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In silico validation of the indigenous knowledge of the herbal medicines among tribal communities in Sathyamangalam wildlife sanctuary, India

Pavithra Chinnasamy, Rajendran Arumugam*, Sarvalingam Ariyan

Department of Botany, Bharathiar University, Coimbatore, Tamil Nadu 641 046, India

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ABSTRACT

The ethno-botanical documentation among ethnic people in Sathyamangalam wildlife sanctuary, Tamil Nadu, India has been investigated for the first time. A total of 61 medicinal plants having new combination uses were reported with adjuvant in the treatment of dermatological, Genitourinary and gastrointestinal ailments. This study could help in the recovery and conservation of traditional medicine system among educated generation. The present study was aimed to: (1) documentation of the traditional knowledge (2) quantitative analysis using Use value (UV), Informant consensus factor (ICF), Index of agreement on remedies (IAR), Relative frequency citation (RFC) and Cultural Importance index (CII) (3) validation of ethno-botanical data using *in silico* biological activity and toxicity prediction studies. Semi-structured direct interviews were conducted to acquire information from the study area tribes. Total of 89 tribes including both gender among various communities were interviewed and their ethno-botanical knowledge was documented. The data were assessed using ethno-botanical indices methods to estimate the consistency of usage herbal knowledge in various ailments. A total of 61 species were recorded for treatment of categorized ailments. The collected medicinal information from ethnic groups shows remarkable new usage of medicinal plants to particular ailments. Our comparative *in silico* studies also supported the traditional medicine results with correspondence to their bioactive. Traditional knowledge of ethnic people also linked to their culture and history. This study also infers the usage of traditional plant based medicine. Further research related to the bioactivities of reported plants should be encouraged to explore the importance in pharmaceutical industry.

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1. Introduction

Indigenous knowledge is the neighbourhood information acquired by indigenous groups that is exceptional to an ethnic society. The scientific investigation and documentation of indigenous knowledge of plant resources are vital strategy to understand traditional life style of local ethnic people.[1] The traditional herbal formulations from indigenous knowledge were considered as the oldest and great health care system. It includes plant species as regular medicine sources and still is an important system of healthcare in India.[2] Common plants with adverse effects are being a part of our daily life and their toxic metabolites are closely related in the aspect of human's health condition.[3] Traditional people are using poisonous plants either processed or as raw form over a period of time for treating diseases.[4]

The increasing interest in ethno-botanical studies also reveals their importance of traditional medicinal plants in various countries for local living holds and the important role these play in health care system.[2,5] The impact of traditionally formulated medicines from various ancient systems in the communal health condition in India is considerably elevated and is closely associated with traditions.[6] Various patented drugs and active compounds from various plant sources are also on the basis of ethno-botanical data.[7]

The ethno-botanical data analyzed with quantitative indices is assumed to expose the usage and value of the medicinal plants

* Corresponding author.
E-mail addresses: pavipkp@gmail.com (P. Chinnasamy), arajendran222@yahoo.com, drarajendra@gmail.com (R. Arumugam).

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from ethnic knowledge. These approaches measure the consent of the usage by various hypotheses and playing an important role in the further selection of biomedical analysis of a medicinal plant to treat particular ailment based on the survey results with excellent information.[8] Now days, *In silico* studies are one of the main emerging studies with the ability to predict the drug-protein interaction which relates the mechanism of action of a bioactive compounds mainly from traditional medicinal plants.[9]

So, there is an urgent requirement to document all ethno-botanical data as much as possible and the role of tribes in conserving them. Considering the importance of indigenous medicinal plant knowledge, this study aimed to identify potential medicinal plants and to evaluate *in silico* toxicological potential and biological activity of its major compounds responsible for medicinal activity.

2. Materials and methods

2.1. Study area tribal people

Sathyamangalam wildlife sanctuary located in the Nilgiri biosphere reserve covers about 1411.6 km^2 (545.0 sq mi) forest area along the Western Ghats in Tamil Nadu, India (Fig. 1). This forest is mostly tropical dry forest and restricted to undersized high altitude hill tops between 750 and 1649 m above mean sea level and the slopes and plains are subjected to the average minimum and maximum temperatures of 21–27 °C with two persistent rivers namely Bhavani and Moyar. Uralis are the main ethnic group to this forest with some minor groups includes Soliga, Malayalee and Naicker communities.

2.2. Data collection

The field surveys were conducted between May 2015 and September 2016 in proposed study area and various ethnic community people were randomly interviewed after verbally requested about the purpose of the project in the local language. In this study, 89 informants including traditional herbalist and local people were interviewed and their knowledge on medicinal plants was gathered and documented mostly by Tamil and sometime the Urali language was translated to Tamil using local translator.

2.3. Botanical identification

The collected plants were identified with help of pertinent literature and also authenticated by comparing the species deposited in Madras Herbarium (Botanical Survey of India, Coimbatore). The processed specimens were mounted on herbarium sheets using standard procedures and were deposited for future reference at the Department Herbarium of Bharathiar University.

2.4. Ethno-medicinal data analysis

The recorded data were tabulated using Microsoft Excel and then analyzed with various ethno-botanical reports such as research and review articles, books, in scientific databases to find out the uses of unknown or well-known medicinal plants. The ethno-medicinal quantitative indices were used for interpreting this entire information.

Use reports were calculated by converting collected data with reference to the previous published articles related to quantitative ethno-botanical surveys. These use-reports about medicinal plants were then grouped into 14 ailments categories based on the collected ethno-botanical details from informants. These data were assessed with quantitative indices, such as Informant consensus factor, Fidelity level, Frequency citation and Use value, were calculated from the gathered information. The new medicinal uses from the study area are identified by comparing previous reports on the particular area and related regions of south India.

2.4.1. Informant consensus factor (ICF)

ICF was calculated to highlight the usage of the relevant plants among various informants for each aliments category. The ICF value was calculated by minus the total use citations in each category (Nur) with the total number of species used (nt), divided by the total number of use citations minus one as follows:

$$\boldsymbol{ICF} = (\boldsymbol{Nur} - \boldsymbol{Nt}) / (\boldsymbol{Nur} - 1)$$

The ICF value of approach to 0 indicates that the informants randomly use the species in the treatment of various ailments, and a value of approach to 1 indicates that relatively usage of the species by a large population to a particular ailment.[10]

2.4.2. Fidelity level (FL) and index of agreement on remedies (IAR)

The importance of each species in the treatment of particular illness group was determined by FL and IAR values. A high ratio indicates common use of the ideal plant species for treating specific ailment in the studied area.[11] The fidelity level was calculated as follows:

$$\boldsymbol{FL}\,(\%) = (\boldsymbol{Np}/\boldsymbol{N} \times 100)$$

The FL is the ratio of number of informants who suggesting the plant as medicine for a particular ailment category (Np) and total number of informants who suggesting the plant for any ailment category (N).

$$\boldsymbol{IAR} = (\boldsymbol{Nr} - \boldsymbol{Na}) / (\boldsymbol{Nr} - 1)$$

Where, Nr is the total number of citations registered for a particular species and Na is the number of illness categories that are treated with this species.

2.4.3. Frequency citation (FC) and relative frequency citation (RFC)

The relative expression of usage (FC) is calculated as follows:

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

The RFC value was obtained by dividing the FC by the total number of informants interviewed (N) and not based on used categories. When the RFC value will be approach to zero, it refers, nobody suggests the plants as useful, and when its approach to one, it refers that every informant would suggest as useful and the RFC was calculated as follows:[12]

$$\boldsymbol{RFC} = \boldsymbol{FC}/\boldsymbol{N}$$

2.4.4. Use value (UV) and Cultural importance index (CII)

The importance of each plant species among ethnic people was determined by UV and CII.[12] Based on, the vast usage of a particular ethnically important medicinal plant species was identified using CII value. The use value of a species (UV) is the summation of the number of use reports for the specific plant species (U) and is divided by the total number of informants (N) interviewed. If the use value is high, it indicates the many use reports and important of the plant, and low value indicates the fewer use reports. These were calculated as follows

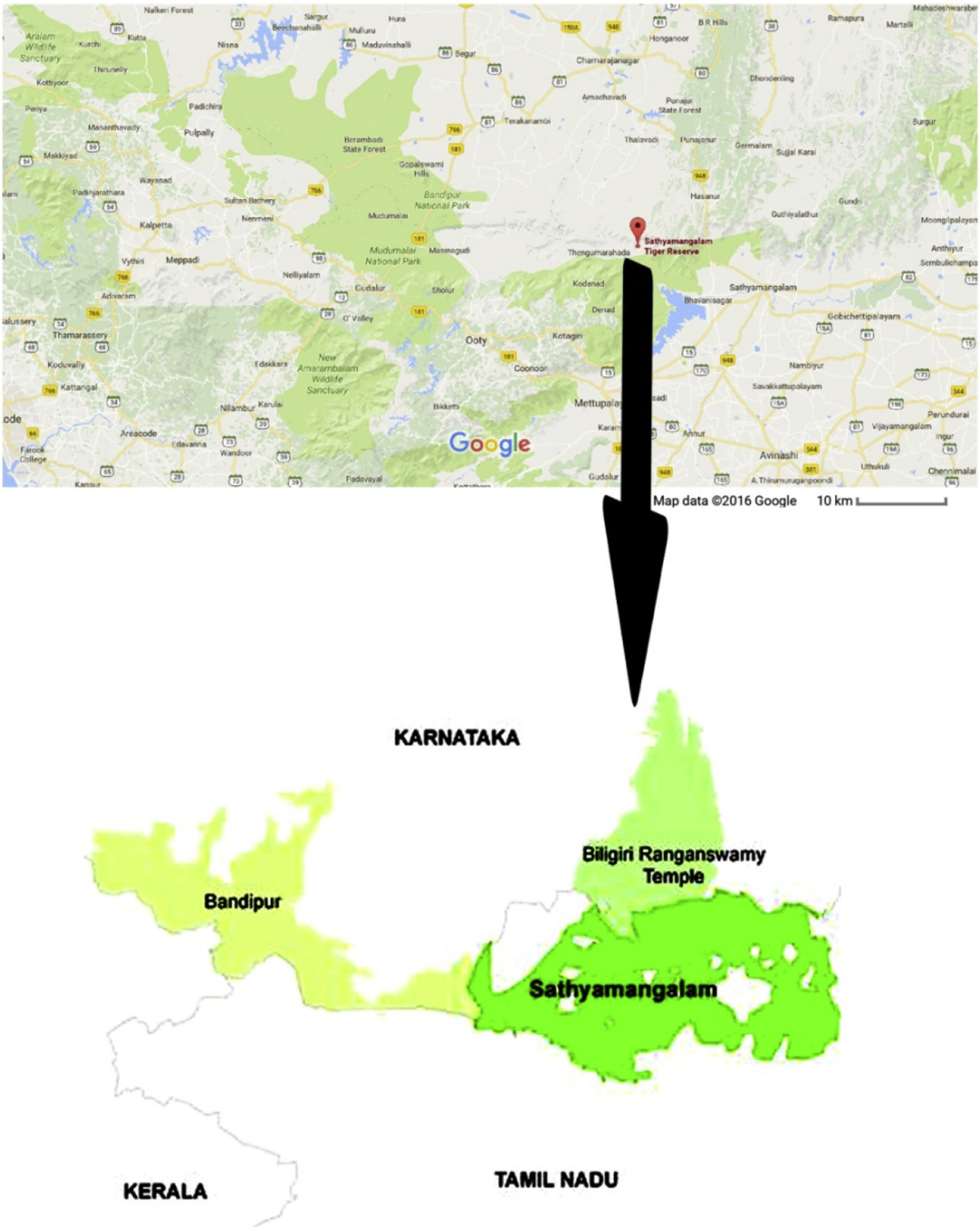


Fig. 1. Study area.

$$UV = \sum UR/N$$

$$\mathbf{CII} = \sum_{u=u1}^{unc} \sum_{i=i1}^{in} \frac{URi}{N}$$

Where NC is the total number of different illness categories for each species, UR is the total number of use citations for each species, and N is the number of informant's interviewed. The ethno-botanical indices such as ICF, UV, RFC and FL could be used to determine the consent individual species in the treatment of an ailment category in a population.

2.5. In silico pharmacological activity and toxicity prediction

The present study employed online based computational bioactive screening (PASS) to obtain biological effects and relationship for compounds which are previously reported on plants major ethno-botanical uses in the study area.[13] The details about the compounds including structure, SMILES and molecular formula were obtained from ACS Chemspider. Probable activity (Pa) and inactivity (Pi) percentages (ranges from 0.000 to 1.000) were used to express the prediction results. Thus, in this study the higher Pa value (>0.900) and lower Pi value indicates higher activity. The adsorption, distribution and toxicity of the listed compounds were predicted by using admetSAR online prediction tool.

3. Results

3.1. Demographical description and documentation of ethno-botanical data

The ethnic people population was found limited in the study area, 89 of informants including male (58) and female (31) of various different age groups (ranges from 31 to 80 years) including 6 herbalists age ranges between 40 and 60 years belonging to the local communities were interrogated (Table 1). The collected data was divided and tabulated according to the corresponding 55 biomedical symptoms into 14 major ailment categories (Tables 2 and 3) respectively to the local term used. When compared to all major ailments categories gastrointestinal ailments had reported with high number of citations (375 citations of 22 plants) which was followed by dermatological (333 citations of 19 plants) and genitourinary ailments category (222 citations of 9 plants) respectively (Table 3). The gastrointestinal (36%) and dermatological ailment category (31%) (Fig. 2) were cited as most treating ailments in the survey. A total of 61 plants species and 54 genera distributed over 23 families with various beneficial effects cited in the present study, particularly 15% of Fabaceae and 10% of Rutaceae (Fig. 3). The usage of different parts of medicinal plant used in traditional medicine were calculated in percentage, among various parts used the leaf showed highest (51%), followed by seeds, fruit, stem and rhizome

Table 1
Demographic representation of informants by age group in Sathyamangalam wildlife sanctuary, India.

Age group of informants (In years)	Local people		Herbalists
	Male (58)	Female (31)	
31–40	28	16	
41–50	15	5	4
51–60	9	8	2
61–70	4	2	
71–80	2		

Table 2
List of ailments category with its corresponding tamil terms used by the tribes in Sathyamangalam wildlife sanctuary, Tamil Nadu, India.

S. No	Ailment category and Biomedical terms	Tamil terms
1	**Circulatory system ailments**	
	Anemia	Raththa soagai
	Heart problem	Idhaya pirachanai
	Cardio tonic	Idhaya valimai
	Blood tonic	Raththa perukki
2	**Dermatological ailments**	
	Burns	Theekkaayam
	Itch	Namaichaal
	Wounds	Kaayam
	Rash	Sori
	Inflammation	Udaleritchal
	Skin disease	Tholnoikal
	Mouth ulcer	Vaaippun
	Leprosy	Thoalunoi
	Skin lotion	Sarumamarunthu
	Bacterial and fungal diseases	Thotrunoi
3	**Ear, nose, throat ailments**	
	Gums ache	Eeralvali
	Earache	Kathu vali
4	**Eye ailments**	
	Eye diseases	Kannoikal
5	**Endocrinal ailments**	
	Diabetes	Sakkara/Neerilivunoi
6	**Fever ailments**	
	Fever	Kaaichal
7	**Gastrointestinal ailments**	
	Dysentery	Vayitrupoakku
	Indigestion	Ajeeranam
	Vomiting	Vaandhi
	Stomach ache	Vayitruvali
	Stomach ulcer	Vayitrupun
	Abdominal pain	Adi Vayitruvali
	Digestion disorders	Jeeranam kolarugal
	Gas trouble	Vaaivuthoandharuvu
	Intestinal disorders	Kudalkoalaarugal
	Diahhroea	Neerpokku
8	**Genitourinary ailments**	
	Bladder infection	Siruneerppaithotru
	Diuretic	Siruneerperukki
	Urinary disorders	Siruneerkoalaarugal
	Kidney stone	Siruneer kalladappu
	Leucorrhoea	Vellaipaduthal
	Venereal diseases	Paalvinainoikal
	Jaundice	Manjalkaamalai
	Liver diseases	Kalleeralnoikal
	Abortion	Karukallaipu
9	**Hemorrhoids ailments**	
	Piles	Moolam
10	**Neurology ailments**	
	Headache	Thalaivali
11	**Oncology ailments**	
	Cancer	Katti
12	**Poisonous bites ailments**	
	Snake bite	Paambu kadi
	Scorpion sting	Thel kadi
13	**Respiratory ailments**	
	Asthma	Kaasa noi
	Cold	Sali
	Cough	Irumal
	Breathing problem	Moochu thinaral
	Small pox	Sitrammai
14	**Skeletal muscular ailments**	
	Edema	Neer veekkam
	Joint pain	Moodu vali
	Body pain	Udal vali
	Rheumatism/Gout	Keel vaadham
	Swelling	Veekam
	Muscle pain	Thasai pidippu
	Arthritis	Moodu vali
	Paralyze	Mudakkuvadm

Table 3
Results obtained from informants belongs to Sathyamangalam wild life sanctuary, Tamil Nadu, India.

S. No	Family/ Binomial name	Vernacular name	Parts Used[a]	Method of preparation	Ailments treated	Administration route[b]	Total number of citation	UV	IAR	FC (%)	RFC
1	**Annonaceae** *Annona squamosa* L.	Seetha maram	L F	Juice Raw	Diabetes (14) Abortion (30)	O	44	0.49	0.98	49.44	0.56
2	**Asteraceae** *Spilanthes calva* Wt.	Vettumarunthuchedi	L	Paste	Wound (20)	T	20	0.22	1	22.47	0.25
3	*Spilanthes acmella* Murr.	Manjapoochedi	F	Paste	Gums ache (7)	T	7	0.08	1	7.87	0.09
4	*Tridax procumbens* L.	Mookuthhichedi	L	Juice, Paste	Wound (9)	O	9	0.10	1	10.11	0.11
5	*Eclipta prostrata* (L.)	Karisilanganni	S, L, Wp	Dried Powder	Head ache (6) Abdominal pain (13) Jaundice (9)	T/O	28	0.31	0.93	31.46	0.35
6	**Fabaceae** *Abrus precatorius* L.	Kundumani	Se, L	Decoction Powder Juice Paste Extract	Stomach ulcer (25) Abortion (20) Dystenry (6) Mouth ulcer (10) Cancer (8) Bacterial fungal infections (2)	O	71	0.80	0.96	79.78	0.90
7	*Bauhinia divaricata* L.	Aathi	L	Fumigation	Fever (15) Asthma (9)	I	24	0.27	0.96	26.97	0.30
8	*Bauhinia tomentosa* L.	Aathi	B	Paste	Diahorrea (21)	O	21	0.24	1	23.60	0.27
9	*Prosopis juliflora* (Sw.) DC.	Vannimaram	L, B	Juice Paste	Snake bite (16)	O/T	16	0.18	1	17.98	0.20
10	*Pongamia pinnata* (L.) Pierre	Pungamaram	Fl	Dried	Abdominal pain (3) Gas trouble (6) Snake bite (6) Diabetes (8)	O	23	0.26	0.91	25.84	0.29
11	*Canavalia cathartica* Thouars	Isaakottai	L	Paste	Body pain (5) Muscle pain (4)	T	9	0.10	1	10.11	0.11
12	*Tephrosia purpurea* (L.) Pers.	Kolinjii	R	Powder	Fever (5) Indigestion (4)	O	9	0.10	0.88	10.11	0.11
13	*Clitoria ternatea* L.	Sangupushpam	L	Juice	Dysentery (28) Indigestion (7)	O	35	0.39	1	39.33	0.44
14	*Sesbania grandiflora* (L.) Poir.	Agathimaram	L	Cooked	Indigestion (10) Dysentery (25) Eye diseases (8)	O	43	0.48	0.98	48.31	0.54
15	**Apocyanaceae** *Plumaria alba* L.	Ezhakalari	B, R	Paste Decoction	Cancer (12) Venereal diseases (9) Urinary disorders (20)	O	41	0.46	0.98	46.07	0.52
16	*Rauvolfia serpentina* (L.) Benth. ex Kurz	Sarpaganthi	L	Juice	Heart problem (5) Cardio tonic (9)	O	14	0.16	1	15.73	0.18
17	*Wrightia tinctoria* R.Br.	Pallayamaram	B	Paste	Itch (5) Rash (3) Wounds (10)	T	18	0.20	1	20.22	0.23
18	**Rutaceae** *Aegle marmelos* (L.) Correa	Vilvam	F, L, B	Raw Juice Decoction Paste	Fever (20) Cold (13) Fever (6) Blood tonic (8) Cancer (10)	O	57	0.64	0.95	64.04	0.72
19	*Citrus aurantiifolia* (Christm.) Swingle	Elumiccai	F	Raw	Stomach ache (29) Blood tonic (20)	O	49	0.55	0.98	55.06	0.62
20	*Citrus limon* (L.) Osbeck	Kiccilippalam	L, F	Decoction Raw	Indigestion (20) Vomiting (13)	O	33	0.37	1	37.08	0.42
21	*Toddalia asiatica* Lamk.	Masihachedi	B	Paste	Paralyze (15)	O/T	15	0.17	1	16.85	0.19
22	*Murraya paniculata* (L.) Jack	Sedisil maram	L	Paste	Wounds (20)	T	20	0.22	1	22.47	0.25
23	*Glycosmis pentaphylla* (Retz.) DC.	Molehulukki	R	Paste	Asthma (15)	O	15	0.17	1	16.85	0.19
24	**Lamiaceae** *Vitex negundo* L.	Nochi	L	Juice	Joint pain (26) Head ache (13)	O	39	0.44	0.97	43.82	0.49
25	*Ocimum basilicum* L.	Thiruneetrupachhai	L	Fumigation	Asthma (25)	I	25	0.28	1	28.09	0.32
26	*Leucas aspera* (Willd.) Link	Thumbai	Wp	Fumigation	Head ache (20)	I	20	0.22	1	22.47	0.25
27	**Euphorbiaceae** *Euphorbia hirta* L.	Ammaan pachcharsi	Wp	Powder	Leucorrhoea (28)	O	28	0.31	1	31.46	0.35
28	*Euphorbia nivulia* Buch.-Ham.	Illaikanni	L	Juice	Ear ache (14)	T	14	0.16	1	15.73	0.18
29	*Jatroba curcas* L.	Kattaamankku	B	Decoction	Stomach ache (19)	O	19	0.21	1	21.35	0.24
30	*Phyllanthus amarus* L.	Keeva nelly	R, F	Juice	Liver problems (34)	O	34	0.38	1	38.20	0.43
31	*Acalypha indica* L.	Kuppaimeni	L	Paste	Burns (10) Itch (27) Skin lotion (9) Bacterial and fungal diseases (11) Edema (18)	T	65	0.73	0.98	73.03	0.82
32	**Asclepiadaceae** *Calotropis gigantea* (L.) Dryand.	Vellai erukku	R	Paste	Rash (20) Edema (17)	T	37	0.42	0.97	41.57	0.47
33	*Calotropis procera* (Aiton) Dryand.	Erukku	L	Paste	Skin diseases (30)	T	30	0.34	1	33.71	0.38
34	*Hemidesmus indicus* (L.) R. Br. ex Schult.	Nannari	L R	Decoction	Head ache (20) Stomach disorders (20)	I/O	40	0.45	0.97	44.94	0.50
35	*Pergularia daemia* (Forssk.) Chiov.	Vellyparuthi	L	Decoction	Head ache (20)	I	20	0.22	1	22.47	0.25

(*continued on next page*)

Table 3 (*continued*)

S. No	Family/ Binomial name	Vernacular name	Parts Used[a]	Method of preparation	Ailments treated	Administration route[b]	Total number of citation	UV	IAR	FC (%)	RFC
36	**Solanaceae** *Solanum xanthocarpum* Schrad	Kandangkathhiri	F L	Cooked Paste	Intestinal disorders (10) Small pox (23)	O/T	33	0.37	0.97	37.08	0.42
37	*Solanum nigrum* L.	Chukuti chedi	L F	Cooked	Mouth ulcer (12) Intestinal disorders (19)	O	31	0.35	0.97	34.83	0.39
38	*Solanum indicum* L.	Mullu chundal	F	Cooked	Intestinal disorders (12)	O	12	0.13	1	13.48	0.15
39	*Datura metal* L.	Oomathai	L	Paste	Joint pain (14) Rheumatism/Gout (15)	T	29	0.33	1	32.58	0.37
40	**Malvaceae** *Sida acuta* Burn.	Kala karandai	L	Paste	Skin disease (23) Burns (10) Wounds (12)	T	45	0.51	1	50.56	0.57
41	*Abutilon indicum* (L.) Sweet	Thuthi	Wp, L	Cooked Paste	Piles (10) Inflammation (15) Dysentery (9)	O	34	0.38	0.94	38.20	0.43
42	**Acanthaceae** *Andrographis paniculata* (Burm.f.) Nees	Periya nangai	L	Paste Juice	Joint pain/ Rheumatism (12) Gout (5) Swelling (4) Arthritis (8) Leprosy (8) Indigestion (10)	O/T	47	0.53	0.96	52.81	0.59
43	*Justicia adhatoda* L.	Adathodai	L	Decoction	Cold (9) Cough (10) Breathing problem (7)	O	26	0.29	1	29.21	0.33
44	*Ruellia patula* Jacq.	Puni chedi	L	Paste	Fever (10)	T	10	0.11	1	11.24	0.13
45	**Pedaliaceae** *Sesamum indicum* L.	Ellu	Se, L	Powder Paste	Abortion (30) Diuretic (13) Wound (8)	O/T	51	0.57	0.98	57.30	0.64
46	**Myrtaceae** *Psidium guajava* L.	Koyyamaram	L	Paste	Indigestion (11)	O	11	0.12	1	12.36	0.14
47	*Syzygium cumini* L.	Navalmaram	F, L	Powder	Diabetes (20)	O	20	0.22	1	22.47	0.25
48	**Oxalidaceae** *Oxalis corniculata* L.	Pulichikeerai	L, R	Cooked Paste	Blood tonic (10) Fever (10)	O	20	0.22	0.95	22.47	0.25
49	**Nyctaginaceae** *Boerhavia diffusa* L.	Saranda kodi	Wp	Paste	Digestive disorder (9) Urinary tract infection (11) Bladder infection (6)	O	26	0.29	0.96	29.21	0.33
50	**Convolvulaceae** *Ipomea obscura* (L.) Ker.-Gawl	Shiruttallai	Sl	Juice	Wound (6) Fever (5)	T	11	0.12	0.9	12.36	0.14
51	*Evolvulus alsinoides* L.	Vishnukarandai	L	Paste	Burn (6) Wound (8)	T	14	0.16	1	15.73	0.18
52	*Rivea hypocrateriformis* (Desr.) Choisy	Minna chedi	L	Cooked	Indigestion (7)	O	7	0.08	1	7.87	0.09
53	**Rubiaceae** *Haldina cordifolia* (Roxb.) Ridsdale	Manja Kadambai	B	Paste	Anemia (8) Urinary disorders (12)	O	20	0.22	0.95	22.47	0.25
54	*Rubia cordifolia* L.	Chevvali kodi	L	Paste	Scorpion sting (9)	T	9	0.10	1	10.11	0.11
55	**Oleaceae** *Jasminum angustifolium* (L.) Willd.	Kattu malligai	L	Juice	Diahrroea (8)	O	8	0.09	1	8.99	0.10
56	**Poaceae** *Saccharum officinarum* L.	Karumppu	S	Juice	Rash (5)	T	5	0.06	1	5.62	0.06
57	**Mimosoideae** *Acacia nilotica* (L.) Delile	Karuvelam	L	Paste	Wound (6) Piles (3) Cough (5)	O/T	13	0.15	0.83	14.61	0.16
58	**Menispermaceae** *Cocculus hirsutus* (L.) Diels	Kattukodi	L	Paste	Blood tonic (6) Piles (4) Dysentery (8) Diabetes (2)	O	20	0.22	0.84	22.47	0.25
59	*Tinospora sinensis* (Lour.) Merr.	Seenthal kodi	L	Powder	Burn (10) Edema (12)	T	22	0.25	0.95	24.72	0.28
60	**Zingiberaceae** *Zingiber officinale* Roscoe	Injii	Rh	Paste Powder	Head ache (6) Abdominal pain (10) Gums ache (11) Digestive disorder (6) Indigestion (7)	T/O	40	0.45	0.92	44.94	0.50
61	**Sapindaceae** *Cardiospermum halicacabum* L.	Thatu putu chedi	L	Paste	Joint pain (8) Arthritis (10) Asthma (12) Swelling (4) Burn (8) Body pain (12)	T/O	54	0.61	0.96	60.67	0.68

[a] B- bark, L-leaf, S-stem, Se-seed, Fl-flower, F-fruit, R-root, Rh-rhizome, Wp-whole plant, Sl-stem latex.
[b] O- oral, T-topical, I- inhalation.

(ranges between 15 and 16%), and finally flowers (3%) with the lowest among all parts used (Fig. 4). In the studied area there were two modes are normally prescribed for administration either oral or topical in various forms such as juice, paste, cooked, decoction, etc. The paste preparation method (including extract and dried form) is the most used preparation method (47%) followed by powder and decoction (Juice) is ranges between 10 and 17% (Fig. 5).

3.2. Quantitative analysis of ethno-botanical indices

Plants with 20 or more than citations were considered as frequently cited plants and indicated by RFC which was ranges from 0.09 to 0.90 (Table 3). These plants can be explained by their reliable medicinal source among informants of studied area. In the present study, the highest number of citations was for *Abrus*

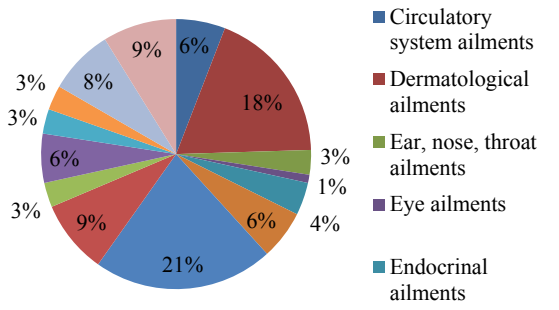


Fig. 2. Ailment percentages of reported ethno-botanical data.



Fig. 3. Family diversity of reported ethno-botanical data.

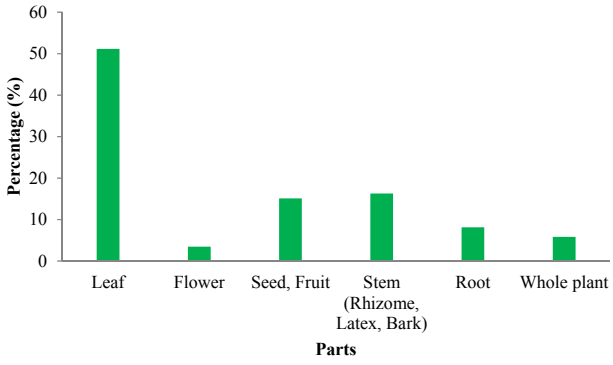


Fig. 4. Usage percentages of different parts.

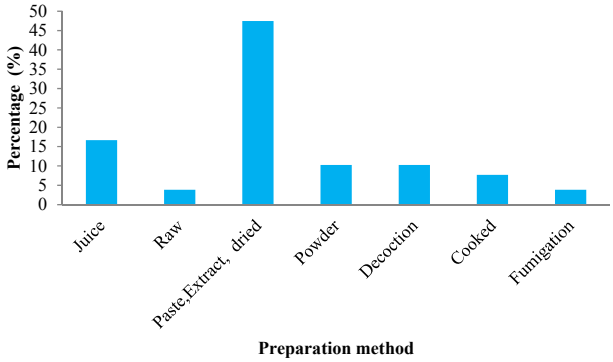


Fig. 5. Common preparation methods of medicinal plants.

precatorius L. (71 citations with RFC 0.90) used in the treatment of gastrointestinal, dermatological and oncological ailments, followed by *Acalypha indica* L. (65 citations with RFC 0.82) and *Aegle marmelos* (L.) Correa (57 citations with RFC 0.72). The higher RFC indicates the more citation (at least 40 out of 89 interviewed informants) and implies the most common medicinal plants among the tribes of Sathyamangalam wildlife sanctuary. The relative use of particular medicinal plant for treating an ailment category was highlighted by ICF value. Based on the calculated ICF values (ranges from 0.88 to 1.00) the ailments are further categorized into Higher, Moderate and Lower ICF value ailments. The eye ailment category shows highest ICF value (1.00) with 8 reports of 1 species and genitourinary (0.96), skeletal-muscular (0.96), gastrointestinal (0.96) and dermatological (0.95) ailments are also categorized as high ICF value ailments category. The moderate and lowest ICF values were observed for diseases of the circulatory system ailments (0.92) followed by Hemorrhoids ailments (0.88) (Table 4). This high value indicates the homogeneity of ethno-medicinal knowledge between the informants. Medicinally significant plant was determined by FL it was calculated for the entire ailment category and tabulated (Table 4). Hemorrhoids, oncology and eye ailments are reported as categories consists lower FL (<<50) than other ailments. Among 14 listed ailment categories 11 ailments at least have one plant had the highest FL (100%) particularly dermatological and gastrointestinal ailments were reported with high number of FL 100% plants (8 respectively). The individual with most use-reports was considered as common medicine for a particular ailment treatment. Based on the use-reports collected from ethnic people CII, UV and IAR indices were calculated to highlight the usage priority, importance, recommendation and sharing medicinal knowledge about the particular species among the informants. In this study *Abrus precatorius* L. (CII-3.191, UV-0.80, IAR-0.96), *Aegle marmelos* (L.) Correa (CII-2.562, UV-0.64, IAR-0.95), *Cardiospermum halicacabum* L. (CII-1.820, UV-0.61, IAR-0.96), *Andrographis paniculata* (Burm.f.) Nees (CII-1.584, UV-0.53, IAR-0.96), *Zingiber officinale* Roscoe (CII-1.348, UV-0.45, IAR-0.92) and *Acalypha indica* L. (CII-1.461, UV-0.73, IAR-0.98) were showed commendable values this indicates the importance of the species among the studied area tribes (Tables 3 and 4). Among 61 recorded medicinal plants from the studied area, 19 plants revealed new use reports which were identified by comparing previous reported literature (Table 5). The local names of the cited plants were almost same among all community in the study area indicates the homogeneity and relevance of particular individual species in herbal medicine.

3.3. Validation of ethno-botanical data using In silico studies

Based on the ethno-botanical uses and literature review the components of the 22 medicinal plants and their pharmacological activities were studied to validate the traditional use by *in silico* study. The biological spectrum analysis (PASS online) used to reveal the correlation between the activities of structural properties of bioactive compounds (Table 7). Previously, *Andrographis paniculata* (Burm.f.) Nees was used ethnically in the treatment of skeletal ailments but the predicted biological spectrum (PASS) results of reported compounds revealed these could acts as best hepatic agent (Pa-0.964) and anti-allergic (Pa-0.721) (Table 6). The admetSAR online prediction was also done to predict the absorption, metabolism and toxicity of the listed compounds of medicinally important species (Table 5). From the results all the reported compounds were considered as they can easily metabolized, absorbed and transported through human intestinal [Example spilanthol, oleanolic acid, ramnazin-3-O-rutinoside, 2,4,8,9-tetrahydroxy-6H-(1)benzofuro(3,2-c)chromen-6-one, torvoside A,

Table 4
ICF value for the illness category and FL and CII values for the reported plants in Sathyamangalam wildlife sanctuary, Tamil Nadu, India.

S. No	Illness category	Number of citation (Nur)	Number of species cited (Nt)	ICF	FL% and CII
Illness with High ICF value					
1	Eye ailments	8	1	1.00	*Sesbania grandiflora* (L.) Pers. (19/0.966)
2	Genitourinary ailments	222	9	0.96	*Haldina cordifolia* (Roxb.) Ridsdale (60/0.449) *Boerhavia diffusa* L. (65/0.584) *Sesamum indicum* L. (84/1.146[a]) *Phyllanthus amarus* Schumach. & Thonn. (100/0.382) *Euphorbia hirta* L. (100/0.315) *Plumaria alba* L. (71/0.921) *Abrus precatorius* L. (28/3.191[a]) *Annona squamosa* L. (68/0.989[a]) *Eclipta prostrata* (L.) L. (32/0.944)
3	Skeletal muscular ailments	179	9	0.96	*Cardiospermum helicacabum* L. (63/1.820[a]) *Tinospora sinensis* (Lour.) Merr. (55/0.494) *Andrographis paniculata* (Burm.f.) Nees (62/1.584[a]) *Datura metel* L. (100/0.326) *Calotropis gigantea* (L.) Dryand. (46/0.831[a]) *Acalypha indica* L. (28/1.461) *Vitex negundo* L. (67/0.876[a]) *Toddalia asiatica* (L.) Lam. (100/0.169) *Canavalia cathartica* Thouars (100/0.101)
4	Dermatological ailments	333	19	0.95	*Spilanthes calva* DC. (100/0.225) *Tridax procumbens* (L.) L. (100/0.101) *Abrus precatorius* L. (17/3.191) *Wrightia tinctoria* R.Br. (100/0.202) *Murraya paniculata* (L.) Jack (100/0.225) *Acalypha indica* L. (88/1.461[a]) *Calotropis gigantea* (L.) Dryand. (54/0.831[a]) *Calotropis procera* (Aiton) Dryand. (100/0.337) *Solanum nigrum* L. (39/0.697) *Sida acuta* Burm.f. (100/0.506) *Abutilon indicum* (L.) Sweet (43/1.146) *Andrographis paniculata* (Burm.f.) Nees (17/1.584) *Sesamum indicum* L. (16/1.146) *Ipomoea obscura* (L.) Ker Gawl. (55/0.247) *Evolvulus alsinoides* (L.) L. (100/0.157) *Saccharum officinarum* L. (100/0.056) *Acacia nilotica* (L.) Delile (46/0.438) *Tinospora sinensis* (Lour.) Merr. (45/0.494) *Cardiospermum halicacabum* L. (16/1.820)
Illness with moderate ICF value					
5	Ear, nose, throat ailments	32	3	0.94	*Zingiber officinale* Roscoe (28/1.348) *Euphorbia nivulia* Buch.-Ham. (100/0.157) *Spilanthes acmella* (L.) L. (100/0.079)
6	Neurology ailments	85	6	0.94	*Zingiber officinale* Roscoe (15/1.348) *Hemidesmus indicus* (L.) R. Br. ex Schult. (50/0.899) *Pergularia daemia* (Forssk.) Chiov. (100/0.225) *Leucas aspera* (Willd.) Link (100/0.225) *Vitex negundo* L. (33/0.876) *Eclipta prostrata* (L.) L. (21/0.944)
7	Gastrointestinal ailments	375	22	0.94	*Eclipta prostrata* (L.) L. (46/0.944[a]) *Abrus precatorius* L. (44/3.191[a]) *Bauhinia tomentosa* L. (100/0.236) *Pongamia pinnata* (L.) Pierre (39/0.775) *Tephrosia purpurea* (L.) Pers. (44/0.202) *Clitoria ternatea* L. (100/0.393) *Sesbania grandiflora* (L.) Pers. (81/0.966[a]) *Citrus aurantiifolia* (Christm.) Swingle (59/1.101) *Citrus limon* (L.) Osbeck (100/0.371) *Jatropha curcas* L. (100/0.213) *Hemidesmus indicus* (L.) R. Br. ex Schult. (50/0.899) *Solanum xanthocarpum* Schrad. & H. Wendl. (30/0.742) *Solanum nigrum* L. (61/0.697[a]) *Solanum indicum* L. (100/0.135) *Abutilon indicum* (L.) Sweet (26/1.146) *Andrographis paniculata* (Burm.f.) Nees (21/1.584) *Psidium guajava* L. (100/0.124) *Boerhavia diffusa* L. (35/0.584) *Rivea hypocrateriformis* Choisy (100/0.079) *Jasminum angustifolium* (L.) Willd. (100/0.090) *Cocculus hirsutus* (L.) W.Theob.(67/0.899[a]) *Zingiber officinale* Roscoe (58/1.348[a])
8	Respiratory ailments	179	9	0.94	*Bauhinia divaricata* L. (38/0.539) *Aegle marmelos* (L.) Correa (23/2.562) *Glycosmis pentaphylla* (Retz.) DC. (100/0.169) *Ocimum basilicum* L. (100/0.281) *Solanum xanthocarpum* Schrad. & H. Wendl. (70/0.742[a]) *Justicia adhatoda* L. (100/0.292) *Acacia nilotica* (L.) Delile (38/0.438) *Cardiospermum halicacabum* L. (22/1.820)
9	Endocrinal ailments	44	4	0.93	*Annona squamosa* L. (47/0.989[a]) *Pongamia pinnata* (L.) Pierre (35/0.775) *Syzygium cumini* (L.) Skeels (100/0.225) (L.) *Cocculus hirsutus* (L.) W.Theob. (11/0.899)
10	Fever ailments	71	6	0.93	*Ipomoea obscura* (L.) Ker Gawl. (45/0.247) *Oxalis corniculata* L. (50/0.449) *Ruellia patula* Jacq. (100/0.112) *Aegle marmelos* (L.) Correa (46/2.562[a]) *Tephrosia purpurea* (L.) Pers. (56/0.202) *Bauhinia divaricata* L. (63/0.539)
11	Oncology ailments	30	3	0.93	*Abrus precatorius* L. (11/3.191) *Plumaria alba* L. (29/0.921) *Aegle marmelos* (L.) Correa (18/2.562)
12	Poisonous bites ailments	31	3	0.93	*Rubia cordifolia* L. (100/0.101) *Pongamia pinnata* (L.) Pierre (26/0.775) *Prosopis juliflora* (Sw.) DC. (100/0.180)
13	Circulatory system ailments	66	6	0.92	*Cocculus hirsutus* (L.) W.Theob. (43/0.899[a]) *Haldina cordifolia* (Roxb.) Ridsdale (60/0.449[a]) *Oxalis corniculata* L. (50/0.449) *Citrus aurantiifolia* (Christm.) Swingle (41/1.101[a]) *Aegle marmelos* (L.) Correa (14/2.562) *Rauvolfia serpentina* (L.) Benth. ex Kurz (100/0.157)
Illness with moderate ICF value					
14	Hemorrhoids ailments	3	3	0.88	*Abutilon indicum* (L.) Sweet (29/1.146) *Acacia nilotica* (L.) Delile (23/0.438) *Cocculus hirsutus* (L.) W.Theob. (25/0.899)

[a] Species were considered more consent to treat particular ailment ethno-botanically.

Table 5
Plants with adverse effects from Sathyamangalam wild life sanctuary, Tamil Nadu, India.

S. No	Binomial name	Adverse effect and interaction
1	*Annona squamosa* L.	The seed is poisonous. Consuming seed leads to abortion. Sometime used as rat poison
2	*Tridax procumbens* (L.) L.	Over dosage of leaves leads to ulcer effect.
3	*Abrus precatorius* L.	Consuming seeds leads to abortion, Hallucination, coma. Consult doctor after consuming
4	*Prosopis juliflora* (Sw.) DC.	Consumption of fruits of this plant leads to paralysis
5	*Plumaria alba* L.	Accidental contact of latex of this plant leads to severe skin irritation
6	*Wrightia tinctoria* R.Br.	Consuming seeds and latex causes ulcer
7	*Aegle marmelos* (L.) Correa	Over dosage leads to emetic condition
8	*Vitex negundo* L.	Over dosage leads to gastric disorders
9	*Leucas aspera* (Willd.) Link	Raw consumption will lead to abortion
10	*Jatropha curcas* L.	Seed consumption leads to neurotoxic effects
11	*Calotropis* spp.	The latex causes severe eye and skin irritation
12	*Pergularia daemia* (Forssk.) Chiov.	Latex leads to skin and eye irritation.
13	*Datura metel* L.	Accidental consumption of fruits leads to coma, hallucination effects.
14	*Sesamum indicum* L.	Consumption of seeds leads to abortion
15	*Acacia nilotica* (L.) Delile	Consumption of seeds leads to vomiting

Table 6
New uses obtained from informants belongs to Sathyamangalam wild life sanctuary, Tamil Nadu, India.

S. No	Binomial name	Medicinal uses from present study	Reported medicinal uses from other studies
1	*Eclipta prostrata* (L.) L.	Head ache	Liver injuries, jaundice[32]
2	*Abrus precatorius* L.	Stomach ulcer, Dysentery, Mouth ulcer	Rheumatism, Anti-diabetic, Head ache[35]
3	*Bauhinia divaricata* L.	Asthma	Fever[14]
4	*Prosopis juliflora* (Sw.) DC.	Snake bite	Poisonous effect[36]
5	*Pongamia pinnata* (L.) Pierre	Abdominal pain, Gas trouble, Snake bite	Diarrhea[37]
6	*Canavalia cathartica* Thouars	Body pain, Muscle pain	Indigestion[16]
7	*Rauvolfia serpentina* (L.) Benth. ex Kurz	Heart problem, Cardio tonic	Blood pressure[38]
8	*Citrus aurantiifolia* (Christm.) Swingle	Stomach ache	Blood tonic[39]
9	*Toddalia asiatica* (L.) Lam.	Paralyze	Stomachic, Anti-pyretic, Diarrhea[40]
10	*Murraya paniculata* (L.) Jack	Wounds	Helminthiasis, liver disease[41]
11	*Euphorbia hirta* L.	Leucorrhoea	Boils, Warts, Ulcers[42]
12	*Pergularia daemia* (Forssk.) Chiov.	Head ache	Acidity[43]
13	*Andrographis paniculata* (Burm.f.) Nees	Leprosy	Dyspepsia, anthelmintic, stomach ache[5]
14	*Evolvulus alsinoides* (L.) L.	Burn, Wound	Fever[44]
15	*Rivea hypocrateriformis* Choisy	Indigestion	Ethno veterinary important[45]
16	*Haldina cordifolia* (Roxb.) Ridsdale	Anemia	Urinary disorders[14]
17	*Saccharum officinarum* L.	Rash	Gastrointestinal ailments, infertility[46]
18	*Acacia nilotica* (L.) Delile	Piles, Cough	Wound healing and sex related ailments[44]
19	*Tinospora sinensis* (Lour.) Merr.	Burn wound healing	Insecticides[47]

β-ionone, umbelliferone and (±)-limonene]. The toxicity profile also reveals the carcinogenicity and cardiogenicity of the identified compounds and the results reveals some non-toxic [(±)-limonene, umbelliferone, procyanidin B1 and spilanthol] and less toxic [4-(β-D-glucopyranosyloxy) benzoic acid, vitexin, (2R,3S,4R,5R,6E)-5-acetamido-2-(acetoxymethyl)-6-(hydroxyimino) tetrahydro-2H-pyran-3,4-diyl diacetate, isoorientin and swertisin] properties of the compounds (Table 6). The remaining herbal species also should be investigated to determine the efficacy and safety evaluation.

4. Discussion

4.1. Demographical description and documentation of ethno-botanical data

Comparing the demographical depiction of the present study with other related studies in nearer area, the average age of local population is close in the studied area.[14–16] Among the interviewed communal tribes herbalist and traditional healers were also limited in number, it clearly indicates the improper sharing of their knowledge on medicinal plants. The extensive single species usage in herbal treatment was specify the particular medicine for particular symptom which can be used to treat all related symptoms to the same category with some adjuvant like honey, milk, etc.[17,18] This study also claims some poly herbal combinations can be used in the treatment of various gastrointestinal and dermal associated ailments mainly from Fabaceae and Rutaceae family members. It clearly shows the various bioactive contents responsible for the medicinal properties in Fabaceae and Rutaceae.[19,20] When compared this medicinal plant (61 plants) diversity of present study with other related regional studies (with 41 and 65 plants) it clearly shows the including of some new reports which are not yet reported.[14–16] This variation in medicinal plant diversity clearly indicates the influence of nature and climate of selected region of the study area. The use of leaf as common medicinal part to treat various ailments was correlated with several ethno-botanical survey and also support the using of other parts because its well known the plants are the factory of chemicals hence its does not denote the particular parts contain more bioactive than other.[21] However, the collection of whole plant may be leads to its disappearance from the area and also the collection and abundance of leaf compared with the other parts makes the most using parts in herbal medicine system.[22] Oral administration and paste preparation are most common methods used in Siddha medicinal system and similar results of various surveys also supporting the present study results.[23,24]

4.2. Quantitative analysis of ethno-botanical indices

This study also proves the importance of ethno medicinal plants in the treatment of genitourinary ailment. The ethnic people have grater medicinal information on indigenous plants. Gastrointestinal system and genitourinary ailment diseases have been reported to have the highest ICF in other surveys and these results indicates the sign of unhealthy lifestyle.[25,26] Some results from current study also correlated with other surveys carried out in India, such as *Cardiospermum halicacabum* L. (63%), *Solanum nigrum* L. (61%) were mentioned to treat same ailment categories in a reported earlier, however these two reported low FL of 63% and 61% respectively to treat skeletal muscular and gastrointestinal ailments category.[27] Three of 14 listed ailment categories i.e. eye, oncology and Hemorrhoids ailments reported with low FL < 50%. But related studies also revealed the activities of *Aegle marmelos* (L.) Correa (18), *Sesbania grandiflora* (L.) Pers. (19) and *Abutilon indicum* (L.) Sweet (29) in the reported uses, it clearly shows the lack of sharing their medicinal knowledge among tribal communities.[28,29] The higher fidelity level indicates the consent use of these medicinal plants for the treatment of particular ailment by informants of the studied area. However, least CII, UV and IAR values were indicate the limited knowledge of medicinal uses and may be due to its adverse effects of those plants. For example, *Annona squamosa* L. was recorded and reported as anti-diabetic agent,[30] despite the fact consuming the fruit may leads to the abortion.[31] *Eclipta prostrata* (L.) L. used for neurological disorders (headache) by tribes in the present study area. It is also reported to treat Liver injuries and jaundice by the traditional healers of Chithoor district, Andhra Pradesh, India.[32] Likewise, there are about 19 species were reported with new uses by comparing with other ethno-botanical studies. This new medicinal information can lead to evaluating active principles to derive new drug molecules.

4.3. Validation of ethno-botanical data using In silico studies

In silico studies are more valuable in ethno botanical research to validate and find potential bioactive compounds which leads in development of new drugs.[33] From the PASS results of listed species

Table 7
In silico validation of important ethno-botanical plants of Sathyamangalam wild life sanctuary, Tamil Nadu, India.

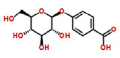
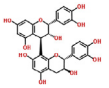
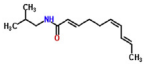
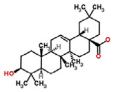
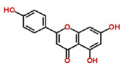
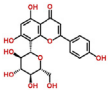
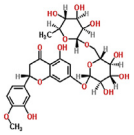
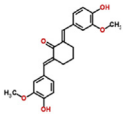
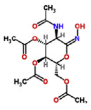
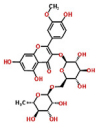
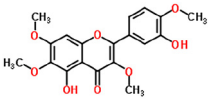
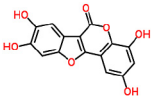
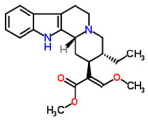
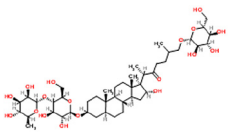
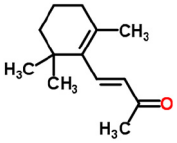
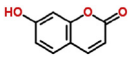
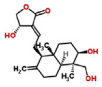
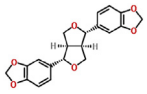
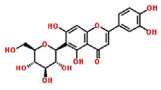
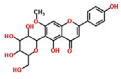
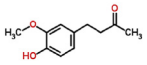
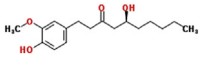
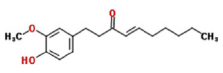
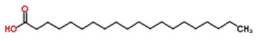
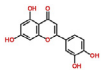
S. No	Binomial name	Ethno uses	Reported pharmacological activities	Reported compounds	PASS prediction			admetSAR prediction[a]		
					Predicted bioactivities	Pa	Pi	A	M	T
1	*Annona squamosa* L.	Diabetes Abortion	Anti-diabetic effect, Effects on early pregnancy[48]	4-(β-D-glucopyranosyloxy)benzoic acid 	Anti-diabetic activity	0.988	0.001	+	+++	+
					Antiinfective	0.972	0.002			
				Procyanidin B1 	Anti-diabetic activity	0.979	0.001	+++	+++	ND
					Phobic disorders treatment	0.929	0.004			
					Antiseborrheic	0.881	0.006			
2	*Spilanthes calva* DC. and *Spilanthes acmella* (L.) L.	Wound Gums ache	Vasorelaxant and antioxidant activities[49]	Spilanthol 	Wound healing	0.820	0.005	+++	+++	ND
					Treatment of anxiety disorder	0.802	0.026			
3	*Sesbania grandiflora* (L.) Pers.	Eye ailments	Anemia, Bronchitis, Ophthalmia, rheumatism hepatoprotective[50]	Oleanolic acid 	Antidiabetic	0.987	0.001	+++	+++	ND
					Anticancer	0.984	0.002			
					Antinociceptive	0.895	0.001			
					Antineoplastic	0.877	0.005			
					Antiviral	0.836	0.002			
4	*Abrus precatorius* L.	Stomach ulcer Abortion Dystenry Mouth ulcer Cancer Bacterial fungal infections	Anti-microbial, Abortion[51]	Apigenin 	Wound healing	0.963	0.003	+++	+	ND
					Anticancer	0.926	0.002			
					Antimutagenic	0.899	0.003			
				Vitexin 	Cardioprotectant	0.950	0.002	+++	+++	+
					Free radical scavenger	0.948	0.001			
					Hepatoprotectant	0.920	0.002			
					Chemopreventive	0.864	0.003			
					Antihemorrhagic	0.826	0.002			
5	*Bauhinia tomentosa* L.	Diahorrea	Anti diarrhea, anti-inflammatory activity[52]	Hesperidin 	Free radical scavenger	0.991	0.001	+++	++	ND
					Anticarcinogenic	0.985	0.001			
					Chemopreventive	0.981	0.001			
					Hepatoprotectant	0.977	0.001			
					Antiprotozoal	0.853	0.004			
6	*Pongamia pinnata* (L.) Pierre	Abdominal pain Gas trouble Snake bite Diabetes	Anti-diabetic[53]	Cyqualon 	Anticancer	0.927	0.004	+++	++	ND
					Antidiabetic	0.703	0.008			
					Choleretic	0.822	0.003			
7	*Acalypha indica* L.	Burns Itch Skin lotion Bacterial and fungal diseases Edema	Wound healing, Analgesic, anti-inflammatory[54]	(2R,3S,4R,5R,6E)-5-Acetamido-2-(acetoxymethyl)-6-(hydroxyimino)tetrahydro-2H-pyran-3,4-diyl diacetate 	Transplant rejection treatment	0.936	0.002	++	+++	+
					Antidiabetic	0.856	0.001			
8	*Calotropis gigantean* (L.) Dryand.	Rash Edema	Wound healing[55]	Ramnazin-3-O-rutinoside 	Free radical scavenger	0.993	0.000	+++	+++	ND
					Cardioprotectant	0.992	0.001			
					Anticarcinogenic	0.987	0.001			
					Antiprotozoal (Leishmania)	0.918	0.003			
9	*Vitex negundo* L.	Joint pain Head ache	Arthritis[56]	Casticin 	Antimutagenic	0.928	0.002	+++	+	ND
					Free radical scavenger	0.845	0.002			
					Anticancer	0.953	0.003			
10	*Eclipta prostrata* (L.) L.	Head ache Abdominal pain Jaundice	Antibacterial, Antioxidant, hypolipidemic[57]	2,4,8,9-Tetrahydroxy-6H-[1]benzofuro[3,2-c] chromen-6-one 	Anticancer	0.956	0.003	+++	+++	ND
					Astringent	0.823	0.001			
					Antiseborrheic	0.733	0.031			

Table 7 (*continued*)

S. No	Binomial name	Ethno uses	Reported pharmacological activities	Reported compounds	PASS prediction			admetSAR prediction[a]		
					Predicted bioactivities	Pa	Pi	A	M	T
11	*Cocculus hirsutus* (L.) W.Theob.	Blood tonic Piles Dysentery Diabetes	Spermatogenic and anti-diabetic activity[58]	Hirsutine 	Antinociceptive	0.814	0.002	+++	+	ND
					Analgesic	0.800	0.005			
					Vasodilator	0.736	0.006			
12	*Solanum* spp.	Mouth ulcer Intestinal disorders Small pox	Neuropharmacological activity[59]	Torvoside A 	Anticancer	0.942	0.002	+++	+++	ND
					Hepatoprotectant	0.902	0.002			
					Antiprotozoal	0.896	0.003			
					Antineoplastic	0.872	0.005			
13	*Aegle marmelos* (L.) Correa	Fever Cold Blood tonic Cancer	Anticancer[60]	β-Ionone 	Antineoplastic	0.892	0.005	+++	+++	ND
					Dermatologic	0.831	0.004			
					Antipsoriatic	0.786	0.004			
14	*Haldina cordifolia* (Roxb.) Ridsdale	Anemia Urinary disorders	Anti-amoebic[61]	Umbelliferone 	Cardiovascular analeptic	0.908	0.003	+++	+++	ND
					Antimutagenic	0.898	0.002			
					Antiseborrheic	0.875	0.006			
15	*Citrus aurantiifolia* (Christm.) Swingle	Stomachache Blood tonic	Anti-ulcer[62]	(±)-Limonene 	Carminative	0.961	0.001	+++	+++	ND
					Antieczematic	0.896	0.005			
					Antineoplastic	0.818	0.010			
					Chemoprotective	0.781	0.002			
16	*Andrographis paniculata* (Burm.f.) Nees	Skeletalmuscular ailments	Anti-inflammatory[63]	(−)-Andrographolide 	Choleretic	0.980	0.001	+++	+++	ND
					Hepatitis	0.975	0.002			
					Antineoplastic	0.964	0.004			
					Antiallergic	0.721	0.007			
17	*Sesamum indicum* L.	Genitourinary ailments	Affecting sex hormones[64]	Sesamin 	Anticancer	0.800	0,005	+++	+	ND
					Antineoplastic	0.797	0.012			
					Antidyskinetic	0.742	0.010			
					Antineurotic	0.738	0.030			
					Carminative	0.761	0.004			
18	*Oxalis corniculata* L.	Blood tonic Fever	Cardioprotective[65]	Isoorientin 	Cardioprotectant	0.963	0.002	+++	+++	+
					Anticancer	0.922	0.004			
					Hepatoprotectant	0.913	0.002			
					Antihemorrhagi	0.821	0.002			
				Swertisin 	Cardioprotectant	0.957	0.002	+++	+++	+
					Chemopreventive	0.901	0.002			
					Antineoplastic	0.783	0.014			
					Antidiabetic	0.769	0.005			
19	*Zingiber officinale* Roscoe	Ear, nose, throat ailments, Neurology ailments	Digestive disorders[66]	Zingerone 	Antidiabetic	0.920	0.003	+++	+++	ND
					Fibrinolytic	0.867	0.004			
					Antimutagenic	0.796	0.004			
				(+)-[6]-Gingerol 	Preneoplastic treatment	0.773	0.004	+++	+++	ND
					Fibrinolytic	0.758	0.008			
					Vasodilator	0.729	0.007			
					Antipyretic	0.725	0.004			
				Shogaol 	Antimutagenic	0.851	0.003	+++	+++	ND
					Antieczematic	0.842	0.011			
					Mucositis treatment	0.803	0.013			
					Antiinflammatory	0.732	0.012			

(*continued on next page*)

Table 7 (*continued*)

S. No	Binomial name	Ethno uses	Reported pharmacological activities	Reported compounds	PASS prediction			admetSAR prediction[a]		
					Predicted bioactivities	Pa	Pi	A	M	T
20	*Cardiospermum helicacabum* L.	Skeletal muscular ailments	Anti-arthritic activity[67]	Arachidic acid 	Anti-diabetic	0.945	0.002	+++	+++	ND
					Phobic disorders	0.939	0.003			
					Mucositis treatment	0.874	0.008			
					Antihypoxic	0.798	0.004			
				Luteolin 	Antimutagenic	0.915	0.002	+++	+	ND
					Vasoprotector	0.894	0.003			
					Antihemorrhagic	0.836	0.002			
					Antioxidant	0.717	0.004			

[a] A-Absorption, M-Metabolism, T-Toxicity; The scale of ranges from low (+), medium (++), high (+++) and not detected (ND).

we found that most of the ethno-botanical uses correlate their predicted bioactivities and some compounds targeted as new ligands for particular receptor targets.[34] The greater Pa values indicate the binding capacity of the particular compounds as ligands to that respective receptor.[34] *In silico* studies combined with traditional knowledge evidently recommend a reasonable efficient background and support in the drug formulation of suitable drug for laboratory testing.

5. Conclusion

From this study, 61 ethno-botanical plants among tribes of Sathyamangalam wildlife sanctuary, were validated and documented through *in silico* for treating various illness categories. The obtained quantitative results (UV, ICF, CII and FL), *in silico* validation and new reports from this study also used to reveal compounds responsible for bio-activities of herbal formulations. This study results also indicates the importance of experience and knowledge about traditional herbal formulation by the tribes in the treatment of various ailments. The present study suggested promoting programs such as digital documentation of traditional knowledge. These could be used to derive some drug development and application of medicinal plants to treat various disorders and also to promote obtains medicine from nature.

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