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# Ethnobotanical Investigation of Medicinal Plants used as antidote in Natham Taluk, Dindigul, Tamil Nadu, India

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## Abstract

The current study identified the ethnomedicinal plants utilised as antidotes by the people of Natham Taluk in Dindigul District, Tamil Nadu, India. An extensive ethnobotanical survey yielded documentation of 62 plants from 37 families and 55 genus used as antidotes and classified into seven categories. The most prominent families were Fabaceae (7%), Amaranthaceae (7%), and Acanthaceae (7%). Herbs were the most commonly utilised plant form in ethnomedicine formulations (55%). The majority of plant drugs were made from leaves (38%). The study area made extensive use of paste (44%) and oral (57%) delivery of plant-based medicines. Quantitative indices such as use value (UV), informant consensus factor (ICF), and Jaccard Index (JI) were computed. The locally important species recorded were *Opuntia stricta* (Haw.) Haw (UV= 1.45), *Argemone mexicana* L. (UV= 1.21), *Tylophora indica* (Burm. f.) Merr. (UV = 1), and *Pergularia daemia* (Forssk.) Chiov. (UV = 1). Higher ICF scores suggest that traditional knowledge in the studied area is being shared properly. This documentation aids in the discovery of region-specific anti-venoms required for the development of novel venom neutralising medications.

***Key words*:** *Opuntia stricta, Argemone mexicana, Tylophora indica, Pergularia daemia,* Ethnomedicine, Antidote

Snakebites are a major medical concern in both underdeveloped and developed countries [1-2]. Snakebite is a major medical, social, and economic issue in many parts of the world, particularly in tropical and subtropical regions. Snake envenomation is one of the major causes of death around the world, and the World Health Organization has classified it as a neglected tropical illness. According to the World Health Organization, 4.5-5.4 million people are bitten by snakes each year. 1.8-2.7 million were bitten by the venomous snake, and 81,000-138,000 died as a result. Every year, nearly 2.8 million people in India are bitten by snakes, and 46,900 people die as a result of snakebite, while 250 people die worldwide as a result of scorpion sting [3]. Traditional herbal medication for snakebite treatment is widely available in rural regions of tropical countries. People rely heavily on plant sources for their daily necessities, food, and herbal treatments for illness and disease prevention. Despite modernization, many rural and aboriginal communities of developing countries are still dependent on natural plant sources even for their health care because of its availability and affordability. Anti-venomous capabilities of medicinal plants have been tested in laboratories and linked to ethnopharmacological investigations [4]. Several plant extracts and their active compounds, isolated inhibitors like steroids, terpenoids, and phenolic compounds have been identified and tested against the lethal action of venoms [5-6]. However, in most situations, the efficacy of this traditional therapy regimen has not been demonstrated properly. Only a few species have been scientifically researched, with their active components extracted and structurally and functionally characterized. A recent study indicates the need for region-specific antivenom for better snakebites management as the existing antivenoms are ineffective in neutralizing the effect of certain venoms [7]. The current study focuses on a preliminary assessment of medicinal plants for therapeutic application of antidotes and their traditional use in the study area Natham Taluk in Dindigul District. This study would add to the existing medico-ethnobotanical knowledge and region-specific remedies for venom treatment.

## MATERIALS AND METHODS

*Study area*

Dindigul is one of the 38 districts in Tamil Nadu, located at latitude 10.4747° N and longitude 77.8367° E (Fig 1). It is surrounded by the Eastern Ghats, which are densely forested and rich in wildlife. The average temperature in this area ranges from 25° C to 37° C. The yearly rainfall in this district ranges from 700 to 1600 mm. Natham Taluk's population is mostly dependent on Mango and Tamarind cultivation, Cattle husbandry, and Medicinal plant harvesting for their livelihood.

*Survey, data collection and identification*

Several visits were made to the study region in order to find herbalists with extensive traditional knowledge. Semi-structured interviews with herbalists and medicinal plant collectors who agreed to share their expertise on antidote medicinal plants have been carried out.

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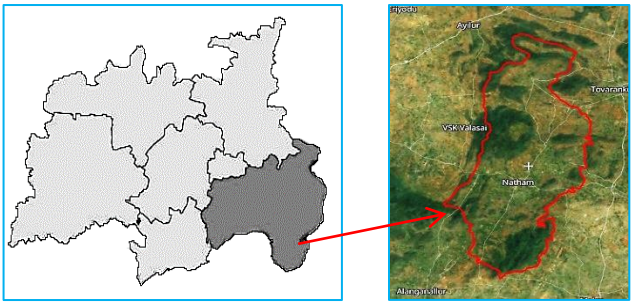
(a) Tamil Nadu in India

(b) Dindigul in Tamil Nadu




(c) Natham Taluk in Dindigul District

Fig 1 Location of the study area

Between December 2021 and March 2022, approximately 15 field visits were conducted in Dindigul District's Natham Taluk. Field trips, surveys, questionnaires, and semi-structured interviews were used to gather and document data [8]. The semi-structured interviews were done in Tamil, the vernacular language. The ethnobotanical data was gathered using the proposed methods [9]. A total of 33 informants were found and recorded for their traditional knowledge. They were interviewed about information such as local plant names, diseases treated, parts used, mode of preparation and administration, and dosage of medicine. For identification of the plants collected, the Flora of the Presidency of Madras [10] and Flora of Central Tamil Nadu [11] were used. Some of the plants were collected and identified with the help of the traditional healers by going for forest walks with them and the remaining plants were identified through literature review. Plant photographs were taken (Fig 2) and voucher specimens collected for herbarium preparation will be deposited in the PG and Research Department of Botany, Thiagarajar College, Madurai after the completion of this research.

*Data analysis*

The data collected in this study were qualitative in nature. Therefore, ethnobotanical data were analyzed using quantitative indices like, UV, FUV and ICF using the following formulae in Microsoft excel.

*Pergularia daemia* (Forsskal) Chiov

*Argemone mexicana* L.

*Barleria prionitis* L.

*Datura meteloides* L.

Fig 2 Plant photographs

*Use value (UV)*

The use value (UV) of a species gives the relative importance of plants known locally. It was calculated using the following formula [12-13].

$$UV = \sum \frac{Ui}{N}$$

Where;

Ui is the number of use reports mentioned by each informant (i)

N is the total number informants interviewed.

*Informant consensus factor* (ICF)

The informant consensus factor (ICF) was used to test the homogeneity of knowledge among the plant users of the study area [14]. It is sometimes referred to as Informant agreement ratio (IAR) or Fic.

$$ICF = \frac{Nur - Nt}{Nur - 1}$$

Where;

Nur = Number of use-reports for a particular ailment category

Nt = The number of taxa used for a particular ailment category by all informants.

ICF values ranges from 0 to 1. If the values are closer to 0, it means a large number of taxa have been used for one ailment category but the informants disagree on the taxa. Meanwhile, if the values are closer to 1, only few taxa have been used by the informants and they agree with each other on its usage [15].

*Jaccard index* (JI)

Jaccard index was used to compare with the previously collected data from neighbouring regions. JI is calculated using the following formulae:

$$JI = \frac{c \times 100}{a + b - c}$$

Where; a is the number of species of the area A, b is the number of species of the area B, and c is the number of species common to both A and B [16].

## RESULTS AND DISCUSSION

*Demographic features of the informants*

From the total 33 informants, 73% were male and the remaining 27% were female (Fig 3). In general, informants with average age of 41-60 (55%) had the traditional knowledge on medicinal plants, then the age group of 21-40 (6%) and above 60 years (39%). It was found that the literate people in the study area relatively have a less ethnomedicinal knowledge than the illiterate people. Of all the informants interviewed, 45% were traditional healers, 55% were agricultural labourers.

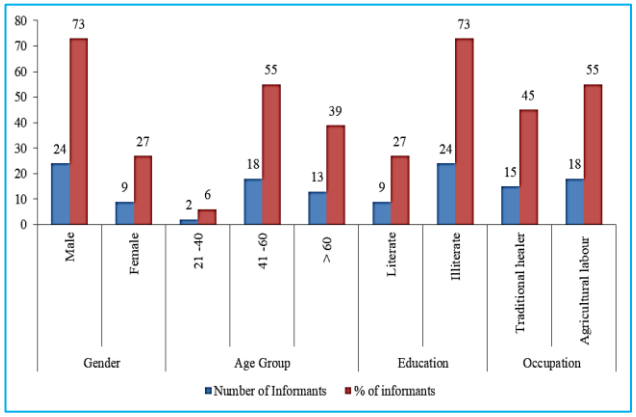



Fig 3 Demography of the informants

*Family of the antidote medicinal plants*

From the survey, it was revealed that about 62 species belonging to 37 families were recorded in the study area, Natham Taluk of Dindigul District, Tamil Nadu, India. The most cited family was Fabaceae that occupied 10% of the total number of families followed by Amaranthaceae and Acanthaceae each occupying 7 % (Fig 4). These families have been recorded to possess antivenin potential in the ethnobotanical surveys conducted across other countries. For example, Fabaceae was previously recorded in Africa, Pakistan and Bangladesh as one of the dominant families in ethnobotanical surveys [17-20]. Fabaceae is an important family that continues to dominate in several ethnobotanical surveys across the world due to the abundance of plant species in this family [21-22].

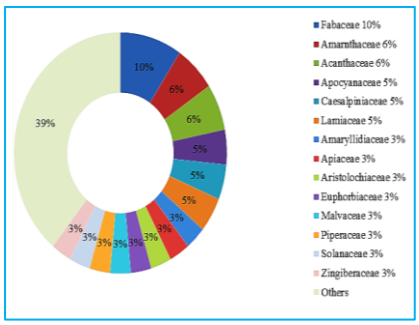



Fig 4 Families of medicinal plants

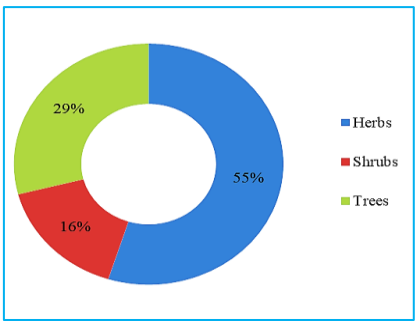



Fig 5 Habit of the plants used as antidotes

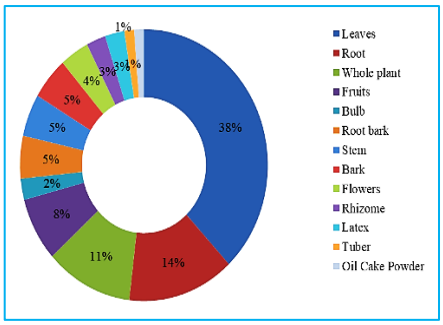



Fig 6 Plant parts used as antidotes

*Growth habit, parts used, preparation, administration, condition and habitat of antidotes*

When looking at the growth forms (Fig 5) of these antidotes, most of them were herbs (55%), followed by some amount of trees (29%) and shrubs (16%) which is supported by results from other studies showing the usage of herbaceous plants as antidotes [23-24] and the commonly used plants parts were leaves (38%), roots (11%) (Fig 6). Similar results were reported in other ethnobotanical studies made in Karnataka, Assam and Andhra Pradesh [25-27]. The usage preference of roots and leaves as antidotes than any other plant parts is an important feature of antivenin treatment [28-29].

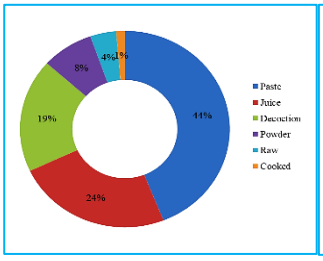



Fig 7 Mode of preparation of herbal drugs

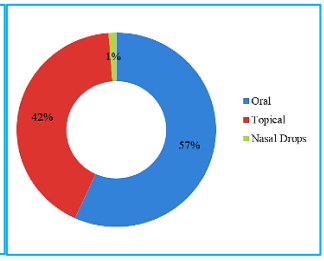



Fig 8 Route of administration of antidotes

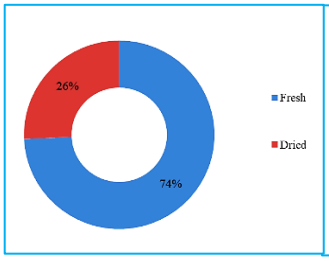



Fig 9 Fresh / dried medicinal plants

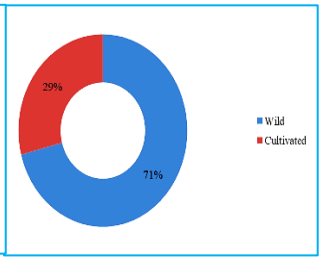



Fig 10 Habitat of the medicinal plants

The most commonly used preparation of herbal drug is paste (44%), followed by juice (24%) (Fig 7). Though many studies reported the usage of decoction or extract, there were few studies that documented paste as the most common mode of preparation of herbal drug [30-31]. Among the recorded data (Fig 8), 57% of the remedies were administered orally, 42% of the total remedies were administered topically on the bitten area and 1 % was administered as nasal drops. Most antidotes were given orally in other similar studies recorded [32-33].

The antidotes were mostly prepared from plants that are collected fresh (74%) rather than dried plants (Fig 9) and about 71% of plants were usually collected from the wild and 29% of plants were cultivated (Fig 10).

Table 1 List of medicinal plants used in the study area Natham Taluk

| Botanical name | Family | Habit | Local mame | Parts used | Fresh / Dried condition | Mode / Route of administration | Antidote for | Preparation | UR | UV |
|---|---|---|---|---|---|---|---|---|---|---|
| *Jatropha gossypiifolia* L. | Euphorbiaceae | S | Aathandai | L | F | Pa/O J/T | Snake bite | The leaf paste was given orally and the juice was applied topically on the bitten area | 5 | 0.15 |
| *Albizia lebbeck* (L.) Benth. | Fabaceae | T | Vaagai | Fl | F | Pa/O | Snake bite | The flowers of this plant were ground to paste and given orally with hot water | 25 | 0.75 |
| *Carum carvi* L. | Apiaceae | H | Karunn jeeragam | S L | D | Pa/ T | Dog bite | Two pinch of seeds were ground to paste with salt and applied topically | 3 | 0.09 |
| *Senna tora* (L.) Roxb. | Caesalpiniaceae | T | Thagarai | R | F | Pa/O | Snake bite | The root was ground to paste and given orally | 4 | 0.12 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Crateva religiosa* G. Forst. | Capparaceae | T | Maavilangam | Ba | D | Dec/O Pa/T | Bug bite | The bark was pounded and boiled in water, reduced to 1/4$^{th}$ part of the total volume, filtered and given orally twice a day | 15 | 0.45 |
| *Leucas aspera* Link | Lamiaceae | H | Thumbai | R, L | F | Pa/O and T | Snake bite | The root was ground to paste and given orally while the leaf paste was applied with honey topically on the bitten area | 31 | 0.93 |
| *Achyranthes aspera* L. | Amaranthaceae | H | Naayuruvi | L | F | J/T | Scorpion sting | Leaf juice was applied topically | 5 | 0.15 |
| *Hemidesmus indicus* (L.) R. Br. ex Schult. | Asclepidaceae | H | Nannari | R | F | Dec/O | Snake bite | The root of this plant was soaked in water for a day, filtered and given orally twice a day | 7 | 0.21 |
| *Ruellia patula* Jacq. | Acanthaceae | H | Kiranthi nayagam | L | F | R/O Pa/T | Scorpion sting | 5 to 6 raw leaves were given orally and its paste was applied topically over the bitten area | 9 | 0.27 |
| *Asystasia gangetica* (L.) T.Anderson | Acanthaceae | H | Silanthi nayagam | Wp | F | J/O Pa/T | Snake bite | The whole plant was ground and the juice was given orally and the paste was applied topically on the bitten area | 6 | 0.18 |
| *Dichrostachys cinerea* (L.) Wight & Arn. | Fabaceae | H | Vidather | L, Fl, Fr, Ba | F | Dec/ O | Centipede bite | Equal parts of all those plant parts were boiled in water, filtered and given orally as decoction | 3 | 0.09 |
| *Indigofera tinctoria* L. | Fabaceae | H | Neeli | L | F | J/O | Snake bite | Leaves juice was given orally thrice a day in empty stomach | 15 | 0.45 |
| *Alangium salviifolium* (L.f.) Wangerin | Cornaceae | T | Alinjil | Rb | D | Po/O | Snake bite | Root bark of this plant was powdered and given orally twice a day | 7 | 0.21 |
| *Aristolochia indica* L. | Aristolochiaceae | H | Thalai suruli | R, L | F | Pa/O And T | Snake bite | The root was ground to paste and given orally while the leaf paste was applied topically on the bitten area | 28 | 0.84 |
| *Aristolochia bracteolata* Lam. | Aristolochiaceae | H | Aadutheendapaalai | R | F | Dec/O | Scorpion sting | The root of this plant was pounded, boiled in water, reduced to 1/8$^{th}$ of its volume and given orally 2 – 3 times a day | 32 | 1.51 |
| | | | | L | D | Po/O | Snake bite | Leaves of this plant were dried, powdered and was given orally 2 pinch a day in hot water for 3 days | 18 | |
| *Strychnos nux-vomica* L. | Loganiaceae | T | Etti | Fr | F | Pa/T | Snake bite | The unripe fruits were ground to paste and applied topically | 4 | 0.12 |
| *Madhuca longifolia* J.F.Macbr | Sapotaceae | T | Iluppai | OCP | F | Pa/O | Snake bite | The oil cake powder of this tree was ground to paste and given orally with water | 8 | 0.24 |
| *Polygala chinensis* L. | Polygalaceae | H | Siriya nangai | R | F | Pa/O | Snake bite | The roots of the plant were ground to paste in milk and given orally twice a day for 3 days | 15 | 0.45 |
| *Premna latifolia* Roxb. | Lamiaceae | T | Munnai | Rb | D | Dec/O | Rat bite | Root bark of this plant was made to decoction with palm jaggery and salt and given orally twice a day for 48 days | 2 | 0.06 |
| *Clerodendrum inerme* (L.) Gaertn. | Verbenaceae | S | Peesangu | L | F | J/O | Snake bite (*Naja naja*) | Leaves juice was given orally | 17 | 0.5 |
| *Enicostema axillare* (Lam.) A. Raynal | Gentianaceae | H | Vellarugu | Wp | F | J/O Pa/T | Snake bite | The whole plant juice was given orally and the paste was applied topically on the bitten area | 8 | 0.24 |
| *Acalypha indica* L. | Euphorbiaceae | H | Kuppai meni | L | F | Pa/T | Bug bite | Leaf paste of this plant made with salt is applied topically on the bitten area | 9 | 0.81 |
| | | | | R | F | Dec/O Pa/T | Snake bite | The roots of this plant were pounded, boiled in water and reduced to 1/10$^{th}$ of its volume, given orally 2- 3 times a day and the ground paste was applied topically on the bitten area | 18 | |
| *Thespesia populnea* Sol.ex Correa | Malvaceae | T | Poovarasu | L, Fl, Ba | F | Dec/O | Rat bite | The leaves, flowers and bark were soaked in milk and given orally | 10 | 0.66 |
| | | | | Ba | D | Dec/O | Snake bite | Tree bark was boiled in water and reduced to 1/4$^{th}$ of its volume and given orally twice a day | 12 | 0.24 |
| *Streblus asper* Lour. | Moraceae | T | Pirayan | Wp | D | Po/O | Bug bite | Whole plant was dried, powdered and given orally with milk | 8 | 0.45 |
| *Mangifera indica* L. | Anacardiaceae | T | Maa | Lat | F | R/T | Bee sting | Latex was applied topically over the stung area | 15 | 0.72 |
| *Datura metel* L. | Solanaceae | S | Oomaththai | L | F | Pa/T | Dog bite | The leaves of this plant were sautéed in sesame oil, ground to paste and applied on the dog bite wound | 29 | 0.87 |
| *Piper betle* L. | Piperaceae | H | Vetrilai | L | F | J/T | Centipede bite | Leaf juice was applied topically | 15 | 0.45 |
| *Piper nigrum* L. | Piperaceae | H | Milagu | Fr | D | Dec/O | Snake bite | A handful of pepper was boiled in ½ l of water and reduced to half of its volume and given orally | 27 | 0.81 |
| *Tamarindus indica* L. | Caesalpiniaceae | T | Puli | Fr | D | Pa/T | Bee sting | Tamarind juice mixed with sunnambu and applied over the sting topically | 14 | 0.42 |
| *Celosia argentea* L. | Amaranthaceae | H | Magili keerai | R | F | Pa/O | Snake bite | The root was ground to paste, mixed with neem oil and given orally | 19 | 0.57 |
| *Tylophora indica* (Burm. f.) Merr. | Apocynaceae | H | Nanjaruppan | Wp | D F | Po/O | Snake bite | The whole plant was dried, powdered and mixed with equal parts of pepper and given orally twice a day with buttermilk | 33 | 1 |
| *Prosopis juliflora* (Sw.) DC. | Caesalpiniacaee | T | Karuvelam | L | F | Pa/O | Snake bite | The young leaves of this plant were ground to paste in buttermilk and given orally | 11 | 0.33 |
| *Pergularia daemia* (Forssk.) Chiov. | Apocyanaceae | H | Veli paruthi | L | F | J/T | Snake bite | The leaf juice was applied topically on the snake bitten area | 33 | 1 |
| *Heliotropium indicum* L. | Boraginaceae | H | Siruthel kodukku | L | F | J/T | Scorpion sting | The leaf juice was extracted, boiled with sesame oil and applied topically on the bitten area | 22 | 0.66 |
| | Cactaceae | S | Chappatikalli | R | D | Po/O | Bug bite | The root of this plant was dried, powdered and given orally | 18 | 1.45 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Opuntia stricta* (Haw.) Haw | | | | Fr | F | Cd/T | Scorpion sting | The unripe fruit was burnt in fire and applied topically on the bitten area | 17 | |
| | | | | L, Tu | F | R/O & Pa/O | Snake bite (for Cattle) | The flesh of the cactus was cut into pieces and given orally with freshly ground pepper while the tuber of cactus was ground to paste and given orally | 14 | |
| *Calotropis procera (Aiton)* Dryand. | Apocynaceae | S | Erukkaalai | L | F | R/T | Centipede bite | Rub the young leaves on the bitten area until the swelling subsides | 15 | 0.33 |
| | | | | L, Lat | F | Pa/T | Scorpion sting | The leaves of this plant were ground to paste and applied topically over the bitten area or the milky latex was applied topically | 14 | |
| *Argemone mexicana* L | Pappavaraceae | H | Bramma thandu | Wp | F | J/O Pa/T | Snake bite (*Naja naja)* | The whole plant juice was given orally and the paste was applied topically on the bitten area | 16 | 1.21 |
| | | | | L | F | J/T | Scorpion sting | Leaf juice was applied topically to reduce sting pain | 24 | |
| *Justicia adhatoda* L. | Acanthaceae | S | Aadathodai | L | F | J/O | Bug bite | Leaf juice was given orally with hot water | 33 | 1 |
| *Aerva lanata* (L.) Juss | Amaranthaceae | H | Kanupoola | Wp | F | Pa/ O | Snake bite (cattle) | The whole plant was ground to paste and administered orally | 22 | 0.66 |
| *Allium sativum* L. | Amaryllidaceae | H | Vellai poondu | Bu | F | Pa/T | Dog bite | The pods were ground to paste and applied topically | 5 | 0.15 |
| *Allium cepa* L. | Amaryllidaceae | H | Chinna vengayam | Bu | F | Pa/O | Centipede bite | The bulbs were ground to paste and given orally | 3 | 0.09 |
| *Curcuma longa* L. | Zingiberaceae | H | Manjal | Rh | D | Pa/T | Dog bite | The rhizome was ground to paste and applied topically | 5 | 0.15 |
| *Calophyllum inophyllum* L. | Calophyllaceae | T | Punnai | S | F | Pa/T | Dog bite | The stem was ground to paste and applied topically | 5 | 0.15 |
| *Mimosa pudica* L. | Fabaceae | H | Thottal surungi | R | D | Po/O | Snake bite | The roots were dried, powdered and given orally | 3 | 0.09 |
| *Allmania nodiflora* (L.) R. Br. ex-Wight | Amaranthaceae | H | Kumitti | R | F | Pa/O | Snake bite | The roots were ground to paste and given orally | 27 | 0.81 |
| *Cleome gynandra* L | Cleomaceae | H | Thaivelai | L | F | Pa/O | Snake bite | The leaves were ground to paste and given orally thrice a day | 25 | 0.75 |
| *Moringa oleifera* Lam. | Moringaceae | T | Murungai | L | F | J/O | Snake bite | Juice extracted from the leaves was given orally | 26 | 0.78 |
| *Datura meteloides* Dunal | Solanaceae | S | Karuo omathai | L | F | Pa/O | Snake bite | The leaves were ground to paste and given orally | 28 | 0.84 |
| *Phyllanthus emblica* L. | Phyllanthaceae | T | Nelli | L | F | Pa/O | Snake bite | The leaves were ground to paste and given orally | 2 | 0.06 |
| *Ocimum tenuiflorum* Burm.f. | Lamiaceae | H | Thulasi | L | F | J/O | Snake bite | The juice extracted from the leaves was given orally | 18 | 0.54 |
| *Musa paradisiaca* L. | Musaceae | T | Vaalai | S | F | J/O | Snake bite | Juice extracted from the pseudostem was given orally | 4 | 0.12 |
| *Zingiber officinale* Roscoe | Zingiberaceae | H | Sukku | Rh | D | Pa/Nd | Snake bite | The dried rhizome was ground to paste with asafoetida powder, diluted with water and used as nasal drops | 5 | 0.15 |
| *Cynodon dactylon* (L.) Pers. | Poaceae | H | Arugu | Wp | F | Pa/T | Centipede bite | The whole plant was ground to paste and given orally thrice for 6 days | 17 | 0.51 |
| *Sida cordifolia* L. | Malvaceae | H | Arivaalmanai poondu | L | F | Pa/O and T | Snake bite | The leaves were ground to paste, given orally and applied topically on the bitten area | 19 | 0.57 |
| *Catunaregam spinosa* (Thunb.) Tirveng | Rubiaceae | S | Marakkarai | Rb | D | Dec/ T | Bug bite | The root barks were dried, powdered, made into decoction which is applied topically on the bitten area | 15 | 0.45 |
| *Crotolaria verrucosa* L. | Fabaceae | S | Vattkilu kiluppai | Rb | D | Dec/ T | Bug bite | Root bark was dried, powdered, made into decoction and then applied topically over the bitten area | 13 | 0.39 |
| *Barleria prionitis* L. | Acanthaceae | H | Kaatu kanagambaram | Wp | F | J/O | Snake bite (cattle) | The whole plant was ground to juice and given orally to the cattle | 25 | 0.75 |
| *Cuminum cyminum* L. | Apiaceae | H | Seeragam | S | D | J/O | Snake bite (cattle) | The seeds were ground to juice and given orally to the cattle | 25 | 0.75 |
| *Mukia maderaspatana* (L.) M. Roem. | Cucurbitaceae | H | Musumusukkai | L | F | Dec/T | Bug bite | The leaves were boiled in sesame oil, applied all over body and then taken bath | 9 | 0.27 |
| *Gliricidia sepium* (Jacq.) Steud. | Fabaceae | T | Seemai Awhathi | Wp | F | Dec/T | Bug bite | Whole plant was boiled in water, applied all over body and then taken bath | 5 | 0.15 |
| *Terminalia chebula* Retz. | Combretaceae | T | Kadukkai | Fr | D | Dec/T | Bug bite | The dried fruits were powdered, mixed with sesame oil, applied all over the body and then taken bath | 3 | 0.09 |
| *Plumbago zeylanica* L. | Plumbaginaceae | S | Kodiveli | L | F | J/O | Snake bite | The leaf juice was extracted and given orally | 23 | 0.69 |

UR – Use Reports, UV – Use value, Habit*: H –Herb, S – Shrub, T – Tree; Plant parts used*: Pa – Paste, Po – Powder, Dec – Decoction, J- Juice, Nd – Nasal Drops, Cd – Cooked, R - Raw, L- Leaves, Rb – Root bark, R – Root, Res-Resin, Ba – Bark, Wp – Whole Plant, Fr – Fruits, Fl – Flowers, Bu – Bulbs, Bd – Buds, Rh – Rhizome, Tu – Tuber, Lat – Latex, OCP – Oil Cake Powde; Condition*: F – Fresh, D – Dried; Route of Administration: O – Oral, T – Topical

*Use value (UV)*

To determine the relative importance of the recorded medicinal plants, use value use value (UV) was calculated based on the informants use reports for each species [34]. The use value ranged from 0.06 to 1.45. The plants *Opuntia stricta* (Haw.) Haw (UV = 1.45), *Argemone mexicana* L. (UV = 1.21), *Tylophora indica* (Burm. f.) Merr. (UV = 1), *Pergularia daemia* (Forssk.) Chiov. (UV = 1), have higher use values among all the recorded species which reveals that these species are locally important as they were cited by a large number of informants in the study area. Higher the use value (UV), higher its uses as reported by the informants. These species must be conserved since they are under higher threat as they are mostly preferred by the local medicinal plant collectors and also due to their higher demand in the local markets.

Table 2 Informant consensus factor

| Category | List of plants and number of use reports per species | Nt* | Nur* | ICF* |
|---|---|---|---|---|
| Snake bite | *Acalypha indica* L. – *18*, *Aerva lanata* (L.) Juss. – 22, *Alangium salviifolium* (L.f.) Wangerin – 7, *Albizia lebbeck* (L.) Benth. – 25, *Argemone mexicana* L. – *16*, *Aristolochia bracteolata* Lam. – *18*, *Aristolochia indica* L. – 28, *Asystasia gangetica* (L.) T.Anderson – 6, *Barleria prionitis L.* – *25*, *Cuminum cyminum* L. 25, *Celosia argentea* L. – 19, *Cleome gynandra* L. – 25, *Clerodendrum inerme* (L.) Gaertn. – 17, *Datura meteloides* L. Dunal. – 28, *Enicostema axillare* (Lam.) A. Raynal – 8, *Hemidesmus indicus (L.) R. Br. ex Schult.* – 7, *Indigofera tinctoria* L. – 15, *Jatropha gossypifolia* L. – 5, *Leucas aspera* Link. – 31, *Madhuca longifolia* J.F.Macbr – 8, *Mimosa pudica* L. – 3 –, *Moringa oleifera* Lam. – 26, *Musa paradisiaca* L. – 4, *Ocimum tenuiflorum* Burm.f. -18, *Opuntia stricta* (Haw.) Haw – *14*, *Pergularia daemia* (Forssk.) Chiov. – 33, *Phyllanthus emblica* L. – 2, *Piper betle* L.} – 24, *Piper nigrum* L. – 27, *Plumbago zeylanica* L. – *23*, *Polygala chinensis* L. – 15, *Prosopis juliflora* (Sw.) DC. – *11*, *Senna tora* (L.) Roxb.– 4,*Sida cordifolia* L.– 19, *Strychnos nux-vomica* L. – 4, *Thespesia populnea* Sol.ex Correa - 12, *Tylophora indica* (Burm. f.) Merr. – 33, *Zingiber officinale* Roscoe – 5 | 37 | 605 | 0.94 |
| Scorpion sting | *Achyranthes aspera* L. - 5, *Argemone mexicana* L. – 24, *Aristolochia bracteolata* Lam. – 32, *Calotropis procera* (Aiton) Drand. – *14*, *Heliotropium indicum* L. – 22, *Opuntia stricta* (Haw.) Haw – 17, *Ruellia patula* Jacq. – 9 | 7 | 123 | 0.95 |
| Centipede bite | *Allium cepa* L. – 3, *Calotropis procera* (Aiton) Dryand. – *15*, *Cynodon dactylon* (L.) Pers. – *17*, *Dichrostachys cinerea* (L.) Wight & Arn. – 3, *Piper betle* L. – 15; | 5 | 53 | 0.87 |
| Bee sting | *Mangifera indica* L. – 15, *Tamarindus indica* L. – 14 | 2 | 29 | 0.91 |
| Bug bite | *Acalypha indica* L. – 9, *Justicia adhatoda* L. – 33, *Catunaregam spinosa* (Thunb.) Tirveng -15, *Crateva religiosa* G.Forst. f. – 15, *Crotolaria verrucosa* L.-13, *Gliricidia sepium* (Jacq.) Steud. – 5, *Mukia maderaspatana* (L.) M. Roem. – 9, *Opuntia stricta* (Haw.) Haw – 18, *Streblus asper* Lour. – 8, *Terminalia chebula* Retz. - 3 | 10 | 128 | 0.96 |
| Rat bite | *Premna latifolia* Roxb. – 2, *Thespesia populnea* Sol.ex Correa – *10* | 2 | 12 | 0.90 |
| Dog bite | *Allium sativum* L. – 5, *Calophyllum inophyllum* L.- 5, *Carum carvi* L. – 3, *Curcuma longa* L.- 5, *Datura metel* L. – 29 | 5 | 47 | 0.86 |

Nt - Number of taxa, Nur – Number of use reports, ICF – Informant Consensus Factor

*Informant consensus factor (ICF)*

The antidotes were categorized into 7 types. Some are bites, while others are stings. A bite is when an organism utilises its mouth to puncture its skin and release venom, whereas a sting occurs when an organism employs another body component such as a barbed stinger at its tail end to pierce the skin and inject venom [35]. They were represented in the (Table 2). In the present study, the ICF values ranged from 0.86 to 0.96 per ailment categories. The ailment category with the highest ICF value from informants (Fig 12) were bug bite (0.96), scorpion sting (0.95), snake bite (0.9) and low ICF values for the category dog bite (0.86). High ICF values indicate reliability of informants on the use of medicinal plant species. The informant agreement values also indicated that the people in the study area share their traditional knowledge of the medicinal plant species necessary to treat the most common ailments.

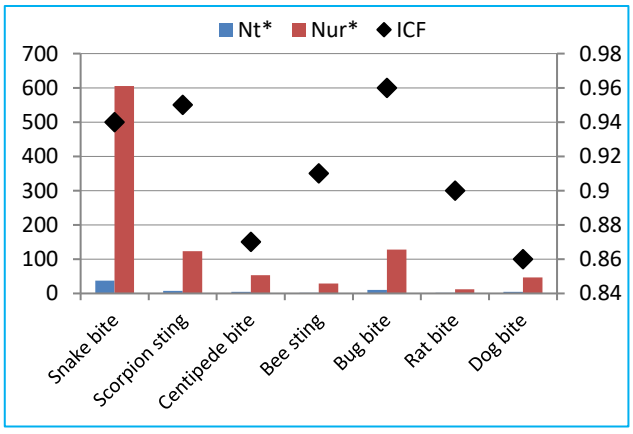



Fig 11 Number of taxa and use reports per category (left axis); ICF (right axis)

*Jaccard index (JI)*

The present study was compared with other ethnobotanical studies that have been done in the other districts of the state Tamil Nadu [36-39]. Data in (Table 3) illustrates the number of common medicinal plants between the current study and other earlier studies in the neighbouring regions. There weren't many recent studies that recorded antidote medicinal plants in Tamil Nadu. The Jaccard index (JI) calculated between the current study and earlier studies ranged from 8.33 to 34.84. From the above results, *Aristolochia indica* L., *Aristolochia bracteolata* Lam., *Hemidesmus indicus* (L.) R. Br. ex Schult. *Pergularia daemia* (Forssk.) Chiov. were the most common antidote medicinal plants in the study area and the neighbouring regions. There were considerable similarities in usage of certain plants in these studies that had similar objectives of documenting antidote medicinal plants.

There were earlier records of similar usage of certain medicinal plants that are recorded in the present study. *Aristolochia bracteolata* Lam., and *Musa paradisiaca* L. have been used as antidotes for snake bite [23]; *Zingiber officinale* Roscoe [26], *Aristolochia indica* L were reported to have neutralizing capacity of snake venom [31]; *Mimosa pudica* L. inhibited myotoxicity induced by *Naja kaouthia* venom [40], likewise in the study area, *Argemone mexicana* L. and *Clerodendrum inerme* (L.) Gaertn. were documented to specifically work against *Naja naja* venom. Several of the antidotes like *Strychnos nux-vomica* L., *Tamarindus indica* L., were recorded from the study area have been evaluated earlier for their antivenom activity [41-43]. Some of them have been evaluated for their species – specific antivenom activity. *Acalypha indica* L. against *Vipera russelli*, *Azadirachta indica* against Russel's viper, *Mangifera indica* L. was reported to neutralize the *Naja naja* venom [44-46].

Table 3 Comparison with other ethnobotanical studies

| Year | Study area | Number of species recorded | Number of common medicinal plants | Jaccard index (JI) | Reference |
|---|---|---|---|---|---|
| 2018 | Kancheepuram | 27 | 9 | 11.25 | [36] |
| 2012 | Udhagamandalam | 27 | 23 | 34.84 | [47] |
| 2020 | Sivagangai | 16 | 6 | 8.33 | [23] |
| 2011 | Salem | 48 | 19 | 20.87 | [39] |

## CONCLUSION

About 62 species belonging to 37 families and 55 genus was recorded in the study area, Natham Taluk of Dindigul district, Tamil Nadu, India which were used as antidote for seven different categories of venomous bites or stings. Many plants have already been documented in prior ethnomedicinal investigations and corroborated through scientific studies investigating the value of indigenous knowledge. The current investigation demonstrated the rural communities' ethnobotanical knowledge regarding antidotes in Natham Taluk, Dindigul district, Tamil Nadu, India. This observation intrigues scientific interest in future research into these plants' phytochemical contents, mode of action, safety, efficacy, and conservation and sustainable utilization of plant sources thereby developing region specific antidotes to neutralize the lethal action of venom.

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***Conflict of Interest***

*Authors have declared that no competing interests exist*.

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