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Prevalence and Risk Factor Assessment of Gastrointestinal Parasitic Infections in Cattle of Flood Prone Eastern Plains of Rajasthan

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ABSTRACT

A total of 756 faecal samples (429 from native cattle and 327 from crossbred cattle) from flood prone eastern plains of Rajasthan were examined from January, 2022 to December, 2022. Out of them, 527 samples were found positive, with an overall prevalence of 69.71% for different gastrointestinal parasitic infections with mixed infection in 26.85%. The study revealed strongyles (43.25%) and *Eimeria* sp. (30.29%) as the most dominant infections followed by, *Strongyloides* sp., Amphistomes, *Trichuris* sp., *Moniezia* sp., *B. coli* and *Capillaria* sp.. Season wise analysis revealed a highly significant statistical seasonal variation ($p<0.01$) with maximum infection in rainy season (77.95%) whereas, a non-significant statistical difference in district wise prevalence was reported with the highest prevalence rate in Bharatpur district (76.47%). Quantitative analysis based on the estimation of oocysts and eggs gram^{-1} (OPG and EPG) of faeces revealed highest severity of *Eimeria* sp. infection ranging from 300–2200 (1107.14±171.12) followed by strongyle infection 200–1200 (509.09±84.70). Coproculture examination exhibited *Haemonchus* sp. as a predominant nematode genus, followed by *Oesophagostomum* sp., *Bunostomum* sp., *Trichostrongylus* sp., *Cooperia* sp., *Chabertia* sp., *Ostertagia* sp. and *Strongyloides* sp.. Sporulation studies showed higher prevalence of *Eimeria bovis* followed by *E. zuernii*, *E. subspherica, E. auburnensis, E. ellipsoidalis, E. cylindrica*, *E. pellita*, *E. alabamensis*, *E. bukidnonensis* and *E. canadensis*. The findings of the present study may be used to formulate effective control strategies against gastrointestinal parasitic infections in the cattle of the region.

KEYWORDS: Cattle, flood prone eastern plains, gastrointestinal parasitic infections

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1. INTRODUCTION

A large portion of the people in India is employed in agriculture and animal husbandry, making the country an agriculture-based economy. The nation's rural socioeconomic conditions and national economy both heavily rely on cattle. With 193.46 million cattle, India has the world's highest cattle population. As per the 20th Livestock census of 2019, Rajasthan holds the sixth rank in the country with 13.93 million cattle, comprising 2.32 million exotic and 11.61 million indigenous cattle (Anonymous, 2023). In India, the entire livestock population is predicted to expand by 1.1% annually, although the yearly growth rate of the cattle population is only 0.5% (Wadhwa et al., 2011). Reproductive and productive performance of animals is negatively impacted by intestinal parasites, which also cause problems with feed intake, conversion, and utilization, as well as growth (Radostits et al., 1994; Yadav et al., 2004). This results in prolonged periods of emaciation, poor reproductive performance, loss of body weight, and increased susceptibility of animals to other infections. Estimates of the potential economic losses of each parasite species or group are based on numbers of animals at risk and on the available data on losses in milk production and weight gain of beef cattle. Several reports have indicated the substantial economic losses incurred by the gastrointestinal parasites on dairy industry (Grisi et al., 2014; Shephard et al., 2022; Strydom et al., 2023; Rizwan et al., 2023). Incidences of parasitic infections in cattle have been reported around the globe viz. Pakistan (Ali et al., 2023), Ethopia (Terfa et al., 2023; Tiele et al., 2023), Nepal (Thapa et al., 2022), Columbia (Pinilla Leon et al., 2019), Srilanka (Gunathilaka et al., 2018) as well as from different parts of India such as, Sikkim (Rahman et al., 2012), Kashmir valley (Bushra et al., 2013), Meghalaya (Laha et al., 2013), Assam (Das et al., 2018), Bihar (Deo et al., 2019), Madhya Pradesh (Das et al., 2018), Gujarat (Maharana et al., 2016; Thakre et al., 2019), Haryana (Bhanot et al., 2023) and Rajasthan (Monika et al., 2017; Renwal et al., 2017; Choudhary et al., 2018a; Panwar et al., 2018 and Sodha et al., 2021). Despite being the largest state in terms of area, Rajasthan never has enough pastures because of predominant dry conditions. Development of control measures may be complicated by the possibility of parasite infections transfer between domestic and wild animals due to competition for pastures demanding interface studies (Gupta et al., 2010; Allwin et al., 2016, Zanetti et al., 2021; Khattak et al., 2023; Esteban-Sánchez et al., 2024). Critical analysis of the data will be of immense help to the policy makers to develop strategic control programs for effective parasite management in the country (Bandyopadhyay et al., 2020; Singh and Das, 2021; Suresh et al., 2022; Krishanamoorthy et al., 2024) including sustainable parasite management (Gupta et al., 2017; Burke and Milan, 2020) as well as to develop parasitic diseases forecasting models (Suresh et al., 2022). Given that it is the largest state in terms of area in India, the state's single control program could not be sufficient to keep the number of parasite illnesses in cattle under control. To effectively manage the same, a zone-specific control program is necessary. Additionally, the study aims to gather baseline data that will aid in the development of control and prevention strategies in the near future to reduce the financial losses brought on by gastrointestinal parasite infections. The goal of the current study is to ascertain the prevalence rate, types, and severity of gastrointestinal parasite infections in cattle that are located in Rajasthan's flood-prone eastern plains.

2. MATERIALS AND METHODS

The present cross-sectional investigation was carried out for a period of one year from January 2022 to December 2022 including all three seasons viz. winter, summer and rainy to determine the prevalence of gastrointestinal parasitic infections in the cattle of flood prone eastern plains of Rajasthan.

2.1. *Study area*

The state of Rajasthan is separated into ten main agroclimatic zones. The current research has been conducted in flood-prone eastern plains of Rajasthan. The zone is situated between longitudes 76°3' and 78°17' east and latitudes 25°58' and 27°56' north. The districts of Alwar, Bharatpur, Dholpur, Karauli, and Sawai Madhopur are included in the study region. The maximum temperature is 40.0°C in the summer and drops to 8.2°C in the winter, with an average rainfall of 500 to 700 mm (Anonymous., 2022).

2.2. *Collection of samples*

In five districts of Rajasthan's flood-prone eastern plains, 756 cattle faecal samples with 429 native cattle and 327 crossbred cattle, were randomly collected during the winter, summer, and rainy seasons, spanning from January 2022 to December 2022. The information on the region, cow breeds, age, sex, history of deworming, and collection season was appropriately labeled on the sterile zip lock polythene bags containing the samples. Samples were transported to the Department of Veterinary Parasitology, PGIVER, Jaipur, Post Graduate Laboratory, for additional analysis, and stored in a cool transport box.

2.3. *Coprological examination*

In order to identify parasite eggs, cysts, and oocysts, the faecal samples were first submitted to normal qualitative faecal sample inspection utilizing flotation and sedimentation procedures (Soulsby, 1982). The modified McMaster egg counting methodology (Coles et al., 1992) was then used to quantify the results. Coproculture investigation to identify and harvest infective strongyle larvae was conducted as per Van Wyk and Mayhew (2013). Based on the physical characteristics of the oocysts as reported by Taylor et al. (2007) and Soulsby (1982), the coccidian parasites were identified.

2.4. Statistical analysis

Statistical analysis was performed by using IBM SPSS Statistics Version 26 software by applying Chi square (χ^2) test and subjected to the multivariate binary logistic regression model with significant association at $p \leq 0.05$ (two-side).

3. RESULTS AND DISCUSSION

A total of 756 bovine faecal samples were examined, and 527 of them tested positive for various gastrointestinal parasite infections, with a prevalence of 69.71% overall and 26.85% for mixed infections (Table 1). Strongyle types infections (43.25%) were the most common parasitic infections reported; these were followed by *Eimeria* sp. (30.29%), *Strongyloides* sp. (10.58%), Amphistomes (7.01%), and *Trichuris* sp. (5.16%). A few other parasitic infections were also reported, including meager infections with *Moniezia* sp. (1.72%), *B. coli* (1.59%), and *Capillaria* sp. (1.06%) (Table 1). The present investigation reports of various parasites from the cattle population closely align with the earlier findings in the bovine population of the state viz., Godara and Manohar (2004), Wadhwa et al. (2011), Monika et al. (2017), Renwal et al. (2017), Panwar et al. (2018), and Sodha et al. (2021). However, other researchers from diverse regions of India, including Rahman et al. (2012), Bushra et al. (2013), and Laha et al. (2013), reported comparable findings. In line with the findings of Monika et al. (2017), the current investigation found that among helminthic infections, nematode infections were more common than trematode and cestode infections. The fact that the animals in the study area are primarily stall fed may be the reason for the lower prevalence of trematode and cestode infection, which lowers the likelihood of exposure to the infectious intermediate host present on the vegetation near water bodies (Maharana et al., 2016).

Table 1: Overall prevalence of gastrointestinal parasitic infections in cattle of flood prone eastern plains of Rajasthan

		Examined	Infected	Mixed	Gastrointestinal parasites			
					Helminth			
					Strongyle	*Strongyloides* sp.	*Trichuris* sp.	*Moniezia* sp.
Cattle	Native	429	306 (71.33%)	105 (24.47%)	189 (44.05%)	42 (9.79%)	22 (5.13%)	06 (1.40%)
	Crossbred	327	221 (67.58%)	98 (29.97%)	138 (42.20%)	38 (11.62%)	17 (5.20%)	07 (2.14%)
χ^2 value			1.232	2.851	0.260	0.657	0.002	0.605
Total		756	527 (69.71%)	203 (26.85%)	327 (43.25%)	80 (10.58%)	39 (5.16%)	13 (1.72%)

Table 1: Continue...

		Examined	Gastrointestinal parasites			
			Helminth		Protozoa	
			Amphistome	*Capillaria* sp.	*Eimeria* sp.	*B. coli*
Cattle	Native	429	30 (6.99%)	06 (1.40%)	131 (30.54%)	05 (1.16%)
	Crossbred	327	23 (7.03%)	02 (0.61%)	98 (29.97%)	07 (2.14%)
χ^2 value			0.000	1.098	0.028	1.130
Total		756	53 (7.01%)	08 (1.06%)	229 (30.29%)	12 (1.59%)

3.1. Animal type wise analysis

According to animal type, crossbred cattle had a non-significant difference in prevalence (67.58%) compared to native cattle (71.33%), which is consistent with the findings of Monika et al. (2017), Renwal et al. (2017), and Sodha et al. (2021) in the Rajasthan state bovine population. A positive relationship, or an increase in the odds ratio of infection by 1.337 in native cattle, was found by statistical analysis using a multivariate binary logistic regression model for gastrointestinal parasite infections (Table 4). Higher prevalence in native cattle than in crossbred cattle which are primarily raised in stalls for feeding with relatively improved animal husbandry practices, may be attributed to the native animals' longer periods of extensive grazing, which increases the chances of exposure to the infectious stages (Renwal et al., 2017 and Monika et al., 2017).

3.2. Seasonal dynamics

The prevalence of gastrointestinal parasite infections showed a very significant difference (p<0.01) according to seasonal dynamics, with the rainy season having the highest prevalence rate (77.95%), followed by the summer (67.06%) and winter (64.00%) seasons (Table 2). Highest overall prevalence rate of gastrointestinal parasitic infections in the rainy season is similar to the previous findings of Renwal et al. (2017), Monika et al. (2017), Choudhary et al. (2018a) and Sodha et al. (2021) in bovine population from Rajasthan state; Gupta et al. (2012), Gupta et al. (2019), and Deo et al. (2019) from different parts of India. Statistical analysis using multivariate binary logistic regression model revealed a positive association in rainy season and a negative association in winter season and i.e. odds ratio of infection increased by 1.860 in rainy season and decreased by 0.980 in winter season as compared to summer season (Table 4). The highest prevalence during rainy season might be due to adequate moisture and optimum temperature which favored the growth and survival of infective stages on the pasture.

Table 2: Season wise prevalence of gastrointestinal parasitic infections in cattle of flood prone eastern plains of Rajasthan

Seasons	Examined	Infected	Mixed	Gastrointestinal parasite			
				Helminth		Protozoa	
				Strongyle	*Strongyloides* sp.	*Trichuris* sp.	*Moniezia* sp.
Summer	252	169 (67.06%)	53 (21.03%)	111 (44.05%)	22 (8.73%)	09 (3.57%)	01 (0.39%)
Rainy	254	198 (77.95%)	85 (33.46%)	118 (46.46%)	33 (12.99%)	17 (6.69%)	07 (2.75%)
Winter	250	160 (64.00%)	65 (26.00%)	98 (39.20%)	25 (10.00%)	13 (5.20%)	05 (2.00%)
χ^2 value		12.869**	10.093**	2.800	2.562	2.521	4.339
Total	756	527 (69.71%)	203 (26.85%)	327 (43.25%)	80 (10.58%)	39 (5.16%)	13 (1.72%)

Table 2: Continue...

Seasons	Examined	Infected	Mixed	Gastrointestinal parasite			
				Helminth		Protozoa	
				Amphistome	*Capillaria* sp.	*Eimeria* sp.	*B. coli*
Summer	252	169 (67.06%)	53 (21.03%)	19 (7.54%)	02 (0.79%)	64 (25.40%)	03 (1.19%)
Rainy	254	198 (77.95%)	85 (33.46%)	22 (8.66%)	05 (1.97%)	86 (33.86%)	07 (2.75%)
Winter	250	160 (64.00%)	65 (26.00%)	12 (4.80%)	01 (0.40%)	79 (31.60%)	02 (0.80%)
χ^2 value		12.869**	10.093**	3.044	3.213	4.592	3.467
Total	756	527 (69.71%)	203 (26.85%)	53 (7.01%)	08 (1.06%)	229 (30.29%)	12 (1.59%)

Note: Figures in parentheses indicate percentage, **= highly significant

3.3. District wise analysis

There was a non-significant difference found across the five districts with the greatest prevalence rate being Bharatpur (76.47%), followed in decreasing order of prevalence by Alwar (72.18%), Sawai Madhopur (70.20%), Dholpur (67.55%), and Karauli (62.00%) (Table 3). When compared to Alwar district, the odds ratio of infection increased by 1.864 and 1.391 in Karauli and Bharatpur and decreased by 0.893 and 0.750 in Sawai Madhopur and Dholpur districts, respectively, according to statistical analysis using a multivariate binary logistic regression model (Table 4). It also revealed a positive association in Bharatpur and Karauli districts. This disparity between the districts in Rajasthan's flood-prone eastern plains may be caused by differences in cow pasture management, animal husbandry techniques, and deworming program administration (Renwal et al., 2017, Choudhary et al., 2018a, and Monika et al., 2017).

3.4. Intensity of gastrointestinal parasitic infections

Table 5 shows the severity of gastrointestinal parasite infections in cattle as represented by egg and oocyst gram-1 (epg and opg). In the current investigation, native cattle showed the highest intensity, followed by crossbred cattle. Differences in agro-ecology, the quantity of faecal samples analyzed, sample size, sampling period, managemental conditions, and deworming procedures in the various study regions could be contributing factors to variations.

The coccidia infection ranged from 300 to 2200, with an average of 1107.14±171.12, which is consistent with the findings of Gupta et al. (2016) but somewhat higher than those of Yu et al. (2011), Das et al. (2015), and Squire et al. (2013). Differences in the agro-ecology, management circumstances, sample size, sampling period, and husbandry

Table 3: District wise prevalence of gastrointestinal parasitic infections in cattle of flood prone eastern plains of Rajasthan

District	Examined	Infected	Mixed	Gastrointestinal parasite			
				Helminth		Protozoa	
				Strongyle	*Strongyloides* sp.	*Trichuris* sp.	*Moniezia* sp.
Alwar	151	109 (72.18%)	40 (26.49%)	64 (42.38%)	15 (9.93%)	05 (3.31%)	02 (1.32%)
Bharatpur	153	117 (76.47%)	50 (32.68%)	72 (47.06%)	21 (13.72%)	12 (7.84%)	03 (1.96%)
Dholpur	151	102 (67.55%)	39 (25.83%)	69 (45.69%)	19 (12.58%)	08 (5.30%)	01 (0.66%)
Karauli	150	93 (62.00%)	38 (25.33%)	59 (39.33%)	13 (8.67%)	05 (3.33%)	05 (3.33%)
Sawai Madhopur	151	106 (70.20%)	36 (23.84%)	63 (41.72%)	12 (7.95%)	09 (5.96%)	02 (1.32%)
χ^2 value		8.324	3.609	2.399	3.993	4.533	3.642
Total	756	527 (69.71%)	203 (26.85%)	327 (43.25%)	80 (10.58%)	39 (5.16%)	13 (1.72%)

Table 3: Continue...

Seasons	Examined	Infected	Mixed	Gastrointestinal parasite			
				Helminth		Protozoa	
				Amphistome	*Capillaria* sp.	*Eimeria* sp.	*B. coli*
Alwar	151	109 (72.18%)	40 (26.49%)	10 (6.62%)	01 (0.66%)	54 (35.76%)	04 (2.65%)
Bharatpur	153	117 (76.47%)	50 (32.68%)	17 (11.11%)	04 (2.61%)	43 (28.10%)	02 (1.31%)
Dholpur	151	102 (67.55%)	39 (25.83%)	04 (2.65%)	01 (0.66%)	42 (27.81%)	02 (1.32%)
Karauli	150	93 (62.00%)	38 (25.33%)	13 (8.67%)	00	39 (26.00%)	03 (2.00%)
Sawai Madhopur	151	106 (70.20%)	36 (23.84%)	09 (5.96%)	02 (1.32%)	51 (33.77%)	01 (0.66%)
χ^2 value		8.324	3.609	9.274	5.698	5.101	2.224
Total	756	527 (69.71%)	203 (26.85%)	53 (7.01%)	08 (1.06%)	229 (30.29%)	12 (1.59%)

Table 4: Multivariate binary logistic regression for gastrointestinal parasitic infections in cattle of flood prone eastern plains of Rajasthan

Parameter			Logistic regression coefficient (B)	S.E.	Wald test	*p* value	Odds ratio
Season	Summer (Constant)		.235	.321	.535	.464	1.265
	Rainy		.621	.316	3.867	.049	1.860
	Winter		-.020	.282	.005	.944	.980
District	Alwar (Constant)		.642	.613	1.097	.295	1.900
	Bharatpur		.330	.432	.585	.444	1.391
	Dholpur		-.288	.415	.481	.488	.750
	Karauli		.623	.376	2.744	.098	1.864
	Sawaimadhopur		-.113	.414	.075	.784	.893
Animal type	Cattle	Native	.291	.263	1.220	.269	1.337
		Crossbred (Constant)	.523	.233	5.501	.019	1.687

techniques of the various study locations could be the cause of severity variances. Additionally, factors that affect the severity of infection include an animal's genetic predisposition, innate or adaptive immunity, stress, cleanliness, farm management, animal breeding, research design and methodology, and climate and geographic

Table 5: Intensity of gastrointestinal parasitic infections (epg and opg) in cattle of flood prone eastern plains of Rajasthan

Parameter			Strongyle	*Strongyloides* sp.	*Trichuris* sp.	*Moniezia* sp.	*Eimeria* sp.
Animal type	Native	Range	200-1200	200-800	200-800	200-600	400-2200
		Mean±SE	600±139.04	475±137.69	525±125	400±91.29	1085.71±253.01
	Crossbred	Range	200-600	200-500	200-400	200-300	300-1900
		Mean±SE	400±70.71	366.67±88.19	300±57.74	250±50	1128.57±250.44
Overall		Range	200-1200	200-800	200-800	200-600	300-2200
		Mean±SE	509.09±84.70	428.57±83.71	428.57±83.71	350.00±67.08	1107.14±171.12

location (Yu et al., 2011). The estimation of EPG counted for strongyle ranging from 200–1200 with an average of 509.09±84.70 in cattle of flood prone eastern plains of Rajasthan which is in close agreement with the finding of Wadhwa et al. (2011) and unlike to the finding of Jithendran and Bhat (1999) and Squire et al. (2013). The estimation of EPG for *Strongyloides* sp. ranging from 200–800 with an average of 428.57±83.71 which is unlike to other investigators (Jithendran and Bhat (1999) and Chandravati and Kumar (2015). Severity of infection in regards to the *Moniezia* sp. ranged from 200–600 with an average of 350.00±67.08 unlike the findings of Squire et al. (2013).

3.5. Coproculture studies

In the coproculture study, *Haemonchus* sp. had the highest prevalence (40.67%), in decreasing order of prevalence, *Oesophagostomum* sp. (16.33%), *Bunostomum* sp. (12.33%), *Trichostrongylus* sp. (10.33%), *Cooperia* sp. (7.33%), *Chabertia* sp. (5.67%), *Ostertagia* sp. (4.67%), and *Strongyloides* sp. (2.67%) (Table 6). Throughout the course of the investigation, *Haemonchus* sp. larvae were observed, with sporadic encounters with other species. It was discovered through seasonal dynamics that *Oesophagostomum* sp. was prominent throughout the summer, whereas *Haemonchus* sp. predominated during the rainy season. The findings of Monika et al. (2017), Renwal et al. (2017), Choudhary et al. (2018a), Panwar et al. (2018), and Sodha et al. (2021) in the bovine population from the Rajasthan state are in close agreement with the finding that *Haemonchus* sp. is the most prevalent parasite of cattle among the various gastrointestinal nematodes recovered in the current study.

3.6. Sporulation studies

Ten morphotypes of *Eimeria* sp. were identified by microscopic examination and identification of sporulated oocysts. *Eimeria bovis* (32.00%) was found to be the

Table 6: Mean measurements (µm) of 3rd stage strongyle larvae in cattle of flood prone eastern plains of Rajasthan (Mean±SE)

Nematodes	Total length (Range)	Extension of tail sheath beyond tail (Range)	Intestinal cell no. and shape	Salient features
Haemonchus sp.	816.72±12.15 777.36-865.92	87.15±5 68.88-108.24	16 Triangular	Narrow Bullet shaped head, the pointed tail of larva and tail sheath is usually 'kinked'.
Oesophagostomum sp.	818.13±20.76 747.84-875.76	151.82±4.59 127.92-167.28	18-22 Triangular	Long tail ending in a long fine filament.
Bunostomum sp.	546.17±7.49 521.52-570.72	60.68±3.02 49.20-68.88	16 Triangular	Short straight larvae with wide body sudden tapering to long thin tail.
Trichostrongylus sp.	688.8±11.22 659.28-718.32	28.54±1.84 24.60-34.44	16 Triangular	The tail sheath is conical and blunt at the tip.
Cooperia sp.	818.69±16.29 777.36-865.92	66.91±3.68 59.04-78.72	16 Triangular	Two conspicuous oval bodies at the anterior end of the oesophagus with tail ending bluntly.
Chabertia sp.	751.12±8.68 738.0-767.52	147.6±5.68 137.76-157.44	28-32 Rectangular	Squared head, tail is bluntly pointed and extremely slender posteriorly
Ostertagia sp.	852.52±8.47 836.40-865.08	62.32±3.28 59.04-68.88	16 Triangular	Tail is bluntly pointed and extremely slender posteriorly
Strongyloides sp.	644.52±63.96 580.56-708.48	-	-	No sheath and slender body with long oesophagus 1/3 to ½ of total length of larvae.

primary contributor to the coccidia population, followed in decreasing order of prevalence by *E. zuernii* (15.00%), *E. subspherica* (14.00%), *E. auburnensis* (10.00%), *E. ellipsoidalis* (7.00%), *E. cylindrica* (6.00%), *E. pellita* (5.00%), *E. alabamensis* (4.00%), *E. bukidnonensis* (4.00%), and *E. canadensis* (3.00%) (Table 7). Similar findings were reported by Choudhary et al. (2018b), Panwar et al. (2019), Monika et al. (2020), from the Rajasthan state; Das et al. (2015) and Gupta et al. (2016) from India.

Table 7: Mean measurements (µm) of sporulated coccidian oocysts in cattle of flood prone eastern plains of Rajasthan (Mean±S.E.)

Coccidia	Length (Mean±S.E.)	Width (Mean±S.E.)	Shape	Salient features
Eimeria bovis	28.04±1.16 24.6-31.49	19.85±0.78 17.71-22.63	Ovoid to subspherical	Smooth wall with inconspicuous micropyle
E. zuernii	18.45±1.09 15.74-20.66	15.99±0.62 14.76-17.71	Subspherical to round	Colourless smooth wall with no micropyle or oocysts residuum
E. subspherica	11.32±0.64 9.84-12.79	10.33±0.28 9.84-10.82	Subspherical	Smooth wall without micropyle
E. aubernensis	35.09±1.43 32.47-37.39	23.95±1.43 21.65-26.57	Ovoid to ellipsoidal	Smooth wall with narrow micropyle
E. ellipsoidalis	22.14±1.3 19.68-25.58	15.99±0.62 14.76-17.71	Ellipsoidal to slightly ovoid	Smooth wall without micropyle
E. cylindrica	22.14±1.17 19.68-24.60	13.53±1.09 10.82-15.74	Elongated cylindrical	Smooth wall without micropyle
E. pellita	39.36±1.14 37.39-41.33	27.22±0.87 25.58-28.54	Egg shaped	Very thick wall with a micropyle
E. alabamensis	18.21±0.49 17.71-18.70	13.29±0.5 12.79-13.78	Ovoid	Smooth wall without micropyle
E. bukidnonensis	46.25±0.98 45.26-47.23	33.95±0.49 33.45-34.44	Pear shaped to oval	Two layered & dark yellowish to brown oocyst wall with a micropyle
E. Canadensis	32.97±1.48 31.49-34.44	23.62±0.99 22.63-24.60	Ovoid or ellipsoidal	Colourless or pale yellow, with an inconspicuous micropyle

4. CONCLUSION

The present study showed that this region of Rajasthan is very suitable for the development and year-round dissemination of gastrointestinal parasites in cattle. Risk analysis presented native cattle at more and also presented rainy season as the most suitable time of the year for parasitic proliferation. Among districts of the zone Bharatpur was reported to be highly susceptible for gastrointestinal parasitic infections. These findings could be highly beneficial in the near future for the development of parasite control strategies.

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