

Review

Toxic plants and companion animals

L. Severino*

Address: Division of Toxicology, Department of Pathology and Animal Health, Faculty of Veterinary Medicine, University of Naples Federico II, via Delpino 1, 80137 Naples, Italy

***Correspondence:** Email: lorella.severino@unina.it

Received: 1 December 2008

Accepted: 12 January 2009

doi: 10.1079/PAVSNNR20094008

The electronic version of this article is the definitive one. It is located here: <http://www.cababstractsplus.org/cabreviews>

© CAB International 2009 (Online ISSN 1749-8848)

Abstract

Poisoning by substances of plant origin is unusual in both dogs and cats, yet it is possible; as many veterinarians do not know which plants can contain toxic active principles, the possibility of intoxication by ornamental plants commonly used to decorate houses, gardens and parks cannot be considered in clinical practice; on the other hand, overestimating the problem is the opposite risk. Being aware of the conditions under which these poisonings can occur and carrying out all the necessary preventive measures, poisoning incidence can be reduced. The aim of the present work is to help veterinarians to know which plants can be responsible, even occasionally, for intoxication in companion animals. This review is not a botanical report, so specific works are suggested for a more detailed description of the plants mentioned; nevertheless, for each plant, the parts responsible for the intoxication, toxic principles and clinical symptoms following the ingestion of the latter and the correct therapeutic practice in cases of such poisoning are described.

Keywords: Toxic plants, Dog, Cat

Review Methodology: We searched the following database: PubMed NCBI Journals. In addition, we used the references from the articles obtained by this method to check for additional relevant material.

Introduction

The possibility that plants can represent a risk for companion animals is not described as widely as for herbivorous animals in the scientific literature. The incidence of intoxication by substances of plant origin is limited in both dogs and cats because plants are not normally part of their diet; nevertheless, many veterinarians do not know the plants that represent a risk for domestic animals, and therefore the possibility of such poisoning could not be taken into account in clinical practice; in contrast, overestimating the problem is the opposite risk. For these reasons, identification of the plants suspected to have evoked clinical symptoms in the animals is essential; moreover, knowing the places where the plant grows (parks, gardens and indoor, such as ornamental plants) and where the animals live or go regularly are also important elements for diagnosis.

Poisoning by substances of plant origin is unusual in companion animals, yet possible [1, 2]; such intoxications

can be avoided if the circumstances in which they can occur are known and if all relevant preventive measures are put into practice. The suspicion of poisoning by substances of plant origin can be confirmed by a careful anamnesis and considering the circumstances in which the animals might be highly exposed; for example, the habit of chewing the plants or parts of them is most frequent in puppies during teething or in bored animals that spend most part of the day at home. Chewing a plant does not necessarily mean it will be swallowed; moreover, when parts of a toxic plant are swallowed, the amount of plant is tightly associated with the manifestation of clinical symptoms. Finally, it is important to note that only few plants, such as oleander and castor bean, are highly toxic; in other cases, the ingestion of small amounts of a dangerous plant may not cause any symptoms or the death of the animal.

Antidotes do not exist for most of the poisonings caused by dangerous plants in small animals; as a consequence, treatment is symptomatic and supportive care.

In general, it is possible to administer emetic drugs to remove toxic parts from the organism only if the diagnosis is carried out within 2 h of the ingestion of the plant; in addition, it is possible to administer activated charcoal 2–3 times during the first 24 h. It is very important to monitor the fluid and electrolyte balance that could be altered by vomiting and diarrhoea induced in pets by many plant species.

Indoor Ornamental Plants

Among the ornamental plants often used for decorative purposes at home, dumb cane (*Dieffenbachia picta*) can represent a risk for the health of companion animals. It belongs to the Araceae family and originates from South America. The big elliptic leaves are green with white variegations. The toxic parts are leaves, roots and the trunk, which contain a very irritating juice; it is rich in fine calcium oxalate crystals. Indirect toxicity enhances the penetration of proteolytic enzymes in animal tissues partially degraded by the latex [3]. Moreover, calcium oxalate crystals cause mechanical injuries to mast cells, favouring the release of histamine. Calcium oxalates are irritating for mucosae and cause intense pain in the mouth, salivation, paralysis of the tongue and dysphagia. The symptoms mainly affect the digestive apparatus (such as stomatitis and tough oedema), skin (such as vesicular rash or toxic erythema), kidney and respiratory apparatus, with the death of the animal following the ingestion of large amounts of the plant [4, 5]. Therapy is symptomatic and includes the administration of antihistamine and washing the mouth with sodium bicarbonate solution or water. Removing the residues of plant from the stomach of the animal by administering emetic drugs represents a good practice if the ingestion has happened within the last 2 h.

Philodendron (*Philodendron scandens*) is a plant belonging to the Araceae family. It is often responsible for lethal poisoning in cat. The dangerous parts of the plant are the trunk and stipes, containing toxic substances such as proteolytic enzymes and calcium oxalate. The symptoms are similar to those evoked by *Dieffenbachia* and they include symptoms affecting the digestive apparatus (such as stomatitis and tough oedema), skin (such as vesicular rash or toxic erythema), kidney and lung. Therapy is symptomatic and includes the administration of antihistamine.

Breadfruit tree (*Monstera deliciosa*) belongs to the Araceae family. It is also called *Philodendron pertusum* because of the holes present in the biggest leaves. It is often used to decorate houses and offices and can reach great dimensions. The toxic parts are leaves and stalks, which contain a very irritating juice that is dangerous for companion animals; it can cause oedema of the oral and labial mucosa and dermatitis by direct contact.

Administration of antihistamine and washing the mouth with calcium gluconate could be useful for therapy.

Croton (*Codiaeum variegatum pictum*) belongs to the Euphorbiaceae family. It is a plant with wide variegated leaves; there is a caustic and vesicant latex in the leaves and trunk that is rich in calcium oxalate. Moreover, seeds contain a proteic phytotoxin that can be dangerous for companion animals. The latex provokes localized eczema when it directly touches the skin at first; then the lesion extends to the body parts not directly exposed to the toxic. Moreover, the latex can cause proteinuria, cylindruria and, sometimes, hyperthermia. The ingestion of seeds causes colic, bleeding diarrhoea and emesis. The therapy is symptomatic.

Azalea (*Rhododendron simsii*), belonging to the Ericaceae family, is a plant with flowers of different colours. The toxic parts are leaves, containing a grayanotoxin, which causes anorexia, depression, hypersalivation, emesis, colic, tenesmus, tachypnea followed by bradypnea [6]. Other symptoms of poisoning include kidney and liver failure. A specific therapy does not exist.

Rubber plant (*Ficus elastica*) belongs to the Moraceae family. It is frequently used to decorate not only houses but also gardens, where it can become as large as a tree. It has oval bright green leaves. The toxic substances are present in the leaves and the trunk, where they form a latex causing digestive disorders such as emesis and diarrhoea. Such substances show vesicant properties too. Sometimes, in addition to lesions affecting mucosa, skin and digestive apparatus, renal injuries are also present. The prognosis is often favourable and the therapy is symptomatic.

A few plants are commonly used during certain times of the year to decorate houses: for example poinsettia, mistletoe, holly and other winterberries are frequently found indoors during Christmas time in many countries.

Poinsettia (*Euphorbia pulcherrima*) belongs to the Euphorbiaceae family: the toxic parts are leaves, trunk and red bracts containing a latex rich in cyclic tetraterpenes that can provoke lacrimation, photophobia, conjunctivitis and keratitis when it directly touches the eyes. More rarely this toxic plant can evoke dermatitis, sialorrhea, stomatitis and gastroenteritis. The therapy is symptomatic; cleansing the affected parts with lukewarm water represents a good practice.

Mistletoe (*Viscum album*) belongs to the Viscaceae family. It is a parasitic plant that grows on deciduous trees; it has green leaves and translucent white berries that remain on the plant throughout the winter. Leaves and stems contain alkaloids, glycosides and saponines. Moreover, mistletoe contains viscotoxins, which are long-chain polypeptides with cardiac and neurotoxic actions. The characteristic symptoms are gastrointestinal disorders, vomiting, diarrhoea and sialorrhea; neurological symptoms include ataxia, mydriasis, hypersensitivity and weakness, while the effects on cardiovascular functions include hypotension. Treatment is symptomatic and supportive care.

Holly (*Ilex aquifolium*) belongs to the Aquifoliaceae family. Dog is the species most frequently poisoned by this plant. The leaves contain ilicine, ilexanthin, ilex acid and tannins, while the berries contain both emetic and purgative toxins. Symptoms include gastrointestinal disorders, vomiting and diarrhoea. Treatment is symptomatic.

Outdoor Ornamental Plants

Many plants, trees and shrubs frequently used to decorate gardens and parks can represent a risk to the health of companion animals. Oleander (*Nerium oleander*) is a very common shrub in the Mediterranean basin. It belongs to the Apocynaceae family. Oleander is a highly toxic plant in which all parts, leaves particularly, are toxic for companion animals; consumption of only a few leaves, in fact, is lethal for domestic animals [7]. Nevertheless, poisoning is not frequent in dogs and cats. The oleander contains many glycosides, such as oleandroside, nerioside, neriatosside and rozagenin, showing cardiotoxic action similar to digitalis. During the poisoning, the animals show hypercalcaemia, hyperkalaemia and hypomagnesaemia; yet more representative symptoms are vomiting, diarrhoea and heart block [8]. The therapy is symptomatic; good results are obtained by administering of sulphate ephedrine [9], sulphate atropine and propranolol [10].

Castor bean (*Ricinus communis*) belongs to the Euphorbiaceae family. In many countries it is used as an ornamental plant but it grows mainly as a wild plant from the coast to the mountains. The toxic principle is a lectin called ricin that is present in the seeds; it is a potent poison and a few seeds could kill companion animals or a child [11–13]. The symptoms differ among different species; humans and horse are the most sensitive. The symptoms of the poisoning appear about 6–42 h following the ingestion of the seeds and they include digestive disorders, vomiting, diarrhoea, gastrointestinal bleeding, abdominal pain, a rise in body temperature, dehydration, intense thirst and colic [14]. Other symptoms can appear 1 day following the ingestion of the seeds such as bleeding diarrhoea, tachycardia and convulsions until the death of the animal [15–17]. The therapy is symptomatic.

Yew (*Taxus baccata*) is a shrub growing wild in mountain and sub-mountain areas. It is among the most dangerous plants for domestic animals; the toxins are cardiotoxic alkaloids called taxins, present in seeds, leaves, bark and wood. Although the large animals are the most frequently intoxicated species [18, 19], companion animals can also be affected by the toxic substances present in the plant. The nervous symptoms represent the most characteristic ones; after an early period of excitation characterized by agitation and muscular tremors, a status of depression follows with a depletion of the respiratory frequency. Frequently, animals die without

showing any symptoms but post-mortem diagnosis is easy because of the presence of leaves fragments in the gastric content. There is no effective therapy because the evolution of the poisoning is very fast; nevertheless, heptaminol, administered precociously, seems to be an effective antidote. The administration of analeptics and purgatives could be useful. Sometimes, ameliorations are obtained by administration of sodium thiosulphate.

Box (*Boxus sempervirens*) belongs to the Buxaceae family; it is often used to delimit flowerbeds, grass and gardens. Sometimes it causes intoxication in pig, but rarely in companion animals. The leaves contain alkaloids, inducing a sudden heart failure in animals, which have eaten the plant. The therapy is symptomatic.

Silk tree or mimosa (*Albizia julibrissin*) belongs to the Leguminosae family, and can reach the dimension of a tree. Domestic animals can eat its seeds accidentally; in such circumstances they show different symptoms as emesis, colic, bleeding diarrhoea, tachycardia, tetanic spasms and convulsions; moreover, proteinuria and cylindruria could also be present. The toxic principle is phytohaemagglutinin. The therapy is symptomatic.

Rhododendron (*Rhododendron ferrugineum*) belongs to the Ericaceae family and it is commonly used to decorate gardens and parks because it reaches a large size. Rarely, pets such as dogs and cats are intoxicated by this plant; the most frequently poisoned species are sheep and goat. The toxic parts are leaves containing a grayanotoxin that provokes in animals anorexia, hypersalivation, emesis, colic, tenesmus, tachypnea followed by bradypnea. Kidney and liver failures could also be present in the intoxicated animals. The therapy is symptomatic [6].

Juniper (*Juniperus sabina*) is an evergreen shrub reaching the dimension of a tree with aciform leaves that belongs to the Cupressaceae family. It is a spontaneously arising plant that is used as an ornamental outdoor plant in some countries. Intoxication is rare because of the bitter taste of the plant. Horses, cattle, sheep and goats could be intoxicated if they ingest leaves or branches, while poisoning is extremely rare in both dogs and cats. The toxic principles are essential oil, resins and gums present in the whole plant. The symptoms include salivations, diarrhoea (sometimes haemorrhagic) and dyspnea. Experimental *in vivo* studies showed that *J. sabina* essential oil is embryotoxic in mice [20]. Specific treatment does not exist; administering activated charcoal could be helpful for treatment.

Laburnum (*Cytisus laburnum*), also known as gold chain, belongs to the Leguminosae family. It is a spontaneous plant that is used to decorate gardens or parks in some countries. Laburnum is a shrub reaching the dimension of a tree, with yellow flowers formed in bunches; the fruits are green pods that dry up, become black and release little dark brown seeds. Horses and cattle are the animals most frequently intoxicated by this plant, while dogs are poisoned only occasionally. The toxic parts are leaves and seeds that contain toxic alkaloids such as

cytisine, methylcytisine, laburinine and laburnamin. Clinical symptoms include agitation, dyspnea, vomiting, convulsions and tachycardia. The death of the animal happens only in the most severe cases. Specific treatment does not exist [21].

A few plants such as tulip, lily and narcissus are often used to decorate gardens but they can be found also in houses as potted plants or flower compositions because of their coloured flowers.

Iris (*Iris sibirica*) belongs to the Iridaceae family and is an ornamental plant used mainly in gardens. The flowers are violet, yellow or white. The toxic substances are alkaloids present in the bulbs and glycosides called iridin, which has irritant and purgative actions. The symptoms are those characteristic of gastroenteritis with haemorrhagic diarrhoea; the therapy is symptomatic.

Amaryllis (*Hippeastrum ibrido*) is an ornamental plant that belongs to the Amaryllidaceae family with scarlet flowers. There are toxic alkaloids present in the bulbs as in those of *I. sibirica*. The symptoms are similar to gastroenteritis and the therapy is symptomatic.

Tulip (*Tulipa ibrido*) belongs to the Liliaceae family; it is a well-known ornamental plant with flowers of many colours. The bulbs are toxic because of the presence of toxic alkaloids affecting the digestive system where they cause a syndrome similar to gastroenteritis. The therapy is symptomatic.

Lily (*Lilium* spp.) belongs to the Liliaceae family. It is a plant with coloured flowers; several cultivars exist such as Easter lily, tiger lily and Japanese lily. Just a few leaves or only one flower represent a risk for the health of cats, which is the most susceptible species. In particular, an aqueous extract of leaves and flowers is nephrotoxic and pancreatotoxic [22]. The bulbs are nephrotoxic and contain toxic alkaloids that cause renal failure, particularly in cats, while dogs are more resistant; sometimes lily determines acute renal failure that leads to the death of animals which are oliguric or anuric [23]. Symptoms appear early within 24 h after ingestion and include vomiting, depression, polyurea, polydipsia, glucosuria, proteinuria and azotemia. Significant histologic kidney changes included acute necrosis of proximal convoluted tubules [24] and degeneration of pancreatic acinar cells [22]. Successful treatment can be accomplished with early decontamination with emetic drugs within at least 2 h from ingestion or administering activated charcoal and aggressive fluid therapy as soon as possible, continuing it for at least 48 h.

Narcissus (*Narcissus* spp.) belongs to the Amaryllidaceae family. It is an ornamental plant with white or yellow flowers. Dog is the most often intoxicated species because it can chew or swallow the toxic parts of the plant, but narcissus toxicosis can happen in cat too [25]. Bulbs are the most toxic parts because they contain toxic alkaloids such as galanthamine and lycorine, but flowers and leaves can also represent a risk for companion animals. Symptoms appear early and they include vomiting

and diarrhoea, abdominal pain, anorexia and sialorrhoea, but intoxicated animals can show ataxia, lethargy, hypothermia, bradycardia, hypotension and depression until overcome by coma if the ingested amount is high; in some severe poisoning the animal dies, approximately 15 g of bulb may be capable of killing a dog. Specific treatment does not exist, so it is necessary to carry out a symptomatic treatment and decontaminate the organism via emesis if the poisoning is diagnosed within a few hours of ingestion.

Plants and Plant Products Used in Human Diet

Some plants commonly used for human consumption can represent a risk for companion animals. Onion (*Allium cepa*) is frequently used in human diet, while dogs and cats generally do not eat raw onion. Nevertheless, sometimes it is possible that home food containing onions could be administered to pets by owners. An experimental study carried out with cats fed with baby food containing onion powder showed that they developed anaemia associated with increased Heinz body formation [26]. A recent study has showed that onion causes haemolytic anaemia in dogs fed with cooked onions at 30 g/kg body weight for 2 days. Blood samples collected at different days revealed that red blood cells counts, haemoglobin and haematocrit were significantly decreased from the first day, also the number of Heinz bodies in erythrocytes was increased and other erythrocyte parameters were altered [27]. Sodium *n*-propylthiosulphate, isolated from (boiled) onions, was considered as the agent responsible for induced haemolytic anaemia in dogs. It causes oxidative damage to haemoglobin and erythrocyte membrane and such oxidative injury seems to be associated with the amount of glutathione (GSH) present in the red cells [28]. Eccentrocytes appeared after dogs were fed onions and they resulted from a direct injury to the erythrocyte membrane, while reticulocytes could be observed only 5 days after onion feeding [29]. Clinical signs appear as early as 1 day after ingestion. The typical lesion is anaemia; other symptoms are intravascular haemolysis, pale mucosae, decreased haematocrit value, increased methaemoglobin content and Heinz bodies in red cells. Blood transfusions could be helpful in cases of severe anaemia.

The family Rosaceae includes many of the most common fruit trees such as cherry, apricot, peach, apple and plum. They could represent a risk for companion animals only occasionally because pets playing with pips or kernels of these fruits could ingest them. In fact, pips of apples, kernels of fruits and leaves are toxic because they contain cyanogenetic glycosides such as amygdalin, prunasin and prunelaurasin. Clinical signs can develop within few minutes from the ingestion and include tremors or ataxia, frothing at the mouth, dyspnea and convulsions. Cyanides inhibit cytochrome oxidase and cellular

respiration; as a consequence, it can be useful to administer sodium nitrate, which forms methaemoglobin that binds with cyanide forming cyan-methaemoglobin, and sodium thiosulphate, which converts cyanides to thiocyanate [30].

The fruit of *Theobroma cacao* represents the source of cocoa; the plant belongs to the Sterculiaceae family and contains the toxic principle theobromine, which affects primarily the heart. Clinical symptoms include cardiovascular effects (tachycardia, hypertension and arrhythmias), gastrointestinal effects (vomiting and diarrhoea) and, following the ingestion of large amounts of the toxic principle, nervous effects can occur such as agitation, hyperactivity, tremors and seizures. In severe intoxication, death can occur because of heart failure [31].

Acknowledgement

The author thanks Dr Rosario Russo, Department of Pathology and Animal Health, Faculty of Veterinary Medicine of Naples (Italy) for his assistance in the preparation of this article.

References

- Severino L, Russo R. Piante ornamentali pericolose per cani e gatti. *SUMMA Animali da Compagnia* 2007;2:31–6.
- McKenzie RA. Poisoning of companion animals by garden and house plants in Queensland: a veterinary practice survey. *Australian Veterinary Journal* 2007;85(11):467–8.
- Loretti AP, da Silva IlhaMR, Riberlo RE. Accidental fatal poisoning of a dog by *Dieffenbachia picta* (dumb cane). *Veterinary and Human Toxicology* 2003;45(5):233–9.
- Dip EC, Pereira NA, Fernandes PD. Ability of eugenol to reduce tongue edema induced by *Dieffenbachia picta* Schott in mice. *Toxicol* 2004;43(6):729–35.
- Pedaci L, Krenzelok EP, Jacobsen TD, Aronis J. *Dieffenbachia* species exposures: an evidence-based assessment of symptoms presentation. *Veterinary and Human Toxicology* 1999;41(5):335–8.
- Puschner B, Holstege DM, Lamberski N. Grayanotoxin poisoning in three goats. *Journal of the American Veterinary Medical Association* 2001;218(4):573–5.
- Mahin L, Marzou A, Huat A. A case report of *Nerium oleander* poisoning in cattle. *Veterinary and Human Toxicology* 1984;26(4):303–4.
- Aslani MR, Movassaghi AR, Mohri M, Abbasian A, Zarehpour M. Clinical and pathological aspects of experimental oleander (*Nerium oleander*) toxicosis in sheep. *Veterinary Research Communications* 2004;28(7):609–16.
- Gasparini G, Pompa G, Ormas P. Avvelenamenti: Oleandro. In: *Terapia Veterinaria. Organizzazione Editoriale Medico-Farmaceutica*, Milan, Italy; 1982. p. 518–9.
- Szabuniewicz M, McCrady JD, Camp BJ. Treatment of experimentally induced oleander poisoning. *Archives Internationales de Pharmacodynamie et de Thérapie* 1971;189(1):12–21.
- Bradberry SM, Dickers KJ, Rice P, Griffiths GD, Vale JA. Ricin poisoning. *Toxicology Reviews* 2003;22(1):65–70.
- Albretsen JC, Gwaltney-Brant SM, Khan SA. Evaluation of castor bean toxicosis in dogs: 98 cases. *Journal of the American Animal Hospital Association* 2000;36(3):229–33.
- Wedin GP, Neal JS, Everson GW, Krenzelok EP. Castor bean poisoning. *The American Journal of Emergency Medicine* 1986;4(3):259–61.
- Doan LG. Ricin: mechanism of toxicity, clinical manifestation, and vaccine development. A review *Journal of Toxicology: Clinical Toxicology* 2004;42(2):201–8.
- Mouser P, Filigenzi MS, Puschner B, Johnson V, Miller MA, Hooser SB. Fatal ricin toxicosis in a puppy confirmed by liquid chromatography/mass spectrometry when using ricinine as a marker. *Journal of Veterinary Diagnostic Investigation* 2007;19(2):216–20.
- Audi J, Belson M, Patel M, Schier J, Osterloh J. Ricin poisoning: a comprehensive review. *JAMA: the Journal of the American Medical Association* 2005;294(18):2342–51.
- Soto-Blanco B, Sinhorini IL, Gorniak SL, Schumacher-Henrique B. *Ricinus communis* cake poisoning in a dog. *Veterinary and Human Toxicology* 2002;44(3):15–6.
- Tiwary AK, Puschner B, Kinde H, Tor ER. Diagnosis of *Taxus* (yew) poisoning in a horse. *Journal of Veterinary Diagnostic Investigation* 2005;17(3):252–5.
- Cope RB, Camp C, Lohr CV. Fatal yew (*Taxus* sp.) poisoning in Willamette Valley, Oregon, in horses. *Veterinary and Human Toxicology* 2004;46(5):279–81.
- Pages N, Fournier G, Chamorro G, Salazar M, Paris M, Boudene C. Teratological evaluation of *Juniperus sabina* essential oil in mice. *Planta Medica* 1989;55(2):144–6.
- Lorgue G, Lechenet J, Riviere A. Gold chain. In: *Veterinary Clinical Toxicology*. Cristiano Giraldi Editore, Ozzano dell'Emilia (BO), Italy; 1999. p. 263–4.
- Rumbeiha WK, Francis JA, Fitzgerald SD, Nair MG, Holan K, Bugyei KA, et al. A comprehensive study of Easter lily poisoning in cats. *Journal of Veterinary Diagnostic Investigation* 2004;16:527–41.
- Langston CE. Acute renal failure caused by lily ingestion in six cats. *Journal of the American Veterinary Medical Association* 2002;220(1):49–52.
- Brady MA, Janovitz EB. Nephrotoxicosis in a cat following ingestion of Asiatic hybrid lily (*Lilium* sp.). *Journal of Veterinary Diagnostic Investigation* 2000;12:566–8.
- Saxon-Bury S. Daffodil toxicosis in an adult cat. *The Canadian Veterinary Journal* 2004;45:248–50.
- Robertson JE, Christopher MM, Rogers QR. Heinz body formation in cats fed baby food containing onion powder. *Journal of the American Veterinary Medical Association* 1998;212(8):1260–6.
- Tang X, Xia Z, Yu J. An experimental study on hemolysis induced by onion (*Allium cepa*) poisoning in dogs. *Journal of Veterinary Pharmacology and Therapeutics* 2008; 31(2):143–9.
- Yamato O, Hayashi M, Kasai E, Tajima M, Yamasaki M, Maede Y. Reduced glutathione accelerates the oxidative damage produced by sodium *n*-propylthiosulfate, one of

6 Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources

- the causative agents of onion-induced hemolytic anemia in dogs. *Biochimica et Biophysica Acta* 1999;1427:175–82.
29. Harvey JW, Rackear D. Experimental onion-induced hemolytic anemia in dogs. *Veterinary Pathology* 1985;22(4):387–92.
30. Plumlee KH. Plant hazards, The Veterinary Clinics of North America. *Small Animal Practice* 2002;32:383–95.
31. Drolet R, Arendt TD, Stowe CM. Cacao bean shell poisoning in a dog. *Journal of the American Veterinary Medical Association* 1984;185(8):902.