



Review Article

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EXPLORING THE AYURVEDIC KNOWLEDGE ON ENVENOMATION: A REVIEW ON ETHNO PHARMACOLOGICAL APPROACH

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ABSTRACT

Envenomation is one of the significant public health issues in several tropical and subtropical countries due to high morbimortality. In developing countries like India their management is basically inadequate due to poor transportation and subsequent delay in antivenom administration. So improvement in the therapeutic approaches to envenomation is necessary and therefore the medicinal plants, available locally, which have been used since ages to treat a great variety of diseases including Envenomation, needs attention. Ayurveda, a well-established medical paradigm from ancient India dealt comprehensively on management of acute envenomation and treatment of its complications with the usage of abundant medicinal plants. The present study was designed to bring together information on medicinal plants with antivenin properties and actions. Data has been collected with prominence on the plants, family, parts used, indications, mode of use etc. from Ayurveda literatures in an ethnobotanical perspective. In recent years, many studies have been published on pharmacological confirmation of antivenin potential of these plants against a broad range of envenomation, including enzyme inhibiting activity, anti-hemolytic activity, anti-proteolytic activity, anti-cytotoxicity and anti-myotoxicity. However, several plants claimed to be Vishahara (anti-poisonous) in Ayurveda need to be explored scientifically for their antivenin potential.

Keywords: Envenomation, Ayurveda, Vishahara, Anti-Venom

INTRODUCTION

The introduction of venom into a body by means of the bite or sting of a venomous animal is envenomation.¹ Envenomation is considered as a significant public health problem especially in rural populations across the globe.² Numerous species of spiders, scorpions, insects, centipede, mollusks, jelly fish, sea anemones, fishes, snakes, lizards, frogs, moles, platypus, shrews are animals capable of producing venom.³ WHO enlists snake bite, cat bite, dog bite and monkey bites under animal bites. Amongst venomous animals, snake bite is considered to be the cause for the utmost burden of human suffering. Current estimates indicate that snake envenoming affects 2.4 million people and result in 94,000–1,25,000 deaths every year, with an additional 4,00,000 amputations and other severe health consequences, such as infection, tetanus, scarring, contractures and psychological sequelae.⁴ Scorpion stings is another common yet neglected health issue especially found lethal in young children.⁵ Bite by rabid mammals (99% dog-mediated) is estimated to cause 59,000 human deaths annually in over 150 countries, with 95% of cases occurring in Africa and Asia.⁶ The burden of venomous bites and stings causing mortality and morbidity continues to be a serious concern for the people and the health-care providers in developing countries despite the successful outcomes with anti-venom therapy. Most Envenomation happens in the world's most remote and poorly developed tropical communities where majority of victims do not seek hospital treatment but prefer indigenous snake bite remedies.⁷ The lack of medical facility in the vicinity in the rural area is considered as one of the major reasons for seeking traditional healers. Measures adopted by traditional healers are blamed as the reason for poor outcomes in

cases of envenomation. Few beliefs regarding snake bite and health seeking behavior studies conducted in Sri Lanka found that people firmly believed in Ayurvedic treatment for snake bite.⁸ Both traditional and conventional systems of medicine have limitations for management of envenomation from lack of resources and awareness. Evidence based, scientifically sound, integrative or multidisciplinary approach of native medical systems and conventional medical systems is the need of the hour for strengthening the health care in envenomation. The broad aim of this article is to provide a general outline on descriptions of poisons and their management from an Ayurvedic perspective. This article reviews the ethno botanical aspect and pharmacological researches on anti-poisonous herbs delineated in Ayurveda.

Ayurveda understanding and approach to Envenomation

Ayurveda is considered as the earliest medical system with a specialized discipline of toxicology (Agada Tantra) in a codified form with texts and scriptures. Acharya Sushruta, the father of surgery in his treatise, Sushruta Samhita dealt extensively on toxicology in one of the six cantos i.e. Kalpa sthana. Consciousness of the security of the king and the methods employed for his protection from accidental and homicidal poisoning are important applied aspects of the subject of toxicology during ancient times. Various observations that one comes across in the treatise seems relevant even at present. Acharya Agnivesha, in his treatise Charaka Samhita observes that "Even an acute poison can become an excellent drug if properly administered and similarly a drug if not properly administered becomes an acute poison".⁹ William Withering (1789) makes a

similar observation that poison in small doses are the best medicines and useful medicines in too large doses are poisons.¹⁰

Ayurveda understands Visha (poison/toxin) as Akritrima (natural) and Kritrima (artificial). Akritrima is further categorized as Sthavara (inanimate) and Jangama (animate). Kritrima Visha is developed by combination of two poisonous materials and combination of non-poisonous materials is Gara (concocted poison). Incompatible food (Viruddhaahara) is also considered similar to Gara.¹¹ Inanimate poisons include poisons of plant origin, toxic minerals, metals and metal ores in their natural form. Animate poisons include venoms of poisonous varieties of snakes, scorpions, spiders, rabid animals, insects, worms, fishes, frogs etc. Visha of mild potency, continuing to exist in the body for many years which is of animate or inanimate origin and constantly polluting the bodily tissues thereby leading to chronic ailments is termed as Dushi Visha.¹² The principles of management of Dushi Visha described in Ayurveda could be utilized for the management of long-term specific and nonspecific complications following envenomation.

Visha is attributed with ten qualities as per Ayurveda such as Laghu (lightness), Ruksha (unctuousness), Ashu (quickness), Vishada (non-sliminess/clear), Vyavayi (spreading without digestion/ pervades all body before getting digested) Tikshna (sharpness), Vikasi (relaxant), Sukshma (minuteness), Ushna (hotness) and Anirdishya rasa (indistinct taste). All these properties of poison by virtue of its quickness vitiate the Tridoshas thus hindering them to perform normal functions attributed to them. Biotransformation, a function of the Tridoshas is adversely affected precipitating retention of toxins in the body and blocking their elimination.¹¹ Ayurvedic texts quote that Ojas, the prime substance imparting immunity to the body is vitiated by Visha (toxic substance or poison). Visha, by virtue of its ten properties deactivate the ten opposite qualities of Ojas leading to impaired immunity and death. The signs and symptoms and principles of treatment of animate and inanimate poisons in general are based on Tridoshas and also on the Visha vega (toxic manifestation within a bodily tissue).¹³ Twenty-four methods of therapy are described by Acharya Charaka in his treatise, Charaka Samhita for the management of Visha. Treatment starts from ligation (Arishta bandhana) above the affected part and ends in revival of the apparently dead (Mrtasanjivana). Administration of specific antidotes for combating envenomation is part of these twenty-four methods of therapy.¹⁴

Ayurvedic medicinal plants for different Envenomation: Ethno pharmacological perspective

All the three major treatises of Ayurveda have chapters dedicated for Envenomation. Several hundreds of drugs of plant, mineral and animal origin are utilized for the management of envenomation under the term Vishahara in Ayurveda treatises. In the current review we have presented more than hundred plant drugs being recorded in Ashtanga Hridaya (Table 1) for the management of a variety of envenomations.¹⁵ Interestingly more herbs are recorded for the management of spider venom followed

by snake bite, rat bite, scorpion sting respectively which is depicted as a figure (Figure 1). The identity of the plant source has been confirmed from Encyclopedia on Indian Medicinal Plants in FRLHT's ENVIS Resource Partner on Medicinal Plants.¹⁶ Medicinal plants belonging to 61 families have been identified used in treating envenomation. Many plants belonging to Fabaceae (14), Cucurbitaceae (6), Verbenaceae (5) and Zingiberaceae (4) were found used to treat different kinds of bite (Figure 2). Fabaceae was cited as the botanical family consisting of the greatest number of plants reputed against snake bite.¹⁷ The plant part designated in the classical text has been reported here for researchers to utilize the information for new drug development. In case the specific part is not mentioned then the useful part indicated in the Ayurveda pharmacopeia¹⁸ is reported here. Acharyas have preferred using sustainable plant parts like leaves, stem bark, fruits and flowers wherever possible, even though use of roots are also common. Ayurvedic texts specify that wherever the useful part is not specified in a given context, then root is to be procured.¹⁹ These medicinal plants are intended for use either internal or external or both in different dosage forms such as juice, aqueous decoctions, medicated jams, powders, fermented drinks, pastes etc.

Scientifically validated Visha hara herbs with anti-venom activity

Several plant species have been studied for pharmacological evidence against snake venoms including inhibitory potential against hyaluronidase, phospholipase, proteolytic, hemorrhagic, myotoxic and edematogenic activities. However, research into Ayurvedic anti-venom herbs is still in a very premature stage. Very few (approximately 22%) of the species used in Ayurvedic medicine against various Envenomation were studied in preclinical assays with different snake venoms as shown tabulated (Table 2) along with details of the extract and the research model. Some medicinal plants used repeatedly in the management have not been explored such as *Valeriana wallichii* DC., *Saussurea lappa* (Decne.) Sch. Bip., *Coscinium fenestratum* (Goetgh.) Colebr., *Glycyrrhiza glabra* L., *Acorus calamus* L., *Mesua ferrea* L. etc.

CONCLUSION

Medicinal plants *Albizia lebbbeck* (L.) Benth., *Valeriana wallichii* DC., *Saussurea lappa* (Decne.) Sch. Bip., *Curcuma longa* L., *Piper longum* L., *Coscinium fenestratum* (Goetgh.) Colebr., *Glycyrrhiza glabra* L., *Zingiber officinale* Roscoe., *Acorus calamus* L., *Vitex negundo* L., *Aegle marmelos* (L.) Corrêa, *Clitoria ternatea* L., *Amaranthus spinosus* L. occupy prime place in the management of envenomation in Ayurveda. These drugs are administered in different dosage forms, through enteral and parenteral routes to treat Cobra, Viper, Krait envenomation, spider and scorpion venom, rat bite and rabid dog bite. Most of these medicinal plants are scantily studied for their role in envenomation and hence researchers can thoroughly screen these herbs for anti-venom new drug development.

Table 1: Ethno-botanical information on Ayurvedic drugs used in the management of Envenomation

Plant name	Family	Habit	Plant part used	Ailment treated	Other details
<i>Achyranthes aspera</i> L.	Amaranthaceae	Herb	Whole plant	Spider venom	Internal
<i>Aconitum heterophyllum</i> Wall. ex Royle	Ranunculaceae	Herb	Tuber	Snake bite – viper and krait, insect bite	Internal and External
<i>Acorus calamus</i> L.	Acoraceae	Herb	Rhizome	Viper bite, insect bite, spider venom, rat bite	Internal and External
<i>Adhatoda vasica</i> Nees	Acanthaceae	Shrub	Root, Leaves	Snake bite, spider venom, scorpion sting, rat bite	Internal
<i>Aegle marmelos</i> (L.) Corrêa	Rutaceae	Tree	Root	Snake bite – viper, cobra and krait, spider venom, rat bite	Internal and External
<i>Alangium salvifolium</i> (L.f.) Wangerin	Cornaceae	Small tree	Bark	Spider venom, rat bite	Internal for Emesis, external
<i>Albizia lebbek</i> (L.) Benth	Fabaceae	Tree	Stem, bark, leaves, flowers, fruit, root	Snake bite – viper and krait, spider venom	Internal and External
<i>Albizia procera</i> (Roxb.) Benth.	Fabaceae	Tree	Stem bark, seeds	Snake bite – viper, cobra and krait, rat bite	Internal and External
<i>Amaranthus spinosus</i> L.	Amaranthaceae	Herb	Root, whole plant	Snake bite – viper, cobra and krait, rat bite	Internal and External
<i>Aquilaria agallocha</i> Roxb.	Thymelaeaceae	Evergreen tree	Heartwood	Spider venom	External
<i>Aristolochia indica</i> L.	Aristolochiaceae	Perennial climber	Root	Snake bite – viper, cobra and krait	Internal and External
<i>Azadirachta indica</i> A. Juss.	Meliaceae	Tree	Bark, leaves	Spider venom	Internal and external
<i>Baliospermum montanum</i> (Willd.) Müll. Arg.	Euphorbiaceae	Undershrub	Root, seed, leaf	Spider venom	External
<i>Bambusa arundinacea</i> Willd.	Poaceae	Herb	Seeds, tender stem	Viper bite, spider venom	Internal and external
<i>Boerhaavia diffusa</i> Linn.	Nyctaginaceae	Herb	Whole plant, root	Rat bite	Internal
<i>Boswellia serrata</i> Roxb.	Burseraceae	Tree	Resin	Snake bite – viper, cobra and krait	Internal
<i>Caesalpinia sappan</i> L.	Fabaceae	Tree	Heartwood	Insect bite, spider venom	Internal and External
<i>Callicarpa macrophylla</i> Vahl	Verbenaceae	Evergreen shrub	Fruit	Spider venom	External
<i>Calophyllum inophyllum</i> L.	Calophyllaceae	Evergreen tree			External
<i>Calotropis gigantea</i> (L.) Dryand.	Apocynaceae	Shrub	Root, flower latex	Snake bite, scorpion sting, rabid animal bite	Internal and External
<i>Catunaregam spinosa</i> (Thunb.) Tirveng.	Rubiaceae	Small tree	Fruit	Spider venom, rat bite	Internal and External
<i>Cedrus deodara</i> (Roxb.) G. Don	Pinaceae	Tree	Heartwood	Snake bite, scorpion sting, spider venom, rat bite	Internal and External
<i>Cinnamomum tamala</i> (Buch.-Ham.) T. Nees and Eberm.	Lauraceae	Tree	Bark, leaves	Spider venom	Internal and External
<i>Cinnamomum zeylanicum</i> Nees	Lauraceae	Small evergreen tree	Bark	Spider venom	Internal
<i>Citrullus colocynthis</i> (L.) Schrad.	Cucurbitaceae	Creeper	Fruit	Snake bite – viper, cobra and krait	Internal
<i>Clerodendrum phlomidis</i> L.f.	Verbenaceae	Shrub	Root	Spider venom	Internal
<i>Clerodendrum serratum</i> (L.) Moon	Verbenaceae	Shrub	Root	Spider venom	External
<i>Clitoria ternatea</i> L.	Fabaceae	Perennial climber	Root	Snake bite – viper, cobra and krait, rat bite	Internal
<i>Coixlacryma-jobi</i> L.	Poaceae	Annual herb	Root	Viper bite	Internal
<i>Coleus vetiveroides</i> Jacob	Lamiaceae	Perennial herb	Whole plant	Spider venom	External
<i>Cordia myxa</i> L.	Boraginaceae	Small tree	Fruit	Snake bite – viper, cobra and krait, spider venom	Internal
<i>Coscinium fenestratum</i> (Goetgh.) Colebr.	Menispermaceae	Climbing shrub	Wood	Snake bite – viper, cobra and krait, spider venom, scorpion sting, insect bite, rat bite	Internal and External
<i>Crataeva nurvala</i> Buch.-Hum	Capparaceae	Tree	Bark	Spider venom	Internal
<i>Crocus sativus</i> L.	Iridaceae	Herb	Stigma	Spider venom, rat bite	External
<i>Curcuma longa</i> L.	Zingiberaceae	Herb	Rhizome	Snake bite – viper, cobra and krait, spider venom, scorpion sting, insect bite, rat bite	Internal and External

<i>Cyclea peltata</i> (Lam.) Hook. f. and Thomson	Menispermaceae	Twining shrub	Whole plant	Snake bite, insect bite and spider venom	Internal and External
<i>Cyperus esculentus</i> L.	Cyperaceae	Perennial herb	Whole plant	Spider venom	Internal
<i>Cyperus rotundus</i> L.	Cyperaceae	Perennial herb	Whole plant	Spider venom	Internal
<i>Datura metel</i> L.	Solanaceae	Perennial herb	Leaves, root	Snake bite, rabid animal bite	Internal and External
<i>Desmodium triflorum</i> (L.) DC.	Fabaceae	Herb	Whole plant	Rabid animal bite	External
<i>Dipterocarpus alatus</i> Roxb. ex G. Don	Dipterocarpaceae	Tree	Wood	Rabid animal bite	External
<i>Elettaria cardamomum</i> (L.) Maton	Zingiberaceae	Herb	Fruit	Snake bite, Insect bite and spider venom	Internal and External
<i>Emblica officinalis</i> Gaertn.	Phyllanthaceae	Tree	Fruit	Snake bite, scorpion sting, spider venom, rat bite	Internal and External
<i>Euphorbia hirta</i> L.	Euphorbiaceae	Herb	Whole plant	Spider venom	External
<i>Feronia limonia</i> (Linn.) Swingle	Rutaceae	Large tree	Fruit pulp, fruit, root, leaves, flower, bark	Snake bite-krait, cobra, viper venom, rat bite	Internal
<i>Ficus benghalensis</i> L.	Moraceae	Large tree	Tree bark	Snake bite-krait, cobra, viper venom, insect bite	Internal
<i>Ficus glomerata</i> Roxb.	Moraceae	Large tree	Tree bark	Snake bite- krait, cobra, viper venom, insect bite	Internal
<i>Ficus lacor</i> Buch-Ham	Moraceae	Large tree	Tree bark	Snake bite- krait, cobra, viper venom, insect bite	Internal
<i>Ficus religiosa</i> L.	Moraceae	Large tree	Tree bark	Snake bite - krait, cobra, viper venom, insect bite	Internal
<i>Flacourtia jangomas</i> (Lour.) Raeusch.	Salicaceae	Tree	Bark, fruit	Spider venom	External
<i>Gloriosa superba</i> L.	Liliaceae	Herb	Root	Spider venom	Internal and External
<i>Glycyrrhiza glabra</i> L.	Fabaceae	Perennial herb	Root	Spider venom, snake bite – krait, viper, cobra	Internal and External
<i>Gmelina arborea</i> Roxb.	Verbenaceae	Deciduous tree	Root, fruit	snake bite – krait, viper, cobra	Internal and External
<i>Hemidesmus indicus</i> (L.) R. Br. ex Schult.	Asclepiadaceae	Training vine	Root	Rat bite, spider venom	External Internal
<i>Indigofera tinctoria</i> L.	Fabaceae	Shrub	Root	Rat bite, spider venom	External
<i>Lagenaria siceraria</i> (Molina) Standl.	Cucurbitaceae	Annual vine	Fruit	Rat bite	Internal
<i>Luffa acutangula</i> (L.) Roxb.	Cucurbitaceae	Annual vine	Fruit	Spider venom	External
<i>Luffa cylindrica</i> (L.) M. Roem.	Cucurbitaceae	Annual vine	Fruit	Spider venom	External
<i>Luffa echinata</i> Roxb.	Cucurbitaceae	Annual vine	Fruit	Rat bite	Internal
<i>Malaxis acuminata</i> D. Don	Orchidaceae	Terrestrial orchid	Rhizome	snake bite – krait, viper, cobra	Internal
<i>Mesua ferrea</i> L.	Clusiaceae	Evergreen tree	Dry flower, stamen	All types of Envenomation, Viper bite and spider venom, insect bite	Internal and External
<i>Microstylis wallichii</i> Lindl.	Orchidaceae	Terrestrial orchid	Rhizome	snake bite – krait, viper, cobra	Internal
<i>Moringa oleifera</i> Lam.	Moringaceae	Tree	Bark, fruit	Rat bite	Internal
<i>Nardostachys jatamansi</i> (D. Don) DC	Caprifoliaceae	Perennial herb	Root	Snake bite	Internal and External
<i>Nerium oleander</i> L.	Apocyanaceae	Shrub	Root, flower	Snake bite - krait, cobra, viper	Internal and External
<i>Nymphaea alba</i> L.	Nymphaeaceae	Aquatic herb	Flower	Snake bite - krait	Internal
<i>Ocimum sanctum</i> L.	Lamiaceae	Herb	Whole plant	All types of Envenomation , Snake bite – viper, cobra and krait, spider venom, scorpion sting, insect bite, rat bite	Internal and External
<i>Ocimum tenuiflorum</i> L.	Lamiaceae	Herb	Whole plant	All types of Envenomation , Snake bite – viper, cobra and krait, spider venom, scorpion sting, insect bite, rat bite	Internal and External
<i>Onosma bracteata</i> Wall.	Boraginaceae	Perennial herb	Whole plant	Rabid animal bite	External
<i>Operculina turpethum</i> (L.) Silva Manso	Convolvulaceae	Herbaceous vine	Root	Insect bite, spider venom, rat bite	Internal
<i>Pergularia daemia</i> (Forssk.) Chiov.	Asclepiadaceae	Perennial herb	Whole plant	Spider venom	External

<i>Picrorhiza kurroa</i> Royle ex Benth.	plantaginaceae	Herb	Root	Snake bite – viper, cobra and krait, spider venom	Internal and External
<i>Piper longum</i> L.	Piperaceae	Climber	Fruit	All types of Envenomation , Snake bite – viper, cobra and krait, spider venom, scorpion sting, insect bite, rat bite	Internal and External
<i>Piper nigrum</i> L.	Piperaceae	Climber	Fruit	All types of Envenomation , Snake bite – viper, cobra and krait, spider venom, scorpion sting, insect bite, rat bite	Internal and External
<i>Pluchea lanceolata</i> (DC.) C. B. Clarke	Asteraceae	Perennial herb	Root, leaves	Snake bite – viper, cobra and krait, spider venom, insect bite	Internal and External
<i>Plumbago indica</i> L.	Plumbaginaceae	Perennial herb	Root, leaves	Spider venom	Internal and External
<i>Pongamia pinnata</i> (L.) Pierre	Fabaceae	Tree	Bark, fruit, leaves	Snake bite, scorpion sting, spider venom, rat	Internal and External
<i>Premna herbacea/ Clerodendrum serratum</i>	Lamiaceae	Herb	Root	Snake bite – cobra	Internal
<i>Premna serratifolia</i> L.	Lamiaceae	Shrub	Root	Snake bite	Internal and External
<i>Prosopis cineraria</i>	Fabaceae	Tree	Wood, bark	Spider venom	Internal and External
<i>Prunus cerasoides</i> Buch.-Ham. ex D. Don	Rosaceae	Tree	Bark, fruit	Snake bite – krait, spider venom	Internal and External
<i>Prunus cerasus</i> L.	Rosaceae	Tree	Bark	Snake bite – krait	Internal and External
<i>Pterocarpus santalinus</i> L.f.	Fabaceae	Tree	Heart wood	Spider venom	Internal and External
<i>Punica granatum</i> L.	Lythraceae	Tree	Fruit	Snake bite – viper, cobra and krait	Internal
<i>Rubia cordifolia</i> L.	Rubiaceae	Perennial climber	Root	Snake bite – viper, cobra	External
<i>Salix caprea</i> L.	Salicaceae	Tree	Bark	Spider venom	External
<i>Santalum album</i> L.	Santalinaceae	Tree	Heart wood	Snake bite – viper, spider venom	Internal and External
<i>Saussurea lappa</i> (Decne.) Sch.Bip.	Asteraceae	Herb	Root	Snake bite – krait, cobra, rat bite, spider venom	Internal and External
<i>Scindapsus officinalis</i> (Roxb.) Schott	Araceae	Epiphytic climber	Dried mature inflorescence	Insect bite	Internal and External
<i>Sesamum indicum</i> L.	Pedaliaceae	Herb	Seed	Rat bite, rabid animal bite	Internal
<i>Stereospermum suaveolens</i> (Roxb.) DC.	Bignoniaceae	Tree	Root	Snake bite, spider venom	Internal and External
<i>Symplocos racemosa</i> Roxb.	Symplocaceae	Tree	Bark	Spider venom	Internal and External
<i>Tephrosia purpurea</i> (L.) Pers.	Fabaceae	Herb	Seed	Rat bite	Internal
<i>Terminalia bellerica</i> Roxb.	Combretaceae	Tree	Fruit	Snake bite-spider venom, scorpion sting, rat bite,	Internal and External
<i>Terminalia chebula</i> Retz.	Combretaceae	Tree	Fruit	Snake bite-spider venom, scorpion sting, rat bite,	Internal and External
<i>Thespesia populnea</i> (L.) Sol. ex Corrêa	Malvaceae	Tree	Bark	Snake bite- krait and viper venom, insect bite	Internal and External
<i>Tinospora cordifolia</i> (Thunb.) Miers	Menispermaceae	Climbing shrub	Stem	Rat bite	Internal and external
<i>Tribulus terrestris</i> L.	Zygophyllaceae	Herb	Root, whole plant	Rat bite	Internal
<i>Valeriana wallichii</i> DC.	Valerianaceae	Herb	Root	Snake bite – krait, scorpion sting, spider venom, rat bite, insect bite	Internal and External
<i>Vitex negundo</i> L.	Verbinaceae	Large shrub	Leaf, root	Snake bite – cobra, viper and krait, spider venom, rat bite	Internal
<i>Vitis vinifera</i> L.	Vitaceae	Climber	Fruit	Snake bite – cobra, viper and krait	Internal
<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Herb	Rhizome	All types of Envenomation, Snake bite – viper, cobra and krait, spider venom, scorpion sting, insect bite, rat bite	Internal and External

Table 2: Anti-venom activity and their model reported

Plant name	Plant part and Extract used	Model studied	Reference
<i>Abutilon indicum</i> (L.) Sweet	Hexane and methanolic leaf extract	Enzyme inhibiting activity on <i>Echis carinatus</i> s (Saw scaled viper)	20
<i>Achyranthes aspera</i> L.	Aqueous and ethanolic extract of the leaves	Inhibition of phospholipase activity, Inhibition of Procoagulant activity, Inhibition of Hemolytic activity	21
<i>Acorus calamus</i> L.	Root extract using distilled water	Neutralization of lethality, edema-forming activity, hemorrhagic activity, phospholipase activity (PLA2) and pro-coagulant activity caused by <i>Echis carinatus</i> venom	22, 23

	Rhizome of <i>Acorus calamus</i> - cold extracts were prepared using Methanol	Inhibition of effect of the enzymatic components present in the venom of the Viperidae family	
<i>Aegle marmelos</i> (L.) Corrêa	Methanolic extract of Leaf, stem and root bark	Anti-haemolytic activity, Inhibition of cobra venom induced anti-acetylcholinesterase activity, Anti-proteolytic activity against Najanaja venom	24
<i>Albizia lebbek</i> (L.) Benth	Seed methanolic extract -hot extracts by the Soxhlet method using different solvents (1:25 w/v) with increasing polarity (<i>n</i> -hexane, chloroform, ethyl acetate, methanol and water)	Neutralization potential against the toxic enzymes of ECV (proteases and hyaluronidases), prevented the characteristic ECV induced hemorrhage and myotoxicity	25
<i>Andrographis paniculata</i> (Burm. f.)	Dried Ariel part (after 90 – 120 days of sowing) Alcoholic extract Dried Ariel part - Ethanolic extract	Anti-cobra venom activity Anti-scorpion venom activity	26
<i>Aristolochia indica</i> L.	Aristolochic acid and its derivatives from the aqueous root extract	<i>In vitro</i> Assay for L-amino acid oxidase (LAAO) – – Russel viper venom <i>In vivo</i> -	27
<i>Azadirachta indica</i> A. Juss.	Methanolic leaf extract	<i>In vitro</i> - PLA2 Inhibitor activity – inhibits the cobra and Russell's viper venoms	28
<i>Caesalpinia crista</i> L.	Seeds and leaves	Anti- Contractile skeletal muscle against <i>Bitis arietans</i>	29
<i>Calotropis gigantea</i> (L.)	Methanolic extract of plant	Neutralization of Haemorrhagic Activity, Neutralization of Necrotizing Activity, Neutralization of Edema forming activity	30
<i>Cinnamomum tamala</i> (Buch.-Ham.) T. Nees and Eberm.	Aqueous and alcoholic extracts of dried bark	<i>In vivo</i> and <i>In vitro</i> models were used to determine the anti-venom capacity of the plant extract by using two dose levels and it showed a significant neutralization of lethality, PLA2 activity and bleeding time.	31
<i>Coixlacryma-jobi</i> L.	Ethanolic root extract	Neutralization of venom-induced HRBC lysis, inhibition of PLA ₂ , nucelotidase (DNase), fibrinogenolytic enzyme activity	32
<i>Curcuma longa</i> L.	Rhizome extract Hexane extract of rhizome	Enzyme inhibition activity, anti cytotoxicity and anti myotoxicity against Najanaja venom Anti hemorrhagic activity against Both <i>Rop jararaca</i> venom and anti lethal activity against <i>Crotalus durissus terrificus venom</i>	33, 34
<i>Cycleapeltata</i> (Lam.) Hook. f. & Thomson	Aqueous extract of <i>Cyclea peltata</i> root	<i>Ex vivo</i> neutralization tests such as acetylcholinesterase, protease, direct hemolysis assay, phospholipase activity and procoagulant activity	35
<i>Embllica officinalis</i> Gaertn.	Methanolic root extract	<i>In vitro</i> and <i>in vivo</i> - <i>V. russellii</i> and <i>N. kaouthia</i> induced hemorrhage, coagulant, defibrinogenating and inflammatory activity	36
<i>Euphorbia hirta</i> L.	Whole plant methanolic extract	Protease, PLA ₂ , hyaluronidase and hemolytic inhibitory activity of Najanaja venom induced toxicity	37, 38
<i>Gloriosa superba</i> L.	Root ethanolic extract	<i>In vitro</i> and <i>in vivo</i> neutralizing effect against the venom of <i>Najanigri collis</i>	39
<i>Hemidesmus indicus</i> (L.) R. Br. ex Schult.	Methanolic extract of root	<i>In vitro</i> and <i>In vivo</i> studies- viper venom-induced lethal, hemorrhagic, coagulant and anticoagulant activity	40,41
<i>Indigofera tinctoria</i> L.	Ariel parts methanolic extract	<i>In vitro</i> and <i>in vivo</i> neutralizing effect against the venom of <i>Najanigri collis</i>	42
<i>Piper longum</i> L.	Ethanolic extract of fruits	inhibited venom induced lethality, hemorrhage, necrosis, defibrinogenation and inflammatory paw edema, reduced venom induced mast cell degranulation	43
<i>Symplocos racemosa</i> Roxb.	Methanolic extract of stem bark	Enzyme inhibition activity against phosphodiesterase I	44
<i>Vitex negundo</i> L.	Methanolic root extract	Anti-lethal activity, anti hemorrhagic activity, coagulant, defibrinogenating, fibrinolytic activity	45
<i>Vitis vinifera</i> L.	Methanolic seed extract	Daboia/ <i>Vipecr russelli</i> induced proteolytic and hyaluronidase activities, pro-coagulant activity	46

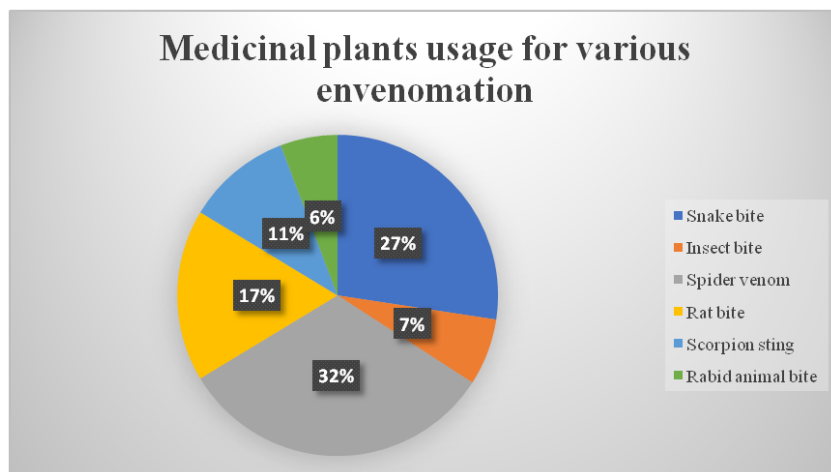


Figure 1: Medicinal plants used in various kinds of Envenomation

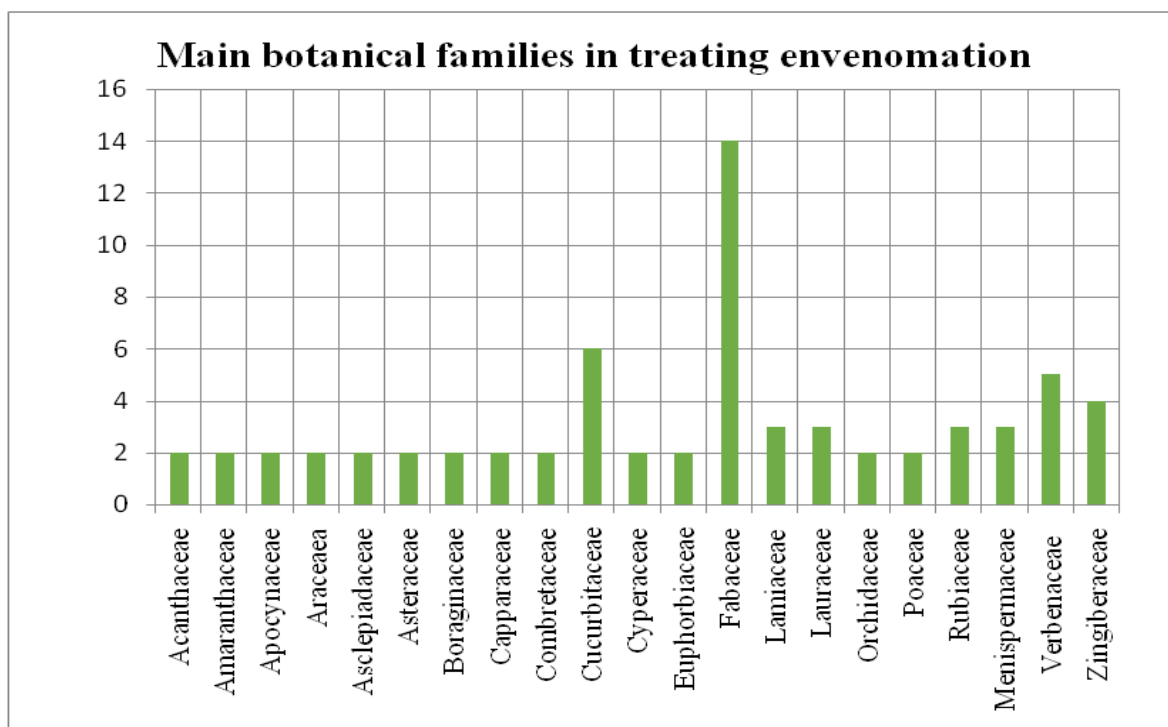


Figure 2: Botanical families in treating Envenomation

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