Prevalence of gastrointestinal helminths in sheep raised in intermediary geographical region of Paraiba state, Brazil

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ABSTRACT

The objective of this study was to evaluate the prevalence of gastrointestinal nematodes (GIN) of sheep herds from twenty-three sheep farms spread in the Alto Sertão region of Paraíba state, Brazil. Sample size was obtained through a simple random sampling, which was determined from the total amount of sheep head of the microregion. It was collected 262 faecal samples directly from the rectum of the animals, conditioned in polyethylene bags previously identified and kept refrigerated until processing. Faecal egg counting was performed and cultures in pool of each farm were done separately. It was observed a prevalence of GN of 84.7% (222/262) to the evaluated sheep. Furthermore, it was noted the presence of unless one positive animal for helminths in 100.0% of sheep farms. Among the 222 positive animals, 49.6% presented EPG<1000, 28.8% EPG among 1000-2000 and 21.6% presented EPG>2000. Recovered third stage larvae showed that the most prevalent nematode was *Haemonchus* sp. (79.6%), followed by *Trichostrongylus* sp. (13.8%), *Oesophagostomum* sp. (3.6%), *Strongyloides* sp. (2.4%) e *Bunostomum* sp. (0.6%). High prevalence of GIN in sheep from the Alto Sertão region can explain low productivity of the herd and economic losses.

Keywords: sheep farming, nematodes, Semiarid region.

Prevalência de helmintos gastrintestinais em ovinos criados em região geográfica intermediária da Paraíba, Brasil

RESUMO

O objetivo deste estudo foi avaliar a prevalência de nematódeos gastrintestinais (NGI) de rebanhos ovinos de 23 unidades de produção distribuídas no Alto Sertão da Paraíba, Brasil. O tamanho da amostra foi determinado por meio de amostragem aleatória simples, calculada a partir da quantidade total de cabeça de ovinos da microrregião. Foram coletadas 262 amostras fecais diretamente do reto dos animais, acondicionadas em sacos de polietileno previamente identificados e mantidas refrigeradas até o processamento. A contagem de ovos nas fezes foi realizada e coproculturas em pool de cada fazenda foram feitas individualmente. Observou-se uma prevalência de GN de 84,7% (222/262) para os ovinos avaliados. Além disso, notou-se a presença de ao menos um animal positivo para helmintos em 100,0% das fazendas de ovinos. Entre os 222 animais positivos, 49,6% apresentaram OPG<1000, 28,8% OPG entre 1000-2000, e 21,6% apresentaram OPG>2000. Larvas de terceiro estágio recuperadas mostraram que o nematódeo mais prevalente foi *Haemonchus* sp. (79,6%), seguido por *Trichostrongylus* sp.

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(13,8%), *Oesophagostomum* sp. (3,6%), *Strongyloides* sp. (2,4%) e *Bunostomum* sp. (0,6%). A alta prevalência de NGI em ovinos do Alto Sertão da Paraíba pode explicar a baixa produtividade do rebanho e as perdas econômicas.

Palavras-chave: ovinocultura, nematódeos, Semiárido.

Prevalencia de helmintos gastrointestinales en ovinos criados en una región geográfica intermedia del estado de Paraíba, Brasil

RESUMEN

El objetivo de este estudio fue evaluar la prevalencia de nematodos gastrointestinales (NGI) de rebaños de ovinos de veintitrés granjas de ovinos diseminadas en la región de Alto Sertão en el estado de Paraíba, Brasil. El tamaño de la muestra se obtuvo a través de un muestreo aleatorio simple, que se determinó a partir de la cantidad total de cabezas de ovinos de la microrregión. Se recogieron 262 muestras fecales directamente del recto de los animales, se acondicionaron en bolsas de polietileno previamente identificadas y se mantuvieron refrigeradas hasta su procesamiento. Se realizó el recuento de huevos fecales y los cultivos en grupo de cada granja se realizaron por separado. Se observó una prevalencia de NGI de 84.7% (222/262) en los ovinos evaluadas. Además, se observó la presencia de un animal positivo para helmintos en el 100% de las granjas ovinas. Entre los 222 animales positivos, el 49,6% presentó OPG<1000), 28,8% OPG 1000-2000, y 21,6% OPG>2000. Las larvas recuperadas de la tercera etapa mostraron que el nematodo más prevalente fue *Haemonchus* sp. (79.6%), seguido por *Trichostrongylus* sp. (13,8%), Oesophagostomum sp. (3.6%), *Strongyloides* sp. (2.4%) e *Bunostomum* sp. (0,6%). La alta prevalencia de NGI en ovinos de la región de Alto Sertão puede explicar la baja productividad del rebaño y las pérdidas económicas.

Palabras clave: criación de ovinos, nematodos, Semiárido.

INTRODUCTION

Sheep raising is an important socioeconomic activity distributed throughout the Brazilian territory. In the world scenario, Brazil occupies the 18th place in number of sheep, with a herd of 18,433,810 head, where 63.0% of this contingent is in the Brazilian Northeast (1). In the semiarid region, beyond its importance as a traditional subsistence activity, sheep production contributes for the emergence of job and income opportunities (2).

According to the IBGE (1) in the state of Paraíba, Brazil, there are approximately 523 thousand sheep head, and more than half of these are found in the semiarid region.

Although it is considered a promising activity, semiarid sheep farming still faces several barriers due mainly to the inefficient nutritional and sanitary management adopted by farmers (3,4).

Health problems among gastrointestinal nematode (GIN) infections have been considered the main obstacles for sheep farmers worldwide, since they cause a large part of the losses observed in this species (5), especially in tropical regions, where economic losses are more pronounced (6). Cases of intense parasitism are relatively common, and such cases are an important cause of high mortality, especially in young animals (7).

According to Amarante (8), in Brazil the main endoparasites of small ruminants are *Haemonchus contortus*, *Trichostrongylus colubriformis* and *Oesophagostomum columbianum*. Additionally, *Haemonchus contortus* is the main gastrointestinal nematode parasite of small ruminants raised in tropical and subtropical areas around the world.

The economic losses of this type of infection are high, due to productivity reduction, reflected in lower feed conversion and consequently reduction in weight gain, decrease in milk production, lower reproductive performance, lower carcass quality, increased mortality, and higher expenses with veterinary services and products, such as anthelmintics (7,9).

Thus, the purpose of the trial was to evaluate the occurrence and prevalence of gastrointestinal helminths of sheep herd from the intermediary geographical region of Sousa-Cajazeiras, Alto Sertão region of Paraíba state, Northeast Brazil.

MATERIAL AND METHODS

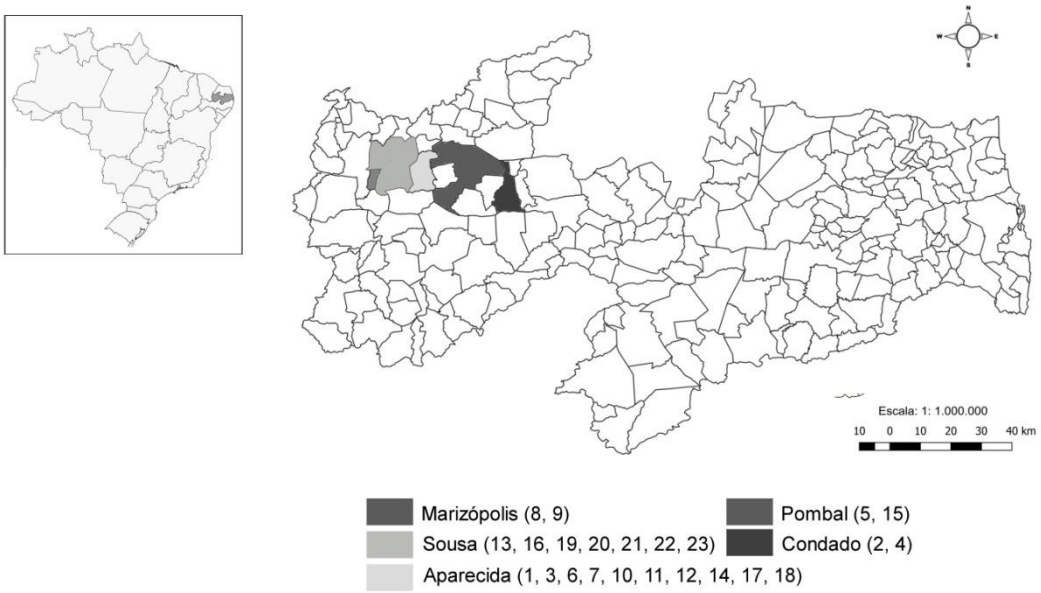
The experiment was conducted in Sousa microregion (area of 4 803 km²; altitude, 285 m), which is composed by 17 municipalities. This microregion is inserted in an area called intermediary geographical region of Sousa-Cajazeiras, in the Alto Sertão region of Paraíba state, Brazil (10).

According to the Köppen classification system, the predominant climate of the region is type BSH (hot semiarid), with a minimum temperature of 21.2 °C and a maximum temperature of 33.1°C, and relative humidity of 63.7% (11). The region is under Caatinga biome, which is characterized by irregular rainy summers and falls. The average accumulated annually precipitation is between 300 and 800 mm, with rainfall usually concentrated in the months of January to May.

The study was developed during the transition time from dry to rainy season (from November 2015 to February 2016, and from November 2016 to January 2017).

Among the 17 municipalities of the microregion, it was chosen five (Figure 1): two with the highest number of head, two with medium number, and one municipality presenting a small herd (Sousa, Pombal, Condado, Aparecida and Marizópolis, respectively).

Figure 1. Municipalities and respective numbers of the 23 sheep farms distributed in the Alto Sertão region of Paraíba state, Brazil.



According to the IBGE (12), Sousa microregion has approximately 45945 sheep head, therefore to define the minimal sample size to be part of this trial, the simple random sampling was calculated according to Thrusfield (13).

$$n = \frac{z^2 P_{esp} (1 - P_{esp})}{d^2}$$

n = minimal sample size;
z = critical value of the normal distribution value for confidence level of 95.0%;
Pesp = expected prevalence of 79.0% (adapted from Santos et al. (14) and Vieira et al. (15);
d^2= statistical error (5%).

Following the parameters above, the minimal sample size found for the study was 262 animals.

Animals used in this trial were crossbred and of both sex (males and females). Furthermore, they were divided into three age categories: less than 12 months old, aging between 12 and 24 months old, and more than 24 months old.

Faecal samples from each animal were collected directly of the rectum and kept refrigerated until processing in a maximum period of 3 hours. Samples were individually processed using the modified McMaster technique with a sensitivity of 100 EPG (16). On the same collection days, faecal cultures in *pool* were prepared for each sheep farm individually to obtain and differentiate third stage larvae into parasitic genus (16).

Helminth infection level was evaluated from the EPG values, using the following classification: EPG<1000, EPG among 1000-2000, and EPG>2000.

Once data were collected, analyses were performed through a descriptive analysis. The data of prevalence was analyzed by frequency analysis using chi-square test at 5% level of significance, through the Statistical Analysis System, version 9.4 (SAS Institute, Inc., Cary, NC, USA).

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RESULTS

The prevalence of sheep gastrointestinal helminthiasis in Sousa microregion, Paraiba state, Brazil, was 84.7% (222 animals). At least one animal tested positive for helminthiasis in 100.0% of the farms evaluated (Table 1).

Table 1. Average (minimum-maximum values) of strongyles and *Strongyloides* spp. eggs per gram of faeces (EPG) of the sheep from 23 farms spread in the Alto Sertão region of Paraíba state, Brazil.

Farm	Number of animals examined	Number of positive animals	Mean EPG [range]	
			Strongyles	*Strongyloides* spp.
1	11	9	218 [0-700]	0
2	11	6	1082 [0-5300]	0
3	11	9	2118 [0-9700]	0
4	11	7	236 [0-800]	0
5	11	9	1455 [0-4100]	0
6	10	10	1660 [0-6600]	0
7	6	4	483 [0-1400]	0
8	13	10	1400 [0-6000]	15 [0-200]
9	13	12	1331 [0-4400]	15 [0-100]
10	8	5	288 [0-1100]	13 [0-100]

11	4	2	50 [0-100]	50 [0-100]
12	10	7	1280 [0-0-4500]	0
13	10	8	1460 [0-10000]	0
14	8	7	2750 [0-17800]	13 [0-100]
15	12	11	1208 [0-2500]	0
16	12	9	942 [0-3100]	0
17	10	9	850 [0-2800]	0
18	9	8	2667 [0-6500]	0
19	9	9	456 [0-100]	11 [0-100]
20	8	6	738 [0-1500]	100 [0-700]
21	10	10	1750 [100-11200]	10 [0-100]
22	30	30	1567 [500-6100]	3 [0-100]
23	25	25	708 [500-1300]	0

Among the 262 sheep evaluated, 15.3% (40) presented negative EPG. Within the 222 positive animals in the EPG analyses, 49.6% (110) of them presented EPG<1000, 28.8% (64) EPG among 1000-2000, and 21.6% (48) EPG>2000.

There was a significant association between the age of the animals and their positive results for helminthiasis (Table 2), indicating that the age interfere in the infection status of the animal. The highest rate of infection occurred for animals aging less than 12 months old, with 97.47% of the animals being positive for GIN infections.

Table 2. Prevalence of gastrointestinal nematodes in sheep from farms spread in the Alto Sertão region of Paraíba state, Brazil.

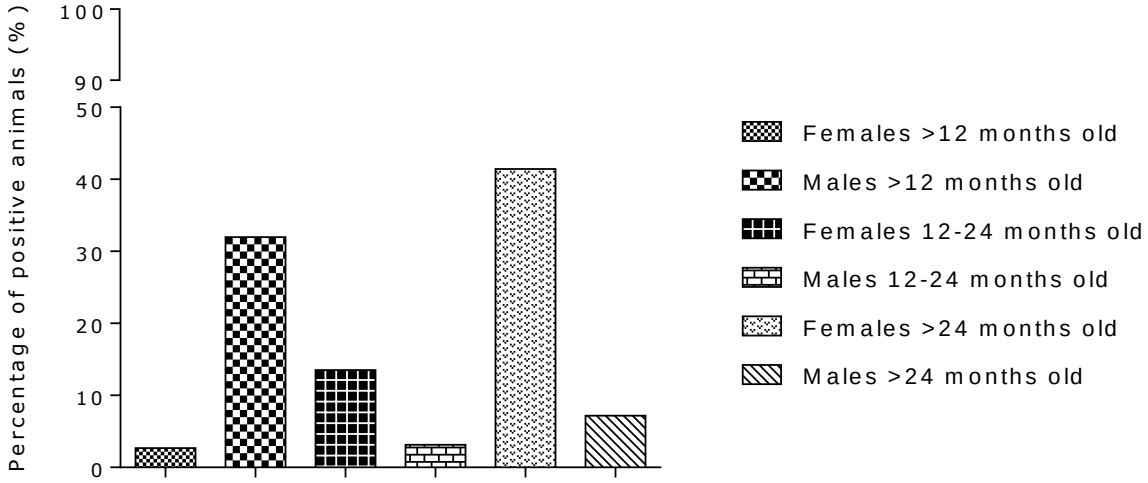
Variables	Category	Total number of animals	Number of positive animals (%)	P-value*
Sex	Male	105	94 (81.53)	0.0779
	Female	157	128 (89.52)	
Age (months)	<12	79	77 (97.47)	0.0003
	12-24	43	37 (86.05)	
	>24	140	108 (77.14)	

* Chi-square test.

Sex and age were associated to infection status (p<0.0001). Independently of sex (male or female), animals <12 months old (p=0.0381) and >24 months old (p=0.0357) showed a greater predisposition to NGI.

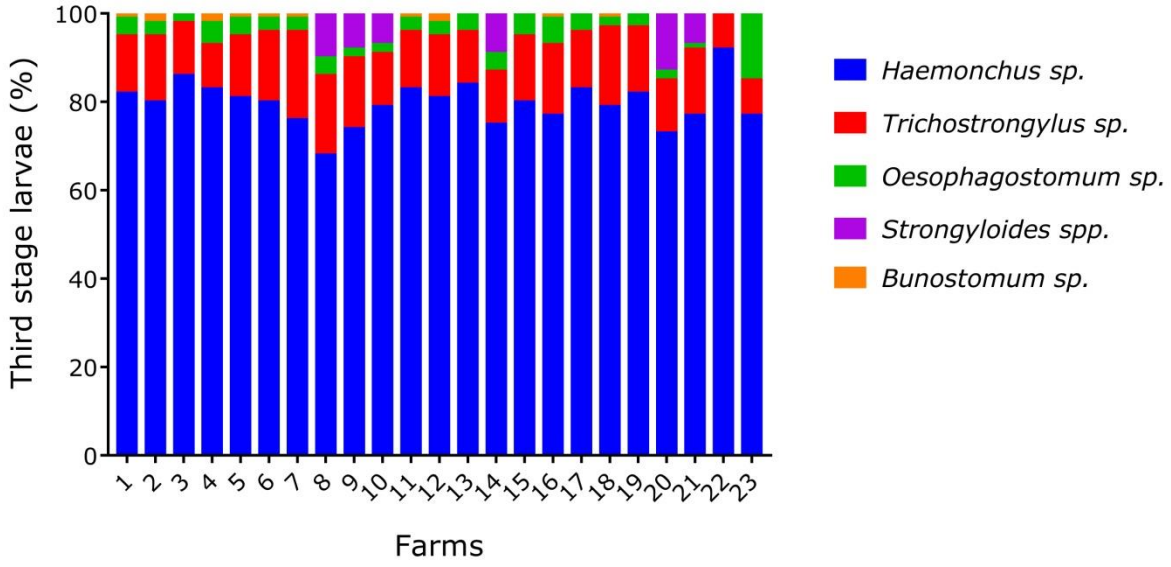
Amongst the 108 positive animals above 24 months old, 98 were females (Figure 2) and among them, 28.26% (26 animals) were in periparturient period.

Figure 2. Relative number of positive animals for gastrointestinal nematode infection presented by sex and age, for the 23 sheep farms spread in the Alto Sertão region of Paraíba state, Brazil.



In faecal cultures of the 23 sheep farms (Figure 3), *Haemonchus* sp. was the most prevalent helminth (79.65%), followed by *Trichostrongylus* sp. (13.8%), *Oesophagostomum* sp. (3.6%), *Stongyloides* sp. (2.4%) and *Bunostomum* sp. (0.6%).

Figure 3. Third stage larvae (%) in faecal cultures of sheep from farms spread in the Alto Sertão region of Paraíba state, Brazil.



DISCUSSION

Regarding to the prevalence of sheep GIN, it was observed a similar value (84.7%) to the one expected for the region (79.0%). Vieira et al. (15) found that the prevalence to GIN in the Sertão mesoregion of Paraíba state was 75.9%, while Ahid et al. (17) in study conducted in the west region of Rio Grande do Norte state, Brazil, found a prevalence of 75.2%. The prevalence of GIN found in sheep herds of the Alto Sertão region can be attributed to the adoption of semi-extensive breeding management systems (11). The high sheep rate in an area of cultivated pasture associated to shading areas, that avoid desiccation of eggs and infectious larvae, can contribute to the increase of GIN infections in small ruminants.

In this study, animals <12 months old proportionally presented the highest number of positive for GIN (97.47%), followed by animals between 12 and 24 months of age, and older than 24 months old. GIN infections can affect any animal of the herd, however young animals and ewes in periparturient period are more affected than other sheep categories (7).

The most prevalent helminth genus was *Haemonchus* sp. (79.6%), followed by *Trichostrongylus* sp. (13.8%), *Oesophagostomum* sp. (3.6%), *Strogyloides* sp. (2.4%) and *Bunostomum* sp. (0.6%). The results found in this trial are in agreement with those found by Vieira et al. (15) and Vilela et al. (18) in the Sertão mesoregion, presenting 79.9% and 81.0% for *Haemonchus* sp., respectively. Lins et al. (2) in study developed in two sheep farms from Sousa microregion, the most prevalent genus recovered from faecal cultures was also *Haemonchus* sp. (76.1%), corroborating with the results found in this study.

The blood-feeding nematode *Haemonchus contortus* is one of the most pathogenic parasites in sheep (7) and this specie is considered an important bottleneck to sustainability of sheep industries almost all over the world (19).

Furthermore, the percentage for the other genus found on this study did not corroborated with those found by Vieira et al. (15): *Strongyloides* sp. (9.6%), *Trichostrongylus* sp. (8.6%), *Oesophagostomum* sp. (1.9%), and *Cooperia* sp. (0.1%). Lins et al. (20) found that the second most prevalent genus was *Trichostrongylus* sp. (13.4%), followed by *Oesophagostomum* sp. (3.0%), corroborating with our results.

Vieira et al. (15) and Lins et al. (2,20) did not recover any third stage larvae *Bunostomum* sp. in the faecal cultures, however in goat herd from Paraiba state, it was found the genus *Bunostomum* sp. (0.2%) in 63.33% of the samples analyzed (21), being in agreement with the results found in this trial. According to Costa et al. (22) the main parasites of the small intestine of sheep and goats from semiarid region are *Trichostrongylus colubriformis*, *Strongyloides papillosus*, *Cooperia punctata*, *Cooperia pectinata* and *Bunostomum trigonocephalum.*

CONCLUSION

Sheep herd from Alto Sertão region presents high prevalence of GN, being *Haemonchus contortus*, the most prevalent parasite. These results can explain low productivity of the herd and consequently the economic losses in the region.

ACKNOWLEDGEMENTS

The authors are grateful for the technical assistance provided by the Instituto Federal de Educação, Ciência e Tecnologia da Paraíba (IFPB). J. G. G. Lins received scholarships from the National Council for Scientific and Technological Development (CNPq) grant #180852/2015-9 and grant #113589/2016-6.

REFERENCES

1. Instituto Brasileiro de Geografia e Estatística - IBGE. Produção da Pecuária Municipal 2016 [Internet]. Rio de Janeiro: IBGE; 2016 [cited 2019 Mar 16]. p.1-53. v.44. Available from: https://biblioteca.ibge.gov.br/visualizacao/periodicos/84/ppm_2016_v44_br.pdf

2. Lins JGG, Duarte ALL, Ferreira TLA, Nascimento AC, Nascimento PP, et al. Eficácia de anti-helmínticos no controle de parasitas gastrintestinais de ovinos no Alto Sertão da Paraíba, Brasil. Principia [Internet]. 2018 [cited 2019 Mar 16];1(43):128-39. Available from: http://dx.doi.org/10.18265/1517-03062015v1n43p128-139

3. Lins JGG, Sales IC, Seal DCM, Valencio BA, Marques AVMS. Consolidação da ovinocultura em região do Semiárido paraibano [Internet]. In: Proceedings of the 1st Symposium of Research, Innovation and Post-graduation of the Federal Institute of Education, Science and Technology of Paraíba; 2015; João Pessoa, PB. João Pessoa: SIMPIF; 2015 [cited 2019 Mar 12]. p. 215. Available from: http://www.ifpb.edu.br/prpipg/editora-ifpb/documentos/anais-encontro-internacional-de-educacao-profissional-2015.pdf

4. Lins JGG, Marques AVMS, Rodrigues SD, Souza JR, Pordeus GO, Bonifacio BF. Sheep farmer profile in the west of the Alto Sertão of Paraíba state. Tecnol Cienc Agropecu. 2018;12(1):65-9. Available from: http://revistatca.pb.gov.br/edicoes/volume-12-2018/volume-12-n-1-2018/10-011806-perfil-do-ovinocultor-no-oeste-do-alto-sertao-paraibano.pdf

5. Amarante AFT, Amarante MRV. Advances in the diagnosis of the gastrointestinal nematode infections in ruminants. Braz J Vet Res Anim Sci. 2016;53(2):127-37. doi: https://doi.org/10.11606/issn.1678-4456.v53i2p127-137.

6. Corrêa MN, Rabassa VR, Gonçalves FM. Produção animal: ovinocultura. Pelotas, RS: Editora Gráfica Universitária PREC/UPEL; 2009.

7. Amarante AFT. Os parasitas de ovinos [Internet]. São Paulo: Editora Unesp; 2014 [cited 2019 Mar 27]. Available from: http://books.scielo.org/id/nv4nc

8. Amarante AFT. Sustainable worm control practices in South America. Small Rumin Res [Internet]. 2014 [cited 2019 Mar 27];118:56-62. Available from: https://doi.org/10.1016/j.smallrumres.2013.12.016

9. Costa Júnior GS, Mendonça IL, Campelo JEG, Cavalcante RR, Dantas Filho LA, et al. Effect of strategic vermifuge, with active beginning the base of ivermectina in the incidence of gastrointestinal parasites in goat herd of University Federal of Piauí. Cienc Anim Bras [Internet]. 2005 [cited 2019 Aug 12];6(4):279-86. Available from: https://www.revistas.ufg.br/vet/article/view/373/348

10. Instituto Brasileiro de Geografia e Estatística. Produção da pecuária municipal [Internet]. Rio de Janeiro: IBGE; 2017 [cited 2019 Mar 16]. p.1-108. Available from: https://biblioteca.ibge.gov.br/visualizacao/periodicos/84/ppm_2017_v45_br_informativo.pdf

11. Brasil. Ministério da Agricultura, Pecuária e Abastecimento. Instituto Nacional de Meteorologia. Normais climatológicas: 1981-2010 [Internet]. Brasília: INMET; 2010 [cited 2019 Sep 5]. Available from: http://www.inmet.gov.br/portal/index.php?r=clima/normaisClimatologicas

12. Instituto Brasileiro de Geografia e Estatística. Produção da pecuária municipal 2015 [Internet]. Rio de Janeiro: IBGE; 2016 [cited 2019 Mar 16]. p.1-49. v.43. Available from: https://biblioteca.ibge.gov.br/visualizacao/periodicos/84/ppm_2015_v43_br.pdf

13. Thrusfield M. Veterinary epidemiology. 3rd ed. Oxford: Blackwell Science; 2007.

14. Santos WB, Ahid SMM, Suassuna ACD. Aspectos epidemiológicos da caprinocultura e ovinocultura no município de Mossoró (RN). Hora Vet [Internet]. 2006 [cited 2019 Mar 16];26(152):25-8. Available from:

http://www2.ufersa.edu.br/portal/view/uploads/setores/98/publicados/ASPECTOS%20EPIDEMIOLOGICOS.pdf

15. Vieira VD, Vilela VLR, Feitosa TF, Athayde ACR, Azevedo SS Souto DVO, et al. Sheep gastrointestinal helminthiasis in the Sertão region of Paraíba State, Northeastern Brazil: prevalence and risk factors. Braz J Vet Parasitol. 2014;23(4):488-94. doi: http://dx.doi.org/10.1590/s1984-29612014089.

16. Ueno H, Gonçalves PC. Manual para diagnóstico das helmintoses de ruminantes. 4a ed. Tokyo: Japan International Cooperation Agency; 1998.

17. Ahid SMM, Suassuna ACD, Maia MB, Costa VMM, Soares HS. Parasitos gastrintestinais em caprinos e ovinos da região oeste do Rio Grande do Norte, Brasil. Cienc Anim Bras [Internet]. 2008 [cited 2019 Mar 16];9(1):212-8. Available from: https://www.revistas.ufg.br/vet/article/view/3681

18. Vilela VLR, Feitosa TF, Lôbo KMS, Bezerra DAC, Athayde ACR. Anthelmintic potential of *Solanum paniculatum* Linnaeus (1762) root for sheep from semi-arid of Paraíba state, Brazil. Acta Vet Bras. 2009;3(1):20-4.

19. Saccareau M, Sallé G, Robert-Granié C, Duchemin T, Jacquiet P, Blanchard A, et al. Meta-analysis of the parasitic phase traits of *Haemonchus contortus* infection in sheep. Parasit Vectors. 2017;10(201):1-14. doi: https://doi.org/10.1186/s13071-017-2131-7.

20. Lins JGG, Marques AVMS, Seal DCM, Segundo FAS. Avaliação do perfil e comportamento populacional de helmintos gastrintestinais m ovinos, criados nas Várzeas de Sousa no Alto Sertão Paraibano [Internet]. In: Proceedings of the 67st Annual Meeting of the Brazilian Society for the Advancement of Science; 2015; São Carlos. São Carlos: SBPC; 2015 [cited 2019 Mar 16]. Available from: http://www.sbpcnet.org.br/livro/67ra/resumos/resumos/3786_207b0c8f001e7ba500356326150ebd185.pdf

21. Martins Filho E, Menezes RCAA. Parasitas gastrintestinais em caprinos (*Capra hircus*) de uma criação extensiva na microrregião de Curimataú, estado da Paraíba, Brasil. Braz J Vet Parasitol. 2001;10(1):41-4.

22. Costa VMM, Simões SVD, Riet-Correa F. Controle das parasitoses gastrintestinais em ovinos e caprinos na região semiárida do Nordeste do Brasil. Pesqui Vet Bras. 2011;31(1):65-71. doi: http://dx.doi.org/10.1590/S0100-736X2011000100010.