ventes d'animaux à utiliser dans les cérémonies culturelles et comme source de viande. Leur production est, cependant, limitée par des maladies dont celles causées par des parasites gastro-intestinaux (PGI). Pour ce faire, cette étude a été menée pour déterminer si la prévalence et l'abondance des PGI des chèvres angora sont influencées par le district, la zone agro-écologique, l'âge et le sexe des chèvres. Des informations sur la prévalence et l'abondance des GIP ont été collectées grâce à une étude longitudinale à partir de laquelle 1795 échantillons de matières fécales de chèvre ont été collectés dans les deux districts (Maseru et Quthing) classés par agro-écologie, âge et sexe. Les nématodes et les coccidiens étaient les espèces de parasites les plus répandues, 79% et 52% des chèvres abritant respectivement ces PGI à Maseru et 74% et 36% à Quthing, respectivement. La prévalence de ces PGI différait significativement ($P<0,05$) parmi les zones

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agro-écologiques de chaque district. Les effets de l'âge des chèvres n'a pas été significatif (P>0,05) dans la prévalence des nématodes mais l a été dans la prévalence des coccidiens. Les chèvres mâles et femelles ne différaient pas dans leur prévalence et l'abondance des nématodes et des coccidies. Les nématodes étaient très répandus en octobre, mais le nombre d'œufs fécaux (NOF) était plus élevé en novembre. La prévalence des coccidies et l'accumulation d'oocystes étaient élevées en hiver (juillet) mais ont chuté considérablement par la suite. Par conséquent, il est important de prendre en considération la zone agro-écologique, l'âge et le mois de l'année lors de la conception d'un programme intégré de lutte contre les GIP pour les chèvres angora au Lesotho.

Mots clés: Zone agro-écologique, parasites gastro-intestinaux, âge de la chèvre, Lesotho

INTRODUCTION

Angora goat farming is an important economic activity in Lesotho. These goats are multi-purpose animals, produced for mohair, meat and as a form of capital accumulation and savings under smallholder farming conditions. The mohair is largely produced for export. Lesotho ranks second to South Africa in global mohair exports (Mokhethi *et al*., 2015). Income generated from mohair and animal sales is vital to the rural economy in many parts of the country (Hunter, 1987). Goats are also culturally important as they are often used in ceremonies and in payments of bride price (lobola). Angora goat farming therefore, forms an integral part of the livelihood of smallholder farmers in Lesotho.

The most recent estimate of the national population of Angora goats (i.e., 824 698) (BOS 2013/14) is much lower than the historical maximum of one million reported at various times, including in the early 1990s (Quinlan, 1995). A number of factors are suspected to have contributed to this decline, chief among which is the impact of diseases, including those caused by gastrointestinal parasites (GIPs) (Annor-Frempong, 2008). For example, according to the latest estimates by the Lesotho Bureau of Statistics (2013/14), farmers ascribe as much as 12% of the goat mortality to parasites and 40% to diarrhoea, a disease that is closely associated with GIPs, especially the coccidial protozoa (Chartier and Paraud, 2012). Metazoan GIPs such as nematodes (roundworms), trematodes (flukes) and cestodes (tapeworms) also infect goats. Nematodes and trematodes are considered highly prevalent and abundant in small stock in most parts of the world, where they seriously reduce production through a variety of effects (Yusof and Muhammad, 2016; Zvinorova *et al*., 2016). Goats infected by these parasites exhibit numerous signs including reduced reproductive efficiency, impaired growth rate, mortality and susceptibility to other diseases (Hoste *et al*., 2010).

GIP infection rates are also known to be influenced by a number of factors ranging from environmental (ecological), host-related physiological factors such as age and sex as well as season (monthly variations) (Zuk and McKean, 1996). Animals are believed to get infected by these parasites through ingesting infective stages or sporulated oocysts from contaminated grazing lands and rearing areas. Therefore, to sustainably manage GIPs, it is necessary to understand the GIP seasonal levels and biology. This information has not been established in Lesotho. This study was hence undertaken to determine whether prevalence and abundance of GIPs of Angora goats are influenced by district, agro-ecological zone, goat age and sex.

MATERIALS AND METHODS

Experimental design. A longitudinal study was conducted for six months in three agro-ecological zones (AEZ) of Maseru and Quthing districts. Each AEZ was randomly stratified into three villages. From each village, three farmers were randomly selected to provide experimental animals. Selected animals from each farmer were of different sex and age and were tagged in order to easily identify them during subsequent faecal collection visits. Faecal samples were collected from the respective kraals. Overall of 1,795 faecal samples of an average of five grams per sample were collected directly from the rectum of study animals and taken to the laboratory at the National University of Lesotho. In the laboratory, faecal samples were refrigerated at 4 ^{0}C and processed within 48 hours. For each sample, two grams was mixed with 58 ml of salt solution to recover GIP eggs/oocysts. Few drops (3-6) of amyl alcohol were used to remove bubbles. Parasite egg/oocyst counts were determined using the McMaster technique and their identification was based on their morphological characteristics.

Data analysis. Prevalence was calculated as a percentage of number of faecal samples infected out of the total number of samples examined. Binary logistic regression was used to ascertain the effect of district, agro-ecological zone, age, sex and month on the likelihood that the goats have gastrointestinal parasites. Negative binomial and Poison regressions were used to test the significance of faecal egg/oocyst counts between non genetic parameters. All the analysis were performed using SPSS software for Windows version 16.0 and confidence level was held at 95% and P value of 0.05 was set as the level of significance.

RESULTS

Overall prevalence and abundance of GIPs. The present results showed that gastrointestinal nematodes and coccidia were the most prevalent (Fig. 1) and abundant (Fig. 2) species of parasites in this study. Nematode prevalence and abundance did not differ significantly between Maseru and Quthing ($P>0.05$) whereas coccidial prevalence and abundance differed significantly between the two districts ($P<0.05$) (Figs. 4 and 5).

Effect of host-related physiological factors on GIPs. Goat age did not significantly influence nematode prevalence and abundance ($P>0.05$) but it significantly influenced coccidial infection ($P<0.05$) (Table 1). With respect to sex, Table 1 shows that both prevalence and abundance of nematodes and coccidia were not significantly influenced by the sex of the animal ($P>0.05$).

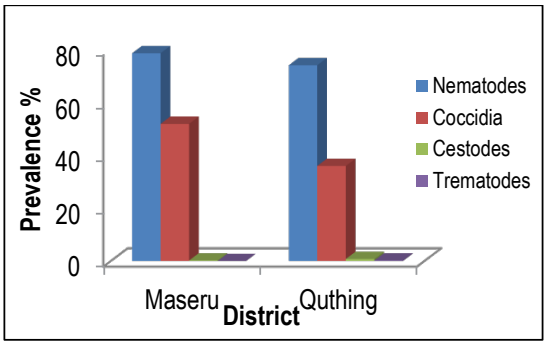


Figure 1. Regional prevalence of gastrointestinal parasites (GIPs)

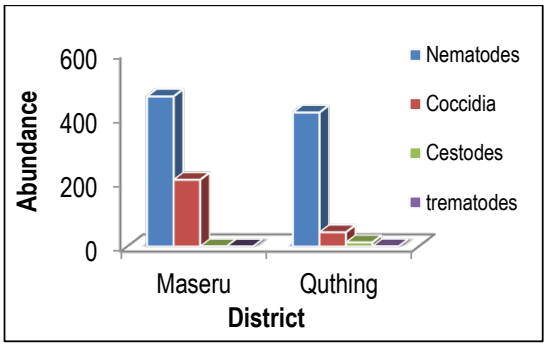


Figure 2. Regional abundance of gastrointestinal parasites (GIPs)

Table 1. Effect of age and sex on prevalence and abundance of nematodes and coccidia in Lesotho

Source of variation	Samples examined (%)	Prevalence	Mean abundance	Source of variation	Samples examined	Prevalence (%)	Mean abundance
Goat age	Nematode				Coccidia		
Juvenile	851	78.14[a]	427.81[a]	Juvenile	851	48.77[a]	188.88[a]
Adult	944	74.89[a]	452.22[a]	Adult	944	39.94[b]	48.34[b]
Sex of goats	Nematode				Coccidia		
Female	1000	74.50[a]	430.80[a]	Female	1000	77.30[a]	98.25[a]
Male	795	78.87[a]	449.08[a]	Male	795	71.90[a]	92.93[a]

Prevalence with different superscripts within the same column are statistically significant (P<0.05), Mean abundances within the same column with no common superscript differ significantly (P<0.05)

Effect of agro-ecological zone on GIPs . Although agro-ecological zone had a significant (P<0.05) effect on nematodes prevalence and abundance (Fig. 3), there was no clear pattern.

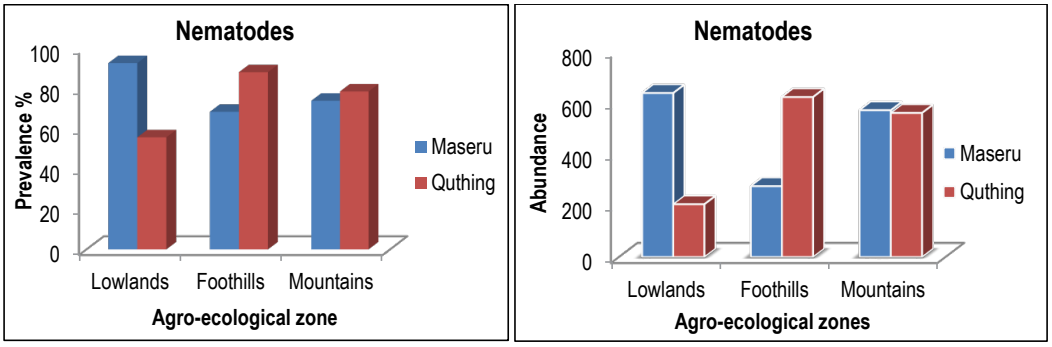


Figure 3. Interaction of AEZs and district on nematode prevalence and abundance in Lesotho

The present results further showed that agro-ecological zone significantly influences coccidia prevalence and abundance (Fig. 4), with mountains in both districts having higher infection levels (P<0.05).

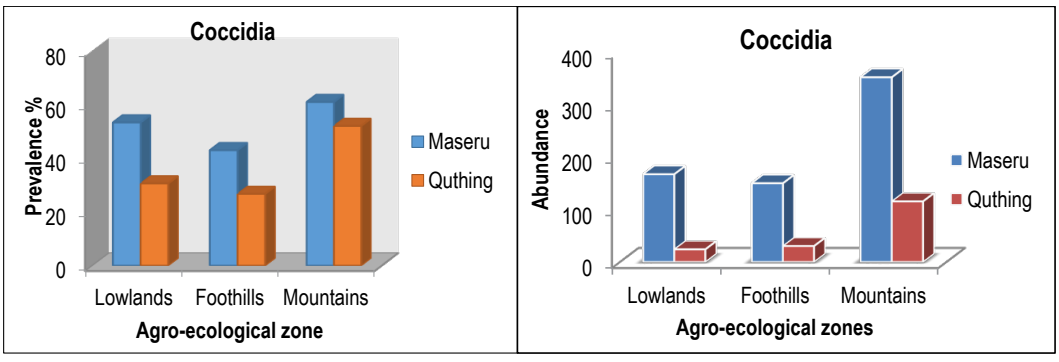


Figure 4. Effect of agro-ecological zones on coccidia prevalence and abundance

The monthly variation in nematode prevalence, fluctuated between 70% and 85%, with no apparent trend (Fig. 5) but monthly variation in abundance followed an upward trend from July to December (Fig. 6).

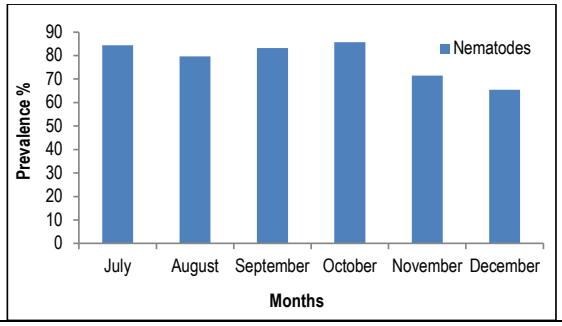


Figure 5: Monthly prevalence of nematodes

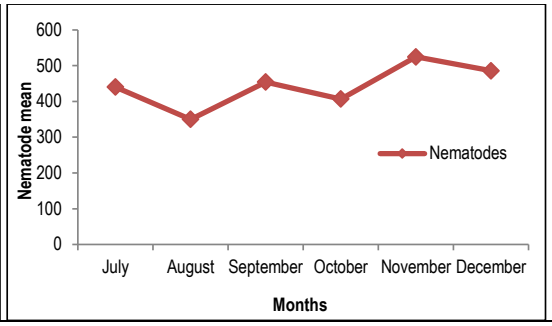
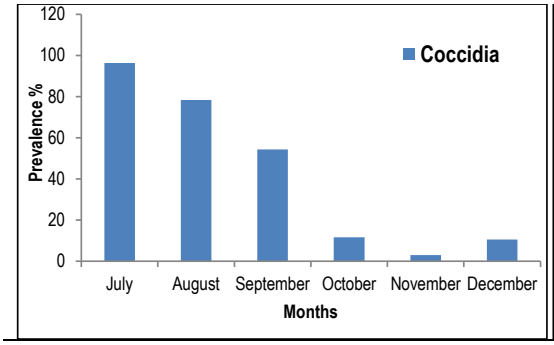


Figure 6: Monthly abundance of nematodes

Both coccidia prevalence and abundance (Fig. 7) showed a declining trend from the winter month (July) to the summer month (December).



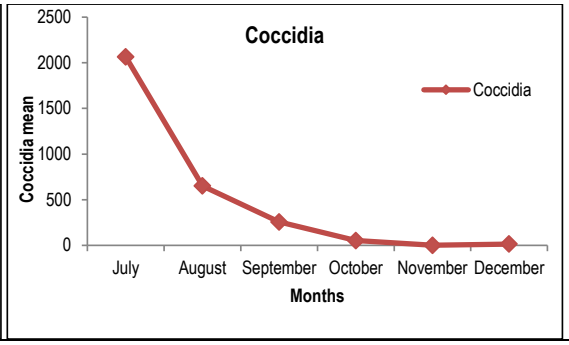


Figure 7. Monthly prevalence and abundance of coccidia in Lesotho

DISCUSSION

Goat farming is very valuable in smallholder farming systems in Lesotho. Nevertheless, problems with GIP constrain performance of these animals. The present diagnosis revealed insignificant influences of age on nematode infection which could be because all ages of goats are herded together in communal setting. However, significant differences in coccidian infestations between the goat ages may be due to differences in levels of immunity to coccidia infection that is reported to be acquired with age. Andrew *et al*. (2010) stated that young animals are highly susceptible to helminthiasis due to low natural immunity. Dagnachew *et al*. (2011) reported that animals develop acquired immunity against helminth infections as they get mature due to repeated exposure. On the contrary, Dinka *et al*. (2010) reported higher prevalence of GIP in adults than in young goats. Zvinorova *et al*. (2016) also reported higher faecal oocysts counts in young goats and linked it to higher rainfall. In view of the current results, insignificant (P>0.05) differences between male and female goats could be due to similar exposure to the same managerial practices and contaminated areas. We expected females to have higher infection levels than males as they experience physiological stress associated with reproduction, which might make them more

susceptible to GIPs. Zvinorova *et al*. (2016) found similar results of insignificant difference in parasite infection between sexes. However, Sharma *et al*. (2009) reported females having higher oocyst loads than males (P>0.05).

Although there was a clear pattern of influence of agro-ecological zones on nematode prevalence and abundance, lowlands of Maseru district had high nematodes infestation. This was expected because it is assumed to be warmer than the other agro-ecological zones. However, a reverse observation in lowland of Quthing may be due to this area being nested within the Senqu river valley. Therefore, because of the river influence on temperature, an unfavourable climate for parasite survival may have been created. Apart from that, foothills of Quthing where experimental animals came from, is geographically outside the valley hence it is warmer and conducive for parasites development. In the case of coccidia, high prevalence and abundance in the mountains could be attributed to differences in temperatures suggesting that coccidia thrive well in cooler areas. The present results of high prevalence and abundance on nematodes in flat and warmer areas are compatible with Dagnachew *et al.* (2011). On the other hand, Kantzoura *et al.* (2012) reported that farms located on high elevation had a higher prevalence of gastrointestinal helminth in sheep and goats. These results are similar to the present findings especially in Quthing foothills. Koinari *et al*. (2013) similarly reported higher (p<0.05) coccidia (*Eimeria* spp.) oocyst in the mountains but lower in the lowlands.

Farmers in Lesotho take their animals for grazing early in the morning and bring them back home at sunset to compensate for the shortening of the day and nutritional stresses. Therefore, there is high possibility of contact between animals and parasites which might be the reason for the high parasitic infestation during winter (July). However, Katoch *et al.* (2000) found low prevalence of GIPs in winter and associated it with reduced grazing hours of the animals. Higher prevalence and abundance of nematodes observed during study period suggests that farmers dose their animals to protect them but differences in farm management bring about variation as goats from different households communally use same grazing areas. High infection of nematodes and coccidia in colder months among other things could be attributed to the pregnancy period of does which could have affected their immunity (periparturient egg rise) coupled with parturition stress as goats were in gestation and kidding at this time of the year. The goat management system operated by farmers in winter confines animals in a small roofed pen to avoid death from cold. Consequently, animals overcrowd pens which are not regularly cleaned hence exacerbating mixing and re-infection rates.

Winter is also associated with poor pastures, dried and shed off browsing shrubs. These possibly forces goats to graze close to faecal materials. The present results are similar to those of Saha *et al*. (1996) who reported high prevalence of parasites in winter in goats from West Bengal. Similarly, Sharma *et al*. (2017) reported higher prevalence of coccidial infection in winter followed by rainy and summer seasons. A continuous fall of coccidial infestation from colder months implied a negative relationship between coccidial infestation and temperature suggesting that changes from colder to warmer conditions may be associated with alteration of animal physiological functioning. On the other hand, availability of browse might have reduced grazing hours of goats thereby reducing chances of picking infective stages of parasites. Singh *et al*. (2017) found similar results of high mean values of EPG load of helminth infection in monsoon (July - October) followed by winter and then summer. Similarly, Kheirandish *et al*. (2014) reported higher faecal oocyst counts in winter season even though no obvious seasonal patterns were shown in the faecal levels of coccidial oocysts.

CONCLUSION

Gastrointestinal nematodes and coccidia were the most prevalent and abundant goat GIPs in our study areas. Near absence of flukes may have been largely due the method of faecal analysis used. Geographical area (district and agro-ecological zone), season and host age appear to influence GIP prevalence and abundance, particularly for the coccidia more than nematodes. However, there is still a need to study parasite population ecology and species composition. This will assist in developing a sustainable control approach.

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STATEMENT OF NO-CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this paper.

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