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PLANT-BASED TRADITIONAL REMEDIES FOR SNAKEBITE IN INDIA: A RECENT UPDATE REVIEW

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ABSTRACT: Medicinal plants are a potential source of therapeutic drugs and play a central role in the health care system throughout the world. Plants have been an integral part of the life of many indigenous communities. Snakebite is a neglected tropical disease. Snakebite remains a major health concern throughout the world, especially in India. The highest Morbidity and Mortality occurs in rural and tribal people in the country. The problem is complicated by delay in seeking medical help or not seeking medical help due to belief in traditional healers. However, abundant plant species are used as a folk medicine to treat poisonous snakebites all over the world. In the present study, given the145 plants from the 55 families that are either used as a traditional medicine to treatment of venomous snakebites, which phytocompounds responsible for the antivenom activity.

INTRODUCTION: 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 of 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. Globally, about 60% of the healthcare products available in markets are known to be derived from plant origin. In India, medicinal plants are widely used by the people. Folk remedies, pharmaceutical preparations and also in different indigenous systems of medicine like Siddha, Unani and Ayurveda for the treatment of various diseases. About 80% of the world population relies on plants and their products for primary health care. Awareness of plant-based medications and therapeutics is continuously increasing worldwide, and hence there are high acceptance and demand. Since ancient times, plants have been used for the 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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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. India is home to different ethnic groups' comprising [5]. 4 corers 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, 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.

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. Snakebites represent a severe medical, social, and economic challenge in many parts of the world, chiefly in tropical and subtropical nations.

Based on their morphological characteristics, including the arrangement of scales, dentition, osteology, mycology, sensory organs, *etc*., snakes are characterized into families. The snakes found in India show great biodiversity, and their length varies from 6 mm to 10 mm, while weight ranges between few grams to several kilograms. Snakes occupied deserts, forests, marshy, swampy places, lakes, streams, and rivers of difficult terrains. The families of venomous snakes are Atract aspididae, Elapidae, Hydrophidae and Viperidae. There are about 216 species of snakes in India, of which 52 species are reported to be poisonous (Bawaskar, 2004). The major families in the India subcontinent are Elapidae which includes common cobra, king cobra and krait, Viperidae which includes Russell's viper, pit viper and saw-scaled viper and Hydrophidae (Sea snakes) of the 52 poisonous species in India, majority of bites and consequent morbidity is attributable to 5 species *viz*. *Ophiophagus hannah* (King cobra), Najanaja (Common cobra), *Daboia rusellii* (Russell's viper), *Bungarus caeruleus* (krait) and *Echis carinatae* (Saw-scaled viper).

Snake venoms are one of the most intense "mysterious" biological fluids within class Mammalian, having complex medical effects owing to the presence of complex mixtures of proteins and peptides, and they contain at least 25 enzymes [25–27]. 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.

Snakebite envenomation is a neglected tropical disease that kills more than 100,000 people and maims more than 400,000 people every year. The country most affected by snakebites is India, with 46,000 deaths/year and around 4.1 cases of snakebite per 100,000 inhabitants.

Snake Bites Treatment: Snakebites are commonly treated by parenteral administration of horse or sheep-derived polyclonal anti venoms 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 anti-venom.

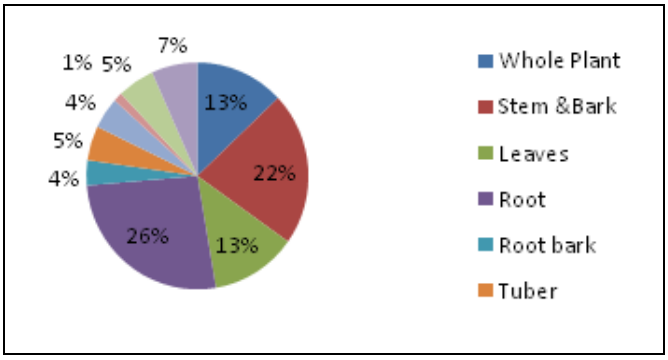

FIG. 1: PLANTS PARTS USED FOR SNAKE BITE TREATMENT

Ophidia accidents are a serious problem in public health due to the resulting high morbidity and mortality rates. The only specific treatment available is anti-venom. Therefore, the search for complementary alternatives for snakebite treatment is very important and necessary. In order to develop alternatives to current therapies, researchers have been looking for bioactive compounds isolated from plant extracts with different properties such as analgesic, anti myotoxic, anti-hemorrhagic, and anti-inflammatory effects for many years. In recent years, studies have been published that have provided pharmacological evidence regarding the benefits of various extracts and compounds isolated from different plant

species against the local and systemic effects induced by a wide range of snake venoms, including lethality. 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 anti-snake venoms or supportive plants. Thus, in the management of snakebite, the study of herbal antidotes against snake venom is of considerable significance to society.

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 the treatment of snakebites. As this is a detailed "scrutiny," we also carried out an appraisal of plants used in the treatment of snakebite poisoning throughout India. An extensive review of the literature was conducted, which came from different scientific sources, such as Pub Med (https://www.ncbi.nlm.nih.gov/pubmed), Science Direct (http://www.sciencedirect.com/), Scopus (https://www.scopus.com/), Web of Science (http://www.web of knowledge.com/), Scientific Electronic Library Online (SciELO) (http://www.scielo.org/), Scifinder and Google Scholar (https://scholar.google.com). The study databases included original articles published in peer-reviewed journals, as well as books, theses, dissertations, patents, and other reports covering information related to plants used in the treatment of snakebite envenomation (Ethnopharmacological studies, original articles, or comments). Publications with ethnobotanical studies, bioactive substances, or bio-guided pharmacological studies were analyzed in the search for therapeutic alternatives for the treatment of snakebites. This paper helps readers to find out more about these plants by including their local names from local inhabitants. 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 is obtained from the original sources **Table 1**.

TABLE 1: PRECISION OF BOTANICAL IDENTIFICATION OF PLANTS IS OBTAINED FROM THE ORIGINAL SOURCES

S. no.	Plant Name	Family	Part Used	Preparation Method
1	*Abrus precatorius* Linn	Fabaceae	Leaves, Seed, 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.)
2	*Acalypa indica* Linn.	Euphorbiaceae	Whole Plant, Leaves	Leaf, Whole plant Leaf paste applied over the bitten part or paste smeared on spot of bite (3–4 d) [29, 46–50].
3	*Acanthus ilicifolius* Linn.	Acanthaceae	Fruit	Fruit For dressing snakebite crushed fruits are used.
4	*Achyranthes aspera* Linn.	Amaranthaceae	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].
5	*Aconitum balfourii (Bruhl) Muk.*	Ranunculaceae	Root, tuber	Tuber paste used externally and internally [78–81].
6	*Aconitum ferox Bikh, Bish*	Ranunculaceae	Tuberous root	Tuberous roots [82].
7	*Acorus calamus* Linn.	Araceae	Rhizome	Rhizomes are crushed to paste and given with warm water as well as applied externally [29, 65, 68, 69, 72, 76, 83–86].
8	*Adiantum lunulatum* Linn.	Adiantaceae	Rhizome	Rhizome powder used for snake bite [87].
9	*Adiantum philippense* Linn.	Adiantaceae	Rhizome	Powder of rhizome is used.
10	*Aegle marmelos (*Linn.*)*	Rutaceae	Fruit, leaves, root bark	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].
11	*Aerva lanata (*L.*) Juss. ex Schult*	Amaranthaceae	Whole plant, rhizome, root	Juice is prepared and taken orally (for 11 d) [29, 72, 93, 94].
12	*Ageratum conyzoides* Linn.	Asteraceae	Leaves	Paste of leaf with rhizome of *Zingiber officinale* is used [50, 58, 96-98].
13	*Alangium salvifolium* (Linn.f) Wang.	Alangiaceae	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].
14	*Albizia lebbeck* (Linn). Benth.	Fabaceae	Leaves, bark, flower, whole	Paste of bark is used [45, 54, 55, 73].

			plant, root	
15	*Allium cepa* Linn.	Liliaceae	Skin bulb	Skin bulb Paste taken from fresh skin bulb for external application (5 d) [29, 65].
16	*Allium sativum* Linn.	Liliaceae	Bulbs	Bulb is made into paste and given orally [68, 69].
17	*Alstonia constricta*	Apocynaceae	Whole plant, root, leaf, stem	75 Leaves juice, Whole plant paste applied on the snake bite
18	*Alstonea scholaris* (Linn.) R.Br.	Apocynaceae	Leaf, bark Bark	Leaf, bark Bark decoction given orally [54, 73].
19	*Alstonia venenata R.Br.*	Apocynaceae	Stem, bark root	Tablets made from paste of stem bark are taken with cow's urine. Decoction also taken orally [49, 70].
20	*Alternanthera sessilis* (Linn.) R. Brown ex DC	Amaranthaceae	Stem, leaf	External application of stem and leaf paste is used [72].
21	*Amaranthus spinosus* Linn	Amaranthaceae	Roots, leaf, whole plant	Paste of leaves is applied locally [50, 72].
22	*Amaranthus viridis* Linn.	Amaranthaceae	Leaf, stem	Leaves/stem paste are applied externally [70, 96].
23	*Ammannia baccifera* Linn.	Lythraceae	Whole plant	Whole plant powder mixed with hot cow's milk to drink [65, 70].
24	*Anacardium occidentale*	Anacardiaceae	Bark	Methanolic extract of bark
25	*Andrographis echioides* Nees	Acanthaceae	Whole plant	Paste of whole plant is given orally with water. It is also applied externally [65, 84].
26	*Andrographis lineate Wallich ex*	Acanthaceae	Whole plant, leaves	Paste of leaves is applied externally. About 30 g of whole plant paste is directly administered orally [29, 65].
27	*Andrographis paniculata* (Burm f) Wall. Ex. Nees.	Acanthaceae	Leaf, leaves, whole plant	A decoction of the leaves with the leaves of Andrographis alata is given. Decoction or extract is applied externally [29, 31, 33-35, 40, 49, 51, 57, 65, 68, 69, 72, 94, 98].
28	*Andrographis stenophylla*	Acanthaceae	Leavevs	Leaf powder of the plant along with *Evolvulus alsinoides*, roots of *Aristolochia indica*, *Cryptolepis buchananii*, *Ichnocarpus frutescens*, *Rauvolfia serpentina* and *Rhinacanthus nasutus* is administered orally
29	*Annona squamosa*	Annonaaceae	Leaves	Incision of snakebite is washed with this plant's juice and then *Datura metel* leaf paste is applied
30	*Argemone mexicana* Linn.	Papaveraceae	Leaf, Seed, root	Leaf/seed decoction given orally (7 d). Root paste is also used [29, 59, 65].
31	*Arisaema tortuosum (*Wall.*) Schott*	Araceae	Tuber, bulb	Paste of the tuber in applied. Infusion of fresh bulb is taken orally thrice a day [72, 77].
32	*Aristolochia bracteolate Lamk.*	Aristolochiaceae	Leaves, root	Leaves paste applied externally as well as infusion is taken orally [41, 49, 65, 72].
33	*Aristolochia indica* Linn.	Aristolochiaceae	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].
34	*Aristolochia tagala* Cham	Aristolochiaceae	Root	Root Crushed mixed with water and drunk as well as fresh roots are grounded and applied externally on affected portion [32, 63, 72].
35	*Azadirachta indica* A. Juss	Meliaceae	Flower, bark, leaf, fruit	Decoction/paste is prepared and given orally (7 d) [29, 49, 50, 66, 68, 69, 93].
36	*Bacopa monnieri* (Linn) Pennell	Scrophulariaceae	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].
37	*Balanites aegyptica*	Zygophyllaceae	Stem, bark	Acetone & methanolic extract of stem bark
38	*Barleria cristat* Linn.	Acanthaceae	Leaves, roots, seed, Leaf	Leaves, roots, seed Leaf juice is applied.
39	*Bauhinia purpurea* L.	Fabaceae	Flowers, seeds, bark	Flowers, seeds, bark
40	*Bauhinia variegate* L.	Fabaceae	Bark, roots, leaves, seeds	Bark, roots, leaves, seeds
41	*Biophytum petersianum Klotzsch.*	Oxiladaceae	leaves	Leaf powder with the leaves of *Aristolochia tagala*, *Alangium salvifolium*, stem bark of *Strychnos nux-vomica*, *Wrightia tinctoria*, *Thespesia populnea* and roots of *Abrus precatorius* is heated with water and taken internally for 14 days
42	*Biophytum sensitivum*	Oxiladaceae	leaves	Leaf powder with the leaves of *Aristolochia tagala*, *Alangium salvifolium*, stem bark of *Strychnos nux-vomica*, *Wrightia tinctoria*, *Thespesia populnea* and roots of *Abrus precatorius* is heated with water and taken internally for 14 days

43	*Blepharispermum petiolare DC.*	Asteraceae	Leaves, stem bark	Powdered leaf and stem bark with leaves of *Strychnos nux-vomica, Pavetta indica, Cyanodon dactylon*, the root of *Sida cordifolia* and *Hedyotis umbellata* is internally taking
44	*Boerhaavia diffusa* Linn.	Nyctaginaceae	Leaf, whole plant	Leaf juice is also applied locally and taken orally for 7 d [66, 67, 98].
45	*Bombax ceiba* Linn.	Bombaceae	Flowers, roots, bark, seed	Paste of flowers/fruits/leaves is applied on the bitten spot [46, 55, 59, 73, 92].
46	*Boswellia delzielli*	Burseraceae	Stem bark	
47	*Bryonia laciniosa* L.	Cucurbitaceae	Seeds	
48	*Buchanania lanzan Spr.*	Anacardiaceae	Bark	[55, 58, 72, 83, 98]
49	*Butea monosperma* (Lamk.)	Fabaceae	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].
50	*Caesalpinia bonduc* (Linn.) Roxb.	Caesalpiniaceae	Seeds	Seeds paste applied externally (2 wk) [29].
51	*Caladium bicolor Vent.*	Araceae	Tuber	Tuber paste is applied on the snake bite [88]
52	*Calotropis gigantea* (L.) R. Br	Asclepiadaceae	Roots, latex, Root bark	Roots, latex, the Root bark is ground into paste and made into pills n given orally. Leaf latex is applied externally [29, 38, 43, 58, 62, 65, 68-70, 92].
53	*Calotropis procera* (Ait.) R. Br.	Asclepiadaceae	Latex, root, young buds, Leaves	Latex is applied on bitten area. Root is crushed and given to drink and applied externally [48, 58, 66].
54	*Carica papaya* Linn.	Caricaceae	Fruit, seed, latex Un ripped fruit	Fruit, seed, latex Un ripped fruit of Carica papaya 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].
55	*Cassia alata* Linn.	Caesalpiniaceae	leaves	Leaf Paste of leaves is applied externally as well as given orally [29, 65].
56	*Cassia fistula* Linn.	Caesalpiniaceae	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].
57	*Cassia occidentalis* Linn.	Caesalpiniaceae	Root, leaf	Root, leaf Oral administration of root paste [65, 70, 74].
58	*Cassia tora* Linn	Caesalpinaceae	Root, leaf	Root paste and leaf decoction is applied externally (14 d) [29, 65, 70, 98].
59	*Cayratia trifolia* Linn.	Vitaceae	Tuberous	Paste of tuberous
60	*Cissampelos pareira* Linn	Menispermaceae	Tuber, root	Root paste with long pepper is prescribed once daily for 5 d [59, 70].
61	*Citrullus colocynthis (Linn) Schrad.*	Cucurbitaceae	Seed, root, fruit	Seeds oil used externally as well as root is crushed and given to drink [66].
62	*Clerodendrun viscosum*	Verbenaceae	Root	Alcoholic root extract
63	*Clitoria ternatea* Linn.	Fabaceae	Roots	The root extract is taken with the root of A. indica and Rauwolfia serpentina [53, 55, 58, 62].
64	*Cocculus villosus* DC.	Menispermaceae	Root, Root bark	The root bark extract is given internally and applied [58].
65	*Corallocarpus epigaeus* (Rottl. & Willd.) Hook. f.	Cucurbitaceae	Root, tuber	Root decoction given internally 3–7 times [41, 70, 71].
66	*Costus speciosus* (Koen) Sm	Costaceae	Root, rhizome	Rhizome and root paste is used internally and externally [59, 92].
67	*Crinum jagus*	Amyrillidaceae	Bulb	Bulb paste was applied externally [29].
68	*Crypttolepis buchananii Roem. & Schult.*	Asclepiadaceae	Root	Leaf powder of the plant along with *Evolvulus alsinoides*, roots of *Aristolochia indica*, *Cryptolepis buchananii*, *Ichnocarpus frutescens*, *Rauvolfia serpentina* and *Rhinacanthus nasutus* is administered orally
69	*Curculigo orchioide Gaertn.*	Amaryllidaceae	Root, tuber	Root paste use topically 31,72
70	*Curcuma longa* Linn.	Zingiberaceae	Rhizome	Rhizome paste is applied externally (3 wk) [29, 73].

71	*Cyperus rotundus* Linn.	Cyperaceae	Whole plant, root, tuber, rhizome	Decoction of root/tubers/rhizome given orally (7 d) [29, 53, 55, 84].
72	*Datura metel* Linn.	Solanaceae	Seeds, root, leaf	Extract of roots are taken with garlic [58, 68, 69].
73	*Desmodium gangeticum* (Linn.) DC.	Fabaceae	Roots	Half-cup root decoction is taken orally 73.
74	*Drymaria cordata* (L.) Willd. Ex *Roem. & Schult.*	Caryophyllaceae	Whole plant	Whole plant is used (crushed, paste applied) [97].
75	*Eclipta alba* (Linn.) Hassk.	Asteraceae	Whole plant	Whole plant juice is given orally (14 d) [29, 65].
76	*Eclipta prostrata* Linn.	Asteraceae	Leaves	Leaf paste is applied externally [29, 65].
77	*Elaeodendron glaucum Pers.*	Celastraceae	Bark, root	Roots and bark of plant made into paste taken orally with cow's milk [48, 83, 84].
78	*Elytraria acaulis* (L. f.) Lindau	Acanthaceae	Root	Root paste with black piper is applied on snakebite
79	*Emblica officinalis* Gaertn.	Euphorbiaceae	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].
80	*Enydra fluctuans* Lour.	Asteraceae	Whole plant	Whole plant, decoction given orally [29].
81	*Euphorbia hirta* Linn.	Euphorbiaceae	Latex, whole plant	Latex or whole plant, decoction given orally [29, 31].
82	*Euphorbia neriifolia* Linn.	Euphorbiaceae	Latex, root	Latex is applied locally. Root is used with black pepper [68, 69].
83	*Ficus religiosa* Linn.	Moraceae	Leaf, bark, fruit, stem bark	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].
84	*Gloriosa superb* Linn.	Liliaceae	Tuber, root, rhizome, seed	Root paste or tuber paste is applied externally (2–5 d) [29, 59, 65, 75].
85	*Gymnema sylvestre* (Retz.) R. Br.	Asclepiadaceae	Leaf, root	Root Tincture or leaf powder taken orally (4 d) [29, 41, 58, 68, 69, 92, 93].
86	*Helicteres isora* Linn.	Sterculiaceae	Bark, root	Bark power is given in snakebite [70, 73].
87	*Heliotropium indicum* Linn.	Boraginaceae	Leaf	The leaf juice mixed with hot water is used [65].
88	*Hemidesmus indicus* (Linn.) R. Br.	Asclepiadaceae	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].
89	*Hibiscus aethiopicus*	Malvaceae	Leaves	Aqueous extract of Leaf given orally [29, 35].
90	*Holarrhena antidysentrica wall*	Apocynaceae	Bark, root	The root is crushed and applied as well as paste is taken orally with water [58, 72, 98].
91	*Holarrhena pubescens* (Buch.-Ham.) Wall. ex G.Don	Apocynaceae	Seeds, root, stem bark	Paste is applied on the bitten area two times a day 70
92	*Imperata cylindrical Beauv.*	Poaceae	Rhizome	Paste is applied on the bitten area [29]
93	*Isonandra lanceolata Wight*	Sapotaceae	Leaf, Fruit, Bark, Root	Laef, un ripened fruit and root bark along with leaves of *Andrographis paniculata* and leaf and root bark of *Thespesia populnea* are heated with water to make a decoction and taken internally for 30 days
94	*Lantana camara* Linn.	Verbenaceae	Roots, flower, stem, leaf, whole plant	Decoction of roots, flower and stem are used [66, 96].
95	*Lantana indica Roxb.*	Verbenaceae	Leaf	Leaf decoction externally used [70, 73].
96	*Lecus aspera*	Lamiaceae	Root and bark	Root and bark infusion of the plant and *Leucas aspera* leaves with roots of *Ocimum adscendens* and bark of *Artocarpus* mixed with milk and butter are filtered and used in snakebite
97	*Leucas cephalotes* (Roth) Spreng	Lamiaceae	Whole plant	Decoction of whole plant (twice a day for 6 d) [29].
98	*Leucas .linifolia* (Roth) Spreng	Lamiaceae	Leaves	Fresh leaf juice (5 ml) is taken orally at an interval of 15 min in the treatment of snakebite
99	*Luffa acutangula*	Cucurbitaceae	Fruit, tendril,	Fruit, tendril, seed Tendrils and seed paste is used [53, 55].

	(Linn.) Roxb.		seed Tendrils	
100	*Madhuca indica (Koenig.) macbride* Gmel	Sapotaceae	Flower, leaves, bark, seeds	Bark paste is externally applied (2–3 d) [45, 83, 84].
101	*Malva sylvestris* L**.**	Malvaceae	Leaf	Leaf extract mixed with lime juice is used in snakebite
102	*Mangifera indica* L.	Anacardiaceae	Stem bark	As a protective measure against snakebite, inflorescence of the plant is massaged on hands
103	*Mimosa pudica* Linn	Mimosaceae	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].
104	*Mitragyna parvifolia* (Roxb.) Korth.	Rubiaceae	Bark, fruit	Bark, fruit paste applied externally on the snake bite place 44
105	*Momordica charantia* Linn	. Cucurbitaceae	Whole plant, Shoot, root	Juice of tender shoot or root is applied [29].
106	*Moringa oleifera* Lam	Moringaceae	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].
107	*Mucuna pruriens (*Linn.) DC	Fabaceae	Seed, fruit, root	Aqueous extract of root is given orally for twice a day [50,56].
108	*Murraya paniculata* (Linn.) Jack.	Rutaceae	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].
110	*Musa paradisiaca* Linn.	Musaceae	Bark, stem, skin bark	A plant extract is given orally [29, 49, 74].
111	*Nerium indicum* Mill. Gard.	Apocynaceae	Leaf, bark, root	The root is crushed with roots of Capparis sepiaria and *Datura innoxia*, and paste applied externally thrice for 5 d [46, 66].
112	*Nerium oleander* Linn.	Apocynaceae	Seeds	Seeds paste applied externally (14 d) [29, 49].
113	*Nicotiana tabacum* Linn.	Solanaceae	Leaf	Leaves decoction given orally (3 d) [29].
114	*Ocimum adscedens* Willd	Lamiaceae	Root and bark	Root and bark infusion of the plant and *Leucas aspera* leaves with roots of *Ocimum adscendens* and bark of *Artocarpus* mixed with milk and butter are filtered and used in snakebite
115	*Ocimum basilicum*	Lamiaceae	Whole Plant	Whole plant paste and fresh leaves juice was applied [29]
116	*Ocimum sanctum* Linn.	Lamiaceae	Leaf, root, whole plant	A paste of ocimum leaf with the rhizome of Curcuma longa L. (Zingiberaceae) is applied externally. Leaf juice, oral (8 d) [29, 45, 66].
117	*Ophiorrhiza mungos* Linn.	Rubiaceae	Root	Root juice is given (twice a day for 6 days) [29, 43].
118	*Opuntia dillenii* (Ker-Gawl) Haw	Cactaceae	Stem bark, fruit, entire plant	Stem bark, fruit, entire plant The fruits paste is applied [64].
119	*Oxalis corniculata Linn.*	Oxalidaceae	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].
120	*Pergularia daemia (Forrsk.) Chiov*	Apocynaceae	Root, leaf	The decoction of the leaves is used [42].
121	*Piper longum Linn.*	Piperaceae	Roots	Roots [73]
122	*Piper nigrum Linn.*	Piperaceae	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].
123	*Plectranthus rugosus* Wall. ex Benth.	Lamiaceae	Leaves	Leaf extract is mixed with hot water or milk to form bitter syrup and administered orally
124	*Plumbago zeylanica Linn.*	Plumbaginaceae	Whole plant, root	Whole plant paste is given internally [36, 62].
125	*Radermachera xylocarpa (Roxb.) K.Schum.*	Bignoniaceae	Fruit, seed	Fruit paste applied and taken internally as well as pulp of seeds with little water is taken [92].
126	*Rauvolfia serpentina (Linn.) Benth. ex Kurz.*	Apocynaceae	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].
127	*Rhinacanthus nasutus (L.) Kurz*	Acanthaceae	Leaves	Fresh leaves are taken orally as well as the paste of the leaf is applied externally [65,70].
128	*Sapindus laurifolius* Vahl	Sapindaceae	Fruit	Fruit foam is applied on snakebite while the fruit juice is given orally

129	*Sauromatum venosum* (Ait.) Kunth	Araceae	Tuber	The paste of tuber is applied on the affected part [72].
130	*Semicarpus anacardium* Linn.	Anacardiaceae	Root	Root is taken orally (7 d) [29, 72].
131	*Solanum xanthocarpum* Schard & Wendl	Solanaceae	Leaves, root	Fresh leaves extract (paste or decoction) of this species is given [66].
132	*Soymida febrifuga* A. Juss.	Meliaceae	Stem bark, root	Fresh bark of this plant together with root of H. pubescens (1:1) are made into paste, and mixed with drinking water, given orally three times a day for 3 d [56].
133	*Strychnos nux-vomica* Linn.	Loganiaceae	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].
134	*Tabernaemontana divaricata (*Linn.) R.Br.	Apocynaceae	Root, leaf, seed	The extract of the seed is given as well as crushed, paste applied on bitten area [62].
135	*Tamarindus indica* Linn.	Caesalpiniaceae	Seed, root	Seed, root paste is used for snake bite [58, 69]
136	*Tephrosia purpurea (*L.) Pers.	Fabaceae	Root	Root decoction along with black pepper is prepared and taken orally (7 d) [29, 56, 98].
137	*Terminalia arjuna* (DC) Wight & Arn.	Combretaceae	Bark	Bark paste applied externally (5 d) [29, 65].
138	*Tinospora cordifolia* (Willd) *Miers ex Hook f. &* Thoms	Menispermaceae	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].
139	*Tridax procumbens* Linn.	Asteraceae	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].
140	*Tylophora indica* (Burm. f.) Merr.	Asclepiadaceae	Leaf, root	Paste of leaf and root is mixed with equal amount of root paste of *Rauvolfia serpentina* and applied externally on the spot as well as leaf juice alone is also taken internally [65, 70].
141	*Uraria picta Desv.*	Fabaceae	Root, leaf	Leaf paste or root decoction is given twice daily [57, 98].
142	*Verbascum thapsus* Linn.	Scrophulariaceae	Whole plant	The infusion of whole plant is given [59, 77].
143	*Viscum articulatum* Burm.f	Santalaceae	Whole plant	The infusion of whole plant is given [29, 59, 77].
144	*Vitex negundo* Linn.	Verbenaceae	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].
145	*Vitex penduncularis Wall*	Verbenaceae	Bark	Decoction of the bark is given orally at 30-min interval [84].
146	*Withania somnifera* (L.)Dunal	Solanaceae	Root	Root paste is applied on the bitten area [29, 59,77].

Currently, the only accepted treatment for snakebite envenomation involves intravenous administration of conventional serum therapy aims to bind and neutralize the snake venom proteins. It is a fact that the antivenom allows the body to try to reverse the damage caused by the venom. However, it is known that such therapy can cause problems related to different antivenom characteristics, such as:

- Immediate hypersensitivity reaction to the alien immunoglobulins, including anaphylactic and pyrogenic reactions such as chills rigor, headache, and tachycardia.

Delayed antivenom reactions or serum sickness is observed after 8 to 12 days of treatment; these are characterized by cutaneous eruptions, fever, and allergies, among other effects

- Limited efficacy of antivenom therapy to protect the affected organ/s against immediate local tissue damage and low stability.
- Ineffectiveness of the antivenom due to significant geographic variation in the com-position of the venom.
- Antigenic reactivity due to the taxonomic diversity of the snakes.
- Improper use of the antivenom due to incorrect medical management, which contributes to a high incidence of adverse reactions, a low toxin is neutralizing potency, or both.

Review Findings: The present review is an attempt to compile information about traditional/ethno botanical 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 Table1, and plant parts used to treat snakebite **Fig. 1**.

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 a long history of medicinal plant utilization in traditional and tribal culture.

From the present review, a total of 145 species from 49 plant families have been used against snakebites, as reported by different ethnobotanical investigations mostly carried out during the past few years in India.

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 invest-tigation of drug discovery has been found to be one of the most reliable approaches toward the use of medicinal plants for the treatment of various conditions, and even now, there are still many more things for us to discover.

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