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Prevalence of brucellosis in beef cattle in the northern region of Tocantins, Brazil, and implications of anatomopathological changes discovered during post mortem inspection of the carcass

Prevalência de brucelose em rebanhos bovinos de corte da região norte do Tocantins e implicações em alterações anatomopatológicas identificadas durante a inspeção post mortem da carcaça

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Highlights

High prevalence of brucellosis in beef cattle herds and animals.
No *post-mortem* brucelic changes.
No significant differences between microregions of northern Tocantins.

Abstract

Brucellosis is a infectious zoonosis with important health and economic impacts, both for animal production and public health. We aimed to determine the prevalence of brucellosis in beef cattle in the microregions of Araguaína and Bico do Papagaio in northern Tocantins and to verify whether there are *post-mortem* changes suggestive of brucellosis in the carcasses. A total of 2,871 serum samples (2,203 males and 668 females) were collected in the municipality of Araguaína between October and November 2019, from 76 beef cattle herds in 25 municipalities in the north of Tocantins. The screening for buffered acidified plate antigen test (BAPA) and confirmation test for 2-mercaptoethanol (2-ME) were conducted as recommended by the Brazilian Ministry of Agriculture, Livestock, and Supply (MAPA). Of the samples, 37.31% were reactive in the BAPA test, and of these, 26.24% were confirmed for 2-ME. Thus, 9.79% (281) of the total evaluated samples tested positive for the presence of brucellosis. The prevalence in males and females was 6.45% (142) and 20.81% (139), respectively. Among the herds evaluated, 77.6% (59) had at least one individual test positive for brucellosis, and at least one herd tested positive in each of the 25 municipalities sampled. As this study

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evaluated animals in a slaughterhouse, the higher prevalence of positive females may have been related to the disposal of animals with reproductive problems. There was no significant difference in the prevalence of brucellosis in slaughter cattle between the microregions evaluated (p > 0.05). No animals were reagent for brucellosis in *ante-mortem* documentation, and no anatomopathological changes suggestive of brucellosis were observed during *post-mortem* inspection. The most frequent *post-mortem* findings were contamination (43.91%), blood aspiration (17.36%), and pulmonary emphysema (15.98%). Considering the official results of the monitoring programs of the state of Tocantins and previous studies, *post-mortem* macroscopic inspection of carcasses may not be enough to detect animals with this zoonosis, and it may be necessary to take measures to promote animal and public health.
Key words: BAPA. *Brucella abortus.* Infectious disease. Slaughterhouse. 2-mercaptoethanol.

Resumo

A brucelose é uma doença infectocontagiosa tendo impacto sanitário e econômico, tanto na produção animal quanto na saúde pública por ser uma zoonose. O objetivo do presente trabalho foi determinar a prevalência de brucelose em bovinos de corte nas microrregiões de Araguaína e Bico do Papagaio no norte do Tocantins e verificar se havia ocorrência de alterações *post mortem* sugestivas de brucelose nas carcaças. Foram coletadas 2.871 amostras de soro, 2.203 de machos e 668 de fêmeas, durante a sangria em frigoríficos do município de Araguaína, entre outubro e novembro de 2019. Os animais foram oriundos de 76 rebanhos de corte de 25 municípios do norte do Tocantins. Foi realizada a prova de triagem do Antígeno Acidificado Tamponado (AAT) e a prova confirmatória do 2-mercaptoetanol (2-ME) conforme preconizado pelo Ministério da Agricultura, Pecuária e Abastecimento (MAPA). Das 2.871 amostras avaliadas, 37,31% foram reativas na prova do AAT, destas 26,24% foram confirmadas no 2-ME, o que representa 9,79% (281) do total avaliado. A prevalência em machos foi de 6,45% (142) e em fêmeas foi de 20,81% (139). Entre os rebanhos avaliados foi observada prevalência de brucelose em 77,6% (59), com pelo menos um rebanho com animais positivos em cada um dos 25 municípios amostrados. Como este estudo avaliou animais em frigorífico, a maior prevalência de fêmeas positivas pode estar relacionada com o descarte de animais com problemas reprodutivos. Não foi observada diferença significativa entre a prevalência de brucelose nos bovinos abatidos entre as microrregiões do estado de Tocantins avaliadas (p > 0,05). Durante o período de coleta de amostras nenhum animal foi notificado como positivo na documentação *ante mortem* e nenhuma alteração anatomopatológica sugestiva de brucelose foi observada durante a inspeção *post mortem* das carcaças de animais amostrados no presente estudo. Os achados *post mortem* mais frequentes foram contaminação (43,91%), aspiração de sangue (17,36%) e enfisema pulmonar (15,98%). Considerando os resultados oficiais dos programas de monitoramento do estado do Tocantins e estudos anteriores, foi possível observar que é preciso aprimorar e intensificar as ações para promoção de sanidade animal e, nesse caso, de saúde pública, uma vez que o processo de inspeção macroscópico *post mortem* das carcaças pode não ser suficiente para detectar animais com essa zoonose.
Palavras-chave: AAT. *Brucella abortus.* Infectocontagiosa. Abatedouro. 2-mercaptoetanol.

Introduction

Brucellosis is an infectious and contagious zoonosis caused by microorganisms of the genus *Brucella,* and results in significant economic losses in dairy and beef cattle farming, and has a great impact on both public and animal health (Alves & Villar, 2011).

The prevalence of brucellosis in humans is directly linked to the number of infected animals, especially bovine species (Empresa Brasileira de Pesquisa Agropecuária {EMBRAPA], 2014). Professionals who work directly and frequently with animals or their carcasses are at risk of contracting the disease (Tenório et al., 2008; Langoni et al., 2009).

Brucellosis is endemic in Brazil (Lage et al., 2008; Vendrame et al., 2021), and has persisted even with the implementation of the National Program for the Control and Eradication of Brucellosis and Tuberculosis (PNCEBT) by the Ministry of Agriculture, Livestock and Supply (MAPA) of the Brazilian federal government Ministério da Agricultura, Pecuária e Abastecimento [MAPA] (2001). In the state of Tocantins in northern Brazil, preliminary studies indicate a 4.33% prevalence in cattle (Ogata et al., 2009), and the only Brazilian report of an outbreak of human brucellosis was described in employees of companies related to the slaughter of animals in Araguaína, in the northern region of Tocantins (Secretaria de Vigilância em Saúde [SVS], 2008).

Brazil is the largest exporter of bovine protein in the world and the second-largest commercial producer of cattle, with an estimated herd of 187 million heads of cattle (Associação Brasileira das Indústrias Exportadoras de Carnes [ABIEC], 2022). Tocantins, with approximately 8.5 million heads (Secretaria da Agricultura, Pecuária e Aquicultura [SEAGRO], 2019), covers the international market by exporting beef to more than 30 countries.

The municipality of Araguaína has a strategic position in the state of Tocantins. Located between the states of Pará and Maranhão, it is an important commercial hub in the northern region of Tocantins; it has six beef slaughterhouses under the federal and state inspection regime, with a daily slaughter capacity of more than 3 thousand animals. Araguaína also exports beef to more than 10 countries. The high flow of animals means that monitoring animal health in Araguaína allows for monitoring in several states.

Studies on the prevalence of brucellosis and monitoring of infection rates in bovine herds are essential for establishing risk mitigation strategies and consequently will impact animal and public health. Thus, the present study aimed to determine the prevalence of bovine brucellosis in slaughter animals according to sex and origin in microregions of northern Tocantins, in addition to verifying the occurrence of the disease in herds and its possible manifestation in macroscopic anatomopathological changes detectable during *post-mortem* inspection of carcasses.

Material and Methods

Sampling

To determine the minimum number of samples necessary for the significant representation of the Tocantins animals, EpiInfo™ v.7.2 software was used (https://

www.cdc.gov/epiinfo), considering the state herd in 8.5 million animals (SEAGRO, 2019), a confidence level of 99%, a margin of error of 1%, and an estimated prevalence of 4% (Ogata et al., 2009). From these variables, the minimum necessary sample size was determined to be 2,557 bovine serum samples. A total of 2,871 serum samples were collected and considered by this study. Females aged less than 24 months were excluded from sampling because of possible immunological interference from the B19 vaccine strain.

Collection of blood and serum samples

Blood collection was performed during bleeding and after the animal was stunned by the percussive penetrative method in two slaughterhouses in the municipality of Araguaína, one under federal and one under state inspection. Bovine blood samples (approximately 10mL) were collected in sterilized conical polypropylene tubes with a capacity of 15mL between October and November 2019. All animals from the daily slaughter were collected.

Immediately after collection, the tubes were placed upright on a plastic shelf and kept at rest for natural coagulation. The tubes were sent to the Laboratory of Hygiene and Public Health of the Federal University of the North of Tocantins, where they were centrifuged at 3,500rpm for 7 minutes to separate the serum. Aliquots of 1mL of serum were stored at -20°C until serological examination.

Serological diagnosis of bovine brucellosis

The buffered acidified plate antigen test (BAPA) was performed as triage according to the recommendations of the Brazilian MAPA Normative Instruction No. 41 of 2006 (MAPA, 2006). The antigen used in this study was produced and provided by the Federal Agricultural Defense Laboratory of Minas Gerais (LFDA/MG), Pedro Leopoldo, Brazil. The BAPA-positive samples were submitted to the confirmatory 2-mercaptoethanol test (2-ME), in accordance with MAPA guidelines (MAPA, 2006). The antigen for the confirmatory test was also provided by the LFDA/MG.

Positive and negative controls sera obtained from a previous study (Santos et al., 2019) were used for each repetition of the screening and in the confirmatory tests.

Ante-mortem information and anatomopathological changes during post-mortem inspection

Immediately after each day of blood collection, pre-slaughter information for each animal, including origin, quantity, municipality, age, sex, slaughter order, and health status were obtained. All information was contained in the documents for receiving the animals from the Quality Control (QC) and Health Bulletin (HB) of the industries.

Information related to anatomopathological changes observed in the *post-mortem* inspection lines of the evaluated lots was also made available by the internal QC section of the establishments, in accordance with the Regulation of Industrial and Sanitary Inspection of Animal Products (MAPA, 2017a) and the standards complementary to the two establishments where the samples were collected.

Grouping of samples in the microregions of northern Tocantins

Sera samples originated from 76 randomly and distributed beef cattle herds located in 25 municipalities in the northern region of the Tocantins state. The 76 beef cattle herds sampled were grouped into the microregions Araguaína and Bico do Papagaio (Ogata et al., 2009; Vendrame, 2018). Sixty-seven beef catle herds and 2,379 animals were sampled in Araguaína microregion from the municipalities of Aragominas (n = 56), Araguaína (n = 385), Araguanã (n = 84), Arapoema (n = 202), Babaçulandia (n = 16), Bandeirantes (n = 295), Bernardo Sayão (n = 109), Carmolândia (n = 72), Couto Magalhães (n = 59), Filadélfia (n = 53), Itaporã (n = 96), Muricilândia (n = 114), Nova Olinda (n = 82), Palmeirante (n = 20), Pau D'arco (n = 108), Piraquê (n = 144), Santa Fé do Araguaia (n = 154), Wanderlândia (n = 60), and Xambioá (n = 270). In Bico do Papagaio microregion, nine beef cattle herds and 492 animals sampled from the municipalities of Ananás (n = 382), Araguatins (n = 18), Augustinópolis (n = 20), Nazaré (n = 36), Riachinho (n = 16) and Sítio Novo (n = 20).

Statistical analysis

The information in the HB and the results of serological analyses were tabulated and statistically evaluated using WinPepi® software v.3.18, with descriptive statistics calculated using the prevalence of bovine brucellosis in males versus females for each microregion and the entire north of Tocantins state.

Ethics in research with animals

This research was approved by the Ethics Committee on the Use of Animals of the Federal University of Tocantins, process No. 23.101.003/2019-52.

Results and Discussion

Of the 2,871 sera samples evaluated, 1,071 (37.30%) were reactive in the BAPA test. These sera samples were reevaluated in the 2-ME test, and a reactive result was observed in 281 (9.79% [8.70-10.87%]), with 6.45% (5.42-7.47%) in males and 20.81% [17.73-23.89%]) in females. The inconclusive results in the 2-ME test included 68 (2.36%) of the evaluated samples.

A larger sample of males (76.73%) was expected because samples were collected at slaughterhouses and the females are mostly reared for reproductive purposes. The total number of sera samples by animals and herds, and the results of the exams of the animals were distributed according to the microregions of northern Tocantins (Table 1).

It was observed that 26.24% (281/1,071) of the reactive samples in the BAPA test were confirmed using the 2-ME test. This difference may be explained by the occurrence of nonspecific reactions through the exchange of epitopes with microorganisms generating false positives in the BAPA. Costa (2001) and Oliveira (2003) reported that *Bordetella bronchiseptica, Yersinia enterocolitica* O:9, *Moraxella* spp., *Escherichia coli* O:116 and O:157, *Salmonella* spp., *Staphylococcus* spp., *Pseudomonas maltophilia, Francisella tularensis, Campylobacter* spp., and others may cause cross-reactions in BAPA. In addition

to the small amount of hemolysis that may be expected when using this form of collection (Alton, Jones, Angus, & Verger, 1988; Costa, 2001).

Table 1
Brucellosis prevalence in 2,871 beef cattle animals from 76 herds slaughtered in Araguaína and Bico do Papagaio microregions of northern of Tocantins between October and November 2019, according to results observed in the confirmatory 2-mercaptoethanol test (2-ME)

Microregion	Animals		2-ME			Herds			
						Total	Positive		
	Sex*	n	Positive	%**	CI (95%)***	n	Positive	%	CI (95%)
Araguaína	M	1804	98	5.43	4.39 - 6.48	67	50	74.6	64.21 - 85.05
	F	575	126	21.91	18.53 - 25.29				
	T	2379	224	9.42a	8.24 - 10.59				
Bico do Papagaio	M	399	44	11.03	7.95 - 14.10	9	9	100	100
	F	93	13	13.98	6.93 - 21.03				
	T	492	57	11.59[a]	8.76 - 14.41				
Both regions	M	2203	142	6.45	5.42 - 7.47	76	59	77.6	68.26 - 87
	F	668	139	20.81	17.73 - 23.89				
	T	2871	281	9.79a	8.70 - 10.87				

* M = male; F = female; T = total.
** Percentages followed by the same letter do not differ at the 5% level of significance (p> 0.05).
*** Confidence interval of 95%.

In the Araguaína microregion 2,379 samples were collected, of which 5.43% (98/1,804) of males and 21.91% (126/575) of females were positive in 2-ME test (Table 1). In the Bico do Papagaio microregion, 492 samples were collected, of which 11.03% (44/399) of males and 13.98% (13/93) of females were positive in 2-ME test (Table 1).

A high prevalence of brucellosis was observed in females destined for slaughter in both Araguaína and Bico do Papagaio microregions. Kuss et al. (2005) described that the discarding of animals is routine in beef cattle and results mainly from reproductive problems, advanced age, or poor maternal skills. Brucellosis can cause an increase in the interval between births, repetition of heat, and the occurrence of abortion, therefore, females with brucellosis may slaughter at relatively high rates and may be overrepresented in our sample. The prevalence of brucellosis differed among females between Araguaína and Bico do Papagaio microregions, but this difference was not significant (Table 1).

The prevalence of brucellosis in cattle in the Tocantins state was reported in a previous study (Vendrame, 2018) in which described a prevalence of 2.21% [1.05-4.01%] in animals and 6.42% [4.76-8.62%] in herds, and no difference in prevalence rates between the state's microregions evaluated. The latest situation diagnosis on the PNCEBT published by MAPA in 2020 (MAPA, 2020) reported only 229 positive cases of brucellosis in Tocantins

from 2014 to 2018, and a significant reduction in the number of tests performed during that period (65,958 in 2014 to 28,465 in 2018) despite an increase in the number of reported cases from 14 in 2014 to 168 in 2018. Ogata et al. (2009) reported a brucellosis prevalence of 4.40% among 20,908 bovine females evaluated in Tocantins, ranged from 2.0 to 8.50% (0.00-11.18%) depending on the region of the state. In the present study, brucellosis was observed in 9.79% [8.70-10.87%] of cattle sampled in the northern region of Tocantins. Our results fall within the confidence interval previously described in Ogata et al. (2009) for herds sampled from 2002 to 2003 and above the prevalence described by Vendrame (2018).

In previous studies which did not carry out on-site examinations but instead used results provided by the state's agricultural defense agency, brucellosis prevalence varied from 0.26% [0.06-0.70%] (Vendrame, 2018) to 8.54% [5.89-11.18%] (Ogata et al., 2009) in the Bico do Papagaio microregion, and from 1.79% [0.17-6.80%] (Vendrame, 2018) to 6.40% [3.92-8.89%] (Ogata et al., 2009) in the Araguaína microregion.

In the present study, the difference between microregions (9.42% [8.24-10.59%] in Araguaína vs. 11.59% [8.9 %-11.41%] in Bico do Papagaio) was larger than that reported by Vendrame (2018) but was within the confidence interval observed by Ogata et al. (2009). Notably, these studies focused on the prevalence of females and herds in the Tocantins state whereas the present study sampled slaughter animals in slaughterhouses. Thus, the higher prevalence of brucellosis observed in the present study may be related to the discarding of females with reproductive problems. Viana, Baptista, Teles, Ribeiro e Pigatto (2010) found brucellosis in 17.20% of slaughtered cattle herds in Tocantins in 2007, and Baptista, Cerqueira, Amaral, Almeida e Pigatto (2012) found brucellosis in 6.20% of animals in Araguaína in 2010. The large variance in infection rates observed across studies may result from variation in the sample unit, from not using data from official monitoring programs, and/or from the discard of animals.

In the present study, the 2,871 animals evaluated belonged to 76 beef cattle herds, and at least one positive animal was found in 59 (77.60%) herds. As shown in Table 1, 100% and 74.60% of the herds evaluated in Bico do Papagaio and Araguaína, respectively, were positive for brucellosis. In the PNCEBT situational diagnosis published in 2020 by MAPA, only five outbreaks of brucellosis were reported in 2018 in the state of Tocantins, in which 168 positive animals were detected (MAPA, 2020).

Of the 25 municipalities evaluated all presented herds with positive animals for brucellosis. The frequency of brucellosis in animals among the municipalities ranged from 0.93% in Pau D´Arco to 43.75% in Babaçulandia. It´s important to note that the number of animals and herds in each of the municipalities evaluated in the present study was random; therefore, the individual sampling of these municipalities may not be representative and so is not detailed in this study.

No anatomopathological changes compatible with brucellic infection were observed in any of the 2,871 carcasses that comprised this sample unit, nor had any QC been notified of the arrival of animals positive for brucellosis, according to the *ante-mortem* documentation. The anatomopathological

changes observed in the carcasses *post-mortem* likewise did not indicate or suggest brucellosis infection (Table 2) and did not lead to their partial condemnation and other judgment by final inspection. Among all of the carcasses evaluated in the present study, only three (0.10%) were judged for conditional use by the use of heat (fusion) due to extensive neoplastic manifestations and traumatic injuries.

Table 2
Anatomopatological lesions observed during post-mortem sanitary inspection of 2,871 carcasses of beef cattle slaughtered in Araguaína, Tocantins, between October and November 2019

Anatomopathological alteration	Quantity (n)	Frequency (%)
Contamination	1261	43.91
Blood aspiration	498	17.36
Pulmonary emphysema	459	15.98
Nephritis	419	14.61
Congestion	417	14.54
Urinary cyst	257	8.97
Spotted teleangiectasia	139	4.84
Bronchitis	82	2.85
Pericarditis	50	1.73
Food aspiration	46	1.60
Hepatical cirrhosis	41	1.44
Worms	41	1.44
Abscess	30	1.06
Uronephrosis	29	1.02
Perihepatitis	28	0.96
Traumatic injury	25	0.86
Hydatidosis	19	0.67
Pleuritis	18	0.64
Actinomycosis	15	0.51
Neoplasm	13	0.45
Anemia	10	0.35
Anemic infarction	9	0.32
Bruise	5	0.16
Steatosis	5	0.16
Enteritis	3	0.10
Lymphadenitis	2	0.06
Sinusitis	2	0.06
Glossitis	1	0.03

Brucella spp. have tropism for organs that offer important elements for their metabolism, such as erythritol (polyhydric alcohol containing four carbons) (Carter & Chengappa, 1991). This element is present in mammary glands, organs of the male reproductive system, joints, and the pregnant uterus (Ribeiro, Motta, & Almeida, 2008; Xavier, 2009). These changes are due to the systemic installation of the microorganism, especially in the lymphatic system, as well as the chronicity of the infection due to its permanence and ability to survive inside macrophages (Thoen, Enright, & Cheville, 1993; Gorvel & Moreno 2002; Xavier, Paixão, Poester, Lage, & Santos, 2009), because they prevent the formation of phagolysosomes by inhibiting the fusion of lysosomes with secondary granules (Carter & Chengappa, 1991; Poester, Gonçalves, & Lage, 2002).

Abortion is the main clinical sign of brucellosis infection. During pregnancy, microorganisms reach the uterus and multiply in the chorion, cotyledons, and fetal fluids (Díaz Aparicio, 2013), causing necrosis of the placentomas and infecting the fetus (Nielsen, 1990; Metcalf, Luchsinger, & Ray, 1994; Schlafer & Foster, 2016; Xavier et al., 2009). These injuries culminate in the elimination of villi (Díaz Aparicio, 2013) and consequent abortion between the 5th and 7th months of pregnancy (Radostits, Blood, & Gay, 2002), especially in the first post-infection pregnancies (Alves & Villar, 2011). In later pregnancies, the possibility of miscarriage is reduced due to natural immunity, which considerably reduces the intensity and size of the lesions caused by the bacteria (Lage et al., 2008; Seleem, Boyle, & Sriranganathan, 2010), but the possibility of stillbirth and birth of weak calves remains (Radostits et al., 2002).

The anatomopathological manifestations suggestive of brucellosis expected in females would therefore be purulent, brown or gray-red vaginal discharge and the appearance of clinical signs of infection in the udder (Campanã, Gotardo, & Ishizuka, 2003). In males, inflammation in the testicles, ampoules, seminal vesicles, and epididymis was expected, manifesting as uni- or bilateral orchitis, with increased organ size (Lage et al., 2008). For both sexes, polyarthritis, arthritis (tarsus and metatarsus), hygromas, tenosynovitis, cutaneous abscesses, and bursitis could be related to brucellosis (Campaña et al., 2003). In the forequarter, animals with brucellosis can present two injuries: brucellic bursitis and joint changes. These changes are noticeable in the incision of the cervical ligament and the aspect of the limbs. However, of all animals evaluated in the present study, only a diffuse abscess (after removal of the superficial abscess resulting from vaccination against foot-and-mouth disease) and a contusion, probably caused by trauma during transport or pre-slaughter, were detected. Of the 9.79% of animals that tested positive for brucellosis, no carcass showed anatomopathological alterations suggestive of the disease. Thus, the rarity of presenting macroscopic changes in infected animal carcasses is emphasized (Viana et al., 2010).

Casalinuovo, Ciambrone, Cacia e Rippa (2016) detected genetic material from *Brucella* spp. in carcasses of bovines that tested positive for brucellosis in serological tests. This suggests that even in the absence of anatomopathological alterations suggestive of brucellic infection in the carcass, it is possible to verify the presence of genome of the microorganism in the muscle. Kolo et al. (2019) also reported the detection of genetic

material and isolation by the microbiological culture of *B. melitensis* and *B. abortus* in the lymph nodes, liver, and spleen of bovine carcasses with positive serology.

The Brazilian RIISPOA, as modified by Decree No. 9,069 of 2017 (MAPA, 2017b) allows for the release of carcasses for consumption without any restriction, even with the prior knowledge that the animal is serologically positive for brucellosis. Only udder, genital tract and blood should be discarded, even with the presentation of localized lesions. This update of the RIISPOA can facilitate the disposal of animals known to be positive on the properties without causing greater damage to the producer. Thus, the disposal of positive animals from the herd should be facilitated and producers less resistant, resulting in a decrease in infection rates of Brazilian cattle herds. Despite this, in the latest publication of MAPA data, only 49 (29.17%) of the 168 animals reported as positive in 2018 were eliminated from herds in the Tocantins (MAPA, 2020).

There is known underreporting in beef cattle herds in Tocantins, possibly due to deficiencies in the vaccination process, fraud in vaccination certificates, vaccine failures, reduction in the number of diagnostic tests, large flow of animals between properties, failure in sanitary control by rural properties, limited inspection resources, and because there are not always specific macroscopic anatomopathological lesions in carcasses in animals slaughtered during sanitation inspection, as observed in the present study. This restriction of the real epidemiological situation in the state can negatively influence regional public health. The northern region of Tocantins, it is an area with a high number of professionals working in livestock and slaughterhouses, so the possible deficiency in effective and widespread animal health monitoring in the state and lack of specific diagnostic means can influence the risk of brucellosis.

Conclusion

A high prevalence of brucellosis was observed in slaughtered beef cattle in the Tocantins state, and prevalence did not vary between microregions in the north of the state. A higher prevalence was observed in females than in males, potentially due to the low reproductive performance of females destined for slaughter. *Post-mortem* inspection was not sufficient to detect anatomopathological signs of brucellosis and, consequently, was not sufficient to judge suitability for consumption in inspection lines. As brucellosis is one of the main infectious diseases of beef cattle in the state of Tocantins and potentially one of the main zoonoses, intensification of inspection, vaccination, and sanitary measures is necessary.

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