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Quantitative indices-based study on ethnomedicinal plants utilised by the Adiyan community residing in Manathavady taluk, Wayanad, India

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The ethnomedicinal knowledge possessed by the Adiyan tribe holds significant cultural and medicinal importance. Quantitative analysis will verify ethnomedicinal plant characteristics and assess their therapeutic use. Direct observation, semi-structured interviews, group discussions, and a standard questionnaire were used to collect ethnomedicinal data. About 47 informants, comprising 20 men and 27 women, were interviewed by age group. 90 medicinal plants from 87 genera and 48 families were documented for the treatment of various ailments. In quantitative study, *Curcuma longa* L. was the most widely utilised species showing the highest use value (1.46) and usage report (69). Oncology has the lowest ICF value, 0.75, whereas viral infections have the highest, 0.97. The highest FL percentage is 100, and 5 is the lowest. A high IAR value implies informants agree on taxonomic selection, whereas a low IAR value indicates disagreement. Culture significance index CII is 0.02-4.8. *Ocimum tenuiflorum* L. has the highest CII, 4.8. High values indicate cultural significance of a plant. FC was found in between 0.08–5.52. *Curcuma longa* L. has the greatest FC value (5.52), while *Pandanus odorifer* (Forssk.) Kuntz and *Benincasa hispida* (Thunb.) Cogn. have the lowest (0.08). *Curcuma longa* has the highest RFC (0.12), *Alstonia scholaris* (L.) R.Br. and *Rhaphidophora pertusa* (Roxb.) Schott have the lowest (0.001). FIV values ranged from 0.08-9.68. Lamiaceae has the highest FIV (9.68), followed by Zingiberaceae (8.32). The data reveals the community understands a lot regarding traditional medicines and their uses. Further studies on the phytochemistry and pharmacological properties of these plants are necessary.

Keywords: Ethnomedicinal assessment, Indigenous community, Quantitative analysis, Traditional knowledge, Wayanad

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Medicinal plants provide significant potential for pharmacological research. An ethnobotanical study, which records traditional knowledge on medicinal plant utilisation, is crucial for novel drug development and comprehending the interplay between biodiversity and cultural practices[1]. Medicinal plants are utilised not just in traditional treatment but also serve as the source for several modern drugs. Drawing on proven knowledge from traditional ethnomedicine helps researchers to select plants for drug development. At the same time, modern research leads to the discovery of novel medicines. Overharvesting for commercial purposes has resulted in the depletion and eventual local extinction of several therapeutic plant species. Moreover, flora utilised in traditional medicine are often incorporated into the preparation of food and beverages, rendering them an essential element of the indigenous diet[2,3]. Forests are integral to the social structure of tribal groups, serving as habitats for those who depend entirely or partially on the forest for their livelihoods[4]. Plants are the foundation of human existence and welfare, particularly for tribal cultures that continue to gather and utilise resources from the wild[5,6]. Forest inhabitants are confronted with an immense degree of ethnic diversity and traditional knowledge. Wild edible plants are crucial for the subsistence strategies of tribal communities. The ethnomedicinal knowledge acquired by the tribal community is transmitted to subsequent generations as a component of cultural legacy. Numerous studies indicate that tribal communities in isolated regions rely on plant resources for food, fuel, medicinal purposes, and the preservation of natural resources[7]. Also, employed in the treatment or prevention of a

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Abbreviations: Cultural importance index (CII), Family importance value (FIV), Fidelity Level (FL), Frequency of Citation (FC), Index of agreement on remedies (IAR), Informant consensus factor (ICF), Relative Frequency of Citation (RFC), Use Value (UV)

diverse array of diseases, including cardiovascular issues, cancer, and diabetes[8]. The Government of India is demonstrating significant interest in documenting the ethnobotanical and ethnoveterinary practices of the state's tribal populations, as they serve as essential observers of their natural environment and contribute to environmental conservation through their cultural traditions and customary resource management[9]. The data collected on the therapeutic properties of plants was juxtaposed with prior research from ethnobotanical surveys undertaken in this region[10,11]. This study contributes baseline information for future research that may lead to novel plant-based herbal medications in the following decades. The documenting of ethnomedicinal plants and the evaluation of their utilisation by quantitative analysis by the Adiyan community in Mananthavady Taluk, Wayanad, has not been extensively documented. In light of this gap, the present investigation aims to provide, in particular, a quantitative evaluation of the ethnomedicinal plants used by the corresponding indigenous community. The study not only records indigenous therapeutic practices and plant utilization patterns unique to the Adiya community, but also provides a regional comparison with ethnobotanical reports from the Western Ghats, thereby highlighting both shared and distinct traditional healthcare practices.

Materials and Methods

Study area

The study was conducted in the remote tribal settlements of Adiyan, located in the Mananthavady (11°48'04.9"N 76°00'15.7" E) taluk of Wayanad district of Keralam (Fig. 1). The area is characterized by undulating terrain with elevations ranging from low-lying valleys to high hills, receiving abundant southwest monsoon rainfall and experiencing a humid tropical climate. The region is dominated by tropical evergreen, semi-evergreen, and moist deciduous forests interspersed with agricultural landscapes such as paddy fields, plantations, and agroforestry systems.

The study area and tribal settlements were selected after consulting with the tribal development office in Mananthavady. The study was carried out where the population of the Adiyan community is higher. The tribal settlements located in Kattikulam, Valat, Edavaka, Thirunelly, Begur, Panamaram, and Ellumanam of Mananthavady Taluk were selected for the study.

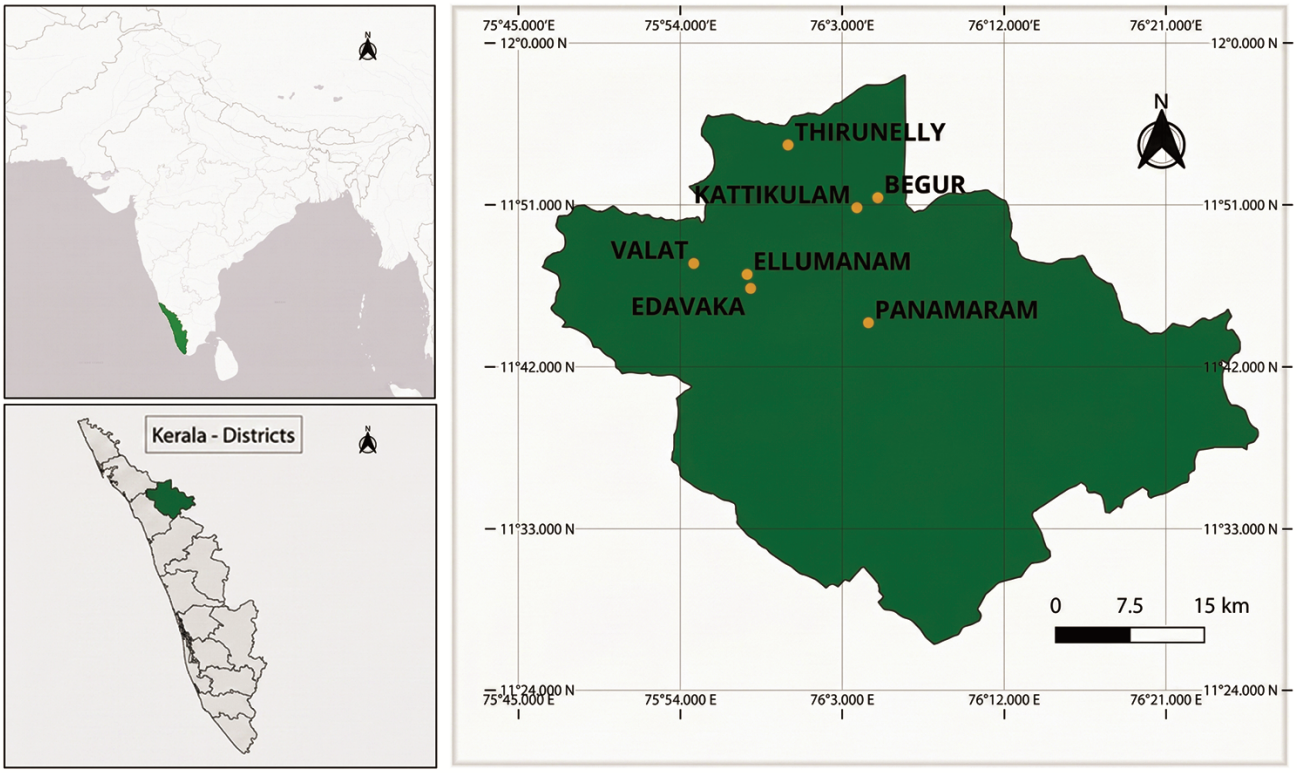


Fig. 1 — Study area (Source: https://earth.google.com/web/)

Field research and data acquisition

The field study was conducted from June to November 2023, with prior approval from the relevant tribal development offices and the support of tribal promoters. A list of knowledgeable tribal medicinal practitioners and elders was compiled. Also, a tribal promoter accompanied us during the visit to each Adiyan settlement. Prior informed consent (PIC) was obtained from all informants after a written explanation of the objectives of the study was provided their local language, in accordance with the ethical guidelines of the International Society of Ethnobiology Code of Ethics (2006). The data was collected through direct observation, semi-structured interviews, and group discussions. The collected data was then analysed using Microsoft Excel and compared with various ethnobotanical reports. Different ethnobotanical indices such as Use Value (UV), Informant Consensus Factor (ICF), Frequency Citation (FC), Index of Agreement on Remedies (IAR), Cultural importance index (CII), Family importance value (FIV) and Fidelity level (FL). Various ethnomedicinal quantitative indices were used for interpreting information. A standard questionnaire following the approaches of Martin (1995)[12], with slight modifications to suit the local context of the study area was used to collect data, which included the name of the respondent, age, sex, vernacular designation of the plant, therapeutic use of the plant, and mode of administration. Plant species collected during the study were identified using the Flora of the Presidency of Madras[13]. The scientific names of plant species and their respective families were verified and updated using the website Plants of the World Online (POWO)[14]. The acquired specimens were affixed to herbarium sheets following standard protocols described by Jain and Rao[15], and were placed for future reference at the Kannur University departmental herbarium.

Quantitative analysis

***Use Value* (*UV*)**

The value of a species is its importance for its uses in traditional medicine, relative to other reported species. It is used to estimate all the possible uses of a plant species. Use value was calculated according to Phillips *et al.*[16] using the following formula:

$$UV = \sum U/N$$

Where "U" is the number of use reports mentioned by the informants for a given species, and "N" refers to the total number of informants. A high UV score indicates many use reports and high potential for that plant, while a low UV score indicates fewer use reports cited by the informants.

Informant consensus factor (ICF)

ICF was used to know the level of consensus or the agreement level among the informants or healers on the use of a plant for a particular ailment category. The ICF was calculated according to the formula of Trotter & Logan[17].

$$Fic = Nur-Nt/(Nur-1)$$

Nur is the number of use-reports for a specific ailment category, while Nt is the number of species used for that category by all informants. A high ICF indicates strong agreement among informants on which plant to use for a particular ailment. The ICF ranges from 0 to 1. A value of 1 indicates that many informants use relatively few species, while a value of 0 indicates no consensus on species selection. This formula measures the consistency of ethnomedicinal information provided by traditional healers.

Frequency of Citation (FC)

The FC value was calculated according to Janackovic *et al.*[18].

FC= (Number of times a particular species was mentioned/) (total number of times that all species were mentioned) ×100.

Relative Frequency of Citation (RFC)

The RFC value was calculated according to Tardio & Pardo[19]:

$$RFC = FC/N$$

Where, FC refers to the frequency of citation and N is the total number of informants who participated in the documentation. The RFC value ranges from 0-1. When nobody referred to a plant as useful, then the value is 0, and when all informants referred to a plant as useful, its value is 1.

Index of Agreement on Remedies (IAR)

The importance of each species for the treatment of a particular ailment group was determined by IAR Value (Trotter and Logan, 1986)[17].

$$IAR= (Nr-Na) / (Nr-1)$$

Nr = Total number of citations registered for a particular species.

Na = Number of illness categories that are treated with this species.

Cultural importance index (CII)

It can be found by using formula according to Tardio & Pardo[19].

CII = (No. of ailment category × total no. of citation)/total no. of informants.

The vast usage and ethnical importance of particular plants can be found out by CII. This index aims to assess the cultural significance of plant species.

Fidelity level (FL)

FL is a quantitative analysis tool to determine the most frequently used plant species as per the informants for the treatment of a disease in a particular ailment category. It was calculated according to the formula proposed by Friedman *et al.*[20].

FL (%) = (Np/N) × 100

Here, Np is the number of use-reports for a species within a specific ailment category, and N is the total use-reports for that species in the same category. A higher FL indicates the species is primarily used for one treatment purpose, while a lower FL suggests it is used to treat multiple ailments. The high FL Value also indicate strong agreement or preference for a plant in treating particular ailment[21].

Family importance value (FIV)

Family Importance Value (FIV) was used to determine the relative importance of families. It was calculated according to Napagoda *et al.*[22] as the percentage of informants mentioning the family:

FIV = FC (family)/N × 100

Where, FC is the number of informers revealing the family, while N is the total number of informants who participated in the research.

Results

Informant demography and medicinal plant diversity

A systematic field investigation was carried out in Mananthavady taluk of Wayanad district to document the ethnomedicinal plant use of the Adiyan community, during which 47 informants (20 males and 27 females) aged between 20 and 90 years were interviewed (Fig. 2), field observations were recorded, and plant specimens were photographed and collected (Fig. 3, 4). 90 medicinal plant species from 87 genera and 48 families were documented for the treatment of various disorders (Table 1). Among these, angiosperms comprised 74 dicotyledons (29 Polypetalae, 28 Gamopetalae, and 17 Monochlamydeae) and 16 monocotyledons, including *Acorus calamus* L., *Areca catechu* L., *Asparagus racemosus* Willd., *Bambusa vulgaris* Nees, *Cocos nucifera* L., *Curcuma longa* L., *Cynodon dactylon* (L.) Pers., and *Eleusine coracana* Gaertn (Fig. 5). Herbs (39 species; 43%) are predominant, followed by shrubs (16 species; 18%), trees (22 species; 25%), and climbers (13 species; 14%) (Fig. 6). Herbs are often used because they are more common and accessible. Traditional remedies are made from herbaceous plants because they contain bioactive compounds that treat many diseases. The Adiyan community used different plant parts, such as leaves, stems, bark, flowers, flower buds, seeds, fruits, and rhizomes, each of which is recognized for its medicinal properties in the treatment of a wide range of ailments. Leaves are the most commonly used plant part (52), followed by rhizomes (9), bark (7), fruits (7), seeds (7), the entire plant (6), flowers (2), and flower buds (1) (Fig. 7). Fabaceae has 6 species and dominates the 48 families, followed by Rutaceae with 5 species. Asteraceae Cucurbitaceae, Euphorbiaceae and Poaceae, are each represented by three species. The families Acanthaceae, Amaranthaceae, Apocynaceae, Lamiaceae and Solanaceae have four species each (Fig. 8). The remaining 37 families comprise two or one species each. *Clitoria ternatea* L., *Desmodium triflorum* (L.) DC, *Erythrina variegata* L., and *Pongamia pinnata* L. are the commonly used Fabaceae members.

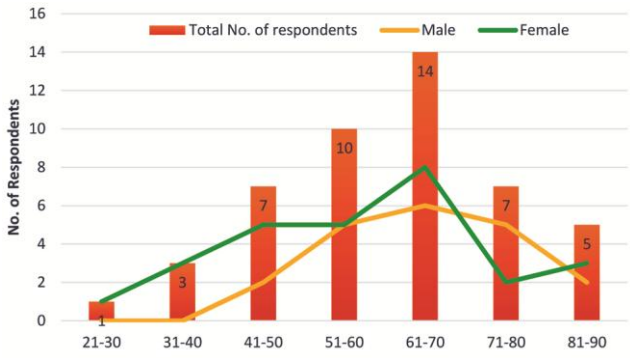


Fig. 2 — Demographic representation of informants by their age group

Quantitative analysis of ethnobotanical data

The ethnobotanical data evaluated using quantitative indices revealed the utilization patterns of medicinal plants based on traditional knowledge. These approaches assess the degree of agreement regarding plant use through various parameters and provide valuable insights for prioritizing plants for further biomedical investigation.

Use value (UV)

Use value quantifies species significance. The use value (UV) of 90 medicinal herbs from the Adiyan tribe is investigated. *Curcuma longa* L. was the most utilised species which is evident from its high use value (1.46) and use report (69). Among the Adiya community, *Curcuma longa* L. is widely used to cure stomach pain, honey bee bites, and wounds. Similarly, *Azadirachta indica* A. Juss. and *Piper nigrum* L. show high usage values of 1.10 and 1.19 with use reports of 52 and 56 respectively. In contrast, about 15 plant species have usage values below 0.1. The use value of each plant appears to fluctuate based on its availability and depth of knowledge held by informants. A plant species with higher use value is typically considered more effective therapeutically. On the other hand, lower use value suggests less knowledge about the plant (Supplementary Table S1).

Informant consensus factor (ICF)

The informant consensus factor (ICF) measures the degree of agreement among informants on the use of specific plants for each ailment category. Diseases are categorised into 16 ailment categories. ICF value ranges from 0.7-1. Viral diseases have the highest ICF value, which is 0.97, and the oncology category has the lowest ICF value, which is 0.75. ICF value indicates how much knowledge the informants have about the plants used for the treatment of a specific disorder (Supplementary Table S2).

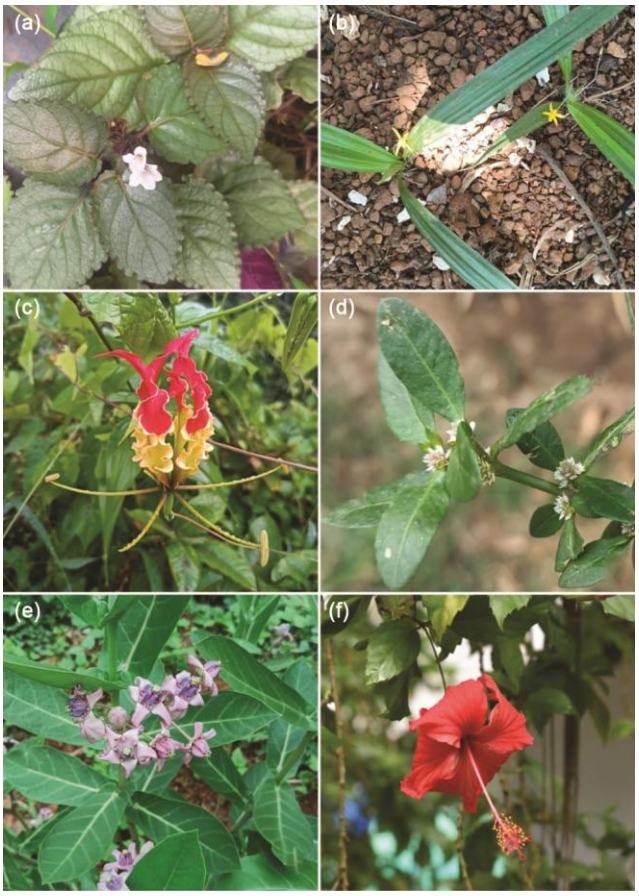


Fig. 3 — (a) *Strobilanthes alternata* (Burm.f.) Moylan *ex* J.R.I.Wood, (b) *Curculigo orchioides* Gaertn. (c) *Gloriosa superba* L. (d) *Alternanthera sessilis* (L.) DC (e) *Calotropis gigantea* (L.) W.T.Aiton (f) *Hibiscus rosa-sinensis* L.

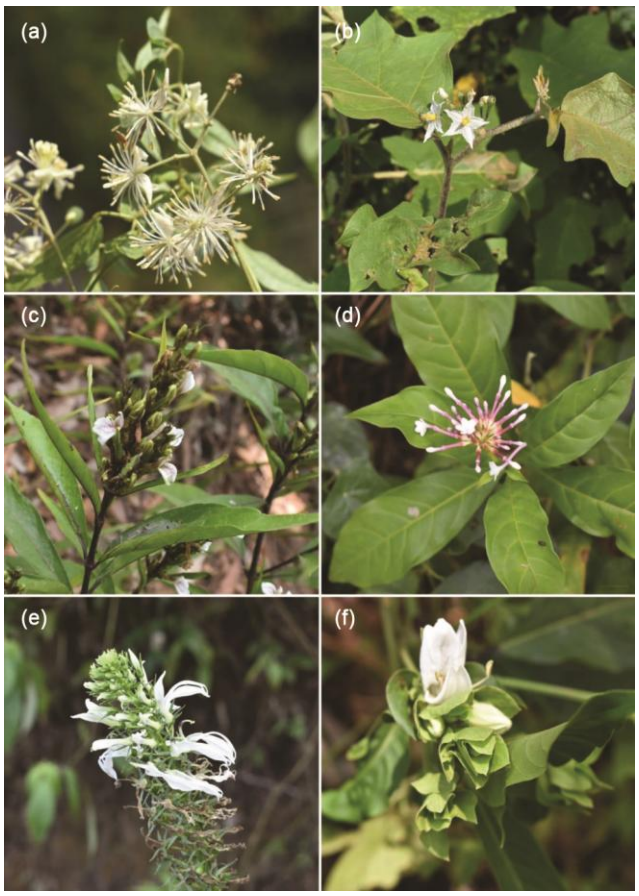


Fig. 4 — (a) *Clematis zeylanica* Poir (b) *Solanum nigrum* L. (c) *Justicia gendarussa* Burm.f. (d) *Rauvolfia serpentina* (L.) Benth. *ex* Kurz (e) *Lobelia nicotianifolia* B.Heyne *ex* Roth (f) *Justicia adhatoda* L.

Table 1 — Utilisation of medicinal plants by the Adiyan tribal community in Mananthavady taluk of Wayanad district, Southern Western Ghats, India

Sl. No	Botanical Name	Vernacular Name	Habit	Family	Parts Used	Medicinal Uses
1	*Acorus calamus* L.	Vayambu	Herb	Acoraceae	Rhizome	Decoction of the rhizome mixed with salt reduces stomach pain.
2	*Aegle marmelos* (L.) Correa	Koovalam	Tree	Rutaceae	Leaf, Root, Fruit	Consuming the decoction of the leaves reduces asthma. Dried root powder is taken orally to treat bronchitis. Filtered leaf decoction is used as an eye wash to reduce inflammation.
3	*Aloe vera* (L.) Burm.f.	Kattarvazha	Herb	Asphodelaceae	Gel, latex	Gel of *Aloe vera* mixed with turmeric is applied on the skin for skin burning. Gel is applied to the scalp to increase hair growth.
4	*Alstonia scholaris* (L.) R.Br.	Ezhilampala	Tree	Apocynaceae	Leaf	Ground leaves mixed with mustard are applied or consumed as a traditional remedy for managing skin rashes and infection.
5	*Alternanthera sessilis* (L.) DC	Ponnankanni	Herb	Amaranthaceae	Leaf	Crushed leaves are used for making hair oil to increase hair growth.
6	*Amaranthus spinosus* L.	Mullancheera	Herb	Amaranthaceae	Leaf	Consumption of leaves boost immunity, digestion and reduce inflammation. Consumption of cooked leaves are used in the management of breast cancer.
7	*Areca catechu* L.	Kavungh	Herb	Arecaceae	Shoot apex	Drinking about 100 mL juice of crushed shoot apex mixed with salt can cure pain after delivery.
8	*Aristolochia indica* L.	Eswara Mulla	Herb	Aristolochiaceae	Leaf, Root	Grinded leaves and roots to a snake bite to help neutralize venom.
9	*Artocarpus heterophyllus* Lam.	plavu	Tree	Moraceae	Leaf, bark	Drinking the water boiled with leaves of *Artocarpus*, ummam and pepper to cure body pain. Yellow exudation from the bark is applied on the face for curing mumps.
10	*Asparagus racemosus* Willd.	Shatavari	Climber	Asparagaceae	Rhizome	Drink the water boiled with rhizome for curing stomach ulcer, drink the juice of crushed rhizome for stomach ache.
11	*Azadirachta indica* A. Juss.	Aryaveppu	Tree	Meliaceae	Leaf	Bathing in water boiled with leaves can be used to cure allergy and scars appeared on skin due to chicken pox. Decoction of the roots of *Azadirachta indica* mixed with garlic is used for toothache. Drinking the mixed juice of *Azadirachta indica* and *Phyllanthus amaraus* leaves can cure jaundice.
12	*Bacopa monnieri* (L.) Wettst.	Brahmi	Herb	Plantaginaceae	Leaf	Decoction of the leaf is used as a memory enhancer. Leaf paste added to the milk and given to the children helps improve speech ability.
13	*Bambusa vulgaris* Nees	Mula	Tree	Poaceae	Shoot apex	Shoot apex of *Bambusa* can cure any tissue inflammation in the body.
14	*Benincasa hispida* (Thunb.) Cogn.	Kumbalanga	Climber	Cucurbitaceae	Leaf	Apply ground leaves to the burned area
15	*Beta vulgaris* L.	Beetroot	Herb	Amaranthaceae	Rhizome	Eating cooked beetroot used for blood purification.
16	*Biophytum sensitivum* (L.) DC.	Mukkutti	Herb	Oxalidaceae	Whole plant	Paste of the whole plant part is applied on the forehead for headache. It is crushed and added to honey for cough.
17	*Boerhavia diffusa* L.	Thazhuthama	Herb	Nyctaginaceae	Leaf, stem	Decoction of the leaf and stem orally taken for kidney disorders.
18	*Caesalpinia bonduc* (L.) Roxb.	Kazhanjikkuru	Climbing shrub	Caesalpiniaceae	Seeds	Seeds are roasted and crushed then mixed with curd or honey and taken for stomach disorders.
19	*Calotropis gigantea* (L.) W.T.Aiton	Erikk	Shrub	Apocynaceae	Leaf	Leaves boiled with oil then applied on the knee for pain at night.

… *Contd*.

Table 1 — Utilisation of medicinal plants by the Adiyan tribal community in Mananthavady taluk of Wayanad district, Southern Western Ghats, India (Contd.)

Sl. No	Botanical Name	Vernacular Name	Habit	Family	Parts Used	Medicinal Uses
20	*Carica papaya* L.	Karumoosa	Tree	Caricaceae	Latex, Leaf, Fruit	Leaves boiled in water and bath in it which cure body pain. Raw fruit dipped in latex and roasted directly from fire and consumed for worm infestation.
21	*Catharanthus roseus* (L.) G.Don	Nithyakalyani, Kuppavela	Herb	Apocynaceae	Whole plant	Plant decoction is consumed for curing diabetes.
22	*Centella Asiatica* (L.) Urb.	Muthill, kodangal	Herb	Apiaceae	Leaf	Decoction is orally taken for curing urinary tract infection. Crushed leaves taken for body pain and stomach ache.
23	*Citrus limonum* Risso	Cheunarangha	Tree	Rutaceae	Fruit	Fruit juice is taken with warm water to soothe sore throat.
24	*Clematis zeylanica* Poir	Vathakkodi	Climber	Ranunculaceae	Leaf	Grinded leaves apply for wound healing. steam the water boiled with leaves of *clematis zeylanica* and stem of *Piper nigrum* for curing toothache.
25	*Clitoria ternatea* L.	Sankhupushpam	Climber	Fabaceae	Root	Roots boiled with water and taken to cure stomach ache.
26	*Coccinia grandis* (L.) Vogt	Kovakka	Climber	Cucurbitaceae	Fruit	Consumption of the fruit of *Coccinia grandis* is traditionally used for the management of Diabetes.
27	*Cocos nucifera* L.	Thengh	Tree	Arecaceae	Root	Roots are boiled with water and the liquid is drunk to cure urinary tract infection.
28	*Commiphora caudata* (Wight & Arn.) Engl.	Idinjil	Tree	Burseraceae	Bark	A paste prepared from the crushed bark is mixed with egg yolk and Ragi is applied for the management of bone fracture.
29	*Coriandrum sativum* L.	Malli	Herb	Apiaceae	Seeds	Drink the water boiled with seeds for diabetes. Wash eyes with water boiled with seed of coriandrum to help reduce glaucoma.
30	*Curculigo orchioides* Gaertn.	Nilappana	Herb	Hypoxidaceae	Rhizome	Powder of dry rhizome boiled in milk and consumed to cure asthma.
31	*Curcuma longa* L.	Manjal	Herb	Zingiberaceae	Rhizome	Powder of rhizome dissolved in ghee and consumed orally for curing stomach ache. mixture of Turmeric and slaked lime used against rashes on the body and honey bee bite. Turmeric mixed with leaves of *Senna tora* is used for wound healing.
32	*Cyanthillium cinereum* (L.) H.Rob.	Poovamkurunnila	Herb	Asteraceae	Bud, leaf, flower	Drinking the juice of crushed leaves can make blood pure. Buds, flowers and leaves are crushed and applied for curing eye diseases.
33	*Cyathula prostrata* (L.) Blume	Cherukadaladi	Herb	Amaranthaceae	Stem, leaf	Crushed leaves and stem mixed with milk and drunk before 7 days of menstruation to reduce pain.
34	*Cynodon dactylon* (L.) Pers.	Karuka	Herb	Poaceae	Whole plant	Crushed plant parts boiled with water and drunken for kidney disorders. Plant parts boiled with oil and applied on the hair for reducing hair fall.
35	*Datura stramonium* L.	Ummam	Shrub	Solanaceae	Leaf	Drink water boiled with leaves of *Datura*, *Artocarpus heterophyllus* and *Piper nigrum* seeds for curing body pain.
36	*Desmodium triflorum* (L.) DC.	Nilamparanda	Herb	Fabaceae	Whole plant	Crushed plant parts are applied on the body during bathing for curing itching.
37	*Eleusine coracana* Gaertn.	Muthari	Herb	Poaceae	Seeds	Ragi powder boiled in water makes baby food good for health. Ragi mixed with water, egg yellow and bark of idinjil is applied for bone fracture.
38	*Emilia sonchifolia* DC.	Muyalcheviyan	Herb	Asteraceae	Stem, leaf	Juice of Crushed stem and leaves are mixed with turmeric used for body swelling.
39	*Erythrina variegata* L.	Murikk	Tree	Fabaceae	Leaf	Grinded leaves applied on the burning area.

… *Contd.*

Table 1 — Utilisation of medicinal plants by the Adiyan tribal community in Mananthavady taluk of Wayanad district, Southern Western Ghats, India (Contd.)

Sl. No	Botanical Name	Vernacular Name	Habit	Family	Parts Used	Medicinal Uses
40	*Ficus racemosa* Willd.	Athi	Tree	Moraceae	Root	Drink the water boiled with roots of Aathi for reducing blood pressure.
41	*Garcinia gummi-gutta* (L.) N.Robson	Kudampuli	Tree	Clusiaceae	Fruit	Fruit of garcinia is made into oil and mixed with peppercorns and garlic. Then it is eaten for curing ulcer.
42	*Gloriosa superba* L.	Menthonni	Climber	Colchicaceae	Rhizome	Rhizome grinded with red ochre applied for spider poisoning. Rhizome extract applied during childbirth for reducing labour pain.
43	*Glycosmis pentaphylla* (Retz.) DC.	Paanal	Shrub	Rutaceae	Leaf	Crushed leaves and of *Glycosmis* is mixed with crushed *Azadirachta* leaves and turmeric are consumed for stomach ache.
44	*Helicteres isora* L.	Idampirivalampiri	Shrub	Sterculiaceae	Seeds	Seeds are used for making hair oil for curing dandruff.
45	*Hemidesmus indicus* (L.) R.Br.	Nannaari	Climber	Apocynaceae	Root, rhizome	Drink the water boiled with rhizome and roots for curing stomach ache and blood purification.
46	*Hibiscus rosa-sinensis* L.	Chembarathi	Shrub	Malvaceae	Leaf	Crushed leaves applied on the scalp for curing dandruff.
47	*Hygrophila auriculata* (Schumach.) Heine	Vayalchulli	Herb	Acanthaceae	Leaf	Drink water boiled with leaves is used for curing urinary problems.
48	*Ipomoea mauritiana* Jacq.	Palmuthak	Climber	Convolvulaceae	Leaf, root	Grinded leaves and roots applied externally for headache and fever.
49	*Justicia adhatoda* L.	Adalodakam	Shrub	Acanthaceae	Leaf, root	Decoction is taken orally for curing cough, cold and asthma.
50	*Justicia gendarussa* Burm.f.	Vathamkolli	Shrub	Acanthaceae	Leaf	Decoction is taken for curing rheumatism, arthritis, inflammation.
51	*Lantana camara* L.	Konghini	Shrub	Verbenaceae	Whole plant	Powder of dried whole plant part mixed oil and applied for burnings.
52	*Lobelia nicotianifolia* B.Heyne *ex* Roth	KattuPukayila	Shrub	Campanulaceae	Leaf	Bath in the water boiled leaves for curing rheumatism.
53	*Leucas aspera* (Willd.) Link	Thumba	Herb	Lamiaceae	Leaf	Decoction is taken to stop bleeding in the head. decoction taken drop by drop through nostrils during epilepsy.
54	*Maranta arundinacea* L.	Koova	Herb	Marantaceae	Rhizome, stem, root, leaf	Plant part is dried and made into powder, this powder boiled with water and drink for curing urine infection.
55	*Pongamia pinnata* (L.) Pierre	Ungh	Tree	Fabacaea	Bark	Crushed bark is given to newborn babies during delivery for cleaning their stomach.
56	*Mimosa pudica* L.	Thottavadi	Herb	Mimosaceae	Root, stem, leaf	Drink water boiled with the whole plant part for ulcer. Grinded leaves are applied for headache. Paste of root or stem or leaf applied for wound healing.
57	*Momordica dioica* Wall.	Kattupaval, Erumappaval	Climber	Cucurbitaceae	Leaf	Eat grinded leaves mixed with turmeric and mustard, Drink boiled water with grinded leaves, both remedies are used for curing rabies.
58	*Moringa oleifera* Lam.	Muringha	Tree	Moringaceae	Bark, leaf	Drink water boiled with crushed bark of *Moringaoleifera* for curing stomach ache.
59	*Mussaenda frondosa* Roxb.	Musanda, vellila	Shrub	Rubiaceae	Leaf	Grinded leaves are applied on the head as a shampoo for dandruff.
60	*Myristica fragrans* Houtt.	Jathikka	Tree	Myristicaceae	Seed	Grinded seeds mixed with honey and consumed for curing stomach ache for children.
61	*Naringi crenulata* (Roxb.) Nicolson	Nerinara	Tree	Rutaceae	Leaf	Drink leaf juice for curing stomach disorders.
62	*Ocimum tenuiflorum* L.	Thulasi	Herb	Lamiaceae	Leaf, inflorescence	Decoction of *Ocimum tenuiflorum* is used for curing cough, cold, fever. steam inhalation using water boiled with leaves is used to relieve breathing problems. extract of crushed inflorescence applied in the eye for curing irritation in the eye.

… *Contd*.

Table 1 — Utilisation of medicinal plants by the Adiyan tribal community in Mananthavady taluk of Wayanad district, Southern Western Ghats, India (Contd.)

Sl. No	Botanical Name	Vernacular Name	Habit	Family	Parts Used	Medicinal Uses
63	*Oxalis corniculata* L.	Puliyarila	Herb	Oxalidaceae	Leaf	Grinded leaves mixed with turmeric and applied on the nail for nail fungus. Grinded leaves mixed with curd and rinse in mouth for curing ulcer.
64	*Pandanus odorifer* (Forssk.) Kuntze	Kaitha	Shrub	Pandanaceae	Inflorescence	Inflorescence is mixed with honey is used for better vision.
65	*Phyllanthus amarus* Schumach. & Thonn.	Keezharnelli	Herb	Euphorbiaceae	Leaf	Consume ground leaves on an empty stomach in the morning to help treat jaundice.
66	*Physalis angulata* L.	Mottampulli	Herb	Solanaceae	Leaf	A lotion prepared from the plant extract is eaten or applied and is used for curing dermatitis, hepatitis, rheumatism, malaria, asthma.
67	*Piper betle* L.	Vettila	Climber	Piperaceae	Leaf	Juice of leaves can cure stomach ache for small children.
68	*Piper nigrum* L.	Kurumulaku	Climber	Piperaceae	Seed, leaf, root, stem	Grinded leaves or applied on the teeth for toothache. Bath in the water boiled with leaves for curing body pain. Decoction is used for cough and cold.
69	*Coleus barbatus* (Andrews) Benth. *ex* G .Don	Panikooka	Herb	Lamiaceae	Leaf	Take juice of heated leaves and consume for curing cough, cold, fever.
70	*Psidium guajava* L.	Perakka	Tree	Myrtaceae	Leaf	Drink water boiled with leaves for curing diabetes.
71	*Rhaphidophora pertusa* (Roxb.) Schott	MandilKudam	Climber	Araceae	Bark	Bark crushed with water and drink it to cure stomach ache.
72	*Rauvolfia serpentina* (L.) Benth. *ex* Kurz	Sarpagandha	Shrub	Apocynaceae	Root	Grinded root mix with hot water and eat it for stomach ache.
73	*Ricinus Communis* L.	Aavanakk	Shrub	Euphorbiaceae	Leaf, bark	Gargle the water boiled with the bark
74	*Ruta graveolens* L.	Arutha	Herb	Rutaceae	Leaf	Crushed leaves mixed with breast milk and given to babies for stomach ache and digestion problems.
75	*Scoparia dulcis* L.	Kallurukki	Herb	plantaginaceae	Whole plant	Grind the whole plant part and consume it in tender coconut water once in every day for 7 days to relieve kidney stone.
76	*Senna tora* (L.) Roxb.	Thakara	Herb	Fabaceae	Leaf	Apply Crushed leaves mixed with turmeric on a poisonous bite. Juice of grinded leaves apply for red eye and eye itching. Consume the juice of leaves for stomach ache.
77	*Sida cordifolia* Forssk.	Kurunthotti	Shrub	Malvaceae	Root	Decoction of its root is used for curing arthritis. For reducing back pain of the pregnant ladies consume its root with milky white asafoetida.
78	*Solanum americanum* Mill.	Manithakkali	Herb	Solanaceae	Leaf	Its leaves are crushed with peppercorns and consumed for sneezing.
79	*Solanum nigrum* L.	Kakkachappu	Shrub	Solanaceae	Leaf, Fruit	Leaf paste is used to apply externally for swelling on skin. The juice of the leaves is used for ulcers.
80	*Blainvillea acmella* (L.) Philipsons	Eripacha	Herb	Asteraceae	Flower	Flower buds are used for toothache.
81	*Strychnosnux-blanda* A.W.Hill,	Kanjiram	Tree	Loganiaceae	Seed	Grinded seeds are consumed for curing stomach ache.
82	*Strobilanthes alternata* (Burm.f.) Moylan *ex* J.R.I.Wood	Murikootti	Herb	Acanthaceae	Leaf	Crushed leaves applied for wound healing.
83	*Syzygium cumini* (L.) Skeels	Njaval	Tree	Myrtaceae	Fruit	Eating fruit can increase haemoglobin content, prevent oral infection, reduce diabetes, help weight loss and help prevent cancer.
84	*Tamarindus indica* L.	Valanpuli	Tree	Fabaceae	Leaf	Paste of Tamarind leaves, Egg, Ragi powder, Bark of *Commiphora caudata*, Leaves of *Bryophyllum pinnatum* applied for bone fracture.

… *Contd*.

Table 1 — Utilisation of medicinal plants by the Adiyan tribal community in Mananthavady taluk of Wayanad district, Southern Western Ghats, India (Contd.)

Sl. No	Botanical Name	Vernacular Name	Habit	Family	Parts Used	Medicinal Uses
85	*Tinospora cordifolia* Miers	Chittamruthu	Climber	Menispermaceae	Leaf	The leaves are crushed and applied to treat fever.
86	*Tragia involucrata* L.	Kodithoova, choriyanam	Herb	Euphorbiaceae	Leaf	Drink the juice of crushed leaves mixed with hot water for asthma and rheumatic disorders.
87	*Vanda testacea* (Lindl.) Rchb.f.	Maravazha	Herb	Orchidaceae	Leaf	Juice of crushed leaves is applied to the ear to remove any microorganisms in the ear.
88	*Vitex negundo* L.	Karinochi	Tree	Lamiaceae	Leaf	Bathing in water boiled with leaves can cure arthritis and rheumatism. Drinking the juice of crushed leaves can cure mouth ulcers.
89	*Wrightia tinctoria* B.Heyne *ex* Roth	Danthapala	Tree	Apocynaceae	Bark	Crushed bark is applied to treat psoriasis and toothache.
90	*Zingiber officinale* Roscoe	Inji	Herb	Zingiberaceae	Rhizome	Drinking water boiled with rhizome is used for suffocation. drink the water boiled with ginger rhizome and peppercorn for curing digestive problems.

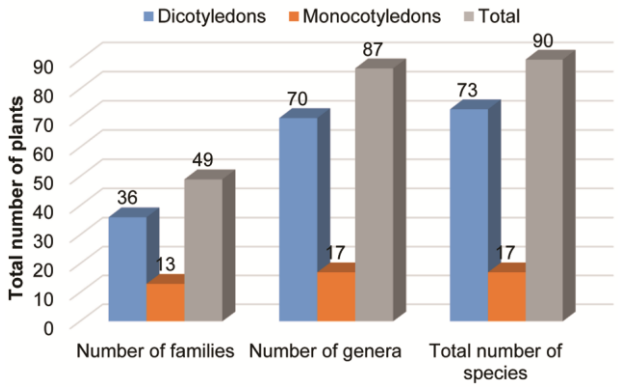


Fig. 5 — Numerical representation of medicinal plants used by the Adiyan tribes

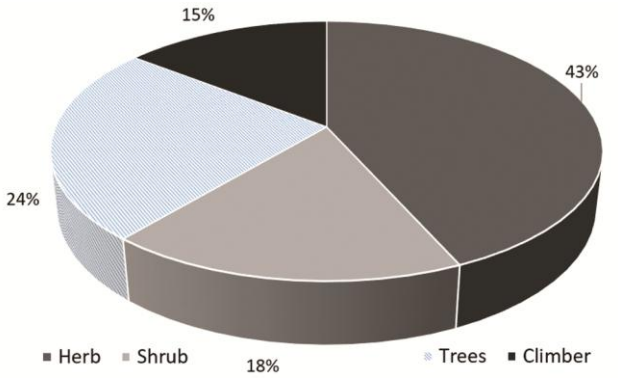


Fig.6 — Percentage of life forms of medicinal plants used

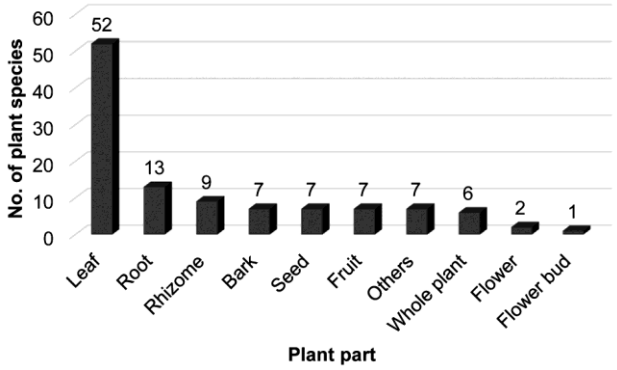


Fig.7 — Plant parts used for the preparation of medicine

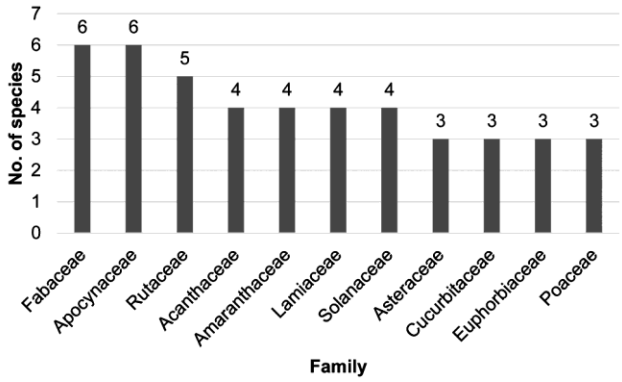


Fig.8 — Dominance of families

Fidelity level (FL)

Many plant species are used to treat different diseases. Fidelity level indicates the percentage of informants who report the use of a particular plant species for the same specific ailment. In this study, FL ranged from 5% to 100% (Supplementary Table S2). 60 plants have the highest FL value (100%), *Syzygium cumini* (L.) Skeel has the lowest FL value (5%). A high FL value indicates that many informants recommend specific plants as medicine for a particular category of ailments. In contrast, a low FL

value indicates that some plants have multiple uses for the treatment of various ailments.

Index of agreement on remedies (IAR)

The importance of each species in treating specific group of ailments was assessed using the IAR value, which reflects the availability of plants in the study area for disease treatment. IAR ranges from 0 to 1. A high IAR indicates strong agreement among informants in taxon selection, while a low value indicates disagreement. In this study highest IAR value 1 is obtained for *Hygrophila auriculata* (Schumach.) Heine and *Strobilanthes alternata* (Burm.f.) Moylan *ex* J.R.I. Wood and the lowest IAR value 0.5 is obtained for *Wrightia tinctoria* B. Heyne*ex* Roth (Supplementary Table S1).

Cultural importance index (CII)

The Cultural Importance Index (CII) is a quantitative ethnobotanical metric designed to evaluate the cultural significance of plant species by assessing the diversity of their uses and the frequency with which they are mentioned by informants, thereby reflecting their widespread usage and ethnobotanical importance. In this study, CII ranges from 0.02-4.8 (Supplementary Table S2). *Ocimum tenuiflorum* L. has the highest CII value, 4.8 and *Rhaphidophora pertusa* (Roxb.) Schott, *Alstonia scholaris* (L.) R.Br., *Benincasa hispida* (Thunb.) Cogn. has the lowest CII value, 0.02. The highest value of CII indicates that a particular plant has high cultural importance, and the lowest value of CII indicates that the plant has less cultural importance.

Frequency citation (FC)

FC represents the number of informants who reported using a particular species. In this study, FC ranges from (0.08-5.52). *Curcuma longa* L. has the highest FC value (5.52), and *Benincasa hispida* (Thunb.) Cogn, *Pandanas odorifer* (Forssk.) Kuntze, *Glycosmis pentaphylla* (Retz.) DC., *Alstonia scholaris* (L.) R.Br. and *Raphidophora pertusa* (Roxb.) Schott have the lowest FC value (0.08). A high FC value indicates that more informants mentioned the use of a particular plant, and a low FC value indicates that fewer informants mentioned the use of a particular plant (Supplementary Table S1).

Relative frequency citation (RFC)

Curcuma longa L. exhibited the highest Relative Frequency of Citation (RFC) among the documented medicinal plants, indicating its widespread recognition and frequent utilization among the informants. The species was followed by *Piper nigrum* L. (4.48) and *Azadirachta indica* A.Juss (4.16). *Benincasa hispida* (Thunb.) Cogn, *Pandanas odorifer* (Forssk.) Kuntze, *Glycosmis pentaphylla* (Retz.) DC., *Alstonia scholaris* (L.) R.Br. and *Raphidophora pertusa* (Roxb.) Schott which also demonstrated considerable ethnomedicinal relevance among the local population.

Family importance value (FIV)

The family importance value indicates the significance of the plant family for a specific medicinal plant. In this study, FIV ranges from 0.08-9.68. High FIV indicates that the species belongs to the particular family was cited by more informants. The lowest FIV value indicates that the species belongs to a particular family that is cited by fewer informants. The Lamiaceae family has a high FIV value of 9.68, followed by Zingiberaceae (8.32). The families Pandanaceae and Araceae have the lowest FIV value of 0.08, and it is cited by only a few informants (Supplementary Table S1).

Discussion

Informant demography and Medicinal plant diversity

The current study examined 47 informants, comprising 20 males and 27 females, aged 20-90. Since most responders were women, they used traditional medicine to heal themselves and their children. Female participants were more common because they preserve local plant knowledge[23]. The ethnic demographics of the region shows that most people live in rural regions and depend on natural resources and vegetation for sustenance. Plants are the village's main food source[3]. The Adiyan community in Mananthavady taluk uses 90 medicinal plant species, representing 87 genera and 48 families, to treat various illnesses. Indigenous knowledge must be documented to preserve tribal uniqueness and customs. The current study shows that Adiyan population utilise medicinal plants to treat gastrointestinal, respiratory, snakebite, ophthalmic, arthritis, cancer, and rheumatism. Similar observations were reported among the Adiyan community of Wayanad district, Kerala, where medicinal plants were documented for managing a wide range of human ailments including digestive disorders, respiratory complaints, inflammatory conditions, and poisonous bites[24]. The similarity

between the findings indicates the continued dependence of the Adiyan community on traditional herbal medicine and reflects the persistence of indigenous knowledge across generations. Herbs (39 species; 43%) most dominated the plant habit, followed by shrubs trees (22 species; 25%), Shrubs (16 species, 18%) and climbers (13 species; 14%). Herbs are more common than other habitats, indicating their therapeutic value. Due to their abundance and availability, herbs are used more often. Traditional remedies are based on herbaceous plants since they contain bioactive chemicals that treat numerous ailments. The present study is in agreement with earlier studies conducted by[25,26]. The study area exhibits a higher diversity of herbaceous plants, enhancing its utilisation. The Adiyans used leaves, stems, bark, flowers, flower buds, seeds, fruits, and rhizomes. Leaves are mostly used medicinally. These findings corroborated prior research that healers generally utilised leaves to prepare medicines[11,27,28]. Among the various medicinal plant families represented, Fabaceae and Apocynaceae are the most dominant family in terms of species richness, followed by Rutaceae, Poaceae, Cucurbitaceae, Asteraceae, and Euphorbiaceae. It has been reported that the members of Fabaceae represent the dominant families in the studies of[25,29,30]. *Azadirachta indica* A.Juss., one of the most prominent herbal medicines mainly used for treating several gynaecological problems like dismenorrhea, chronic joint pain, constipation, intestinal worms, and also preferred for diabetes and rheumatic arthritis[31]. Bioactive metabolites such as phenolics, alkaloids, flavonoids, carotenoids, and terpenoids confer black pepper's pharmacological properties. These chemicals are antibacterial, anti-inflammatory, and digestive, that's why black pepper is used to treat intermittent fever, dysentery, stomach ache, intestinal worms, and piles. Traditional medicine and modern science agree that dried black pepper seeds have many health advantages[32].

Use value (UV)

In contrast to the findings of Thongkhao *et al.*[33] who reported *Vitex negundo* as the species with the highest use value followed by *Curcuma longa*, the present study recorded *Curcuma longa* as the species with the highest use value. This variation may be due to differences in plant availability, traditional therapeutic practices, and the medicinal preferences of the informants in the study area. *Curcuma longa* has been extensively reported for its anti-inflammatory, antioxidant, antimicrobial, wound healing, and hypoglycemic activities, mainly due to the presence of curcumin and other bioactive compounds in its rhizome[34].

Informant consensus factor (ICF)

In contrast to the findings of Sureshkumar *et al.*[24] who reported the highest ICF values for poisonous bites and respiratory disorders, the present study recorded the highest ICF value for viral diseases. This variation may be attributed to differences in disease prevalence, healthcare practices, and ethnomedicinal knowledge among the informants in the study area. This ICF value helps the pharmacological and phytochemical industry in developing new drugs[34]. The most significant ICF for viral disease showed that these diseases are frequent in the study area owing to changing food choices, environment, and informant communication for treatment. Oncology-related diseases (0.75), eye illnesses (0.8), etc. had the least agreement amongst informants. Low ICF values for various illness categories in this study may be due to insufficient communication among local populations about disease treatments within the study region. The presence of plant species utilised to cure various disorders may also affect these results[35].

Fidelity level (FL)

According to local informants, plants with the greatest fidelity level (FL) values may have considerable therapeutic potential for certain disorders[11]. This study reported 60 species with 100% FL to cure different ailments, meaning that interviewees always selected the same species. Only eight of the 47 informants utilised *Acorus calamus* L. for stomach pain, but all of them used this plant to treat stomach pain, which gives the plant 100 % FL value. *Asparagus racemosus* Willd., *Myristica fragrans* Houtt., *Glycosmis pentaphylla* (Retz.) DC., *Ruta graveolens* L., *Zingiber officinale* Roscoe, *Commiphora caudata* Engl., *Tamarindus indica* L., *Bambusa vul*garis Nees, *Justicia adhatoda* L., *Solanum americanum* Mill., *Erythrina variegata* L. Schumach. & Thonn., *Aristolochia indica* L. are reported to have 100% FL value in treating a specific disease.

Index of agreement on remedies (IAR)

The IAR value indicates the relative importance of each species in treating specific disease categories. IAR levels depend medicinal plant availability in the

research area also[36,37]. The IAR ranges from 0 to 1. High IAR values indicate informant consensus on taxonomic selection, whereas low values indicate disagreement. The study found that *Wrightia tinctoria* (Roxb.) R.Br. had the lowest IAR value of 0.5, and *Hygrophila auriculata* (Schumach.) Heine the highest (1). The high IAR of *Hygrophila auriculata* likely results from its established therapeutic efficacy and broad pharmacological activities, including antimicrobial, anti-inflammatory, hepatoprotective, nephroprotective, antidiabetic, antioxidant, and anticancer effects[38].

Cultural importance index (CII)

Due to its extensive therapeutic uses and profound religious significance, *Ocimum tenuiflorum* L. was emphasised as a plant with great cultural value. The cultural significance index (CI) highlights species that represent informant consensus while considering its numerous uses[39]. *Aegle marmelos* (L.) Correa is important to Indian culture and ethnobotany, but its commercial potential is underutilised. Promoting large-scale commercial production might help save this near-threatened species[40].

Frequency citation (FC) and Relative frequency citation (RFC)

Frequency citation (FC) is widely used in ethnobotanical research. In this study, FC values ranged from 0.08 to 5.52, showing different levels of association among informants. *Curcuma longa* L., exhibiting the highest FC value (5.52) and RFC Value (5.52), is well recognised and commonly utilised, underscoring its significant ethnomedicinal importance. *Curcuma longa* L. has been reported to exhibit the highest frequency of citation in other ethnobotanical studies also[41]. The frequency of citations highlights the sociocultural importance of medicinal plants in shaping perceptions of their therapeutic effectiveness[42].

Family importance value (FIV)

In this study, FIV ranged from 0.08-9.68. A high FIV indicates that more informants reported a species in a family. The minimal FIV value signifies that the species is associated with a certain family, as reported by a limited number of informants. Lamiaceae has a high FIV of 9.68, followed by Zingiberaceae at 8.32. The present finding is in agreement with the study conducted by Ali *et al.*[43] where Lamiaceae exhibited the highest Family Importance Value (FIV) among the documented plant families. A small number of informants reported the lowest FIV value of 0.08 for Pandanaceae and Araceae[44]. The significance of a plant family escalates as the frequency of citations for all species rises. FIV measures species and plant family significance. This illustrates the importance of family in an area[45].

Conclusion

According to this study, the Adiyan tribal community in Mananthavady taluk of Wayanad district still uses certain traditional remedies. Since this traditional knowledge is largely passed down orally, just a few Adiyans know about these plants. Modernisation, urbanisation, industrialisation, habitat degradation, and human encroachment are eroding traditional wisdom. The indigenous society believes that sharing plant therapeutic properties with civilisation will reduce their potency.

Tribal ethnicity, variation, and customs must be preserved through indigenous knowledge recording. The Adiyan community uses medicinal herbs to treat rheumatism, arthritis, cancer, snakebite, gastrointestinal issues, and respiratory ailments, according to this study. This ethnobotanical survey revealed the medical uses of 90 plants from 87 genera and 48 families reported by 47 informants, 20 males and 27 females aged 20-90. Plant collections and images are used to gather data. The most common herb for wound healing and gastrointestinal issues is *Curcuma longa* L. Toothache, body pain, cough, and cold symptoms are treated by *Piper nigrum* L. *Ocimum tenuiflorum* L. treats respiratory difficulties, fever, and eye pain.

Quantitative studies show this traditional knowledge is scientifically important for communities and future generations. The plants with highest use values are *Curcuma longa* L. (1.4) and *Ocimum tenuiflorum* L. (0.9), while the lowest are *Glycosmis pentaphylla* (Retz.) DC. and *Pandanus odorifer* (Forssk.) Kuntze (0.02). More phytochemicals may be found in plants with better fidelity and use value. The lowest FC value is 0.08 which is represented by 5 species, while the highest is 5.52 in *Curcuma longa* L. About 60 plant species have 100% Fidelity level. The high fidelity and use value imply they contain phytochemicals that can cure a variety of illnesses. The findings contribute valuable baseline data for biodiversity conservation, preservation of indigenous knowledge systems, and future pharmacological exploration of traditionally used medicinal plants.

Supplementary Data

Supplementary data associated with this article is available in the electronic form at https://nopr.niscpr.res.in/jinfo/ijtk/IJTK_25(10)(2026)959-974_SupplData.pdf

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Author Contributions

ARE: Writing - review and editing, Writing-original draft, Methodology, Investigation Conceptualisation, SKP: Data collection, Writing-review and editing, visualisation. RR: Writing- review and editing, Conceptualisation and supervision, ST: Writing - review and editing, Conceptualisation and supervision

Conflict of Interest

The authors declare that they have no competing interests.

Ethics Approval and Prior Informed Consent

The informants were informed about the nature and purpose of the work. All the informants involved in the study have agreed to be a part of the research, and their consent for participation was obtained. The images in this paper were taken by the first author, and explicit permission was obtained from all individuals in the images before their use.

Use of Artificial intelligence (AI)

No artificial intelligence (AI) tools, including generative AI or AI-assisted writing tools, were used in the preparation of this manuscript. All aspects of the work, including study design, data collection, analysis, interpretation of results, literature evaluation, and manuscript preparation, were carried out independently by the authors. The authors take full responsibility for the originality, accuracy, authenticity, and scientific integrity of the content presented in this manuscript.

Data Availability

All data generated or analysed during this study are included in this published article and supplementary information files.

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