

## Review Article

**Ethnomedicinal plants used for snakebite in India: a brief overview**Sughosh V. Upasani<sup>a,\*</sup>, Vishal G. Beldar<sup>b</sup>, Anil U. Tatiya<sup>b</sup>, M.S. Upasani<sup>c</sup>, Sanjay J. Surana<sup>b</sup>, Divyata S. Patil<sup>b</sup><sup>a</sup> R.C. Patel Institute of Pharmacy, Shirpur, India<sup>b</sup> Department of Pharmacognosy, R.C. Patel Institute of Pharmaceutical Education and Research, Shirpur, India<sup>c</sup> H.R. Patel Institute of Pharmacy, Shirpur, India

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## ABSTRACT

The result of human interface and assortment of the most desirable, influential, and successful plant species found in the immediate environment at a precise circumstance is attributable to indigenous knowledge of plant species. India has a rich variety of medicinal plants growing under different geographical and ecological conditions; 1500 out of 15,000 privileged plant species have been reported to have medicinal uses. Snakebite is a severe medical, social, and economic problem in many parts of the world, chiefly in tropical and subtropical nations where majority of the world's dangerous snakes are found and where access to treatment is limited. In India, a range of medicinal plants are used as antidotes for snakebites, used either singly or in combination with other agents. The present study makes an effort to assemble information on medicinal plants that are grown and used for snakebite treatment in India. From a range of literature sources, data have been compiled with emphasis on the plants, family, parts used, etc., depending on the availability of information. This paper enumerates 523 plant species belonging to 122 families that act as antidotes against snakebites. We believe this study of herbal antidotes against snake venom is of substantial significance to society.

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**1. Introduction**

Historically, humans have depended on nature to provide for their fundamental needs, namely food, clothing, medicines, and natural healing remedies. This reliance led the aborigi-

nal people living in synchronization with nature to develop a system of knowledge about plants, which play several important functions in human life.<sup>1-3</sup> The result of human interface and assortment of the most desirable, influential, and successful plant species found in the immediate environment during specific events is attributable to the indigenous knowledge

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of plant species.<sup>4,5</sup> The World Health Organization estimates that about 80% of the world's population in developing countries depends on plants for the management of a variety of diseases, because of the lack of modern healthcare services.<sup>6,7</sup>

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## 2. Ethnobotany

Ethnobotany is the field of science that deals with the associations between plants and humans. An ethnobotanical survey encompasses discussion with local natives, use of accessible data in the literature, and the folklore of each area.<sup>1</sup> Documentation of indigenous medicinal knowledge of plant species has contributed to a number of modern drug formulations for basic healthcare.<sup>8,9</sup> Medicinal plants are an important source of bioactive compounds that assist directly in the handling of ophidian envenomation, or ultimately, as supplements to conventional serum therapy. Thus, plant extracts are a valuable substitute, used either alone or in combination with other agents, when antisera are not available in emergency situations. Exploration on the traditional use of medicinal plants has attained significant consideration within the scientific community in recent years; about 25% of the drugs prescribed worldwide come from plants.<sup>10,11</sup> The conventional system of medicine could not be the entire solution for miscellaneous human pathological conditions,<sup>12</sup> whereas drug discovery through ethnobotanical study has been found to be one of the most reliable approach and even today this area holds promise for its considerable potential.<sup>13</sup> Since ancient times, plants have been used for treatment of various diseases. The traditional systems of medicine, together with folklore systems, continue to serve a large portion of inhabitants, particularly in rural and tribal areas despite the advent of modern medicine.

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## 3. India

India has a rich variety of medicinal plants growing under different geographical and ecological conditions; 1500 species out of about 15,000 privileged plants species in India have been reported to have medicinal uses.<sup>14</sup> India is composed of 29 states and seven union territories comprising a total area of 3,287,263 km<sup>2</sup>. Indians speak a variety of languages, which include 23 regional languages (Assamese, Bengali, Bodo, Dogri, Gujrathi, Kannada, Kashiri, Kokborok, Konkani, Maithili, Malayalam, Manipuri, Marathi, Mizo, Nepali, Odia, Punjabi, Sanskrit, Santali, Sindhi, Tamil, Telugu, and Urdu). Moreover, there are many more local or tribal dialects spoken by Indians. India is home to different ethnic groups comprising 5.4 crores of indigenous peoples living in various territories, having diverse cultures, religious rites, and food traditions that separate them from each other. These people also have a healthy awareness of traditional medicine,<sup>15–19</sup> especially herbal and folk medicine for treatment in snakebites. Traditional herbalists operate closer to the people, taking advantage of the biodiversity of plant species in such areas to cure various diseases and ailments.<sup>20–22</sup>

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## 4. Snake and snake venoms

Snakes have been used to symbolize war and peace, love and hate, God and devil, as well as life and death; many times they have been used as contradictory symbols within the same civilization.<sup>23</sup> Snakebites represent a severe medical, social, and economic challenge in many parts of the world, chiefly in tropical and subtropical nations. Majority of the world's dangerous snakes are found in developing countries, where access to treatment is limited. It is estimated that about 2 million people are bitten annually, resulting in up to 125,000 deaths, and 400,000 permanent disabilities from severe complications, which may lead to amputation.<sup>24</sup> Snake venoms are one of the most intense "mysterious" biological fluids within class Mammalia, having complex medical effects owing to the presence of complex mixtures of proteins and peptides and they contain at least 25 enzymes.<sup>25–27</sup> There are many prospective effects in humans following envenoming by snakes, but just a few broad categories are of major clinical significance such as systemic myolysis flaccid paralysis, coagulopathy and hemorrhage, cardiotoxicity, renal damage and failure, and local tissue injury at the bite site. Sometimes, it causes secondary effects such as potential morbidity and mortality.<sup>28</sup>

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## 5. Snakebites treatment

Snakebites are commonly treated by parenteral administration of horse or sheep-derived polyclonal antivenoms aimed at neutralization of toxins. However, despite the widespread success of traditional therapy, it is still important to search for other different venom inhibitors, either synthetic or natural, that could complement or substitute for the action of the traditional antivenom. Even if in a variety of cases the effectiveness of some traditional courses of therapy is not particularly apparent, conventional herbal medicine is easily available in the countryside for snakebite treatment. Some of the methods used to treat snakebites include topical application of plant leaves–juice–paste, etc.; chewing of leaves and plant parts; and drinking plant extracts or decoctions. In India as well as in other parts of the world, medicinal plants are used as antidotes for snakebites, administered either singly or in combination with other antisnake venoms or supportive plants. Thus, in the management of snakebite, the study of herbal antidotes against snake venom is of considerable significance to society.<sup>18,19,29,30</sup>

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## 6. Procedure for review—methodology

In this systematic review, we compile information on medicinal plants that are grown and utilized in various parts of India for treatment of snakebites. As this is a detailed "scrutiny," we also carried out an appraisal of plants used in treatment of snakebite poisoning throughout India. This paper helps readers to find out more about these plants by including their local names from local inhabitants. The appropriate literature was reviewed such as technical studies published in journals, books, theses, and reports, and we searched for relevant information through various electronic databases (Science Direct,

NISCAIR, MEDLINE, Scopus, Scirus and Google Scholar) using keywords such as “medicinal plants”; “snakebite”; “ethnobotany or ethnopharmacology or indigenous or Indian” and “survey”. It is not possible to incorporate all the information about use of medicinal plants for snakebite treatment; so we chose to focus on information that is easily accessible to researchers. In the past few decades; different tribal communities have tried to record traditional and tribal knowledge related to medicinal plants. However; in most cases; this information has yet to be made available to the modern world.

A list of medicinal plants was produced, showing biological source(s), Family, local name(s) part(s) used, method of preparation, and reference(s). In this review, the precision of botanical identification of plants are obtained from the original sources (Table 1).

While preparing the list of medicinal plants, the following points were considered: biological source(s), family, local name(s) part(s) used, method of preparation, and reference(s). The methodology of preparations depends on the availability of plant part(s) and urgency of utilization. Often, the preparation is done by crushing the plant with the help of stones or a wooden piece, and making juice or paste that will be applied on the affected area; sometimes they are also given orally. If we consider their popularity on the basis of more than five plants used from one family, then there are 29 families. The widely used families are Acanthaceae, Araceae, Fabaceae, and Rubiaceae (>22%). They are followed by Apocynaceae (>20%), Euphorbiaceae (>19%), and Lamiaceae (>18%). A recent study revealed that rich ethnomedicinal knowledge from community members should be recognized, documented, and preserved appropriately so future generations can benefit. Predominantly, it is required that ethnomedicinal plants used by local groups and tribes of people be comprehensively studied to determine the value of these plant species so that they can be managed and conserved for the welfare of mankind.

## 7. Indian Vaidya concept

In India, there is a group of people known as “Vaidya” (a doctor of herbs, compounder of medicinal preparations such as Churna, Pills, Syrup, Asava, Arishta, Taila), and elderly persons with folk knowledge about the uses of various household spices and herbs. Their native beliefs, skills, and cultural practices concerned with people’s health are useful in curing various diseases. Some elderly women with expertise in delivering babies have proficient knowledge about folk medicines for facing day-to-day health problems, especially among puberty girls, lactating mothers, and pregnant women. As per Indian beliefs, Mother Nature nurtures us. Hippocrates also stated that “Nature cures, not the physician.” Plants are rich sources of medicinal compounds by which we can cure a variety of diseases, as well as maintain and improve our health.<sup>99</sup> Ayurveda states that each and every plant has medicinal use; you just need to find the right person to show that. Owing to the various undesirable effects of some modern-day drugs, an increasing number of people from both developed and developing countries have turned to medicinal plants.<sup>98</sup>

There is an extraordinary thinking that understanding knowledge is the key for any revolution. India is a megadiverse nation, home to approximately 10% of the world’s species. For the past several thousands of years, India has nurtured a rich cultural heritage, and large numbers of Indians have used a variety of plants through their rituals and cultural activities. Unfortunately, because of the sudden huge increase in population, negligent behavior toward environmental care guidelines, and global climate change, so many species are now on the verge of vanishing. This has had a strong effect on the food chain, standard of living, and cultural practices—rituals—of thousands of Indians. To maintain biodiversity, many conservation organizations in India are working to alleviate this trend.

## 8. Review findings

The present review is an attempt to compile information about traditional/ethnobotanical medicinal plants used in various parts of India for snakebite treatment. This study will help future researchers understand various approaches to treat snakebites. Data obtained from the present investigation are presented in Table 1 (the plant species are arranged in alphabetical order). A total of 523 plant species belonging to 122 families have been reported for the treatment of snakebite. However, this appraisal applies only to a small compilation of essential plants that are frequently used in snakebite poisoning in India. Acanthaceae, Amaranthaceae, Apocynaceae, Araceae, Asteraceae, Caesalpiniaceae, Cucurbitaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Moraceae, Rubiaceae, Rutaceae, and Zingiberaceae are the most significant families from which a variety of plants are used. The local names of these plants are given in brackets, and for a better understanding, we also included the actual meanings of these names as well as descriptions.

## 9. Local names of plants with meanings

The following list includes the plants that are most frequently used in snakebite treatment in India:

- *Abrus precatorius* Linn. (*Gunj*)—Two or three grams of fresh leaves or roots of the plant with seeds are made into paste and consumed along with cold water or cow’s milk. (Two times a day for 5–7 days to cure any poisonous bite, as well as root powder applied topically.)
- *Achyranthes aspera* Linn. (*Apamarg*)—“Apamarg” means to cure in a “wrong way.” The whole plant’s extract and/or root’s extract is given orally. The paste obtained from the root is also used for 3 weeks. *Achyranthes bidentata* Blume and *Achyranthes porphyristachya* W are also significant in snakebite treatment.
- *Acorus calamus* Linn. (*Vekhand*)—The term “vekhand” is regularly used by Indian women to describe anti-inflammatory, expectorant in infants. The rhizomes are crushed to paste and given with warm water as well as applied externally on affected area.

**Table 1 – List of medicinal plants used for treatment of snakebite in India.**

Biological source	Family	Local names	Part used	Method of administration	References
<i>Abrus precatorius</i> Linn.	Fabaceae	Kundumani, Sonakaich, Takharichum, Gunj	Seed, leaf, root	2–3 g of fresh leaves or roots with seeds are made into paste and consumed along with cold water or cow's milk. (Two times a day for 5–7 d to cure any poisonous bite, as well as root powder applied topically.)	29,31–40
<i>Acalypha indica</i> Linn.	Euphorbiaceae	Kuppi (Indian acalypha), Kuppe gida, Muktajuri, Kuppimani	Leaf, Whole plant	Leaf paste applied over the bitten part or paste smeared on spot of bite (3–4 d).	29,46–50
<i>Acanthus ilicifolius</i> Linn.	Acanthaceae	Maranda, Maraneli, Kazhimulli	Fruit	For dressing snakebite crushed fruits are used.	52
<i>Achyranthes aspera</i> Linn.	Amaranthaceae	Apamarg, Khoruch, Puth Kanda, Apang, Ola kanta, Kutri, Puthkanda, Adhajhara, Latjira, Chirchiti Kutri, Chirchita, Valiya kadaladi, Kempu Uttarani, Uttarane, Kakralata, Adhijhara, Nayuruvi	Root, seeds, whole plant, leaf, stem	The whole plant extract or root extract is given orally as well as the paste obtained from the root has been used (for 3 wk)	29,38,43,49,50,53–74
<i>Aconitum balfourii</i> (Bruhl) Muk.	Ranunculaceae	Meetha	Root, tuber	Tuber paste used externally and internally.	78–81
<i>Aconitum ferox</i>	Ranunculaceae	Bikh, Bish	Tuberous roots	Unknown	82
<i>Acorus calamus</i> Linn.	Araceae	Vekhand, Ghorbach, Bach, Bojo, Shyoiako, Vasambo	Rhizome	Rhizomes are crushed to paste and given with warm water as well as applied externally.	29,65,68,69,72,76,83–86
<i>Adiantum lunulatum</i> Linn.	Adiantaceae	–	Rhizome	Rhizome powder used for snake bite	87
<i>Adiantum philippense</i> Linn.	Adiantaceae	Kalijhant	Rhizome	Powder of rhizome is used.	89,90
<i>Caladium bicolor</i> Vent.	Araceae	Rudra chama	Tuber	Unknown	88
<i>Aegle marmelos</i> (Linn.) Correa	Rutaceae	Bel, Vilvam	Fruit, leaves, root bark	Decoction/extract (twice a day upto 5 d) of the leaves is given orally or root bark extract is administered internally for every 4 h up to 3 d.	29,41,65,66,91,92
<i>Aerva lanata</i> (L.) Juss. ex Schult	Amaranthaceae	Kannu peelai, Poolapo	Whole plant, rhizome, root	Juice is prepared and taken orally (for 11 d)	29,72,93,94

**Table 1 (Continued)**

Biological source	Family	Local names	Part used	Method of administration	References
<i>Ageratum conyzoides</i> Linn.	Asteraceae	Khoobi, Sahdevi, Kynbatblu myngai, Ajgandha, Sadevi Uchunti	Leaves	Paste of leaf with rhizome of <i>Zingiber officinale</i> is used.	50,58,96–98
<i>Alangium salvifolium</i> (Linn.f) Wang.	Alangiaceae	Ankol, Ankula, Alangi, Aankla	Whole plant, root, leaf, stem bark,	About 15 g of bark, ground with 10–12 black peppers and mixed with 60 g animal fat, is given every 2 h to cure snakebite. Root bark decoction is given internally to treat.	29,38,60,65,70
<i>Albizia lebeck</i> (Linn). Benth.	Fabaceae	Siris, Kala Siris, Segta/Siris, Hombage, bhandi	Leaves, bark, flower, whole plant, root	Paste of bark is used.	45,54,55,73
<i>Allium cepa</i> Linn.	Liliaceae	Piyaz, Venkayam	Skin bulb	Paste taken from fresh skin bulb for external application (5 d).	29,65
<i>Allium sativum</i> Linn.	Liliaceae	Rosun	Bulbs	Bulb is made into paste and given orally.	68,69
<i>Alstonea scholaris</i> (Linn.) R.Br.	Apocynaceae	Saptarni, Chatni, Satina, Barap lei, Lawthong	Leaf, bark	Bark decoction given orally.	54,73
<i>Alstonia venenata</i> R.Br.	Apocynaceae	Analivegham, Elaipalai, Analivegham	Stem, bark root	Tablets made from paste of stem bark are taken with cow's urine. Decoction also taken orally.	49,70
<i>Alternanthera sessilis</i> (Linn.) R. Brown ex DC	Amaranthaceae	Kandilijari	Stem, leaf	External application of stem and leaf paste is used.	72
<i>Amaranthus spinosus</i> Linn	Amaranthaceae	Kateli, Mullikeerai, Kateli Chaurai, Kanta-bhaji, Kateli-chaulai	Roots, leaf, whole plant	Paste of leaves is applied locally.	50,72
<i>Amaranthus viridis</i> Linn.	Amaranthaceae	Khutora, Chaulai	Leaf, stem	Leaves/stem paste are applied externally.	70,96
<i>Ammannia baccifera</i> Linn.	Lythraceae	Neerumulli	Whole plant	Whole plant powder mixed with hot cow's milk to drink.	65,70
<i>Andrographis echioides</i> Nees	Acanthaceae	Nadnaur, Gusum puru, Gopuranthangi	Whole plant	Paste of whole plant is given orally with water. It is also applied externally.	65,84
<i>Andrographis lineate</i> Wallich ex	Acanthaceae	Siriyangai, Periyangai, Malaiveempu	Whole plant, leaves	Paste of leaves is applied externally. About 30 g of whole plant paste is directly administered orally.	29,65

<i>Andrographis paniculata</i> (Burm f) Wall. Ex. Nees.	Acantheceae	Kalmegh, Bhumi neem, Neelaveppu, Nilavaambu, Chirianangai, Sirianangai, Periyangai	Leaf, leaves, whole plant	A decoction of the leaves with the leaves of <i>Andrographis alata</i> is given. Decoction or extract is applied externally.	29,31,33–35,40,49,51,57,65,68,69,72,94,98
<i>Argemone mexicana</i> Linn.	Papaveraceae	Sialkatahi, Datturi, Pilikateli, Bharbhand, Brahmasthanu	Leaf, Seed, root	Leaf/seed decoction given orally (7 d). Root paste is also used.	29,59,65
<i>Arisaema tortuosum</i> (Wall.) Schott	Araceae	Haap roodakaro, Halida, Kotukand, Chambus, Chakrata	Tuber, bulb	Paste of the tuber in applied. Infusion of fresh bulb is taken orally thrice a day.	72,77
<i>Aristolochia bracteolata</i> Lamk.	Aristolochiaceae	Kalipad, Aduthinpalai	Leaves, root	Leaves paste applied externally as well as infusion is taken orally.	41,49,65,72
<i>Aristolochia indica</i> Linn.	Aristolochiaceae	Sapasan, Cheriya eswaramulla, Garalika, Garudi, Nagbel, Arkamul, Birthwort, Ishwarmul, Bhedi-Janete, Karalakam, Kaliparh, Kaligulesar, Issavari, Eashwari, Eshwarballi, Eshwari gida, Perumarindu, Karuda kodi, Garudakodi, Thalaisuruli	Root, entire plant	Fresh roots are grounded along with rouwalfia serpentina mixed in water taken twice daily (3 d). Root powder is snuffed; root juice is given orally and root paste applied locally.	29,33,35,41–43,63,65,68,69,72,84,94
<i>Aristolochia tagala</i> Cham	Aristolochiaceae	Samta, Valiya Eswaramulla, Perumarunt Hukodi	Root	Crushed, mixed with water and drunk as well as fresh roots are grounded and applied externally on affected portion.	32,63,72
<i>Azadirachta indica</i> A. Juss	Meliaceae	Vembu, Veempu, Neem	Flower, bark, leaf, fruit	Decoction/paste is prepared and given orally (7 d).	29,49,50,66,68,69,93
<i>Bacopa monnieri</i> (Linn) Pennell	Scrophulariaceae	Brahmisak, Nirbirami, Neeripirami, Brahmi	Bark, leaf, whole plant	Juice mixed with castor oil is applied externally to treat. Leaf powder decoction mixed with hot cow's milk taken orally.	46,65,66,70,73
<i>Barleria cristata</i> Linn.	Acanthaceae	Kali Brenkad	Leaves, roots, seed	Leaf juice is applied.	72

Table 1 (Continued)

Biological source	Family	Local names	Part used	Method of administration	References
<i>Boerhaavia diffusa</i> Linn.	Nyctaginaceae	Punarnawa, Dabbal bhaji, Chotwa bhaji, Patharchatta, Biskhapara, Ittsitt	Leaf, whole plant	Leaf juice is also applied locally and taken orally for 7 d.	66,67,98
<i>Bombax ceiba</i> Linn.	Bombaceae	Ilavu, Kate savar, Semal, Simul, Semar, Phunchawng, Simbal, Pikriisii	Flowers, roots, bark, seed	Paste of flowers/fruits/leaves is applied on the bitten spot.	46,55,59,73,92
<i>Buchanania lanzan</i> Spr.	Anacardiaceae	Char, Chironji, Achar, Chironji, Chirongi, Pial	Bark	Unknown	55,58,72,83,98
<i>Butea monosperma</i> (Lamk.) Taub.	Fabaceae	Palash, Dhak, Parsa, Plash	Bark, leaf, flower, gum, seed, stem bark, resin, latex	Bark paste applied on swelling. Paste of one seed in 10 mL lemon juice is given orally.	58,59,66,73,83,98
<i>Caesalpinia bonduc</i> (Linn.) Roxb.	Caesalpiniaceae	Poonainagam, Karanj	Seeds	Seeds paste applied externally (2 wk).	29
<i>Calotropis gigantea</i> (L.) R. Br	Asclepiadaceae	Dev rui, Aak, Ekke, Akanda, Erukku, Aakdo, Safedaakdo, Gadsa, Akanda, Erukku	Roots, latex	Root bark is ground into paste and made into pills n given orally.	29,38,43,58,62,65,68–70,92
<i>Calotropis procera</i> (Ait.) R. Br.	Asclepiadaceae	Rui, Rai, Aakori: Aakra, Biliekke, Ekka (Safed Ak), Rakta arka, Vellerukku, Akra, Aak, Madar, Safed Madar, Gadsa, Akwan	Latex, root, young buds	Leaf latex is applied externally. Leaf latex is applied on bitten area. Root is crushed and given to drink and applied externally.	48,58,66
<i>Carica papaya</i> Linn.	Caricaceae	Papita, Amrurbhanda, Papita	Fruit, seed, latex	Unripped fruit of <i>Carica papaya</i> is taken and the skin is removed by slicing. Salt is then rubbed over it. The fruit is then placed over the bite with sliced portions in contact with the bite and bandaged. Few drops of latex are applied to wound due to snakebite for quick healing.	66
<i>Cassia alata</i> Linn.	Caesalpiniaceae	Senna, Khor-pat, daopata, Seemaiyagathi	Leaf	Paste of leaves is applied externally as well as given orally.	29,65
<i>Cassia fistula</i> Linn.	Caesalpiniaceae	Amaltash, Dhanba, Amaltas, Sonarkhi, Kakke	Fruit pulp, seed, leaf, stem, roots, bark	The paste and decoction of root bark with black pepper is given orally. Paste of stem bark applied on bitten place.	58,62,84,98

<i>Cassia occidentalis</i> Linn.	Caesalpiniaceae	Kasaundi, Kasondi, Peeperambi, Thagarai	Root, leaf	Oral administration of root paste.	65,70,74
<i>Cassia tora</i> Linn	Caesalpinaceae	Takala, Sickle senna, Chakawad, Chakunda, Tagarai, Bon medelwa	Root, leaf	Root paste and leaf decoction is applied externally (14 d).	29,65,70,98
<i>Cissampelos pareira</i> Linn	Menispermaceae	Patha, Patindu, Batindu, Patha, Urikkakodi, Chokipar, Tijumala	Tuber, root	Root paste with long pepper is prescribed once daily for 5 d.	59,70
<i>Citrullus colocynthis</i> (Linn) Schrad.	Cucurbitaceae	Ekladi, Poa Kadva inravarna, Tumba, Gadumba, Tumbo, Indrayan	Seed, root, fruit	Seeds oil used externally as well as root is crushed and given to drink.	66
<i>Clitoria ternatea</i> Linn.	Fabaceae	Ruhu tuhu, Aparajita, Syahiful, Aparajita, Gokarni, Aparajita, Bili Shankhapushpa	Roots	The root extract is taken with the root of <i>A. indica</i> and <i>Rauwolfia serpentina</i> .	53,55,58,62
<i>Cocculus villosus</i> DC.	Menispermaceae	Nagdun, Vachan, karalla	Root	The root bark extract is given internally and applied.	58
<i>Corallocarpus epigaeus</i> (Rottl. & Willd.) Hook. f.	Cucurbitaceae	Aathalai, Marsikand, Kollan, Kova killangu	Root, tuber	Root decoction given internally 3–7 times.	41,70,71
<i>Costus speciosus</i> (Koen) Sm	Costaceae	Keon Kanda, Kebuk, Mahalakri, Jamlakhuti, Pewa, Jamlakhuti, Khongbam Takhelei, Sumbul, Jomalkhuti, Myonpobap	Root, rhizome	Rhizome and root paste is used internally and externally.	59,92
<i>Curculigo orchioide</i> Gaertn.	Amaryllidaceae	Nilapanai, Nela tengu, Kali musli	Root, tuber	Root paste use topically	31,72
<i>Curcuma longa</i> Linn.	Zingiberaceae	Manchal	Rhizome	Rhizome paste is applied externally (3 wk).	29,73
<i>Cyperus rotundus</i> Linn.	Cyperaceae	Motha, Nagar Motha, Musta, Lavhala, Koraipullu	Whole plant, root, tuber, rhizome	Decoction of root/tubers/rhizome given orally (7 d).	29,53,55,84
<i>Datura metel</i> Linn.	Solanaceae	Kala Dhatura, Dhutura	Seeds, root, leaf	Extract of roots are taken with garlic.	58,68,69
<i>Desmodium gangeticum</i> (Linn.) DC.	Fabaceae	Kareti, Salparni	Roots	Half-cup root decoction is taken orally.	73
<i>Drymaria cordata</i> (L.) Willd. Ex Roem. & Schult.	Caryophyllaceae	Mecanachil, Theiphelwang, Kynbat thalap	Whole plant	Whole plant is used (crushed, paste applied).	97
<i>Eclipta alba</i> (Linn.) Hassk.	Asteraceae	Manchal, karisalankanni, Bhringraj, Maka	Whole plant	Whole plant juice is given orally (14 d).	29,65



**Table 1 (Continued)**

Biological source	Family	Local names	Part used	Method of administration	References
<i>Eclipta prostrata</i> Linn.	Asteraceae	Karisalankanni, Bhingraj	Leaf	Leaf paste is applied externally.	29,65
<i>Elaeodendron glaucum</i> Pers.	Celastraceae	Ratangaur, Bhairao, Niuri, Mamri, Jamrasi, Mukarathi (Bhutphal)	Bark, root	Roots and bark of plant made into paste taken orally with cow's milk.	48,83,84
<i>Emblica officinalis</i> Gaertn.	Euphorbiaceae	Amla, Avala, Nelli	Stem, leaves, fruit, roots	Root extract is given orally along with black pepper. Leaf juice as well as stem infusion is given orally.	65,68,69
<i>Euphorbia hirta</i> Linn.	Euphorbiaceae	Ammanpacharisi	Latex, whole plant	Latex or whole plant, decoction given orally.	29,31
<i>Euphorbia nerifolia</i> Linn.	Euphorbiaceae	Mausa sij, Dudhbol, Thor, Thundar, Manasa	Latex, root	Latex is applied locally. Root is used with black pepper.	68,69
<i>Ficus religiosa</i> Linn.	Moraceae	Peepal	Leaf, bark, fruit	25 g stem bark and 8–10 cloves are pounded with animal fat (pure ghee) and given 4–6 times a day.	50
<i>Gloriosa superba</i> Linn.	Liliaceae	Vadhavadiyo, Vach Nag, Nagardi, Gowri Huvu, Kalihari, Kalihari, Karianaga, Agnishikha, Kariyari, Kalappa, Kilangu	Tuber, root, rhizome, seed	Root paste or tuber paste is applied externally (2–5 d).	29,59,65,75
<i>Gymnema sylvestre</i> (Retz.) R. Br.	Asclepiadaceae	Dudhkhuri, Sirukurinchan, Gurmar, Afumari, Gurmarbooti, Sirukurinjan	Leaf, root	Root Tincture or leaf powder taken orally (4 d).	29,41,58,68,69,92,93
<i>Helicteres isora</i> Linn.	Sterculiaceae	Hateri, Murud sheng, Maror Phali	Bark, root	Bark power is given in snakebite.	70,73
<i>Heliotropium indicum</i> Linn.	Boraginaceae	Nakkipoo	Leaf	The leaf juice mixed with hot water is used.	65
<i>Hemidesmus indicus</i> (Linn.) R. Br.	Asclepiadaceae	Suganti Jad, Anantmul, Choti dudhia, Anantamul, Analsing, Nannari, Anantamul	Root, leaf	Aqueous extract of root is prepared in water and given orally, and root paste is applied two or three times a day.	29,35,49,55,58,65,68,69,84
<i>Holarrhena antidysenterica</i> wall	Apocynaceae	Kurwa, Dudhkhuri, Koraya	Bark, root	The root is crushed and applied as well as paste is taken orally with water.	58,72,98
<i>Holarrhena pubescens</i> (Buch.-Ham.) Wall. ex G.Don	Apocynaceae	Pandhara Kula, Bolmatra	Seeds, root, stembark	Paste is applied on the bitten area two times a day	70
<i>Lantana camara</i> Linn.	Verbenaceae	Ragadd, Gajukampa, Arippu	Roots, flower, stem, leaf, whole plant	Decoction of roots, flower and stem are used.	66,96

<i>Lantana indica</i> Roxb.	Verbenaceae	Siruunnichedi	Leaf	Leaf decoction externally used.	70,73
<i>Leucas cephalotes</i> (Roth) Spreng	Lamiaceae	Goma, Gumbi, Gumma	Whole plant	Decoction of whole plant (twice a day for 6 d).	29
<i>Luffa acutangula</i> (Linn.) Roxb.	Cucurbitaceae	Torai, Peerkan, Jangli Torai	Fruit, tendril, seed	Tendrils and seed paste is used.	53,55
<i>Madhuca indica</i> (Koenig.) macbride Gmel	Sapotaceae	Mahua, Mahuwa, Madgi, Mahua, Dori, Mahuda, Saathikkai	Flower, leaves, bark, seeds	Bark paste is externally applied (2-3 d).	45,83,84
<i>Mimosa pudica</i> Linn	Mimosaceae	Lajwanti, Thotta Sinungi, Uskadpoda, Chhuimui/Lajwanti, Thottal surungi, Thottalvadi, Thottasiniki	Root, leaf, whole plant	Whole plants are made extract in drinking water and shaken well and filtered. Extract of whole plant is given twice a day in 1 d only. Leaves are ground and made into paste and applied over affected area.	29,49,53,55,56,58,68,69,97
<i>Mitragyna parvifolia</i> (Roxb.) Korth.	Rubiaceae	Neer-kadamba, Kadamba	Bark, fruit	Unknown.	44
<i>Momordica charantia</i> Linn.	Cucurbitaceae	Karela, Pakakai	Whole plant, Shoot or root	Juice of tender shoot or root is applied.	29
<i>Moringa oleifera</i> Lam	Moringaceae	Sajina, Nugge, Sahigan, Mungna, Sainjna, Sahjan, Sainjnad, Murungaih	Root, seed, whole plant, stem bark, leaf	Fresh extract of bark is taken orally. Bark, root tincture applied externally (3 d).	29,62,68,69,73,91,98
<i>Mucuna pruriens</i> (Linn.) DC	Fabaceae	Kevach, Konch	Seed, fruit, root	Aqueous extract of root is given orally for twice a day.	50,56
<i>Murraya paniculata</i> (Linn.) Jack.	Rutaceae	Gandhela, Angarapputhalai	Root, leaf	Infusion prepared from shadily dried root/leaf powder and administered orally for every 1 h up to 2 d.	59,65,70,73
<i>Musa paradisiaca</i> Linn.	Musaceae	Vazhai, Valaimaram Valai	Bark, stem, skin bark	A plant extract is given orally.	29,49,74
<i>Nerium indicum</i> Mill. Gard.	Apocynaceae	Kaner, Kaner/Kanail, Lal kanher	Leaf, bark, root	The root is crushed with roots of <i>Capparis sepiaria</i> and <i>Datura innoxia</i> , and paste applied externally thrice for 5 d.	46,66
<i>Nerium oleander</i> Linn.	Apocynaceae	Alari, Aralli, Bogakorobi	Seeds	Seeds paste applied externally (14 d).	29,49
<i>Nicotiana tabacum</i> Linn.	Solanaceae	Tambakhu, Pukhaielai	Leaf	Leaves decoction given orally (3 d).	29

Table 1 (Continued)

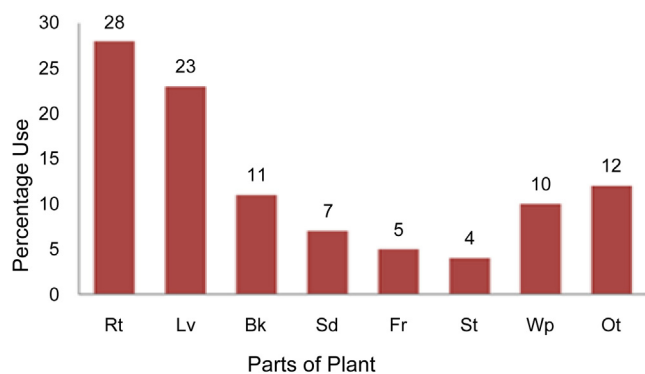
Biological source	Family	Local names	Part used	Method of administration	References
<i>Ocimum sanctum</i> Linn.	Lamiaceae	Barpai, Tulasi	Leaf, root, whole plant	A paste of ocimum leaf with the rhizome of <i>Curcuma longa</i> L. (Zingiberaceae) is applied externally. Leaf juice, oral (8 d).	29,45,66
<i>Ophiorrhiza mungos</i> Linn.	Rubiaceae	Havina gedde, Pambupoo, Keeripundu	Root	Root juice is given (twice a day for 6 days).	29,43
<i>Opuntia dillenii</i> (Ker-Gawl) Haw	Cactaceae	Sappathikali	Stem bark, fruit, entire plant	The fruits paste is applied.	64
<i>Oxalis corniculata</i> Linn.	Oxalidaceae	Simejar, Chhota Tangesi, Ambuti, Kaitka, Sohdkhiew	Whole plant, leaves	Whole plant is crushed and paste is tied on the specific spot of bite, the juice is also drunk.	86,92,97
<i>Pergularia daemia</i> (Forssk.) Chiov.	Apocynaceae	Veliparuthi	Root, leaf	The decoction of the leaves is used.	42
<i>Piper longum</i> Linn.	Piperaceae	Pipla	Roots	Unknown	73
<i>Piper nigrum</i> Linn.	Piperaceae	Bolkaalu, Menasina kaalu, Maricha, Kali-mirch, Milagu	Flower, seed, fruit	Seed powder mixed with butter is given orally against snakebite. Flower paste with ghee given orally (4 d).	29,62,84,93,94
<i>Plumbago zeylanica</i> Linn.	Plumbaginaceae	Koduveli	Whole plant, root	Whole plant paste is given internally.	36,62
<i>Radermachera xylocarpa</i> (Roxb.) K.Schum.	Bignoniaceae	Tetu	Fruit, seed	Fruit paste applied and taken internally as well as pulp of seeds with little water is taken.	92
<i>Rauwolfia serpentina</i> (Linn.) Benth. ex Kurz.	Apocyanaceae	Nagbel, Bhuin karuan, Patal-garuda, Bhuikurma, Sarpagandha, Keramaddinagaddi, Sutranabhi, Sarpagandha, Lairusich, Sarpagandha	Leaf, root	Leave juice used as antidote. Roots and leaf buds crushed with milk and make into paste used both internally and externally on affected area.	29,48,50,54,55,59,62,63,65,68,69,72,84,85,92
<i>Rhinacanthus nasutus</i> (L.) Kurz	Acanthaceae	Nagamalli	Leaves	Fresh leaves are taken orally as well as the paste of the leaf is applied externally.	65,70
<i>Sauromatum venosum</i> (Ait.) Kunth	Araceae	Halida, Samp ki dawa	Tuber	The paste of tuber is applied on the affected part.	72
<i>Semicarpus anacardium</i> Linn.	Anacardiaceae	Cashew nut	Root	Root is taken orally (7 d).	29,72
<i>Solanum xanthocarpum</i> Schard & Wendl	Solanceae	Bhui ringani, Bhat kataiyan, Choti kateli	Leaves, root	Fresh leaves extract (paste or decoction) of this species is given.	66

<i>Soymida febrifuga</i> A. Juss.	Meliaceae.	Rohina	Stem bark, bark, root	Fresh bark of this plant together with root of <i>H. pubescens</i> (1:1) are made into paste, and mixed with drinking water, given orally three times a day for 3 d.	56
<i>Strychnos nux-vomica</i> Linn.	Loganiaceae	Kajara, Kaasarka, Kanjiram, Vishamushti, Etti, Visakkotai, Yeti	Root, seed	Root bark juice in cow's milk is externally rubbed 3-4 times a day, to treat. The seed powder is also used.	29,32,41,49,62,65,70
<i>Tabernaemontana divaricata</i> (Linn.) R.Br.	Apocynaceae	Nanjatte, Maddarasa, Kathona, Amlī, Tengtere, Tetul	Root, leaf, seed	The extract of the seed is given as well as crushed, paste applied on bitten area.	62
<i>Tamarindus indica</i> Linn.	Caesalpiniaceae	Puli	Seed, root	Unknown	58,69
<i>Tephrosia purpurea</i> (L.) Pers.	Fabaceae	Sarphankha, Sarphonk, Dhamaso, Kolingi, Wild indigo	Root	Root decoction along with black pepper is prepared and taken orally (7 d).	29,56,98
<i>Terminalia arjuna</i> (DC) Wight & Arn.	Combretaceae	Arjun, Marutham, Vellamarthu	Bark	Bark paste applied externally (5 d).	29,65
<i>Tinospora cordifolia</i> (Willd) Miers ex Hook f. & Thoms	Menispermaceae	Gulvel, Limbvel, Amrutha balli, Guduchi, Gulanchi	Leaf, root, stem	Stem juice or leaf juice along with garlic paste is applied on the spot and also taken orally (3-4 d).	68,69,92
<i>Tridax procumbens</i> Linn.	Asteraceae	Munya arxa, Dagad Ful.	Leaves	The leaves are crushed and the juice is dripped on the wound of snakebite. Juice is taken orally after its dilution with some quantity of water.	84
<i>Tylophora indica</i> (Burm. f.) Merr.	Asclepiadaceae	Nangilai, Asthamakodi	Leaf, root	Paste of leaf and root is mixed with equal amount of root paste of <i>Rauwolfia serpentina</i> and applied externally on the spot as well as leaf juice alone is also taken internally.	65,70
<i>Uraria picta</i> Desv.	Fabaceae	Prasniparni, Dabara, Mahadevjata, Ishwarjata	Root, leaf	Leaf paste or root decoction is given twice daily.	57,98
<i>Verbascum Thapsus</i> Linn.	Scrophulariaceae	Jangli tambaku, Kukalenga, Koti	Whole plant	The infusion of whole plant is given.	59,77
<i>Vitex negundo</i> Linn.	Verbenaceae	Nukki, Lakkigida, Karinochi, Notchi, Nishindi, Shet nishinda	Bark, root, leaf, seed	Leaf paste applied over the bitten area (5 d) as well as root extract is given with warm water.	29,31,49,62,65,69,93
<i>Vitex penduncularis</i> Wall	Verbenaceae	Charaigorh	Bark	Decoction of the bark is given orally at 30-min interval.	84

- *Alangium salvifolium* (Linn.f) Wang. (Ankol)—About 15 g of bark, ground with 10–12 black peppers and mixed with 60 g animal fat, is given every 2 hours to cure snakebite. Root bark decoction is given internally to treat.
- *Albizia lebbek* (Linn). Benth. (Shirish)—Paste of bark is used.
- *Andrographis paniculata* (Burm F) Wall. Ex. Nees. (Kalmegh)—A decoction of the leaves with the leaves of *Andrographis alata* is given. Decoction or extract is applied externally. *Andrographis affinis* Nees., *A. alata* Nees, *Andrographis echiioides* Nees, *Andrographis lineata* Wallich Ex, *Andrographis macrobotrys* Nees, *Andrographis neesiana* Wight., *Andrographis ovate* C.B. Clarke, and *Andrographis serpyllifolia* (Vahl.) Wights are other species that are significant in antiophidian cure.
- *Aristolochia indica* Linn. (*Nagvel*)—The term *Nagvel* is coined from two words—“Nag”, meaning snake, and “Vel”, meaning creeper. Fresh roots are ground along with *rouwalfia serpentina* mixed in water and taken twice daily (3 days). Root powder is snuffed; root juice is given orally and root paste is applied locally. Another species, *Aristolochia bracteolate*'s leaves are turned into paste and applied externally; infusion is taken orally.
- *Bacopa monnieri* (Linn) Pennell (*Brahmi*)—Juice mixed with castor oil is applied externally to treat. Leaf powder decoction mixed with hot cow's milk and taken orally.
- *Boerhaavia diffusa* Linn. (*Punarnawa*)—It is also well known as Hog Weed. “Punarnawa” means making new. Basically, it is diuretic and an expectorant, given for abdominal pain. The juice taken from leaves is applied locally and taken orally for 7 days. *Boerhaavia repens* Linn is also useful.
- *Bombax ceiba* Linn. (*Simul*)—The paste of flowers/fruits/leaves is applied on the bitten spot.
- *Buchanania lanzan* Spr. (*Chironji*)—A range of research and review articles mentioned it as commonly beneficial, but the method of preparation and parts used is unknown.
- *Butea monosperma* (Lamk.) Taub (*Palas*)—Traditionally, leaves of this plant are used to make ecofriendly plates for serving food items. The paste prepared from bark is applied on the swelling. Paste of one seed in 10 mL lemon juice is given orally.
- *Calotropis gigantea* (L.) R. Br (*Dev Rui*)—It is holy plant whose leaves and flowers are used to offer to a supernatural being, Hanuman (monkey-faced Hindu deity). The hanuman is well known for his intelligence, physical strength, loyalty, politeness, etc. The root or bark is ground into paste and made into pills and given orally for relief. This plant's leaf latex is applied on bitten area. Another species, *Calotropis procera* (Ark, Rui), is also useful in healing.
- *Cassia fistula* Linn. (*Amaltas*)—The paste and decoction of root bark along with black pepper is given orally. Also, the paste of stem bark is applied on the bitten area. *Cassia alata*, *Cassia obtusifolia*, *Cassia occidentalis*, *Cassia sophera*, *Cassia tora*, and *Cassia glauca* are also used in snakebite treatment.
- *Cissampelos pareira* Linn (*Patha*)—The term “Patha” means a way. Usually, paste of roots along with long pepper is recommended to be used once daily for 5 days.
- *Clitoria ternatea* Linn. (*Aparajit*)—“Aparajit” means undefeated. The root extract is taken with the root of *A. indica* and *Rauwolfia serpentina*.
- *Corallocarpus epigaeus* (Rottl. & Willd.) Hook. F. (*Killangu*)—The decoction made up from roots is given internally three to seven times.
- *Curculigo orchioide* Gaertn (*Klimoosali*)—The paste of roots is applied topically on the affected site.
- *Gloriosa superb* Linn. (*Vachnag*, *Kalihari*)—It has a versatile local name; “Vachnag” means controlling snake and “Kalihari” means prolonging death. The root paste or tuber paste is applied externally on the bitten area for 2–5 days or until relief.
- *Gymnema sylvestre* (Retz.) R. Br. (*Gurmar*)—The most common antidiabetic medicinal plant also used in antiophidian treatment. Its local name, “Gurmar,” means destroying sweet. The tincture of root or leaf powder is taken orally for 4 days.
- *Hemidesmus indicus* (Linn.) R. Br. (*Anantmool*)—“Anantmool” means life-saving root. The aqueous extract of root is prepared in water and given orally, and root paste is applied two or three times a day.
- *Leucas aspera* Spreng. (*Thumbhai*)—The leaf and root are useful. Leaf paste or crushed leaf is taken both externally on the bitten site and orally to treat. The root juice is mixed with goat's milk three times a day for 4 days.
- *Mimosa pudica* Linn (*Lajwanti*)—The whole plant is useful. Extract of the whole plant is given twice a day in 1 day only. Leaves are ground and made into paste and applied over the affected area.
- *Moringa oleifera* Lam (*Sahigan*)—Bark and roots are used. Fresh extract of bark is taken orally, whereas the tincture of bark and root is applied externally for about 3 days.
- *Musa paradisiaca* Linn. (*Valai*)—A plant extract is given orally.
- *Piper nigrum* Linn. (*Kali Mirch*)—Seed powder mixed with butter is given orally against snakebites. Flower paste with ghee is given orally (4 days).
- *Rauwolfia serpentina* (Linn.) Benth. ex Kurz. (*Sarp Gandha*)—The *Rauwolfia* denotes a snakelike structure. The *rauwolfia* has about 86 different species, but the most frequently used and compelling, antiophidian, plant in the India is *R. serpentina*. The local name, “Sarp Gandha,” means smelling like snake, and shows comprehensive observations of local Vaidya (Doctors), tribal peoples of the surrounding habitat. Its leaves and roots used as antidote. Roots and leaf buds are crushed with milk and made into paste; used both internally and externally on the affected area.
- *Strychnos nux-vomica* Linn. (*Vishmushti*)—The local name is coined from two terms; “Vish,” means poison, and “Mushti” means relief from. The root bark juice in cow's milk is externally rubbed three to four times a day, to treat. The seed powder is also used. *Strychnos colubrina* and *Strychnos potatorum* Linn. are also useful.
- *Vitex negundo* Linn. (*Nishindi*)—The root extract is given orally, and leaf paste is applied on the bitten area.

## 10. Statistical study

When considering the parts used, the most widely used (in descending order) parts are roots (28%), leaves (23%), bark (11%), whole plant (10%), seed (7%), fruit (5%), stem (4%), other



**Fig. 1 – Plant parts used in treatment of snakebite.**  
**Bk, bark; Lv, leaves; Fr, Fruit; Ot, other parts; Rt: root, Sd, seed; St, Stem; Wp, whole plant.**

parts such as latex, rhizomes, bulbs, tubers, gums, and flowers (12%) (Fig. 1). The preparation method of medication sometimes varies from vaidus (local medicine man) to vaidus. The popular forms are decoction, juice, extract, powder, fresh part, and paste. The duration of treatment varies, depending on the type of snakebite. The various preparations are frequently prepared by using a single plant part or a blend of more than a few plant parts. Occasionally, a mixture of two or more different plant species is also applied. The study revealed that medicinal plants still play a vital role in the primary healthcare of tribal Indians, and the knowledge received from them will be very useful for researchers in ethnobotany and pharmacology.<sup>100</sup> The valuable knowledge about their uses is important as some of these plants are on the verge of vanishing. This review is an attempt to compile comprehensive data from various resources and make them available into one organized, ready-to-use, compilation.

## 11. Conclusion

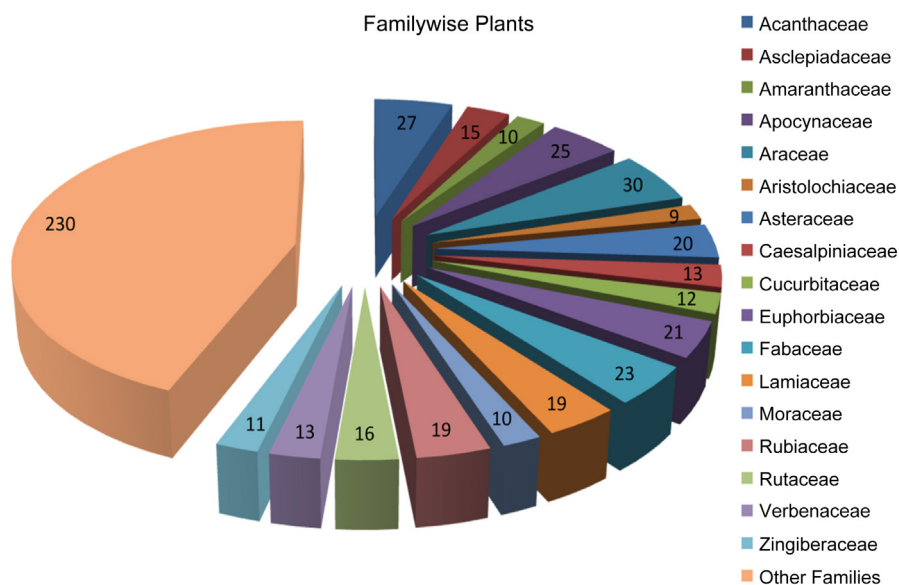
One valuable gift to human health is provided by nature in the form of medicinal plants in the locality and one of the significant ways in which humans directly reap the benefits provided by biodiversity. India has long history of medicinal plant utilization in traditional and tribal culture. From the present review, a total of 523 species from 122 plant families have been used against snakebites, as reported by different ethnobotanical investigations mostly carried out during the past few years in India (Fig. 2). In this review, we focused on the collection of data for the most frequently used plants in snakebite treatment. This work tried to be the most comprehensive review to date, and it shows striking similarities between medicinal plant uses in different nations. Thus, by triangulation, it is probably still possible to document most of the knowledge, but further research should continue, especially in areas within nations that have received less attention. Ethnobotanical investigation of drug discovery has been found to be one of the most reliable approaches toward use of medicinal plants for treatment of various conditions, and even now, there are still many more things for us to discover.

## Conflicts of interest

The authors declare no conflict of interest.

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**Fig. 2 – Graphical representation showing number of plants according to various families.**

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