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Cestrum parqui poisoning in cattle in Northwestern Argentina: report of 10 outbreaks

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ABSTRACT

Cestrum parqui is a perennial plant known for its toxicity in ruminants. This work describes several outbreaks of natural intoxication with *C. parqui* from different sources, affecting cattle in different production systems, with morbidity rates varying from 2,7% and 25%. Clinical signs included tremors in the hindquarters, recumbency, and death. The liver showed swelling, congestion, and a mottled appearance. Histopathological findings consisted mainly of hemorrhagic centrilobular hepatocellular necrosis.

Keywords: poisoning plants, ruminants, acute hepatotoxicity.

RESUMEN

Cestrum parqui es una planta perenne, conocida por su toxicidad en rumiantes. En este artículo, se describen varios brotes de intoxicación natural y de diversas fuentes por C. parqui que han afectado al ganado de distintos sistemas de producción, con tasas de morbilidad que varían entre 2,7% y 25%. Los signos clínicos observados fueron: temblores en los miembros posteriores, decúbito y muerte. Se observó congestión, hepatomegalia, y aspecto reticulado del parénquima. Los hallazgos histopatológicos revelaron principalmente signos de necrosis hemorrágica hepatocelular centrolobulillar.

Palabras clave: *plantas tóxicas, rumiantes, hepatotoxicidad aguda.*

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INTRODUCTION

Poisoning by *Cestrum parqui* (Solanaceae) occurs in several countries in South America (Riet-Correa *et al*., 2023). In Argentina, this poisoning occurs frequently in the central-north area of the country, with cattle being the most frequently affected species (Micheloud and Saravia-Peretti, 2014; Garcia *et al*., 2017; Costa *et al*., 2014). The toxicity of this species is due to carboxyatractyloside-type glycosides called parkin and carboxy parkin (Oelrichs *et al*., 1994). These toxins cause inhibition of mitochondrial respiration and ATP synthesis by altering the ADP / ATP carrier system through the membrane of the organelle, blocking the translocation of adenine dinucleotide in the cell (Lemasters, 1978).

When consumed, *C. parqui,* causes acute liver damage, characterized by the presence of generalized centrilobular necrosis (Matto *et al*., 2010; Riet-Correa, 1986; Costa *et al*., 2014), which rapidly leads to death (Riet-Correa, 1986; Costa *et al*., 2014). These plants affect several animal species, but cattle are the most frequently affected (Riet-Correa *et al*., 2023). Due to the severe and acute liver damage, the affected animals do not respond to any treatment, resulting in high lethality (Matto *et al*., 2010; Riet-Correa, 1986; Costa *et al*., 2014).

Several factors affect the probability of outbreaks due to the consumption of *C. parqui* in cattle— for example, variation in the concentration of toxic compounds in the plant and the presence of special conditions for it to be ingested (Matto *et al*., 2010). Management conditions where animals are restricted in feeding, such as lack of forage, prolonged drought, transport, or confinement, may lead to the occurrence of this intoxication (Riet-Correa, 1986; Costa *et al*., 2014).

This paper aims to describe a sequence of ten cases of *Cestrum parqui* poisoning in cattle in northwestern Argentina. The clinical, pathological, and epidemiological aspects of this occurrence are highlighted.

MATERIALS AND METHODS

A retrospective study on *C. parqui* registered cases was performed by the Animal health research area "Dr. Bernardo Carrillo" (IIACS, INTA Salta, Argentina). For the diagnosis of this intoxication, the presence of centrilobular necrosis along with the finding of the plant with evidence of having been consumed was considered (fig. 1B). The information from the corresponding reports was analyzed by compiling the clinical, pathological, and epidemiological aspects of the outbreaks.

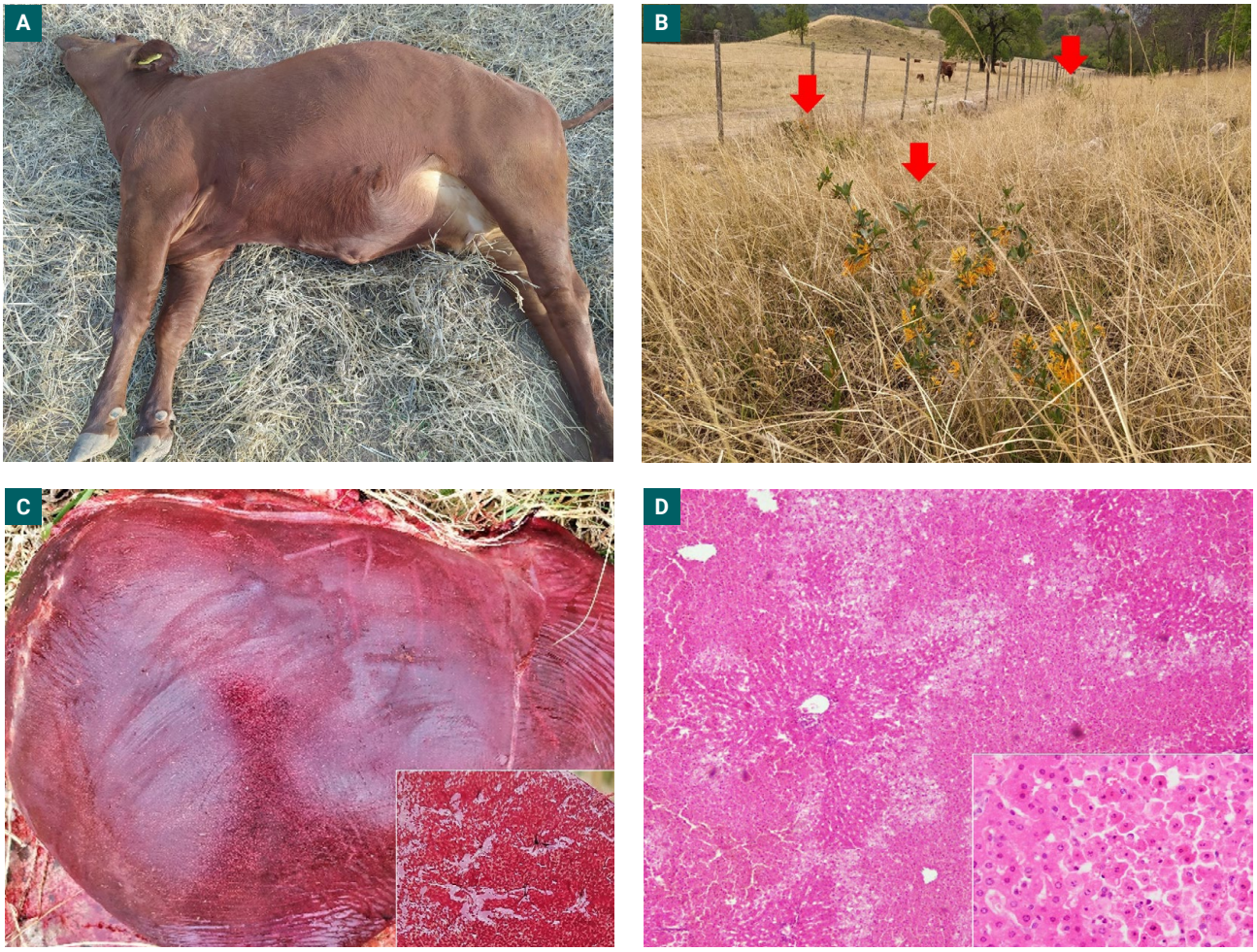

Figure 1. A- Dead cattle found after being grazing in a field with abundant *C. parqui* plants. **B-** *C. parqui* mixed with Gatton panic forage. **C-** Bovine liver. Grossly marked diffuse lobular pattern in the surface and parenchyma (inset) were evidenced. **D-** Bovine liver. Microscopically, centrilobular multifocal necrosis could be observed (H&E. 4X).

Outbreak	Date	Category	Place	Incidence rate	Context
1	Aug-15	Calves	Joaquín V. Gonzalez, Salta	2,7 (7/260)	The outbreak occurred after the animals were put for 8 days in a 5 hectares field with *Gatton panic* and a large amount of *C. parqui* plants.
2	Dec-15	Cows	Pozo Hondo, Santiago del Estero	3,3 (20/600)	The animals were taken to a dismounted field full of *C. parqui*. There was also abundant grass. Deaths occurred 25 days later.
3	mai/19	Calves	La Caldera, Salta	6,6 (2/30)	The animals were grazing in an 8 hectares field with scarce forage and a large amount of *C. parqui* plants. After 1 week, two animals started showing clinical signs in a lapse of 48 hours.
4	mai/20	Heifers	Rosario de la Frontera, Salta	N/I	The animals were put into a field with *Gatton panic* and a large amount of *C. parqui*. In this case there was a high stocking rate and deaths occurred 2 to 3 days later.
5	jul/20	Pregnant heifers	La Silleta, Salta	11,1 (5/45)	The animals were being fed with corn silage, mineral supplementation with monensin and oatmeal sprouts for the past 30 days. The outbreak occurred after a storm, when the animals took refuge in a place with abundant *C. parqui* plants.
6	out/21	Heifers	Metán, Salta	25 (3/12)	The animals were recently put in a *Gatton panic* field with a large amount of *C. parqui*. In this case there was also a high stocking rate. Deaths occurred 2 to 3 days later.
7	out/21	Heifers	La Caldera, Salta	6,3 (9/141)	The animals were put in a field for more than two months with scarce forage and a large amount of *C. parqui*. 1 or 2 animals died every week.
8	Apr-22	Heifers/ Steers	La Silleta, Salta	17,5 (14/80)	The animals were taken to a new paddock with abundant *C. parqui* near the watering place. Deaths started occurring 1 week later.
9	out/22	Calves	Atocha, Salta	10,7 (3/28)	Deaths started occurring after animals were put in a field with abundant trees and *C. parqui*. They were being fed with silage and hay.
10	jul/22	Cows with calf	El Bordo, Salta	5,8 (2/34)	The animals were put in a bean stubble with low forage supply, near a dam with abundant *C. parqui*. Deaths occurred abruptly 5 days later.

Table 1. Clinical and epidemiological data of the outbreak (date, affected category, location, incidence rate and context in which the poisoning occured.

RESULTS

In the period from 2015 to 2023, a total of 10 outbreaks of *C. parqui* poisoning were confirmed, with a total of 430 cases occurring in cattle in that period. This represents 2.32% of the cases. In all 10 outbreaks, we found evidence of hepatic centrilobular necrosis and ingestion of C. parqui.

Epidemiological data are shown in table 1—the date and place where the outbreaks occurred, the affected category, the incidence rate, and the context in which they occurred .

The most commonclinical findings included dehydration, anorexia, tachycardia, rumen atony that could eventually be accompanied by abdominal pain, dry stools with mucus and streaks of blood. The less common signs were the following: hepatic encephalopathy, aggressiveness, locking of jaws, salivation, myoclonus, swinging door and prolonged recumbency. In many cases, the animals did not present any clinical signs, and the consultation was made because they were found dead without previous clinical signs (6 out of 11) (fig. 1A). However, when any clinical sign was evidenced in the animals, death occurred within 12 to 72 hours later.

A total of 14 necropsies were performed. Generalized hepatic centrilobular necrosis was identified in all the necropsied animals, characterized by enlargement of the liver and a diffuse lobular pattern, with red areas interspersed with yellowish-white areas (fig. 1C inset). Furthermore, in all cases, the gallbladder was plethoric with edematous walls. In several cases, petechiae or ecchymosis were observed on the serosae and in the endocardium. In 10 animals, the abomasum had bloody fluid inside, and, in the rectum of several animals (9/14), dry feces with mucus and streaks of blood were observed.

Histopathological findings in the liver included severe diffuse centrilobular (10/14) or mid-zonal (4/14) coagulative necrosis. Necrotic areas were characterized by either loss or retraction of hepatocytes and hypereosinophilic hepatocytes, most of them showing nuclear pyknosis, karyorrhexis, and/or karyolysis. Some more conserved hepatocytes showed microvacuolar degeneration with nuclei peripheral displacement. The affected areas were associated with severe congestion and hemorrhage. In some of the 14 cases, isolated mild random neutrophil foci were found.

DISCUSSION AND CONCLUSIONS

C. parqui poisoning is a relatively common disease in South America (Riet Correa *et al*., 2023). In some regions, the frequency of this intoxication is high, such as in eastern Uruguay, where it is considered one of the most common acutely toxic plants (Matto *et al*., 2010). In Argentina, this intoxication seems to be sporadic (Micheloud and Saravia-Peretti, 2014; Garcia *et al*., 2017); however, in northwestern Argentina, outbreaks occur frequently, as observed in this work.

All the clinical findings described in this work coincide with those mentioned in the literature (Riet-Correa *et al*., 1986; Matto *et al*., 2010; Micheloud and Saravia-Peretti, 2014). Clinical signs can be variable, and sometimes they may not be present, since several animals are found dead without showing any signs in some outbreaks as described herein. The most important pathological finding was hepatic centrilobular necrosis, which is similar to the findings described in intoxications caused by other species of the genus *Cestrum* (Riet-Correa *et al*., 1986; Furlan *et al*., 2008; Bandarra *et al*., 2009; Coutinho *et al*., 2013; Wouters *et al*., 2013; Oliveira *et al*, 2017) and other hepatotoxic species present in South America, such as *Pascalia glauca* and *Xanthium strumarium* (Machado *et al*., 2021; Medina *et al*., 2022).

Although *Cestrum parqui* is not the only plant capable of producing this type of lesion, the simultaneous findings of compatible clinical signs and the presence of the plant with evidence of having been consumed by the affected animals are enough to establish a strong presumptive diagnosis (Riet-Correa, 1986). It is worth mentioning that the micro-histological evaluation of ruminal content for the identification of *Cestrum parqui* can be an important diagnostic tool in cattle (Costa *et al*., 2014), but with little use at present due to the absence of specialists to carry out such studies. Moreover, the sensitivity and specificity of this diagnostic tool have only been tested in experimental conditions and not in natural cases, which may interfere with the interpretation of the results (Yagueddu *et al*., 1998). For this reason, —in practice— the hallmark, of compatible clinical and pathological findings, associated with the presence of the plant with evidence of having been consumed and in the absence of other hepatotoxic agents, are considered sufficient to establish the diagnosis of this poisoning (Bailey, 2019, Medina *et al*., 2022).

As with other plants that produce hepatic necrosis, morbidity is variable, but lethality is high. In outbreaks of poisoning by *C. parqui* and other species of the same genus recorded in Brazil, morbidity ranged from 6.5 to 30%, and lethality was 100% (Riet-Correa *et al*., 1986; Furlan *et al*., 2008; Bandarra *et al*., 2009; Coutinho *et al*., 2013; Wouters *et al*., 2013; Oliveira *et al*., 2017). According to results from this study, the average incidence rate was 9.9±7.2% (Max=25% Min=2,7%) and lethality was 100% in all outbreaks.

In most outbreaks, deaths occurred between 3 and 10 days after the animals entered the infested lot. In only 3 of the total cases deaths were sporadic, with 1 to 2 animals per week over a period of up to 3 weeks. As described in the literature, deaths continued for 24 to 72 hours after the animals were removed from the infested lot (Riet-Correa *et al*., 1986; Furlan *et al*., 2008; Bandarra *et al*., 2009; Coutinho *et al*., 2013; Wouters *et al*., 2013). The present work showed that all categories can be affected—heifers and steers (50%), cows (30%) and calves (20%) respectively.

In northeastern Uruguay, this poisoning occurs throughout the year and problems due to this plant are accentuated during the drought years, when forage is scarce and there is a high stocking rate (Matto *et al*., 2010). In regards to the cases described in this study, although we cannot be conclusive, we can affirm that most outbreaks occurred during winter, a dry season in which forage supply is still low. However, in the state of Rio Grande do Sul, although outbreaks occur especially in spring, this poisoning does not seem to be related to lack of forage (Riet-Correa *et al*., 1986). In some of the cases described in this study, although there was not always a shortage of forage, the stocking rate was too high and the animals were forced to ingest other plants, such as *C. parqui*. Moreover, in many of the outbreaks described in this work, the plant was located near the trees surrounding the paddocks, next to the watering places. It is estimated that the animals remained in the shade of the trees when they went to drink water and to protect themselves from the sun, and that was the moment they ingested the plant.

Finally, plant poisoning is an ongoing problem for livestock throughout South America. However, despite its impact, the literature on this subject is scarce and is usually limited to the description of isolated cases. The epidemiological aspects described in this work contribute to the knowledge of *C. parqui* poisoning in northwestern Argentina and may be useful to mitigate the production losses caused by this plant.

REFERENCES

BAILEY, E.M. 2019. The importance of diagnosing poisoning from plants. The Ecology and Economic Impact of Poisonous Plants on Livestock Production. CRC Press. 337-346 pp.

BANDARRA P.M.; BEZERRA JÚNIOR, P.S.; CORRÊA, A.M.R.; PEDROSO P.M.O.; RAYMUNDO, D.L.; DRIEMEIER, D. 2009. Intoxicação natural por *Cestrum intermedium* em bovinos no Rio Grande do Sul, Brasil. Ciênc. Rural. 39: 262-265.

COSTA, E.; ZEINSTEGER, P.; STREITENBERGER, N.; GIMENO, E.; FAZZIO, L. 2013. Accidental Poisoning with *Wedelia Glauca* ("sunchillo") in a bull confirmed by analysis of rumen content. Revista veterinaria. 24(2):129-132.

COUTINHO, L.T.; COSTA, N.A.; MENDONÇA, C.L.; AFONSO, J.A.B.; RIET-CORREA, F.; DANTAS, A.F.M.; SILVA, N.A.A. 2013. Intoxicação natural de bovinos leiteiros por *Cestrum laevigatum* (Solanaceae) no agreste de Pernambuco – Brasil. Ciênc. Anim. Bras. 14: 352-359.

FURLAN, F.H.; LUCIOLI, J.; BORELLI, V.; FARIA JUNIOR, O.O.; REBELATTO, S.V.; GAVA, A.; TRAVERSO S.D. 2008. Intoxicação por *Cestrum intermedium* (Solanaceae) em bovinos no estado de Santa Catarina. Acta Sci. Vet. 36: 281-284.

LEMASTERS, J. 1978. Phosphate Oxidative. The Journal of Biological Chemistry, 254 (4): 1248-1251.

MACHADO, M.; QUEIROZ, C.R.R.; WILSON, T.M.; SOUSA, D.E.R.; CASTRO, M.B.; SARAVIA, A.; LEE, S.T.; ARMIÉN, A.G.; BARROS, S.S.; RIET-CORREA, F. 2021. Endemic *Xanthium strumarium* poisoning in cattle in flooded areas of the Araguari River, Minas Gerais, Brazil. Toxicon. 200: 23-29.

MATTO ROMERO, C.; GIANNEECHINI, E.; RIVERO, R. 2010. Descripción de focos de intoxicación por *Cestrum parqui* (Duraznillo negro) en bovinos diagnosticados por el laboratorio regional noroeste, DILAVE" Miguel C. Rubino" en el período 1998-2010. XXXVIII Jornadas Uruguayas de Buiatría.

MEDINA, D.M.; AGUIRRE, L.S.; MARIN, R.E.; MICHELOUD, J.F. 2022. *Pascalia glauca* poisoning in ruminants: Report of 12 outbreaks in northwestern Argentina. Toxicon 214, 108-111.

MICHELOUD, J.F.; SARAVIA PERETTI, F. 2014. Intoxicación en terneros con *Cestrum parqui* L´ Hér («hediondilla») en un establecimiento del Dpto. de Anta, Prov. de Salta (Argentina). Cuadernos de la Facultad de Ciencias Agrarias y Veterinaias vol. 2, 57-62, Editorial Universidad Católica de Salta (EUCASA).

OELRICHS, P.B.; PEARCE, C.M.; KUDO, K.; KELLY, W.R. 1994. The isolation, structure, elucidation and toxicity of the kaurene glycosides parquin and carboxiparquin in *Cestrum parqui*. In: COLEGATE, S.M.; DORLING, P.R. (Eds.). Plants Associated Toxins. CAB International, Wallingford. 251-256 pp.

OLIVEIRA NETO, T.S.; RIET-CORREA, F.; BARBOSA, F.M.S.; SILVA, C.M.B.A.; MARQUES M.F.S.; NÓBREGA, G.D.; SIMÕES, S.V.D.; LUCENA, R.B. 2017. Natural and experimental poisoning by *Cestrum laevigatum* (Solanaceae) among cattle in the agreste region of Paraíba, Brazil. Semina: Ciênc. Agrár. 38: 3123-3132.

RIET CORREA, F.; MACHADO, M.; MICHELOUD, J.F. 2023. Plants causing poisoning outbreaks of livestock in South America: a review. Toxicon X. https://doi.org/10.1016/j.toxcx.2023.100150

RIET-CORREA, F.; SCHILD, A.L.; MÉNDEZ, M.C.; PINHEIRO, M.H. 1986. Intoxicação por *Cestrum parqui* (Solanaceae) em bovinos no Rio Grande do Sul. Pesq. Vet. Bras. 6: 111-115.

UBIALI DG, Lee ST, Gardner DR, Cook D, Pereira GO, Riet-Correa F. Cestrum axillare (Solanaceae) poisoning in ruminants. Toxicon. 2022 Oct 30; 218:76-82. doi: 10.1016/j.toxicon.2022.09.005

WOUTERS, A.T.B.; BOABAID, F.M.; WATANABE, T.N.; BANDARRA, P.M.; CORREA, G.L.F.; WOUTERS, F.; MAFESSONI, R.M.; DRIEMEIER, D. 2013. Intoxicação espontânea por *Cestrum intermedium* em bovinos no sudoeste do estado do Paraná. Pesq. Vet. Bras. 33: 47-51.

YAGUEDDU, C.; CID, M.S.; LOPEZ, T. 1998. Microhistological analysis of sheep gastro-intestinal content to confirm poisonous plant ingestion. Rangeland Ecology & Management/Journal of Range Management Archives, 51(6), 655-660.