Gastrointestinal Parasite Infections in Sheep from Torghondi, Islam Qala, and the Herat Slaughterhouse

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Abstract

Gastrointestinal parasites (GIPs) pose significant health and productivity challenges to livestock, especially in regions with limited veterinary care and extensive farming practices. This study evaluated the prevalence of GIPs in sheep at the Torghondi and Islam Qala borders, as well as the Herat Slaughterhouse. A total of 450 faecal samples were examined microscopically, and 200 gastrointestinal tract samples (including stomach and intestinal contents) were analysed by dissection. The overall faecal infection rate was 77.3%, with prevalence rates of 76.7% at Torghondi, 90% at Islam Qala, and 65.3% at Herat Slaughterhouse. *Eimeria* spp. was the most prevalent parasite, detected in 73.7% of faecal samples. Nematodes (*Nematodirus* spp., *Trichuris* spp., *Strongyle* spp.) and trematodes (*Amphistome* spp.) were also identified. Gastrointestinal tract analysis revealed *Trichuris* spp. in 40.5% and *Moniezia* spp. in 37.5% of the samples. These findings highlight the roles of climate, livestock management, and environmental conditions on the distribution of GIPs. The high prevalence of parasites underlines the urgent need for effective control measures, including regular deworming, improved sanitation, and enhanced biosecurity practices. Future research should identify specific risk factors to inform targeted interventions and improve regional livestock health.

Keywords: gastrointestinal parasite, Herat, prevalence, sheep

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INTRODUCTION

In rural Afghanistan, livestock is more than an economic asset; it is integral to daily life and sustenance. Rearing animals such as cows, goats, sheep, and camels is widespread, supplying vital resources, including milk, meat, and wool (World Bank Group, 2014; HoA, 2024). For many rural Afghans, livestock farming fulfils a significant portion of their basic needs, offering employment opportunities and enhancing income by leveraging available natural resources. Gastrointestinal parasites (GIPs) present significant risks to animal health, frequently leading to substantial economic losses in livestock production due to decreased growth and reproduction rates, reduced milk and meat yields, and, in many cases, mortality (Sazmand *et al*., 2020; Sultan *et al*., 2016). In tropical and subtropical regions, GIPs are among the primary challenges hindering the establishment of a profitable livestock sector (Tookhy *et al*., 2024; Skapetas and Kalaitzidou, 2017). Within the array of diseases affecting ruminants, infections caused by gastrointestinal helminths and protozoan parasites are particularly detrimental, resulting in considerable economic losses on a global scale (Asghari *et al*., 2022).

Furthermore, infections by GIPs can heighten the host's vulnerability to various bacterial and viral diseases, often leading to the condemnation of carcasses and organs during the slaughtering process (Squire *et al*., 2019; Sukoco *et al*., 2023). When the disease becomes severe, it can lead to a high mortality rate among livestock, resulting in substantial economic losses and significantly hindering the growth of the livestock industry (Charlier *et al*., 2020). Gastrointestinal parasites affecting goats and sheep encompass helminths and protozoa, with nematodes and coccidia being the most prevalent (Asmare *et al*., 2016).

This research on the prevalence of GIPs in sheep at the Torghondi and Islam Qala borders, as well as the Herat slaughterhouse, is motivated by the need to address a critical issue impacting livestock health and productivity in Afghanistan. Sheep farming is a vital component of rural livelihoods in the region, and GIPs infections pose serious risks to animal health, economic stability, and food security. By investigating the prevalence and types of these parasites, this study seeks to provide valuable insights that can guide effective management and control strategies. The findings aim to support local farmers, veterinarians, and policymakers in improving animal health, enhancing productivity, and ultimately contributing to the sustainable development of the livestock sector in Afghanistan.

MATERIALS AND METHODS

Ethical Approval

This study was approved by the Research Ethics Committee of Herat University, Afghanistan, under the reference number HU-175-2.

Study Period and Location

The study was conducted on the Torghondi border, Islam Qala border, and Herat Slaughterhouse, Afghanistan, in 2020. Geographic Information System (GIS) software such as (ArcGIS 10.5) was used to map the spatial distribution of the study sites, providing a visual representation of their geographic locations and facilitating data analysis (Figure 1).

Sample Size Estimation

The sample size for this study was determined to estimate the prevalence of gastrointestinal parasites in sheep with a 95% confidence level and a 5% margin of error. Since the exact prevalence was unknown, a conservative estimate of 50% (0.5) was used, as it provides the largest sample size.

The formula used to calculate the required sample size is:

$$n = \frac{Z^2 . p . (1 - p}{e^2}$$

Where *n* is the required sample size, *Z* is the Z-value for the desired confidence level (e.g., 1.96 for 95%), *p* is the estimated prevalence (or 0.5 if unknown to ensure maximum variability), and *e* is the margin of error (e.g., 0.05 for 5%).

Substituting the values:

$$n = \frac{(1.06)^2 . (1 - 0.5)}{(0.05)^2}$$

$$n = \frac{3.8416 . 0.25}{0.0025}$$

$$n = 384.16$$

Thus, the initial sample size needed is approximately 384 samples.

Coprological Analysis

Faecal samples of about 10–15 g for parasitological techniques were individually collected from each sheep (n = 450). Fresh faecal samples were collected after defecation from the paddock/pen floors. For each sample, new gloves were used. Fresh faecal samples were collected in a plastic-sealed bottle with a gloved hand. Collected samples were labelled and transferred to the Veterinary Parasitology Laboratory, Faculty of Veterinary Science, Herat University. Faecal samples were kept at 4–8°C in an airtight sterilised container without fixative and examined within 48 hours post-collection.

Simple sedimentation and flotation methods were employed for the coprological analysis to ensure the comprehensive detection of gastrointestinal parasites. The sedimentation method is effective for recovering heavy parasite eggs and larvae that may not float, while the flotation method is optimal for isolating lighter eggs and protozoan cysts. Both techniques increase the likelihood of identifying a broader range of parasitic species, as each method complements the other in detecting different parasites (Widisuputri *et al*., 2020; Taylor *et al*., 2007). Ova identification was conducted based on their morphological characteristics (Soulsby, 1984; Hendrix and Robinson, 2012).

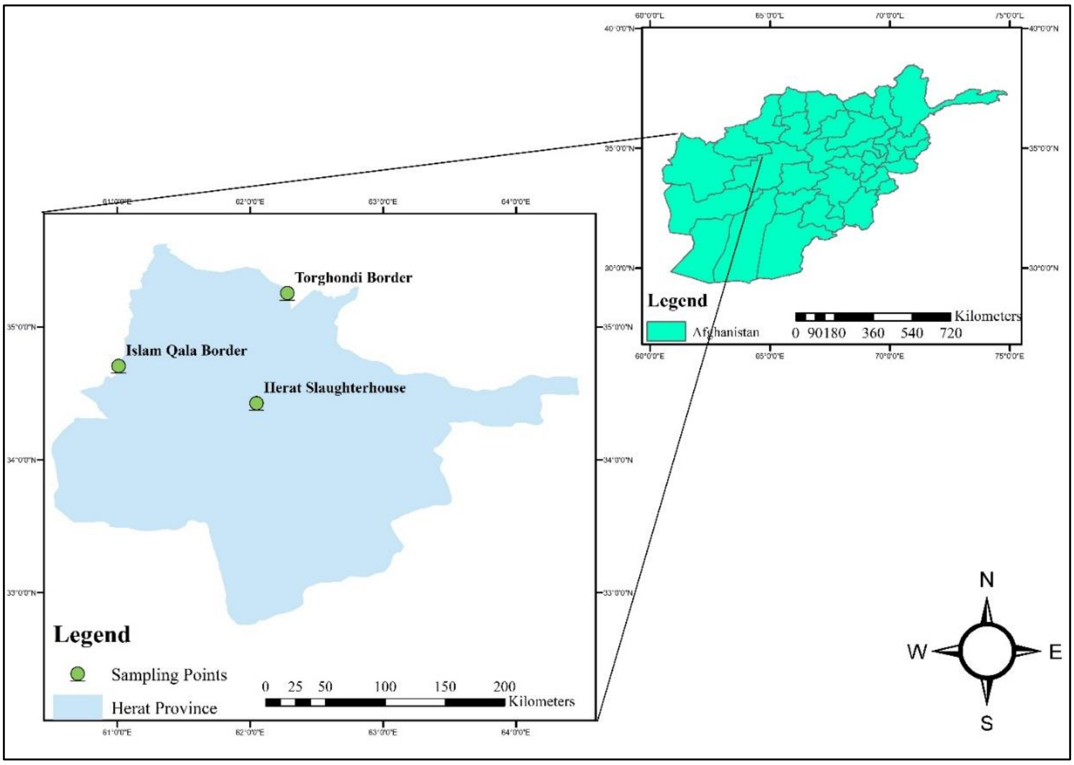

Figure 1. Map of Herat province showing the sampling sites at Torghondi, Islam Qala, and Herat Slaughterhouse.

Simple Sedimentation Method

Approximately 3 g of faeces was mixed with 40–50 mL of distilled water and filtered through a tea strainer into a conical flask. The supernatant was removed carefully with a pipette, and the sediment was resuspended in 5 mL of water and allowed to stand for 5 min. The supernatant was carefully discarded, and the sediment was stained by adding a drop of methylene blue. A small drop of stained sediment was transferred to a microscope slide using a pipette and covered with a coverslip (Widisuputri *et al*., 2020).

Flotation Method

In brief, 10 g of faeces was mixed with 15 mL of saturated saline solution and then filtered using a 250 µm pore-sized filter. The resulting filtrate was centrifuged at 800× g for 5 minutes. A coverslip was then positioned on the surface of the supernatant, and after 3 minutes, the sample was examined under a microscope (Widisuputri *et al*., 2020; Taylor *et al*., 2007).

Collection of the Gastrointestinal Tract

A total of 200 intestinal and stomach samples were collected and examined for the presence of parasites. The intestinal and stomach samples were processed by carefully dissecting the organs and isolating potential parasitic content (Hamzehali *et al*., 2023). Parasites were identified by detecting helminth ova in faecal samples and isolating adult parasites from the gastrointestinal (GI) tract. Adult *Moniezia* spp. worms were identified based on their ribbon-like structure, broad proglottids, and scolex with four suckers, while adult *Trichuris* spp. worms were identified by their whip-like shape with a slender anterior end. Morphological identification of ova and adult helminths was conducted using a stereomicroscope and referencing standard parasitological keys and descriptions (Soulsby, 1984; Hendrix and Robinson, 2012).

Data Analysis

The results of this study are presented descriptively in the form of tables and figures.

RESULTS AND DISCUSSION

The microscopic examination of sheep faecal samples collected from the Torghondi border, Islam Qala border, and Herat

Slaughterhouse revealed a significant overall infection rate, with 77.3% (348/450; 95% CI: 73.2–80.9) of the total samples testing positive for gastrointestinal parasites (GIPs). Specifically, infection rates were highest at the Islam Qala border (90%, 135/150; 95% CI: 84.2–93.8), followed by the Torghondi border (76.7%, 115/150; 95% CI: 69.3–82.7) and the Herat Slaughterhouse (65.3%, 98/150; 95% CI: 57.4–72.5). A chi-square test for independence revealed that the differences in infection rates across the three regions were statistically significant ($\chi^2 = 26.09$, $p < 0.0001$). The higher prevalence at the Islam Qala and Torghondi borders may be attributed to free-grazing practices, which increase exposure to contaminated pastures. Previous studies (León *et al*., 2019; Hassan and Barzinji, 2018) have similarly noted higher GIP prevalence in free-grazing ruminants.

The identification process revealed five primary types of GIPs (Table 1). The most prevalent parasite was *Eimeria* spp., detected in 73.7% (332/450) of the samples. Nematodes were also common, including *Nematodirus* spp. (55.5%, 250/450), *Trichuris* spp. (8.8%, 40/450), and *Strongyle* spp. (7.7%, 35/450). Trematodes, such as *Amphistome* spp., were identified in 5.5% (24/450) of the samples (Figure 2). These findings highlight the diversity and substantial burden of GIPs in the study area.

The overall prevalence of GIPs observed in this study (77.3%) aligns with findings from Bangladesh (77.1%) (Dey *et al*., 2021) and Nigeria (75%) (Otuu *et al*., 2019). The high infection rates at the Islam Qala border (90%) and Torghondi border (76.7%) likely result from free-grazing practices and limited access to veterinary care. In contrast, the lower prevalence at the Herat Slaughterhouse (65.3%) may reflect improved livestock management practices or differences in environmental exposure.

The high prevalence of *Eimeria* spp. (73.7%) aligns with findings from Egypt (El-Alfy *et al*., 2020), where similar climatic conditions favour the development of this parasite. The low prevalence of trematodes such as *Amphistome* spp. (5.5%) in Herat may be attributed to the region's lower rainfall and humidity levels, which are less conducive to the lifecycle of these parasites. Trematode prevalence is generally higher in tropical regions with abundant rainfall, as documented in studies from Romania (55.8%) (Sirbu *et al*., 2019).

Strongyle spp. were less prevalent in this study (7.7%) compared to a study in Italy (68–84%) (Castagna *et al*., 2024) but were consistent with rates reported in Iran (5.3%) (Salehi *et al*., 2022). *Trichuris* spp. prevalence (8.8%) was lower than that reported in Italy (24–25%) (Maurizio *et al*., 2021) but was similar to findings from Pakistan (10.14%) (Irshad *et al*., 2023). These differences may be attributed to variations in grazing systems, climatic conditions, and management practices. However, the prevalence of *Nematodirus* spp. (55.5%) was higher than reported in Iran (3.1%) (Salehi *et al*., 2022) but lower than the 84.4% observed in Italy (Castagna *et al*., 2024). These variations highlight the role of environmental conditions and management practices in parasite transmission.

Climatic conditions significantly influence the distribution of GIPs. Optimal temperatures (18–26°C) and moisture levels (80–100%) are critical for parasite development, while colder temperatures (<10°C) inhibit embryonation and hatching (Taylor *et al*., 2016; Purnama *et al*., 2021; Pinatih *et al*., 2024). The relatively low prevalence of trematodes in Herat is consistent with the region's arid climate and limited water sources. In contrast, suboptimal livestock management practices, such as irregular deworming and free grazing, are likely to sustain nematode prevalence.

An analysis of gastrointestinal tracts further revealed high infection rates for *Trichuris* spp. (40.5%, 81/200; 95% CI: 33.7–47.3) and *Moniezia* spp. (37.5%, 75/200; 95% CI: 30.8–44.2) (Figures 3a, 3b, and 3c; Table 2). The occurrence of *Moniezia* spp. is linked to the ingestion of oribatid mites infected with cysts (Roczen and Tomczuk, 2016). These findings suggest significant gaps in sanitation and control measures, as well as environmental conditions conducive to parasite lifecycles. The absence of *Moniezia* spp. eggs in faeces could be due to

Table 1. Prevalence of GIPs in sheep in Torghondi border, Islam Qala border, and Herat Slaughterhouse

Region	Number of tested samples	Number of positive samples	Number of faecal samples positive for GIPs					Positive (%)
			***Eimeria* spp.**	***Nematodirus* spp.**	***Trichuris* spp.**	***Strongyle* spp.**	***Amphistome* spp.**	
Torghundi border	150	115	106 (70.6%)	103 (69%)	8 (5.3%)	12 (8%)	4 (2.66%)	76.6
Islam Qala border	150	135	135 (90.6%)	124 (82.6%)	16 (10.6%)	14 (9.3%)	8 (5.3%)	90.0
Herat Slaughterhouse	150	98	91 (60.6%)	23 (15.3%)	16 (10.6%)	9 (5.9%)	12 (7.9%)	65.3
Total	450	348	332 (73.7%)	250 (55.5%)	40 (8.8%)	35 (7.7%)	24 (5.3%)	77.3

Table 2. Prevalence rates of gastrointestinal parasites (*Trichuris* spp. and *Moniezia* spp.) in sheep gastrointestinal tract samples

Name of parasite	Number of samples	Positive cases	Percentage (%)	95% CI
Trichuris spp.	200	81	40.5	33.7 to 47.3
Moniezia spp.	200	75	37.5	30.8 to 44.2

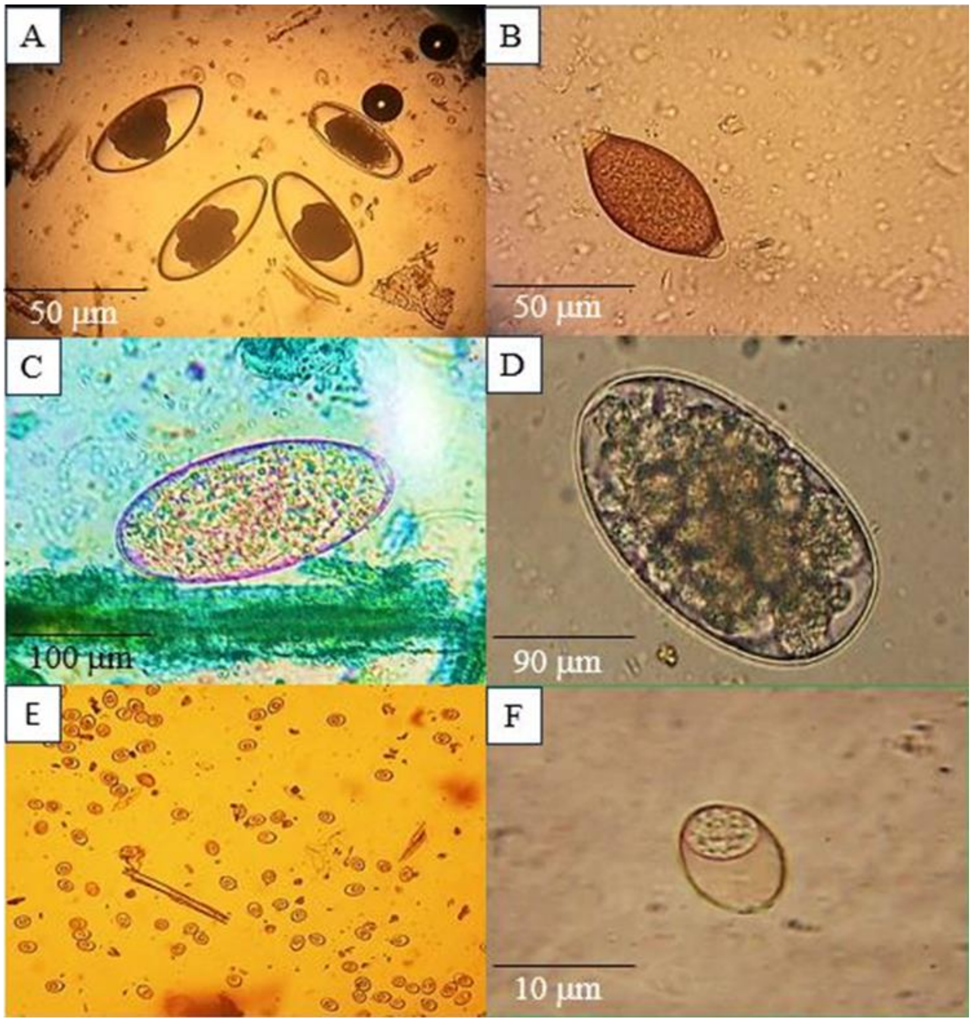

Figure 2. Identifying gastrointestinal parasites in sheep in Torghondi and Islam Qala borders and Herat Slaughterhouse. (A) *Nematodirus* spp., (B) *Trichuris* spp., (C) *Amphistome* spp., (D) *Strongyle* spp., (E–F) Coccidia.

Figure 3. Identification of adult worms recovered from the gastrointestinal tract of sheep in Herat Slaughterhouse. (A–B) *Trichuris* spp., (C) *Moniezia* spp.

intermittent egg shedding, the prepatent stage of the parasite, or sampling limitations where eggs were not present in the analysed sample despite detecting the parasite in the digestive tract. Additionally, methodological issues, such as low sensitivity of the faecal examination technique or environmental factors degrading the eggs, could have contributed to the lack of detection.

CONCLUSION

This study in Herat city, including the Torghondi and Islam Qala borders and Herat Slaughterhouse, demonstrated a high prevalence of gastrointestinal parasites (77.3%) in sheep, with *Eimeria* spp. being the most common parasite (73.7%). Gastrointestinal tract analysis further revealed notable infection rates of *Trichuris* spp. (40.5%) and *Moniezia* spp. (37.5%). These findings emphasise the impact of local climatic and management conditions on parasite distribution. Targeted control strategies such as regular deworming, improved sanitation, and enhanced livestock management are essential to mitigate the high parasitic burden. Future research should focus on identifying specific risk factors to develop targeted interventions and improve livestock health.

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AUTHORS’ CONTRIBUTIONS

NAT conceptualized and designed the study. DTB contributed to methodology development, data analysis, and manuscript editing. EH and SAS participated in data collection, investigation, and formal analysis. ZN and NAM were responsible for sampling, fieldwork, and data curation. AQP contributed to resources, supervision, and validation. MAH contributed to manuscript preparation, critical review, and revision. All authors read and approved the final manuscript.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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