Companion or pet animals

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Plants and mushrooms associated with animal poisoning incidents in South Africa

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ABSTRACT

Background There is extensive literature on animal poisoning from plants and mushrooms worldwide; however, there is limited account of poisoning from South Africa.

Methods This study sought to describe and provide an overview of animal poison exposures in South Africa. Poisoning episodes reported to the Poisons Information Helpline of the Western Cape, jointly run by the Poisons Information Centres at the Red Cross War Memorial Children's Hospital and Tygerberg Hospital over a period of approximately 2.5 years, from June 2015 to November 2017, were analysed to identify exposure patterns, severity and clinical outcomes.

Results Alien plant species accounted for most cases (n=10) of reported poison exposures. Among the 26 recorded animal poisoning episodes, the dog was the most commonly implicated species (n=24), whereas just two enquiries were related to other animals (one rabbit and one cow) . There were 20 plant cases and 6 mushroom cases (all dogs). There was only one fatal case involving cycad in a dog.

Conclusion Features of animal poisoning in South Africa were similar to those in other countries. The reported cases of animals exposed to poisonous plants and mushrooms could represent only a fraction of the actual exposures. Since most reported cases involved taxa that could not be identified to species level, more attention should be paid in case reporting and in animal poisoning prevention, engaging the public to enable people to recognise potentially hazardous plants and reduce the risk of poisoning in animals.

INTRODUCTION

Invasive plants are plants diffusing into areas outside of their natural habitat where they may have a negative effect. The dissemination process can be very rapid and leads to negative consequences[1] for the autochthonous species, affecting soil quality in terms of water and nutrients availability and also having a negative impact on the diversity of native species[2–5] because of their influence on factors such as solar irradiation and temperature levels. For these reasons, invasive plants are generally undesired,[6–11] even more so because of their impact on a large variety of animals quality and quantity of accessible food, refuge/nest sites, basking and perch spots.[12–14]

The most worrying issue is the emerging impact on human health,[15–18] mainly through skin exposure or ingestion leading to poisoning. Indeed, poisoning is a global concern both in humans and animals.[19–23] Animal poisoning occurs as a result of exposure to various toxic substances[22 24–26] and episodes due to plant exposure are anything but rare.[21–23 27–29] Long-term retrospective studies have shown that plants cause major animal poisoning: for example in Germany data of the Poison Centres (2012–2014) showed that plants and mushrooms accounted for 18.6 per cent of all the enquiries on animal (dogs, cats, horses, ruminants, rabbits/rodents and birds) poisoning and, as for calls involving a known toxicant (n=1752), plant and mushroom intoxications were responsible for the highest number of fatal cases (25.7 per cent), whereas in Italy plants accounted for 5.5 per cent of all the enquiries on animal (dogs, cats, horses, ruminants, rabbits, ferrets and exotics) poisoning received by the Poison Control Centre of Milan (2000–2010).[22 30] Buttke and others[27] indicated that between 2000 and 2010 in the USA, animal exposures resulted in 1 371 095 related cases; this represents 4.7 per cent of all the reported cases of poison exposures on humans and animals and, concerning the latter (dogs, cats, horses, ruminants, aquatics, birds and rodents), plants were responsible for 6.9 per cent of the cases.[27] Moreover, according to this study, 15 animal poison exposures occur every hour in the USA, and globally, there are several notable cases of animal poisoning.[21–23 25 27 28 31 32]

In addition, individual case reports addressing single animal exposures are often reported.[33–35] However, it is also worth noting that the underlying causes of animal poison exposures are difficult to ascertain due to various reasons, such as exposures occurring at night or going unobserved by the owners.[25 36] Furthermore, in developing countries, there is the challenge of under-reporting of poison exposure cases, which could be attributable to the lack of knowledge and infrastructures.[37]

Previous studies conducted in South Africa focused on poisoning in humans,[19 20 38–40] and only a few studies specifically focused on human poisonings due to plant exposures.[19 38] Plant poisoning in South Africa has been described for horses and livestock,[41 42] but no report describing poisoning exposures in all types of animals at a country scale has previously been published. Therefore, the aim of this study was to retrospectively collect, evaluate and analyse reports on plant and mushroom poisoning in animals in South Africa.

MATERIALS AND METHODS

A retrospective review of records from the Poisons Information Helpline of the Western Cape (PIH), jointly run by the Poisons Information Centres (PICs) at the Red Cross War Memorial Children's Hospital and Tygerberg Hospital, was conducted over approximately 2.5 years, from June 1, 2015 to November 30, 2017. Standard PIC consultation forms include the date, origin of the call (province and district), circumstance of exposure, animal characteristics (species/sex/age), substances involved, clinical signs and route of exposure (eg, oral). All reported cases related to animal poisoning between June 1, 2015 and November 30, 2017 were reviewed to identify those caused by plants and mushrooms . The plants were identified by experts in the PIC in consultation with Universities and the South African National Biodiversity Institute. According to the data, the causative substances were classified into three main categories: alien, native and unknown taxa (unknown taxa refers to cases involving taxa that could only be identified to genus level), the origin of plants follows the classification by Richardson and others,[1] alien plant species 'Plant taxa in a given area whose presence there is due to intentional or accidental introduction as a result of human activity'. The Gwaltney-Brant method[43] for classifying the severity of exposure was used postevent by the researchers, with the following categories: 'no signs', 'mild', 'moderate' or 'severe'.

RESULTS

The PIH handled 790 cases related to plants and mushrooms during the 2.5-year period and 26 recorded cases involving animals that were accidentally exposed to biological toxins (corresponding to 3.3 per cent of all animal-related exposures) (table 1). Of these enquiries, 24 cases involved dogs. Calls related to other species happened only two times, regarding one rabbit and one cow. In all reported cases, the route of exposure was ingestion.

Plants and mushrooms involved

Most reported cases involved plants (n=20, table 1), while mushrooms accounted for six cases (table 2). Cases involving plant species for which no records of poisoning in literature could be found were *Echeveria subsessilis* (one case involving a rabbit), *Mammillaria toluca* and *Phoenix sylvestris*. In 11 cases, the plants and mushrooms involved were not identified to species level.

Clinical signs and outcomes

We found that the majority of the reported cases showed no clinical signs (n=12), followed by less than a third of cases showing mild symptoms (n=8), while few cases showed moderate and major symptoms (n=3, figure 1). Most animals with clinical signs of poisoning recovered with treatment. The most common clinical signs were hypersalivation, vomiting, diarrhoea and weakness. An intoxication in a cow from *Sarcostemma viminale* was reported with the animal exhibiting hypersalivation and weakness possibly due to the presence of pregnane glycosides.[44] Severe symptoms developed in three dogs as a result of exposure to *Nerium oleander, Chlorophytum comosum* and cycad species, the last of which resulted in death after a dog ingested seeds of a cycad species.

Categories of the origin of species

Cases associated with alien plant species accounted for 10 out of 26 episodes, while unknown taxa were responsible for 12 out of 26 cases (ie, *Clivia* species, *Lycoperdon* species, *Malva* species, Cycad and mushrooms). Calls related to native species were much fewer in comparison (ie, *C comosum, Crassula perforata variegata, S viminale, Zantedeschia aethiopica*) (figure 2).

DISCUSSION

Limitations

The major limitation of the study is the limited number of cases reported; moreover, there is uncertainty as to whether the reported cases reflect the actual situation with regards to animals being affected (mostly dogs reported) and severity. Furthermore, there is the possibility that owners may call the poison centre reporting as poisonings, symptoms actually due to other medical conditions. It is also a weakness that other underlying causes of the symptoms described were not ruled out by veterinary professionals, in particular when plant poisoning was suspected but the involved plants were believed to be non-toxic. The plant/mushroom variables analysed in this study were limited by the lack of description of some of the reported species, since not all the plants and mushrooms could be identified to a species level. Nevertheless, it should be considered that toxicity can often be similar throughout a broader taxon, thus specific classification is not always essential. Moreover, the correct classification of the plants according to their

Table 1 List of the poisoning cases due to plants reported to the Poisons Information Helpline of the Western Cape (PIH), jointly run by the Poisons Information Centres (PICs) at the Red Cross War Memorial Children's Hospital and Tygerberg Hospital in South Africa from June 2015 to November 2017 with information on year of reporting, animal species involved, suspect plant species, active principles, origin of the plant species, severity of intoxication and clinical signs

		Suspected plant species					
Year	Animal poisoned	Taxon	Common name	Toxic compounds	Origin of plant species (native/alien/unknown)	Severity of intoxication (no sign/mild/moderate/severe/death)*	Clinical signs
2017	Dog	*Allium sativum*	Garlic	Alliin (NPAA) cleaved to allicin and various allylsulphides†; disulfides and sulfoxides.‡	Alien	No signs	Asymptomatic.
2017	Dog	*Brugmansia candida*	Angel's trumpet	Tropane alkaloids (eg, scopolamine, hyoscyamine and tigloidine).†	Alien	Severe	Vomiting and diarrhoea.
2016	Dog	*Chlorophytum comosum*	St. Bernard's lily	Non-toxic.‡§	Native	Severe	Severe vomiting and diarrhoea.
2016	Dog	*Crassula perforata variegata*	Variegated necklace vine	No information.	Native	No signs	Asymptomatic.
2016	Dog	*Duranta repens*	Pigeon berry	Iridoid glycosides (durantoside I, II and III); saponins; alkaloids (narcotine).	Alien	No signs	Asymptomatic.
2016	Rabbit	*Echveria subsessilis*	Morning beauty	No information.	Alien	No signs	Asymptomatic.
2016	Dog	*Euphorbia marginata*	Snow-on-the-mountain	Latex§; phorbol esters; triterenoids.†	Alien	Moderate	Vomiting.
2017	Dog	*Ficus carica*	Common fig	Latex§; fluranocoumarins, flavenoids, triterpenes and sesquiterpine glycosides.†	Alien	No signs	Asymptomatic.
2016	Dog	*Mammillaria toluca*	Mammillaria	No information.	Alien	No signs	Asymptomatic.
2016	Dog	*Melia azedarach*	Chinaberry tree	Triterpenoid limonoids§ triterpines, kulinone, kulacton, meliantrol, meliatoxins and alkaloids.†	Alien	No signs	Asymptomatic.
2016	Dog	*Nerium oleander*	Oleander	Oleandrine and cardenolides.†	Alien	Severe	Protracted vomiting and collapsed today. Resuscitated with fluids and epinephrine.
2016	Dog	*Phoenix sylvestris*	Silver date palm	Non-toxic (Indian date).	Alien	Moderate	Weak, with watery diarrhoea.
2017	Cow	*Sarcostemma viminale*	Caustic bush	Latex§; Sarcovimicide A and other steroid glycosides.†	Native	Severe	Lots of salivation and animal cannot lift its head.
2017	Dog	*Zantedeschia aethiopica*	Calla lily	Calcium oxalates.†§	Native	No signs	Asymptomatic

Mind-Altering and Poisonous Plants of the World. Timber Press; 2008.
*(45).
†Data from Wink M and Van Wyk B-E.
‡Data from Toxinz database.
§Data from AfriTox database.

Table 2 List of the poisoning cases due to fungi reported to the Poisons Information Helpline of the Western Cape, jointly run by the Poisons Information Centres at the Red Cross War Memorial Children's Hospital and Tygerberg Hospital in South Africa from June 2015 to November 2017 with information on year of reporting, animal species involved, suspect fungus species, active principles, origin of the fungus species, severity of intoxication and clinical signs

Year	Animal poisoned	Suspected fungus species	Origin of fungus species (native/alien/unknown)	Severity of intoxication (no sign/mild/moderate/severe/death)	Clinical signs
September 30, 2017	Dog	Mushroom	Unknown	No signs	Dog is asymptomatic.
February 15, 2017	Dog	Mushroom	Unknown	Mild	Dog showing convulsive behaviour could also have ingested seagro organic plant food or ant-trap on intravenous drip and giving AC.
May 29, 2016	Dog	Small white mushrooms	Unknown	No signs	Puppy is asymptomatic.
March 6, 2016	Dog	Mushrooms - unidentified	Unknown	Mild	Dog's nose is warm but otherwise asymptomatic.
February 28, 2016	Dog	Mushroom	Unknown	No signs	Dog is asymptomatic.
January 24, 2016	Dog	Garden mushroom	Unknown	No signs	Dog is asymptomatic.

characteristics may be challenging for the public. Certain information was not available, such as the age of the animals involved. Our study was limited with regards to the quantity ingested; however, this is not unique due to the subject of study being animals.

Incidence of plant and mushroom poisoning in animals

Our results confirmed that animal poisoning exposures to plant and mushrooms are important in the world. In South Africa, 3.3 per cent of all plant–mushroom related calls involved animals, which is similar to the situation in Germany where animal-related calls accounted for at most 3.7 per cent of all poison calls received.[30] Poisoning was most commonly reported in dogs. Notwithstanding our small sample size, this finding is consistent with previous studies that indicated higher poisoning exposures from accidental poisoning in dogs.[21–23 28 29 45–48] As for the other animals, we had just one report concerning a cow and one on a rabbit. This fact could possibly be attributed, among various reasons, to a poor reporting of cases due to lack of knowledge of the existence of facilities such as the PIH.[37]

Clinical signs and outcomes

Our findings are in line with those of studies carried out in Germany, Italy and the USA, which demonstrated that many reported cases of animal poison exposures showed no clinical signs and that few cases result in fatalities.[22 25 28 30 31 45] Furthermore, our study was similar to a previous research carried out in Italy over two 10-year periods (2000–2010 and 2000–2011), which showed that the most common clinical signs observed in poisoning episodes involving dogs and cats were hypersalivation, vomiting, diarrhoea and weakness, whereas diarrhoea and depression were the most frequently reported in cases concerning ruminants.[22 28] This study has also described a dog fatality due to a cycad species that are generally known to possess toxic compounds such as cycasin.[49 50] In this regard, it would be useful to implement the indications of McFarland and others,[30] who

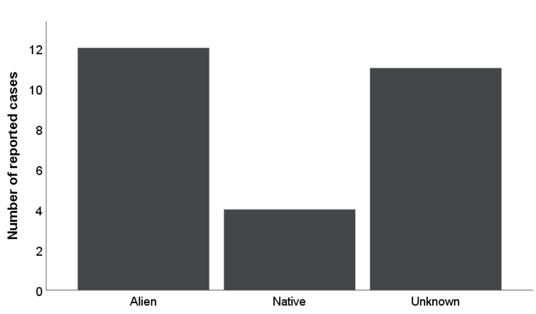

Figure 1 Categories of plant and mushrooms species involved in animal exposures.

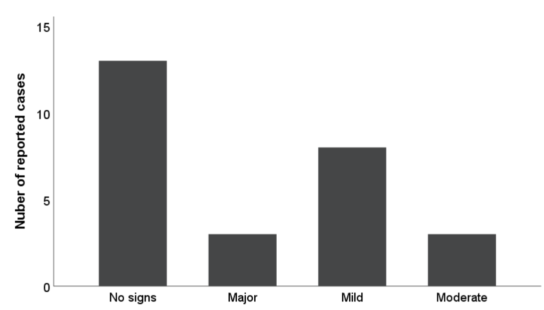

Figure 2 Severity of clinical signs of animal exposure to plants and mushrooms according to Gwaltney-Brant.[43]

suggested the importance of a systematic collection of data concerning poisoning episodes, for example, establishing sentinel laboratories and clinics throughout the country to perform a correct risk evaluation as well as to improve the outcomes.

Categories of the origin of species

This study revealed that the majority of poisonings were caused by alien plant species, followed by plants and mushrooms that could not be identified to a species level (predominantly mushrooms), while native plants only accounted for a few reported cases. The most common toxic plants reported in literature, which were also reported in this study, include *Brugmansia candida,*[51] *Melia azedarach,*[45 52] *N oleander,*[24 28] *Duranta repens*[53 54] and *Euphorbia marginata,*[55 56] whereas the less common plants, both in this study and in previous literature, include *E subsessilis, Ficus carica L., M toluca* and *P sylvestris.* However, this could be attributed to the fact that most of the plants are ornamental plants; hence, the exposure of pets is likely.[53] According to the study by Caloni and others,[28] which focused on plant poisonings in domestic animals in Italy between 2000 and 2011 and revealed causative species that are also present in South Africa, *N oleander* was responsible for nine poisoning cases in dogs, of which one case resulted in death. Due to the increased globalisation, many plants are moved around the world for various purposes such as pot plants or for gardening.[57] However, since these plants did not naturally occur in the area of introduction, people have little to limited knowledge about their toxicity in both humans and animals.[57]

The episode of intoxication recorded in a cow due to the ingestion of *S viminale* with the animal exhibiting hypersalivation and weakness probably due to the presence of pregnane glycosides[44] is new in the literature. In South Africa, the most common episodes involving cows are exposures to cardiac glycoside-containing plants, mainly *N oleander*, species that has been frequently implicated also in the southern USA, where it is very common, and in Brazil.[41 58–60] Our findings are similar to those reported in other studies, which showed that the native plants that were the primary causes of animal poisoning around the world.[28 44] There are few studies reporting animal poisoning from *C comosum* and *Crassula perforata variegata*.[61] In livestock, the exposures generally occur when the hay or silage are contaminated by poisonous plants or when forage alternatives are not accessible. Other causes are drought, recently burned pastures, introduction of animals in new areas with different plants and factors like climate and livestock/pastures management.[41 62]

CONCLUSION

This is one of the first studies to access poison centre reported records of animal poisoning at national scale in South Africa, and the data described provide useful information on animal exposure to plants and mushrooms in this country. The dog was the most reported species, and the most implicated group of plants were those not native to South Africa, probably because this species, which generally share the owner's domestic environment, is more likely to come in contact with ornamental plants that are usually native to other geographical regions. The results indicated that there seem to be an underreporting of intoxication incidences and that there is the need to implement strategies to stimulate the reporting of the cases. Moreover, more attention should be paid to prevention of poisoning in animals and that there is a need to engage the public for future surveillance and to enable people to recognise potentially hazardous plants and reduce the risk of poisoning in animals. Finally, strengthening the case management and increasing the pharmacovigilance would be beneficial to improve the survival and presentation of animal-related cases of poisoning.

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Contributors MCM conceived of the presented idea. MCM, NPM, CM and CS participated in study design. MCM, CM and CS collated the data. MCM drafted the manuscript with help from AB, LM, FC and NPM. MCM and NPM performed analysis. AB and FC verified the analytical methods. All authors read and approved the final manuscript.

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Competing interests None declared.

Ethics approval This study was approved by the Health Research Ethics Committee of the University of Cape Town (UCT HREC R 014/2014, 035/2016) and the South African National Biodiversity Institute SANBI 0004/2017 (SANBI).

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REFERENCES

1 Richardson DM, Pyšek P, Rejmánek M, *et al*. Naturalization and invasion of alien plants: concepts and definitions. *Divers Distrib* 2000;6:93–107.
2 Castro-Díez P, Vaz AS, Silva JS, *et al*. Global effects of non-native tree species on multiple ecosystem services. *Biol Rev* 2019;125.
3 Chamier J, Schachtschneider K, Le Maitre DC, *et al*. Impacts of invasive alien plants on water quality, with particular emphasis on South Africa. *Water SA* 2012;38:345–56.
4 Enright WD. The effect of terrestrial invasive alien plants on water scarcity in South Africa. *Physics and Chemistry of the Earth, Part B: Hydrology, Oceans and Atmosphere* 2000;25:237–42.
5 Mccormick FH, Contreras GC. *Effects of Nonindigenous invasive species on water quality and quantity. in: a dynamic invasive species research vision: opportunities and priorities*. Washington, DC: U.S. Department of Agriculture, Forest Service, Research and Development, 2009: 111–20.
6 Bacon SJ, Bacher S, Aebi A. Gaps in border controls are related to quarantine alien insect invasions in Europe. *PLoS One* 2012;7:e47689–9.
7 Bebber DP, Holmes T, Smith D, *et al*. Economic and physical determinants of the global distributions of crop pests and pathogens. *New Phytol* 2014;202:901–10.
8 Blaser S, Heusser C, Diem H, *et al*. Dispersal of harmful fruit fly pests by international trade and a loop-mediated isothermal amplification assay to prevent their introduction. *Geospat Health* 2018;13:370–3.
9 Brasier CM. The biosecurity threat to the UK and global environment from international trade in plants. *Plant Pathol* 2008;57:792–808.
10 Early R, Bradley BA, Dukes JS, *et al*. Global threats from invasive alien species in the twenty-first century and national response capacities. *Nat Commun* 2016;7:12485.
11 Kenis M, Auger-Rozenberg MA, Roques A, *et al*. Ecological effects of invasive alien insects. *Ecol Impacts Non-Native Invertebr Fungi Terr Ecosyst* 2009:21–45.
12 Alexander ME, Dick JTA, Weyl OLF, *et al*. Existing and emerging high impact invasive species are characterized by higher functional responses than natives. *Biol Lett* 2014;10:20130946.
13 Rejmánek M, Richardson DM, Rejmanek M. What attributes make some plant species more invasive? *Ecology* 1996;77:1655–61.
14 Traveset A, Richardson DM. Biological invasions as disruptors of plant reproductive mutualisms. *Trends Ecol Evol* 2006;21:208–16.
15 Bayliss HR, Schindler S, Adam M, *et al*. Evidence for changes in the occurrence, frequency or severity of human health impacts resulting from exposure to alien species in Europe: a systematic MAP. *Environ Evid* 2017;6:1–13.
16 Essl F, Rabitsch W, Staska B, *et al*. Alien species and public health impacts in Europe: a literature review. *NeoBiota* 2015;27:1–23.
17 Rasmussen K, Thyrring J, Muscarella R, *et al*. Climate-change-induced range shifts of three allergenic ragweeds (*Ambrosia* L.) in Europe and their potential impact on human health. *PeerJ* 2017;5:e3104.
18 Schindler S, Rabitsch W, Essl F, *et al*. Alien species and human health: Austrian Stakeholder perspective on challenges and solutions. *Int J Environ Res Public Health* 2018;15:2527.
19 Moshobane MC, Wium C, Mokgola LV. Acute poisoning in children from Jatropha curcas seeds. *S Afr J CH* 2017;11:149–50.
20 Marks CJ, Van hoving DJ. A 3-year survey of acute poisoning exposures in infants reported in telephone calls made to the Tygerberg poison information centre, South Africa. *S Afr J CH* 2016;10:43–6.
21 Wang Y, Kruzik P, Helsberg A, *et al*. Pesticide poisoning in domestic animals and livestock in Austria: a 6 years retrospective study. *Forensic Sci Int* 2007;169:157–60.
22 Caloni F, Cortinovis C, Rivolta M, *et al*. Animal poisoning in Italy: 10 years of epidemiological data from the poison control centre of Milan. *Vet Rec* 2012;170:415.
23 Caloni F, Berny P, Croubels S, *et al*. Epidemiology of Animal Poisonings in Europe. In: Gupta R-VT, ed. *Veterinary toxicology*. 3rd edn. Elsevier, 2018: 45–56. http://www.sciencedirect.com/science/article/pii/B9780128114100000039
24 Langford SD, Boor PJ. Oleander toxicity: an examination of human and animal toxic exposures. *Toxicology* 1996;109:1–13.
25 McLean MK, Hansen SR. An overview of trends in animal poisoning cases in the United States: 2002-2010. *Vet Clin North Am Small Anim Pract* 2012;42:219–28.
26 Bertero A, Chiari M, Vitale N, *et al*. Types of pesticides involved in domestic and wild animal poisoning in Italy. *Sci Total Environ* 2020;707:136129.
27 Buttke DE, Schier JG, Bronstein AC, *et al*. Characterization of animal exposure calls captured by the National poison data system, 2000-2010. *J Clin Toxicol* 2012;2:1–17.
28 Caloni F, Cortinovis C, Rivolta M, *et al*. Plant poisoning in domestic animals: epidemiological data from an Italian survey (2000-2011). *Vet Rec* 2013;172:580.
29 Caloni F, Cortinovis C, Rivolta M, *et al*. Suspected poisoning of domestic animals by pesticides. *Sci Total Environ* 2016;539:331–6.
30 McFarland SE, Mischke RH, Hopster-Iversen C, *et al*. Systematic account of animal poisonings in Germany, 2012-2015. *Vet Rec* 2017;180:327.
31 Berny P, Caloni F, Croubels S, *et al*. Animal poisoning in Europe. Part 2: companion animals. *Vet J* 2010;183:255–9.
32 Vandenbroucke V, van Pelt H, De Backer P, *et al*. Animal poisonings in Belgium: a review of the past decade. *Vlaams Diergeneeskd Tijdschr* 2010;79:259–68.
33 Soler-Rodríguez F, Martín A, García-Cambero JP, *et al*. Datura stramonium poisoning in horses: a risk factor for colic. *Vet Rec* 2006;158:132–3.
34 Fitzgerald KT. Lily toxicity in the cat. *Top Companion Anim Med* 2010;25:213–7.
35 Ferreiro D, Orozco JP, Mirón C, *et al*. Chinaberry tree (Melia azedarach) poisoning in dog: a case report. *Top Companion Anim Med* 2010;25:64–7.
36 Fitzgerald KT, Bronstein AC, Flood AA. "Over-the-counter" drug toxicities in companion animals. *Clin Tech Small Anim Pract* 2006;21:215–26.
37 Pocock SJ, Collier TJ, Dandreo KJ, *et al*. Issues in the reporting of epidemiological studies: a survey of recent practice. *BMJ* 2004;329:883.
38 Mampane KJ, Joubert PH, Hay IT. Jatropha curcas: use as a traditional Tswana medicine and its role as a cause of acute poisoning. *Phytother. Res.* 1987;1:50–1.
39 Du Plooy WJ, Jobson MR, Osuch E, *et al*. Mortality from traditional-medicine poisoning: a new perspective from analysing admissions and deaths at Ga-Rankuwa Hospital. *S Afr J Sci* 2001;97:70.
40 Balme KH, Roberts JC, Glasstone M, *et al*. The changing trends of childhood poisoning at a tertiary children's hospital in South Africa. *S Afr Med J* 2012;102:142–6.
41 Penrith M-L, Botha CJ, Tustin RC. Plant poisonings in livestock in Brazil and South Africa. *J S Afr Vet Assoc* 2015;86:2–4.
42 Botha CJ, Naudé TW. Plant poisonings and mycotoxicoses of importance in horses in southern Africa. *J S Afr Vet Assoc* 2002;73:91–7.
43 Gwaltney-Brant SM. *Epidemiology of animal poisonings*. Veterinary Toxicology Elsevier, 2007: 67–73.
44 Vleggaar R, van Heerden FR, Anderson LAP, *et al*. Toxic constituents of the asclepiadaceae. structure elucidation of sarcovimiside A-C, pregnane glycosides of Sarcostemma viminale. *J Chem Soc Perkin 1* 1993;0:483.
45 Bille L, Toson M, Mulatti P, *et al*. Epidemiology of animal poisoning: an overview on the features and spatio-temporal distribution of the phenomenon in the north-eastern Italian regions. *Forensic Sci Int* 2016;266:440–8.
46 Russo R, Restucci B, Severino L. Recent trends in diagnosing poisoning in domestic animals. *J Anim Plant Sci* 2013;23:657–65.
47 Giuliano Albo A, Nebbia C. Incidence of poisonings in domestic carnivores in Italy. *Vet Res Commun* 2004;28 Suppl 1:83–8.
48 Cortinovis C, Rivolta M, Davanzo F, *et al*. Poisonings in domestic animals: 2009 report of the poison control centre of Milan. *Toxicol Lett* 2010;196:S51.
49 Yoo J, Kim H, Park C, *et al*. Cycad revoluta toxicosis in a dog. *Korean J Vet Res* 2007;47:209–12.
50 Ferguson D, Crowe M, McLaughlin L, *et al*. Survival and prognostic indicators for cycad intoxication in dogs. *J Vet Intern Med* 2011;25:831–7.
51 De Feo V, Feo D V. The ritual use of Brugmansia species in traditional Andean medicine in northern Peru. *Econ Bot* 2004;58:S221–9.

52 Petersen DD. Common plant toxicology: a comparison of national and Southwest Ohio data trends on plant poisonings in the 21st century. *Toxicol Appl Pharmacol* 2011;254:148–53.
53 Morton JF. Ornamental plants with poisonous properties. *Proc Florida State Hortic Soc* 1958;71:372–80.
54 da Silva TBC, Costa Cinara O D'Sousa, Galvão AFC, *et al*. Cytotoxic potential of selected medicinal plants in northeast Brazil. *BMC Complement Altern Med* 2016;16:199.
55 Urushibata O, Kase K. Irritant contact dermatitis from Euphorbia marginata. *Contact Dermatitis* 1991;24:155–6.
56 Szafran L. [Acute conjunctivitis and keratitis due to the sap of Euphorbia marginata]. *Pol Tyg Lek* 1967;22:671–2.
57 Trade HPE. Transport and trouble: managing invasive species pathways in an era of globalization. *J Appl Ecol* 2009;46:10–18.
58 Galey FD, Holstege DM, Plumlee KH, *et al*. Diagnosis of oleander poisoning in livestock. *J Vet Diagn Invest* 1996;8:358–64.
59 Mahin L, Marzou A, Huart A. A case report of Nerium oleander poisoning in cattle. *Vet Hum Toxicol* 1984;26:303–4.
60 Soto-Blanco B, Fontenele-Neto JD, Silva DM, *et al*. Acute cattle intoxication from Nerium oleander pods. *Trop Anim Health Prod* 2006;38:451–4.
61 Wink M, Van Wyk B-E. *Mind-altering and poisonous plants of the world*. Timber Press, 2008: 464.
62 Cortinovis C, Caloni F. *Alkaloid-Containing plants poisonous to cattle and horses in Europe*. . Toxins. MDPI AG, 2015: 7. 5301–7.