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MICROBIOLOGY

Bovine tuberculosis in the state of Rio Grande do Norte based on secondary data

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ABSTRACT: This study determined the frequency of positive tests for bovine tuberculosis in animals and breeders/establishments in Rio Grande do Norte, Brazil. Data were provided by the Instituto de Defesa e Inspeção Agropecuária do Rio Grande do Norte (IDIARN), from its Unidade Local de Sanidade Animal e Vegetal (ULSAV'S), acquired in monthly reports issued by qualified Veterinarians under the National Program for the Control and Eradication of Brucellosis and Animal Tuberculosis (PNCEBT), from June 2012 to December 2021. For diagnosis, the comparative cervical test was used as a routine and confirmatory test. A total of 45,804 cattle were tested, 53 (0.1%) of which tested positive. Secondary data are essential in the evaluation of sanitary measures, allowing rapid generation of hypotheses about diseases and providing support for decision-making. Measures such as raising awareness among producers, sanitary control in the acquisition and sale of cows for reproduction, inspection of sanitary barriers, and conducting epidemiological surveys to understand the actual situation of this disease in the state of Rio Grande do Norte are crucial.
Key words: *Mycobacterium bovis*, tuberculosis, epidemiology, frequency.

Tuberculose bovina no estado do Rio Grande do Norte com base em dados secundários

RESUMO: O objetivo do trabalho foi determinar a frequência de animais e estabelecimentos positivos para a tuberculose bovina no estado do Rio Grande do Norte, Brasil. Os dados foram fornecidos pelo Instituto de Defesa e Inspeção Agropecuária do Rio Grande do Norte (IDIARN) e são oriundos de suas Unidades Locais de Sanidade Animal e Vegetal (ULSAV) coletados dos relatórios mensais emitidos por Médicos Veterinários habilitados para atuação no âmbito do Programa Nacional de Controle e Erradicação da Brucelose e da Tuberculose Animal (PNCEBT), compreendendo o período de junho de 2012 a dezembro de 2021. Para o diagnóstico foi utilizado o Teste Cervical Comparativo (TCC) como teste de rotina e confirmatório. No total, foram testados 45.804 bovinos, dos quais 53 animais (0,1%) apresentaram resultado positivo. Os dados secundários são informações de extrema importância na avaliação de medidas sanitárias, permitindo uma rápida geração de hipóteses sobre as enfermidades e dando suporte na tomada de decisões. É fundamental a condução de medidas que incluam a conscientização dos produtores, controle sanitário na aquisição e venda de matrizes, fiscalização nas barreiras sanitárias e a realização de um inquérito epidemiológico para se conhecer a real situação desta doença no estado do Rio Grande do Norte.
Palavras-chave: *Mycobacterium bovis*, tuberculose, epidemiologia, frequência.

INTRODUCTION

The economy of the state of Rio Grande do Norte (RN) is based on agriculture, livestock, industry, tourism, and services. In this context, cattle farming plays an important role because it contributes to the creation of jobs and the generation of income. However, cattle farming activity still has some limitations. Poor technical skills of producers, consecutive years of drought, and infectious diseases have caused significant damage to breeders in this state (SECRETARIA DE ESTADO DO PLANEJAMENTO E DAS FINANCIAS - SEPLAN, 2016). In this regard, infectious disease, such as bovine tuberculosis caused by *Mycobacterium bovis,* was detected. The microorganism is adapted to cattle as its host; however, it also causes diseases in other animal species, including humans (CEZAR et al., 2016). This disease has a significant economic impact, reducing meat and milk production and preventing the use of carcasses and affected parts that become unsafe for human consumption (FAO, OMS, OIE, 2017).

In Brazil, the National Program for the Control and Eradication of Brucellosis and Animal Tuberculosis (PNCEBT), established in 2001 and recently updated by Normative Instruction no. 10/2017, aims to reduce the prevalence and incidence of brucellosis and tuberculosis in bovines

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and buffaloes by eradicating both diseases through a set of mandatory sanitary measures associated with voluntary adherence actions (BRASIL, 2017). This regulation recommends the sanitary slaughter of cattle that were tested positive in the tuberculin skin test (antemortem diagnosis) and the inspection of carcasses with macroscopic lesions in abattoirs (postmortem diagnosis) (ARAÚJO et al., 2014).

Several surveys with animal-level prevalence rates of 0.0009–1.6% were conducted to characterize the epidemiological situation of bovine tuberculosis in the Federative Units of Brazil (BAHIENSE et al., 2016; BELCHIOR et al., 2016; DIAS et al., 2016; FERREIRA NETO et al., 2021; GALVIS et al., 2016; GUEDES et al., 2016; LIMA et al., 2016; NÉSPOLI et al., 2016; QUEIROZ et al., 2016; RIBEIRO et al., 2016; ROCHA et al., 2016; SILVA et al., 2016; VELOSO et al., 2016; VENDRAME et al., 2016).

In the absence of epidemiological surveys, evaluations performed by disease control programs are often limited (TEBUG et al., 2014). Therefore, secondary data, which are provided by qualified Veterinarians, are essential in assessing health measures, allowing rapid generation of hypotheses and supporting decision-making. Using these data can result in optimizing resources and efficiency, such as in the monitoring and surveillance systems of animal health programs (TODESCHINI et al., 2018; RIBEIRO et al., 2020).

Considering the importance of PNCEBT in ensuring the beef and milk production chain and the lack of epidemiological surveys on bovine tuberculosis in the state, this study determined the frequency of animals an0d establishments positive for bovine tuberculosis in RN from June 2012 to December 2021.

MATERIALS AND METHODS

The state of RN has 167 municipalities, and, according to the Instituto de Defesa e Inspeção Agropecuária do Rio Grande do Norte (IDIARN), they are divided into 12 Unidade Local de Sanidade Animal e Vegetal (ULSAV), i.e., Assú, Caicó, Currais Novos, João Câmara, Mossoró, Nova Cruz, Umarizal, Santa Cruz, São Paulo do Potengi, Parnamirim, Pau dos Ferros, and Lajes (Figure 1).

Secondary data provided by IDIARN were used, resulting from all monthly state reports issued by the 65 MVH for actions within the scope of PNCEBT by the Ministry of Agriculture, Livestock, and Supply (MAPA) of the different ULSAV. The data cover the period from June 2012 to December 2021.

For the diagnosis of *Mycobacterium bovis* infection, the comparative cervical test (CCT) was

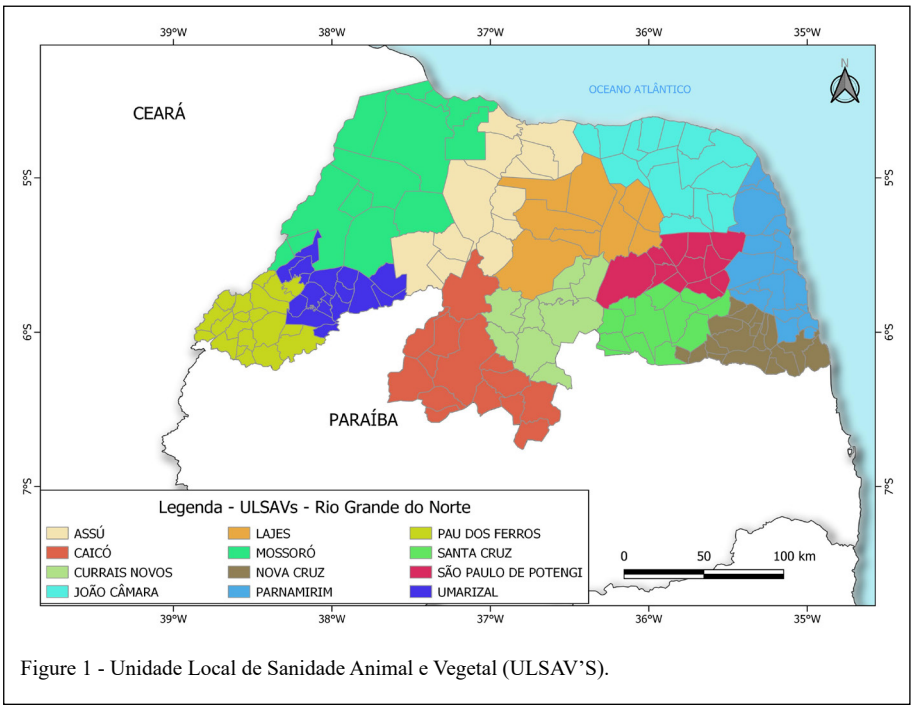

Figure 1 - Unidade Local de Sanidade Animal e Vegetal (ULSAV'S).

used as a routine and confirmatory test, according to the conditions and criteria established by PNCEBT (BRASIL, 2017). A property was considered positive (focused) if at least one animal responded to the test.

Microsoft Excel 2013 was used to calculate the frequencies of positive animals and establishments per unit. Fisher's exact test was performed with a significance level of 5 % ($P < 0.05$) to verify the association between the positive tuberculin skin test and sex (female and male). The tests were performed in the R environment (R CORE TEAM, 2020) using the "rstatix" package (KASSAMBARA, 2021).

RESULTS AND DISCUSSION

Of the 45,804 cattle tested, 53 (0.1%) tested positive in the tuberculin skin test. Of the 44,722 females, 50 (0.1%) tested positive, while of the 1,082 males, three (0.2%) tested positive (Table 1). Using Fisher's exact test, no differences were observed in the frequency of positivity between females and males at a significance level of 5% ($P = 0.1298$), with an odds ratio of 2.48 (95% CI, 0.5–7.71), and females representing 97.6% of all animals tested. In the establishment, 4,100 cattle were tested for bovine tuberculosis, with a frequency of 0.7% (Table 2).

Secondary data may enable the generation of consistent hypotheses about diseases, especially in the absence of broader studies, such as official epidemiological surveys, which; although, were more appropriate in most cases, requiring a lot of resources and presenting difficulties in their elaboration. However, they have some limitations, such as intrinsic biases, internal quality, and inferential limits (TODESCHINI et al., 2018). Furthermore, according to IDIARN, it is not possible to state that all animals were tested only once.

The study showed a low frequency of positive animals, 53 (0.1%) testing positive for tuberculosis. Similar results were observed in the state of Paraíba, where 54,472 cattle were tested and 136 (0.25%) were positive (FIGUEIREDO et al., 2010). Superior results were observed in a survey in Rio Grande do Sul, where 62,149 cattle were tested with a positivity frequency of 0.87% was detected (TODESCHINI et al., 2018).

The highest frequencies of positive animals (Figure 2) were observed in the ULSAV of Santa Cruz, Currais Novos, and Caicó (0.3%, 0.3%, and 0.2%, respectively). These observed frequencies may be related to the presence of dairy herds in ULSAV. They produce approximately 46% of all bovine milk in RN (IBGE, 2017). In addition to the ULSAV in Santa Cruz and Caicó, the São Paulo do Potengi unit, which has properties with tuberculosis-free certification and increased tests, presented the highest frequencies of positive establishments. The results of this study were consistent with the study by NETO et al. (2016), who observed that the highest prevalence rates of infected herds and bovines that tested positive in the tuberculin skin test were found in the state of Espírito Santo, north of São Paulo, south

Table 1 - Frequency of animals tested and that tested positive for bovine tuberculosis in the 12 ULSAV'S in the state of Rio Grande do Norte, from June 2012 to December 2021.

ULSAV'S	----------Number of animals tested----------						----------Number of animals that tested positive--------					
	TOTAL	%	male	%	female	%	TOTAL	%	male	%	female	%
ASSÚ	3484	7.6	82	2.3	3402	97	5	0.1	1	1.2	4	0.1
CAICÓ	3508	7.6	74	2.1	3434	97	9	0.2	0	0.0	9	0.3
CURRAIS NOVOS	4296	9.3	143	3.3	4153	96	14	0.3	1	0.7	13	0.3
JOÃO CÂMARA	3485	7.6	92	2.6	3393	97	0	0.0	0	0.0	0	0.0
MOSSORÓ	4339	9.4	100	2.3	4239	97	0	0.0	0	0.0	0	0.0
NOVA CRUZ	1008	2.2	18	1.7	990	98	0	0.0	0	0.0	0	0.0
UMARIZAL	6722	14.6	131	1.9	6591	98	0	0.0	0	0.0	0	0.0
SANTA CRUZ	3029	6.6	80	2.6	2949	97	11	0.3	1	1.2	10	0.3
SÃO PAULO DO POTENGI	5558	12.1	131	2.3	5427	97	8	0.1	0	0.0	8	0.1
PARNAMIRIM	3734	8.1	84	2.2	3650	97	6	0.1	0	0.0	6	0.2
PAU DOS FERROS	5001	11	115	2.2	4886	97	0	0.0	0	0.0	0	0.0
LAJES	1640	3.5	32	1.9	1608	98	0	0.0	0	0.0	0	0.0
TOTAL	45804	100	1082	2.3	44722	97	53	0.1	3	0.2	50	0.1

Table 2 - Frequency of establishments with animals tested and that tested positive for bovine tuberculosis in the 12 ULSAV'S in the state of Rio Grande do Norte, from June 2012 to December 2021.

ULSAV'S	Number of establishments with animals tested	Number of establishments with animals that tested positive	%
ASSÚ	341	1	0.3
CAICÓ	317	2	0.6
CURRAIS NOVOS	530	3	0.5
JOÃO CÂMARA	301	0	0.0
MOSSORÓ	369	0	0.0
NOVA CRUZ	107	0	0.0
UMARIZAL	445	0	0.0
SANTA CRUZ	313	4	1.3
SÃO PAULO DO POTENGI	453	5	1.1
PARNAMIRIM	326	2	0.6
PAU DOS FERROS	455	0	0.0
LAJES	143	0	0.0
TOTAL	4.100	17	0.7

of Minas Gerais, and south of Goiás, the Brazilian milk-producing zone.

In this study, it was observed that during the study period, the ULSAV from Umarizal had the highest number of animals tested (6,722 animals), while the ULSAV from Nova Cruz tested only 1,008 bovines. This difference may be associated with some factors, such as the increased number of qualified veterinarians working in the municipalities that comprised the first ULSAV, in addition to the widespread dissemination of the program by the local team, raising awareness among breeders.

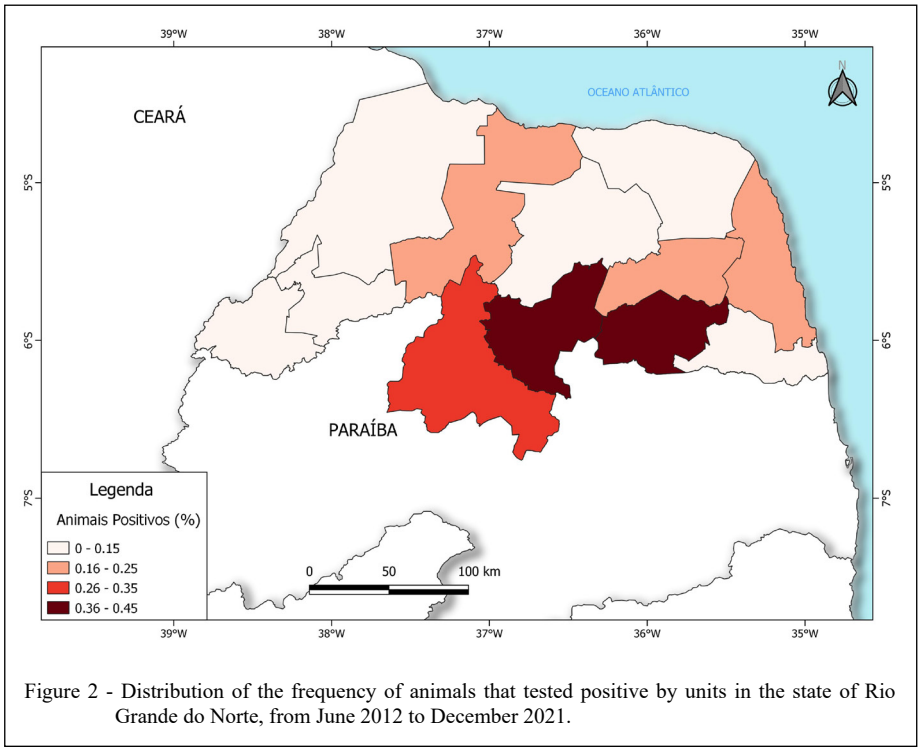

Figure 2 - Distribution of the frequency of animals that tested positive by units in the state of Rio Grande do Norte, from June 2012 to December 2021.

It should be noted that in the state of RN, cattle farming predominantly comprises dairy herds and 79% of the breeders are family farmers. These establishments account for 44% of the state's production of bovine milk (SEPLAN, 2016a). As a result, the state government has been financing projects related to milk production and its derivatives, in order to, introduce these products into the market and help agriculture industries (cheesemaking) adapt to family agriculture (SEPLAN, 2016b).

CONCLUSION

Measures that include raising awareness among producers, sanitary control in the acquisition and sale of cows for reproduction, inspection of sanitary barriers, and conducting epidemiological surveys to understand the actual situation of this disease in the state of RN are crucial.

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DECLARATION OF CONFLICT OF INTEREST

The authors declared no conflicts of interest.

AUTHORS' CONTRIBUTIONS

The authors have contributed equally to the manuscript.

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