

## Seneciosis in cattle associated with photosensitization<sup>1</sup>

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**ABSTRACT.**- Giaretta P.R., Panziera W., Galiza G.J.A., Brum J.S., Bianchi R.M., Hammerschmitt M.E., Bazzi T. & Barros C.S.L. 2014. **Seneciosis in cattle associated with photosensitization.** *Pesquisa Veterinária Brasileira* 34(5):427-432. Laboratório de Patologia Veterinária, Departamento de Patologia, Universidade Federal de Santa Maria, Camobi, Santa Maria, RS 97105-900, Brazil. E-mail: claudioslbarros@uol.com.br

*Senecio* spp. poisoning is the main cause of cattle mortality in the central region of Rio Grande do Sul. This paper reports an outbreak of seneciosis in cattle with high prevalence of photosensitization, where 83 out of 162 cows (51.3%) presented this clinical sign. The outbreak occurred in September 2013, affecting adult cows that were held in a 205 hectare-pasture from April to October 2013 with abundant *Senecio brasiliensis* infestation. Main clinical signs were weight loss, excessive lacrimation or mucopurulent ocular discharge, nasal serous discharge, ventral diphtheric glossitis, crusts in the nose, teats, dorsum of ears, and vulva. Liver biopsy was performed in all the cows under risk; the histopathological findings in the liver biopsies consisted of fibrosis, megalocytosis, and biliary ductal proliferation and were present in 73.4% of the biopsied animals. Six cows had increased serum activity of gamma glutamyl transferase. Three affected cows were necropsied. The main necropsy findings were a hard liver, distended gall bladder, edema of the mesentery and abomasum. Liver histological changes in the necropsied cows were similar to those of the biopsied livers. Spongiosis was detected in the brain of necropsied cows and is characteristic of hepatic encephalopathy.

INDEX TERMS: Poisonous plants, *Senecio brasiliensis*, Asteraceae, photosensitization, liver, seneciosis, plant poisoning, cattle disease.

**RESUMO.- [Seneciose em bovinos associada a fotossensibilização.]** A intoxicação por plantas do gênero *Senecio* é a principal causa de morte de bovinos na região central do Rio Grande do Sul. Neste trabalho, relata-se um surto de intoxicação por *Senecio brasiliensis* em bovinos com alta prevalência de fotossensibilização, onde 83 vacas de um to-

tal de 162 (51,3%) apresentaram esse sinal clínico. O surto ocorreu em setembro a outubro de 2013, acometendo vacas adultas que foram colocadas de abril a início de outubro de 2013 em um campo de 205 hectares com abundante infestação por *Senecio brasiliensis*. Os principais sinais clínicos foram emagrecimento, lacrimejamento excessivo ou secreção ocular mucopurulenta, secreção nasal serosa, glossite diftérica ventral e crostas no plano nasal, tetos, ponta das orelhas e na vulva. Realizou-se biópsia hepática em todas as vacas do rebanho; os principais achados histopatológicos nas biópsias hepáticas foram fibrose hepática, megalocitose e proliferação de ductos biliares. As lesões hepáticas foram observadas em 73,4% dos bovinos submetidos à biópsia hepática. Seis vacas testadas apresentaram aumento da atividade sérica da gama glutamyl transferase. Três vacas doentes foram necropsiadas. Nas vacas necropsiadas, o fígado era firme, a vesícula biliar distendida e havia edema do mesentério e do abomaso. As lesões histológicas observadas nos fígados dos bovinos necropsiados eram semelhantes às encontradas nas biópsias hepáticas.

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Espongiose foi detectada no cérebro das vacas necropsiadas e é uma lesão característica de encefalopatia hepática.

TERMOS DE INDEXAÇÃO: Plantas tóxicas, *Senecio brasiliensis*, Asteraceae, fotossensibilização, fígado, seneciose, intoxicação por plantas, doenças de bovinos.

## INTRODUCTION

Seneciosis is a chronic hepatotoxicosis of livestock caused by the ingestion of *Senecio* spp. plants that contain pyrrolizidine alkaloids (Kellerman et al. 2005). It is the main cause of death in adult cattle in the central region of Rio Grande do Sul (Barros et al. 1992, Rissi et al. 2007). A survey in the files of our laboratory confirms that statement, since in 6.706 recorded necropsies of cattle, *Senecio* spp. poisoning accounted for over 50% of the deaths (Lucena et al. 2010). Two most important texts on plant poisonings in livestock (Kellerman et al. 2005, Tokarnia et al. 2012a) classify *Senecio* spp. as plants that cause hepatotoxicosis without causing photosensitization, or infrequently causing it, a statement which is in accordance with our previous observations (Barros et al. 1992).

The purpose of this paper is to report a large outbreak of seneciosis in cattle in which the main clinical sign was photosensitivity.

## MATERIALS AND METHODS

Data for this report were obtained during five on-site visits to the farm where the problem occurred. During these visits the pastures were observed in detail and all the cows under risk were clinically examined. Six affected cows were bled for liver function tests (aspartate aminotransferase [AST], gamma glutamyl transferase [GGT], alkaline phosphatase [AP]), and complete red cell count. Liver biopsy was performed in all 162 cows according to previously described (Barros et al. 2007). Necropsies were performed in three affected cows from which several tissues were sampled and routinely processed for histopathology. Plant specimens were sent to the Botanic Department at *Universidade Federal de Santa Maria* for classification.

## RESULTS

The outbreak occurred in a farm located in the municipality of São Sepé, Rio Grande do Sul, Brazil (30°09'38" South, 53°33'55" West, 85 meters above sea level). The population under risk consisted of 162 pregnant cows which were impregnated in November/December, 2012. In April/May, 2013 the 162 cows were placed in 205 hectare-pasture (Pasture 1) where they were additionally fed rice stubs hay and proteinated salt supplement<sup>5</sup>. In October 3, 2013 the 162 cows were moved to another pasture (Pasture 2) that used to be a soybean crop which had been harvest in April that year. The cows stayed in Pasture 2 until October 23, 2013. The majority of the 162 cows calved between August and September 2013. In late September a disease characterized by weight loss and photosensitization was noted affecting several cows which were then moved to another pasture (Pasture 3).

The grass of Pasture 1 consisted almost exclusively of South African lovegrass (*Eragrostis plana* Nees) or, as it is named in Brazil, capim-annoni. *Senecio brasiliensis* (Fig.1) was abundant in part (about 85 hectares) of Pasture 1. No known toxic plants were observed either in Pasture 2 or 3. Dry soybean stubs were abundant in Pasture 1.

The first sick cows were observed in the second half of September 2013. Main observed clinical signs were weight loss and photosensitization. By October 25, 2013, when liver biopsy was carried out in the 162 cows under risk, it was estimated that loss of weight was 50-80 kg per affect cow although some affected cows that subsequently died with acute clinical signs were in good body condition.

Clinical findings of photosensitization included photophobia, excessive lacrimation or mucopurulent ocular discharge (Fig.2), and nasal serous discharge which provoked a continuous licking of the nose (Fig.3) resulting in ventral diphteric glossitis (Fig.4) due to persistent exposure of the ventral surface of the tongue to sunlight. Skin lesions were frequently seen in the nose (Fig.5), teats (Fig.6), dorsum of ears (Fig.7), vulva and vagina (Fig.8), and over the tuberosity of the ischium. The initial lesions were edematous and erythematous with fluid oozing through the affected skin to form crusts. Those then progressed and within 15-30 days the necrotic skin became dry and parchment-like. These portions of sloughed off imparting to the lesion an aspect of the bark of a tree (Fig.9). Some of the cows that died presented behavioral changes. They presented compulsive aimless walking, mania and seek water ponds and woods.



Fig.1. Blooming *Senecio brasiliensis* specimen observed in the pasture where the cattle affected in the outbreak of seneciosis were held.

<sup>5</sup> Presencefós. In Vivo Nutrição e Saúde Animal Ltda, Rua Guilherme Schell, 10.780, Canoas, RS 92420-000, Brazil.

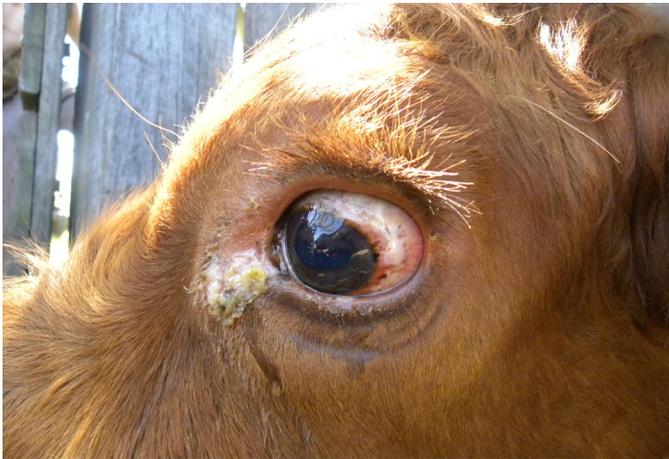


Fig.2. Cow affected with photosensitivity due to liver failure in *Senecio brasiliensis* toxicosis showing conjunctival hyperemia and mucopurulent ocular discharge.



Fig.3. Cow affected with photosensitivity due to liver failure in *Senecio brasiliensis* toxicosis showing nasal discharge which provoked a continuous licking of the nose.

Serum activity of GGT was increased in six affected cows that were tested, with values varying from 181-799 U/L (reference values: 6.1-17.4 U/L). All the other hematological and serological parameters tested were within normal limits.

Lesions found at necropsy of two affected cows were essentially similar. There were striking edema of the mesentery, ascites, and marked distension of the gallbladder. The liver was diffusely firm and had a multinodular cut surface in two cows and a smooth appearance in another one.

Histologically, in biopsied and necropsied cows there was disruption of hepatic architecture, where the cords and lobules were dissected by abundant connective tissue and fibroblasts. Remaining hepatocytes had vacuolated cytoplasm and appeared to form nodules surrounded by connective tissue (Fig.10). Enlarged hepatocytes (megalocytosis) were seen mainly in periportal areas (around five megalocytes by high-power field). There were marked bile ducts proliferation and a small amount of a yellowish pigment was present in bile canaliculi. In the brain of necropsied cows, there was mild vacuolation (*status spongiosus*,



Fig.4. Cow affected with photosensitivity due to liver failure in *Senecio brasiliensis* toxicosis showing ventral diptheric glossitis caused by persistent exposure of the ventral surface of the tongue to sunlight.



Fig.5. Erosions and ulcerations of the nasal plane covered by crusts in a cow with photosensitivity due to liver failure in *Senecio brasiliensis* toxicosis.

spongiosis) observed mainly at the junction of the cerebral grey matter and subcortical white matter of the frontal, parietal and occipital telencephalon, and basal ganglia.

Liver damage characteristic of pyrrolizidine alkaloid poisoning was present in 119 (73.4%) of the 162 biopsied cows. Affected cows were classified in groups according to the severity and morphological aspects observed. Forty-five were classified as mildly affected, i.e. presented only megalocytosis or megalocytosis associated to mild periportal fibrosis. Thirty nine cows were moderately affected; these showed megalocytosis, bile ducts proliferation, and/or moderate periportal to coalescing fibrosis. Thirty-five cows were considered severely affected, i.e. presented megalocytosis associated to marked bile ducts proliferation and diffuse hepatic fibrosis dissecting the hepatocytes cords.

## DISCUSSION

Photosensitization, is a severe dermatitis of animals resulting from a reaction induced by fluorescent pigments depo-

sited in tissues and exposed to ultraviolet (UV) wave length sunlight (Rowe 1989). This inflammatory reaction is most severe in non pigmented skin where these reactive compounds are most directly exposed to light in the UV spec-



Fig.6. Skin of teats and udder showing ulcerations and crusts. Photosensitivity due to liver failure in *Senecio brasiliensis* toxicosis.



Fig.7. Crusts and ulcers of the skin of the dorsum of ears. Photosensitivity due to liver failure in *Senecio brasiliensis* toxicosis.



Fig.8. Fibrinonecrotizing vulvitis and vestibulitis. Cow with photosensitivity due to liver failure in *Senecio brasiliensis* toxicosis.



Fig.9. Cow with photosensitivity due to liver failure in *Senecio brasiliensis* toxicosis. Portions of sloughed off necrotic skin imparting to the lesion an aspect of the bark of a tree.

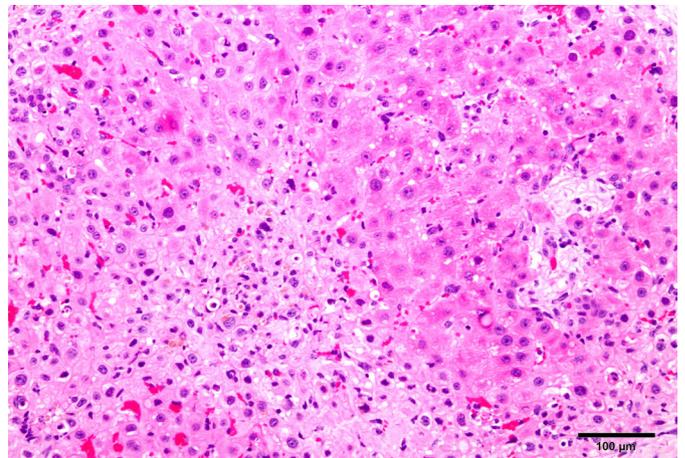


Fig.10. Liver biopsy of an affected cow in the outbreak of seneciosis. Disruption of hepatic architecture. The lobules are dissected by abundant fibrous connective tissue. The remaining hepatocytes form nodules surrounded by connective tissue. Numerous megalocytes can be observed. HE, obj.20x.

trum. Photosensitization is classified into two major types – primary and secondary (Knight & Walter 2001). Primary photosensitization is associated with photodynamic compounds present in certain plants which once absorbed from the digestive tract react in the nonpigmented skin with UV light to cause severe dermatitis. Secondary or hepatogenous photosensitization occurs when the liver fails to remove phylloerythrin, a bacterial breakdown product of chlorophyll that can react with UV light to cause photosensitization (Tokarnia et al. 2012b). In Brazil as in other parts of the world, the hepatogenous type of photosensitization is far more common and severe than the primary photosensitization (Tokarnia et al. 2012b). Main plants that may cause primary photosensitization in livestock in Brazil include *Fagopyrum esculentum*, *Ammi majus*, and *Froehlichia humboldtiana*. The latter two were described in Southern and Northeastern Brazil respectively. *F. esculentum* is a crop from southern Brazil but there is no report of photosensitization in livestock associated with this plant in

the country (Tokarnia et al. 2012b). Several plants are associated with hepatogenous photosensitization in livestock in Brazil including *Brachiaria* spp., *Lantana* spp., *Panicum dichotomiphlorum*, *Myoporum laetum*, and *Enterolobium gummiferum* (Tokarnia et al. 2012b). None of these plants were found in the pasture where the outbreak reported here occurred.

The pasture of the farm where this outbreak occurred were highly infested by blooming *Senecio brasiliensis*. In addition, histopathological findings in the liver of biopsied and necropsied cows were characteristic of pyrrolizidine alkaloid poisoning in cattle (Driemeier et al. 1991, Barros et al. 1992). Chronic aflatoxicosis should be considered as a differential diagnosis (Pierezan et al. 2010) but this was ruled out since adult cattle are relatively resistant to aflatoxicosis and did not have access to possible aflatoxin sources. Therefore, it was concluded that *Senecio brasiliensis* poisoning was the culprit in this outbreak.

Additionally to being present in *Senecio* species, pyrrolizidine alkaloids are also found in plants of the following genera: *Crotalaria*, *Erechtites*, *Heliotropium*, *Echium*, *Trichodesma*, *Cynoglossum* and *Amsinckia* (Stalker & Hayes 2007, Tokarnia et al. 2012b). These plants when ingested cause progressive and irreversible damage to hepatocytes characterized by mitotic inhibition. Hepatocytes do not divide further, but still synthesize DNA and this causes them to increase in size, i.e. megalocytosis (McLean 1970). Eventually hepatocytes die and fibroplasia and bile ducts proliferation take in (Stalker & Hayes 2007). In terminal phases, hepatocytes do not metabolize urea and hyperammonemia ensues. Hyperammonemia is considered the cause of death in seneciosis (Stalker & Hayes 2007). Ammonia is toxic to the central nervous system causing vacuolation (spongiosis) in the white matter (Riet-Correa & Méndez 2007, Stalker & Hayes 2007), as observed cattle of this outbreak. Clinical signs are characteristic of hepatic encephalopathy: apathy or hyperexcitability, incoordination, aggression, tenesmus, diarrhea, and rectal prolapse usually for 24-96 hours (Barros et al. 1987).

Photosensitization related to hepatic damage due seneciosis is not a common finding in cattle (Barros et al. 1987), differently from sheep (Barros et al. 1989, Ilha et al. 2001) and horses (Pilati & Barros 2007). However, there are few reports of *Senecio* poisoning in cattle in which the clinical course was prolonged (20-60 days) and the main clinical sign was photosensitization (Motta et al. 2000, Guagnini et al. 2006) as was the case of the cows from this report. When hepatic damage is multifocal, photosensitization tends to be less likely, because there are enough healthy hepatocytes to remove phyloerythrin from bloodstream (Kellerman et al. 2005). In these cases, the hepatic injury was diffuse with substitution of the hepatic parenchyma by connective tissue. Supplementation with proteinated salt might have increased the ingestion of *S. brasiliensis*, since the administration of protein sources is known to enhance intake and digestibility of low-quality forages (Köster et al. 1996).

Liver function tests showed elevated serum level activity of gamma glutamyl transferase (GGT), which is an

induced enzyme. GGT increased serum activity in cholestasis may occur by an increase in enzyme production and solubility of GGT adhered to the cell membrane (Hoffmann & Solter 2008). Serum GGT activity remains high throughout the course of the disease, whereas other enzymes are constantly changing. Consequently the determination of serum GGT activity is the best parameter for biochemical diagnosis of *Senecio* spp. poisoning in cattle (Johnson et al. 1985, Craig et al. 1991, Barros et al. 2007).

In conclusion *Senecio* spp. poisoning in cattle should be a differential diagnosis in cases of photosensitivity. Although uncommon, cases of photodermatitis associated with seneciosis have been reported, especially if the clinical course is prolonged and liver damage is diffuse. The diagnosis can be made through liver biopsy and epidemiological evidences.

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