Prevalence Of Gastrointestinal Helminth Parasites In Domestic Ruminants From Srikakulam District, Andhra Pradesh, India.

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Research Article

Keywords: Prevalence, Gastrointestinal helminth parasites, Domestic ruminants, faecal samples, Seasons

DOI: https://doi.org/10.21203/rs.3.rs-230123/v1

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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 3,527 fecal samples were examined including 595 from cows, 485 from buffaloes, 1342 from sheep and 1105 from goat. Out of 3,527 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.

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 ruminants 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 & Kumar, 2007; Haque et al., 2011; Singh et al., 2012; Rahman et al., 2012; Krishnamurthy and D'souza 2014; Rafiullah et al., 2011; Laha et al., 2013; Mir et al., 2013 a & 2013 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.

**Materials & 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 5,837 square kilometers with a rural area constituting 5,650.96 sq km. 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 3,527 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**

i. 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 3,527 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 & buffaloes) harbored much higher infection with GIHs, when compared to small ruminants (sheep & 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 & buffaloes) and small ruminants (sheep & 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).

| 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 | 3,527                           | 1,084                  | **30.73%**              |

### ii 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 (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), *Strongyloides* and *Trichuris*, two species of trematodes
(Fasciola & 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 occurring 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 & 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 & Fig −2).

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 | Number infected | 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%        |
| TROMATODES                        |             |             |             |             |               |             |             |             |               |               |             |
| Fasciola                          | 42         | 16.41%      | 44          | 22.23%     | 22           | 5.59%       | 21           | 8.89%       | 129          | 11.91%        |
| Paramphistomum                    | 78         | 30.47%      | 93          | 46.57%     | 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           | 4.95%         |
| HC + SD                           | 15         | 5.86%       | 0           | 0%         | 24           | 6.05%       | 21           | 8.89%       | 60           | 5.44%         |
| 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

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 & Fig. 3). Whereas 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. (Table 4) (p < 0.05)

| Season | Host | Overall Infection | Number infected and Prevalence of infection with different groups of Parasites |
|--------|------|-------------------|---------------------------------------------------------------------------------|
|        |      |                   | NEMATODES | TREMATODES | CESTODES | MIXED INFECTION |
|        |      |                   | NE | NI | PI | No. infect ed | Prevalence of infection | No. infect ed | Prevalence of Infection | No. infect ed | Prevalence of Infection | No. infect ed | 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
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 1,084 infected samples, 39.12% showed infections with nematode eggs, 37.37% with trematode eggs and 3.51% with cestode eggs. Mixed infections with two or three varieties of parasite eggs were also noted (20.01%) (Table 2 & 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., 2011; Singh et al., 2012; Mir et. al., 2013 a & 2013 b; Sreedevi and Hafeez, 2014; Jamra, et al., 2014). 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 & Singla 2012; Singh et al., 2013; Patel et al., 2015; Varadharajan & 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 uke 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 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 – Shazley et al. (2002) stated higher infection during autumn and summer and lowest during winter, contrary to the 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 and Thakuria et al., 2015).

Table 5 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 management of domestic ruminants, thereby safeguarding the economic impact.

Declarations

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.

**Funding:** Self supported study, no outside funding

**Conflicts of Interest/Completing interests:** We have no conflict of Interest to declare

**Ethics approval:** Not Applicable

**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.

**Availability of the data and Material:** All the data is submitted and will be available whenever required.

**Coded Availability:** Not Applicable

**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

**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](https://doi.org/10.3923/ajava.2008.390.399). [Google Scholar]

Belem AMG, Ouedraogo OP, Bessin R (2001) Gastrointestinal nematodes and cestodes of cattle in Burkina Faso. Biotech Agro Society Env. 5(1):17-21. [Google Scholar]

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](https://doi.org/10.1016/bs.apar.2016.02.022)[Google Scholar]

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 Ani Plant Sci 19(2):67-70.[Google Scholar]

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 Sci5:175-179. [Google Scholar]
Chavan PB, Khan LA, Raut PA, Maske DK, Rahman S (2008) Prevalence of nematode parasites of ruminants at Nagpur. Vet World 1(5):140. [Google Scholar]

Coles EH (1986) Veterinary Clinical Pathology, 4th edition. W.B. Saunders Co. Philadelphia. [Google Scholar]

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

Dhama K, Chakraborty S, Mahima, Wani MY, 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. [Google Scholar]

El-Shazly AM, El-Wafa SA, Haridy FM, Soliman M, Rifaat MMA, Morsy TA (2009) Fascioliasis among live and slaughtered animals in nine centers of Dakahlia Governorate. J Egyptian Soc Parasitol 32(1):47-57 [Google Scholar]

Gupta SK, Singla LD (2012) Diagnostic trends in parasitic diseases of animals. In book: Veterinary Diagnostics: Current Trends. [Gupta RP, Garg SR, Nehra V and Lather D (Eds)], Satish Serial Publishing House, Delhi, pp 81-112. [Google Scholar]

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

Haque M, Singh NK, Juyal PD, Singh H, Singh R, Rath SS (2011) Incidence of gastrointestinal parasites in dairy animals of western plains of Punjab. J Vet Parasitol 25(2):168-17. [Google Scholar]

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

Jamra N, Das G, Haque M, Singh P (2014) Prevalence and intensity of Strongyles in buffaloes at Nimar region of M.P. Int J Agri Vet Med 2(1):54-57. [Google Scholar]

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

Krishnamurthy CM, Placid E. D'Souza (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 [Google Scholar]

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 and Plant Pro 4(5):869-872. [Google Scholar]
Laha R, Das M and Goswami A (2013) Gastrointestinal Parasitic infections in organized cattle farms of Meghalaya. Vet World 6(2):109-112. [Google Scholar]

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 [Google Scholar]

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 Agri Res 16:128-136. [Google Scholar]

Makhdoomi DM, Singh AP, Singh M, Krishnamurthy V (1995) Intestinal obstruction in ruminants: A review. Indian J Vet Sur 16(2):81-82. [Google Scholar]

Mamun MAA, Begum N, Mondal MMH (2011) A coprological survey of gastro-intestinal parasites of water buffaloes (Bubalus bubalis) in Kurigram district of Bangladesh. J Bangladesh Agri Univ 9(1):103-109 https://dx.doi.org/10.3329/jbau.v9i1.8752 [Google Scholar]

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

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&K) India. Int J Food Agri Vet Sci 3(1): 233-237 [Google Scholar]

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

Murthy GSS, Rao P V (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. [Google Scholar]

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 Ani Health 5(12):344-352. https://doi.org/10.5897/JVMAH2013.0209 [Google Scholar]

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. [Google Scholar]

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. [Google Scholar]
PFUKENYI DM, Mukaratirwa S, Willingham AL, Monrad J (2006) Epidemiological studies of Fasciola gigantica infections in cattle in the highveld and lowveld communal grazing areas of Zimbabwe. Onderstepoort J Vet Res 73(1):37-51. [Google Scholar]

Preethi M, Venu R, Srilatha Ch, Srinivasa Rao K, Rao PV (2020) Prevalence of Paramphistomosis in Domestic ruminants in Chittoor District of Andhra Pradesh, India. Agri Sci Digest 40:61-68. https://doi.org/10.18805/ag.D-5014. [Google Scholar]

Rafiuallah, Turi AA, Sajid A, Shah SR, Ahmad S, Shahid M (2011) Prevalence of gastrointestinal tract parasites in cattle of Khyber Pakhtunkhwa. J Agri Biol Sci 6(9):9-15 [Google Scholar]

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 [Google Scholar]

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. [Google Scholar]

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. [Google Scholar]

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 [Google Scholar]

Sharma DK, Agarwal N, Mandal Ajoy, Nigam P, Bhusan Saket (2009) Coccidia and gastrointestinal nematode infections in semi-intensively managed Jakhrana goats of Semi-Arid region of India. Tropical and Subtropical Agroecosystems 11:135-139. [Google Scholar]

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 [Google Scholar]

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 [Google Scholar]

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. [Google Scholar]

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 [Google Scholar]

Soulsby EJL (1982) Helminths, Arthropods and Protozoa of Domesticated Animals, 7th edition, Bailliere and Tindall, London.
Sreedevi C, Hafeez Md (2014) Prevalence of gastrointestinal parasites in buffaloes (Bubalus bubalis) in and around Tirupati, India. Buffalo Bulletin 33(3):251-255. https://doi.org/10.14456/ku-bufbu.2014.43 [Google Scholar]

Sreedhar S, Mohan EM, Babu DS (2009) Prevalence 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 Amphistomides Orthcoelium and Scoliocoelium (Trematoda: Digenea) in Udaipur (Rajasthan). Int J Sci Res 2(3): 395-396https://doi.org/10.15373/22778179/MAR2013/130 [Google Scholar]

Swarnakar G, Kumawat A, Sanger B, Roat K, Goswami H (2014) Prevalence of amphistome parasites (Trematoda: Digenea) in Udaipur of Southern Rajasthan, India. Int J Current Micro App Sci 3:32-37. [Google Scholar]

Swarnakar G, Bhardawaj B, Sanger B, Roat K (2015) Prevalence of gastrointestinal parasites in cow and buffalo of Udaipur district, India. Int J Current Micro App Sci 4(6):897-902. [Google Scholar]

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. [Google Scholar]

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. [Google Scholar]

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. [Google Scholar]