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PARASITOLOGY

Prevalence of bovine fascioliasis and economic losses in an abattoir located in the state of Espírito Santo, Brazil

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ABSTRACT: *Bovine fasciolosis is a neglected parasitic zoonosis that causes economic losses to beef production chains due to liver condemnation at abattoirs. Despite the characterization of Bovine fasciolosis in several areas of Brazil, an update on its prevalence in the states of Rio de Janeiro and Espirito Santo is lacking. Thus, fasciolosis prevalence from 2018 to 2021 is presented here according to cattle origin (municipalities of both states). In addition, the associated economic impact on an abbatoir was analyzed through liver condemnation of bovines from both states. The prevalence of fasciolosis in the state of Espírito Santo (10.4%) was significantly higher than Rio de Janeiro (3.6%) (P < 0.01), and resulted in an economic loss of US$12,678.60 for the abattoir. The following municipalities located in the state of Espírito Santo presented prevalences above the mean (10.3%) established in the study: Vargem Alta, Anchieta, Cachoeiro do Itapemirim, Castelo, Atilio Vivacqua, Apiacá and Ibitirama. Thus, majority of these municipalities are considered high-risk areas. Although, there is an aparrent reduction of fasciolosis prevalence, it continues to be a cause of economic losses in abattoirs especially in the state of Espírito Santo. Accordingly, prophylactic measures must still be adopted in cattle farms.*
Key words: *Fasciola hepatica, liver, meat inspection, parasitology.*

Prevalência de fasciolose bovina e perdas econômicas em um abatedouro frigorífico localizado no estado do Espírito Santo, Brasil

RESUMO: *A fasciolose bovina é uma zoonose parasitária negligenciada que resulta em perdas econômicas para a cadeia produtiva da carne devido à condenação de fígado em abatedouros-frigoríficos. Essa doença é descrita em diversas áreas do Brasil, mas existe uma deficiência de informações atuais sobre a prevalência nos estados do Rio de Janeiro e Espírito Santo. Essa nota descreve a prevalência de fasciolose de 2018 a 2021 de acordo com o município de origem e o impacto econômico devido à condenação de fígados em um abatedouro que recebe animais de ambos os estados. A prevalência no Estado do Espírito Santo (10,4%) foi significativamente maior do que no Rio de Janeiro (3,6%) (P < 0,01) e resultou em uma perda econômica de R$ 64.636,00. Os municípios de Vargem Alta, Anchieta, Cachoeiro do Itapemirim, Castelo, Atilio Vivacqua, Apiacá e Ibitirama apresentaram prevalência superior à prevalência desse estudo (10,3%), sendo que esses municípios vem sendo reconhecidos como áreas de alto risco. Apesar de uma aparente redução na prevalência da enfermidade, a fasciolose persiste como uma causa de perdas econômicas aos abatedouros, especialmente no Estado do Espírito Santo, e medidas profiláticas ainda precisam ser adotadas nas fazendas.*
Palavras-chave: *Fasciola hepatica, fígado, inspeção de carnes, parasitologia.*

Fasciolosis is a neglected parasitic disease caused by the liver fluke *Fasciola hepatica*. The disease affects bovines and is widespread in Brazil (ALBUQUERQUE et al., 2022). Bovines with the parasite can present a decrease in body weight gain, poor welfare, and liver condemnation during meat inspection (ARIAS-PACHECO et al., 2020). Although, Fasciolosis is common in ruminants, reports of its incidence in other animals, such as capybaras, and humans have been reported in Brazil (PRITSCH & MOLENTO, 2018; MARTINS et al., 2021). The spatial distribution of this zoonotic disease is related to the presence of intermediate hosts (*Lymnaea* snails) (BENNEMA et al., 2017; SCHWANTES et al., 2019), which is influenced by climatic conditions (BENNEMA et al., 2017), and altitude (SILVA et al., 2020).

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The presence of this parasite in bovine has been reported in several Brazilian States (BENNEMA et al., 2014). However, there is limited data in the literature about the epidemiology of fasciolosis in the state of Rio de Janeiro (PILE et al., 2001; BENNEMA et al., 2014) while this information is well-documented for the state of Espírito Santo (ALVES et al., 2011; BERNARDO et al., 2011; FREITAS et al., 2014; MARTINS et al., 2014). In this light, there is no recent study focused on fasciolosis prevalence according to cattle origin in these states and the analysis of its economic impact on abattoirs. Understanding the spatial distribution of fasciolosis is useful for a better comprehension of its epidemiology and establishment of priority areas requiring prophylactic strategies in Brazil (FREITAS et al., 2014; ALEIXO et al., 2015).

Therefore, this study described fasciolosis prevalence from 2018 to 2021 according to the municipalities of cattle origin and the economic losses due to liver condemnation in an abattoir that slaughters bovines originating from the states of Espírito Santo and Rio de Janeiro. The abattoir is located in the Southern Region of Espírito Santo and is supervisioned by the state inspection agency (Institute of Agricultural and Forest Defense of Espírito Santo - IDAF). A total of 48,202 bovines were slaughtered and inspected in accordance with the standard meat production technology adopted in Brazil for cattle (BRAZIL, 1971). The animals were from 23 and 8 municipalities of the states of Espírito Santo and Rio de Janeiro, respectively (Figure 1).

The data were obtained from spreadsheets containing registries of *post mortem* inspection condemnations. The inspection of the livers was performed through palpation, external surface observations and visualization of bile ducts through incisions (BRAZIL, 1971). In cases where *F. hepatica* was detected, the livers were considered unfit for human consumption (BRAZIL, 2017). To assess the economic losses due to condemnation, livers weighing 5 kg were considered and their commercial price was obtained from an abattoir (R$ 2.60 or US$ 0.51 per kg) located in the state of Espírito Santo, Brazil.

Prevalence values were determined for each municipality using an individual cow as an epidemiological unit. At the state and municipality levels, the prevalence values were calculated by dividing

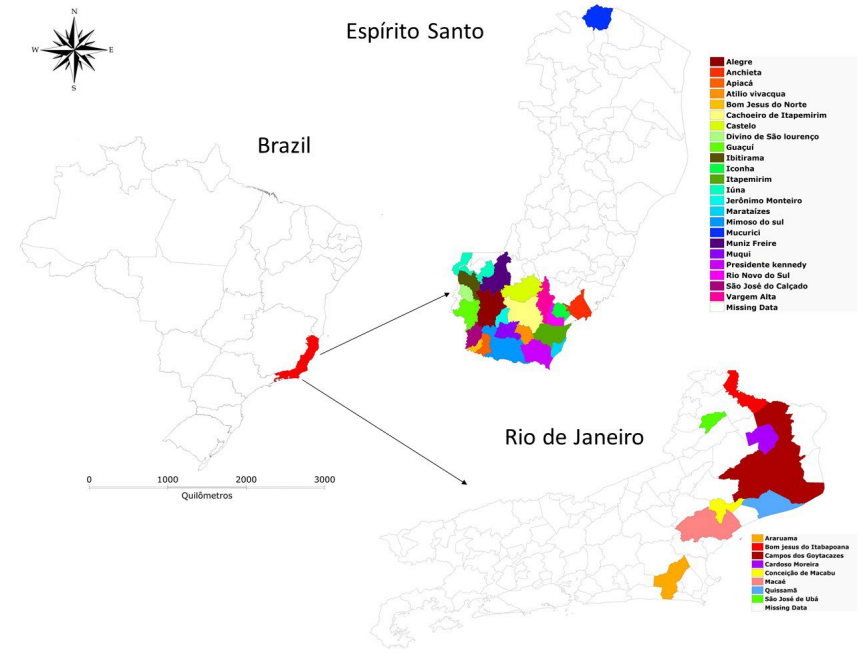

Figure 1 - The municipalities of the states of Espírito Santo and Rio de Janeiro (Brazil), where the bovines were raised before being slaughtered in an abattoir located in the state of Espírito Santo, Brazil. The maps were created using Terraview® Software (INPE, Brazil) (SOFTWARE TERRAVIEW®, 2020).

the number of livers affected with Fasciola lesions by the total amount of slaughtered cattle. The 95% confidence intervals (CI) of prevalence values were calculated based on the Wilson's method using the binomial R package. The difference between the prevalences in the states of Rio de Janeiro and Espírito Santo was assessed using chi-square test (THRUSFIELD & CRHISTLEY, 2018).

The prevalence values of fasciolosis are shown in table 1 and figure 2. The prevalence of bovine fasciolosis in the state of Espírito Santo

Table 1 - Number of fasciolosis cases, controls, inspected bovines, prevalence and 95% confidence interval for 23 municipalities in the state of Espírito Santo and 8 municipalities in the state of Rio de Janeiro, from 2018 and 2021, using meat inspection data at an abattoir located in the Southern region of Espírito Santo.

Municipality	State	Cases	Controls	Number of animals	Prevalence	C.I. 95%
Alegre	Espírito Santo	297	2,590	2,887	10.29	9.23 - 11.45
Anchieta	Espírito Santo	6	18	24	25.00	12.00 - 44.90
Apiaca	Espírito Santo	8	58	66	12.12	6.27 - 22.14
Atilio vivacqua	Espírito Santo	1,416	9,838	11,254	12.58	11.98 - 13.21
Bom Jesus do Norte	Espírito Santo	1	43	44	2.27	0.40 - 11.81
Cachoeiro do Itapemirim	Espírito Santo	1,519	9,076	10,595	14.34	13.68 - 15.02
Castelo	Espírito Santo	14	85	99	14.14	8.61 - 22.35
Divino de São lourenço	Espírito Santo	0	63	63	0.00	0.00 - 5.75
Guaçui	Espírito Santo	13	184	197	6.60	3.90 - 10.96
Ibitirama	Espírito Santo	32	236	268	11.94	8.59 - 16.37
Iconha	Espírito Santo	3	27	30	10.00	3.46 - 25.62
Itapemirim	Espírito Santo	139	1,740	1,879	7.40	6.30 - 8.67
Iúna	Espírito Santo	0	21	21	0.00	0.00 - 15.46
Jeronimo Monteiro	Espírito Santo	60	559	619	9.69	7.60 - 12.28
Marataizes	Espírito Santo	5	126	131	3.82	1.64 - 8.62
Mimoso do sul	Espírito Santo	315	3,520	3,835	8.21	7.39 - 9.13
Mucurici	Espírito Santo	0	15	15	0.00	0.00 - 20.39
Muniz Freire	Espírito Santo	48	503	551	8.71	6.63 - 11.36
Muqui	Espírito Santo	510	5,775	6,285	8.11	7.46 - 8.82
Presidente kennedy	Espírito Santo	478	6,926	7,404	6.46	5.92 - 7.04
Rio Novo do Sul	Espírito Santo	26	264	290	8.97	6.19 - 12.81
São José do Calçado	Espírito Santo	32	719	751	4.26	3.03 - 5.95
Vargem Alta	Espírito Santo	21	61	82	25.61	17.40 - 36.00
Total (ES)		4,943	42,447	47,390	10.4	10.16 - 10.71
Araruama	Rio de Janeiro	0	20	20	0.00	0.00 - 16.11
Bom jesus do Itabapoana	Rio de Janeiro	3	17	20	15.00	5.34 - 36.04
Campos dos Goytacazes	Rio de Janeiro	16	511	527	3.04	1.88 - 4.87
Cardoso Moreira	Rio de Janeiro	1	40	41	2.44	0.43 - 12.60
Conceição de Macabu	Rio de Janeiro	2	18	20	10.00	2.79 - 30.10
Macaé	Rio de Janeiro	5	76	81	6.17	2.67 - 13.65
Quissamã	Rio de Janeiro	0	20	20	0.00	0.00 - 16.11
São José de Ubá	Rio de Janeiro	2	81	83	2.41	0.66 - 8.37
Total (RJ)		29	783	812	3.6	2.50 - 5.08
TOTAL		4,972	43,23	48,202	10.3	10.05 - 10.59

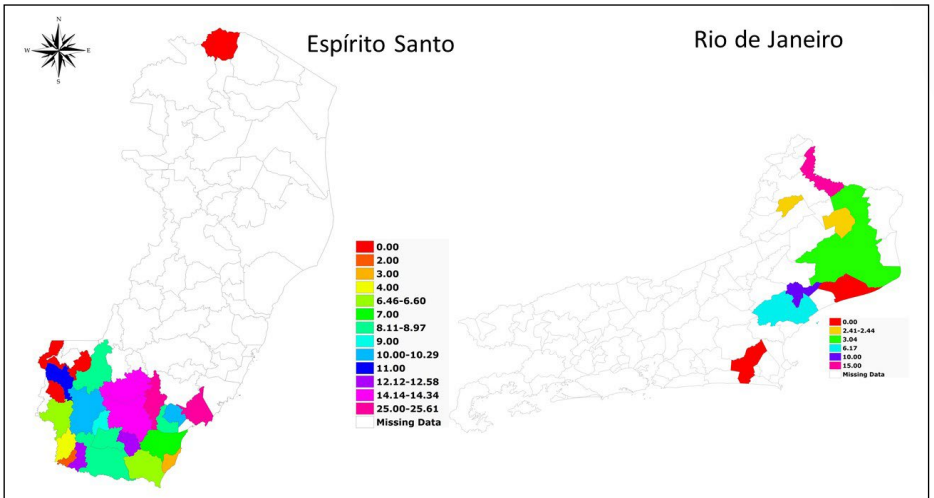

Figure 2 - Prevalence of fasciolosis in bovines from 31 municipalities of the states of Espírito Santo (23) and Rio de Janeiro (8), Brazil, using post mortem data from an abattoir located in the state of Espírito Santo, Brazil. The maps were created using Terraview® Software (INPE, Brazil) (SOFTWARE TERRAVIEW®, 2020).

(10.4%) was significantly higher than Rio de Janeiro (3.6%) ($P < 0.01$). BENNEMA et al. (2014) reported a prevalence of 1.11% in the state of Rio de Janeiro from 2002 to 2011, a lower value than what is observed in this study. However, it is the only study that used *post mortem* inspection to detect the parasite in Rio de Janeiro, thus making data comparisions difficult. Additionally, a high prevalence in the municipalities of Bom Jesus do Itabapoana, Conceição de Macabu and Macaé was observed in this study.

Conversely, fasciolosis prevalence in Espírito Santo has been widely studied because 52.25% of the state´s area favor the occurrence of intermediate hosts and *F. hepatica,* which is related to climatic conditions and altitude (FREITAS et al., 2014). This prevalence is higher than other states, such as São Paulo (6.9%) (MENDES et al., 2019) and Santa Catarina (8.8%) (SILVA et al., 2020). ALVES et al. (2011) reported a prevalence of 21.33% using sedimentation technique on fecal samples and considered the presence of flooded pasture as a risk factor. BERNARDO et al. (2011) presented a prevalence of 24.89% from 2006 to 2009, using data from the same abattoir where this study was conducted. The mentioned authors also reported an increasing trend for fasciolosis occurrence. During a later period in the same abattoir, from 2009 to 2011, FREITAS et al. (2014) found a prevalence of 28.41%. In our study, the prevalence of bovine fasciolosis was lower compared to all values reported previously, probably demonstrating improvements in fasciolosis control and consequent reversal of an increasing trend.

The municipalities of Vargem Alta, Anchieta, Cachoeiro do Itapemirim, Castelo, Atilio Vivacqua, Apiacá and Ibitirama presented prevalences higher than the mean prevalence of this study (10.3%). A high prevalence has been previously reported in the municipalities of Vargem Alta (45%), Cachoeiro de Itapemirim (21.9 - 36.50%), Atilio Vivacqua (28.9 - 30.97%), Castelo (25%) and Apiacá (13%), but not for Ibitirama (ALVES et al., 2011; MARTINS et al., 2014). These municipalities are located in the Southern region of Espiríto Santo, considered a high-risk region for fasciolosis occurrence. It is known that the occurrence of fasciolosis in a certain area is related to the availability of adequate biotopes that allows the development of snails (FREITAS et al., 2014). Conversely, bovines from the municipalities of Divino de São Lourenço, Iúna, Mucurici, Araruama and Quissamã at the abattoir did not present parasites but based on the higher prevalence limits of the 95% confidence intervals the disease may occur in these areas.

Between 2006 and 2009, the abattoir lost US$381.875 US dollars due to the disease (BERNARDO et al., 2011), a higher value than that assessed in this study (US$12,678.60) (Table 2). Besides a reduction

Table 2 - Economic losses due to fasciolosis cases for an abattoir that slaughtered bovines from the states of Espírito Santo (23 municipalities) and Rio de Janeiro (8 muncipalities), from 2018 and 2021, using meat inspection data.

Year	Number of cases	Total weight of condemned livers (kg)	Value per kg (R$/US$)	Total value (R$/US$)
2018	1,715	8,575	2.60/0.51	22,295.00/4,373.25
2019	1,400	7,000	2.60/0.51	18,200.00/3,570.00
2020	1,276	6,380	2.60/0.51	16,588.00/3,253.80
2021	581	2,905	2.60/0.51	7,553.00/1,481.55
Total	4,972	24,860		64,636.00/12,678.60

in fasciolosis prevalence observed over the years, the economic losses of the beef production chain are persistent and cannot be considered irrelevant.

In conclusion, bovine fasciolosis continues to be a cause of economic losses among abattoirs in the state of Espírito Santo;, however an apparent reduction of its occurrence was observed. Thus, prophylactic practices must still be adopted in farms, such as limiting grazing in areas where flooding occurs, detecting positive animals and deworming them, and avoiding animals of different species in the same area (MARTINS et al., 2014).

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DECLARATION OF CONFLICT OF INTEREST

There is no conflict of interest to declare.

AUTHORS' CONTRIBUTIONS

Conceptualization: GAMR, FLT, FRB, LAM and RRB. Data acquisition: DTL, JNT and RRB. Design of methodology and data analysis: GAMR, DTL, FLT, LAM and FRB. DTL, GAMR and JNT prepared the draft of the manuscript. All authors critically revised the manuscript and approved the final version.

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