Ethnobotanical Study of Plants Poisonous to Cattle in Eastern Colombia

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Abstract

A survey of the plants considered to be poisonous to cattle was conducted in eastern Colombia by veterinarians and biologists. This area is characterized by high flora diversity and a large cattle population (approximately 5 million bovines, or 19 percent of the total population in Colombia). Livestock producers on 148 farms were queried about plants empirically known to be poisonous and the effects associated with these plants. Nineteen plants were recognized as toxic by more than two respondents, with *Enterolobium cyclocarpum* the most frequently pointed out by the producers. The plant families and number of species identified as poisonous were Apocynaceae (six), Bignonaceae (three), Verbenaceae (two), Sapindaceae (two), Cyperaceae (one), Heliconaceae (one), Fabaceae (one), Phytolaccaceae (one), and Solanaceae (one). Frequently reported toxic effects were sudden death and photosensitization.

Keywords: Apocynaceae, Colombia, *Enterolobium cyclocarpum*, ethnobotany, poisonous plants

Introduction

Cattle production is an important economic activity in Colombia, which has the ninth largest cattle population in the world (FAO 2010). Cattle are raised extensively on native rangelands, where animals have access to a diverse flora. The flora of Colombia has the second highest biodiversity of plants worldwide (Romero et al. 2008); thus the potential for plant poisoning is high. In the eastern plains of Colombia, where animal husbandry is practiced extensively, significant economic losses to the livestock industry have been reported from a number of toxic plants.

Toxic plants affect cattle in many ways. Signs include muscular weakness, weight loss, gastrointestinal and neuromotor abnormalities, photosensitivity, bleeding, abortions, and birth defects. Sudden death can occur without the presentation of clinical signs (Plumlee 2004). Clinical signs have been attributed to various toxic compounds, including nitrates, oxalates, cyanogenic glycosides, cardiac glycosides, monofluoracetic acid, ptaquiloside, and alkaloids (Frohne and Pfander 2005, Diaz 2010).

The negative economic impact on livestock farms caused by toxic plants is attributed to losses due to livestock deaths, decreased performance parameters, and the need for preventive or therapeutic interventions (Nielsen 1988, Riet-Correa and Medeiros 2001). A first approach to avoid the negative impact of toxicoses on cattle farms is the identification of plant species that can affect animals, using ethnobotany as a source of information. By surveying livestock producers, this study describes the toxic plants that are frequently recognized in the Colombian Orinoco region, where 19 percent of the cattle population in the country is located.

Materials and Methods

The study was conducted in the Colombian Orinoco, specifically in the states of Meta and Casanare, where the largest number of cattle are concentrated. Rainfall in this region may exceed 3,000 mm/year, with a rainy season occurring from April to November, and a dry season from December to

March. The temperature ranges from 22 to 27°C. The relative humidity is above 80 percent during the rainy season and between 60 and 65 percent during the dry season (Rippstein et al. 2001). Meta and Casanare are located between 1° 36' 52" and 6º 20' 45" North latitude and 69° 50' 28" and 74° 53' 57" West longitude, comprising a total of 48 municipalities (29 in Casanare and 19 in Meta), 35 of which were included in this study (figure 1). The total area encompasses approximately 131,000 km^2.

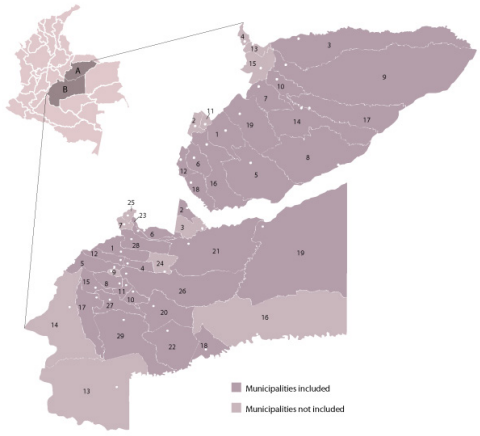

Figure 1. Map of the region considered in this study. The Departments (A and B) and municipalities include: A—Casanare: 1. Aguazul, 2. Chámeza, 3. Hato Corozal, 4. La Salina, 5. Maní, 6. Monterrey, 7. Nunchía, 8. Orocué, 9. Pore, 10. Recetor, 11. Sabanalarga, 12. Sácama, 13. San Luis de Palenque, 14. Támara, 15. Tauramena, 16. Trinidad, 17. Villanueva, 18. Yopal. B—Meta: 1. Acacías, 2. Barranca de Upía, 3. Cabuyaro, 4. Nueva Castilla, 5. Cubarral, 6. Cumaral, 7. El Calvario, 8. El Castillo, 9. El Dorado, 10. Fuente de Oro, 11. Granada, 12. Guamal, 13. La Macarena, 14. La Uribe, 15. Lejanías, 16. Mapiripán, 17. Mesetas, 18. Puerto Concordia, 19. Puerto Gaitán, 20. Puerto Lleras, 21. Puerto López, 22. Puerto Rico, 23. Restrepo, 24. San Carlos de Guaroa, 25. San Juanito, 26. San Martín, 27.San Juan de Arama, 28. Villavicencio, 29. Vista Hermosa.

Municipalities in the Andean natural region and those under armed conflict (civil war) were excluded from the study. For 6 months (July-October 2009 and February-April 2010), trained staff (veterinarians and biologists) visited a total of 148 cattle farms, where the same number of people in charge of handling animals (producers, farmers, veterinarians, and animal scientists) were surveyed to determine which plants they recognized as toxic and queried as to their effects in animals. After the survey, animals in all farms were inspected to detect any signs associated with poisonous plant consumption. In areas where plants considered to be toxic were present, a taxonomic specimen was collected and sent for identification at the Colombian National Herbarium, where specimens were deposited with their respective voucher. To further support the information gathered in this study, only those plants perceived as toxic by at least two people were included. The data collected were analyzed using descriptive statistics. The identification rate was calculated taking into account the number of people identifying a particular plant as toxic in relation to the total number of surveys (148).

Results

A total of 19 plants were identified by more than 2 surveyed people as being poisonous to cattle. Each identified plant is listed in table 1, along with its common name, associated effects, and identification rate.

The plant most frequently identified as poisonous was *Enterolobium cyclocarpum* (figure 2), with an identification rate of 29.1 percent (49 respondents). The fruits of this plant are empirically recognized as a cause of photosensitization. Sudden death syndrome and photosensitivity were the more commonly reported manifestations of cattle intoxication. Other signs attributed to the consumption of these plants are frequent bone fractures, prostration, bloating, nervous signs, and muscular weakness.

The 19 plants are grouped in 9 recognized botanical families, with the largest number of plants being clustered under the family Apocynaceae (6), followed by Bignonaceae (3), Sapindaceae and Verbenaceae (2 plants each), and Cyperaceae, Heliconaceae, Fabaceae, Phytolaccaceae, and Solanaceae, each family with one plant.

Discussion

In order to consider a plant to be toxic for livestock, the poisoning must occur naturally, and the toxicosis must be reproduced under experimental conditions in the animal species involved (Tokarnia et al. 2000, Diaz 2010). Therefore, a careful assessment should be made before attributing a toxicological activity to a plant. Of the 19 plants empirically identified as being toxic to cattle in this study, toxicosis has only been successfully reproduced experimentally with *E. cyclocarpum* and *Petiveria alliacea*, which have been shown to produce the signs quoted by the surveyed population, i.e. photosensitization and muscle weakness, respectively (Núñez et al. 1983, Negrón et al. 1993).

Table 1. Plants identified as poisonous to cattle in the Departments of Meta and Casanare in Colombia by the surveyed population and the main clinical signs associated with their consumption.

Latin name	Family	Common name	(%)*	Main signs
Enterolobium cyclocarpum	Fabaceae	Caracaro	29.1	Photosensitization
Tabernaemontana siphilitica	Apocynaceae	Borrachero arbustivo, borrachero negro	12.8	Sudden death
Marsdenia rubro-fusca	Apocynaceae	Borrachero rojo	10.8	Nervous signs
Mesechites trifidus	Apocynaceae	Borrachero blanco	8.8	Sudden death
Mandevilla trianae	Apocynaceae	Borrachero blanco	8.8	Sudden death
Lantana cujabensis	Verbenaceae	Mermelada	6.1	Photosensitization
Tabernaemontana heterophylla	Apocynacae	Borrachero turma de gato, cojón	6.1	Sudden death
Stemmadenia grandiflora	Apocynaceae	Borrachero turma de perro, jazmín malabar	6.1	Sudden death
Solanum mammosum	Solanaceae	Lulo de perro, friega platos, pepito	4.1	Prostration
Heliconia latispatha	Heliconaceae	Heliconia	2.7	Bone weakness
Adenocalymma purpurascens	Bignonaceae	Barbasco cuatro filos	2.7	Nervous signs
Arrabidaea sceptrum	Bignonaceae	Bejuco mataganado	2.7	Sudden death
Mussatia prieurei	Bignonaceae	Bejuco mataganado	2.7	Sudden death
Serjania grandis	Sapindaceae	Rabo de iguana	2.7	Prostration
Lantana maxima	Verbenaceae	Mermelada	2.7	Photosensitization
Polygonum punctatum	Polygonaceae	Barbasco rojo	1.4	Nervous signs
Rhynchospora nervosa	Cyperaceae	Tote, estrella	1.4	Photosensitization
Paullinia alata	Sapindaceae	Bejuco camándula	1.4	Nervous signs
Petiveria alliacea	Phytolacaceae	Anamú	1.4	Muscle weakness

*Percentage of people who identified a plant as toxic in relation to the total number of people surveyed (148). A minimum of 2 respondents had to identify a plant as toxic for inclusion on this list.

Figure 2. Left, *Enterolobium cyclocarpum*, the most frequently identified poisonous plant affecting cattle, as reported by the surveyed population. Right, fruits of *E. cyclocarpum*, the part of the plant considered to be toxic.

According to the taxonomic classification, the plant family with the largest number of species was Apocynaceae (6), which collectively was the most recognized as toxic after *E. cyclocarpum* (Fabaceae). Among Apocynaceae species, *Stemmadenia grandiflora*, *Tabernaemontana siphilitica* (syn. *Bonafousia tetrastachya*), *Mandevilla* sp., and *Mesechites trifidus* have been previously reported by livestock producers to cause poisoning in cattle, with nervousness and death as the primary clinical signs associated with their consumption (Vargas et al. 1998, Velásquez et al. 2000). However, there are no studies describing the detailed clinical signs associated with their consumption either after natural or experimental poisoning.

Some Apocynaceae plants (*Asclepias curassavica*, *Nerium oleander*, *Thevetia peruviana*) are known to contain cardiac glycosides that can cause rapid death in humans and animals (Barbosa et al. 2008, Bandara et al. 2010), and their presence has been documented in Colombia (Diaz 2010, 2011). Similarly, the *Stemmadenia* and *Tabernaemontana* genera have been verified to contain indole alkaloids, which can be toxic (Van-Beek et al. 1984, Torrenegra et al. 1988, Upmanyu et al. 2009). It is therefore necessary to investigate the identity of the metabolites present in the Apocynaceae species reported here as well as to conduct studies to determine the toxic effects of these plants in cattle.

In the present study, *Arrabidaea sceptrum* was recognized as a cause of sudden death. Although there are no scientific studies reporting this particular species to be toxic, other species of the genus, such as *A. bilabiata* and *A. japurensis*, have been noted to have the same effect on cattle (Tokarnia et al. 2002). Additionally, *A. bilabiata* has been reported to contain monofluoracetic acid (Krebs et al. 1994), which is a highly toxic substance that can block the citric acid cycle and cause rapid death (Diaz 2010). It is possible that *A. sceptrum* contains the same toxic compound as *A. bilabiata*, but this hypothesis must be tested.

Lantana maxima and *L. cujabensis* are species without reports of toxicological implications; however, another species of this genus, *L. camara*,

has been found to contain lantadenes, compounds that cause liver damage. Lantadenes affect the biliary excretion of photoactive compounds and cause photosensitization (Sharma et al. 2007), an effect that has been attributed to the *Lantana* spp. reported here.

Paullinia alata belongs to a genus of plants known for their content of methylxanthines (e.g. caffeine, theobromine, and theophylline) (Carlson and Thompson 1998). Other members of this genus include *Paullinia cupana* (guaraná), which is used in the production of energy drinks (Carlini 2003). It is possible that the nervous signs attributed by the surveyed workers to *P. alata* are the result of CNS stimulation caused by these compounds.

Based on the ethnobotanical use of some of these plants, several authors have identified a pharmacological activity associated with them. Specifically, we refer to *Solanum mammosum*, which is used in the treatment of respiratory disease due to its antimicrobial activity (Caceres et al. 1991); *Heliconia latispatha*, which is effective in the treatment of snake bites due to its proven haemolytic effect on *Bothrops asper* venom (Pereañez et al. 2008); and *Arrabideae sceptrum*, which has anti-inflammatory as well as antiviral activity (Brandao et al. 2010). Plant toxins can often be used as effective treatments for the same diseases (Molyneux et al. 2007). For example, *Polygonum punctatum*, recognized as toxic in this study, has antifungal activity that has been attributed to polygodial, a sesquiterpene aldehyde found in this plant (Almeida-Alves et al. 2001). Toxic plants may also be a rich source of new drug compounds, and therefore the general knowledge provided by the livestock or ethnobotany community is very useful for designing future studies related to the discovery of new pharmacologically interesting molecules. On the other hand, some of the plants cited here have not been reported to have any physiological activity (*Marsdenia rubrofusca*, *Adenocalymma purpurascens*, and *Serjania grandis*), which supports the need to conduct the appropriate phytochemical studies.

Regarding the signs and lesions associated with the plants reported in this study, sudden death and photosensitization were most frequently reported. Sudden death is a clinically inexplicable death that occurs rapidly (within 12-24 hours) during normal activity in apparently healthy animals with no history of significant disease (Bradford 1996). Nitrates, cyanogenic glycosides, cardiac glycosides, monofluoracetic acid, and some alkaloids are possible toxins that can cause sudden death (Tokarnia et al. 2000, Knight and Walter 2001). It is important to assess the potential presence of these toxins in the plants reported to cause sudden death.

Photosensitization was frequently reported by the surveyed people, and its occurrence was verified by field researchers in 85 percent (126) of the farms visited (figure 3). Plants reported to cause this condition were *Enterolobium cyclocarpum*, *Rhynchospora nervosa*, and *Lantana* spp. However, it is important to note that *Brachiaria* spp. (*B. decumbens*, *B. brizantha*, *B. humidicola*, *B. dyctioneura*, and a hybrid known as Mulato) are found abundantly in the studied area. This forage grass is fed to cattle as well as provided on many cultivated pastures. *Brachiaria* spp. are known to cause photosensitivity secondary to liver damage (Diaz 2011). In this study, 93 percent of the farms had *Brachiaria* pastures, which often contain steroidal saponins that can cause liver damage leading to photosensitization (Riet-Correa et al. 2011). It is essential to investigate which is the cause of the photosensitization in the cattle raised in this area of the Colombian eastern plains and to identify the relative contributions of *Enterolobium cyclocarpum*, *Rhynchospora nervosa*, *Lantana* spp., and *Brachiaria* spp. to cattle photosensitization.

Summary

Studies on plants toxic to animals are scarce in Colombia, even though this country has the second highest plant biodiversity in the world. A recent publication reports about 150 species of potentially toxic plants that comprise almost 100 genera and 34 botanical families (Diaz 2010). However, there is still a large number of species that remain to be studied and which can contribute to this problem. The present study adds to knowledge about toxic flora of the eastern zone of Colombia, where a high percentage of the cattle population in Colombia is located. The identification of the toxic plants prevailing in each region will help to decrease their economic impact on livestock farms. It is essential to conduct studies to confirm the ethnobotanical information associated with these plants using appropriate experimental models (ruminants) and to determine the identity of potentially toxic compounds. It should also be noted that these plants may contain compounds of pharmacological interest with potential applications in the treatment of human diseases.

Figure 3. Bovine (Nelore breed) with evidence of photosensitization.

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