

Epidemiological, clinicopathological, and economic aspects of an outbreak of botulism in beef cattle in the State of Tocantins, Brazil

Aspectos epidemiológicos, clínico-patológicos, e econômicos de um surto de botulismo em bovinos de corte no Estado do Tocantins, Brasil

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Abstract

The objective of this work was to quantify the economic losses caused by a botulism outbreak among beef cattle in a semi-containment regime. The animals were fed corn silage and commercial feed and had access to a pasture of Guinea grass (*Panicum maximum*). Of the 150 steers in the herd, 22 (14.6% morbidity rate) presented clinical signs compatible with botulism and died (100% lethality rate). The 22 steers were clinically evaluated and eight were necropsied. The carcasses were evaluated macroscopically, and samples of the main organs were collected for laboratory testing. Ruminal and intestinal contents, and samples of the silage and animal feed provided were also collected. Botulinum toxin type C was identified in the ruminal contents of one steer and in the corn silage. Herein, the epidemiology, clinical signs, and laboratory findings regarding botulinum intoxication are emphasized for this outbreak. Our findings show the importance of keeping the silage well preserved because this represented a means of neurotoxin transmission that generated economic damage to the producer.

Keywords: *Clostridium botulinum*, botulinum neurotoxin type C, corn silage.

Resumo

Este trabalho objetivou quantificar os prejuízos econômicos causados por um surto de botulismo em bovinos de corte, em regime de semiconfinamento, alimentados com silagem de milho, ração comercial e com acesso a pastagem de capim mombaça (*Panicum maximum*). O lote era composto por 150 bois, dos quais 22 animais (14,6% de morbidade) apresentaram os sinais clínicos compatíveis com botulismo e morreram (100% de letalidade). Os 22 bois foram avaliados clinicamente e oito foram necropsiados. As carcaças foram avaliadas e fragmentos dos principais órgãos foram colhidos para exames laboratoriais. Também foram colhidos conteúdos ruminal e intestinal, amostra da silagem e ração fornecidas aos animais. A toxina botulínica do Tipo C foi identificada no conteúdo ruminal de um bovino e na silagem de milho. Na descrição do surto dá-se ênfase à epidemiologia, aos sinais clínicos e aos achados laboratoriais referentes à intoxicação botulínica e demonstra a importância da conservação adequada da silagem ofertada aos bovinos, pois essa representou o meio de transmissão que gerou o prejuízo econômico ao produtor.

Palavras-chave: *Clostridium botulinum*, neurotoxina botulínica tipo C, silagem de milho.



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Introduction

Botulism is a disease caused by the ingestion of botulinum neurotoxins (BoNTs) secreted by *Clostridium botulinum* and is one of the main causes of adult deaths among cattle in Brazil (Döbereiner & Dutra, 2004; Tokarnia et al., 2010). It occurs mainly through the animal's habit of gnawing bones, which cattle develop in regions with great phosphorus deficiency in the soil and forage (Tokarnia et al., 2010). Occasionally, there are outbreaks of the disease associated with water intake (Dutra et al., 2001; Souza et al., 2006) or contaminated food (Dutra et al., 2005; Martins et al., 2017).

The clinical signs of botulism vary depending on the amount and type of BoNT ingested. The manifestations are neuromuscular and are characterized by locomotion difficulties and paresis or flaccid paralysis that affects the skeletal muscles. With paresis and paralysis of the tongue, difficulties in chewing and swallowing ensue. Death occurs through paralysis of the breathing muscles (Döbereiner & Dutra, 2004; Tokarnia et al., 2010).

The diagnosis of botulinum intoxication is based on anamnesis, clinical signs, absence of macroscopic and microscopic lesions, and detection of neurotoxins in tissue samples collected during necropsy and in other materials collected in the field (Tokarnia et al. 2010). The objective of this report was to describe the death of cattle by *C. botulinum* neurotoxin C poisoning, addressing the epidemiological, clinicopathological, and economic aspects.

Materials and methods

During the period from 10/29/2012 to 11/05/2012, a botulism outbreak affected semi-confined beef cattle on a farm located in the Municipality of Araguaína, in the State of Tocantins, Brazil. The lot consisted of 150 mixed steers of approximately 26 months of age and weighing an average of 525 kg. According to the producer, the animals were vaccinated against rabies and foot-and-mouth disease.

The animals were held in a pasture of Guinea grass (*Panicum maximum*) and supplemented daily with 4 kg of commercial concentrate and 15 kg of corn silage per animal. The animals also had *ad libitum* access to a commercial mineral blend in a covered trough.

Approximately 80 days after the start of the semi-confinement regime, 22 steers died within eight days, having presented clinical signs compatible with botulinum intoxication. The disease evolution in these 22 steers was superacute in 12, acute in four, and subacute in six animals. Eight of these steers were subjected to general and neurological examinations and necropsy. Samples of the brain, rumen, reticulum, omasum, abomasum, intestines, liver, spleen, kidney, lung, heart, skeletal muscle, and thyroid and adrenal glands were collected during necropsy, stored in 10% formalin, and routinely processed for histopathological examination.

During the course of the condition, hyporexia (8/8), hypodipsia (8/8), normal mental state (8/8), motor incoordination (8/8), tail paralysis (8/8), paralysis of the pelvic limbs that evolved to the thoracic limbs (8/8), biphasic inspiration (6/8), forced abdominal expiration (8/8), and flaccid paralysis were observed, followed by death (8/8). In the panniculus test (Dirksen et al., 1993), all the animals evaluated presented normal motor alterations and normal sensory activity.

During the visit to the farm, a general inspection of the breeding environment was carried out, whereupon the surface silo where the corn silage was stored was found to be in inadequate conditions, poorly sealed, and with moldy silage inside. Silage samples were collected and sent to the Laboratory of Mycotoxicological Analyses (LAMIC). To detect the botulinum toxin, samples of the liver and ruminal and intestinal contents as well as of the silage and refrigerated rations were sent to the Paulista State University "Júlio Mesquita Filho" (UNESP, Araçatuba Campus) for testing. The mouse bioassay was used for the detection of the BoNT.

Results and discussion

The clinicopathological and epidemiological findings were consistent with botulinum intoxication in ruminants (Döbereiner & Dutra, 2004; Dutra et al., 2005; Tokarnia et al., 2010; Martins et al., 2017). In the panniculus test, four of the eight steers examined had a decrease in tongue tonus, which was observed after the induced exposure.

The silo samples examined by LAMIC did not have the presence of mycotoxins. Of the four samples collected during necropsies and sent to LAMIC, BoNT was detected in one sample of ruminal content. In the mouse bioassay, this botulinum-positive sample was revealed by antitoxin neutralization to be neurotoxin type C.

No osteophagy was observed in the present case, since there were no carcasses or other means of transmission in the pastures. The BoNT was not detected in the concentrate.

Martins et al. (2017) reported botulinum intoxication in a confinement area located in the State of Mato Grosso do Sul, where there were 1700 steers. Of these, 1100 became ill and 1090 died in less than a week. These steers were fed with high amounts of rehydrated corn that was stored in a silo. During the evaluation of the silo, many aggregates of various sizes containing moldy corn were found. The only steers that died on that farm were those that ingested this silage. The sheep and dairy cattle that did not eat this food did not get ill. For this reason, the authors described this intoxication as being due to the ingestion of the rehydrated corn silage.

The data of Martins et al. (2017) are similar to those of our present study, with 14.6% morbidity and 100% mortality rates. The cattle were also fed corn silage from a silo with poor storage conditions and with the presence of mold. The sample of this silage sent for laboratory testing was positive for BoNT type C.

Because the necropsy and histopathological examinations did not show specific tissue alterations, the brain tissue was carefully evaluated to rule out other neurological diseases. None of the histological findings were compatible with rabies, bovine herpesvirus-5 encephalitis, *Aspergillus clavatus* infection, and crotalic accident, which re-inforced the possibility of botulism.

Botulinum intoxication is responsible for large economic losses in Brazilian livestock (Dutra et al., 2001). These losses are associated with the death of the animals and the prior cost of maintaining them in the production system (monetary value of the animal, supplementation, labor, sanitation, and technical assistance). In our present case, the cattle rancher lost 22 steers, with an average of 17.5 arrobas, amounting to a total loss of US\$ 19,287.40 (Table 1), not including the costs related to labor for feeding the cattle and veterinary care, which in this case was free of charge.

Table 1. Estimation of economic losses due to the outbreak of botulism in beef cattle.

Number of dead steers	22
Average weight (@)	17.5
Value of the @ (US\$)	45.8
Loss A (US\$)	17,633.00
Days of confinement	80
Cost of 15 kg of corn silage (US\$)	0.3
Cost of 4 kg of concentrate (US\$)	0.64
Loss B (US\$)	1,654.40
Total Loss (US\$)	19,287.40

Loss A: cost of dead cattle (22 steers × 17.5 arrobas × US\$ 45.80 per arroba). Loss B: cost of silage consumption for 80 days + cost of concentrate consumption for 80 days × 22 steers. Total loss: loss A + loss B. US\$ 1.00 = 2.13 Brazilian reais in the period of the outbreak (10/29/2012 to 11/05/2012), which was the commercial dollar value according to Reuters (2018).

The botulinum intoxication could have been avoided had the corn silage been adequately stored in an environment that did not cause the growth of *C. botulinum* and had a prophylactic health program been adopted with vaccination of the cattle prior to the semi-confinement. Each vaccine dose costs approximately US\$ 0.34 and needs to be re-administered after 30 days; therefore, immunization of the animals would have cost this producer approximately US\$ 0.68 per animal (US\$ 0.68 × 22 steers = US\$ 14.96). Another measure that could have been taken by the cattle rancher was to acquire the technical assistance of professionals specialized in the area, so that they could advise on the production and storage of the corn silage, as well as the necessary animal health-care measures to be taken before starting the semi-confinement.

In Brazil, outbreaks of botulism in cattle of semi-confinement systems are not commonly reported. Because the 150 steers that were in semi-confinement received the same silage daily, all the animals were at risk of botulinum intoxication. It is likely that intoxication did not occur in all cattle because the BoNT was probably concentrated in focal points rather than being evenly distributed in the silage. During the anamnesis and clinical examination of the cattle, the supply of corn silage was recommended to be ceased immediately, which probably decreased the number of intoxicated and dead animals.

Conclusion

The botulism outbreak reported in this study resulted in a great economic loss to the cattle rancher. Such loss could have been avoided if there had been correct technical assistance during the preparation of the corn silage, as well as vaccination of the cattle through a prophylaxis program.

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