Review Article

Infrequent use of medicinal plants from India in snakebite treatment

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\textbf{A B S T R A C T}

Snakes have fascinated humankind for millennia. Snakebites are a serious medical, social, and economic problem that are experienced worldwide; however, they are most serious in tropical and subtropical countries. The reasons for this are 1) the presence of more species of the most dangerous snakes, 2) the inaccessibility of immediate medical treatment, and 3) poor health care. The goal of this study was to collect information concerning rare, less utilized, and less studied medicinal plants. More than 100 plants were found to have potential to be utilized as anti-snake venom across India. Data accumulated from a variety of literature sources revealed useful plant families, the parts of plants used, and how to utilize them. In India, there are over 520 plant species, belonging to approximately 122 families, which could be useful in the management of snakebites. This study was conducted to encourage researchers to create herbal antidotes, which will counteract snake venom. These may prove to be an inexpensive and easily assessable alternative, which would be of immense importance to society. Plants from families such as Acanthaceae, Arecaceae, Apocynaceae, Caesalpiniaeae, Asteraceae, Cucurbiteae, Fabaceae, Euphorbiaceae, Lamiaceae, Rubiaceae, and Zingibeaceae are the most useful. In India, experts of folklore are using herbs either single or in combination with others.

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1. **Introduction**

For centuries, plants have been important in the treatment of a wide variety of illnesses, diseases, and disorders. The inherent traditional systems of medicine, along with information from conservative folklore, are serving a large section of the populace, particularly in rural and tribal areas, despite the dawn of modern medicine. Ethnobotany is the scientific and systematic study of traditional knowledge and customs of people concerning plants and their medical, religious, and other uses. Studies involve literature surveys, detailed investigations, analyses, interpretation, and conclusions concerning various research and scientific data. An ethno-medicinal-botanical appraisal includes discussions with natives, as well as utilization of available facts and data regarding folklore literature. Indigenous medicinal plant species have been added to several recent drug formulations and preparations for fundamental health care.

2. **Methodology**

The current study provides a collection of information on medicinal plants that grow and can be utilized in various regions of India for snakebite treatment. The appropriate literature, including books, journals, and reports, was reviewed. The relevant information was searched using various electronic catalogs (e.g., Google Scholar, Medline, NISCAIR, Science Direct, Scirus, and Scopus) and keywords such as “anti-venom activity,” “ethnobotany,” “ethnopharmacology,” “Indian,” “indigenous,” “medicinal plants,” “snake bite,” and “survey.” It was difficult to include all the information regarding medicinal plants used for snakebite treatment, and as such this study focused on information that would be easily accessible for researchers. Over the last few decades, people from different tribal communities have been recording and maintaining data regarding traditional and tribal knowledge related to the use of medicinal plants. However, this information has, until now, not been made available to the modern world. In this regard, information on tribal and local use of various plants has been made available and a systematic “ready to use” list of medicinal plants has been formed. The list consists of data, including biological source(s), family, local name(s), part(s) used, method(s) of preparation/formulations, and reference(s). In this review, care was taken to ensure the identification of the herbal medicinal plants that were in the original resources (Table 1).

3. **The Indian subcontinent and snakes**

The Republic of India (3rd largest in Asia and 7th by area in world) is a multilingual country home to a diverse culture with a rich and glorious heritage. India’s land border covers 151,067 km, which is shared with neighboring countries, including Bangladesh (border shared = 40,967 km), China (3488 km), Pakistan (3323 km), Nepal (1751 km), Myanmar (1643 km), Bhutan (699 km), and Afghanistan (106 km). India’s coastline covers 75,166 km, and land area including island territories covers more than 3,287,260 km². Some of these countries were part of India before the partition.

India has numerous and diverse medico-herbal plants. They are dispersed, depending upon geographical and ecological conditions, across the country. Of these, more than 1500 species have demonstrated significant medicinal properties. Envenomation, especially by snakebite, is a serious worldwide public health crisis. Inappropriate and unwarranted treatment results from reasons such as the failure to identify the snake species (venomous or non-venomous), which increases the risk of complications. According to the Integrated Taxonomic Information System (ITIS), Elapidae and Viperidae are the two major families of venomous snakes. Elapidae consists of 325 species distributed in 61 genera. Viperidae includes 224 species distributed in 22 genera. In and around India, approximately 216 species of snakes belong to these families, and only 52 are known to be poisonous. The ‘Big Four’ snakes cause the largest number of snakebite deaths on the Indian subcontinent. The ‘Big Four’ snakes consist of Russell’s viper (Daboia russellii; Marathi translation, ghonas tawarya), Indian cobra (Naja naja; Marathi translation, Nag), saw-scaled viper (Echis carinatus; Marathi translation, phoorsa), and common krait (Bungarus caeruleus; Marathi translation, manyar kanadar) (Fig. 1). Apart from these big four, the hump-nosed viper is also hazardous. Envenomation is a ‘choice’ and voluntary action or reaction by snakes. Their bite is a natural protective defense mechanism. All venomous snakes have the ability to bite without including venom (dry bite). Farmers, fieldmen, and outdoor workers find suffering from snakebites to be an occupational hazard. It is also a leading problem in rural areas of India. It is estimated that snakebite poisoning causes approximately 50,000 deaths annually, and the number is likely higher because not all cases from rural areas are reported.

4. **Snake venom and snake anti-venoms**

Snake venom is one of the most intense and ‘mysterious’ biological fluids within the animal kingdom, causing complex medical effects. This is because of the presence of complex mixtures of proteins, peptides, and contain at least 25 enzymes. Venom is a complicated combination of proteins (both enzymatic and non-enzymatic), peptides, and small organic compounds, such as acetylcholine citrate and nucleoside. There are many potential effects of snake envenomation on humans; however, a few broad categories of major clinical significance are:

1. Systemic myolysis
2. Flaccid (drooping) paralysis
3. Coagulopathy and hemorrhage
4. Cardotoxicity
5. Renal damage or failure
6. Local tissue injury at the bite site

Each of these may cause a number of secondary effects, and each is associated with potential morbidity and mortality. Similar to other modern medicines, anti-venom can have side effects. In addition, it takes too long to develop and
| Biological source | Family | Local names | Part used | Method of administration | References |
|-------------------|--------|-------------|-----------|--------------------------|------------|
| Ajuga reptans Wall | Lamiales | Neelkanthi, Nilkanthi, Kanasar | Rt | Root extract is used as an antidote | 29 |
| Alstonia involucrata Thwaites | Simaroubaceae | - | Br | Bark paste is taken orally | 32 |
| Alstonia involucrata Thwaites | Simaroubaceae | Ankol, Ankula, Alangi, Aankla | Wp, R, Lw, St, Br | Approximately 15 g of bark ground + 10–12 black peppers mixed with 72 g animal fat given every 2 h to cure snakebite | 33–36 |
| Albizia lebbeck (Linn) Benth | Fabaceae | Siris, Kala, Siris, Segta/Siris, Hombage, bhandi | Lw, Br, Fl, Wp, R | Paste of bark is used | 31,37–40 |
| Allium cepa Linn | Liliaceae | Piya, Venkayam | Bb | The paste made from fresh skin of bulb is used for external application (5 d) | 38,41 |
| Allium cepa Linn | Liliaceae | Lasoon | Bb | Bulb is made into paste and given orally | 41,42 |
| Allium sativum Linn | Liliaceae | - | Db | Unknown | 43 |
| Ailanthus altissima (L.) ex DC | Simaroubaceae | - | Br | Bark decoction given orally | 44–47 |
| Alternanthera sessilis (Linn) R Brown ex DC | Amaranthaceae | Analivegham, Elaipalai, Analivegham | St, Br, Rt | Tablets made from paste of stem bark are taken with cow's urine | 48,49 |
| Amaranthus spinosus Linn | Amaranthaceae | Chaulai | Rt | Root powder is used | 39 |
| Amaranthus viridis Linn | Amaranthaceae | Khodora, Chaulai | Lw, St | Leaf/stem paste is applied externally | 53 |
| Anonemum amarcatinum Roxb | Zingiberaceae | Borelachi, Chakma, Bodealachi | Sd | Whole plant powder mixed with hot cow's milk to drink | 57 |
| Anonemum subalatum Roxb | Zingiberaceae | Bara elach | Pd | Seed paste is used | 58 |
| Amorphophallus campanulatus Blume | Araceae | Bhabdi | Tb | Boil 2–3 pods and drink the extract twice daily for a week | 59 |
| Amorphophallus commutatus (Schott) Engler | Araceae | - | Tb | The tubers are crushed and applied externally | 60 |
| Andrographis alata Nees | Acanthaceae | Periyangani | Lw | A handful of fresh leaves or juice is taken orally | 61 |
| Andrographis echioides Nees | Acanthaceae | Nadnur, Gusum puru, Gopuranthangi | Wp | Paste of whole plant is given orally with water | 62 |
| Andrographis lineate Wall ex | Acanthaceae | Siriyanangai, Periyanangai, Malaiweempu | Wp, Lw | It is also applied externally | 63–65 |
| Andrographis paniculata (Burm f) Wall Ex Nees | Acanthaceae | Kalmegh, Bhume, neem, Neelweppu, Nilavaembu, Chirianangai, Sirianangai, Periyanangai | Lw, Lw, Wp | Paste of leaves is applied externally | 30,63,65–74 |
| Biological source | Family            | Local names                                      | Part used | Method of administration                  | References |
|-------------------|-------------------|--------------------------------------------------|-----------|-------------------------------------------|------------|
| Anisomeles indica | Lamiaceae         | Paeimiratti                                      | Lv        | Paste of leaf is taken                    | 75         |
| Anisomeles malabarica | Lamiaceae     | Siriyapaeyamarati, Peymarutti                    | Lv, St, Br | The leaf or juice mixed with water to drink | 75, 57, 76 |
| Annona squamosa    | Annonaceae        | Seethaphala                                      |           | Unknown                                   |            |
| Anogeissus acuminata Wall | Linn   | Dhavra                                           | Pl        | Poultice is applied                       | 77         |
| Anthocephalus cadamba Miq | Rubiaceae | Kadam                                            | Wp        | Unknown                                   | 39         |
| Antidesma bunius  | Phyllanthaceae    | Tuaitit                                          | Lv        | Unknown                                   | 78         |
| Arachne cordifolia | Euphorbiaceae    | –                                                | Lv, St    | Unknown                                   | 79         |
| Ardisia humilis Vahl | Myrsinaceae     | Kumbreth                                         | Br        | Crushed paste is applied                  | 80, 53, 81, 82 |
| Argyomeone Mexicana | Papaveraceae    | Sialkatahi, Datturi, Pilikateli, Bhrbhhand, Brahmathandu | Br, Sd, Rt | Leaf/seed decoction given orally (7 d) Root paste is also used | 80, 53, 81, 82 |
| Arisaema barnesii C Fischer | Araceae | Kaattuchenai                                     | Tb        | Dried tuber of this plant and whole plant paste of Andrographis paniculata (1:1) applied over wounds twice a day The tubers are crushed and a paste is made that is applied | 69 |
| Arisaema flavum (Forsskai) Schott | Araceae | Sapp googli                                      | Tb        | Unkown                                   | 83         |
| Arisaema jacquemontii Blume | Araceae | Khaprya                                          | Fr, Rz    | Unknown                                   | 79, 80     |
| Arisaema leschenaultii Bl ume | Araceae | Havina jola                                      | Rt, Lv, Fr | Fruit/leaf and root paste is applied on the spot of snakebite thrice a day for about 8 d Paste of the tuber in applied Infusion of fresh bulb is taken orally thrice daily Leaf paste applied externally, as well as infusion taken orally Fresh roots are ground 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 | 81 |
| Arisaema tortuosum (Wall) Schott | Araceae | Haap rookdaroo, Halida, Kotukand, Chambus, Chakrata | Tb, Bb     | Paste of the tuber in applied Infusion of fresh bulb is taken orally thrice daily Leaf paste applied externally, as well as infusion taken orally Fresh roots are ground 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 | 60, 84, 85, 60, 75, 85, 86, 3, 4, 5, 6, 7, 8, 9, 75, 87, 89 |
| Aristolochia bracteolate Lamk | Aristolochiaceae | Kalipad, Aduthinnapalai, Sapasan, Garalika, Garudi, Nagbel, Arkamul, Bhrthwurt, Ishkuskemul, Bhdhi-janete, Karalakam, Karupar, Kaligulesar, Eashwari, Eshwarkeli, Perumarindu, Karuda kodi, Garudakodi, Thalaisuruli | Lv, Rt, Wp | Paste of the fasciculate root is applied externally Leaf paste is given | 3, 4, 5, 6, 7, 8, 9, 75, 87, 89 |
| Aristolochia indica Linn | Aristolochiaceae | Samta, Vallya, Eswaramulli, Perumarunt, Hukodi | Rt        | Crushed and mixed with water and drunk, as well as fresh roots ground and applied externally on affected area Drink 1 cup juice thrice daily Bark paste made with coconut oil and applied | 80, 98, 94, 99 |
| Aristolochia tagala Cham | Aristolochiaceae | Samta, Vallya, Eswaramulli, Perumarunt, Hukodi | Rt        | Crushed and mixed with water and drunk, as well as fresh roots ground and applied externally on affected area Drink 1 cup juice thrice daily Bark paste made with coconut oil and applied | 80, 98, 94, 99 |
| Artocarpus heterophyllus Lam | Moraceae | Kanthal                                          | Pn        | Drink 1 cup juice thrice daily Bark paste made with coconut oil and applied | 94         |
| Artocarpus hirsutus Lam | Moraceae | –                                                | Br        | Drink 1 cup juice thrice daily Bark paste made with coconut oil and applied | 94         |
| Artocarpus integrifolia | Moraceae | Kothal, Theibong, Halavu, Makkala, Beru, Satvari, Sildhindhinaayagam | Fr, Rt, Lv | Paste of the fasciculate root is applied externally Leaf paste is given | 94, 99, 78, 79, 100 |
| Asparagus racemosus Willd | Liliaceae | –                                                | Br        | Unknown                                   |            |
| Asystasia gangetica Linn | Acanthaceae | –                                                | Br        | Unknown                                   |            |
| Azadirachta indica A Juss | Meliaceae | Vembu, Veempu, Neem                               | Fl, Br, Lv, Fr | Decoction/paste is prepared and given orally (7 d) | 38, 54, 59, 101 |
| Biological source        | Family              | Local names                                                                 | Part used | Method of administration                                                                 | References |
|--------------------------|---------------------|----------------------------------------------------------------------------|-----------|------------------------------------------------------------------------------------------|------------|
| *Bacopa monnieri* (Linn) | Pennell Scrophulariaceae | Brahmisak, Nirbirami, Neeripirami, Brahmi                                   | Br, Lv, Wp | Juice mixed with castor oil is applied externally to treat                                | 3, 66      |
| *Barleria cristata* Linn | Anacanthaceae       | Kali, Brenkad, Kattukanagambaram R, Purnarana, Dabball bhaji, Gotam bhaji, Patharhotta, Bishapara Ittsitt | Lv, R, Sd | Leaf powder decoction mixed with hot cow’s milk taken orally                              | 50         |
| *Barleria prionitis* Linn | Anacanthaceae       | Ilavu, Kate savar, Semal, Semul, Semar, Punhachwong, Sinbali, Pilkisii       | Lv, Wp    | Leaf juice is applied                                                                    | 49         |
| *Boerhavia diffusa* Linn | Nyctaginaceae       | Ponownowa, Iruv, Kate savar, Semal, Purnarana, Dabball bhaji, Gotam bhaji, Patharhotta, Bishapara Ittsitt | Rt        | Decoction taken orally                                                                    | 39, 50     |
| *Boerhavia repens* Linn  | Nyctaginaceae       | Ilavu, Kate savar, Semal, Semul, Punhachwong, Sinbali, Pilkisii              | Ls, RBr, Sd | Leaf juice is also applied locally and taken orally for 7 d                                |            |
| *Bombax ceiba* Linn      | Bombaceae           | Dapartenga                                                                  | Lv        | Unknown                                                                                  | 39, 80     |
| *Bryophyllum pinnatum* Kuntz | Crassulaceae     | Char, Chironji, Achar, Chironji, Chironji, Pial                           | Br        | Unknown                                                                                  | 53         |
| *Butea monosperma* (Lamk) Taub | Fabaceae        | Palash, Dhak, Pasa, Plash                                                   | Br, Lv, F, Gu, Sd, St, Br, Re, Lx | Bark paste applied on swelling                                                            | 38         |
| *Caesalpinia bonduc* (Linn) Roxb | Caesalpiniaceae   | Poonainagam, Kannj                                                         | Sd        | Paste of one seed in 10 mL lemon juice is given orally                                     | 39, 95     |
| *Calotropis gigantea* (L) R Br | Asclepiadaceae | Dev rui, Aak, Ekke, Akanda, Erukku, Aakdo, Safedaakdo, Gadsa, Akanda, Erukku | R, Lx    | Seeds paste applied externally (2 weeks)                                                  | 43, 76, 77, 90 |
| *Calotropis procera* (Ait) R Br | Asclepiadaceae | Rui, Rai, Aakori: Aak, Biilekke, Ekka (Safed Ak), Rakta arka, Erukk, Aakdo, Safedaakdo, Gadsa, Akanda, Erukku | Lx, Rt, Young, Bd | Root bark is ground into paste and made into pills and given orally                        | 75, 99     |
| *Cannabis sativa* Linn   | Cannabaceae         | Bhang, Kareel, Kareerua                                                    | Lv        | Leaf latex is applied on cutaneous area                                                   | 38         |
| *Capsicum annum* Linn     | Solanaceae          | Marchiya                                                                    | Rt        | Root is crushed and given to drink and applied externally                                 | 39, 92     |
| *Carispermum luridum* Linn | Sapindaceae         | Moddacoatan                                                                | Wp        | Leaf paste is used                                                                        | 41         |
| *Caris papaya* Linn       | Caricaceae          | Papita, Amurubhanda, Papita                                                | Fr, Sd, Lx | The whole plant powder mixed with goat’s milk to drink                                    | 75         |
| *Cassia alata* Linn       | Caesalpiniaceae     | Senna, Khor-pat daopata, Sennaiyagathi, Amaltash, Dhanba, Amalas, Sonarkhi, Kakke | Lv        | Unripened fruit of Carica papaya is taken and the skin is removed by slicing, salt is then rubbed over it, and 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 snakebite wound for quick healing. | 34         |
| *Cassia fistula* Linn     | Caesalpiniaceae     | Fr, Sd, Lv, St, R, Br                                                      |          | Paste of leaves is applied externally, as well as given orally                            | 78         |
| *Cassia fistula* Linn     | Caesalpiniaceae     | Fr, Sd, Lv, St, R, Br                                                      |          | The paste & decoction of root bark with black pepper is given orally                      | 37–39, 62  |
| Biological source | Family | Local names | Part used | Method of administration | References |
|-------------------|--------|-------------|-----------|--------------------------|------------|
| Cassia occidentalis Linn | Caesalpiniaceae | Kasaudni, Kasondi, Peeperambi, Thagarai | Rt, Lv | Oral administration of root paste | 36,39,67 |
| Cassia sophora Linn | Caesalpiniaceae | Salarai, Takala, Sickle, senna, Chakwad, Chakunda, Tagarai, Bon medelwa | Rt, Lv | Root paste & leaf decoction is applied externally (30 d) | 86,39,53 |
| Catharanthus roseus G Don | Apocynaceae | Nithya pushpa | Rt | Root paste mixed with pepper and lime is applied externally | 81 |
| Cayratia trifolia (Linn) Domin | Vitaceae | Khhata nimbi | Tb | Paste of tuber applied on the affected area | 84 |
| Centratherum anthelminticum (L) Kunze | Asteraceae | Kattujeerakam | Sd | Unknown | 66 |
| Chelocostus speciosis (JKeonig) CDSpecht | Costaceae | Keu, Chengalva kostu | Rz | Unknown | 95 |
| Chlorophyllum laxum R Br | Liliaceae | Neerootikizangu | Tb | Tuber paste applied on affected area | 89 |
| Cissampelos pareira Linn | Menispermaceae | Patha, Patindu, Batindu, Patha, Urrakkodi, Chokipar, Tijumala, Kasaundi, Ekladi Poa | Tb, Rt | Root paste with long pepper is prescribed once daily for 5 d | 92,93,96 |
| Citrullus colocynthis (Linn) Schrad | Cucurbitaceae | Kadva inravarma, Tumba, Gudumba, Tumbo, Indrayan | Sd, Rt, Fr | Seed oil used externally, as well as root crushed and given to drink | 33,38 |
| Clematis triloba Linn | Ranunculaceae | Badarisiti, Jangali, Bhoda, Bendar, Siti | Rt | Root paste is applied | 77 |
| Cleome glycandra Linn | Cleomaceae | Hul-hul | Lw, Wp | Unknown | 39 |
| Cleome viscosa Linn | Capparidaceae | Nayivelai | Lv | Leaf paste applied externally | 30 |
| Clerodendron inerme Gaertn | Verbenaceae | Vishaparihari | Rt | Root paste mixed with lime is applied twice daily for a week | 81 |
| Clitoria ternatea Linn | Fabaceae | Ruhu tuhu, Aparajita, Syahiful, Aparajita, Gokarni, Aparajita, Bili, Shankhapushpa | R | The root extract is taken with the root of Aristolochia indica and Rauwolfia serpentina | 39,87 |
| Cocculus illovosus DC | Menispermaceae | Nagdu, Vachan karalla | Rt | The root bark extract is given internally and applied | 3,38 |
| Commelina bengalensis Linn | Commelinaceae | Kana simolu | R | Roots are useful | 53 |
| Corallocarpus epigeae (Rottl & Wild) Hook f | Cucurbitaceae | Aathalai, Marsikkand, Kollan, Kova killangu | Rt, Tb | Root decoction given internally 3–7 times | 64,68,97 |
| Costus speciosus (Koen) Sm | Costaceae | Keon, Kanda, Kebuk, Mahalaki, Jamlakhuti, Sawmbul, Jomalkhuti, Khongbam, Takhelei, Sumbul, Jomalkhuti, Myonpobap | Rt, Rz | Rhizome and root paste is used internally & externally | 58,60,80,87 |
| Crateva magna (Lour) DC | Capparaceae | Jong-sia | Br | Chewed and applied on bitten area | 80 |
| Curculigo orchioides Gaertn | Amaryllidaceae | Nilapanai, Nela tengu, Kali musli | Rt, Tb | Root paste use topically | 39,80,81 |
| Curcuma amada Roxb | Zingiberaceae | Amba haldi | Rz | The powder of the rhizome is applied locally | 84 |
| Curcuma aromatica | Zingiberaceae | Bon haladhi, Lam-yangang Kalaahalud, Kalaahaldi krushna kedara, Neelkanth | Rz | Paste of rhizome taken with water | 58 |
| Curcuma caesia Roxb | Zingiberaceae | The dried rhizome powder is mixed with powdered seeds of Andrographis paniculata and applied | | | 34,58 |
## Table 1 (Continued)

| Biological source | Family            | Local names | Part used | Method of administration | References |
|-------------------|-------------------|-------------|-----------|--------------------------|------------|
| Cyathula tomentosa Roth | Amaranthaceae | –           | Lv        | Unknown                  | 79         |
| Cyphostemma auriculatum (Roxb) Singh & Shetty | Vitaceae | Kali-vel   | Br        | Bark is taken in some water and once a day (7–8 d) | 96         |
| Daemia extensa RBr | Asclepiadaceae | Vaelipparuththi | Rt | Powder of root is given | 90         |
| Datura metel Linn | Solanaceae | Kala Dhatura, Dhatura | Sd, Rt, Lr | Extract of roots are taken with garlic | 39,70,80,81 |
| Delphinium denudatum Wall ex Hook f & Thomson | Ranunculaceae | Nibishi     | Rt        | Unknown                  | 41         |
| Desmodium gangeticum (Linn) DC Dick | Fabaceae | Kareti, Salparni | R | Half-cup root decoction is taken orally | 39,60 |
| Dichrostachys cinerea Linn Wight & Arn | Araceae | Vedatalai, Kheri | Lr, Rt | Root powder is used | 54         |
| Dicliptera paniculata (Forsk) Darbasy | Acanthaceae | Chebeera    | Wp        | Leaves are crushed into paste and applied locally | 95         |
| Dioscorea pentaphylla Linn | Dioscoreaceae | Lalvala vahrikand | Tp | Extract is also given | 60         |
| Dregia volubilis (L) Benth Ex Hookf | Apocynaceae | Dudipala, Bandi gurija | Lr | Unknown | 95,96 |
| Drymaria cordata (L) Willd Ex Roem & Schult | Caryophyllaceae | Mecanachil, Theiphelwang, Kynbat thalap Ghoti Bhulan | Wp, Lr, R | Whole plant is used (crushed paste applied) | 80         |
| Dryopteris cochleata CChr | Aspidiaceae | –           | Wp, Lr, R | The whole plant crushed in a bowl and the extract is given orally twice a day | 43         |
| Eleptra alba (Linn) Hassk | Asteraceae | Manchal karisalankanni, Bhringraj, Maka | Wp | The leaves and roots are applied on the bite wound | 38         |
| Elaeodendron glaucum Pers | Celastraceae | Ratangaur, Bhairao, Niuri Mamri, Jamrasi Mukarthi (Bhuphal) Elasi | Sd, Pd | Whole plant juice is given orally (30 d) | 62         |
| Elettaria cardamomum Maton | Zingiberaceae | L | Root and bark infusion mixed with milk and butter, filtered, and used | 58         |
| Eulmisine indica (L) Gaertn | Poaceae | Maltkantari-Mundari | Rt | Decoction | 92         |
| Enicostemma axillare (Lam) A Raynal | Gentianaceae | Vellaru | Rt | 20 g root is crushed along with 10 g Zingiber officinale and nine black pepper pieces; paste is divided into two equal parts | 91         |
| Ervatsamia coronaria Stapf | Apocynaceae | –           | Rt, Br    | One part with a few drops of honey is administered orally and the other part is applied on the snake bitten area | 99         |
| Eruatania heynana Cooke | Apocynaceae | Kadunandibattalo | Rt | 5–10 drops of root extract is poured in the spot | 91         |
| Euphorbia neriifolia Linn | Euphorbiaceae | Mauza sij, Dudhbol, Thor, Thundar, Manasa | Lx, Rt | Root paste mixed with lemon juice & applied | 81         |
| Ficus benghalensis Linn | Moraceae | Badd, Bar, Bargad | Lx, Ap, Rt, Fr | Latex is applied locally | 54,80 |
| Ficus glomerata Roxb | Moraceae | Medi | St, Br | Root is used with black pepper | 31         |
| Ficus kirta Vahl | Moraceae | Tamangaddu | Rt | The stem bark paste is applied | 47         |
| Ficus racemosa Linn | Moraceae | Gular | Br | Root crushed & rubbed | 54         |
| Biological source | Family | Local names | Part used | Method of administration | References |
|--------------------|--------|-------------|-----------|--------------------------|------------|
| Ficus religiosa Linn | Moraceae | Peepal | Lv, Br, Fr | 25 g stem bark and 8–10 cloves are pounded with animal fat (pure ghee) and given 4–6 times a day | 35,37,59 |
| Ficus tinctoria Forstf | Moraceae | Telia barnika | Lv | Unknown | 31 |
| Fimbristylis spathacea Roth | Cyperaceae | Hathiya | Rt | The fresh root is taken internally & externally | 87 |
| Gloriosa superba Linn | Liliaceae | Vadhavadiyo, Vach, Nag, Nagardi, Gowri, Huvu, Kalihari, Kalihari, Karianaga, Agnishikha, Kariyari, Kalappa, Kilangu | Tb, Rt, Rz, Sd | Root paste or tuber paste is applied externally (2–5 d) | 38,39,81,82 |
| Habenaria communis Wall | Orchidaceae | Ankra | Tb | The tuber paste is applied | 59 |
| Hedychium spicatum SM | Zingiberaceae | Aithur, Tahhellei-hanggam-mapan | Rz, Rt | Root decoction is used | 58 |
| Helicteres isora Linn | Sterculiaceae | Hatapi, Murud sheng, Maror Phali | Br, Rt | Bark power is given in snakebite | 39,57 |
| Heliotropium indicum Linn | Boraginaceae | Nakkipoo | Lv | The leaf juice mixed with hot water is used | 75 |
| Heliotropium marifolium Koen ex Retz | Boraginaceae | Choti-santri | Wp | Unknown | 82 |
| Hemidesmus indicus (Linn) R Br | Asclepiadaceae | Suganti Jad, Anantmul, Choti dudha, Anantamul, Analasing, Nannari, Anantamul | Rt, Lv | Aqueous extract of root is prepared in water and given orally & root paste is applied two or three times a day | 92,94 |
| Heteropogon contortus (Linn) P Beauv | Poaceae | Lapia, Lapida, Soorwala | Rt | Root paste is taken orally & poultice of root paste is also applied on the bitten portion for early cure | 60 |
| Holarrhena pubescens (Buch-Ham)Wall ex GDon | Apocynaceae | Pandharu Kula, Bolmatra | Sd, Rt, St, Br | Paste is applied on the bitten area two times a day | 80 |
| Hordeum vulgare Linn | Poaceae | Jav, Jav Ban Talu | Gr | Unknown | 54 |
| Hyptis suaveolens (Linn) Poit | Lamiaceae | Banu | R | Unknown | 39 |
| Impatiens glandulifera Royle | Balsaminaceae | Hilla | Fls | Unknown | 83 |
| Ipomoea obscura (L) Ker Gawler | Convolvulaceae | Siruthaadikkodhi | Lv | Leaf juice is administered | 91 |
| Jatropha gossypifolia Linn | Euphorbiaceae | Kattamanakku | Lv, St, Br, Sd, Lx | Unknown | 55 |
| Kyllinga monoecephala Rothb | Cyperaceae | Safad, Nirbashi | Un | Unknown | 38 |
| Lantana camara Linn | Verbenaceae | Ragadd, Gajukampa, Arippu Durum bon, Gumba, Bhodaki, Tumbe, Thumbai, Gadde tumbe, Thumbi, Thumbai, Kennathumhai Gomma | R, Fl, St, Lv, Wp | Decoction of roots, flower, and stem are used | 75 |
| Leucas aspera Spreng | Lamiaceae | Gomma, Gumbi, Gumma | Wp, Lw, Rt | Leaf paste or crushed leaf is taken both externally & internally to treat | 73,75,81,90,99,100 |
| Leucas cephalotes (Roth) Spreng | Lamiaceae | Gomma, Gumbi, Gumma Chatti | Wp | The root juice is mixed with goat’s milk three times a day (4 d) | 38,39 |
| Lindenhergia muraria (Roxb) Brühl | Scrophulariaceae | | | Decoction of whole plant (twice a day for 6 d) | 82 |
| Biological source                  | Family               | Local names                                      | Part used | Method of administration                              | References |
|-----------------------------------|----------------------|-------------------------------------------------|-----------|-------------------------------------------------------|------------|
| Lobelia nichotianaefolia Heyne    | Campanulaceae        | Heddumbe, Kadu hokesoppu                        | Lv, Lx    | Latex is applied externally                            | 81,100     |
| Luffa acutangula (Linn) Roxb      | Cucurbitaceae        | Torai, Peerkan, Jangli Fr, Tn, Sd              |           | Tendrils & seed paste is used                          | 39,90      |
| Malva sylvestris Linn             | Malvaceae            | Torai                                            |           | Extract of leaf mixed with lime juice given            | 99         |
| Martynia annua Linn               | Martyniaceae         | Bagnakha, Thota, Sinungi, Uskadpoda, Chhuimui/Lajwanti, Thottal surungi, Thottalvadi, Thottasiniki |           | Decoction                                             | 67         |
| Mimosa pudica Linn                | Mimosaceae           |                                                |           | Whole plants are made into extract in drinking water and shaken well and filtered | 31,39,47,90 |
| Ochis phylla                    | Ochnaceae            |                                                |           | Extract of whole plant is given twice a day for one day only Leaves are ground and made into paste and applied over affected area |           |
| Moringa oleifera Lam             | Moringaceae          | Sajina, Nugge, Sahigan, Mungna, Sainjna, Sahjan, Sainjnad, Murungah | Rt, Sd, Wp, St, Br, Lv | Fresh extract of bark is taken orally | 3,54 |
| Mucuna pruriens (Linn) DC        | Fabaceae             | Kevach, Konch                                   | Sd, Fr, Rt | Bark root tincture applied externally (3 d) | 39         |
| Musa paradisiaca Linn            | Musaceae             | Vazhai, Valaimaram, Br, St, skin, Br Valai     |           | Aqueous extract of root is given orally twice a day | 30,68      |
| Nerium indicum Mill Gard          | Apocynaceae          | Kaner, Kaner/Kanail, Lv, Br Rt                  |           | A plant extract is given orally | 39,54 |
| Nymphoides hydrophylla O Kuntze   | Menyanthaceae        | –                                                | Lv        | The root is crushed with roots of Capparis sepia and Datura innoxia and paste applied externally thrice for 5 d | 52         |
| Ocima lutea                      | Lamiaceae            | Heddumbe                                        | Rt        | Leaf paste is used                                      |           |
| Ocima sanctum Linn               | Lamiaceae            | Naitulis, Kali Tulsi                            | Wp        | Powder of root drunk with hot water frequently         | 80         |
| Ophiopogon mungos Linn            | Rubiaceae            | Havina gedde, Pambupoo, Keeripundu              |           | Unknown                                               | 99         |
| Opuntia dillenii (Ker-Gawl) Haw   | Cactaceae            | Sappathikali                                    | St, Br, Fr, Wp | The fruit paste is applied                            | 75         |
| Othelia alisoides (L) Pers        | Verbenaceae          | –                                                | Lv        | Unknown                                               | 57         |
| Oxalis debilis HK var corymbosa (DC) Lour O martiana Zucc | Oxalidaceae | Khatti Booti                                    | Wp        | Unknown                                               | 39         |
| Pandanus nepalensis St John       | Pandanaceae          | –                                                | Lv        | The fruit is applied                                   | 42         |
| Parnassia rubicola Wall ex Royle  | Parnassiaceae        | –                                                | Tbs, Rt   | Unknown                                               | 79         |
| Martynia annua Linn               | Martyniaceae         | Bagnakha, Thota, Sinungi, Uskadpoda, Chhuimui/Lajwanti, Thottal surungi, Thottalvadi, Thottasiniki |           | Decoction                                             | 67         |
| Mimosa pudica Linn                | Mimosaceae           |                                                |           | Whole plants are made into extract in drinking water and shaken well and filtered | 31,39,47,90 |
| Ochis phylla                    | Ochnaceae            |                                                |           | Extract of whole plant is given twice a day for one day only Leaves are ground and made into paste and applied over affected area |           |
| Biological source                           | Family                | Local names                  | Part used | Method of administration                              | References |
|--------------------------------------------|-----------------------|------------------------------|-----------|-------------------------------------------------------|------------|
| Pavetta indica Linn                        | Rubiaceae             | Therani                      | Lv, Rt    | A leaf paste is used externally                       | 68         |
| Pericaria daemia (Forsk) Chiov             | Apocynaceae           | Veilaputhi                   | Rt, Lv    | The decoction of the leaves is used                   | 30,75,95   |
| Peucedanum anallayense Cl                  | Apiaceae              | Padachurukki                 | Wp        | Whole plant paste along with cow’s urine is taken     | 48         |
| Phyllanthus acidus (Linn) Skeels           | Euphorbiaceae         | Kawsunhlu                    | Rt        | Decoction of roots is given                           | 78         |
| Piper nigrum Linn                          | Piperaceae            | Bolkaalu, Menasina kaalu,    | Fl, Sd, Fr| Seed powder mixed with butter is given orally against | 3,54       |
|                                            |                       | Maricha, Kali-mirch, Milagu  |           | snakebite                                             |            |
|                                            |                       |                              |           | Flower paste with ghee given orally (4 d)             |            |
| Pistia stratiotes Linn                     | Araceae               | Jalkumbhi                    | Sd, Br    | Decoction of seeds is given                           | 67         |
| Pittosporum tetraspernum Wight & Arn      | Pittosporaceae        | Analivegam                   |           | Paste of stem bark is taken with cow’s urine          | 48,66      |
| Plantago erosa Wall                       | Plantaginaceae        | Chhakur-blang, Nela site huvu| Lv, Rt    | Poultice of the leaves is given                       | 80         |
| Platanthera susannae Lind                 | Orchidaceae           |                              |           | In combination with lime and salt, the paste of root  | 81         |
|                                           |                       |                              |           | tubers is applied on the affected area                |            |
| Pouzolzia indica Gaud                     | Urticaceae            | Dudhmor                      | Wp, Br    | Unknown                                               | 53         |
| Prosopis cineraria Druce                  | Fabaceae              | Khejdi, Vanni maram          |           | Paste of bark tied on the affected area               | 71         |
| Quercus leucotrichophora A Camus          | Fagaceae              | Banj                          | Sd        | Unknown                                               | 41         |
| Randia dumetorum (Retz) Poiret Linn       | Rubiaceae             | Kaare                        | Rt        | Paste with water                                      | 81         |
|                                           |                       |                              |           | The root of this plant and leaves of Acacia suma      |            |
|                                           |                       |                              |           | (Mimosaceae) are pounded with salt and applied        |            |
|                                           |                       |                              |           | externally                                            |            |
|                                           |                       |                              |           | Leave juice used as antidote Roots and leaf buds     | 34,39,43,62,76,99 |
|                                           |                       |                              |           | crushed with milk to make into paste used both       |            |
|                                           |                       |                              |           | internally and externally on affected area          |            |
| Rauwolfia serpentina (Linn) Benth ex Kurz | Apocynaceae           | Nagbel, Bhuin karuan, Patal- | Lv, Rt    | Leave juice/paste is orally taken                     | 49,61      |
|                                           |                       | garuda, Bhuikurma, Sarpagandha, Keramaddinagaddi, Sutranabhi, Sarpagandha lairisich, Sarpagandha | | | |
| Rhinacanthus nasutus (L) Kurz              | Acanthaceae           | Nagamalli                    | Lv        | Fresh leaves are taken orally, as well as the leaf    | 49,96      |
|                                           |                       |                              |           | applied externally                                    |            |
|                                           |                       |                              |           | The plant juice/paste is orally taken                 |            |
| Rivea hypercitriformis (Desr) Choisy       | Convolvulaceae        | Parh                          | Wp, Rt    | Root paste is used                                    | 79         |
| Rubus niveus Thunb                        | Rosaceae              | –                             | Fr        | Tuberous root paste is applied on the area of         | 97         |
| Rutaceae                                  |                       | Nagadali                      | Rt        | snakebite                                             |            |
| Sanseveria roxburghiana Schultes F         | Agavaceae             | Saganaara, Gaju kura         | Rt        |                                                       |            |
| Saraca asoca (Roxb) De Wilde              | Celasalpiniaceae      | Ashok, Asoka                 | Sd        |                                                       | 40         |
| Sauratomatum venosum (Ait) Kuntz          | Araceae               | Halida, Samp ki dawa          | Tb        |                                                       | 33,84      |
| Sausurea costus (Pall) Lipsch              | Asteraceae            | Kuth                          | Rt        | The paste of tuber is applied on the affected area    | 41         |
| Sesamum indicum Linn                      | Pedaliaceae           | Til                            | Sd        | Seed is mixed with ghee, ginger powder, and oil and   | 54         |
|                                           |                       |                              |           | given orally                                          |            |
| Sida acuta Burm                           | Malvaceae             | –                              | Wp        | The whole plant extract is given internally and       | 3          |
|                                           |                       |                                |           | applied externally                                    |            |

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- Poiret, E. (1833). *The Genera of the Plantae*. Printed by J. May
| Biological source | Family | Local names | Part used | Method of administration | References |
|-------------------|--------|-------------|-----------|--------------------------|------------|
| Sida caprinifolia Linn | Malvaceae | Arivaal mania poondu, Kungyi, Makoi, Bhui ringani, Bhat katiyan, Choti kateli, Rohina | Lv, Rp | Leaf paste is used | 90 |
| Sida cordifolia Linn | Malvaceae | | | | |
| Solanum nigrum Linn | Solanaceae | | | | |
| Solanum xanthocarpum Schard & Wendl | Solanaceae | | | | |
| Sowaida febrifuga A Juss | Meliaceae | | | | |
| Sterculia urens Roxb | Sterculiaceae | Karaya, Kajara, Kaasarka, Kanjiram, Vishamushi, Etti, Visakkotai, Yeti | Rt, Sd | Root bark juice in cow’s milk is externally rubbed 3–4 times a day to treat | 60, 69 |
| Strychnos nux-vomica Linn | Loganiaceae | Kajana, Kaasarka | Rp | The crushed root mixed with salt and turmeric is applied | 81, 80 |
| Strychnos potatorum Linn | Leguminosae | Thethamkottai | Sd | The seed powder is also used | 49 |
| Tabernaemontana coronaria RBr | Apocynaceae | Nandibattalu huvu | Rt | Seed powder given orally | |
| Tabernaemontana divaricata (Linne) RBr | Apocynaceae | Nanjatte, Madderasa, Kathlona, Amli, Tengtere, Tetul, Kuttalvayana, Padamchurukkil-pam, Kuttalavayana | Rt, Lv Sd | The extract of the seed is given, as well as crushed paste applied on bitten area | |
| Tamrindus indica Linn | Caesalpiniaceae | Pul, | Sd, Rt | Unknown | 51, 55 |
| Tectona grandis Linnaeus (DC) Wight & Arn | Verbenaceae | Sagwan, Arjun, Marutham, Vellamarthu, Kuttalvayana, Padamchurukkil-pam, Kuttalavayana | Lv, Br | Unknown | 44, 45 |
| Thotea siliquosa (lamk) Ding Hou | Aristolochiaceae | | | | |
| Tiliacora acuminata (Lamk) Miers | Menispermaceae | Kappa teega | Lv | Roots and leaves decoction are given orally | 66, 89 |
| Trichosanthes cucumerina Linn | Cucurbitaceae | Nagfani beldi | Tb | | 84 |
| Tridax procumbens Linn | Asteraceae | Munya arxa, Dagas Ful | Lv | | |
| Tylophora indica (Burm f) Merr | Asclepiadaceae | Nangilai, Ashamakodi | Lv, Rt | | 31, 63, 65 |
| Urginea indica (Roxb) Kunth | Liliaceae | Kolknada | Cm | | 35 |

References: 31, 63, 65
is expensive. Strict and specific conditions are required for long-term storage.\textsuperscript{15} Because of the lack of availability of antidotes and anti-venoms at any specific time, alternatives from plant sources (which are abundant) should developed. Adequate information about herbal preparations or formulations is needed. The Indian system of medicine, especially Ayurveda medicine, has thrown light on this subject. A variety of plants mentioned in Ayurvedic literature are useful in snakebite treatment.\textsuperscript{20} Considering that treatment at a proper clinic or hospital is at an unreachable distance for approximately 80\% of victims, these people are primarily treated or handled by a traditional practitioner, or Vaidya, or other tribal herbalist. If the situation is beyond their control, they must proceed to a nearby clinic or hospital for advanced therapy.\textsuperscript{8} The traditional practitioners rely on various plants for treatment because they are knowledgeable about a variety of plant species that are helpful against snakebites and associated complications.\textsuperscript{3,21} In the management of snakebites, there are two main aspects:

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### Table 1 (Continued)

| Biological source | Family   | Local names | Part used | Method of administration | References |
|-------------------|----------|-------------|-----------|--------------------------|------------|
| Vitex negundo Linn | Verbenaceae | Nukki, Lakkigida, Karinochi notchi, Nishindi, Shet nishinda | Br, Rt, Lv, Sd | Leaf paste applied over the bitten area (5 d), as well as root extract is given with warm water | \textsuperscript{81} |
| Vitex penduncularis Wall | Verbenaceae | Charanigorh | Br | Decoction of the bark is given orally at 30 min intervals | \textsuperscript{62,68} |
| Zingiber rubens Roxb | Zingiberaceae | Pauphok | Lv | The leaves are torn into thin strips and rope is made that is used to tie up parts of snakebite to prevent flow of venom in blood | \textsuperscript{45} |

Abbreviations used – Ap, arial portion; Bb, bulb; Bd, bud; Br, bark; Cm, corm; Fl, flower; Fr, fruit; Gr, grain; Gu, gum; Lv, leaves; Lx, latex; Pd, pods; Pl, poultice; Pn, penduncle; Re, resin; Rt, root; Rz, rhizomes; Sd, seeds; Sh, shoot; St, stem; Tb, tuber; Tn, tendril; Un, unknown; Wp, whole plant; d, day(s); h, hour(s).

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Fig. 1 – Big Four Russell’s viper (Daboia russelii, Marathi – ghonas, tawarya), Indian cobra (Naja naja, Marathi – Nag), saw-scaled viper (Echis carinatus, Marathi – phoorsa), and the common krait (Bungarus caerules, Marathi – manyar, kanadar). Images reprinted with permission from indiansnakes.org.
1. Proper first aid treatment and
2. Anti-venom/anti-ophidian treatment, such as serum therapy

Because of side effects or adverse reactions (e.g., anaphylacti-
c reactions), serum sickness and sometimes the anti-venom itself produces complications during treatment.22

5. Diversity of India

World Health Organization (WHO) stated that almost 80% of the population in developing countries depend on various herbal plants for the management of diverse diseases and illnesses because of the lack of modern health care services.3,23 In addition, for prime health care, people are dependent on their earnings and improvement of the standard of living. More than 65,000 plant species are traditionally used in addition to modern medicines.24 In India, Ayurveda is the most widely practiced system of medicine, which has a marvelous diversity of plant information. The Republic of India has 29 states and seven union territories comprising an area of 3,287,263 km². The Indian people speak a variety of languages, including 23 regional languages: Assamese, Bengali, Bodo, Dogri, Gujarathi, Kannada, Kashmiri, Kokborok, Konkani, Malayalam, Manipuri, Marathi, Mizoram, Nepali, Odia, Punjabi, Sanskrit, Santali, Sindhi, Tamil, Telugu, and Urdu. Apart from these, other local or tribal people have their own native or native language per locality. India encompasses different ethnic groups with over 539 core indigenous people living in diverse territories. It has varied cultures, foods, traditions, and religious rituals, which causes separations among the people. Furthermore, there is a wealth of knowledge of conventional medicine, particularly herbal and folk medicine, for treatment of snakebites.

6. Clinical significance of snakebite

Traditional herbalists treat people earlier and use plants to cure various complications and ailments.3 The snake is still not perfectly understood to worldwide researchers. The word ‘snake’ invokes feelings of fear because of an instinctive human emotion and its image is powerful and primal. Snakes are as fascinating to psychologists, pharmacologists, and clinicians as they are to evolutionists. Snakes are either poisonous or nonpoisonous. Snakebites can be considered as environmental or occupational hazard because they occur regularly and repeatedly, with overwhelming frequency, particularly in remote rural areas in tropical developing nations. It is estimated that each year in India there are more than 80,000 snake envenomings and 11,000 deaths, which makes India a seriously affected nation. Snakes are present on each continent, except Antarctica.9 Mishal et al listed some critical and medically significant (clinical) conditions and syndromes related to snakebite envenomation14 as follows:

1. Local or restricted area envenoming (swelling of the affected part) with hemorrhage or difficulty clotting (this is particularly seen in Viperidae envenomation).
2. Local or restricted area envenoming (viz. swelling) with hemorrhage or difficulty clotting damages the kidneys or contributes to infections that cause neuro-paralysis and shock.
3. Local or restricted area envenoming (such as swelling) along with paralysis.
4. Paralysis with/without local or restricted area envenoming.
5. Paralysis with urine that is dark brown in color in addition to acute kidney injury.

7. Composition of snake venom

Medical science occasionally ignores community health values. Snake venom is rich in protein and peptide toxins. These proteins have a definite action on numerous tissue receptors. The wide range of action of snake venoms makes them clinically demanding and scientifically interesting, in particular, for drug design.25 The mysterious biological nature of venom and its complex medical effects have long captured human imagination and inquisitiveness. Venoms, mainly snake venoms, have been the focus of ancient mythology, early biomedical speculation, folklore, and scientific investigation, in addition to pharmacognosy.24 The venom of any species may have more than 100 diverse toxic and non-toxic proteins and peptides, along with non-protein toxins (amines, carbohydrates, lipids, and additional small molecules).25 Proteins and peptides comprise approximately 90 ± 05% of the dry weight of venom. Supplementary components in the venom consist of carbohydrates, metallic cations, nucleo-sides, biogenic amines, and a small amount of free amino acids and lipids. The venom of snakes contains at least 25 enzymes, although no single snake venom has all of them. Enzymes are responsible for catalyzing numerous precise biochemical reactions that occur in living matter. They are the mediators upon which cellular metabolism depend. Among the available choices, the more important snake venom enzymes are as follows: 5’-nucleotidase, acetylcholinesterase, arginine ester hydrolyase, collagenase, DNase, hyaluronidase, lactate dehydrogenase, l-amino acid oxidase, NAD nucleosidase, phosphodiesterase, phospholipase A2 (A), phospholipase B, phospholipase C, phosphomonoesterase, proteolytic enzymes, RNase, and thrombin-like enzymes. All these enzymes are not present in all venoms. Among the peptides originating in snake venoms are pre-synaptic and postsynaptic neurotoxins, myotoxins, cytotoxins, cardiotoxins, and potassium channel-binding neurotoxins, along with platelet aggregation inhibitors (disinterring).23,26,27

8. Snakebite treatment in India

Because India is the only country of its kind in terms of the diversity of geographical, environmental, and climatic features, it has a rich and wide-ranging flora of medicinal herbal plants that have been used since the Vedic period. A huge portion of the nation still uses plants as home remedies in rural and remote areas for a number of illness, infections, and diseases, including snakebites. India is a nation with mega diversity; moreover, approximately 10% of world’s species are
indigenous to India. Because India has a prosperous, flourishing, enlightening legacy, almost all Indians have directly and indirectly been connected with a variety of herbs during their ritualistic ceremonies and various cultural activities. A recent study found that rich ethno-medicinal knowledge could be gathered from the community members, which would provide a great advantage to future generations by documenting and preserving the knowledge. This requires that the ethnomedicinal plants used by the native tribal people should be comprehensively revised and the proper significance of these plant species assigned, such that they can be managed and conserved for the welfare of mankind. Reliable progress has been made in that direction. Snakebite treatment in India (before partition) consisted of various snake antivenom drugs and/or combination formulations, such as Suruimuina (1908), Ofidina (1909), Viborina (1910), an unknown plant used by the Civil Surgeon of Hugli (1912), an ointment made by Mr M Robert of Bordeaux (1914), Goor Boineche Antitoxicum (1915), Tiiriyaq (1916, repeated in 1929), white champa pod and root (1920), Payam-i-Hayat (February 14, 1921), El Elixir Antiviperino Lexin (1923), remedy by firuzuddin (June 1928), and lobelin (1929) that have been tested since 1906 in various pharmacological labs across India, then British India and the Indian subcontinent. The severity of snakebite poisoning is always a catastrophic issue for the sufferer and physician. Usually death will result because of many reasons, such as failure of the patient to reach the hospital, lack of appropriate treatment, difficulty in production, deployment, and accessibility of current snake anti-venoms. The mortality rate depends largely on the species of snake. Elapid poisoning (viz. cobra and krait) always has a higher mortality rate than that of Viperidae poisoning (saw-scaled viper and Russell’s viper). The point to be considered is that an approximately 70-kg healthy person will succumb to only a small quantity of venom, and typically it takes the venom 6 seconds or less to reach the heart. In various ancient texts and literature, more than 320 medicinal plants and more than 180 different combinations are reported to have snake anti-venom activity. However, after comprehensive evaluation, all of these Ayurvedic preparations from medicinal plants had no snake anti-venom properties.

9. Vaidya – Indian herbalist, physician, compoudner and dispenser

In the Indian system of medicine, the Vaidya is known as doctor of herbs, who makes a diagnosis of illness and compounds medicinal preparations, such as asava, arista, churna (powders), lotions, liniments, pills, syrup, and taila. Furthermore, many old-aged persons (such as a grandmother) are familiar with the application of various herbs. Practitioners of Ayurveda believe that every plant on the Earth has some significant medicinal property for the purpose of the good of the world; the right person just has to show you. The practitioner of Ayurveda states (Naasti Moolam Anaushadhim translation Every plant on earth has a medicinal property). Allopathy (the treatment of disease by conventional means, that is, with drugs having effects opposite to the symptoms) or modern medicinal systems sometimes has a number of undesired effects from drugs, such as adverse drugs reactions. Therefore, an increasing number of people in developed and developing countries are using medicinal plants for some betterment. The formulations or plant preparations rely on the availability of the plant part(s). Usually preparation is made by crushing the plant or its part(s) by using stones or pieces of wood. Often a juice or paste is made to apply to the affected area or sometimes is given orally. A number of villagers or Vaidya have a specific stone set called a “Paata-Varvanta” (Fig 2). The Paata is a Marathi language word meaning base on which the plant or its part(s) are kept. The Varvanta is a Marathi language word meaning a pastel-like stone to crush the plants or its part(s). The present review is an attempt to cover the traditional/ethnobotanical medicinal plants utilized in various parts of India for snakebites. Apart from previous reviews, this will also help future researchers to recognize the herbal approach for the treatment of snakebites. In Table 1, the data from the current analysis is presented. Arrangement of medicinal plant species is in alphabetical order.

10. Conclusion

Mother Nature has given humans a most precious gift in medicinal plants. The natives of India are people who are very connected to Nature, as Indians are “celebration affectionate” people. In almost every festival in India, there is connectivity of human beings to animals and Mother Nature. The local tribes understand biodiversity and serve as a source of knowledge regarding proper use of medicinal plants. For various reasons, the focus altered from modern medicine to Ayurveda herbs and medicinal plants for various diseases or disorders. India is homeland for such a marvelous variety of diversity. In cultural heritage, India has a long history.
of medicinal plant utilization. This review has attempted to cover remarkable similarities among medicinal plants that are used across India. In our study, a total of 523 plant species belonging to 122 families were reported for treatment of snakebites. Furthermore, this review encompasses some plants that are rarely or less often used. The most common families include Acanthaceae, Apocynaceae, Areceae, Asteraceae, Caesalpiniaceae, Cucurbitaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Rubiaceae, and Zingiberaceae (Fig. 3).

For a long time, the traditional healers have practiced using herbal traditional medications for snakebite treatment, as well as numerous other diseases. Biological source(s), family, local name(s), part(s) used (Fig. 4), method of preparation, and reference(s) are provided to increase the ease of availability for the data.

There is a lot of information yet to be gathered and formulated. Ethno-botanical investigation is the future branch that will aid in maintaining good health for all mankind because much is still hidden and there are chances to make new phytochemical phytopharmacological drug discoveries, which will become the most reliable progression in the direction of utilization of medicinal plants for the treatment of various illnesses.

Conflict of interest statement
The authors declare no conflict of interest.

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