Indian Journal of Traditional Knowledge
Vol 21(3), July 2022, pp 605-615

Medicinal plants used in the treatment of snakebite and scorpion sting by the tribes of Shahapur and Jawhar forest division

Rasika Kolhe[a], Arun Gurav[a,*], Goli Penchala Prasad[a], Chinmay Rath[b], A K Mangal[b] & N Srikanth[b]

[a]Regional Ayurveda Institute For Fundamental Research, Kothrud, Pune 411 038 India

[b]Central Council for Research in Ayurvedic Sciences, Ministry of AYUSH, New Delhi 110 058 India

E-mail: gurav_am@yahoo.co.in

Received 27 January 2020; revised 01 February 2022

Many tribal communities living in the forest area deal with emergency cases of snakebite and scorpion sting by using traditional knowledge of medicinal plants. They possess traditional and authentic information gained from their elders about the antidote for poisonous bites. The present study was conducted in the tribal pockets of Shahapur and Jawhar forest division of Thane forest circle, Maharashtra, India. Data was collected through interviews with folk healers and informers by using a specially designed open and close-ended proforma. Collected data have been verified from the classical text of Ayurveda, books, and available articles. This medico-ethnobotanical survey reveals detailed information on 27 plants belonging to 19 families. A total of 17 and 10 claims have been reported for the treatment of snakebite and scorpion sting, respectively. Only 1 plant is claimed for veterinary use. Tribal communities have been using flower, fruit, pod, root, stem, stem bark, leaf, etc. as an antidote in the form of fresh juice, powder for internal use, and paste for local application. They also are administering medicine via., *Nasya* (nasal administration) and *Dhumapana* (smoke). The observation generated by this research creates scientific curiosity regarding further studies to evaluate the efficacy and develop antidotes from medicinal plants based on tribal knowledge.

Keywords: Ayurveda, Ethnomedicinal survey, Medicinal plants, Thane forest circle, Tribal

IPC Code: Int Cl.[22]: A61K 36/00, A61P 39/02

Tribal people mainly depend on plant sources to fulfill their daily needs, food source, and herbal remedies for illness and prevention of diseases. Despite the advent of modern medicine, tribal people are still dependent upon native plant sources for the management of even emergency conditions like snakebite and scorpion sting. Farmers, plantation workers, herdsmen, hunters, or field workers living in villages are mostly affected by snakebite and scorpion sting, particularly in the rainy and summer seasons[1]. Considering its severity and need for immediate management, tribal people use certain medicinal plants in the form of topical application and oral administration of juice, powder, and decoction. Medicinal plants are used as antidotes for snakebites and scorpion stings, which are administered either singly or in combination with other supportive plants. WHO reported that worldwide, every year 4.5–5.4 million people came across a snake bite. Amongst them, 1.8–2.7 million were bitten by the venomous snake, and 81,000–138,000 were reported dead[2]. In India, it is estimated that approximately 2.8 million people are bitten by snakes and 46,900 people die because of snakebite every year, and worldwide 250 deaths are recorded due to scorpion sting[3]. Therefore, there is an urgent need to develop an easily available antidote to prevent the prospective effect of envenoming. In such conditions, traditional knowledge and ethnomedicinal claims are the reliable approaches for their considerable potential. Ethnobotany is also the foundation of drug discovery in recent years.

Maharashtra has the second largest tribal population in the country, next only to Madhya Pradesh. There are as many as 49 tribes or tribal groups in Maharashtra. These tribal communities have precise knowledge about the identification and usage of medicinal plants based on their conventional wisdom and experience. Shahapur and Jawhar division of Thane forest circle of Maharashtra, India, is known for its dense forests and dwelling of various tribal communities. Previously, these areas also have

*Corresponding author

been surveyed for exploration of traditional knowledge about ethnic food, folk claims for combating various ailments, etc. But yet, proper documentation of conventional knowledge for the management of emergency conditions occurring due to snakebite and scorpion sting is lacking. Therefore, the present study was conducted in the Shahapur and Jawhar divisions of Maharashtra State of India. The present article is intended to prepare an inventory of various medicinal plants used for scorpion sting and snakebite by the tribals dwelling in the selected study area. This would contribute to existing medico-ethnobotanical knowledge and curative remedies found in the Shahapur and Jawhar forest divisions of Maharashtra.

The aim of the study was to analyze the patterns of use of the medicinal plant in the studied area and compare with references available in the text of Ayurveda and already recorded data to find out the novel claim.

Methodology

Survey area

A medico-ethnobotanical survey was conducted in tribal pockets of Shahapur and Jawhar forest division of Thane Forest Circle of Maharashtra (Fig. 1). The selected area falls under the Northern Western Ghats region, which is, rich in biodiversity with a moist deciduous type of forest ecosystem. Shahapur lies in the Western Ghats located at 19.45°N; 73.33°E and Jawhar lies between 19.92°N and 73.23°E. The selected area covers 65.02% and 34.59% tribal population in Shahapur and Jawhar areas, respectively. Thane forest circle covers about 3463 square km. the area under the forest which is about 37.10% of the total geographical area. Out of this, 20.62% of the forest area is in the Shahapur forest division and 9.99% in the Jawhar forest division. Shahapur and Jawhar forest divisions are situated merely 120-150 km from the cities like Thane and Nashik, still, the lifestyle, living standard, occupation economic status, and culture are entirely different. Jawhar forest division falls under the newly formed Palghar district, which was carved out of Thane district on 1st August 2014, whereas Shahapur forest division comes under the Thane district of Maharashtra.

Tribal communities in the study area

Tribal like Katkari, Kolams, MadiaGonds, Bhils, Gonds, Mahadev Kolis, Malhar Kolis, and Kokans reside in the surveyed areas among which Katkari (Kathodi), Madia Gond, and Kolam are the vulnerable tribal groups.

Materials and Methods

The present data is the outcome of an extensive survey of medico ethnobotanical studies conducted in four visits covering all the seasons during the year 2018-19 in the Shahapur and Jawhar division of Thane forest circle. The survey team consisting of Ayurvedic physicians and botanists visited tribal

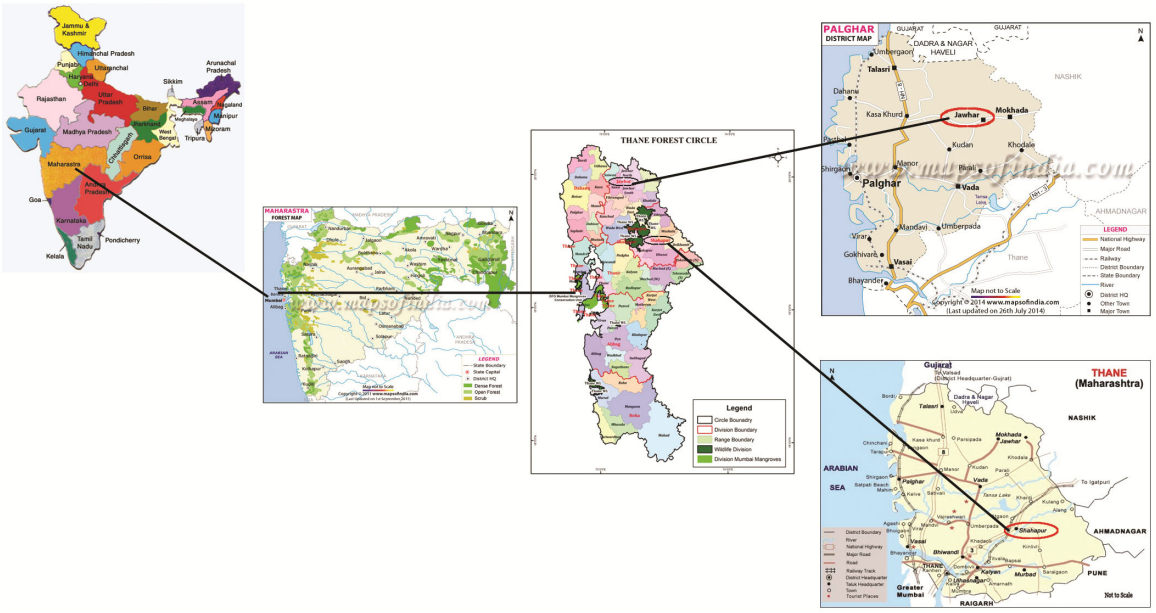

Fig. 1 — Surveyed area of Thane forest division of Maharashtra

pockets and pastoral villages of selected forest divisions after getting prior permission from the Forest Department of Thane Forest Circle. For the collection of authentic data, well-known folk healers (*Vaidya*/ *Bhagat*), forest guards, and elderly people having experience with the usage of medicinal plants were identified and interviewed by the survey team during the survey of 18 Villages (*Pada*), after explaining to them the aim of the study in local language followed by obtaining prior informed consent as per the CBD (Convention on Biological Diversity) guidelines. The survey team was accompanied by local persons and forest guards to translate some local words used by the tribals. Information about the usage of medicinal plants as a single drug or compound formulation was recorded. To determine the authenticity of the collected data during fieldwork, specific and reliable information was incorporated. Plant samples were collected from the field with the help of folk healers and forest guards to facilitate the identification of claimed plant species. Samples of raw drugs and compound formulations were also collected during the interview for further reference. The collected plant samples were identified with the help of Floras. Plant specimens were preserved in the form of herbarium specimens following the standard method. Voucher specimens were submitted to the Herbarium of the Regional Ayurveda Research Institute, Kothrud, Pune for future reference. Information regarding the local plant names, part(s) used, methods of preparation and application, dose, duration, indication, method of diagnosis, etc. along with the details of knowledge providers were recorded during the interview. The medicinal plant species used by the local communities of the study area were authenticated with the help of flora, published literature, and botanist of the institute. Collected data of medicinal plants was verified for Sanskrit and local names from websites like ENVIS-FRLHT(http://envis.frlht.org/bot), Biodiversity portal (http://indiabiodiversity.org). The Plant List (http://www.theplantlist.org) and International Plant Name Index (http://www.ipni.org) were used for the correct botanical name.

Quantitative analysis

The ethnobotanical data were analyzed using different quantitative indices including Use Value (UV) and Family Importance Value (FIV) and Informant Consensus Factor (ICF). Data were reported in numbers and percentages.

Use value (UV)

Use value (UV) determines the relative importance of the uses of plant species. It is calculated using the following formula[4,5]

$$UV_i = \Sigma U_i / N$$

Where,

U_i - the number of use reports cited by an informant for a particular plant species

N - the total number of informants interviewed during the survey.

Family Importance Value (FIV)

Family Importance Value (FIV) gives local importance to the families of wild species. It was calculated by calculating the percentage of informants mentioning a specific family[6].

$$FIV = (FC / N) \times 100$$

Where,

FC - the number of informants mentioning the family

N - the total number of informants who participated in the study.

Informant Consensus Factor (ICF)

ICF value specifies the informant's consensus on the medicinal plant utilization species and evaluates variability in the method of utilization against reported diseases. During calculating ICF values, diseases are broadly categorized into different categories. The maximum ICF value i.e., close to 1 indicates that popular species are employed by a huge number of local populations due to their authenticity regarding diseases. Nevertheless, a low ICF index close to 0 defines that the informants practice this species randomly to treat reported disease conditions[7]. ICF was calculated by using the formula-

$$ICF = (N_{ur}-N_t)/ (N_{ur} -1)$$

Where, ICF = informants consensus factor, N_{ur} = number of used citations, N_t = number of used species

Collected data were also revalidated from the classical textbook of Ayurveda, Ayurvedic Pharmacopoeia of India, Database of medicinal plants[8], Indian Materia Medicaand different search engines like Google Scholar, Pubmed to explore the novel claim reported during the study.

Results

This study represents the data collected during the survey of a total of 21 respondents belonging to 18 different villages. Amongst them, 12 respondents (57.14%) were of the age group of more than 50 years.

Except for 01, all the respondents were male. 03 respondents (14.28%) were illiterate, and farming was the major occupation.

Plant part(s) used, mode of preparation, and application

Amongst the 27 plant species, a maximum of 26.83% stem bark was used followed by leaf and root (24.39%). Details of the useful parts of medicinal plants are given in Figure 2.

Mode of administration

Amongst the collected claims, 43.75% of remedies were administered orally whereas 28.12% were applied topically to the affected area. Tribals also administer medicines in the form of *Nasya*- 12.5% (errhine- medication through nasal route), *Dhumapana*- 3.17% (inhalation-medicated smoking). Touch therapy like holding a twig of medicinal plant in hand or behind the ear is also practiced in the studied area. Details of the mode of administration are shown in Figure 3

Data analysis

Use Value (UV)

Data analysis of plant species used or narrated by the respondents is expressed as Use Value (UV). The highest use value (UV) 0.22 was recorded for *Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC., whereas the lowest used value was 0.04. Details of the use-value index are given in Table 1.

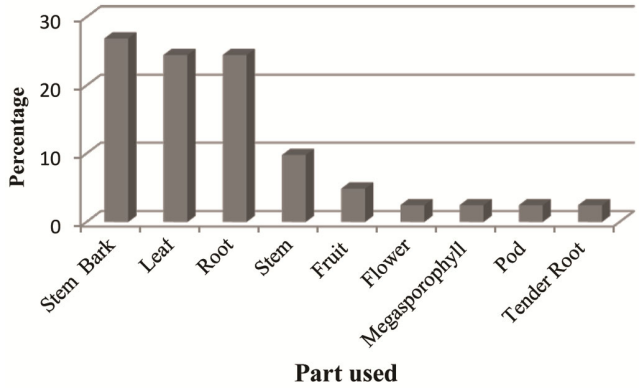

Fig. 2 — Medicinal plant parts used by the tribal

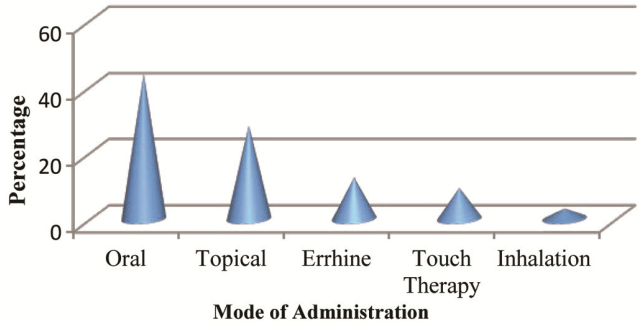

Fig. 3 — Percentage of the mode of administration of medicine

Family Importance Value (FIV)

This study revealed the use of 27 plant species belonging to the 21 genera and 21 families. Among these, the maximum of 27.27% of the utilization of plants was recorded in the Primulaceae family, utilized by a total of 6 informants. Lamiaceae was recorded with 4 utilization reports showing an 18.18% importance value. Families showing FIV values are shown in Table 2.

Informant Consensus Factor (ICF)

As per the recorded data, tribals suggested different plants as per different locations, therefore ICF value was not nearer to 1. The results of ICF are shown in Table 3

Table 1 — Use Value of the medicinal plants

Used value	Name of medicinal plant
0.22	*Embelia tsjeriam-cottam* (Roem. & Schult.) A.DC.
0.13	*Casearia graveolens* Dalzell; *Pogostemon benghalensis* (Burm.f.) Kuntze.
0.09	*Dregea volubilis* (L.f.) Benth. ex Hook.f., *Jatropha curcas* L., *Vitex negundo* L.
0.04	*Acacia caesia* (L.)Willd.; *Achyranthes aspera* L.; *Haldina cordifolia* (Roxb.) Ridsdale; *Anacardium occidentale* L.; *Bambusa arundinacea* Willd.; *Bauhinia racemosa* Lam.; *Butea monosperma* (Lam.) Taub.; *Cycas circinalis* L.; *Capparis divaricata* Lam.; *Clerodendrum serratum* (L.) Moon; *Cassine paniculata* (Wight & Arn.) Lobr.-Callen; *Holarrhena antidysenterica* (Roth) Wall. ex A.DC.; *Madhuca indica* J.F.Gmel.; *Ocimum tenuiflorum* L.; *Oroxylum indicum* (L.) Kurz; *Phyllanthus emblica* L.; *Plumeria obtusa* L.; *Sapindus emarginatus* Vahl.; *Solanum virginianum* L.; *Tinospora cordifolia* (Willd.) Miers; *Ziziphus xylopyrus* (Retz.) Willd.

Table 2 — Family Importance Value

Family Importance Value	Name of the Family
27.27	Primulaceae
18.18	Lamiaceae
13.63	Apocynaceae, Euporbiaceae , Salicaceae, Verbenaceae
9.09	Fabaceae
4.54	Amaranthaceae, Anacardiaceae , Bignoniaceae, Capparaceae, Celastraceae , Cycadaceae, Flacourtiaceae, Menispermaceae, Mimosaceae, Poaceae, Rhamnaceae, Rubiaceae, Sapindaceae, Solanaceae.

Medicinal plants reported for their uses in snakebite poisoning are presented in Tables 4 and 5. Table 4 describes the single plants used in the treatment of snakebite poisoning whereas Table 5 describes the compound formulations. Medicinal plants used in scorpion stings are presented in Table 6. After critical analysis of collected data, it was observed that a total of 18 claims were recorded for the management of snakebite amongst them, a total of 14 claims of single medicinal plants have been reported in snake bite by using 10 medicinal plants whereas 4 compound formulations have been reported by using 11 medicinal plants. In the treatment of scorpion stings, a total of 9 medicinal plants have been used in 10 ethnomedicinal claims.

Discussion

Snakebite and scorpion stings are medical emergencies, mostly faced in forest areas, due to a lack of medical facilities and antivenin supply. Tribal

Table 3 — Showing Informant consensus factor of specified disease category during the survey

Category of diseases	N_{ur}	N_t	N_{ur}-N_t	N_{ur}-1	ICF
Snake bite	23	21	2	22	0.09
Scorpion sting	10	9	1	9	0.11

Table 4 — Medicinal plants used in the treatment of snakebite

Sr. No.	Name of the Plant			Part used	Mode of administration
	Local name	Sanskrit name	Botanical Name, family, and Voucher Specimen Number (VSN)		
			Sakharam Ganapat Mukane - (75-M), Kalambvihiri (Jawhar), Farmer		
	Ambat Tingali/ Phatangai	*Vidang bhed*	*Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC. (Primulaceae) (VSN- 14599)	Root	Approximately 30 mL of juice extracted from the freshly collected root is to be administered orally to the patient suffering from Snake poisoning immediately, once a day.
			Govinda Sonu Chaudhary (52-M) Umbardacha Pada, Farmer		
	Ambat Tingali/ Phatangai	*Vidang bhed*	*Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC. (Primulaceae) (VSN- 14599)	Root	Two drops of fresh juice of roots is to be administered in each nostril of the patient instantly after the snake bite and apply some juice over the forehead. Repeat the same procedure after 12 h, if the symptoms remain to persist.
			Parashuram Pavar (50-M) Ghaypatpada, Farmer		
	Ambat Tingali/ Phatangai	*Vidang bhed*	*Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC. (Primulaceae) (VSN- 14599)	Stem bark	Fresh juice is extracted from the freshly collected stem and administered 2 drops in the nostril of the sufferer of snake bite.
			Lasha Ragho Mahakal (60-M) Vaki Palasunpada, Farmer		
	Bharangi	Bharangi	*Clerodendrum serratum* (L.) Moon (Verbenaceae) (VSN- 14106)	Root	A single dose of 2-3 g root powder is given to the patient instantaneously after a snake bite
			Ramesh Dhakal Bobe (55-M) Kharonda/ Kuturvihir- Farmer		
	Chander Jyot	*Dravanti*	*Jatropha curcas* L. (Euphorbiaceae) (VSN- 14070)	Stem Bark	To treat the Snake poisoning of deadly poisonous Manyar (*Bungarus caeruleus*) 30 mL juice extracted from the stem bark is administered orally to the victim of snake poisoning.
			Malu Hambira (57-M) Gandulvadi, Retired forest guard		
	Chander Jyot	*Dravanti*	*Jatropha curcas* L. (Euphorbiaceae) (VSN- 14070)	Stem Bark	Extract the juice of a 3-4 inch long piece of stem bark by crushing and adding a sufficient quantity of water. Administer immediately to the patient.

(*Contd*.)

Table 4 — Medicinal plants used in the treatment of snakebite (*Contd*.)

Sr. No.	Name of the Plant			Part used	Mode of administration
	Local name	Sanskrit name	Botanical Name, family, and Voucher Specimen Number (VSN)		
			Ramesh Balu Bhusara- (52-M) Kharonda, Forest guard		
	Chander Jyot	*Dravanti*	*Jatropha curcas* L. (Euphorbiaceae) (VSN- 14070)	Tender Root	Crush 3-4 tender roots 6-7 inches long and add a glass of hot water and filter it. Administer 100 mL orally immediately after snake bite
			Gopal Bhoye (56-M) Dhobipada, Forest labour		
	Chilhar	*Valiikhadir*	*Acacia caesia* (L.) Willd (Fabaceae) (VSN- 14060)	Stem Bark	Fresh juice from freshly collected stem bark is administered to the animal (Cow/Buffalo) in a dose of 1 liter.
			Dattatray Antu Gharat (47-M) Golbhan, Folkhealer		
	Ekot/ Harandodi/ Kardodi	Hemajivanti	*Dregea volubilis* (L.f.) Benth. ex Hook. f. (Asclepiadaceae) (VSN- 763)	Stem Bark	Freshly collected juice extracted from stem bark is given to the patient with snakebite, once a day, immediately after biting in a dose of 30 mL.
			Rajaram DarmaVangad (43-M), Kasatwadi, Folkhealer		
	Ekot/Harandodi/ Kardodi	*Hemajivanti*	*Dregea volubilis* (L.f.) Benth. ex Hook. f. (Asclepiadaceae) (VSN- 763)	Leaf	Apply a fine paste of leaf on the site of snakebite to reduce the swelling of the affected part
			GovindaSonu Chaudhary (52-M) Umbardacha Pada, Folkhealer		
	Gorphada	-	*Cycas circinalis* L. (Cycadaceae) (VSN- 14701)	Megasporophyll	Approximately 1 g fine powder of Megasporophyll mixed in 20-30 mL water is given orally, once in a day instantly after a snake bite.
			Gopal Bhoye (56-M) Dhobipada, Forest labour and Ramesh Balu Bhusara- (52-M) Kharonda, Forest labour		
	Kiramira	*Chilhaka*	*Casearia graveolens* Dalzell (Flacourtiaceae)(VSN- 14310)	Stem	A tender stick after removing leaves is kept in the hands or behind the ear of the victim of snakebite. It is claimed as the primary treatment which prevents the poisonous effect for up to 3-4 h.
			Parashuram Pavar (50-M) Ghaypatpada, Farmer		
	Kuda	*Kutaj*	*Holarrhena antidysenterica* (Roth) Wall. ex A. DC. (Apocynaceae) (VSN- 14082)	Stem Bark	Juice prepared from freshly collected stem bark is administered orally in a dose of 30 mL. It is claimed that within 20–25 min, the patient expels poison through vomiting.
			Bhaskar Dagala (50-M) Medhi Savarai, Watchman		
	Phangali	Pangala	*Pogostemon benghalensis* (Burm.f.) Kuntze (Lamiaceae) (VSN- 14255)	Root	Juice prepared by pounding freshly collected root in water is administered orally in a single dose of 30 mL.
			Dattatray Antu Gharat (47-M), Golbhan, Folkhealer		
	Chapha	-	*Plumeria obtusa* L. (Apocynaceae) (VSN- 108)	Pod	Make a fine paste of 1-2 inch piece of the pod and mix one teaspoon of honey. Administered 7-10 mL of this dose once a day.

* Bracket – indicating age and gender

Table 5 — Compound formulation for the treatment of Snakebite

Sr. No	Name of the Plant			Part used	Mode of administration
	Local name	Sanskrit name	Botanical Name, family, and Voucher Specimen Number (VSN)		
			Raju Mahale (45-M) KalidhondJawhar, Folkhealer		
	Gulvel	Guduchi	*Tinospora cordifolia* (Willd.) Miers (Menispermiaceae) (VSN- 14207)	Stem	A mixture prepared from three ingredients, 1 g powder of each ingredient is administered orally once a day.
	Ritha	Arishtaka	*Sapindus emarginatus* Vahl (Sapindaceae) (VSN- 14252)	Fruit	
	Ambat-Tingali	Vidangbheda	*Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC.- (Primulaceae) (VSN- 14599)	Root	
			Raju Bhima Fadavale (65-M) Kharonda, Labour		
	Hedu	Haridru/ Dharakadamba	*Haldina cordifolia* (Roxb.) Ridsdale (Rubiaceae) (VSN- 14176)	Leaf	Juice extracted from freshly collected ingredients is mixed in equal quantities and 2 nasal drops are administered for snake poisoning.
	Apata	Ashmantaka/Shweta kanchanara	*Bauhinia racemosa* Lam. (Fabaceae) (VSN- 14617)	Leaf	
	Bamboo	Bamboo	*Bambusa arundinacea* Willd. (Poaceae) (VSN- 14356)	Leaf	
	Ambat-Tingali	Vidangbheda	*Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC.- (Primulaceae) (VSN- 14599)	Root	
			Chandu Mahadu Baraf (44-M), Kogade, Watchman		
	Alan	-	*Cassine paniculata* (Wight &Arn.) Lobr.-Callen (Celastraceae) (VSN- 14334)	Stem Bark	Administered 30-50 mL decoction prepared from an equal quantity of stem bark of three ingredients.
	Tetu	*Shyonak*	*Oroxylum indicum* (L.) Kurz (Bignoniaceae) (VSN- 14268)	Stem Bark	
	Avala	*Amalaki*	*Phyllanthus emblica* L. (Euphorbiaceae) (VSN- 14049)	Stem Bark	
			Kanhu Kama Songal, (65-M), Tokarkhand, Washala, Folkhealer		
	Waghoti	*Himstra*	*Capparis divaricate* Lam. (Capparaceae) (VSN- 14333)	Stem Bark	The physician should bite a piece of Stem of Waghoti and take one ripe fruit of Ringani/Kantakari. Extract the juice of the above ingredient by adding water and administered orally (approx.5 mL)
	Ringani	*Kantakari*	*Solanum virginianum* L. (Solanaceae) (VSN- 2368)	Fruit	
			Kashinath Lakshman Kokera (45-M), Jambha, Folkhealer		
	Phatangali/aambatbibali	*Vidanga*	*Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC. (Primulaceae) (VSN- 14599)	Root	Extract the juice of freshly collected roots of Phatangali and 2-3 leaves of Vanai (Nirgundi). Instill 2 drops in the nostrils
	Vanaai	*Nirgundi*	*Vitex negundo* L. (Verbenaceae) (VSN- 14043)	Leaf	

* Bracket – indicating age and gender

people and folk healers depend on medicinal plants and natural sources available in their locality to overcome these medical emergencies occurring due to snakebite and scorpion stings. Several plants are being used by tribals, but only a few of them have been scientifically validated. Assessment of the medicinal plants for their reported anti-venom properties in laboratories and correlating them with ethnopharmacological studies is the need of the hour to give safe and cost-effective treatment. Therefore, extensive ethnomedicinal surveys are being conducted in different regions of India, and it was observed that the same claim is also reported by different tribal groups of India. In the present investigation, medicinal plants reported for the treatment of snakebite and scorpion sting by the tribals of Shahapur and Jawhar region of Thane forest circle Maharashtra has been presented.

In the present study, a total of 14 ethnomedicinal claims of single drugs and 4 claims of compound formulation have been reported as an antidote to snakebite whereas, for the treatment of scorpion sting,

Table 6 — Medicinal plants used for the treatment of Scorpion sting.

Sr. No.	Name of the Plant			Part used	Mode of administration
	Local name	Sanskrit name	Botanical Name, family, and Voucher Specimen Number (VSN)		
			Bhimsing Vasavi (26-M), Latifvadi, Forest guard		
	Aghada	*Apamarga*	*Achyranthes aspera* L. (Amaranthaceae) (VSN- 14055)	Root	Paste (Kalka) of freshly collected root on the sting site is applied instantly and kept for half an hour.
			Lahu Laghu Vatas (55-M), Vaki, Folkhealer		
	Bora	*Badar*	*Ziziphus xylopyrus* (Retz.) Willd. (Rhamnaceae) (VSN- 14221)	Leaf	The juice obtained by crushing fresh leaf is applied locally on-site of scorpion sting and kept for a day
			Bhaskar Dagala (50-M) Medhi Savarai, Watchman		
	Kaju	*Kajutak*	*Anacardium occidentale* L (Anacardiaceae) (VSN- 14259)	Stem Bark	Paste prepared by chewing freshly collected stem bark (Approximately 1 inch) is applied locally on the sting site
			Chandu Mahadu Baraf (44-M), Kogade, Watchman		
	Kirmira	*Chilhaka*	*Casearia graveolens* Dalzell (Flacourtiaceae) (VSN- 14310)	Leaf	The cigar is prepared by filling fine powder of dried leaf in an intact leaf of the same plant. It is used as medicated smoke puffed up into the nostrils 7-8 times
			Raju Mahale (45-M) Kalidhond Jawhar, Folkhealer		
	Moha	*Madhuka*	*Madhuca indica* J.F.Gmel. (Sapotaceae) (VSN- 14124)	Flower	Paste prepared from the freshly collected flower is applied to the sting site.
			Nirmala Bharasat (35-M) Vaki Palasunpada, Forest guard		
	Phanagali	*Phangala*	*Pogostemon benghalensis* (Burm.f.) Kuntze (Lamiaceae) (VSN- 14255)	Leaf	Freshly collected leaves are crushed and paste is applied to the site of the scorpion sting.
			Yadunath Baraf (26-M) Kuturvihir, Forest guard		
	Phanagali	*Phangala*	*Pogostemon benghalensis* (Burm.f.) Kuntze (Lamiaceae) (VSN- 14255)	Root	Paste of freshly collected root is applied locally.
			Jagan Pandu Chaudhari (55-M) Vaki, Palasunpada, Forest labour		
	Vanai	*Nirgundi*	*Vitex negundo* L. (Verbenaceae) (VSN- 14043)	Leaf	A fine paste of fresh leaves is applied to the sting site
			Antu Gharat, (65-M), Golbhan, Folkhealer		
	Tulasi	*Tulasi*	*Ocimum tenuiflorum* L. (Lamiaceae) (VSN- 2680)	Leaf	Folk-healer take a handful of fresh Tulasi leaves and ask the patient to look at the leaves and chant Mantras
			Sakharu Roma Amale (31-M), Pothala, Vashala, Watchman		
	Palas	*Palash*	*Butea monosperma* (Lam.) Taub. (Fabaceae)(VSN- 14185)	Root	A fine paste of the freshly collected root is applied to the sting site

* Bracket – indicating age and gender

a total of 10 folk claims have been reported. Amongst the collected data, 10 medicinal plants have been reported as a single drug for internal use in the treatment of snake poisoning including one plant for the veterinary claim. In the compound formulations, 04 formulations have been reported from the surveyed area consisting of 11 plants.

The most common dosage was administered in the form of paste prepared by fresh medicinal plants and applied on the affected site in the management of scorpion stings, suggesting the effect of the drug by topical application.

Analysis of data shows that tribal people follow sustainable harvesting and mostly use stem bark and

prefer to use native plants. *Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC.is extensively used in snake bite treatment. *Nasya* (Administration of drugs by the route of nasal cavity) of root and stem is administered whereas juice of the root is administered orally in single as well as compound formulation. Its root and stem have proven antioxidant properties[9,10] and *Nasya* (Errhine) of the root is also already reported[11], so further studies may be conducted to evaluate and compare the anti-snake venom activity of a different part of *Embelia tsjeriam-cottam* (Roem. & Schult.) A. DC. The only veterinary claim of *Acacia caesia* (L.) Willd. is reported with the anti-snake venom property of the root[12], whereas in the surveyed area the use of stem bark is in practice.

In snakebite treatment, a majority of medicine is administered orally, whereas, leaf of *Dregea volubilis* (L.f.) Benth. ex Hook.f. is applied locally. Effect of *Casearia graveolens* Dalzell plant by putting its piece of the tender stem in hands or behind the ear was narrated by 4 folk healers of surveyed area[13], it is also being practiced to chew the stem by tribals of Nashik District of Maharashtra of India[14]. This claim is being used as the primary treatment of snakebite as well as for the prevention of snakebite; scientific investigations are yet to be carried out. Local tribes of Kotiahills, Andhra Pradesh also use *Jatropha curcas* L. as an antidote for snakebite and it has been scientifically validated also[15]. Studies have been reported for the leaf and the root of *Clerodendrum serratum* (L.) Moon for the anti-snake venom in the venom of *B. caeruleus* and *D. Russelii*[16,17]. Whereas, the root is used by the folk healers of Uttarakhand and Maharashtra state of India[18] and also reported in Indian Materia Medica. Therefore, the root may be evaluated further for certain compounds that inhibit the toxins. Use of stem bark, root, and the leaf of *Dregea volubilis* (L.f.) Benth. ex Hook.f. is also indicated in the treatment of snakebite[19,20] but the local application of a paste of its leaf is the new finding of the surveyed area. Cycus gum has been reported with antidote activity for snake poisoning[21], instead of the whole megasporophyll as reported in the present study. Consumption of pod of *Plumaria* species is reported with Cow milk, unlike the reported claim[22]. Use of *Kutaj Holarrhena pubescens* Wall. ex G.Don stem bark[23,24,28] and the root of *Pogostemon benghalensis* (Burm.f.) Kuntze[25] in snake poising is well documented. Use of *Tinospora cordifolia* (Willd.) Miers[26,27], *Bauhinia racemosa* Lam.[26], *Oroxylum indicum* (L.) Kurz,[28] *Phyllanthus emblica* L.[29,30] which are used in the compound formulation are also well documented in published literature, but compound formulations reported in the present study urgently need a detailed scientific study to evaluate their efficacy.

The efficacy of plants against scorpion sting may be associated with the presence of various phytochemicals, whilst symptomatic relief may be due to the anti-inflammatory, anti-pruritic, and analgesic effects of medicinal plants[31]. In the available literature, the use of the root of *Achyranthes aspera* L.[32,33] is also proven for its anti-inflammatory activity[34], seed oil, and leaves of *Madhuca indica* J.F.Gmel. are also reported for the same ethnomedicinal claim[35,36] and also proven for its analgesic and anti-inflammatory activities[37], the fresh root of *Pogostemon benghalensis* (Burm.f.) Kuntzehasbeen reported the same activity[38] and fresh leaves have shown analgesic, anti-inflammatory activities[39], the analgesic potential of the leaf of *Ziziphus xylopyrus* (Retz.) Willd. has also been proved[40] and reported in the management of scorpion sting[41], leaf of *Vitex negundo* L.are documented for its use in scorpion sting and is a well-known analgesic and anti-inflammatory drug[8,42]. Leaves of *Ocimum sanctum* L. are used in the treatment of scorpion bites[43] in other parts of India and are also mentioned in the text of Ayurevda[44]. Anti-inflammatory, antioxidant, and cardioprotective, properties of leaves of *O. sanctum* are proven scientifically[45].

For the management of scorpion sting, none of the plants is administered internally. Leaves of *Tulasi* are advised to be held in hand. Chanting of *Mantras* is also advised to pacify the symptoms of the scorpion stings while using leaves of *Tulasi* and the root of *Palash.* Tribals believe in touch therapy and the efficacy of chanting Mantras, though it is not well-proven scientifically. Classical text of Ayurveda also advised chanting of Mantra to nullify the poison.

In the treatment of scorpion sting, *Casearia graveolens* Dalzell has been advised to be used in the form of *Dhumpana*. (Medicated smoke is puffed up into the nostrils). Use of stem bark of *Anacardium occidentale* L. in a specific way of application, the flower of *Madhuca indica* J.F.Gmel. and root of *Butea monosperma* (Lam.) Taub. is found to be novel in this study. Amongst the reported plants, *Plumeria alba* L. and *Cycas circinalis* L. are not reported in the text of Ayurveda.

It was also observed that many of the well-known plants used in the Ayurveda are known by different local names in different localities which led to the difficulty in identifying the plant species. For example, *Nirgudi* is known as *Vanai* in the local language. Other than this, a few other challenges were also faced during the current survey study. None of the folk healers or Vaidya have documented the number of patients treated by them. So the exact data of treated patients was not concrete. There was not much clarity about the exact quantity of ingredients and the method of preparation was not uniform. Few of the local "*Vaidu*" or village doctors were not comfortable narrating the medicinal significance of various plant species used in the treatment of diseases. The survey team encountered the stubborn approach of some folk healers; such an approach of limited sharing of information with the next generation is the major problem leading to the potential loss of valuable knowledge and experiences.

Therefore, it is high time to make folk healers convinced and get them involved in more such studies to preserve their traditional knowledge. Further scientific validation and preclinical trials of these reported claims may be carried out to unfold the hidden values and could incorporate into Ayurvedic pharmacopeias after scientific validation. Such type of knowledge of traditional information reveals the benefits of plants for mankind. Information and revalidation of such traditional knowledge will encourage the conservation of this knowledge of medicinal plants.

Conclusion

Based on ancient knowledge and field experience, tribal people have authentic knowledge to protect the people from the hazardous effect of snakebite and scorpion sting. Many plants have been already reported in the previous ethnomedicinal survey studies and validated through scientific studies exploring the importance of hidden knowledge of tribal people. The present study revealed the ethnobotanical knowledge of tribal communities living in the Thane forest circle. This observation generates scientific curiosity regarding further studies of these plants for their chemical contents, mode of action, safety, efficacy as well as conservation, and sustainable utilization of plant sources.

Acknowledgments

The authors are thankful to Director General, CCRAS, New Delhi for his valuable guidance and financial support. The authors also express their gratitude to CCF Thane Forest Circle and DCF Jawhar and Shahapur area, for providing administrative permission, cooperation, and support for the survey. All the informants of the survey study are cordially acknowledged for their valuable cooperation throughout the survey study.

Conflict of Interest

All the authors declare that they have no conflict of interest

Authors' Contributions

RK, AG, and GP conducted the field study and collected and analyzed the data. CR, AM, and NS gave technical and administrative support. All authors read and approved the manuscript.

References

1 Warrell D A, WHO/SEARO Guidelines for the clinical management of snakebite in the Southeast Asian Region, *Southeast Asian Southeast Asian J Trop Med Public Health*, (30) (1) (1999) 85.

2 Alcoba G, *et al*., Novel transdisciplinary methodology for cross-sectional analysis of snakebite epidemiology at national scale, *PLoS Negl Trop Dis*, (15.2) (2021) e0009023.

3 Available on https://www.who.int/snakebites/epidemiology/en/ Kenya, Snakebite Challenges In. "Hai Snakebite Project In Kenya." (2019).

4 Phillips O & Gentry A H, The useful plants of Tambopata.Peru: Statistical hypotheses\test with new quantitative technique, *Econ Bot*, 47 (1993)15-32

5 Amjad M S, Zahoor U, Bussmann R W, Altaf M, Gardazi S M *et al*., Ethnobotanical survey of the medicinal flora of Harighal, Azad Jammu & Kashmir, Pakistan, *J Ethnobiol Ethnomed*, (2020) (1) 1-28.

6 Vitalinin S, Iriti M, Puricelli C, Ciuchi D, Segale A, *et al*., Traditional Knowledge on medicinal and food plants used in Val San Giacomo, *J Ethnopharmacol,* 145 (2) (2013) 517-529.

7 Canales M, Hernández T, Caballero J, *et al.,* Informant consensus factor and antibacterial activity of the medicinal plants used by the people of San Rafael Coxcatlán, Puebla, México. *J Ethnopharmacol*, 97 (3) (2005) 429-439

8 Sharma P C, Yelne M B & Dennis T J, Database on Medicinal Plants used in Ayurveda Vol. 3, (CCRAS Publication, New Delhi) 2001

9 Thu Z M, Aye M M, Aung H T, Sein M M, Vidari G, A Review of Common Medicinal Plants in Chin State, Myanmar, *Nat Prod Commu*, (2018) (11) 1934578-1801301134.

10 Mohapatra M & Basak U C, Quantitization of antioxidant potency in various plant parts of *Embelia tsjeriam-cottam*, an important medicinal plant, *J Med Plants Stud,* 5 (3) (2017) 241-249.

11 Natarajan B & Paulsen B S, An Ethnopharmacological study from Thane District, Maharashtra, India: Traditional

knowledge compared with modern biological science, *Pharm Biol,* 38 (2) (2000) 139-151.

12 Bharath Kumar R, & Suryanarayana B, Promising antidote plant species from the tribals of Sriharikota Island, Andhra Pradesh, *Life Sci Leafl,* 19 (2011) 769-779.

13 Lele Y, Thorve B, Tomar S & Parasnis A, Traditional uses of the wild plants by the tribal communities of Jawhar, Palghar, Maharashtra, India, *Int J Botany Res,* 6 (7) (2017)19-22.

14 Patil M V& Patil D A, Ethnomedicinal practices of Nasik district, Maharastra, *Indian J Tradit Know*, 4 (3) (2005) 287-290.

15 Reddi K V N, Rathnakar, Sivarathri SR, Kumara N, *et al*., *In vitro* anti-venom potential of various venom potential of various Jatropha extracts on extracts on neutralizing cytotoxic effect induced by phospholipase A2 of crude of crude venom from Indian cobra (Najanaja), *Bangladesh J Pharmacol*, (9) (2014) 22-28.

16 Vasudev S, More S S, Santhekadur G A & More V S, Anti-snake venom potential of *Clerodendrum serratum* extracts on Bungarus caeruleus and Daboia russelii venom, *Bangladesh J Pharmacol*, 13 (2) (2018) 187-191.

17 Richard L, Punitha I S R, Rajendran K Arun S, *et.al.,* Preliminary study on the anti-snake venom activity of alcoholic root extract of *Clerodendrum viscosum* (Vent.) in *Najanaja* venom, *Nat Prod Sci,* 12 (3) (2006) 153-156.

18 Kala C P, Herbal treatment for snakebite in the Uttarakhand state of India, *Indian J Nat Prod Resour,* 6 (1) (2015) 56-61.

19 Kanneboyena O, Suthari S & Raju V S, Ethnomedicinal knowledge of inhabitants from Gundlabrahmeswaram Wildlife Sanctuary (Eastern Ghats) Andhra Pradesh India, *Am J Ethnomed*, 2 (6) (2015) 333-346.

20 Sekhar J & Penchala G P, Ethnic information on treatment for snakebite in Kadapa district of Andhra Pradesh, *Life Sci Leafl,* (12) (2011) 368-375.

21 Kumar A, Botany for Degree Gymnosperm (Multicolor Edition), (S. Chand Publishing, New Delhi), 2006, p. 230.

22 Lakshminarayana V, Rao G N, Ethnoveterinary practices in Northcoastal Districts of Andhra Pradesh, India, *J Nat Remedies*, 13 (2) (2013) 109-117.

23 Jain S K & Srivastava S, Traditional use of some Indian plants among islanders of Indian Ocean, *Indian J Tradit Know*, 4 (4) (2005) 345-357.

24 Singh A K, Raghubanshi A S, & Singh J S, Medical ethnobotany of the tribals of Sonaghati of Sonbhadra district, Uttar Pradesh, India, *J Ethnopharmacol*, 81 (1) (2002) 31-41.

25 Shigwan A V, Khade A B, Hatpakki B C & Ghurghure S M, A Comprehensive Review on *Pogostemon benghalensis* (Burm. F.) O, Kuntze, *J Pharmacogn Phytochem*, 1 (1) (2013) 10-15.

26 Dharmadasa R M, Akalanka G C, Muthukumarana P R M & Wijesekara R G S, Ethnopharmacological survey on medicinal plants used in snakebite treatments in Western and Sabaragamuwa provinces in Sri Lanka, *J Ethnopharmacol*, (179) (2016) 110-127.

27 Penchala G P, Sudarsanam G, Pushpan R & Prasad G P, Herbal remedies for snake bites in ethnic practices of Chittoor District, Andhra Pradesh, *Anc Sci Life*, 29 (4) (2010) 13-16.

28 Kadir M F, Karmoker J R, Alam M R, Jahan S R, Mahbub S, *et al*., Ethnopharmacological survey of medicinal plants used by traditional healers and indigenous people in Chittagong Hill Tracts, Bangladesh, for the treatment of snakebite, *Evid Based Complement Alternat Med*, (2015) 1-23.

29 Samy R P, Thwin M M, Gopalakrishnakone P & Ignacimuthu S, Ethnobotanical survey of folk plants for the treatment of snakebites in Southern part of Tamilnadu, India, *J Ethnopharmacol*, 115 (2) (2008) 302-312.

30 Hasan M N, Azam M N K, Ahmed M N & Hirashima A, A randomized ethnomedicinal survey of snakebite treatment in southwestern parts of Bangladesh, *J Tradit Complement Med*, 6 (4) (2016) 337-342.

31 Dupre G, New synthesis on plants used to treat scorpion stings, *Am J PharmTech Res*, 3 (1) (2013) 175-225.

32 Jain S K, Dictionary of Indian folk medicine and ethnobotany, (Deep Publications, New Delhi, India), 1991.

33 Anonymous, Database on Medicinal Plants used in Ayurveda Vol 1, (CCRAS Publication, New Delhi), 2005, p. 11.

34 Kumar S V, Sankar P & Varatharajan R, Anti-infammatory activity of roots of *Achyranthes aspera*, *Pharm Biol*, 47 (10) (2009) 973-975.

35 Kala C P, Aboriginal uses and management of ethnobotanical species in deciduous forests of Chhattisgarh state in India, *J Ethnobiol Ethnomed*, 5 (20) (2009) 1-9.

36 Yadaiah G, Oshi P J & Oza B, Traditional knowledge of wild medicinal plants of Baria forest division, Dahod District, Gujrat State, *Indian Forest,* 137 (7) (2011) 814-821.

37 Shekhawat N & Vijayvergia R, Investigation of Anti-Inflammatory, Analgesic and Antipyretic Properties of Madhuca Indica Gmel, *Eur J Inflamm*, 8 (3) (2010) 165-171.

38 Anonymous, Medicinal and Aromatic Plants of India, (Council of Scientific and Industrial Directorate, Jammu-Tawi, India), 1986.

39 Aryal S, Adhikari B, Panthi K, Aryal P & Mallik S K, Antipyretic, antinociceptive, and anti-inflammatory activities from *Pogostemon benghalensis* leaf extract in experimental Wister rats, *Medicines* (*Basel*), 6 (4) (2019) 96.

40 Agrawal S & Shivhare Y, Formulation and evaluation of herbal cream containing extract of *Zyziphus jujube* leaves for analgesic potentical, *Res J Pharm Dosage Forms Technol,* 4 (6) (2012) 320-323

41 Dolui A K, Sharma H K, Breen M T & Lalhriatpuii T C, Folk herbal remedies from Meghalaya, *Indian J Tradit Know,* 3 (4) (2004) 358-364.

42 Dharmasiri M G, Jayakody J R A C, Galhena G, Liyanage S S P, *et al*., Anti-inflammatory and analgesic activities of mature fresh leaves of *Vitex negundo, J Ethnopharmacol,* 87 (2-3) (2003) 199-206

43 Prajapati N D, Purohit S S, Sharma A K & Kumar T A, Hand book of medicinal plant. (Agrobios, India), 2003; 367.

44 Anonymous, Sushrut Samhita, Kalpasthana, 68th chapter, 8th Shlok, 2000

45 Ediriweera E R H S S, Ratnasooriya W D & Kamathewatta K W M D, Ethnomedicinal uses in scorpion poisoning (*gonusuvisha*) in Sri Lankan traditional medicine, *Int J Ayurveda Res*, 6 (7) (2018) 29-43.