

ALKALOID-BEARING POISONOUS PLANTS OF THE THAR-DESERT OF PAKISTAN

Syeda Saleha Tahir^{*}, Musarat Joyo^{**} & T.G. Kazi^{***}

^{*}*Department of Botany, University of Sindh, Jamshoro, Sindh, Pakistan.*

Abstract

Eight species of Alkaloid-bearing poisonous plants are identified, from the Thar-desert of Pakistan. The morphological features of the plants, and their alkaloids, with their names and empirical formula and the symptoms of poisoning are given. This paper will help in identifying poisonous plants, and also provide information about their toxicity.

Key words

Poisonous plants, Alkaloids, Thar desert, Pakistan.

Introduction

Many plants produce certain chemical compounds that interfere in the metabolism of human being and animals or in simple words, they can exert some toxic actions. Plants that are poisonous do not have any special distinguishing features, and there is no universal test for recognising the toxicity of a plant.

Alkaloids are usually basic substances with nitrogen bound in ring system. They usually occur with plant acids, and are widely distributed in plant kingdom. In this contribution the names of poisonous plants and of their contained alkaloids, and also the names and empirical formulas of the alkaloids are provided.

It is believed that this is the first attempt to bring botanical and chemical information together in one place about the poisonous plants of Thar-desert.

^{**}Department of Chemistry, Shah Abdul Latif University, Khairpur, Sindh, Pakistan.

^{***}National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Sindh, Pakistan

Material and method

The information about poisonous plants was collected through literature, interviews and some personal observations.

The scientific name of the plants have been used according to the Flora of Pakistan by Nasir & Ali (1970-91) and from Dictionary of flowering plants and ferns, by Willis (1988). A brief description of all the poisonous plants is provided.

Most Thari people have some knowledge of poisonous plants, but elders are more acquainted with the morphology and use of plants.

The chemical information about alkaloids is obtained from the published records, informations of toxicity of plants, and also from the notes, accompanying herbarium specimens, housed at the Sindh University herbarium (SUH), Pakistan, collected by Dr. I.I. Choudhri (1964-66) & Rajput, (1985-90).

The over all approach in this study is similar to the one that have employed in collecting information on medicinal plants of Thar desert (Rajput et al. 1991.) although the number of poisonous species are less.

Geography of the study area

The study area i.e. Thar desert of Pakistan is an extension of the great Indian desert, separated only by a political boundary. The Thar desert extends from the Runn of Kutch to well beyond the northern boundaries of Sindh. Thar desert occupies a total area of ca. 14000 sq. miles in the south east corner of Pakistan. It is situated between Long. 24°-27°N N & Lat. 69°-72° E. Towards the south is the sandy salt marsh of the Runn of Kutch; Nara canal runs along the western boarder.

Little information on the vegetation on the Thar desert of Pakistan is available, because the area has largely been neglected by the researchers. Much of the indigenous flora has been lost, due to the increase of aridity. Much decrease in rainfall, has resulted in a decrease in vegetation cover, which is of great concern to both the government and inhabitants.

Observations and Results

The poisonous plants can be classified on several basis, but in this contribution the poisonous plants are arranged family wise, alphabetically. In general each poisonous species is considered in the following sequence; scientific name, vernacular name, Botanical description, poisonous constituents, poisoning in animals, poisoning in human beings. Poisonous plants and their alkaloids, and the empirical formulas of alkaloids are given in Table-I.

Heliotropium europaeum L. (Boraginaceae)

Vern. *Unth chara*

Botanical Description

A perennial herb, with woody stems, branches green to grayish-green, with dense white hairs. Leaves petiolate, petiole up to 4.5 cm. long. Lamina elliptic-ovate to obovate, hairy on both surfaces; hair white, appressed. Inflorescence terminal, 3-14 cm. long; flowers, bluish white, Calyx sessile, persistent, hairy on the outside, glabrous inside; throat constricted. Corolla lobes \pm orbicular to oblong, 1-2 mm. long, sinuses often with appendages. Anthers elongated, branched at the base, attached to the corolla tube base. Stigma basally bifid. Fruit a nut, ovoid, dense pilose.

Poisonous Constituents

This species contain pyrrolizidine alkaloid including heliosupine and cynoglossine. According to Mattocks (1980) concentrations of alkaloids are highest in small, young leaves in the early season.

Poisoning in animals

In Thar desert this species is considered to cause sickness in goats and cows, but exact type of poisoning is not known. Bull et al., (1956, 1961) have reported a syndrome of toxic liver due to the use of *Heliotropium europaeum* in Australian sheep & cattle.

Observations and Results

The poisonous plants can be classified on several basis, but in this contribution the poisonous plants are arranged family wise, alphabetically. In general each poisonous species is considered in the following sequence; scientific name, vernacular name, Botanical description, poisonous constituents, poisoning in animals, poisoning in human beings. Poisonous plants and their alkaloids, and the empirical formulas of alkaloids are given in Table-I.

Heliotropium europaeum L. (Boraginaceae)

Vern. *Unth chara*

Botanical Description

A perennial herb, with woody stems, branches green to grayish-green, with dense white hairs. Leaves petiolate, petiole up to 4.5 cm. long. Lamina elliptic-ovate to obovate, hairy on both surfaces; hair white, appressed. Inflorescence terminal, 3-14 cm. long; flowers, bluish white, Calyx sessile, persistent, hairy on the outside, glabrous inside; throat constricted. Corolla lobes \pm orbicular to oblong, 1-2 mm. long, sinuses often with appendages. Anthers elongated, branched at the base, attached to the corolla tube base. Stigma basally bifid. Fruit a nut, ovoid, dense pilose.

Poisonous Constituents

This species contain pyrrolizidine alkaloid including heliosupine and cynoglossine. According to Mattocks (1980) concentrations of alkaloids are highest in small, young leaves in the early season.

Poisoning in animals

In Thar desert this species is considered to cause sickness in goats and cows, but exact type of poisoning is not known. Bull et al., (1956, 1961) have reported a syndrome of toxic liver due to the use of *Heliotropium europaeum* in Australian sheep & cattle.

Poisoning in human

No poisoning has been reported by this species. A few local people say, it cause skin irritation, which is mainly due to the presence of glandular trichomes present on the plant body.

Chenopodium album L. (Chenopodiaceae)

vern. Chill, Bathu, Lambs quarters, Fat hen

Botanical description

An erect annual herbaceous weed. The whole plant, including the tightly clustered flower heads is green with a powdery appearance. Stem fleshy. Leaves oval or diamond shaped, with variably toothed edges. The leaf stalk and upper leaves are sometimes reddish-purple, or reddish-green, alternate, exstipulate. Flowers inconspicuous, often green, bisexual; perianth 5, fruit nut, indehiscent, often enclosed by the enlarged persistent perianth. Seeds usually with curved embryo.

Poisonous constituents

This plant species accumulate nitrates and oxalate which are considered to have poisonous properties Hibbs, (1979). During digestion, when soluble oxalate combines with calcium, the calcium concentration in blood is reduced which cause hypocalcaemia.

Poisoning in animals

The symptoms of *Chenopodium album* poisoning are common in animals like sheep, goats and cows. In Thar desert local peoples generally believe that the milk production is reduced by eating this species and animals takes a long deep sleep.

Poisoning in human

According to Grzybowski (1948) and Sebastynski (1960) the consumption of raw or cooked, followed by exposure to sunlight cause skin ulcer. If *Chenopodium album* had been eaten in large quantity causes weakness and fatigue.

Ricinus communis L. (Euphorbiaceae)

Vern, Arand, Heran, Caster oil Plant

The castor oil plant is an African species, was cultivated in Egypt as long ago 4,000 B.C., as a source of lamp oil. The oil extracted from the seeds of this species is known as Caster oil, and was used as a purgative. Now a days it is used in the manufacture of lubricants, paints, polishes, candles and plastics. In many countries, mostly in India and Brazil it is commercially grown. In some countries including Pakistan and Britain it is grown as an ornamental plant.

Botanical description

The Castor oil plant is a monoecious, erect, single or much branched shrubby or tree like somewhat glucose herb upto 5 m., rarely taller, Stem hollow, becoming woody at the base. Petioles 5-20 cm. long. Leaf-base commonly 7-9 lobed. Inflorescence panicles, 10-25 cm. long. The flowers are of separate sexes, but born on the same inflorescence. The male flowers with a mass of stamens, are at the base and the female flowers with prominent red stigmas are near the apex, with inconspicuous caducaus perianth. Fruit trilobite, echinate or smooth, dehiscing into 3 bivalved cocci. Seeds dorsoventrally compressed-ovoid, smooth, carunculate, testa crustaceous, albumen fleshy cotyledons broad, flat.

Poisonous constituents

The main poisonous constituent of the castor oil is ricin, lectin and kind of simple protein, Corwin (1961) which generally considered most toxic naturally occurring substance. The leaves of the plant are mildly toxic, but the ricin content is very high in the seeds. The extract of the castor beans coagulate red blood cells, hence it is regarded as blood poison. The oil fraction of castor beans constitute hydroxy fatty acids, and contain upto 90% being ricinoleic.

Poisoning in Animals

The animals being fed with castor beans suffered from severe diarrhoea, with blood clots in the feces. The local peoples reveals that goats and cows died after eating the castor beans. The sheep normally do not eat the castor leaves or castor beans, but if by chance sheep eat, the leaves or seeds they do not die.

Poisoning in Human

Chewing the castor oil seeds is the most frequent cause of poisoning in children in Thār. This is also reported in U.S.A. and other part of the world (Lampe, 1976; O'Leary, 1964). Severe poisoning occurs with eating a few beans and sometimes it can be fatal, Scott (1969). In small children even two well chewed beans can be fatal.

The poisoning symptoms are severe irritation and haemorrhage of the digestive track, which causes profuse vomiting and diarrhoea, nausea, gastric pain, thirst, and dullness of vision. The main factors which make *Ricinus* seeds so dangerous are:- attractive appearance, hazelnut-like taste, the high content ricin, and great stability of ricin towards the proteolytic enzymes of the gastro-intestinal track.

Argemone mexicana L. (Papaveraceae)

Vern: *Pilawala dhatura*, *Bhat katia*, *Mexican poppy*, *Prickly poppy*

Botanical description

A prickly annual erect branched herb. Leaves alternate, elliptical-oblong, pinnatifid, sinuately lobed, prickly on the margin, midrib, and on veins. Flowers solitary, showy, yellow; petals 4-6; stamen numerous. Fruit a capsule, oblong or oblong-elliptical with rounded ribs, covered with sharp erect prickles, valves 3-6. Seeds many, brown-back \pm rounded.

Poisonous constituents

Morphine, thebaine and papaverine alkaloids are reported from *Argemone mexicana* by Schlotterbeck, (1901), which are toxic substances.

Poisoning in animals

Mexican poppy contain some toxic substances which may produce poisoning. The seeds have been found to be toxic to fowls.

Poisoning in human

It usually cause poisonous effect when seeds are eaten, and produce painful irritation when its prickles enter the skin. The seeds also have narcotic properties Jafri & Qaiser, (1974).

Sorghum halepense (L.) Pers. (Poaceae)

Vern. Joar ghah, Johnson-grass

Botanical description

Rhizomatous perennial, clums simple or branched, 0.5-3.0 m. high. Leafblades 20-82 cm. long, 0.5-3 cm. wide, inflorescence loose panicle, with 1-5 spikelet pairs. Due to tenacious Rhizomatous habit *Sorghum halepense* has earned a bad reputation as a weed of cultivated crops.

It was introduced as a forage crop, from the Mediterranean region into South-East-Asia as a a forage crop.

Poisonous constituents

It is a cyanogenetic plant and the tissue of this species contain hydrocyanic acid, and prussic acid, which are dangerous to live stock. Crawford, (1906).

Poisoning in animals

It cattle, sheep, and goats poisoning is reported, but nature of poisoning is not known. During study it was revealed that wet stem and leaves have poisonous properties, and thoroughly dried plant has no poisonous effect to stock.

Poisoning in human

Poisoning in human is not reported in That desert area.

Anagallis arvensis L. (Primulaceae)

Vern. billi booti, Shepherd's Weather glass, Poor Man's Weather glass

Botanical description

A small annual herb, with much branched and spreading angular stems. Leaves opposite, simple, ovate-oval, sessile; flowers appear solitary on slender stalks from the axil of leaves; corolla rotate blue; stamens 5, ovary 1-celled. Fruit brown angular capsule.

Poisonous constituents

The nature of toxicity of this species is not known, but the glandular hairs of leaves and stems contains primin. Klein & Trothandl (1929) reported that contact with the glandular hairs may cause a severe dermatitis in human beings.

Poisoning in animals

Anagallis arvensis is reported to produce gastrointestinal symptoms in the horses, dogs, rabbits, (Watt & Breyer-Brandwijk, 1962). In Iraq due to the use of this species, horses, and mules, suffered severe anaemia, restlessness and debility Forsyth, (1979). In South Africa Schneider, (1978) reported a case of poisoning of sheep in which all sheep died, because of eating the *Anagallis arvensis*. After that case the some other sheep had been fed experimentally with the plant and developed the same clinical signs.

In Thar desert difficulty in breathing, and rapid drop in body temperature is reported in goats and sheep, after eating *Anagallis arvensis*.

Poisoning human

Mitchell & Rook, (1979) reported that the contact with leaves of *Anagallis arvensis* and some other members of family Primulaceae, can cause dermatitis in man.

Datura fastuosa L. (Solanaceae)

Vern. *Dhatura*, *Thorn-apple*, *Jamestown weed*, *Jimson weed*

Botanical description

An erect herb upto 1-m tall, stem erect stout mostly with spreading forked stems. Leaves long, petiolate, ovate glabrescent, flowers single, erect tubular, white.

regular whitish-blue; fruit large capsule, spiny, dehiscent irregular; seed numerous, reniform, dark brown to black.

Poisonous constituents

All parts of the plant contain highly active alkaloids, comprising hyoseyamine, tropane. Maximum alkaloid contents are found in fruit.

Poisoning in animals

Due to the strong odour and unpleasant taste animals do not eat the growing plant. If the animals, have taken it directly or indirectly the *Datura* plant or seeds it have always caused poisoning. In livestock poisoning or suspected poisoning has been reported in horses (Borney & Wilson, 1963), in cattle (Singh & Singh, 1971), in Buffaloes, (Watt & Breyer, 1962), in Sheep & Goats, (El. Dirdiri et al., (1981). The first clinical sign that appear in animal is restlessness, dilation of pupils, and increased respiration.

Poisoning in human

The important symptom after ingesting *Datura* plant material are: reddening of face; dryness of the mucous membranes and dilation of the pupils, headache, nausea, burning sensation in the skin, loss of sight, retention of urine, drowsiness, muscle twitching, coma, and sometimes death. (Watt & Breyer, 1962; Schilling & Speaker, 1980).

Solanum nigrum L.(Solanaceae)

Vern. Mako, Kach-Mach, Kawal, Poison berry and Black night shade.

Botanical description

An annual herb, with branched, more or less anuglar stems. Leaves ovate to broad triangular to rhombic, acuminate, often sinuate- denate, almost entire. Flowers in short-pedicellate, in umbel- like cymes, corolla white. Fruit black, glossy, many seeded berry.

Poisonous constituents

All parts of the plant, specially the unripe green berries (fruit) contain the glycoalkaloid solanine, other toxic alkaloids reported by Keeler, (178) are chaconine and salasodine. Nitrates and nitrites also occur in *S. nigrum* in variable amounts and may contribute to its toxic effects, (Liebenow, 1970).

Poisoning in animals

S.nigrum is potentially toxic to most of the animals cattle, sheep, goats, dogs and poultry can be severely poisoned, Fawcett, (1979). In India calcium deposits in blood vessels of Corriedale sheep were reported by Kwatra (1974), due to the ingestion of *S.nigrum* which grown in the area where the animals were kept.

Hubbs, (1947) reported poisoning due to *S. nigrum* in pigs which causes rapid pulse and respiration, low body temperature, and widely dilated pupils. In Saanen goats in Britain, severe abdominal pains, vomiting, have had occurred by the use of this species (Gunning, 1949).

Poisoning in human

The symptom associated with *S. nigrum* poisoning in human are headache, high temperature, dizziness, speech impairment, vomiting, diarrhoea and unconsciousness, (Fawcett, 1979). The toxicity of berries is variable, in ripped berries which are black in colour are least toxic, whereas unripped berries which are green in colour should always be considered poisonous. According to Muenscher, (1959) solanine poisoning may cause narcosis and paralysis.

Acknowledgments

Authors are thankful to Dr. Bernice G. Schubert of Arnold Arboretum, Harvard University, U.S.A. for her help to Senior author, in literature survey, during her stay at Harvard University. We are grateful to Mr. Basir Ahmed for typing the manuscript.

Table 1
Plants and their contained alkaloids

botanical name of Plant	Family	Plant Part	Alkaloid	Formula Struck
<i>Heliotropium europium</i> L.	Boraginaceae	SD	Pyrrolidine	C_4H_9N
<i>chenopodium album</i> L.	Chenopodiaceae	LS	Chenopodine	$C_6H_{13}NO$
<i>Ricinus communis</i> L.	Euphorbiaceae	LSD	Ricinine	$C_8H_8N_2O_2$
<i>Argemone Mexicana</i> L.	Papaveraceae	R	α -Allocryplopine	$C_{21}H_{23}NO_5$
<i>Datura fastuosa</i> L.	Solanaceae	LSFr	Hycocine	$C_{17}H_{21}NO_4$
<i>Solanum nigrum</i> L.	Solanaceae	Fr	Solamargine	$C_{45}H_{73}NO_{15}$
<i>anagallis arvensis</i>	Primulaceae	R	Sapinine	—
<i>Sorghum helipense</i> (L.) Pers.	Poaceae	—	Not Known	—

Abbreviations used in the table.

L, laves; Fr, Fruit, R, Root, S, Stem; SD, Seeds.

References

- Barney, G.H. & Wilson, B.J. (1963) A rare toxicity syndrome in ponies. *Verterinary Medicine*, 58:419-421.
- Bull, L. B., Dick, A. T., Keast, J.C. & Edgar, G. (1950). An experimental investigation of the hepatotoxic and other effects on sheep of consumption of *Heliotropium europaeum* L. helioroe poisoning of sheep. *Australian J. of Agric. Res.* 7:281-232.
- Bull, L.B., Roger, E.S., Keast, J.C., & Dick, A.T. (1961). *Heliotropium* poisoning in cattle *Aust. Vet Journ.* 37:37-43.
- Corwin, A.H., (1961). Toxic constituents of the Castor bean. *Journ. of Medicinal and Pharmaceutical Chemistry*, 4:483-496.
- El. Dirdiri, N. I., Wasfi, I. A. Adam, S. E. I. & Edds, G. T. (1981). Toxicity of *Datura stramonium* to sheep and goats. *Vterinary & Human Toxicology*. 23: 241-246.
- Fawceth, R.C. & Jennings, V. M., (1979). Today's weed. Black nightshade (*Solanum nigrum* L.) weeds today, 10-21.
- Grzybowski, M.D. (1948). a peculiar, pellagra like skin sensitisation to light in starving persons. *British journal of Dermatology*. 60:410-415.
- Hibbs, C. M. (1979). Cyanide and nitrate toxocoses of cattle. *Vterinary & Human Toxicology*. 21:401-403.
- Hubbs, J.C. (1947). Belladonna poisoning in pigs. *Veterinary Medicine*. 428-429.
- Jafri, S.M. H. & Qaisar, M. (1974) *Papaveraceae* in Nasir, E. & Ali, S.I. in *Fl. W.. Pak.* 61:1-32.
- Keeler, R.F. (1978). Alkaloid teratogens from lupines corium, veratrum and related genera. In : *Effects of poisonous plants on livestock*. Edited by R.F. Keeler, K.R. Van Kampen & L. F. James. Academic press New York.397-408.
- Klein, G. & Trothandl. (1929) Nachweis, Verleilung, und verbreitung des Primelgiftes in der pflanze. *Beitr. Biol Pflanze. Chan.*, 17:24-230.

- Lampe, K.F. (1974). Systematic plant poisoning in children. *Pediatrics*, 54:347-351.
- Liebenow, H. (1970). *Solanum nigrum* L. as a nitrate containing plant and the determination of its alkaloid contents. *Wissenschaftliche Zeitschrift der Humboldt Universität Zu Berlin*. 19:59-71.
- Mattocks, A.R. (1980). Toxic pyrrolizidine alkaloids in comfrey. *Lancet*. 2:1132-1137.
- Mitchell, J. & Rook, A. (1979). *Botanical dermatology. Plants and plant products, injurious to the skin, greengrass Ltd. Vancouver, Canada. 544.*
- Muenseler, W.C. (1951). *Poisonous plants of the United States. pp.210. The Macmillan Co. New York.*
- Nasir, E. & Ali, S.I. (1970-1991) *Flora of Pakistan. Department of Botany, University of Karachi.*
- O'LEARY, S.B. (1964). Poisoning in man from eating poisonous plants. *Archives of Environmental Health*, 9:216-242.
- Rajput, M. T. M., Tahir, S.S. & Ahmed, B. (1991). A study of medicinal plants of the Thar-desert Sindh, Pakistan, *Sindh Univ. Res. Jour. (Sci-Ser)*. 22: (7-38).
- Reynard, G.B & Norton, J.B. S. (1942) *Poisonous plants of Maryland in relation to livestock. University of Maryland Agricultural Experimental Station. Technical Bulletin A10:292.*
- Schilling, R. & Speaker, J. (1980). Incidence of plant poisoning in Philadelphia noted as poisons information calls. *Veterinary & Human Toxicology*. 22: 148-150.
- Schlotterbeds, J.D. (1901). does *Argemone mexicana* contain morphine ? *Pharma. Rev.* 19:458-461.
- Schneider, D.J. (1978). Fatal ovine nephrosis caused by *Anagallis arvensis*. *Journal of the South African Veterinary Association*, 49:321-324.
- Scott, H. G. (1969). *Poisonous plants and animals, in food-borne infections and intoxication. edited by Riemann. Academic Press, New York. 543-564.*
- Sebastynski, T. (1960). A case of a pellagra-like condition after consumption of *Chenopodium*. *Polski Tygodnik Lekarski*, 15:688-689.
- Singh, R.C. P. & Singh, R.P. (1971) A suspected case of *Datura* poisoning in a cow. *Indian Veterinary Journal*. 48:194-196.
- Watt, J. M., & Breyer-Brandwijk, M.G. (1962). *Medicinal and Poisonous plants of Southern Africa. E. & S. Livingstone, Edinburgh and London. pp.370.*
- Watt, J. M & Breyer, B. M.. G. (1962). *Medicinal and poisonous plants of Southern and Eastern Africa. E and S. Livingstone Ltd. Edinburgh. pp. 946-953.*
- Will's, J.C. (1968). *A dictionary of flowering plants & ferns. 8th Edition. Revised byairy Shaw Cambridge University Press. New York.*