J Parasit Dis (July-Sept 2021) 45(3):823–830
https://doi.org/10.1007/s12639-021-01367-0

ORIGINAL ARTICLE

Prevalence of gastrointestinal helminth parasites in domestic ruminants from Srikakulam district, Andhra Pradesh, India

Sanapala Malathi[1] · Ummey Shameem[1] · M. Komali[1]

Received: 22 November 2020 / Accepted: 10 February 2021 / Published online: 6 March 2021

Abstract Coprological studies on the prevalence of gastrointestinal helminth (GI) parasites in domestic ruminants from Srikakulam district of Andhra Pradesh, India, were carried out for a period of one year from January 2019 to December 2019. Fecal examination was done using direct smear, sedimentation and floatation methods. Altogether 3527 fecal samples were examined including 595 from cows, 485 from buffaloes, 1342 from sheep and 1105 from goat. Out of 3527 fecal samples examined, 1084 were found to be positive with three groups of gastrointestinal parasites (GI) showing an overall prevalence of 30.7%. Maximum infection was noted with nematodes (39.1%) and trematodes (37.3%), least infection was noted with cestodes (3.5%) and mixed infections were found to be moderate (20.01%). Host wise prevalence of parasitic infection has shown highest in the case of cattle recording 43.03%, followed by 40.8% in buffaloes, 29.4% in sheep, and 21.4% in goats. Total six varieties of parasites were recorded, the predominant being *Haemonchus* (Strongyle group) (29.25%), followed by *Paramphistomum* (25.5%), *Fasciola* (11.9%), *Strongyloides* (7.6%), *Moniezia* (3.5%) and *Trichuris* (2.2%). Season wise data on prevalence showed, high rate of infection in summer season (32.0%) when compared to winter (30.2%) and rainy (29.9%) seasons. Further studies are needed to design a rational for sustainable management of GI parasite infections in domestic animals of local regions.

✉ Ummey Shameem
ummey.shameem@gmail.com

[1] Department of Zoology, College of Science and Technology, Andhra University, Visakhapatnam, Andhra Pradesh 530003, India

Keywords Prevalence · Gastrointestinal helminth parasites · Domestic ruminants · Faecal samples · Seasons

Introduction

India possesses a rapidly growing animal husbandry sector which is striving hard to attain self- sufficiency in the production of livestock products (Dhama et al. 2013). The census report of livestock population for the year 2019, has shown an increase in the livestock population in India by 4.6% from 512 million in 2012 to about 536 million in 2019 (DAHD Report 2019). Parasitic infections have been a serious constrain to health and productivity of livestock including cattle, sheep and goats (Mahusoon et al. 2004). The frequent contamination of aquatic and terrestrial bodies with parasite eggs and larvae has made the task of controlling these infections in veterinary animals a big challenge both in developing and developed countries. These infections are also responsible for considerable economic loss by way of decreased milk yield, reduced weight, severe debilitation and morbidity in livestock, besides causing major health problems in domestic animals (Swarnakar et.al. 2015). GI helminth infections with various groups of parasites viz. nematodes, trematodes and cestodes were reported from ruminants (Ntonifor et al. 2013).

Investigations dealing with loss of livestock productivity, morbidity and mortality in ruminats due to helminth infections are receiving considerable attention in recent years at global level (Biu et al. 2009; Swarnakar et. al. 2015), and also from India (Samanta and Kumar 2007; Haque et al. 2011a, b; Singh et. al. 2012; Rahman et al. 2012; Krishnamurthy and D'souza 2014; Rafiullah et al.

2011; Laha et al. 2013; Mir et al. 2013a, b; Swarnakar et al. 2014). However, such rigorous studies are still lacking from the state of Andhra Pradesh and require more serious attention from scientists and researchers (Sreedhar et al. 2009; Sreedevi and Hafiz 2014; Sivajyothi and Reddy 2014; Preethi et al. 2020). The present investigation is undertaken to study the prevalence of GI helminth infections in domestic ruminants (cows, buffaloes, sheep and goat) from Srikakulam district of Andhra Pradesh, India. In the study area selected i.e. Srikakulam district, though agriculture is the main source of income for majority of the people, rearing of domestic animals and poultry as an important component of mixed farming and as an alternative source of income, is also very common.

Material and methods

Study area (Fig. 1)

The study was carried out in the vicinity of Srikakulam district, Andhra Pradesh (coordinates of 18°–20′ and 19°–10′ N latitude and 83°-50′ and 84°–50′ E longitude). It has an area of 5837 square kilometers with a rural area constituting 5650.96 km^2. It is bounded on the north by Odhisa state, on the west and south by Vizianagaram district and on the east by Bay of Bengal. Srikakulam has the longest coastal line of 193kms extending from Ranasthalam mandal to Itchapuram mandal and has a tropical savanna climate.

Animal species and sampling

The study was conducted from January 2019 to December 2019 covering different locations in Srikakulam district. Fecal samples of *Bos taurus* (cow), *Bubalus bubalis* (buffalo), *Ovis aries* (sheep) and *Capra hircus* (goat) were collected and examined for GI helminth parasite infections. A total of 3527 fecal samples were examined, including 595 from cows, 485 from buffaloes 1342 from sheep and 1105 from goat. Analysis of fecal samples was done by employing methods like direct smear, sedimentation and floatation techniques (Soulsby 1982; Coles 1986,). In direct smear method, saline wet mounts were made by mixing a small volume of fecal sample with a drop of saline on a glass slide and placing a cover slip over the mixture. In the floatation method, each fecal sample was suspended in a solution of high specific gravity, which make parasite eggs to float and get concentrated at the surface. In sedimentation method, a small fecal sample was suspended in a low specific gravity solution so that the eggs form a sediment at the bottom either spontaneously or by centrifugation. Identification of type of parasite infection was done based on the morphology of parasite ova/egg (Soulsby 1982; MAFF 1984; Coles 1986) using low and high-power microscopes.

Statistical analysis

The monthly data collected on prevalence of infection with GI helminth parasites of domestiated animals for one year period was analyzed and compared. Statistical analysis was performed using one way ANOVA and Student's '*t*' test to understand the significant differences in infection between different hosts and seasons ($p < 0.05$). The data was analyzed using MS Excel of Microsoft office version 2010.

Results

Overall prevalence of infection

Prevalence of infection with GI helminth parasites in all four groups of domestic ruminants from Srikakulam district is presented (Table 1). A total of 3527 fecal samples were collected from cows (595), buffalos (485), sheep (1342) and goat (1105) and, out of which 1084 were found positive recording a prevalence of 30.73%. The prevalence of infection was found to be highest in cows with 43.03%, followed by buffaloes with 40.82%, sheep with 29.35% and goat with 21.35% (Table 1). Between the two groups of large and small ruminants, large ruminants (cows and buffaloes) harbored much higher infection with GIHs, when compared to small ruminants (sheep and goat). Similarly, among the four groups of ruminant's cows and sheep harbored higher infection when compared to buffaloes and goat. One-way analysis of the data carried out to understand the differences in the level of significance with prevalence of infection between different hosts revealed the differences to be statistically significant at 5% probability level ($p < 0.05$). Results of "t" test analysis showed the differences in prevalence of infection between large ruminants (cows and buffaloes) and small ruminants (sheep and goat) to be statistically significant at 5% probability level ($p < 0.05$). No significant differences were noted in prevalence of infection between cows and buffaloes, however, the differences were found to be significant between sheep and goat ($p < 0.05$).

Prevalence of infections with GI helminth parasites

The prevalence of infection with individual species of GI helminth parasites collected from fecal samples of ruminants is shown in Fig. 1. Highest infection was found to be with nematodes (39.12%), followed by trematodes

Table 1 Overall prevalence of infection with GI helminth parasites in domestic ruminants

Domestic ruminants	Number of fecal samples examined	Number found infected	Prevalence of infection (%)
Cow (*Bos taurus*)	595	256	43.03
Buffalo (*Bubalus bubalis*)	485	198	40.82
Sheep (*Ovis aries*)	1342	394	29.35
Goat (*Capra hircus*)	1105	236	21.35
Total samples	3527	1084	30.73

(37.37%) and cestodes (3.51%), whereas mixed infections were found to be 20.01% (Fig. 1).

Altogether six species of helminth parasites were identified in fecal samples viz. three species of nematodes (*Haemonchus,* (*Strongyle* group), *Strongyloid*es and *Trichuris)*, two species of trematodes (*Fasciola* and *Paramphistomum*) and one species of cestode *(Moniezia)*. Overall prevalence with each individual helminth parasites was found to be 29.25% for *Haemonchus (Strongyle),* 25.47% for *Paramphistomum* 11.91% for *Fasciola*, 7.66% for *Strongyloides*, 3.51% for *Moniezia*, and 2.22% for *Trichuris*. The data revealed *Haemonchus* (*Strongyle)* with 29.25% as the most frequently occuring infection and *Trichuris* with only 2.22% prevalence is the least represented infection. Host wise analysis of fecal samples for prevalence of infection with helminth parasites was carried out and the data is presented (Table 2 and Fig. 2). Cow samples showed a prevalence of 30.47% for *Paramphistomum*, 16.41% for *Fasciola,* 9.38% for *Trichuris,* 7.04% for *Haemonchus (Strongyle),* 1.96% for *Strongyloides* and 3.52% for *Monezia*. Fecal samples from buffaloes showed a prevalence of 46.97% for *Paramphistomum,* 22.23% for *Fasciola,* 3.04% for *Haemonchus (Strongyle)*, 2.03% and for *Strongyloides*. Fecal samples from sheep showed *Haemonchus (Strongyle)* with a prevalence of 48.74%, *Paramphistomum* with 15.49%, *Strongyloides* with 13.19%, *Fasciola* with 5.59% and *Moniezia* with 5.33% prevalence. Fecal samples from goat showed a prevalence of 42.79% with *Haemonchus (Strongyle)*, 18.65 with *Paramphistomum* 9.33% with of *Strongyloides*, 8.89% with *Fasciola* and 3.39% with *Moniezia* (Table 2 and Fig. 2).

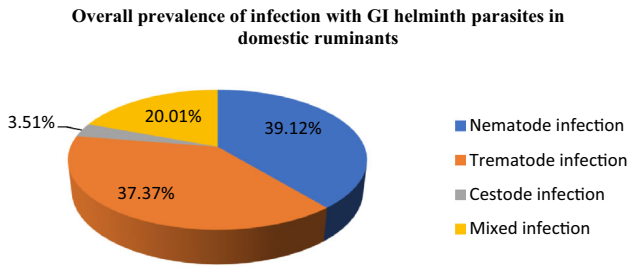

Fig. 1 Overall prevalence infection with GI helminth parasites in domestic ruminants

Seasonal prevalence

Data on the overall prevalence of infection during different seasons indicated maximum during summer (32.0%), followed by winter (30.20%) and rainy seasons (29.9%) (Table 3 and Fig. 3). Slight variations were noted in seasonal prevalence among different parasite groups, with nematodes, trematodes and cestodes showing highest prevalence of 13.33, 13.77 and 1.20 respectively during winter season, and mixed infections recording a high prevalence of 8.25 during summer. On the other hand, data on host wise distribution of prevalence indicted more positive cases of infection during winter in cows and buffaloes and during rainy season in sheep and goats. (Tables 4, 5) ($p < 0.05$).

Discussion

The present study revealed moderate infections with GI helminth parasites in domestic ruminants from Srikakulam district of Andhra Pradesh with an overall prevalence of 30.73% (Table 1). Infections were mainly due to three species of nematode, two species of trematode and a single species of cestode parasites. Among the 1084 infected samples, 39.12% showed infections with nematode eggs, 37.37% with trematodes eggs and 3.51% with cestode eggs. Mixed infections with two or three varieties of parasite eggs were also noted (20.01%) (Table 2 and Fig. 1).

The study recorded infections with six species of helminth parasite eggs in domestic ruminants from Srikakulam district. A review of the available literature revealed similar infections in most of the domestic ruminants i.e. from Bovines (cow and buffalo), Ovine (sheep) and Caprine (goat) hosts from different geographical regions of India (Muraleedharan 2005; Pant et al. 2009; Bilal et. al. 2009; Haque et al. 2011a, b; Singh et al. 2012; Mir et. al. 2013a, b; Sreedevi and Hafeez 2014; Jamra et al. 2014).

Table 2 Prevalence of infection with various GI helminth parasites in cows, buffaloes, sheep and goat

Gastrointestinal Helminth Parasites	Cow (n = 256)		Buffalo (n = 198)		Sheep (n = 394)		Goat (n = 236)		Total (n = 1084)	
	Number infected	Prevalence (%)	Number infected	Prevalence (%)	Number infected	Prevalence (%)	Number infected	Prevalence (%)	Total number	Prevalence (%)
Nematodes										
Haemonchus (Strongyle)	18	7.04	6	3.04	192	48.74	101	42.79	317	29.25
Strongyloides	5	1.96	4	2.03	52	13.19	22	9.33	83	7.66
Trichuris	24	9.38	0	0.00	0	0.00	0	0.00	24	2.22
Total	47	18.35	10	5.06	244	61.93	123	52.12	424	39.12
Trematodes										
Fasciola	42	16.41	44	22.23	22	5.59	21	8.89	129	11.91
Paramphistomum	78	30.47	93	46.97	61	15.49	44	18.65	276	25.47
Total	120	46.88	137	69.19	83	21.07	65	27.55	405	37.37
Cestodes										
Moniezia	9	3.52	0	0.00	21	5.33	8	3.39	38	3.51
Total	9	3.52	0	0.00	21	5.33	8	3.39	38	3.51
Mixed infection										
PA + HC	26	10.16	29	14.65	12	3.04	9	3.82	75	6.92
FS + HC	21	8.21	22	11.12	4	1.02	6	2.55	54	4.99
HC + SD	15	5.86	0	0	24	6.09	21	8.89	60	5.54
FS + SD	18	7.04	0	0	6	1.53	4	1.69	28	2.59
Total	80	31.26	51	25.76	46	11.68	40	16.95	217	20.01

n, No. of infected samples; *FS, *Fasciola*; *HC, *Haemonchus* (*Strongyle*); *SD, *Strongyloides*; *PA, *Paramphistomum*

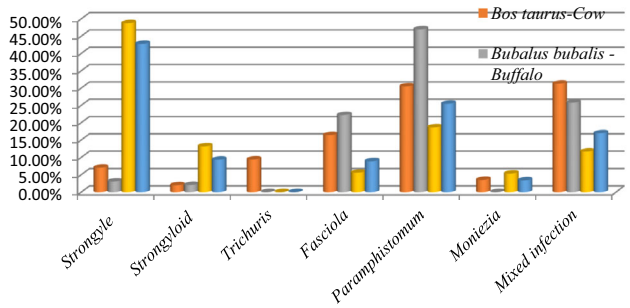

Fig. 2 Prevalence of infection with GI helminth parasites in domestic ruminants

However, no such concrete reports are available from Andhra Pradesh, particularly from the present study area.

During the present study highest overall prevalence of infection was recorded with nematode parasites followed by trematodes, whereas cestodes were found to be the least represented group. A similar observation was made by Almalaik et al. (2008) and Besier et al. (2016) where they noted high prevalence with the nematode parasite *Haemonchus (Strongyle)* in all domestic ruminants. In accordance with the present observations, previous studies have also recorded greater prevalence of infection in buffaloes and sheep when compared to cattle and goat (Mamun et.al. 2011; Gupta and Singla 2012; Singh et al. 2013; Patel et al. 2015; Varadharajan and Vijayalakshmi 2015; Singh, et.al. 2015). This was mainly attributed to their grazing behavior (Lathamani et al. 2016). In the present study, prevalence of the trematode parasite *Paramphistomum* commonly called as rumen fluke is found to be higher than *Fasciola* (liver fluke) particularly in bovines (cattle and buffalo). A similar observation was made in different studies on ruminants by Pfukenyi et al. (2006); Swarnakar and Kumawat (2013); Swarnakar et al. (2014) and Swarnakar et al. (2015).

The nematode parasite *Haemonchus (Strongyle)* was found to be the most common and predominant parasite compared to other parasitic infections, especially in sheep and goat (Biu et al. 2009; Wani et al. 2011; Kuchai et al. 2013; Singh et al 2013). The higher prevalence of *Haemonchus (Strongyle)* could be due to its relatively short generation interval and the ability to take advantage of the favorable environmental conditions (Grant 1981). The only cestode parasite recorded during the present study was *Moniezia.* Raza et, al., (2014 also noted low prevalence of cestode species when compared to other helminth parasite groups.

Analysis of overall seasonal data indicated relatively higher infections during summer (32.06%), followed by

Table 3 Seasonal prevalence of infection with GI helminth parasites in domestic ruminants

Season	Host	Overall Infection			Number infected and Prevalence of infection with different groups of Parasites							
					Nematodes		Trematodes		Cestodes		Mixed infection	
		NE	NI	PI	No. infected	Prevalence of Infection	No. infected	Prevalence of Infection	No. infected	Prevalence of Infection	No. infected	Prevalence of Infection
Rainy	Cow	186	53	28.49	9	4.84	25	13.44	1	0.54	18	9.68
	Buffalo	162	57	35.15	6	3.70	46	28.395	0	0.00	5	3.09
	Sheep	415	140	33.73	92	22.17	24	5.78	6	1.45	18	4.34
	Goat	426	106	24.88	50	11.74	30	7.04	4	0.94	22	5.16
	Total	1189	356	**29.94**	157	13.20	125	10.51	11	0.93	63	5.30
Winter	Cow	192	103	53.64	15	7.81	58	30.20	6	3.13	24	12.50
	Buffalo	158	69	43.67	3	1.90	50	31.65	0	0.00	16	10.13
	Sheep	475	120	25.26	70	14.74	32	6.74	7	1.47	11	2.32
	Goat	337	59	17.51	32	9.50	20	5.93	1	0.30	6	1.78
	Total	1162	351	**30.21**	120	10.33	160	13.77	14	1.20	57	4.90
Summer	Cow	217	100	46.09	23	10.60	37	17.05	2	0.92	38	17.51
	Buffalo	165	72	43.64	1	0.60	41	24.85	0	0.00	30	18.18
	Sheep	452	134	29.65	82	18.14	27	5.97	8	1.77	17	3.76
	Goat	342	71	20.77	41	11.99	15	4.36	3	0.88	12	3.51
	Total	1176	377	**32.06**	147	12.5	120	10.20	13	1.11	97	8.25

NE, Number of animals examined; NI, Number of animals infected; PI, Prevalence of infection

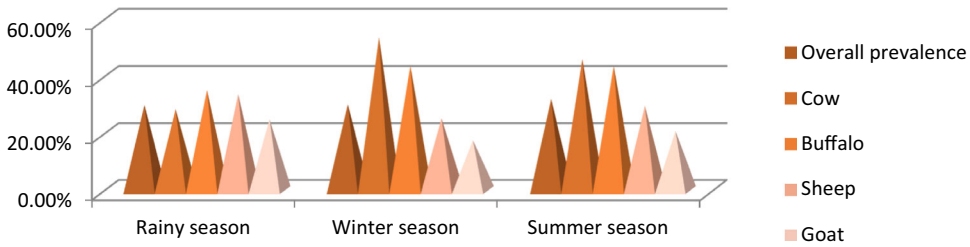

Fig. 3 Seasonal variation in prevalence of infection with GIH parasites in domestic ruminants

ssss

Table 4 Prevalence of infection during different seasons

Seasons	HOSTS (+ ve %)			
	Cows	Buffaloes	Sheep	Goat
Rainy	28.49	35.15	**33.73**	**24.88**
Winter	**53.64**	**43.67**	25.26	17.51
Summer	46.09	43.64	29.65	20.77

winter (30.20%) and rainy seasons (29.94%). This is in accordance with the findings recorded by Makhdoomi et al. (1995) and Khajuria and Kapoor (2003). In the present study, the seasonal fluctuations with in different groups of GI helminth parasites revealed high infection with nematodes, trematodes and cestodes during winter followed by rainy season and least during summer season (Table 3), However, Rangel-Ruiz et. al. (2003) and EL-Shazly et al. (2002) stated higher infection during autumn and summer and lowest during winter, contrary to the

Table 5 One way ANOVA table showing the level of significance ($p > 0.0$) in prevalence of infection between different seasons and hosts

Source of variation	SS	*df*	MS	*F*	*p*-value	*F* crit
Between groups	928.5059	3	309.502	5.570538	0.023254	4.066181
Within groups	444.4841	8	55.56052			
Total	1372.99	11				

$p < 0.05$ (5% Probability level)

present observation. Infection with cestode parasite *Moniezia* was low throughout the year without much variation. Belem et al. (2001), recorded highest infection with Moniezia eggs during rainy seasons. The variations recorded in prevalence of infection during different studies could be due to environmental conditions that can be specific to each geographical location (Chavan et al. 2008; Sharma et al. 2009; Singh et al. 2015; Thakuria et al. 2015).

Table 6 shows reports on the work done so far on GI helminth parasites from the Indian region. It shows that most of the study areas are under tropical places and the most common helminth parasites responsible for causing infection in domestic ruminants are *Haemonchus (Strongyle), Strongyloides* and *Trichuris* (nematodes), *Fasciola* and *Paramphistomum* (Trematodes) and the only cestode found is *Moniezia* (Table 3). Even during the present study the same species of GI helminth parasites were recorded, however, they differ significantly in their geographical location and prevalence of infection.

Conclusion

Present study revealed that infections with both nematode and trematode parasites are high, whereas cestode parasites are least represented. The prevalence of infection with helminth parasites is reported host wise, parasite wise and seasonal wise during the present study in order to understand the distribution and recruitment of parasites and the factors affecting their intensity of infection. Generally deworming will be done to all domestic ruminants in dairy farms during the month of July in order to overcome sudden outburst of infection. This could be one of the reasons for low prevalence of GI helminth infection during rainy season in the present study, however, more intense studies are required to evaluate thoroughly the factors influencing their prevalence of infection during different seasons. Studies of this type could be of great help in understanding the strategies necessary for the health

Table 6 Reports on prevalence of infections with GI helminth parasites in domestic ruminants from India

S. No	Author	Year	Area	Host-species	% of Infection	GI H parasites identified
1	Sreedhar S, Mohan EM, Babu DS	2009	Anantapur dist., Andhra Pradesh	Cattle and Buffalo	42.00	*Paramphistomum, Coccidia* and *Strongyle*
2	Murthy GSS, Rao PV	2014	Karimnagar district, Telangana	Cattle and Buffalo	40.00	*Fasciola, Paramphistomum, Eimeria* and *Toxocara*
3	Murthy GSS, Rao P V	2014	Karimnagar district, Telangana	Sheep and Goat	38.70	*Strongyle, Eimeria, Paramphistomum* and *Moniezia*
4	Muzaffar Rasool Mir et al	2013	Jammu, Jammu and Kashmir	Cattle and Buffalo	51.21	*Strongyle, Strongyloid, Trichuris, Toxocara, Fasciolap, Paramphistomum Moniezia and Eimera*
5	Swarnakar and Kumawat	2014	Udaipur, Rajasthan	Buffalo	75.63	*Paramphisomum* and mixed infections with *Fasciola* and *Gigantocotyle*
6	Jamra et al	2014	Madhya Pradesh	Buffalo	15.57	*Strongyle, Haemonchus, Trichostrongylus, Bunostomum* and *Oesophagostomum*
7	Sridevi et. al	2014	Tirupati, Andhra Pradesh	Buffaloes	40.20	*Paramphistomum, Fasciola Strongyle, Strongyloid, Toxocara, Trichuris* and *Moniezia*
8	[a]Shiva Jyoti S and Reddy S. B	2018	YSR Kadapa district, Andhra Pradesh	Sheep and Goats	91.27	*Haemonchus, Strongyle, Paramphistomum, Fasciola, Trichuris, Strongyloid and Moniezia*
9	Present study	2020	Srikakulam dist., Andhra Pradesh	Cattle, Buffalo, Sheep and Goat	30.73	*Strongyle, Strongyloid, Trichuris, Fasciola, Paramphistomum and Moniezia*

[a]Reference not available

management of domestic ruminants, thereby safeguarding the economic impact.

Acknowledgement The authors are greatly thankful to the authorities of Veterinary Disease Diagnostic Laboratory, Srikakulam and the Department of Zoology, Andhra University, Visakhapatnam, for providing facilities to carry out the work.

Authors contribution We attest to the fact that all Authors listed on the title page have contributed significantly to the work, have read the manuscript, attest to the validity and legitimacy of the data and its interpretation.

Funding Self supported study, no outside funding.

Availability of the data and material All the data is submitted and will be available whenever required.

Declarations

Conflict of interest We have no conflict of Interest to declare.

Consent to participate We attest to the fact that all Authors listed on the title page have contributed significantly to the work, have read the manuscript, attest to the validity and legitimacy of the data and its interpretation, and agree to its submission to the Journal of Parasitic Diseases.

Consent to publication On behalf of the Co-Author and myself, we give our consent for publication in JOPD.

References

Almalaik AHA, Bashar AE, Abakar AD (2008) Prevalence and dynamics of some gastrointestinal parasites of sheep and goats in Tulus area based on post-mortem examination. Asian J Anim Vet Adv 3(6):390–399. https://doi.org/10.3923/ajava.2008.390.399

Belem AMG, Ouedraogo OP, Bessin R (2001) Gastrointestinal nematodes and cestodes of cattle in Burkina Faso. Biotech Agro Soc Environ 5(1):17–21

Besier RB, Kahn LP, Sargison ND, Van Wyk JA (2016) The pathophysiology, ecology and epidemiology of haemonchus contortus infection in small ruminants. Adv Parasitol 93:95–143. https://doi.org/10.1016/bs.apar.2016.02.022

Bilal MQ, Hameed A, Ahmad T (2009) Prevalence of gastrointestinal parasites in buffalo and cow calves in rural areas of Toba Tek Singh, Pakistan. J Anim Plant Sci 19(2):67–70

Biu AA, Mamunatu A, Salamatu A, Agbadu ET (2009) A fecal survey of gastrointestinal parsites of ruminants on the university of Maiduguri Research Farm. Int J Biom Health Sci 5:175–179

Chavan PB, Khan LA, Raut PA, Maske DK, Rahman S (2008) Prevalence of nematode parasites of ruminants at Nagpur. Vet World 1(5):140

Coles EH (1986) Veterinary clinical pathology, 4th edn. W.B. Saunders Co., Philadelphia

DAHD Report (2019) Department of Animal Husbandry and Dairying and Fisheries, Ministry of Fisheries; Government of India. In 20th all Indian Livestock Census, October 2019 Report

Dhama K, Chakraborty S, Mahima WMY, Verma AK, Deb R, Tiwari R, Kapoor S (2013) Novel and emerging therapies safeguarding health of humans and their companion animals: a review. Pakistan J Biol Sci 16(3):101–111. https://doi.org/10.3923/pibs.2013.101.111

El-Shazly AM, El-Wafa SA, Haridy FM, Soliman M, Rifaat MMA, Morsy TA (2002) Fascioliasis among live and slaughtered animals in nine centers of Dakahlia Governorate. J Egyptian Soc Parasitol 32(1):47–58

Gupta SK, Singla LD (2012) Diagnostic trends in parasitic diseases of animals. In: Gupta RP, Garg SR, Nehra V, Lather D (eds) Veterinary diagnostics: current trends. Satish Serial Publishing House, Delhi, pp 81–112

Grant V (1981) Plant Speciation, 2nd edn. Columbia, New York, NY, USA

Haque M, Singh NK, Juyal PD, Singh H, Singh R, Rath SS (2011a) Incidence of gastrointestinal parasites in dairy animals of western plains of Punjab. J Vet Parasitol 25(2):168–217

Haque M, Singh NK, Juyal PD, Kaur A, Rath SS (2011b) Prevalence of gastrointestinal parasites in organized dairy farms. Indian Vet J 88(6):77–78

Jamra N, Das G, Haque M, Singh P (2014) Prevalence and intensity of Strongyles in buffaloes at Nimar region of MP. Int J Agric Vet Med 2(1):54–57

Khajuria JK, Kapoor PR (2003) Prevalence of parasites in sheep and goats at Kathua, Jammu. J Vet Parasitol 17(2):121–126

Krishnamurthy CM, D'Souza PE (2014) Prevalence of gastrointestinal parasites in bovines in Bangalore district, Karnataka. J Parasit Dis 40(3):630–632. https://doi.org/10.1007/s12639-014-0548-x

Kuchai JA, Chisti MZ, Ahmad FM, Mir MR, Darv JA (2013) Impact of health status and species of the host on prevalence of helminthiasis in sheep and goats of Ladakh. Int J Agro Plant Prod 4(5):869–872

Laha R, Das M, Goswami A (2013) Gastrointestinal Parasitic infections in organized cattle farms of Meghalaya. Vet World 6(2):109–112

Lathamani VS, Ramesh PT, Siddalingamurthy HK (2016) Studies on the prevalence of helminth infestation in small ruminants and the anthelmintic effectiveness in Tumkur district of Karnataka. Int J Innov Res Sci Eng Technol 5(2):2169–2173. https://doi.org/10.15680/IJIRSET.2016.0502083

MAFF (1984) Manual of Veterinary Parasitological Laboratory Techniques. Ministry of agriculture, fisheries and food reference book 418. Her Maesty's Stationary Office, London

Mahusoon MM, Perera ANF, Perera ERK, Perera KA (2004) Effect of Molybdenum supplementation on circulating mineral levels, Nematode infection and body weight gain in goats as related to season. Trop Agric Res 16:128–136

Makhdoomi DM, Singh AP, Singh M, Krishnamurthy V (1995) Intestinal obstruction in ruminants: a review. Indian J Vet Sur 16(2):81–82

Mamun MAA, Begum N, Mondal MMH (2011) A coprological survey of gastro-intestinal parsites of water buffaloes (*Bubalus bubalis*) in Kurigram district of Bangladesh. J Bangladesh Agric Univ 9(1):103–109. https://doi.org/10.3329/jbau.v9i1.8752

Mir MR, Chishti MZ, Rashid M, Dar SA, Kuchay DA (2013a) Prevalence of gastrointestinal nematodes in goats of Jammu region. Int J Rec Sci Res 4(3):208–210

Mir MR, Chishti MZ, Rashid M, Dar SA, Katoch R, Mehraj M, Dar MA, Rasool R (2013b) The epidemiology of caprine Fascioliasis in Jammu (J and K) India. Int J Food Agric Vet Sci 3(1):233–237

Muraleedharan K (2005) Prevalence of gastrointestinal parasites of livestock in a central dry zone of Karnataka. J Vet Parasitol 19(1):31–33

Murthy GSS, Rao PV (2014) Prevalence of gastrointestinal parasites in ruminants and poultry in Telangana region of Andhra Pradesh. J Parasit Dis 38(2):190–192. https://doi.org/10.1007/s12639-012-0218-9

Ntonifor HN, Shei SJ, Ndaleh NW, Mbunkur GN (2013) Epidemiological studies of gastrointestinal parasitic infections in ruminants in Jakiri, Bui division, North West region of Cameroon. J Vet Med Anim Health 5(12):344–352. https://doi.org/10.5897/JVMAH2013.0209

Pant K, Rajput M, Kumar J, Sahu S (2009) Prevalence of helminthes in small ruminants in Tarai region of Uttarakhand. Vet World 2(7):265–266. https://doi.org/10.5455/vetworld.2010.265-266

Patel HC, Hasnani JJ, Patel PV, Pandya SS, Solanki JB, Jadav SJ (2015) A study on helminth parasites of buffaloes brought to Ahmedabad slaughter house, Gujarat. India Life Sci J 5(1):20–27

Pfukenyi DM, Mukaratirwa S, Willingham AL, Monrad J (2006) Epidemiological studies of Fasciola gigantic infections in cattle in the highveld and lowveld communal grazing areas of Zimbabwe. Onderstepoort J Vet Res 73(1):37–51

Preethi M, Venu R, Srilatha C, Srinivasa Rao K, Rao PV (2020) Prevalence of paramphistomosis in domestic ruminants in Chittoor District of Andhra Pradesh, India. Agric Sci Digest 40:61–68. https://doi.org/10.18805/ag.D-5014

Rafiullah TAA, Sajid A, Shah SR, Ahmad S, Shahid M (2011) Prevalence of gastrointestinal tract parasites in cattle of Khyber Pakhtunkhwa. J Agric Biol Sci 6(9):9–15

Rahman H, Pal P, Bandyopadhyay S, Chatlod LR (2012) Epidemiology of gastrointestinal parasitism in cattle in Sikkim. Indian J Anim Sci 82(2):151–153

Rangel-Ruiz LJ, Albores-Brahms ST, Gamboa-Aguilar J (2003) Seasonal trends of *Paramphistomum cervi* in Tabasco, Mexico. Vet Parasitol 116(3):217–222. https://doi.org/10.1016/j.vetpar.2003.07.002

Raza MA, Younas M, Schlecht E (2014) Prevalence of gastrointestinal helminths in pastoral sheep and goat flocks in the cholistan desert of Pakistan. J Anim Plant Sci 24(1):127–134

Samanta A, Prabir Kumar S (2007) Prevalence of gastrointestinal helminths in hot and humid zone of West Bengal. J Vet Parasitol 21(2):145–148

Sharma DK, Agarwal N, Ajoy M, Nigam P, Saket B (2009) Coccidia and gastrointestinal nematode infections in semi-intensively managed Jakhrana goats of Semi-Arid region of India. Trop Subtrop Agroecosyst 11:135–139

Singh NK, Singh H, Haque JM, Rath SS (2012) Prevalence of parasitic infections in cattle of Ludhiana district, Punjab. J Parasit Dis 36(2):256–259. https://doi.org/10.1007/s12639-012-0119-y

Singh V, Varshney P, Dash SK, Lal HP (2013) Prevalence of gastrointestinal parasites in sheep and goats in and around Mathura. India. Vet World 6(5):260. https://doi.org/10.5455/vetworld.2013.260-262

Singh AK, Das G, Roy B, Sumathi Siva Kumar A, Naresh R, Nath S (2015) Prevalence of gastrointestinal nematodes of goat on communal pasture in Madhya Pradesh. Indian Vet J 92(3):67–68

Sivajothi S, Sudhakara Reddy B (2014) Immature paramphistomosis in a sheep herd. Int J Biol Res 2(2):140–142. https://doi.org/10.14419/ijbr.v2i2.3398

Soulsby EJL (1982) Helminths, arthropods and protozoa of domesticated animals, 7th edn. Bailliere and Tindall, London

Sreedevi C, Hafeez Md (2014) Prevalence of gastrointestinal parasites in buffaloes (*Bubalus bubalis*) in and around Tirupati, India. Buffalo Bull 33(3):251–255. https://doi.org/10.14456/ku-bufbu.2014.43

Sreedhar S, Mohan EM, Babu DS (2009) Prevalencd of parasitic infections in cattle and buffaloes of Anantapur district of Andhra Pradesh. Indian J Anim Res 43(3):230–231

Swarnakar G, Kumawat A (2013) Incidence of pathogenic Amphistomes *Orthcoelium* and *Scoliocoelium* (Trematoda: Digenea) in Udaipur (Rajasthan). Int J Sci Res 2(3):395–396. https://doi.org/10.15373/22778179/MAR2013/130

Swarnakar G, Kumawat A, Sanger B, Roat K, Goswami H (2014) Prevalence of amphistome parasites (Trematoda: Digenea) in Udaipur of Southern Rajathan, India. Int J Curr Micro Appl Sci 3:32–37

Swarnakar G, Bhardawaj B, Sanger B, Roat K (2015) Prevalence of gastrointestinal parasites in cow and buffalo of Udaipur district, India. Int J Curr Micro Appl Sci 4(6):897–902

Thakuria M, Dutta TC, Phukan A, Islam S, Saleque A, Baruah N (2015) Seasonal prevalence of gastrointestinal nematodes in goats in Assam. Indian Vet J 92:74–75

Varadharajan A, Vijayalakshmi R (2015) Prevalence and seasonal occurrence of gastrointestinal parasites in small ruminants of coastal areas of TamilNadu. Int J Sci Res 5(2):1–4

Wani ZA, Shahardar RA, Shahnawaz M (2011) Prevalence of nemathelminth parasites in sheep of Ganderbal district of Kashmir Valley. J Vet Parasitol 25(1):26–29