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Research Application Summary

Prevalence and faecal egg counts of gastrointestinal parasites of Merino sheep in Lesotho

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Abstract

This study evaluated i) the prevalence and faecal egg counts (FEC) of gastrointestinal parasites (GIPs) of sheep from two districts of Lesotho and ii) the effect of agro-ecological zones, host age and sex on prevalence and faecal egg loads of GIPs. It was conducted for a period of six months (July to December) in different agro-ecological zones of Maseru and Quthing districts. A total of 1, 919 faecal samples were examined over this period using McMaster Technique. Three types of GIPs (nematodes, coccidia and cestodes) were identified. Overall prevalence was found to be 53.9%, 46.5% and 4.3% of nematodes, coccidia and cestodes in Maseru district. Quthing district had 65.0%, 38.2% and 0.9% prevalence respectively for nematodes, coccidia and cestodes. Overall faecal egg counts for Maseru district ranged from 0-20,300, 0-90,000 and 0-600 eggs per gram respectively for nematodes, coccidia and cestodes. In Quthing district faecal egg count ranged from 0-8,000, 0-6,700 and 0-2,000 eggs per gram for nematodes, coccidia and cestodes respectively. Majority (over 69%) of animals in both districts had a lower faecal egg count (100-800) per gram. Agro-ecological zone affected nematode infestation in both districts. Coccidia in Quthing were higher in the mountain areas. In Maseru district, nematode infestations were not affected by age, however, in Quthing district prevalence was higher in juveniles than in adults. Age and sex did not affect the prevalence and faecal egg counts of nematodes and coccidia. The coccidian faecal egg loads were higher in females than in males.

Key words: Agro-ecological zones, age, sex, gastrointestinal parasites, Lesotho, prevalence and faecal egg count

Résumé

Cette étude a évalué i) la prévalence et le nombre d'œufs fécaux (NOF) des parasites gastro-intestinaux (PGI) des moutons de deux districts du Lesotho et ii) l'effet des zones agro-écologiques, âge et sexe de l'hôte sur la prévalence et le nombre d'œufs fécaux des PGI. L'étude a été conduite pour une période de six mois (juillet à décembre) dans différentes zones agro-écologiques des districts de Maseru et Quthing. Au total, 1919 échantillons fécaux ont été examinés au cours de cette période en utilisant la technique McMaster. Trois types de PGI (nématodes, coccidies et cestodes) ont été identifiés. La prévalence globale était respectivement de 53,9%, 46,5% et 4,3% pour les nématodes, coccidies et cestodes dans le district de Maseru.

Le district de Quthing avait respectivement 65,0%, 38,2% et 0,9% de prévalence pour les nématodes, les coccidies et les cestodes. Le nombre total d'œufs fécaux dans le district de Maseru variait de 0 à 20300, 0 à 90000 et 0 à 600 œufs par gramme respectivement pour les nématodes, les coccidies et les cestodes. Dans le district de Quthing, le nombre d'œufs fécaux variait de 0 à 8000, de 0 à 6700 et de 0 à 2000 œufs par gramme pour les nématodes, les coccidies et les cestodes respectivement. La majorité (plus de 69%) des animaux dans les deux districts avaient un nombre d'œufs fécaux inférieur (100-800) par gramme. La zone agro-écologique a affecté l'infestation de nématodes dans les deux districts. Les coccidies à Quthing étaient plus élevées dans les régions montagneuses. Dans le district de Maseru, les infestations de nématodes n'étaient pas affectées par l'âge, cependant, dans le district de Quthing, la prévalence était plus élevée chez les juvéniles que chez les adultes. L'âge et le sexe n'ont pas affecté la prévalence et le nombre d'œufs fécaux des nématodes et des coccidies. Les charges d'œufs fécaux coccidiens étaient plus élevées chez les femelles que chez les mâles.

Mots-clés: Zones agro-écologiques, âge, sexe, parasites gastro-intestinaux, Lesotho, prévalence et nombre d'œufs fécaux

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Introduction

Globally, the sheep industry plays a vital role in the economy of countries, especially among the rural poor. However, in both small and large scale farms GIPs are recognised as a major threat that causes huge losses to the farming industry (Sangster, 2007). The Lesotho Bureau of Statistics report of the 2013/14 shows that there were approximately 1,346,596 merino sheep in Lesotho of which 186,873 were in Maseru and 169, 741 in Quthing district. In Lesotho, GIPs are said to have caused 16,732 merino sheep deaths during the 2013/2014 period (Lesotho Bureau of Statistics, 2014). Over 32% of the recorded fatalities occurred in Maseru, making it one of the most affected districts in Lesotho. Quthing district lost 15%. The prevalence and FEC of GIPs is reported to mostly depend on agro-climatic conditions, host age, host sex, quality and quantity of pasture and grazing behaviour of the host (Shahid *et al.,* 1997).

Therefore, the objective of this study was to evaluate the effect of agro-ecological zone, age, sex and month of the year on prevalence and faecal egg load of GIPs of Merino sheep in Lesotho.

Methodology

Study area. This research project was conducted in the three agro-ecological zones of Lesotho covering the central and southern regions. The agro-ecological zones were the lowlands, foothills and mountains respectively represented by three villages for central region and the other three villages for southern region. Study animals were sourced from three farmers per agro-ecological zone, with animals grouped by age (juveniles vs adults) and sex (males vs females). The 360 selected sheep were tagged to enable easy identification during the repeated monthly collection of faecal samples for the six months study duration (July to December, 2016). Freshly collected samples were subjected to McMaster Technique using floatation solution in the laboratory to observe parasite eggs under the light microscope.

The prevalence of GIPs was calculated by dividing the number of animals harbouring a given parasite by the total number of animals examined. Statistical package for Social Sciences (SPSS 20.00) was used for Generalised Estimating Equations (GEE) under model of binary logistic regression to find the significance differences for the prevalence. FEC data were analysed with GEE for repeated measures. The effect of month was analysed with Generalised Linear Model for repeated measures to find the significance of each month. In all the analyses, confidence level was held at 95% and P< 0.05 was set for significance level.

Cestodes were too low in numbers to be subjected to statistical package consequently the significance levels are not reflected against them.

Results

Over a period of six months collection three types of GIPs were observed with different infestations and these were nematodes, coccidia and cestodes. In Maseru district, GIPs eggs ranged from 0-20,300, 0-90,000 and 0-600 repectively for nematodes, coccidia and cestodes. In Quthing district, gastrointestinal faecal egg counts ranged from 0-8000, 0-6700 and 0-2000 repectively for nematodes, coccidia and cestodes.

Prevalence and faecal egg count of gastrointestinal parasites on different agro-ecological zones. The effect of agro-ecological zone on prevalence faecal egg counts of GIPs is shown in Table 1. Prevalence was 62.4%, 43% and 56% respectively for the lowlands, foothills and mountain. Abundance of faecal egg counts (FEC) per gram was 541.6, , 212.7 and 459.0 eggs for the lowlands, foothills and mountains respectively in Maseru district. Counts from lowlands were significantly lower than counts from the foothills. However, counts from lowlands were non-significant those from the mountains. The results also reported that rearing sheep in the mountains rather than in the foothills would significantly ($P<0.05$) decrease nematodes infection. In Quthing district, the nematodes prevalence of 51.5%, 78.4% and 66.77% respectively from the lowlands, foothills and mountains was recorded. In this district, FEC means of nematodes were found to be 550.7, 661.0 and 527.47 eggs per gram for the lowlands, foothills and mountains respectively. These results showed that agro-ecological zone significantly influenced nematodes infection with respect to both prevalence and FEC.

The prevalence of coccidian infestation is also illustrated in Table 1. It was found to be 45%, 41.7%, 52.7% respectively for the lowlands, foothills and mountains of Maseru district. An almost similar trend was observed in FEC of nematodes which showed means of 204.9, 179.1 and 106.0 in lowlands, foothills and mountains respectively. Coccidian prevalence decreased significantly from the lowlands to the foothills while; there was no significant difference in coccidian prevalence between the lowlands and mountains. However, FEC showed no significant difference in all agro-ecological zones. In Quthing district, the coccidian prevalence was 34.2%, 36.18% and 45.0% respectively for the lowlands, foothills and mountains while . FEC means were 40.1, 54.18 and 67.38 eggs per gram for the lowlands, foothills and mountains respectively. These results revealed the non-significant (P>0.05) increase of coccidian infection from the lowlands to foothills and mountains. However, FEC showed that mountains were significantly more infected than lowlands and foothills. From the same table, cestode prevalence was 7.6%, 4.9% 0.29% respectively for the lowlands, foothills and mountains of Maseru district. In Quthing district cestode prevalence was 1.52%, 0.69% and 0.34% respectively for the lowlands, foothills and mountains.

Table 1. Agro-ecological zones effect on prevalence faecal egg counts of GIPs

Maseru Agro-ecology	Samples examined	Prevalence %	EMM of FEC %	Quthing Samples examined	Prevalence	EMM of FEC
			Nematodes			
Mountains	340	55.88[a]	459.00[a]	291	66.67[a]	527.47[a]
Foothills	326	42.94[b]	212.65[b]	291	78.35[b]	661.01[b]
Lowlands	340	62.35[a]	541.59[a]	331	51.52[c]	250.73[c]
Coccidia						
Mountains	340	52.65[b]	106.01[a]	291	45.02[a]	67.28[a]
Foothills	326	41.72[a]	179.05[a]	291	36.08[a]	54.08[b]
Lowlands	340	45.00[b]	204.85[a]	331	34.24[a]	40.11[b]
			Cestodes			
Mountains	340	0.29		291	0.34	
Foothills	326	4.91		291	0.69	
Lowlands	340	7.65		331	1.52	

Values within rows followed by different superscript (a, b, c) differed significantly (p<0.05) from each other. EMM=Estimated Marginal Means

Prevalence and faecal egg counts of gastrointestinal parasites in different sheep age groups
The results of effect of age on prevalence of gastrointestinal nematodes on sheep are given in Table 2. Findings showed prevalence of 55.25% in adults and 52.50% in juveniles and a FEC intensity of 432.29 eggs in adults and 325.84 eggs in Juveniles in Maseru district. Quthing district had nematode prevalence of 67.90% and 61.95% respectively in adults and juveniles and FEC of 506.98 in adults and 388.58 eggs in juveniles. The former was significant (P<0.05) while the latter was non- significant (P>0.05).

In terms of coccidian infection (Table 2) the findings indicated the prevalence of 40.4% in adults and 52.6% in juveniles and FEC means of 79.0 in adults and 313.0 in juveniles for Maseru district. The juveniles had significantly (P<0.05) higher coccidian infection in both prevalence and FEC than adults for both Maseru and Quthing districts. Prevalence in Quthing district was 32.54% for adults and 44.03% in juveniles while FEC means werev23.5 in adults and 117.9 for juveniles.

The findings on prevalence of cestodes as given in Table 2 show that re juveniles (6.39%) were more vulnerable than adults (2.18%) in Maseru district. Records for Quthing district showed that cestode prevalence was 0.87% in adults and 0.88% in juveniles.

Table 2. Effect of age on prevalence and faecal egg counts of GIPs

	Maseru			Quthing		
Age	Number of samples examined	Prevalence%	EMM of FEC	Number of samples examined	Prevalence %	EMM of FEC
			Nematodes			
Adults	505	55.25[a]	432.29[a]	461	67.90[a]	506.98[a]
Juvenile	501	52.50[a]	325.84[a]	452	61.96[b]	388.58[a]
Coccidia						
Adults	505	40.40[a]	79.00[b]	461	32.54[a]	23.50[b]
Juvenile	501	52.69[b]	313.03[a]	452	44.03[b]	117.94[a]
			Cestodes			
Adults	505	2.18		461	0.87	
Juvenile	501	6.39		452	0.88	

Values within rows followed by different superscript within a column differed significantly (p<0.05) from each other; EMM= Estimated Marginal Means

Prevalence and faecal egg counts of gastrointestinal parasites in different sex groups of sheep. Table 3 shows the effect of sex on gastrointestinal nematode prevalence. In Maseru district, prevalence of nematode eggs was 56.1 and 51.9 % respectively in male and female sheep. Egg counts in the male and fmale were 355.95 and 395.7 respectively. Both prevalence and FEC were not significantly influenced by sheep sex. A similar trend was observed in Quthing. Prevalence in males was 66.5% while in females it was 63.5%. FEC in this district were 437.3 and 450.3 respectively. Again both parameters were not significantly (P>0.05) influenced by sheep sex.

The coccidian infection showed a prevalence of 45.03% in males and 48.07% in females and a FEC of 140.80 eggs for males and 175.63 eggs for females in Maseru district. A similar trend was recorded in Quthing district with coccidian prevalence of 39.03% in males and 37.50% in females and the FEC means of 50.62 eggs in males and 54.75 eggs in females. Although the differences in prevalence rates were also not statistically significant (P>0.05) for both districts, FEC means which were significant (P<0.05) for sex groups in both districts.

Prevalence of cestodes was also obtained with the following prevalence rates; 5.68% in females, 2.92% in males for Maseru district and 1.46% in females, 0.23% in males for Quthing district (Table 3).

Discussion

Regassa (2006) explained that GIPs prefer moist, warm climates for their larval development and multiplication in the presence of a susceptible host. This may explain why prevalence and FEC of GIPs was higher in the lowlands in this study. In the mountains the prevalence was lower because of the coldness which does not favour survival of gastrointestinal nematodes larvae. Further, the mountain areas of Lesotho are prone to snowfall which keeps these area cold (Lesotho Meteorological Services, 2013).

Table 3. Effect of sex on prevalence and faecal egg counts of GIPs

		Maseru			Quthing	
Sex	Number of samples examined	Prevalence%	EMM of FEC	Number of samples examined	Prevalence %	EMM of FEC
		Nematodes				
Male	513	56.14[a]	355.95[a]	433	66.53[a]	437.38[a]
Female	493	51.93[a]	395.71[a]	480	63.54[a]	450.36[a]
		Coccidia				
Male	513	45.03[a]	140.80[a]	433	39.03[a]	50.62[a]
Female	493	48.07[a]	175.63[b]	480	37.50[a]	54.75[b]
Cestodes						
Male	513	2.92		433	0.23	
Female	493	5.68		480	1.46	

Values within rows followed by different letters (a, b) are significantly different (p<0.05); EMM= Estimated Marginal Means

GIPs in Quthing district were affected by the agro-ecological zone since prevalence and FEC in each agro-ecological zone was significantly different from one another. The nematodes prevalence and FEC were higher in foothills followed by mountains and lastly the lowlands. These results are in agreement with those of Regassa *et al.* (2006) who also found high prevalence and FEC of GIPs in the mid-altitudes in his study. The reason for lower prevalence in the lowlands might be due to effect of Senqu valley region in Quthing district which lays predominantly in the lowlands than all other agro-ecological zones and the more coverage it takes in a region the colder it becomes creating conditions that do not favour larval development. Despite the higher altitude of the foothills compared to that of the lowlands, nematode prevalence and FEC were higher in the foothills. This might be due to the fact that the foothills are warmer than the lowlands in Quthing district since the lowlands have an average winter temperature of -6.3^{0}C while the one for the foothills is -0.6^{0}C (LMS, 2013).

Faecal coccidial egg counts in Maseru was high in the lowlands followed by foothills and lastly the highlands, although the differences were not significant (P>0.05). However, as indicated in Table 1, it was observed that the prevalence of coccidia was high in the mountains as compared to other agro-ecological zones. This shows that despite the fact that the higher percentage of animals were infected with coccidia in the mountains the intensity or severity of infection was low as compared to the animals in the lowlands. This scenario could be traced to the style and practice of dosing against coccidial infection done by farmers in different areas. Similar results were also observed by Dagnachew *et al.* (2011) and Whittier et al. (2009) who reported that coccidian infection takes chances and multiply rapidly when host animals are under stress due to coldness or any disease that can affect immune response. This was also observed by Yakhchali and Zarei (2008) who indicated that coccidian oocysts prefer conditions of rainfall but with lower temperatures and relatively high humidity.

In Quthing district, a different trend for coccidian infection was found. FEC and prevalence were higher (P<0.05) in the mountains than in the lowlands. This was also reported by Koinari (2013). He reported high coccidian oocysts (Eimeria) in the mountains compared to other agro-ecological zones. The results indicated that the higher the prevalence of coccidia, the higher the degree of infestation. This would mean that there was a positive correlation between prevalence and infestation. Cestodes prevalence in both Maseru and Quthing decreases from the lowlands to the mountains, behaved more or less like the nematodes. This is supported by Owen (1989) who indicated that Platyhelminthes species are more prevalent in the lowlands than in highlands because of warm and wet areas as well as conducive humidity.

The results on host age factor are supported by Tehmina *et al.* (2014) and Villarroel (2013) who indicated that sheep aged two years and above have higher prevalence and FEC of gastrointestinal helminths than juveniles. The higher prevalence of nematodes in adults though not significant might have arisen from the fact that older sheep get the infective larval stage of helminths on the rangelands where they communally graze with other animal species. In most cases, juveniles are often left behind at homes to be fed. Dagnachew et al. (2011) added that older animals due to repeated exposure to parasitic infections might have developed some resistance and act as carriers of gastrointestinal parasites.

Coccidian infection was found to be significantly ($P<0.05$) higher in juvenile than in adult sheep in both districts. This implies that juveniles are highly susceptible to coccidia because of their weaker immunological response against heavy infections. Adult sheep are exposed to repeated infection and thus have developed enough immunity against coccidian infection.

These results are similar to those of Alade and Mbwala (2015) and Vlassoff *et al.* (2001) who reported higher prevalence and FEC of coccidia in lambs than adult sheep. Yakhchali and Zarei (2008) supported the fact that coccidia species are frequently found in faecal samples but that their occurrence is influenced by age and immunity status of a host, which in the present study was seen mainly in juveniles. Another influencing factor might be farmer's management including sanitation. Juveniles might catch infection from suckling soiled teats of a dam if the kraal is not regularly cleaned and disinfected (Joseph, 2003).

Similarly, cestode infections were higher in juveniles than in adults, which of course confirms the fact that juveniles are highly susceptible to gastrointestinal helminths because of their weaker immunity. In this study, some lambs grazed with adults in a communal grazing system exposing them to easy infection. Several workers such as Maingi and Munyua (1994), Hashemnia *et al.* (2014) and Craig *et al.* (2006) reported nematode and coccidia infection of lambs as in the current study. They explained that male sheep are susceptible to gastrointestinal helminths because of the production of androgen hormones which seem to suppress the immune response of the male animals. This could explain what happened in the present study. Mushtag and Tasawar (2011) reported that production of oestrogen by female sheep stimulates their immune response. This may also explain why prevalence was low in females. Zeryhun (2012) also reported higher prevalence of gastrointestinal helminths in rams. However, the degree of FEC for coccidia were higher in females probably because females become prone to parasitic diseases because of lower immunity during pregnancy and parturition (periparturient rise) (Parkins and Holmes, 1989).

Conclusion

Results of this study showed that merino sheep in Lesotho are mostly infected with gastrointestinal nematodes and protozoan coccidia that can tremendously affect their health and productivity. The gastrointestinal prevalence positively correlated with the faecal egg loads. Nematodes and coccidian infestations were higher in the lowlands of Maseru district and foothills of Quthing district. Adult sheep were more infected with nematodes while coccidia were prevalent in juveniles. Males and females were affected by gastrointestinal parasites equally.

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