

Epidemiological survey of gastrointestinal infections by gastrointestinal nematodes and coccidia in cattle in the semiarid region of Northeastern Brazil

Levantamento epidemiológico das infecções gastrintestinais por nematóides astrintestinais e coccídios em bovinos no Semiárido do Nordeste do Brasil

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Highlights

The occurrence of parasitic infection in cattle is high (96.5%; 803/832).

Haemonchus spp. was the most frequently nematode genera.

Levels of nematode infections are higher in beef cattle and animals reared in extensive system.

Young cattle (≤ 12 months) are more susceptible to coccidian infections.

Cattle with low body score (1 and 2) are more susceptible to coccidian infections.

Abstract

The aim of the present study was to carry out an epidemiological survey on gastrointestinal infections by nematodes and coccidia in cattle herds in the semiarid region of Paraíba, northeastern Brazil. A total of 832 cattle were sampled, of both sexes and different ages, on 21 farms in 21 municipalities in the state of Paraíba, Brazil. Fecal samples were collected individually to perform eggs per gram (EPG) and oocysts per gram (OoPG) counts in feces, and to perform fecal cultures. To assess factors associated with nematode and coccidia infections, epidemiological survey forms were applied to the farmers. The total frequency of infections by nematodes was 59.6% (496/832) and it was 36.9% (307/832) for coccidia. The levels of infection by nematodes and coccidia were most frequently low (EPG < 300; OoPG < 1,000), in 72.4%

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(359/496) and 75.2% (231/307), respectively. The most frequent nematode genera was *Haemonchus* spp. (78.8%). The risk factors for nematode infections in cattle were beef production trait (odds ratio = 2.99) and extensive rearing system (odds ratio = 3.8); the factors for coccidia were age \leq 12 months (odds ratio = 2.9) and body score between 1 and 2 (odds ratio = 5.2). These results prove that there are high frequencies of gastrointestinal infections by nematodes and coccidia in cattle herds in the semiarid region of Paraíba, with predominantly low levels of infection. However, given the importance of subclinical infections, adjustments to sanitary management measures can contribute to reduction of parasite indices and better performance among the animals, thus generating greater profitability for farmers.

Key words: Cattle. Frequency. Parasitic infections. Semiarid.

Resumo

O objetivo do presente estudo foi realizar uma análise epidemiológica sobre as infecções gastrintestinais por nematóides e coccídios em rebanhos bovinos na região semiárida da Paraíba, Nordeste do Brasil. Um total de 832 bovinos foram utilizados, de ambos os sexos e diferentes idades, oriundos de 21 fazendas em 21 municípios do estado da Paraíba, Brasil. Amostras fecais individuais foram coletadas para a realização de contagens de ovos por grama (OPG) e oocistos por grama (OoPG) de fezes e para realizar coproculturas. Para obter os fatores associados às infecções por nematódeos e coccídios, questionários epidemiológicos foram aplicados aos produtores. A frequência total de infecções por nematóides foi 59,6% (496/832) e 36,9% (307/832) para coccídios. O nível de infecção para nematóides e coccídios mais frequente foi o baixo (OPG < 300; OoPG < 1.000), em 72,4% (359/496) e 75,2% (231/307), respectivamente. O gênero de nematóide mais frequente foi *Haemonchus* spp. (78,8%). Os fatores de risco para infecções por nematóides em bovinos foram aptidão para corte (odds ratio = 2.99) e sistema de criação extensivo (odds ratio = 3,8); os fatores para infecções por coccídios foram idade \leq 12 meses (odds ratio = 2,9) e escore corporal entre 1 e 2 (odds ratio = 5,2). Estes resultados demonstraram que são elevadas as frequências de infecções gastrintestinais por nematóides e coccídios em rebanhos bovinos no Semiárido da Paraíba, com predominância de infecções em nível baixo. Entretanto, devido a importância das infecções subclínicas, ajustes em medidas de manejo sanitário podem contribuir para a redução dos índices de infecções por parasitos e melhorar a performance entre os animais, gerando maiores benefícios econômicos aos produtores.

Palavras-chave: Bovinos. Frequência. Infecções parasitárias. Semiárido.

Introduction

Brazil is considered to be the second largest producer of beef in the world and has a herd of over 214 million head. Its agribusiness sector is currently the fastest growing worldwide and ended the year 2020 with a record final balance of US\$ 87.7 billion (Kreter et al., 2021). This country also stands out with regard to milk production, which is one of

the six most important products of Brazilian agribusiness and is an important generator of food and income for the population (Carvalho et al., 2002).

Among the factors that affect the cattle industry in Brazil, gastrointestinal parasites stand out. Several genera of parasites inhabit the digestive tract of cattle and are responsible for causing major economic

losses in herds. These parasites compromise the animals' health through causing clinical pictures of inappetence, anemia, diarrhea, growth retardation and death in extreme cases (Grisi et al., 2014; Pinilla León et al., 2019; Almeida et al., 2020).

Among nematode helminths, the most important and prevalent genera worldwide are those belonging to the superfamily Trichostrongyloidea, especially in tropical areas with a semiarid climate (Almeida et al., 2020). These helminths cause parasitic gastroenteritis in cattle (Micheloud et al., 2015; Henriques et al., 2021; Melo et al., 2021). Among enteric coccidia, *Eimeria* genera stands out because of its cosmopolitan distribution and parasitism in cattle worldwide, causing high levels of cases of coccidiosis, which can affect up to 100% of young cattle, especially during the first weeks of life (Faber et al., 2002; Gunathilaka et al., 2018; Hamid et al., 2019; Melo et al., 2022).

Typically, the frequencies of subclinical cases of helminthiasis and coccidiosis are much higher and have the consequence of compromising intestinal physiology and feed conversion (Cornelissen et al., 1995; Gupta et al., 2016). This consistently retards animal growth for indeterminate amounts of time, compared with clinical cases. However, such clinical cases can be quickly diagnosed and treated before death occurs (Cornelissen et al., 1995; Hamid et al., 2019). The risk factors described, associated with helminth and coccidia infections in cattle, involve body score, age, breeding system (Bacha & Haftu, 2014; Hamid et al., 2019; Squire et al., 2019). Thus, the climatic peculiarity of the Semiarid Region (Penha et al., 2022) and the various ways of raising and handling animals on

farms in Northeast Brazil may contribute to associations of these and other risk factors.

Antiparasitic drugs have been widely used to control gastrointestinal parasitic infections in animals over recent decades (Gunathilaka et al., 2018). However, overuse has developed anthelmintic and anticoccidial resistance, which has been reported in several regions of the world (Baiak et al., 2019; Dubey, 2019; Mohammedsalih et al., 2021). Resistant parasite populations hinder effective control in herds. Recently, anthelmintic multidrug resistance was described in cattle herds in the semi-arid region of northeastern Brazil (Melo et al., 2021) and several species of *Eimeria* parasitizing these animals were later identified (Melo et al., 2022). In such situations, the animals develop clinical symptoms of greater severity, and high mortality rates may occur, thus raising the economic losses (Almeida et al., 2020; Melo et al., 2021). It is known that gastrointestinal nematode infections generate an annual economic impact of 7.11 billion dollars worldwide (Grisi et al., 2014). However, the high incidence of *Eimeria* spp. is associated with a higher prevalence of the subclinical form, which makes it difficult to assess the real economic impact caused by eimeriosis in cattle (Melo et al., 2022).

Studies relating to the frequency and epidemiology of gastrointestinal parasites in cattle in northeastern Brazil are scarce. Nonetheless, evaluation of the parasite profile and severity of infection is important for development of appropriate management strategies for parasite control. Therefore, our aim here was to perform an epidemiological survey of gastrointestinal infections by nematodes and coccidia in naturally infected cattle in the semiarid region of the state of Paraíba, Brazil.

Materials and Methods

Study location

This study was carried out in the semiarid region of the state of Paraíba, northeastern Brazil. This state has a total area of 58,584.6 km², of which 86.2% (48,788.9 km²) are located in areas of semiarid climate. These areas are characterized by irregular rainfall that is concentrated in the months of January to May, with average annual rainfall

totals of between 250 and 800 mm, maximum temperature of 32 °C and minimum of 20 °C, high evaporation rates, average relative humidity of 70% and predominant vegetation of the Caatinga biome (Instituto Brasileiro de Geografia e Estatística [IBGE], 2019). This study was conducted in the period from January to December 2020, in 21 different municipalities belonging to the intermediate regions of Campina Grande, Patos and Sousa- Cajazeiras. One farm per municipality was sampled (Figure 1).

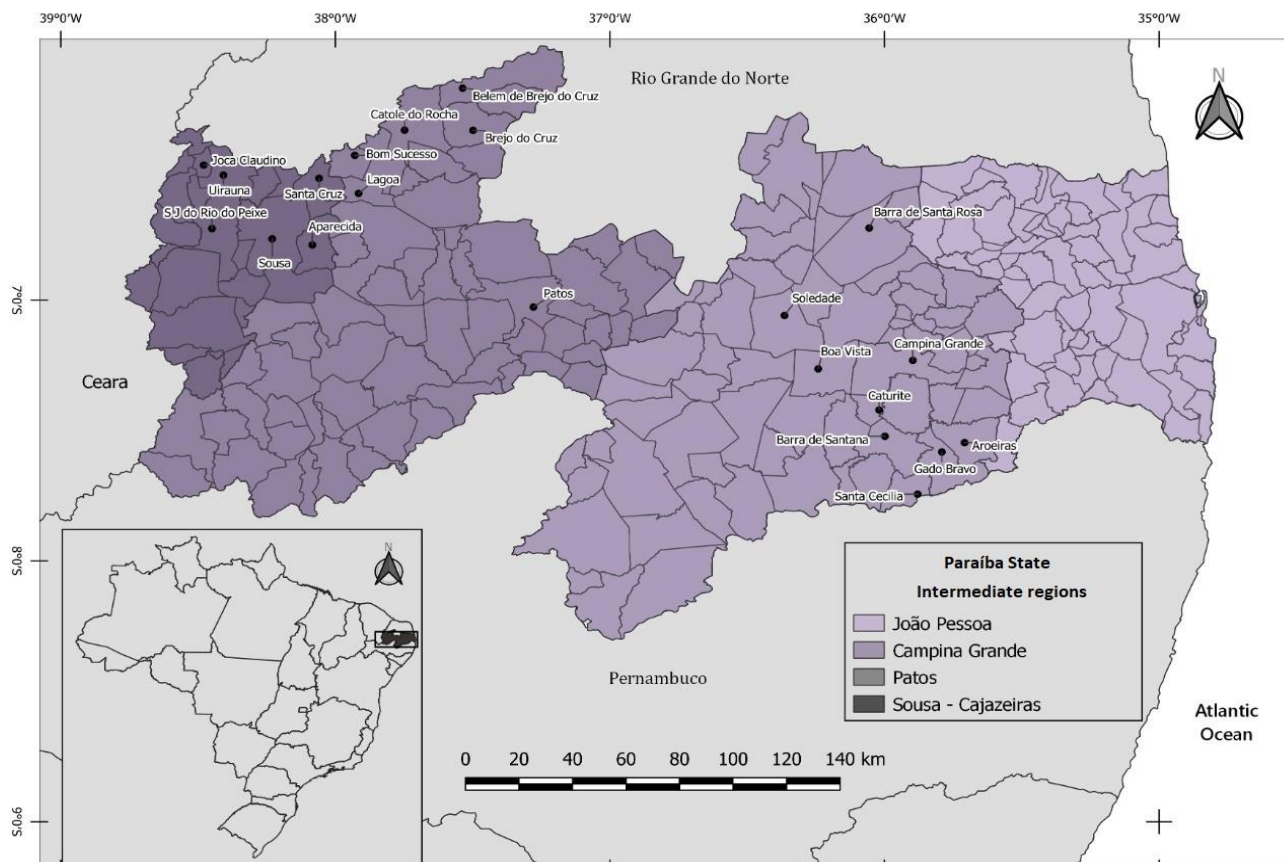


Figure 1. Geographical distribution of the 21 municipalities visited for the epidemiological survey of gastrointestinal infections by nematodes and coccidia in cattle in the semiarid region of Paraíba, northeastern Brazil.

Samples collected and analysis processing

Twenty-one cattle farms with a previous history of gastrointestinal parasitism were used. The herds on the farms visited ranged in size from 36 to 650 animals. To standardize the collections, between 36 and 40 animals were randomly sampled per farm, totaling 832 cattle of both sexes, various breeds and ages ranging from three months to nine years.

Fecal samples were individually collected directly from the rectal ampulla with the aid of procedure gloves lubricated with glycerin. The samples were analyzed using the flotation technique, as described by Gordon & Whitlock (1939). Through this, the levels of parasitism by nematodes (in terms of egg count per gram of feces, EPG) and by coccidia (in terms of oocyst count per gram of feces, OoPG) were determined.

Samples positive for EPG on the same farm were pooled. The pools were used to perform fecal cultures as described by Roberts and O'Sullivan (1950), in order to identify the specific nematode genera according to Ueno and Gonçalves (1998). To assess the levels of infection by helminths and coccidia, the following classification was used: low (300 EPG; < 1,000 OoPG); medium (300 - 1,000 EPG; > 1,000 - 3,000 OoPG); and high (> 1,000 EPG; > 3,000 OoPG).

Epidemiological questionnaire

On the farms that we visited, a structured epidemiological questionnaire was applied to collect possible risk factors associated with gastrointestinal parasite

infections, including animal sex (male or female), age of cattle (≤ 12 months or > 12 months), animal score, farming system (extensive, intensive or semi-intensive), herd type (milk, beef or mixed), average daily milk production, calf shelter, period and amount of annual deworming, farm area and number of animals in the herd.

Statistical analysis

The data collected from the epidemiological questionnaires were used for analyses on factors associated with nematode and coccidian infections. The analyses were done in two stages: univariate and multivariate. In the univariate analysis, each independent variable was correlated with the dependent variable (positivity for infection), and those that presented $P \leq 0.20$, according to the chi-square or Fisher's exact test (Zar, 1999), were entered into multivariate analysis using multiple logistic regression (Hosmer & Lemeshow, 2000). A significance level of 5% was adopted for the multivariate analyses. All the analyses were performed using SPSS 20.0 for Windows.

Results and Discussion

The frequency of gastrointestinal parasitic infections in cattle in the semiarid region of Paraíba, Brazil, was 96.5% (803/832), among which 59.6% (496/832) of the cattle were positive for nematode infections and 36.9% (307/832) were positive for coccidia infections, respectively (Table 1). Coinfections by nematodes and coccidia were observed in 26.7% (222/832) of the animals.

Among the 21 farms analyzed, 95.2% (20/21) and 100% (21/21) had at least one animal positive for helminth infections and for coccidian infections, respectively. The frequencies of animals positive for nematodes ranged from 0% (farm 21) to 86.1% (farm 6), while for coccidia, the frequencies ranged from 5 (farm 5) to 67.5% (farms 3 and 8) (Table 1).

High occurrence rates (99%) for gastrointestinal parasites were also previously reported among dairy cows and calves in the semiarid region of Bahia, northeastern Brazil, with rates of parasitism by helminths and coccidia in cattle of 66% and 33%, respectively (Dantas et al., 2015). Results found by Hillesheim and Freitas (2016), in the state of Paraná, Brazil, reported 48.2% of coccidia prevalence among the evaluated animals, in family farms. In Colombia, a prevalence of 50.5% was observed among the cattle examined (Pinilla León et al., 2019). On the other hand, in tropical regions of Sri Lanka, Gunathilaka et al. (2018) found a prevalence rate of gastrointestinal parasites among cattle of 11.6%. Those authors pointed out that the prevalence of infections and clinical cases may vary depending on the area, environmental factors and sanitary management measures used.

On 20 farms, at least one animal was EPG positive. Thus, 20 fecal cultures were performed to identify third-stage larvae. The presence of five genera of

gastrointestinal nematodes was observed: predominantly *Haemonchus* spp. (79.1%), followed by *Trichostrongylus* spp. (12.1%), *Oesophagostomum* sp. (7.7%) and *Cooperia* spp. (1.1%), without any relevant changes in frequency orders among the genera (Table 2).

The high percentage of *Haemonchus* spp. is probably due to the earlier acquisition of anthelmintic resistance, inherent to its high biotic potential and high genetic variability, thus harboring the allele that causes a decrease in its susceptibility to a drug (Blackhall et al., 1998; Chaudhry et al., 2015). According to Borges et al. (2015), the specie considered most relevant in cattle is *H. placei*, because it causes gastric lesions due to its high capacity for hematophagy (Taylor et al., 2017). Higher prevalences for the order Strongylida were also found in predominantly dairy cattle in northeastern Colombia (17.9%) and in the state of Minas Gerais, Brazil (47.2%), by Pinilla León et al. (2019) and Henriques et al. (2021), respectively.

The levels of infection by nematodes and coccidia in cattle are presented in Table 3. For both groups of parasites, a low level of infection (> 300 EPG; > 1,000 OoPG) was observed most frequently. Gunathilaka et al. (2018), on the other hand, found parasite infection levels in cattle and buffaloes that exceeded EPG \geq 500 and OoPG \geq 5,000, which, according to Gupta et al. (2012) are considered to be very high infection levels.

Table 1
Frequencies, percentages and means \pm standard deviation (SD) of eggs per gram (EPG) and oocysts per gram (OoPG) of cattle positive for nematodes and coccidia on farms in 21 municipalities in the semi-arid region of Paraíba, northeastern Brazil

Nº	Locality	Nº. animals	Nematodes			Coccidia		
			Nº. positive	Percentage (%)	Mean EPG (\pm SD)	Nº. positive	Percentage (%)	Mean OoPG (\pm SD)
1	Uiraúna	40	20	50	250 (634)	19	47.5	278 (175)
2	Aroeiras	39	17	43.6	54 (82)	12	30.8	176 (327)
3	S J do Rio do Peixe	40	29	72.5	380 (559)	27	67.5	479 (575)
4	Caturité	40	13	32.5	59 (127)	04	10	18 (57)
5	Barra de Stª Rosa	40	27	67.5	178 (318)	02	5	1988 (5257)
6	Soledade	36	31	86.1	232 (219)	11	30.5	44 (100)
7	Lagoa	40	27	67.5	91 (122)	10	25	53 (141)
8	Patos	40	21	52.5	94 (163)	27	67.5	1528 (8421)
9	Bom Sucesso	40	23	57.5	138 (265)	08	20	80 (218)
10	Campina Grande	39	22	56.4	128 (164)	07	17.9	17 (42)
11	Santa Cruz	39	19	48.7	45 (59)	15	38.5	60 (126)
12	Boa Vista	40	33	82.5	306 (386)	20	50	138 (209)
13	Gado Bravo	40	34	85	175 (186)	26	65	230 (335)
14	Barra de Santana	40	26	65	305 (420)	14	35	173 (486)
15	Brejo do Cruz	40	20	50	244 (511)	23	57.5	292 (618)
16	Joca Claudino	40	22	55	185 (338)	13	32.5	89 (457)
17	Catolé do Rocha	40	27	67.5	250 (488)	09	22.5	28 (77)
18	B de Brejo do Cruz	40	27	67.5	170 (271)	23	57.5	194 (379)
19	Sousa	40	30	75	234 (362)	05	12.5	9 (27)
20	Aparecida	39	28	71.8	596 (1079)	25	64.1	432 (1412)
21	Santa Cecília	40	0	0	0 (0)	07	17.5	23 (76)
	TOTAL	832	496	59.6	195 (134)	307	36.9	301 (507)

Table 2
Percentage (%) of gastrointestinal nematode genera in cattle per farm in the semiarid region of Paraíba, Brazil

Genera	Farm																				Media
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
H	87	86.2	84	81.3	74.8	83.5	74.5	72	69.8	72.8	84.5	81.1	66.5	82.3	75.1	80.8	85	84.3	87.5	68.8	79.1
T	8.2	9	8	10.8	12.6	1	15	13.2	18.8	22.8	7.4	10.5	21.5	10	11.3	9.2	3.8	11.3	11.7	26	12.1
O	4.8	4	6	4.5	10.3	9	8.2	11.8	11.5	3.7	6.8	8.4	12	7.7	13.6	10	11.2	4.4	0.8	5.2	7.7
C	0	0.8	2	3.4	2.3	6.5	2.3	3	0	0.8	1.3	0	0	0	0	0	0	0	0	0	1.1

H: Haemonchus spp.; T: Trichostrongylus spp.; O: Oesophagostomum sp.; C: Cooperia spp.

Table 3
Level of infection in cattle by nematodes and coccidia in the semiarid region of the state of Paraíba, Brazil

Infection level (EPG*)	Nematodes		Infection level (OoPG*)		Coccidia	
	Positive	Percentage (%)	Positive	Percentage (%)	Positive	Percentage (%)
Low (< 300)	359	72.4	292	95.1	292	95.1
Medium (300 - 1,000)	107	21.6	11	3.6	11	3.6
High (> 1,000)	30	6	4	1.3	4	1.3
Total	496	100%	307	100%	307	100%

* EPG (eggs per gram of feces), OoPG (oocysts per gram of feces).

Despite the low level of infection found in most animals in the present study, it should be pointed out that some parasite species, such as *Haemonchus placei* and *Eimeria bovis* cause more severe damage regardless of the level of infection (Dauguschies & Nadjrowski, 2005; Taylor et al., 2017). The numbers of nematode eggs and oocysts eliminated by animals also varies depending on the species of the parasite, the susceptibility level of the host, the health status of the animal and the immune status of the animal (Urquhart et al., 1996; Sharma & Busang, 2014). The severity of gastrointestinal parasitic infections, on the other hand, may be related to the susceptibility of animals to internal parasites and also to the non-responsive immunity of the host, Gunathilaka et al. (2018).

A high frequency of enteric coccidia was observed in cattle in the present study (36.9%). Florião et al. (2016), in an organic dairy farm in Rio de Janeiro, Brazil, also found a high rate of coccidia, identified as *Eimeria* spp. (100%). However, a lower rate of occurrence of *Eimeria* spp. (17.12%) infecting cattle was observed by Melo et al. (2022), in the semi-arid region of Northeastern Brazil. As well as Pinilla León et al. (2019) found a lower prevalence (17.4%) in northeastern Colombia. Li et al. (2021), in a systematic review study with meta-analysis found that the prevalence of *Eimeria* spp. in cattle in China ranged from 4.6% to 87.5% and recommended prevention strategies for the detection of coccidia in calves in intensive livestock models in that country.

The information obtained from the epidemiological questionnaires was evaluated regarding the characteristics of the farms and the management performed on the cattle. It was observed that semi-intensive management was the system most

used (76.2%; 16/21), followed by extensive (14.3%; 3/21) and intensive (9.5%; 2/21). Dairy farming was the most frequent type of farming on the farms studied (47.6%; 10/21), followed by mixed farming (dairy and beef) (38.1%; 8/21) and beef farming (14.3%; 3/21). The number of cattle per farm ranged from 45 to 650 animals and the average daily milk production ranged from zero in herds that were considered to be beef herds to 1,750 (one thousand seven hundred and fifty) liters in herds that were aimed at dairy production.

Anthelmintics were administered to the entire herd at least once a year, mainly during the rainy season (January to May), on 76.2% (16/21) of the farms. On the other 23.8% (5/21), this was done only when verminosis was suspected (weight loss, diarrhea, frizzy hair, submandibular edema, decreased of productive performance), and it was administered individually. A clinical scenery of diarrhea among the cattle, isolated and in outbreaks, was known among the farmers and suggestive of coccidiosis due to the clinical course of the infection. It was commonly seen especially among calves on dairy farms and such occurrences were claimed to possibly cause the death of sick animals. Acquisition of animals was a common practice reported by the owners, but no quarantine of newly acquired cattle was implemented.

Table 4 shows the categories that presented statistically significant differences ($p \leq 0.20$) regarding nematode and/or coccidian infections in the univariate analysis. Subsequently, in the multivariate analysis, the relevant risk factors for nematode infection were beef cattle and extensive rearing system; and for coccidia, the risk factors were age ≤ 12 months and body score between 1 and 2 (Table 5).

Table 4
Univariate analysis on risk factors associated with positivity for nematodes and coccidia in cattle in the semi-arid region of the state of Paraíba, Brazil

Variable/category	Number of cattle	Nematodes		Coccidia	
		Number of positive cattle (%)	P	Number of positive cattle (%)	P
Gender					
Female	554	302 (54.5)	<0.001*	186 (33.6)	0.005*
Male	278	194 (69.8)		121 (43.5)	
Age					
≤ 12 month	313	205 (65.5)	0.007*	161 (51.4)	<0.001*
> 12 month	519	291 (56.1)		146 (28.1)	
Score					
1-2	479	278 (58)	0.279	225 (47)	<0.001*
>2	353	218 (61.7)		82 (23.2)	
Herd type					
Dairy	399	214 (53.6)	<0.001*	150 (37.6)	<0.001*
Mixed	313	198 (63.2)		140 (44.7)	
Meat	120	84 (70)		17 (14.1)	
Dairy Production					
None	40	27 (67.5)	0.007*	2 (5)	<0.001*
Up to 50 liters	156	108 (69.2)		45 (28.8)	
51 to 100 liters	158	101 (63.9)		72 (45.5)	
101 to 200 liters	79	45 (56.9)		29 (36.7)	
> 200 liters	399	215 (53.8)		159 (39.8)	
Rearing system					
Semi-intensive	632	384 (60.7)	<0.001*	274 (43.3)	<0.001*
Extensive	120	84 (70)		17 (14.1)	
Intensive	80	27 (33.7)		16 (20)	
Calf housing					
Yes	633	373 (58.9)	0.469	256 (40.4)	<0.001*
No	199	123 (61.8)		51 (25.6)	

* Variables that showed p value ≤ 0.20 according to chi-square test.

Table 5**Multivariate analysis on factors associated with nematode and coccidian infection in cattle in the semiarid region of the state of Paraíba, Brazil**

Factors associated with infection	Odds ratio	95% CI	p value
Nematodes			
Beef cattle	2.99	0.99 -8.98	0.050
Extensive farming system	3.8	1.6-9.1	0.003
Coccidia			
Age ≤ 12 months	2.9	1.77-3.85	0.002
Body score between 1 and 2	5.2	1.6-16.9	0.007

CI: confidence interval.

A high prevalence of *Eimeria* spp. (72.1%) in cattle was also diagnosed by Hamid et al. (2019), in nine provinces in Indonesia, mainly in calves, and the farmers were found to have been unaware of coccidiosis. Due to the high occurrence rates of nematodes and coccidia found, it is believed that the number of cases of bovine helminthiasis and coccidiosis were high. Thus, it had a high impact on the development of livestock and economic results in the region studied. The dairy, mixed and beef production types observed among the farms studied here provide a significant source of income for farmers in the Brazilian semiarid region. Gastrointestinal parasitism among cattle is a limiting factor with regard to both dairy and beef production (Diaz et al., 2015). However, analysis on the factors associated with nematode infections revealed that beef animals were more susceptible (odds ratio = 2.99), as was the extensive farming system (odds ratio = 3.8). Probably because beef cattle are more simply managed, they spend most of their time in the extensive farming system, with little or no anthelmintic treatment and/or food supplementation. According to Almeida et al. (2020), the extensive system is

the main form of cattle rearing in Brazil, and this leads to frequent infections by parasites present in the pastures.

Age < 12 months was found to be an associated factor for enteric coccidian infection (odds ratio = 2.9). According to Bilal et al. (2009) and Hamid et al. (2019), the susceptibility of calves to coccidian infections is associated with their lower immunity, compared with the immunocompetence of adult cattle. It is also likely that poor physical condition among calf pens or confinements, high stocking rates, high humidity and temperature contribute to contamination of these environments and oocysts survival. According to Gunathilaka et al. (2018), high humidity and moderate temperature facilitate survival and sporulation of oocysts. One important finding may be that at the time when the calves' rumen begins to become functional and the calves start to ingest feed at the trough, they might lose out in competing for space with larger calves. Thus, they might tend to only ingest food scraps that fall to the floor, thereby increasing fecal-oral contamination by oocysts (Kimeli et al., 2020).

Another factor associated with enteric coccidian infections was cattle body scores between 1 and 2 (odds ratio = 5.2). This situation indicates decreased feed conversion as a consequence of damage to the intestine, which leads to decreased growth rates and weight gains (Jolley & Bardsley, 2006). Similar results were found by Bacha and Haftu (2014) in Ethiopia, in which the body condition of cattle had a strong relationship with the presence of gastrointestinal nematodes and coccidia. Likewise, Regasa et al. (2018) found that infection by different species of *Eimeria* spp. in cattle, especially calves, was also associated with poor body condition among the animals. Furthermore, according to Kumar et al. (2013), the type of diet and the availability of vitamins, minerals and other nutrients are directly related to the susceptibility of the animal to parasites.

Limited knowledge among farmers regarding management practices and animal health contribute to higher levels of nematode and coccidian infections in cattle (Melo et al., 2021). Controlling these infections through good management practices can increase the profit margin of livestock activity in the semiarid region of Paraíba, Brazil.

Conclusion

It was concluded that the frequency of presence of gastrointestinal nematodes and coccidia in cattle herds in the semiarid region of Paraíba, Brazil, is high, especially at low levels of infection. *Haemonchus* spp. was the most frequently found nematode genera. Beef cattle and the extensive breeding system were the factors associated with nematode infections; and age \leq 12 months and body score between 1 and 2 were the

factors associated with coccidian infections. Adoption of health management appropriate to the reality of each herd and availability of periodic technical assistance from a trained veterinarian can contribute to reduction of parasite rates and, consequently, improve animal performance, thereby generating greater profitability for cattle farmers.

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