RESEARCH ARTICLE

Empowering Farmers to Combat Mixed Gastro-Intestinal Parasitism in Small Ruminants: A Pathway to Boosting India's Economy

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Abstract

Parasitic infections often cause production loss and are a major constraint for the livestock sector. The aim of the current study was to take up a detailed investigation of the flock comprising of 850 sheep (600 adults and 250 lambs) and the surrounding areas. Farm visit and clinical examination revealed some of the animals quite sick, recumbent, dull, depressed and diarrhoeic with jowl edema. The majority of the animals showed malnutrition, poor grazing quality, and low weight again. Faecal samples (n=250) examination revealed the presence of Coccidia (*Eimeria intricate*; *E. pallida*) (24.1%), *Monieza* spp. (21.1%) and its segments along with *Strongyle* and *Trichuris* eggs. Haemato-biochemical examination revealed severe anaemia, haemolysis of RBC, neutrophilia, eosinophilia, leucocytosis, deficiency of total protein, albumin, and increased levels of ALT in the serum. It was concluded that lack of good management practices, poor nutrition and contaminated water source (fish ponds) deteriorated the health condition of the animals. The farmers were suggested for the inclusion of concentrate mixture, haematinics to the feed along with routine deworming (Albendazole @ 100 mg/kg b.wt. and Ivermectin @ 0.02 mg/kg b.wt.) to relieve the worm burden. The farmers were enlightened on complete management practices and periodical vaccinations dosing and advised on the protocols for the prevention and control of diseases.

Key words: Deworming, Empowering Farmers**,** Gastro-Intestinal (GI) parasitic infestations, Sheep flock, Vaccination

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Introduction

Sheep, valued for their diverse uses including meat, wool, skin, dung, and, to a lesser extent, milk, play a vital role in the Indian agricultural economy. The relationship between parasitic diseases and animal welfare is bidirectional that is lack of management increases the risk of animals suffering from serious parasitosis. The parasites can cause acute infections with high mortality rates and chronic diseases resulting in substantial economic losses such as reduced live weight gain, wool and milk production, and poor reproductive performances (Sutherland and Scott, 2010). Tropical regions face a significant challenge with helminth transmission due to favourable environmental circumstances (Singh *et al*., 2013). The prevalence of GIP, the genera and species of helminths implicated, and the amount of infection vary greatly depending on the local environment and management approaches.

However, parasitic infestations, notably those caused by gastrointestinal nematodes (GIN) and *Eimeria* spp., are the principal cause of output declines in many intensive and extensive farming systems. The indirect losses incurred are due to decreased milk output, weight gain, poor feed conversion ratios (Mavrot *et al*., 2015; Charlier *et al*., 2020) and increased feed requirement (Carrau *et al*., 2018; Charlier *et al*., 2020) and medical expenses (Martinez-Valladares *et al*., 2015; Charlier *et al*., 2022). Additionally, direct economic losses are associated with mortalities when parasitization is more

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severe (Charlier *et al*., 2014). Anthelmintic medications are the primary method for controlling gastrointestinal nematodes. Moreover, their extensive and uncontrolled usage has caused the development of anthelmintic resistance (AR) (Martinez-Valladares *et al*., 2015).

Studies associated with direct farmer and scientific committee interactions are quite scanty. Tremendous data is available on lab associated research on gastro-intestinal parasitism of small ruminants. Our study exclusively targeted farmer-oriented approach after the local farming community approached the authorities with the aim to support the sheep farmers by evaluating the prevalence and risk factors related to ovine GIT parasites, and provide them with knowledge about GI parasites identification, transmission, and prevention strategies so, they can adopt better management practices to protect their livestock.

Materials and Methods

The study was conducted at the Kuchupaapa village, Chapadu Mandal located in the latitude 14° 43' 39" North in Y.S.R Kadapa District of Andhra Pradesh, India. Chapadu is a hot semi-arid climate characterized by year-round high temperature and receives less rainfall and the soil is red ferruginous, which usually has less nutrients and organic matter compared to black soil. Sheep farmers in Kuchupaapa village sought assistance from the Health Committee of the College of Veterinary Science, Proddatur, following the deaths of sheep on their farms. A team of specialists from various departments conducted a detailed assessment of the flock and its surrounding environment. The farm houses consisted of a total of 850 sheep (Fig. 1), including 650 adults and 250 lambs. Out of these, 250 sheep were found to be diseased, (Fig. 2) and 20 were dead. On Clinical examination, some of the animals showed clinical symptoms like anorexia, diarrhoea, dullness, and jowl edema.

Faecal samples were collected from the affected animals and examined for gastrointestinal parasitic infestations by employing different faecal examination techniques such as direct microscopic examination, sedimentation, and zinc sulphate floatation techniques. Whole blood was collected from the affected animals and haematological parameters were determined as per the standard procedures (Jain, 1993). Serum biochemical parameters such as BUN, creatinine, and total protein were determined using a semi-automatic biochemical analyzer and biochemical kits procured from M/s ERBA Diagnostics, Mumbai at the wavelengths specified in the manufacturer's instructions. The data obtained were subjected to statistical analysis using SPSS 20.00 version according to methods described by Snedecor and Cochran (1994).

Results and Discussion

Among 250 animals' faecal samples examined, 203 animals were found positive for GI parasitic infestations. Of these, 180 animals had single GI parasite and 23 had mixed GI parasitic infestation. A higher infection rate was observed in female animals (63.05%) compared to males (36.94%) (Table 1), which is consistent with findings by Singh *et al.* (2017), where females (85.97%) were significantly more susceptible than males (69.23%). Young animals showed lower susceptibility to parasitic infections than adults (25.12% vs 74.88%, Table 1), likely due to their limited exposure to grazing as they primarily rely on milk. These clinical observations aligned with those of Yadav *et al.* (2006) and Emiru *et al.* (2013).

In this study, the highest prevalence was recorded of Coccidia (Fig. 3, 4) (24.1%), followed by *Moniezia* spp. (Fig. 5, 6) (21.1%), Strongyle (*Haemonchus* spp.) (Fig. 7) (20.1%) and *Strongyloides* spp. (Fig. 8) (10.8%) without statistical difference among them, but the coccidian infection (24.1%) differed significantly from amphistomes (7.8%), *Trichuris* spp. (6.4%) and mixed infestation (9.3%)(Table 2).

This investigation found six gastro-intestinal parasites, some of which infect humans, including *Strongyloides* spp. (Bethony *et al*., 2006). The overall prevalence of GI parasites in sheep flocks was 81.20% (203/250). Previous studies on small ruminants found a similar infestation rate (Paul *et al*., 2020; Dahourou *et al*., 2021) and highest rate observed was 91.6% from China (Cai *et al*., 2023). Similarly, incidence of high prevalence was also documented in India by Singh *et al.* (2017). The prevalence rate of *Moniezia* segments

Fig. 1: Sheep farm showing extensive grazing

Fig. 2: Infected sheep flock with GI parasites

(Fig. 5, 6) was 19.7% (40/250), that simulated the records of Muqaddas *et al.* (2024) with 21.3%, while a low incidence was reported from Portugal (3.1%) (Ruano *et al*., 2019) and India (5.8%)(Bansal *et al*., 2015). Intestinal coccidiosis, a significant parasitic disease in small ruminants, is caused by parasites belonging to the genus *Eimeria* (Alcala Canto *et al*., 2020). The coccidial infection rate in current study (24.1%, 49/250) was lower than that reported in Dakahlia, Egypt (71.6%) (El-Alfy *et al*., 2020), China (71%) (Cai *et al*., 2023) and higher than that reported in New Guinea (17.3%)(Koinari *et al*., 2013). In India, higher infection rate was noticed from Shimoga, Karnataka (61.7%)(Adeppa *et al*., 2016).

In the current study, clinical indications observed in small ruminants with GI parasite infestations were as shown in Table 3. Symptoms of parasitic infestation ranged from asymptomatic to severe, including diarrhoea, emaciation, shedding of wool, pale or icteric mucous membrane, and submandibular edema. Clinical results vary depending on the number of infective stages and time after intake (Abouzeid *et al*., 2010).

Infested animals exhibited significantly lower haemoglobin (Hb), total erythrocyte count, and packed cell volume compared to healthy animals (Table 4). This may result from gastro-intestinal parasites shortening the lifespan of red blood cells and suppressing the haemopoietic system (Kinne and Wernery, 1997). Additionally, acute blood loss due to parasite feeding activity and haemorrhages caused by gastrointestinal parasites could contribute to these findings (Bhat *et al.,* 2004). Infested sheep also showed a higher total leukocyte count compared to healthy controls, likely due to parasite-induced activation of lymphoid tissues and bone marrow stem cells (Maghadder, 2002).

Serum biochemical analysis further revealed that infested sheep had significantly lower levels of total protein and albumin than healthy sheep (Table 4). This reduction may be due to increased plasma leakage through the damaged intestinal lining caused by parasites (Radostits *et al.,* 2007). The loss of albumin, which is more susceptible due to its smaller size and osmotic sensitivity, might be aggravated by enhanced albumin catabolism and impaired protein absorption resulting from intestinal mucosal damage (Tanwar and Mishra, 2001). Infested sheep showed considerably higher levels of SGPT compared to healthy controls, possibly because of injury to hepatic tissue, erythrocytes, and skeletal muscles. Increased enzymatic activity in cells can indicate cellular abnormalities, such as damage to hepatocytes, pathological lesions in the gut, or myocardial infarction (Purohit *et al*., 2003). Creatinine levels did not differ significantly between infested and healthy animals, and were consistent with Ahmed *et al.* (2015).

To avoid these detrimental consequences, the Health Committee advised farmers to enhance the nutrition and concentrate mixture at 200 gm/day per animal, coupled with green fodder and supporting supplements. The committee recommended therapeutic management as routine deworming with a combination of albendazole @ 100 mg/kg b.wt. and ivermectin @ 0.02 mg/kg b.wt. to reduce the worm burden. Coccidia infected animals were treated with amprolium @ 55 mg/kg b.wt. In addition, unwell animals were suggested for supportive therapy with livotas at 5 mL/day and Aviplex EC at 2.5 mL/day for up to 14 days, and anaemic animals, 5 to 10 mL of aRBCe daily for 14 days. Glycine-chelated minerals in haematinics play an important role in iron absorption, while vitamins such as vitamin B_6 and vitamin B_{12} aid in red blood cell synthesis and maturation. Hepatoprotections, which include herbs such as *Silybum marianum* and *Andrographis paniculata*, cleanse the liver by inhibiting free radicals produced during hazardous chemical metabolism, regulating bile secretion, and promoting hepatic cell regeneration (Sandhu, 2014). Gastrointestinal parasites can cause significant changes in haematological and biochemical parameters in severely infested sheep, leading to economic loss. In India interaction between farmers and technocrats is very rare. This study paves the way for better understanding of their problems.

Fig. 3: Photo micrograph of *Eimeria pallida* (400X)

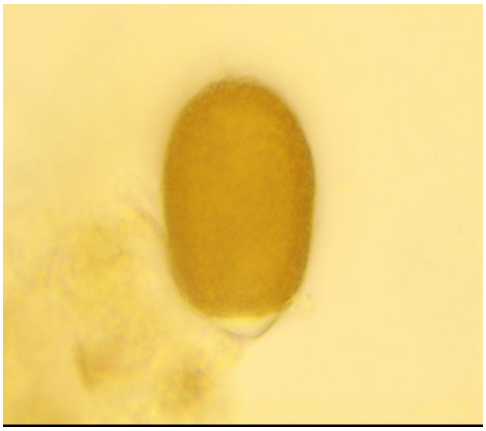

Fig. 4: Photo micrograph of *Eimeria intricata* (400X)

Fig. 5: Photo micrograph of *Moniezia expansa* eggs (400X)

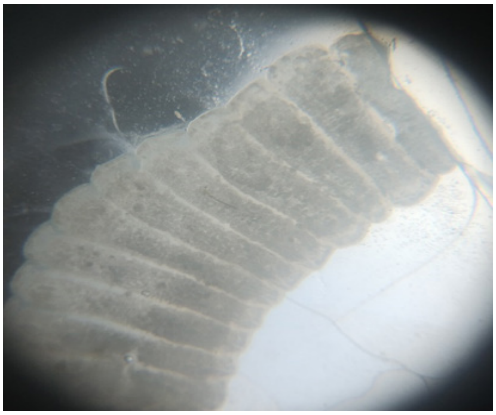

Fig. 6: Photo micrograph of *Moniezia* segments (400X)

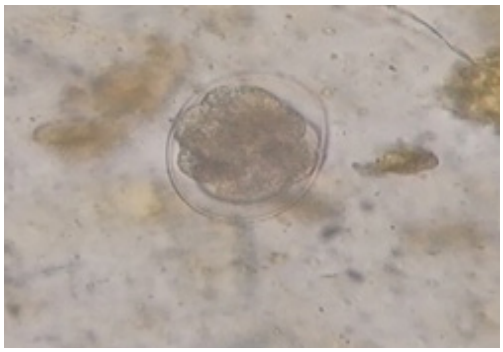

Fig. 7: Photo micrograph of Strongyle egg (*Haemonchus)*(400X)

Fig. 8: Photo micrograph of *Strongyloides* egg (400X)

Table 1: Prevalence of GI parasitic infestation by age and gender in sheep farms of Andhra Pradesh (n=203)

Age	Gender-wise No. (%)		Total	X^2 Value
	Male	Female		
<1 yr	18 (35.3%)	33 (64.7%)	51 (25.12%)	
>1 yr	57 (37.5 %)	95 (62.5%)	152 (74.88%)	0.0798^{NS}
Total	75 (36.94 %)	128 (63.05 %)	203 (81.20%)	

NS = Non-significant at 5% level.

Table 2: Prevalence of gastro-intestinal parasitic infection in sheep farms in Andhra Pradesh (n=203)

GI parasitic infection	No.	Percent
Coccidia	49	24.1^{a}
Monezia spp.	43	21.1^{ace}
Strongyle type	41	20.1^{afg}
Strongyloide	22	10.8^{bcf}
Amphistomes	16	7.8^{b}
Trichuris vulpis	13	6.4^{b}
Mixed infection	19	9.3^{beg}

Percent values with different superscript differ significantly (p<0.05)

Table 3: Clinical signs showed in affected small ruminants (n=203)

S. No	Clinical signs	No. (%)
1.	Anorexia	156 (76.8%)
2.	Pyrexia	47 (23.1%)
3.	Weakness	174 (85.7%)
4.	Pale mucus membrane	52 (25.6%)
5.	Jowl edema	72 (35.4%)
6.	Distended abdomen	27 (13.3%)

Table 4: Haematological and biochemical parameters of sheep (Mean ±SE)

Parameter	Healthy animals (n =10)	Infected animals (n =203)	P value
Hb (g/dL)	10.55±0.28	$7.43\pm 0.11^{**}$	<0.001
TEC ($x10^6$/µL)	9.43±0.8	$7.25\pm0.12^{**}$	<0.001
PCV (%)	32.9±0.87	$22.30\pm0.34^{**}$	<0.001
Neutrophiles (%)	44.1±3.77	$69.60\pm0.42^{**}$	<0.001
Eosinophiles (%)	2.6±0.30	$14.00\pm0.14^{**}$	<0.001
Creatinine (mg/dL)	1.45±0.11	1.19 ± 0.018^{NS}	0.063
TP (g/dL)	6.2±0.112	$4.79\pm0.05^{**}$	<0.001
Albumin (g/dL)	3.01±0.18	$2.41\pm0.03^{**}$	<0.001
SGPT (IU/L)	21.4±3.47	$67.18\pm1.82^{**}$	<0.001

**p<0.001 highly significant, NS- Non significant (p>0.05)

Conclusion

The current investigation of a flock of 850 sheep elucidated a nexus of parasitic infections and suboptimal managemental practices as principal detriments to livestock vitality and productivity. Clinical and faecal analyses disclosed pervasive maladies, including coccidiosis and helminthiosis, compounded by malnutrition and contaminated water sources, culminating in severe anaemia, haemolysis, and hepatic dysfunction. These findings underscore the deleterious synergy of inadequate management and environmental factors in exacerbating ovine morbidity. Consequently, remedial strategies were advocated, encompassing nutritional fortification with concentrate mixtures and haematinics, alongside rigorous anthelmintic regimens employing Albendazole and Ivermectin. Furthermore, comprehensive education on prophylactic protocols and vaccination schedules was imparted to the farmers, aiming to instaurate robust disease prevention and control paradigms, thereby ameliorating flock health and mitigating economic losses within the livestock sector.

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