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Ethnomedicinal assessment of Irula tribes of Walayar valley of Southern Western Ghats, India

Arjunan Venkatachalapathi ^{a,*}, Thekkan Sangeeth ^a, Mohammad Ajmal Ali ^c,
Sulur Senniappan Tamilselvi ^b, Subramaniam Paulsamy ^a

^a PG and Research Department of Botany, Kongunadu Arts and Science College, Coimbatore 641029, India

^b R & D, Bharthiar University, Coimbatore 641046, India

^c Department of Botany and Microbiology, King Saud University, Riyadh 11451, Saudi Arabia

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Abstract The present study was aimed to explore the traditional knowledge of Irula tribal people who are practicing herbal medicine in Walayar valley, the Southern Western Ghats, India. A total number of 146 species of plants distributed in 122 genera belonging to 58 families were identified as commonly used ethnomedicinal plants by them. Interestingly, 26 new claims were also made in the present study. Through the data obtained from Irula tribal healers, the herbs were mostly used for medicine (40.4%) followed by trees (26.7%) and climbers (18.5%). In addition leaves were highly used for medicinal purposes, collected from 55 species (38%) followed by multiple parts from 18 species (12%). *Acorus calamus* is the species of higher use value (1.80) assessed to be prescribed most commonly for the treatment of cough. High informant consensus factor (1.0) obtained for insecticidal uses and cooling agent indicates that the usage of *Canarium strictum* and *Melia dubia*, and *Mimosa pudica* and *Sesamum indicum* respectively for that purposes had obtained high degree of agreement among the healers in using these species for the respective purposes. The most commonly used method of preparation was decoction (63%) followed by raw form (23%), paste (12%) and powder (2%). Therefore, it is suggested to take-up pharmacological and phytochemical studies to evaluate the species to confirm the traditional knowledge of Irulas on medicinal plants.

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1. Introduction

Since few centuries, it is reported that about one fourth of the common drugs used worldwide are derived from plants (Ernst, 2005). Among the top 252 common formulations of the drugs, 219 are obtained from plants alone (Dobson, 1995). As the indigenous people are the more reliable source of information on medicinal plants (Iwu et al., 1999), for the past few decades, use of ethnobotanical information in medicinal plant research

* Corresponding author.

E-mail address: avenkatachalapathi61@gmail.com (A. Venkatachalapathi).

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has gained great attention among the scientific community (Heinrich, 1999). Documentation of ethnobotanical species for further scientific validation and subsequent processing for commercialization in India are also getting importance in recent decades (Venkatasamy et al., 2010; Arunachalam and Parimelazhagan, 2011; Ayyanar and Ignacimuthu, 2011; Senthilkumar et al., 2013; Pushpakarani and Natarajan, 2014). India, the megabiodiversity nation is not only endowed with a variety of flora and fauna but also has several ethnic communities. By practicing and using the plants for thousands of years, the ethnic and aboriginal people have gained immense practical knowledge about the medicinal plants (Pullaiah et al., 2003).

Western Ghats, the biodiversity hotspot and medicinal plants emporium of India harbours about 3500 plant species of therapeutic importance, and many of them are still used by several tribal communities for their health care particularly for first aid remedies (Abraham, 1981; Nair and Jayakumar, 2003). Richness of medicinal plants in the Western Ghats parts of Coimbatore and Nilgiri districts of Tamil Nadu is high due to the existence of varied types of ecosystems in this landscape (Ramachandran, 2007). Irulas, Thodas, Malasars, Muduvas and Puliars are the major tribal communities in this part doing effective medical practice by using plants (Paulsamy, 2004). However, few reports on ethnobotanical information without much quantitative analysis are only available for this region (Umapiya et al., 2011; Rasingam, 2012). Assessment of information on medicinal plants provided by tribal healers is most required as it gives additional support to know the level of healing property of plants. Irulas, one of the 615 tribal communities of India are living in different topographic habitats (plains, mountains, valleys etc. in Tamil Nadu) and also in the Walayar valley and foothills of Siruvani hills of Southern Western Ghats (Edgar, 1909). Using plants for their day-to-day health problems is the common medical practice among them (Karthikeyani, 2003). Despite this ethnobotanical significance, no reports are available on medicinal plants used by the Irulas of Walayar valley. To address this lacuna, documentation and quantitative analysis were made in Walayar valley, among the Irula tribals to explore their traditional knowledge on plants for medicinal uses.

2. Materials and methods

2.1. Study area and the tribal community

The study area, Walayar Valley, located in lower Western Ghats of Coimbatore district, Tamil Nadu State and Palghat district, Kerala State and the Palghat gap of both States covers an area of ca. 12500 ha (ca. 4200 ha in Tamil Nadu and 8300 ha in Kerala) between the altitude 370 and 450 m above msl. The geographical location of Walayar valley is 10° 77' 0-3" N and 76° 51' 06-10" E (Fig. 1). In this landscape, ca. 55% of the geographical area occupied by moist tropical semi-evergreen forest dominated by the tree species, *Chloroxylon swietenia* (Champion and Seth, 1968) is a protected forest for biodiversity conservation. The only inhabitant, Irula tribal community is permitted to do agriculture and collection of minor forest produce for their own use without posing any problem to spe-

cies diversity. The Walayar river runs across the valley and its environ occupies ca. 2% of geographical area of this region. The agricultural land around the forests in this valley spreads over an area of ca. 40% of total geographical area. Annual rainfall ranges between 1500 and 2200 mm for the past 15 years.

The population of Irula tribals in Walayar valley is ca. 470, distributed in six hamlets each consists of 6–15 families. According to anthropological literature, Irula, one of the oldest tribal communities of India belongs to the Negrito race (migrated from Africa) which is one among the six ethnic groups that add to the racial mosaic of India (Von, 1982). Few elders in this community have the knowledge on medicinal uses of plants which are used mainly for first aid remedies like stomach problems, fever, headache, skin problems, etc.

2.2. Data collection

Six field visits were made in Walayar valley for getting ethnobotanical information during the period between October, 2013 and May, 2015 in all the six Irula habitations. Totally five ageold healers of in-depth knowledge on medicinal plants were identified for collecting information by interrogations. To determine the difference in knowledge among the Irula people, we cross checked the information collected with the other informants. The number of times, the healers repeated the same use of the plants was noted. For documenting the ethnobotanical information, field data sheet has been prepared and used. Local name of the plant, parts used for treatment, preparation methods, other plants used as ingredients, mode of administration etc., were collected for all medicinal plants used by Irulas. The plant species were identified with the help of keys provided in 'The Flora of Presidency of Madras' (Gamble and Fischer, 1935) and 'The Flora of Tamil Nadu Carnatic' (Matthew, 1983). Identified species were confirmed with Dr. V. Balasubramaniam, Plant Taxonomist in the Botany Department of Kongunadu Arts and Science College, Coimbatore. Herbarium specimens are maintained in the Botany Department of the College.

2.3. Ailment categories

Sixteen ailment categories were grouped (Cook, 1995) as presented elsewhere (Venkatachalapathi et al., 2016) on basis of the information provided by the Irula healers of Walayar valley.

2.4. Analysis of data

Informant consensus factor (F_{ic}) was used to know the level of consensus among the informants or healers on the use of a plant for a particular ailment category. The *Use Value* (UV) is importance of a species in terms of its use in herbal remedy in relation to other species. *Fidelity level* (FL) is a tool to determine the most frequently used plant species as per the informants for the treatment of a disease in a particular ailment category. The UV , F_{ic} and FL were calculated as per the formula of Trotter and Logan (1986), Phillips et al. (1994) and Friedmen et al. (1986) respectively.

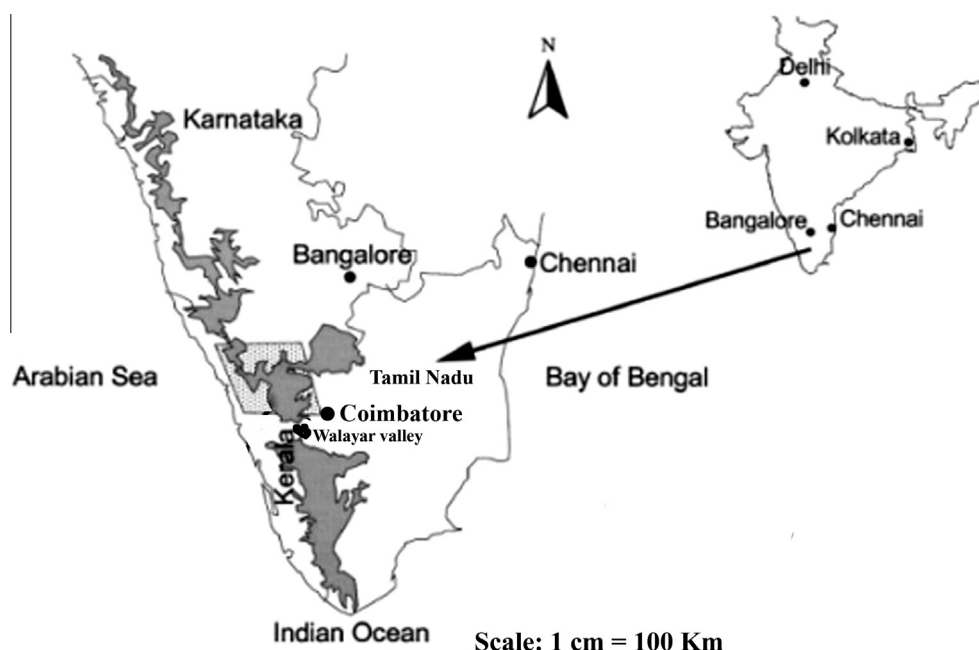


Figure 1 Location of study area, the Walayar valley.

3. Results

The Irula tribes of Walayar valley utilized a large number of 146 species of 122 genera belonging to 58 families for the treatment of various medicaments (Table 1). One of the interesting observations made in the study is that among the 146 ethnomedicinal plants, 26 claims from the species like *Acacia leucophloea*, *Alstonia venenata*, *Artocarpus heterophyllus*, *Carissa spinarum*, *Curculigo orchoides*, *Hybanthus enneaspermus*, *Melia dubia* and *Solena amplexicaulis* etc. are new and are reported for the first time (Table 1). Among the medicinal plant families represented, Fabaceae registered more number of 16 species followed by Euphorbiaceae (9 species), Lamiaceae (7 species) and Asclepiadaceae (6 species). Through the data obtained from life-form analysis, incidence of herbs (40.4%) were the primary source of medicine followed by trees (26.7%) and climbers (18.5%) (Fig. 2). In addition, among the utilization of various plant parts investigated, leaves of greater number of 55 species followed by whole plant (16 species), fruits (13 species) and rhizomes (12 species) were used by the tribal community for the treatment of common ailments such as cold, cough, jaundice, rheumatism etc. (Fig. 3). However, 18 species were exploited for their multiple usage in herbal remedy. They were administered either alone or in combination with parts of other species (Table 2). Generally, they were prescribed as decoction (63%), raw form (23%), paste (12%) and powders (2%) (Fig. 4).

Evidently, the current study documents, *Acorus calamus* as the most commonly used species prescribed for the treatment of cough by the Irula tribes with highest use value of 1.80 (Table 1). Other important species with high use value more than 1.20 were *Abrus precatorius*, *Acacia leucophloea*, *Aerva lanata*, *Albizia amara*, *Cardiospermum canescens*, *Cassia auriculata*, *Dioscorea oppositifolia*, *Enicostemma littorale*, *Justicia adhatoda*, *Mimosa pudica*, *Mukia maderaspatana*, *Ocimum*

sanctum, *Phyllanthus amarus*, *Piper betle*, *Plectranthus amboinicus*, *Plumbago zeylanica*, *Solanum surattense*, *Solena amplexicaulis*, *Syzygium cumini* and *Vitex negundo* (Table 1). For employing informant consensus factor (F_{ic}), more than 50 use-reports were obtained for certain ailment categories viz., dermatological infections (82 use-reports, 45 species), skeleto-muscular system disorders (54 use-reports, 29 species) and gastro-intestinal ailments (50 use-reports, 30 species) (Table 3) and their F_{ic} values ranged between 0.10 and 1.0 (Table 3). In this study, high F_{ic} value was obtained for insecticidal uses (1.0) and cooling agent (0.85), whereas lower F_{ic} was obtained for endocrinal disorders, especially diabetes (0.10). It was found that the Irula tribals commonly apply bark powders of *Canarium strictum* and *Melia dubia* for mosquito repellency and *Mimosa pudica* and *Sesamum indicum* as body coolant in Walayar valley. Appreciably, it has been determined that a high number of 100 species have obtained 100% fidelity and were highly preferred for treating particular ailments (Table 1).

4. Discussion

The information on therapeutic uses of 146 species (Table 1) collected from the Irula tribal community of Walayar valley was compared with that of the early publications (Rajendran and Henry, 1994; Vashistha, 2015). In this content, 26 new claims were documented and are reported for the first time in this study (Table 1). Remaining species were already reported for their various medicinal uses (Jain and Goel, 1995; Yesodharana and Sujana, 2007; Sanjeev et al., 2015). Among the 58 families represented, Fabaceae manifested the first dominant family in terms of species richness followed by Euphorbiaceae, Lamiaceae and Asclepiadaceae (Table 1). It has been reported already that the members of these families, owing to rich variety of secondary metabolites and Lamiaceae

Table 1 List of medicinal plants used by the Irula tribal community in Walayar valley of Coimbatore district, Southern Western Ghats, India.

S. No.	Botanical name and family	Local name	Use value	Parts used	#Ailment category: number of use reports (ailments treated)	Preparation	Application
1	Trees <i>Acacia catechu</i> Willd. (Mimosaceae)	Karungali	0.60	Stem	GIA-1 (ulcer) RSD-1 (chest pain) SMSD-1 (swelling)	Decoction Decoction Decoction	Oral Oral Oral
2	*† <i>A. leucophloea</i> (Roxb.) Willd. (Mimosaceae)	Vellvale maram	1.40	Bark	DID-4 (wound healing) GIA -3 (stomach problem)	Raw Decoction	Topical Oral
3	† <i>A. nilotica</i> (L.) Willd. (Mimosaceae)	Karuvale maram	0.20	Stem and bark	DC-1 (toothache)	Past	Toothpaste
4	<i>Aegle marmelos</i> (L.) Corr. (Rutaceae)	Vilvam	0.60	Leaf and fruit	ED-1 (diabetes) Fvr-1 (fever) DID-1 (antiinflammatory)	Raw Decoction Decoction	Oral Oral Oral
5	† <i>Ailanthus excelsa</i> Roxb. (Simaroubaceae)	Perumaram	0.20	Leaf	GUA-1 (menstrual problem)	Decoction	Oral
6	† <i>Alangium salviifolium</i> (L.f.) Wangerin. (Alangiaceae)	Alangi	0.80	Leaf and stem	GIA-2 (stomach ache) RSD-2 (chest pain)	Raw Decoction	Oral Oral
7	*† <i>Albizia amara</i> ROXB. (Fabaceae)	Arappu	1.20	Leaf	HC-6 (dandruff)	Raw	Oral
8	† <i>A. lebbek</i> (L.) Benth. (Fabaceae)	Vagai	0.20	Leaf	DID-1 (eczema)	Raw	Oral
9	*† <i>Alstonia venenata</i> R. Br. (Apocynaceae)	Sinnappalai	0.20	Latex	DID-1 (wound)	Raw	Oral
10	*† <i>Artocarpus heterophyllus</i> Lam. (Rutaceae)	Pala	0.60	Leaf and fruit	SMSD-1 (arthritis) DID-2 (antioxidant and skin diseases)	Decoction Raw	Oral Oral
11	<i>Azadirachta indica</i> A. Juss. (Meliaceae)	Vembu	0.60	Whole plant	PB-1 (snake bite) CSCD-1 (blood purification) SMSD-1 (rheumatism)	Raw Decoction Decoction	Oral Oral Oral
12	† <i>Canarium strictum</i> Roxb. (Burseraceae)	Sambirani chedi	0.20	Bark	IC-1 (mosquito repellent)	Powder	Topical
13	† <i>Canthium diococcum</i> (Gaertn.) Merr. (Rubiaceae)	Payira maram	0.40	Leaf	PB-1 (dog bite) GIA-1 (stomach ache)	Decoction Decoction	Oral Oral
14	*† <i>Carissa spinarum</i> Linn. (Apocynaceae)	Chrukila	0.40	Fruit and latex	ENT-1 (mouth ulcer) DID-1 (antioxidant)	Decoction Raw	Oral Oral
15	<i>Cassia fistula</i> Linn. (Caesalpiniaceae)	Kakke maram	1.00	Stem and flower	Fvr-2 (fever) GIA-2 (stomach pain) DID-1 (antiinflammatory)	Decoction Decoction Decoction	Oral Oral Oral
16	† <i>Cinnamomum camphora</i> (L.) Nees & Eberm. (Lauraceae)	Pachkarpooram	0.20	Stem	ENT-1 (ear ache)	Decoction	Oral
17	*† <i>Commiphora caudata</i> Wight & Arn. (Burseraceae)	Kiluvai	0.80	Leaf	Fvr-4 (fever)	Decoction	Oral
18	*† <i>Dalbergia sissoo</i> Roxb. ex DC. (Fabaceae)	Ette	0.20	Stem	DID-1 (skin diseases)	Past	Topical
19	† <i>Dodonaea angustifolia</i> (L.f.) Benth. (Sapindaceae)	Baraley	0.40	Leaf and bark	SMSD-2 (Bone fracture and head ache)	Past	Topical
20	† <i>Erythrina variegata</i> (L.) Merr. (Fabaceae)	Mullumurungai	0.40	Leaf	RSD-2 (cold and cough)	Decoction	Oral
21	<i>Ficus racemosa</i> Roxb. (Fabaceae)	Athi	0.60	leaf, bark and fruit	CSCD-1 (blood secretion) GUA-1 (leucorrhoea) SMSD-1 (arthritis)	Raw Decoction Decoction	Oral Oral Oral
22	* <i>Limonia acidissima</i> L. (Rutaceae)	Vilampalam	0.60	Fruit	GUA-1 (leucorrhoea) DID-1 (antioxidant) SMSD-1 (arthritis)	Raw Decoction Decoction	Oral Oral Oral
23	† <i>Mangifera indica</i> L. (Anacardiaceae)	Mavin mara	0.80	Leaf, bark and fruit	DID-2 (Wound healing and antioxidant) GIA-1 (menstrual problem) SMSD-1 (swelling)	Raw Decoction Decoction	Oral Oral Oral
24	*† <i>Melia azedarach</i> L. (Meliaceae)	Malaivembu	0.60	Bark	GIA-3 (stomach ache)	Decoction	Oral
25	* <i>M. dubia</i> L. (Meliaceae)	Malaivembu	0.60	Bark	IC-1 (mosquito repellent) ED-1 (diabetes) GIA-1 (stomach ache)	Powder Decoction Decoction	Topical Oral Oral

Table 1 (continued)

S. No.	Botanical name and family	Local name	Use value	Parts used	#Ailment category: number of use reports (ailments treated)	Preparation	Application
26	*† <i>Mesua ferrea</i> L. (Calophyllaceae)	Churuli	0.20	Flower	GIA-1 (stomach ache)	Decoction	Oral
27	† <i>Moringa oleifera</i> L. (Moringaceae)	Murungai	0.40	Leaf, flower and fruit	GUA-2 (male fertility)	Decoction	Oral
28	† <i>Phyllanthus emblica</i> L. (Euphorbiaceae)	Nelli	0.60	Fruit	CSCD-1 (blood purification) DID-1 (antioxidant) HC-1 (hair tonic)	Raw Decoction Decoction	Oral Oral Oral
29	† <i>Pongamia pinnata</i> L. (Fabaceae)	Pungam	0.40	Seed	SMSD-2 (rheumatism)	Decoction	Oral
30	† <i>Sapindus emarginatus</i> Vahl. (Sapindaceae)	Pucha	0.60	Stem and fruit	SMSD-1 (head ache) GH-2 (piles and bathing)	Decoction Decoction	Oral Oral
31	† <i>Syzygium aromaticum</i> (L.) Merrill & Perry. (Myrtaceae)	Kiraampu	0.60	Fruit	DC-3 (toothache)	Past	Toothpaste
32	† <i>S. cumini</i> L. (Myrtaceae)	Naval	1.40	Leaf, bark, fruit and seed	ED-4 (diabetes) DID-2 (antioxidant) GIA-1 (dysentery)	Raw Raw Decoction	Oral Oral Oral
33	† <i>Tamarindus indica</i> L. (Fabaceae)	Puli	0.40	Seed	PB-1 (scorpion bite) DID-1 (antioxidant)	Decoction Raw	Oral Oral
34	† <i>Terminalia arjuna</i> (Roxb.) W. & A. (Combretaceae)	Marutu	0.20	Bark	RSD-1 (chest pain)	Decoction	Oral
35	† <i>T. bellerica</i> Roxb. (Combretaceae)	Thanikai	0.20	Bark	RSD-1 (chest pain)	Decoction	Oral
36	† <i>T. chebula</i> Retz. (Combretaceae)	Kadukkai	0.20	Fruit	GIA-1 (stomach pain)	Decoction	Oral
37	† <i>Wrightia tinctoria</i> R. Br. (Apocynaceae)	Palai	0.20	Leaf	DC-1 (toothache)	Past	Toothpaste
38	† <i>Ziziphus mauritiana</i> L. (Rhamnaceae)	Elanthai	0.60	Leaf	DID-3 (wound)	Past	Topical
39	† <i>Z. enophylla</i> L. (Rhamnaceae)	Malai elanthai	0.60	Leaf	DID-3 (wound)	Past	Topical
40	Shrubs		0.60	Latex	GIA-1 (ulcer)	Decoction	Oral
	† <i>Argemone mexicana</i> L. (Papaveraceae)	Kutiyotti			DID-2 (pimples and wound healing)	Raw	Oral
41	† <i>Atalantia monophylla</i> L. (Rutaceae)	Kattuelumichai	1.00	Fruit	SMSD-4 (body pain) DID-1 (antioxidant)	Decoction Raw	Oral Oral
42	† <i>Begonia malabarica</i> L. (Begoniaceae)	Rattha choori	0.80	Whole plant	SMSD-4 (arthritis and joint pain)	Raw and Decoction	Oral
43	† <i>Calotropis procera</i> (Aiton) W.T.Aiton. (Asclepiadaceae)	Vella Erukku	0.20	Latex	DID-1 (wound)	Raw	Oral
44	† <i>Cassia auriculata</i> L. (Fabaceae)	Aavaarampoo	1.20	Flower	ED-6 (diabetes)	Raw and Decoction	Oral
45	† <i>Citrus limon</i> (L.) Burm. f. (Rutaceae)	Elumichi	0.20	Fruit	GIA-1 (dysentery)	Raw and Decoction	Oral
46	† <i>Clerodendrum inerme</i> (L.) Gaertn. (Lamiaceae)	Sangam	0.20	Leaf	DID-1 (skin diseases)	Decoction	Oral
47	† <i>Helicteres isora</i> L. (Sterculiaceae)	Valampuri edampuri	0.20	Fruit	ENT-1 (ear ache)	Decoction	Oral
48	† <i>Jatropha gossypifolia</i> L. (Euphorbiaceae)	Adalai	0.60	Latex	ENT-3 (mouth ulcer)	Decoction	Oral
49	† <i>Justicia adhatoda</i> L. (Acanthaceae)	Adatodai	1.20	Leaf	Fvr-6 (fever)	Decoction	Oral
50	† <i>J. gendarussa</i> L. (Acanthaceae)	Vadaikkutti	0.20	Leaf	SMSD-1 (body pain)	Decoction	Oral
51	*† <i>Lantana camara</i> L. (Verbenaceae)	Unnichi	0.40	Leaf	DID-2 (wound healing and antiinflammatory)	Past / Decoction	Topical / Oral
52	† <i>L. wightii</i> L. (Verbenaceae)	Unnichi	0.60	Leaf	DID-3 (wound healing)	Past	Topical
53	† <i>Manihot esculenta</i> L. (Euphorbiaceae)	Maravalli	0.20	Rhizome	DID-1 (wound healing)	Past	Topical
54	*† <i>Pavetta indica</i> L. (Rubiaceae)	Vellaippavattai	0.80	Leaf	PB-4 (snake bite)	Decoction	Oral
55	† <i>Rauvolfia serpentina</i> (L.) Benth. (Apocynaceae)	Amalpori	0.80	Leaf	PB-4 (snake bite)	Decoction	Oral

(continued on next page)

Table 1 (continued)

S. No.	Botanical name and family	Local name	Use value	Parts used	#Ailment category: number of use reports (ailments treated)	Preparation	Application
56	[†] <i>R. tritraphylla</i> L. (Apocynaceae)	Pampukaalaachchedi	0.60	Leaf	PB-3 (snake bite)	Decoction	Oral
57	* [†] <i>Solanum surattense</i> L. (Solanaceae)	Kandankathiri	1.20	Whole plant	RSD-6 (cold and wheezing)	Decoction	Oral
58	[†] <i>Vitex negundo</i> L. (Verbenaceae)	Notchi	1.40	Leaf	SMSD-7 (headache and body pain)	Decoction	Oral
59	Herbs [†] <i>Abutilon indicum</i> L. (Malvaceae)	Thuththi	0.80	Whole plant	GH-4 (piles)	Decoction	Oral
60	[†] <i>Acalypha indica</i> L. (Euphorbiaceae)	Kuppaimeni	0.20	Leaf	LP-1 (jaundice)	Decoction	Oral
61	[†] <i>A. fruticosa</i> L. (Euphorbiaceae)	Punairananki	0.20	Leaf	DID-1 (skin disease)	Past	Topical
62	[†] <i>Achyranthes aspera</i> L. (Amaranthaceae)	Nayuruvi	0.40	Whole plant	PB-2 (dog bite and poisonous bite)	Decoction	Oral
63	[†] <i>Acorus calamus</i> L. (Acoraceae)	Vasambu	1.80	Rhizome	RSD-5 (cough)	Decoction	Oral
64	* [†] <i>Aerva lanata</i> L. (Amaranthaceae)	Poolai poo	1.20	Leaf	ED-6 (kidney stone)	Raw	Oral
65	[†] <i>Alpinia galanga</i> L. (Zingiberaceae)	Perratthei	0.40	Rhizome	SMSD-1 (rheumatism)	Decoction	Oral
66	[†] <i>Aloe vera</i> L. (Liliaceae)	Sotru katrallai	0.80	Whole plant	GIA-1 (ulcer)	Decoction	Oral
					GUA-4 (menstrual problem)	Raw and Decoction	Oral
67	<i>Amorphophallus paenifolius</i> (Dennst.) Nicolson. (Araceae)	Kattukarunai	1.00	Rhizome	GH-2 (tonic)	Raw	Oral
					GIA-1 (carminative)	Decoction	Oral
					GUA-1 (menstrual problem)	Decoction	Oral
					DID- 1 (antiinflammatory)	Decoction	Oral
68	[†] <i>Andrographis paniculata</i> L. (Acanthaceae)	Neelavembu	0.80	Whole plant	PB-4 (snake bite)	Decoction	Oral
69	* [†] <i>Anisomeles malabarica</i> (L.) R.BR. (Lamiaceae)	Peymiratti	0.20	Leaf	DID-1 (eczema)	Past	Topical
70	[†] <i>Asystasia gangetica</i> L. (Acanthaceae)	Mitikirai	0.40	Leaf	SMSD-1 (rheumatism)	Decoction	Oral
					ED-1 (diabetic)	Raw	Oral
71	[†] <i>Centella asiatica</i> L. (Apiaceae)	Vallarai	0.60	Whole plant	CSCD-1 (memory power)	Raw	Oral
					GIA-2 (gas trouble and stomach ache)	Decoction	Oral
72	[†] <i>Chromolaena odorata</i> L. (Astraceae)	Kamyunist Alai	0.20	Leaf	DID-1 (wound healing)	Past	Topical
73	[†] <i>Cleome aspera</i> L. (Cleomaceae)	Karumpoondur	0.20	Leaf	DID-1 (eczema)	Past	Topical
74	[†] <i>C. monophylla</i> L. (Cleomaceae)	Ellukku sakkalathi	0.40	Leaf	Fvr-1 (fever)	Decoction	Oral
					SMSD-1 (inflammation)	Decoction	Oral
75	* [†] <i>C. viscosa</i> L. (Cleomaceae)	Naikadugu	0.80	Leaf	ENT-4 (ear ache)	Decoction	Oral
76	[†] <i>Coleus aromaticus</i> Benth. (Lamiaceae)	Karpooravalli	0.40	Leaf	RSD-2 (cough and cold)	Raw and Decoction	Oral
77	[†] <i>Commelina benghalensis</i> L. (Comlinaceae)	Kancatam	0.20	Whole plant	DID-1 (wound healing)	Past	Topical
78	[†] <i>Curcuma aromatica</i> Salisb. (Zingiberaceae)	Manjal	1.00	Rhizome	SMSD-1 (tumor)	Raw	Oral
					DID-4 (wound healing and antiinflammatory)	Decoction	Oral
79	* [†] <i>Curculio orchids</i> Gaertn. (Hypoxidaceae)	Nilapanai	1.20	Rhizome	CSCD-4(heart problem)	Decoction	Oral
					SMSD-1 (joint pain)	Decoction	Oral
80	[†] <i>Cyanotis axillaris</i> L. (Commelinaceae)	Vallukkai	0.40	Leaf	SMSD-1 (swelling)	Raw	Oral
					DID-1 (itching)	Decoction	Oral
81	[†] <i>Cymbopogon citratus</i> STAPF. (Poaceae)	Elumichai pul	0.20	Root	GIA-1 (diarrhoea)	Decoction	Oral
82	[†] <i>Cynodon dactylon</i> L. (Cyperaceae)	Arugam pull	0.40	Whole plant	GIA-2 (indigestion and stomach ache)	Raw and Decoction	Oral
83	[†] <i>Cyperus rotundus</i> L. (Cyperaceae)	Korai kilangu	0.20	Rhizome	DID-1 (wound)	Past	Oral
84	[†] <i>Desmodium gangeticum</i> (L.) DC. (Fabaceae)	Orilai	0.40	Stem and root	Fvr-1 (fever)	Decoction	Oral
					SMSD-1 (head ache)	Decoction	Oral

Table 1 (continued)

S. No.	Botanical name and family	Local name	Use value	Parts used	#Ailment category: number of use reports (ailments treated)	Preparation	Application
85	[†] <i>Eclipta prostrata</i> L. (Asteraceae)	Karisalankanni	1.00	Leaf	HC-5 (hair tonic)	Decoction	Oral
86	^{*†} <i>Eleusine coracana</i> (L.) Gaertn. (Poaceae)	Kaelvaragu	0.20	Seed	Fvr-1 (fever)	Decoction	Oral
87	[†] <i>Enicostemma axillare</i> L. (Gentianaceae)	Vellarugu	0.20	Leaf	PB-1 (snake bite)	Decoction	Oral
88	[†] <i>E. littorale</i> Blume. (Gentianaceae)	Vellarugu	1.20	Leaf	PB-6 (snake bite)	Decoction	Oral
89	[†] <i>Evolvulus alsinoides</i> L. (Convolvulaceae)	Vishnukiranthi	0.20	Whole plant	Fvr-1 (fever)	Decoction	Oral
90	[†] <i>Hemidesmus indicus</i> L. (Asclipadaceae)	Nannari	0.80	Root	Fvr-1 (fever)	Decoction	Oral
91	^{*†} <i>Hybanthus enneaspermus</i> L. (Violaceae)	Orithalthamarai	1.00	Whole plant	GIA-3 (stomach problem) GUA-5 (male fertility)	Decoction Raw and Decoction	Oral Oral
92	[†] <i>Hygrophylla auriculata</i> Schum. (Acanthaceae)	Voyal chullai	0.20	Leaf	GUA-1 (menstrual problem)	Decoction	Oral
93	[†] <i>Hyptis suaveolens</i> (L.) Poit. (Lamiaceae)	Karunchsatachi	0.20	Leaf	DID-1 (eczema)	Past	Topical
94	[†] <i>Leonotis nepetaefolia</i> (L.) W. T. Ait. (Fabaceae)	Theanthumpai	0.20	Leaf	DID-1 (eczema)	Past	Topical
95	[†] <i>Mimosa pudica</i> L. (Fabaceae)	Thootal sinigi	1.20	Whole plant	CA-4 (body coolant) RSD-2 (asthma)	Decoction Decoction	Oral Oral
96	[†] <i>Notonia grandiflora</i> DC. (Astraceae)	Muyalkathu	0.20	Leaf	ENT-1 (ear ache)	Decoction	Oral
97	[†] <i>Ocimum sanctum</i> L. (Lamiaceae)	Nallathulasi	1.20	Leaf	RSD-6 (cold and cough)	Decoction	Oral
98	[†] <i>O. tenuiflorum</i> L. (Lamiaceae)	Karut tulasi	0.40	Leaf	RSD-2 (cold and cough)	Decoction	Oral
99	[†] <i>Oxalis corniculata</i> L. (Oxalidaceae)	Paliakirai	0.40	Whole plant	Fvr-1 (fever) ED-1 (kidney stone)	Decoction Raw	Oral Oral
100	[†] <i>Phyllanthus amarus</i> Schum. & Thonn. (Euphorbiaceae)	Kizhaanelli	1.20	Whole plant	LP-6 (jaundice)	Decoction	Oral
101	[†] <i>P. maderaspatensis</i> L. (Euphorbiaceae)	Civappu kilanelli	0.60	Fruit	GIA-3 (indigestion)	Raw and Decoction	Oral
102	[†] <i>P. reticulatus</i> Poir. (Euphorbiaceae)	Karunelli	0.40	Leaf	GH-1 (piles) DID-1 (antioxidant)	Decoction Raw	Oral Oral
103	^{*†} <i>Physalis minima</i> L. (Solanaceae)	Kupanti	0.40	Leaf	GIA-1 (gas trouble)	Decoction	Oral
104	[†] <i>Plectranthus amboinicus</i> (Lour.) Spreng. (Lamiaceae)	Karpooravalli	1.20	Leaf	RSD-6 (cold and cough)	Decoction	Oral
105	[†] <i>Plumbago zeylanica</i> L. (Plumbaginaceae)	Chittiramoolam	1.20	Flower	GUA-5 (sterility in women)	Decoction	Oral
106	[†] <i>Polygala arvensis</i> Willd. (Polygalaceae)	Vecinankai	0.20	Root	SMSD-1 (inflammation)	Decoction	Oral
107	[†] <i>Pseudarthria viscida</i> (L.) Wight & Arn. (Fabaceae)	Moovilai	0.60	Stem and root	CSCD-1 (heart problem) Fvr-1 (fever)	Decoction Decoction	Oral Oral
108	[†] <i>Sansevieria roxburghiana</i> Schult. (Agavaceae)	Sanam	0.80	Leaf	GIA-1 (dysentery) ENT-4 (ear ache)	Decoction Decoction	Oral Oral
109	[†] <i>Sesamum indicum</i> L. (Pedaliaceae)	Ellu	0.80	Seed	CA-4 (body coolant)	Decoction	Oral
110	^{*†} <i>Sida rhombifolia</i> L. (Malvaceae)	Kurunthotti	0.40	Leaf and root	SMSD-1 (tumor) GIA-1 (gas trouble)	Raw Decoction	Oral Oral
111	[†] <i>Spermacoce latifolia</i> Aubl. (Rubiaceae)	-	0.20	Leaf	DID-1 (wound healing)	Past	Topical
112	[†] <i>Tephrosia purpurea</i> (Linn.) Pers. (Fabaceae)	Kozhunji	0.20	Root	GIA-1 (stomach problem)	Decoction	Oral
113	^{*†} <i>Tragia involucrata</i> L. (Euphorbiaceae)	Kanchori	0.20	Fruit	SMSD-1 (one side headache)	Raw and Decoction	Oral
114	[†] <i>Tridax procumbens</i> L. (Astraceae)	Vettukkaya puntu	0.80	Leaf	DID-4 (wound healing)	Past	Topical

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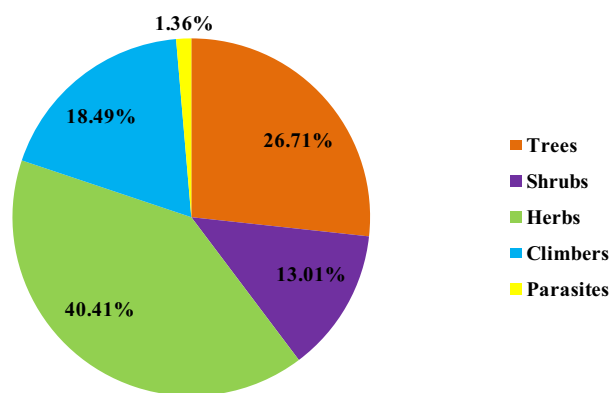
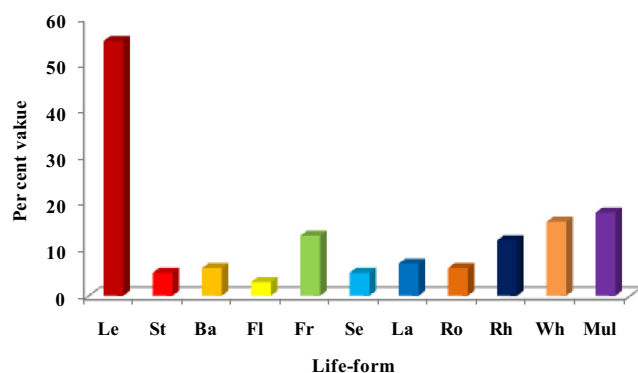
Table 1 (continued)

S. No.	Botanical name and family	Local name	Use value	Parts used	#Ailment category: number of use reports (ailments treated)	Preparation	Application
115	[†] <i>Vernonia cinerea</i> (L.) Less. (Asteraceae)	Mukuttiipoond	0.20	Leaf	SMSD-1 (paralysis)	Decoction	Oral
116	[†] <i>Vigna radiata</i> (L.) R. Wilczek. (Fabaceae)	Pasipayaru	0.20	Seed and latex	DID-1 (skin disease)	Past	Topical
117	[†] <i>Withania somnifera</i> L. (Solanaceae)	Amukkaramkizangu	0.60	Rhizome	SMSD-3 (nervous disorders)	Decoction	Oral
118	Climbers [†] <i>Abrus precatorius</i> L. (Fabaceae)	Kundu mani	1.20	Seed, latex and root	ENT-4 (eye pain) GUA-2 (delivery pain)	Decoction Decoction	Oral Oral
119	[†] <i>Acacia sinuata</i> (Lour.) Merr. (Fabaceae)	Seeyakkai	0.40	Fruit	DC-1 (toothache) HC-1 (dandruff)	Powder Powder	Oral Oral
120	[†] <i>Ampelocissus tomentosa</i> (Roth) Planch. (Vitaceae)	Kattukodi mundiri	0.80	Fruit	DID-4 (antioxidant and skin diseases)	Raw	Oral
121	[†] <i>Asparagus racemosus</i> Willd. (Asparagaceae)	Thanneervittan	1.20	Rhizome	ED-6 (urinary problem)	Decoction	Oral
122	[†] <i>Antigonon leptopus</i> Hook. & Arn. (Polygonaceae)	Kodi roja	0.20	Root	DID-1 (anti-inflammatory)	Decoction	Oral
123	[†] <i>Aristolochia bracteolata</i> L. (Aristolochiaceae)	Aaduthinnapalai	0.80	Leaf	DID-3 (eczema, scabies and ringworm infection) PB-1 (snake bite)	Decoction Decoction	Oral Oral
124	[†] <i>A. indica</i> L. (Aristolochiaceae)	Aaduthinnapalai	0.80	Leaf	DID-3 (eczema, scabies and ringworm infection) PB-1 (snake bite)	Decoction Decoction	Oral Oral
125	[†] <i>Basella rubra</i> L. (Basellaceae)	Kodippasali	0.40	Leaf	CSCD-2 (anaemia and increase WBC)	Raw and Decoction	Oral
126	[†] <i>Cardiospermum canasense</i> Wall. (Sapindaceae)	Mudakathan	1.40	Leaf	SMSD-6 (joint pain) GIA-1 (stomach ache)	Raw Decoction	Oral Oral
127	* [†] <i>C. halicacabum</i> Wall. (Sapindaceae)	Mudakathan	1.00	Leaf	SMSD-4 (joint pain) GIA-1 (stomach ache)	Raw Decoction	Oral Oral
128	[†] <i>Cissus quadrangularis</i> L. (Vitaceae)	Pirandai	1.00	Stem	GIA-5 (indigestion and inducing appetite)	Raw	Oral
129	[†] <i>Coccinia grandis</i> L. (Cucurbitaceae)	Kovai	0.20	Leaf	LP-1 (jaundice)	Decoction	Oral
130	[†] <i>Cucurbita moschata</i> Duch. ex Lam. (Cucurbitaceae)	Poosani	0.20	Fruit	GH-1 (increase weight)	Raw and Decoction	Oral
131	[†] <i>Cuscuta chinensis</i> L. (Convolvulaceae)	Manjapulluruvi	0.20	Stem	SMSD-1 (bone fracture)	Past	Oral
132	* [†] <i>Cyclea peltata</i> L. (Menispermaceae)	Padaikilangu	0.40	Whole plant	GIA-1 (stomach ache) GH-1 (tonic)	Decoction Decoction	Oral Oral
133	[†] <i>Dioscorea oppositifolia</i> L. (Dioscoreaceae)	Kavvala kodi	1.60	Rhizome	GIA-4 (piles) DID-4 (wound)	Decoction Decoction	Oral Oral
134	[†] <i>D. pentaphylla</i> L. (Dioscoreaceae)	Kaattuvali	0.20	Rhizome	GIA-1 (stomach ache)	Decoction	Oral
135	[†] <i>Gloriosa superba</i> L. (Liliaceae)	Kanuvalikodi	0.20	Root	GUA-1 (abortion)	Decoction	Oral
136	[†] <i>Gymnema sylvestre</i> R. Br. (Asclipadaceae)	Chirukurunjan	1.00	Leaf	ED-5 (diabetes)	Decoction	Oral
137	[†] <i>Ipomea staphylina</i> Roemer & Schultes. (Convolvulaceae)	Onan kodi	0.20	Latex	GH-1 (cracked feet)	Raw	Oral
138	* [†] <i>Mukia maderaspatana</i> (Linn.) M. Roemer. (Cucurbitaceae)	Mosumosukkai	1.40	Leaf	GH-7 (piles)	Decoction	Oral
139	[†] <i>Pergularia daemia</i> Forsk. (Asclepiadaceae)	Vaeliparuththi	0.40	Leaf and fruit	RSD-1 (asthma) GIA-1 (gas trouble)	Decoction Decoction	Oral Oral
140	[†] <i>Piper betle</i> L. (Piperaceae)	Vettilai	1.20	Leaf	GIA-4 (indigestion) DID-2 (skin disease)	Decoction Past	Oral Topical
141	[†] <i>P. nigrum</i> L. (Piperaceae)	Kurumilagu	0.40	Seed	RSD-2 (cold and cough)	Decoction	Oral
142	[†] <i>Sarcostemma acidum</i> Roxb. (Asclepiadaceae)	Somamum	0.40	Latex	RSD-1 (cough) DID-1 (antiinflammatory)	Decoction Decoction	Oral Oral
143	* [†] <i>Solena amplexicaulis</i> L. (Curcubitaceae)	Pulivanchi	1.40	Rhizome	DID-7 (skin diseases and antiinflammatory)	Decoction	Oral

Table 1 (continued)

S. No.	Botanical name and family	Local name	Use value	Parts used	#Ailment category: number of use reports (ailments treated)	Preparation	Application
144	[†] <i>Tylophora indica</i> R. Br. (Asclipeaceae)	Mekachettu	0.20	Leaf	RSD-1 (asthma)	Decoction	Oral
145	Epiphytes [†] <i>Loranthus flacata</i> Linn. f. (Loranthaceae)	Pulluruvi	0.20	Bark	GUA-1 (menstrual problem)	Decoction	Oral
146	[†] <i>Viscum album</i> Mistletoe. (Loranthaceae)	Pulluruvi	0.80	Fruit	CSCD-3 (heart problem) SMSD-1 (tumour)	Decoction Decoction	Oral Oral

*Species of new claim; #Ailment categories: Circulatory system/cardiovascular diseases (CSCD), Cooling agent (CA), Dental care (DC), Dermatological infections/diseases (DID), Ear, nose, throat problems (ENT), Endocrinal disorders (ED), Fever (Fvr), Gastro-intestinal ailments (GIA), General health (GH), Genito-urinary ailments (GUA), Hair care (HC), Liver problem (LP), Poisonous bite (PB), Respiratory system diseases (RSD), Skeleto-muscular system disorders (SMSD) and Insecticidal (IC); [†]species with 100% fidelity level.

**Figure 2** Percent life-forms of medicinal plants used by Irulas in Walayar valley.**Figure 3** Percent plant parts used for medicine preparation. Le – Leaf, St – Stem, Ba – Bark, Fl – Flower, Fr – Fruit, Se – Seed, La – Latex, Ro – Root, Rh – Rhizome, Wh – Whole plant and Mul – Multiple parts.

members due to more types of volatile oils are getting importance in healing the illness (Sanjeev et al., 2015). From the life-form analysis, herbs were found to be the most common functional group of plants followed by trees and climbers (Fig. 2). In general, richness of herbaceous species than any other life-forms is higher in any natural community which may lead to

more use of herbs for medicinal purposes than the species of other habits (Giday et al., 2010; Pushpakarani and Natarajan, 2014; Swapna, 2015). In support of this fact, Venkatachalapathi et al. (2014), also enumerated a higher number of herbaceous species than the other life-forms in various vegetations of Attukal area of Western Ghats, an adjoining part of Walayar valley.

Among the assortment of plant parts utilized, leaves were most frequently used by the Irula tribal community for healing purpose (Fig. 3). These results were in accordance with previous literatures that several traditional healers prescribe mainly the leaves for the preparation of medicines (Gonzalez et al., 2010; Amjad et al., 2015). Umapriya et al. (2011) found that the Irula tribals of Palamalai hills of Coimbatore, India also utilize leaves mainly for their therapeutic applications. Perhaps a more likely explanation for the high utility of leaves is that they can be collected very easily than the other parts (Ayyanar and Ignacimuthu, 2011). Furthermore, leaves are the active sites of photosynthesis and hence the production of a variety of bioactive entities (Bahmani et al., 2014). Obviously, for remedies preparations decoction form was prescribed by Irulas in Walayar valley (Fig. 4). Decoction is the major form of medicine preparation in some tribal communities worldwide (Ahirwar, 2010; Bahmani et al., 2014; Amjad et al., 2015). Raw consumption, paste and powder forms were also prepared and prescribed by the Irulas of Walayar. Further, Irula healers informed that preparation of medicine was made by using single plant part or in combination with parts of more than one species (Table 2). The study revealed that a single mode of medicine preparation was more predominant (52.7%) in comparison to multiple modes (26.01%). Umapriya et al. (2011) also reported that the single mode of medicine preparation by the Irula tribe in Palamalai hills of Western Ghats, is the most common type. Similar observations for other tribal communities were documented elsewhere (Erinosa and Aworinde, 2012; Savithramma et al., 2012; Senthilkumar et al., 2013; Shosan et al., 2014). The single mode of medicine preparation by the Irula tribe may be attributed to the presence of phytochemical constituents such as saponins, tannins, alkaloids, alkenyl phenols, flavonoids, terpenoids, phorbol esters and sesquiterpene lactones in the individual herbals which lead to the desired healing effect (Lixin et al., 2014). A single herb may even contain more than one

Table 2 Ingredients added for the preparation of herbal medicines by the Irula healers.

S. No.	Botanical name	Other plants added	Other ingredients added
1	Trees <i>Acacia catechu</i>	<i>Alpinia galanga</i> , <i>Cleome monophylla</i> and <i>Cyanotis axillaris</i> (chest pain)	Milk
2	<i>A. leucophloea</i>	<i>Alangium salviifolium</i> , <i>Cyclea peltata</i> , <i>Dioscorea pentaphylla</i> and <i>Tephrosia purpurea</i> (wound healing and stomach ache)	Coconut oil and honey
3	<i>A. nilotica</i>	<i>Curcuma aromatica</i> (toothache)	Coconut oil
4	<i>Aegle marmelos</i>	<i>Curcuma aromatica</i> , <i>Piper nigrum</i> and <i>P. betle</i> (diabetes)	Coconut oil and honey
5	<i>Ailanthus excelsa</i>	<i>Curcuma aromatica</i> , <i>Piper nigrum</i> and <i>P. betle</i> (menstrual problem)	Coconut oil
6	<i>Alangium salviifolium</i>	<i>Acacia catechu</i> , <i>Terminalia arjuna</i> , <i>T. bellerica</i> and <i>Curculio orchids</i> (chest pain)	Milk and honey
7	<i>Albizia lebeck</i>	<i>Anisomeles malabarica</i> , <i>Cleome aspera</i> and <i>Curcuma aromatica</i> (eczema)	Coconut oil
8	<i>Alstonia venenata</i>	<i>Curcuma aromatica</i> (wound healing)	Coconut oil
9	<i>Artocarpus heterophyllus</i>	<i>Ficus racemosa</i> , <i>Begonia malabarica</i> , <i>Pedaliium murex</i> and <i>Cardiospermum halicacabum</i> (arthritis and skin diseases)	Coconut oil
10	<i>Azadirachta indica</i>	<i>Ficus racemosa</i> , <i>Alpinia galanga</i> , <i>Phyllanthus emblica</i> and <i>Asystasia gangetica</i> (blood purification)	Milk and honey
11	<i>Canarium strictum</i>	<i>Allium sativum</i> and <i>Curcuma aromatica</i> (mosquito repellent)	–
12	<i>Canthium diococcum</i>	<i>Curcuma aromatica</i> , <i>Piper nigrum</i> and <i>P. betle</i> (dog bite and stomach ache)	Salt
13	<i>Cassia fistula</i>	<i>Justicia adhatoda</i> , <i>Oxalis corniculata</i> and <i>Hemidesmus indicus</i> (fever)	Milk
14	<i>Cinnamomum camphora</i>	<i>Helicteres isora</i> , <i>Cleome viscosa</i> and <i>Costus speciosus</i> (ear ache)	Coconut oil
15	<i>Commiphora caudata</i>	<i>Ocimum sanctum</i> , <i>Cleome monophylla</i> and <i>Piper nigrum</i> (fever)	Milk/honey
16	<i>Dalbergia sissoo</i> Roxb.	<i>Curcuma aromatica</i> (skin diseases)	Coconut oil
17	<i>Dodonaea angustifolia</i>	<i>Cardiospermum halicacabum</i> , <i>C. canasense</i> , <i>Curculio orchids</i> and <i>Cissus quadrangularis</i> (joint pain)	Egg white yoke and coconut oil
18	<i>Erythrina variegata</i>	<i>Ocimum tenuiflorum</i> , <i>Piper nigrum</i> and <i>P. betle</i> (cough and cold)	Honey
19	<i>Ficus racemosa</i>	<i>Hemidesmus indicus</i> , <i>Pavetta indica</i> , <i>Vetiveria zizanioides</i> , <i>Curcuma aromatica</i> and <i>Ailanthus excelsa</i> (leucorrhoea)	Milk and honey
20	<i>Limonia acidissima</i>	<i>Hemidesmus indicus</i> , <i>Pavetta indica</i> , <i>Vetiveria zizanioides</i> , <i>Curcuma aromatica</i> , <i>Cardiospermum canasense</i> and <i>Ailanthus excelsa</i> (leucorrhoea and arthritis)	Milk and honey
21	<i>Mangifera indica</i>	<i>Curcuma aromatica</i> (wound healing)	Coconut oil
22	<i>Melia azedarach</i>	<i>Hemidesmus indicus</i> , <i>Terminalia arjuna</i> , <i>T. bellerica</i> , <i>Centella asiatica</i> and <i>Cynodon dactylon</i> (stomach ache)	Milk
23	<i>M. dubia</i>	<i>Allium sativum</i> , <i>Canarium strictum</i> and <i>Curcuma aromatica</i> (mosquito repellent)	–
24	<i>Mesua ferrea</i>	<i>Curcuma aromatica</i> , <i>Piper nigrum</i> and <i>P. betle</i> (dog bite and stomach ache)	Sugar
25	<i>Phyllanthus emblica</i>	–	Sugar, milk and honey
26	<i>Pongamia pinnata</i>	<i>Cardiospermum halicacabum</i> and <i>Cardiospermum canasense</i> (rheumatism)	Neem oil
27	<i>Syzygium cumini</i>	–	Milk and honey
28	<i>Tamarindus indica</i>	<i>Curcuma aromatica</i> , <i>Piper nigrum</i> and <i>P. betle</i> (scorpion bite)	Coconut oil
29	<i>Terminalia arjuna</i>	<i>Alpinia galanga</i> , <i>Curculio orchids</i> , <i>Cleome monophylla</i> , <i>Terminalia bellerica</i> and <i>Cyanotis axillaris</i> (chest pain)	Coconut oil, sugar and honey
30	<i>T. bellerica</i>	<i>Alpinia galanga</i> , <i>Curculio orchids</i> , <i>Cleome monophylla</i> , <i>Terminalia bellerica</i> and <i>Cyanotis axillaris</i> (chest pain)	Coconut oil, sugar and honey
31	<i>T. chebula</i>	<i>Curcuma aromatica</i> , <i>Piper nigrum</i> and <i>P. betle</i> (dog bite and stomach ache)	Salt
32	<i>Wrightia tinctoria</i>	<i>Curcuma aromatica</i> (toothache)	–
33	<i>Ziziphus mauritiana</i>	<i>Curcuma aromatica</i> (wound healing)	Coconut oil
34	<i>Z. enophylla</i>	<i>Curcuma aromatica</i> (wound healing)	Coconut oil
35	Shrubs <i>Argemone mexicana</i>	<i>Curcuma aromatica</i> , <i>Piper nigrum</i> and <i>P. betle</i> (ulcer and pimples)	Milk and coconut oil

Table 2 (continued)

S. No.	Botanical name	Other plants added	Other ingredients added
36	<i>Atalantia monophylla</i>	<i>Adhatoda vasica</i> , <i>Eucalyptus globules</i> and <i>Ocimum basilicum</i> (body pain)	Honey
37	<i>Begonia malabarica</i>	<i>Cardiospermum halicacabum</i> , <i>C. canasense</i> and <i>Cissus quadrangularis</i> (arthritis and joint pain)	Egg white yoke
38	<i>Cassia auriculata</i>	–	Milk
39	<i>Citrus limon</i>	–	Salt and sugar
40	<i>Clerodendrum inerme</i>	<i>Curcuma aromatica</i> (skin diseases)	Coconut oil
41	<i>Helicteres isora</i>	<i>Cleome viscosa</i> and <i>Costus speciosus</i> (ear ache)	Coconut oil
42	<i>Jatropha gossypifolia</i>	–	Coconut oil
43	<i>Justicia adhatoda</i>	<i>Syzygium cuminii</i> , <i>Ocimum sanctum</i> , <i>Begonia malabarica</i> , <i>Piper nigrum</i> and <i>P. betle</i> (fever)	–
44	<i>J. gendarussa</i>	–	Coconut oil
45	<i>Lantana camara</i>	<i>Curcuma aromatica</i> (wound healing)	Coconut oil
46	<i>L. wightii</i>	<i>Curcuma aromatica</i> (wound healing)	Coconut oil
47	<i>Manihot esculenta</i>	<i>Curcuma aromatica</i> (wound healing)	Coconut oil
48	<i>Pavetta indica</i>	<i>Achyranthes aspera</i> , <i>Enicostemma littorale</i> , <i>Rauvolfia serpentina</i> , <i>R. trtraphylla</i> , <i>Ocimum sanctum</i> , <i>Piper nigrum</i> and <i>P. betle</i> (snake bite)	–
49	<i>Rauvolfia serpentina</i>	<i>Achyranthes aspera</i> , <i>Enicostemma littorale</i> , <i>Ocimum sanctum</i> , <i>Rauvolfia trtraphylla</i> , <i>Piper nigrum</i> and <i>P. betle</i> (snake bite)	–
50	<i>R. trtraphylla</i>	<i>Achyranthes aspera</i> , <i>Enicostemma littorale</i> , <i>Rauvolfia serpentina</i> , <i>Ocimum sanctum</i> , <i>Piper nigrum</i> and <i>P. betle</i> (snake bite)	–
51	<i>Solanum surattense</i>	<i>Piper nigrum</i> , <i>Zingiber officinale</i> and <i>Asystasia gangetica</i> (weezing)	Food
52	<i>Vitex negundo</i>	<i>Cleome viscosa</i> , <i>Cynodon dactylon</i> , <i>Euphorbia hirta</i> , <i>Ocimum sanctum</i> and <i>Piper nigrum</i> (headache and body pain)	Coconut oil
53	Herbs <i>Abutilon indicum</i>	<i>Cassia auriculata</i> and <i>Cynodon dactylon</i> (piles)	Castor oil
54	<i>Acalypha indica</i>	<i>Piper nigrum</i> and <i>P. betle</i> (jaundice)	Milk
55	<i>Achyranthes aspera</i>	<i>Citrus limon</i> , <i>Vitex negundo</i> , <i>Piper nigrum</i> and <i>P. betle</i> (dog bite and poisonous bite)	–
56	<i>Acorus calamus</i>	<i>Ocimum sanctum</i> , <i>Piper nigrum</i> and <i>P. betle</i> (cough)	Honey
57	<i>Curculio orchids</i>	<i>Citrus limon</i> , <i>Pseudarthria viscid</i> , <i>Terminalia arjuna</i> and <i>T. bellerica</i> (heart problem)	–
58	<i>Cleome monophylla</i>	<i>Cardiospermum halicacabum</i> and <i>C. canasense</i> (joint pain)	Egg white yoke
59	<i>C. viscosa</i>	<i>Commiphora caudate</i> , <i>Ocimum sanctum</i> and <i>Piper nigrum</i> (fever)	Milk/honey
60	<i>Coleus aromaticus</i>	<i>Cinnamomum camphora</i> , <i>Helicteres isora</i> and <i>Costus speciosus</i> (ear ache)	Coconut oil
61	<i>Cymbopogon citratus</i>	<i>Piper nigrum</i> and <i>P. betle</i> (cough and cold)	–
62	<i>Cynodon dactylon</i>	<i>Allium sativum</i> and <i>Piper nigrum</i> (diarrhoea)	Sugar/salt
63	<i>Desmodium gangeticum</i>	–	Sugar
64	<i>Eclipta prostrata</i>	<i>Curcuma aromatica</i> , <i>Piper nigrum</i> , <i>Hemidesmus indicus</i> and <i>Ocimum sanctum</i> (fever)	Gingelly oil and Neem oil
65	<i>Eleusine coracana</i>	<i>Cleome viscosa</i> and <i>Cynodon dactylon</i> (headache)	Coconut oil
66	<i>Enicostemma axillare</i>	<i>Phyllanthus emblica</i> , <i>Hibiscus rosa-siensis</i> , <i>Cleome viscosa</i> and <i>Cynodon dactylon</i> (hair tonic)	–
67	<i>E. littorale</i>	–	Salt
68	<i>Evolvulus alsinoides</i>	<i>Achyranthes aspera</i> , <i>Enicostemma littorale</i> , <i>Rauvolfia trtraphylla</i> , <i>Hibiscus rosa-siensis</i> , <i>Ocimum sanctum</i> , <i>Piper nigrum</i> and <i>P. betle</i> (snake bite)	Salt
69	<i>Hemidesmus indicus</i>	<i>Achyranthes aspera</i> , <i>Enicostemma axillare</i> , <i>Rauvolfia trtraphylla</i> , <i>Hibiscus rosa-siensis</i> , <i>Ocimum sanctum</i> , <i>Piper nigrum</i> and <i>P. betle</i> (snake bite)	Salt
70	<i>Hybanthus enneaspermus</i>	–	Sugar

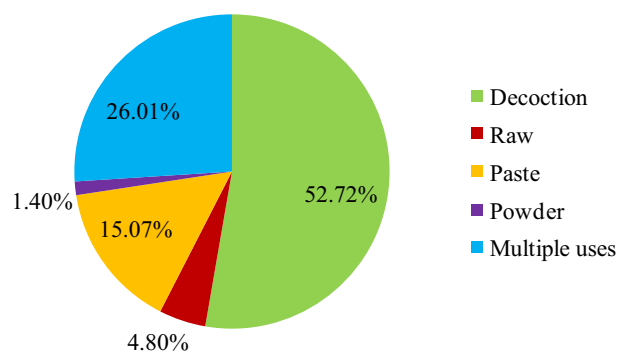
(continued on next page)

Table 2 (continued)

S. No.	Botanical name	Other plants added	Other ingredients added
71	<i>Hygrophylla auriculata</i>	–	Honey
72	<i>Mimosa pudica</i>	<i>Alpinia galanga</i> , <i>Piper nigrum</i> and <i>Zingiber officinale</i> (asthma)	Honey
73	<i>Notonia grandiflora</i>	<i>Helicteres isora</i> , <i>Cleome viscosa</i> and <i>Costus speciosus</i> (ear ache)	Coconut oil
74	<i>Ocimum sanctum</i>	<i>Piper nigrum</i> and <i>P. betle</i> (cough and cold)	Honey
75	<i>O. tenuiflorum</i>	<i>Piper nigrum</i> and <i>P. betle</i> (cough and cold)	Honey
76	<i>Oxalis corniculata</i>	<i>Hemidesmus indicus</i> , <i>Piper nigrum</i> and <i>P. betle</i> (fever)	Honey
77	<i>Phyllanthus amarus</i>	<i>Andrographis paniculata</i> , <i>Piper nigrum</i> and <i>Piper betle</i> (jaundice)	Milk
78	<i>P. reticulatus</i>	<i>Abutilon indicum</i> , <i>Cassia auriculata</i> and <i>Cynodon dactylon</i> (piles)	–
79	<i>Physalis minima</i>	<i>Piper nigrum</i> and <i>P. betle</i> (gas trouble)	Milk
80	<i>Plectranthus amboinicus</i>	<i>Piper nigrum</i> and <i>P. betle</i> (cough and cold)	Honey
81	<i>Plumbago zeylanica</i>	<i>Hemidesmus indicus</i> , <i>Pavetta indica</i> , <i>Vetiveria zizanioides</i> , <i>Hybanthus enneaspermus</i> , <i>Begonia malabarica</i> and <i>Piper nigrum</i> (sterility in women)	Milk/honey
82	<i>Pseudarthria viscida</i>	<i>Terminalia arjuna</i> , <i>T. bellerica</i> , <i>T. chebula</i> , <i>Curculio orchids</i> , <i>Phyllanthus emblica</i> and <i>Desmodium gangeticum</i> (heart problem and fever)	Coconut oil, Milk/honey
83	<i>Sansevieria roxburghiana</i>	<i>Helicteres isora</i> , <i>Cleome viscosa</i> and <i>Costus speciosus</i> (ear ache)	Coconut oil
84	<i>Sida rhombifolia</i>	<i>Curcuma aromatica</i> , <i>C. neilgherrensis</i> , <i>Piper nigrum</i> , <i>Zingiber officinale</i> , <i>Wrightia tinctoria</i> and <i>Asparagus racemosus</i> (tumor)	Coconut oil, salt, milk/honey
85	<i>Spermacoce latifolia</i>	<i>Commelina benghalensis</i> and <i>Curcuma aromatica</i> (wound healing)	Coconut oil
86	<i>Tephrosia purpurea</i>	<i>Hemidesmus indicus</i> , <i>Cymbopogon citratus</i> and <i>Zingiber officinale</i> (stomach problem)	Milk/honey
87	<i>Tridax procumbens</i>	<i>Curcuma aromatica</i> (wound healing)	Coconut oil
88	<i>Vernonia cinerea</i>	<i>Curcuma aromatica</i> , <i>Cardiospermum halicacabum</i> and <i>C. canasense</i> (paralysis)	Egg white yoke
89	<i>Vigna radiata</i>	<i>Curcuma aromatica</i> (skin disease)	Coconut oil
90	<i>Withania somnifera</i>	<i>Syzygium cumini</i> , <i>Begonia malabarica</i> , <i>Piper nigrum</i> and <i>P. betle</i> (fever)	Milk/honey
91	Climbers <i>Abrus precatorius</i>	<i>Asparagus racemosus</i> , <i>Acalypha indica</i> , <i>Citrus limon</i> , <i>Curcuma aromatica</i> , <i>Piper nigrum</i> , <i>Allium sativum</i> , <i>Cleome viscosa</i> and <i>Costus speciosus</i> (delivery pain and eye pain)	Milk/honey
92	<i>Ampelocissus tomentosa</i>	<i>Curcuma aromatica</i> and <i>Citrus limon</i> (antioxidant and skin diseases)	Honey and coconut oil
93	<i>Antigonon leptopus</i>	<i>Curcuma aromatica</i> , <i>Solena amplexicaulis</i> and <i>Citrus limon</i> (anti-inflammatory)	Coconut oil
94	<i>Asparagus racemosus</i>	<i>Allium sativum</i> , <i>Citrus limon</i> , <i>Cyperus rotundus</i> and <i>Phyllanthus amarus</i> (urinary problem)	Butter milk/cow milk
95	<i>Aristolochia bracteolata</i>	<i>Achyranthes aspera</i> , <i>Aristolochia indica</i> , <i>Curcuma aromatica</i> , <i>Zingiber officinale</i> , <i>Wrightia tinctoria</i> , <i>Citrus limon</i> , <i>Vitex negundo</i> , <i>Piper nigrum</i> and <i>P. betle</i> (snake bite, eczema, scabies and ringworm infection)	Coconut oil
96	<i>Basella rubra</i>	<i>Basella alba</i> , <i>Phyllanthus emblica</i> , <i>Centella asiatica</i> and <i>Ficus racemosa</i> (anaemia and increase WBC)	Honey
97	<i>Cardiospermum canasense</i>	<i>Cardiospermum halicacabum</i> , <i>C. canasense</i> , <i>Curculio orchids</i> , <i>Cissus quadrangularis</i> and <i>Dodonaea angustifolia</i> (joint pain)	Pungam oil, egg white yoke and coconut oil
98	<i>Cissus quadrangularis</i>	<i>Allium cepa</i> , <i>A. sativum</i> and <i>Murraya koenigii</i> (indigestion and inducing appetite)	Asafoetida
99	<i>Coccinia grandis</i>	<i>Azadirachta indica</i> , <i>Phyllanthus amarus</i> , <i>Ocimum sanctum</i> , <i>Piper nigrum</i> and <i>P. betle</i> (jaundice)	Milk and honey
100	<i>Cucurbita moschata</i>	<i>Allium cepa</i> , <i>A. sativum</i> and <i>Murraya koenigii</i> (increase weight)	Gingelly oil
101	<i>Cuscuta chinensis</i>	<i>Cardiospermum halicacabum</i> , <i>Cissus quadrangularis</i> and <i>Curculio orchids</i> (joint pain)	Egg white yoke and coconut oil
102	<i>Cyclea peltata</i>	<i>Hemidesmus indicus</i> , <i>Pavetta indica</i> and <i>Vetiveria zizanioides</i> (stomach ache and tonic)	Milk
103	<i>Dioscorea oppositifolia</i>	<i>Abutilon indicum</i> , <i>Cassia auriculata</i> and <i>Cynodon dactylon</i> (piles)	Castor oil

Table 2 (continued)

S. No.	Botanical name	Other plants added	Other ingredients added
104	<i>D. pentaphylla</i>	<i>Hemidesmus indicus</i> , <i>Allium cepa</i> and <i>A. sativum</i> (stomach ache)	Milk and honey
105	<i>Gloriosa superba</i>	<i>Cynodon dactylon</i> , <i>Justicia adhatoda</i> , <i>Piper nigrum</i> and <i>P. betle</i> (abortion)	Coconut oil and honey
106	<i>Gymnema sylvestre</i>	–	Milk and honey
107	<i>Ipomea staphylyna</i>	<i>Curcuma aromatica</i> , <i>Cocculus hirsutus</i> , <i>Cuminum cyminum</i> and <i>Madhuca longifolia</i> (cracked feet)	Coconut oil
108	<i>Mukia maderaspatana</i>	<i>Curcuma aromatica</i> (piles)	Coconut oil
109	<i>Pergularia daemia</i>	<i>Piper nigrum</i> and <i>Tephrosia purpurea</i> (asthma and gas trouble)	Milk
110	<i>Piper betle</i>	<i>Coccinia grandis</i> , <i>Cissus quadrangularis</i> , <i>Curcuma aromatica</i> and <i>Piper nigrum</i> (indigestion and skin diseases)	Milk and honey
111	<i>P. nigrum</i>	<i>Allium cepa</i> , <i>A. sativum</i> , <i>Piper nigrum</i> and <i>P. betle</i> (cold and cough)	Milk and honey
112	<i>Sarcostemma acidum</i>	<i>Cocculus hirsutus</i> , <i>Cuminum cyminum</i> and <i>Madhuca longifolia</i> (cough and antiinflammatory)	Coconut oil
113	<i>Solena amplexicaulis</i>	<i>Cuminum cyminum</i> and <i>Madhuca longifolia</i> (antiinflammatory)	Coconut oil
114	<i>Tylophora indica</i>	<i>Piper nigrum</i> , <i>Withania somnifera</i> , <i>Allium sativum</i> and <i>Tephrosia purpurea</i> (asthma and gas trouble)	Milk
115	Epiphytes <i>Loranthus flacata</i>	<i>Curcuma aromatica</i> , <i>Piper nigrum</i> and <i>P. betle</i> (menstrual problem)	Coconut oil
116	<i>Viscum album</i>	<i>Acacia catechu</i> , <i>Terminalia arjuna</i> , <i>T. bellerica</i> and <i>Curculio orchids</i> (chest pain)	Milk and honey

**Figure 4** Percent form of medicine preparation by Irula tribe.

forementioned phytochemical constituents which works synergistically with each other in producing pharmacological effect (Bahmani et al., 2015). A sizeable number of 38 species used for multiple modes of preparation of medicine in the present study may be explained that certain pharmacological actions of active constituents of certain herbals are significant only when potentiated with other plants, but not evident when used alone (Parasuraman et al., 2014). Similar to Kani tribe (Ayyanar and Ignacimuthu, 2011), Irula tribal healers of Walayar valley utilize oils of coconut, castor, gingelly, pongam and neem for the preparation of paste. According to their traditional knowledge, certain specific plant parts were used for the preparation of medicines and they were administrated in dosage according to the age of the patients. The present study clearly demonstrated that some plants have high use value (Table 1). Among them, *Acorus calamus* is the most specifically used species well recognized by all informants for the treatment of cough. Similar to our study, Arunachalam and

Parimelazhagan (2011) also reported that this species is generally prescribed by the Hooralis tribes of Kadambur hills of Eastern Ghats, India for treating cough and other throat problems. Saikia et al. (2013) in Assam and Venkatachalapathi et al. (2015) in nearby Walayar valley also found that *A. calamus* is mainly prescribed for the treatment of cough. In contrast, certain plant species were reported to have very low use values (0.20) in the present study as they were used for very little number of specific uses (Table 1).

4.1. Informant consensus factor (F_{ic})

F_{ic} arrived for any species depends upon its availability and the knowledge of informants on medicinal plants (Venkatachalapathi et al., 2015). In the present study, the illnesses were grouped into 16 major ailment categories and their F_{ic} values ranged between 0.10 and 1.0 per illness category (Table 3). The average F_{ic} value for all ailment categories was 0.55, indicating a moderate level of informant consensus. However, it was not comparable to that of other studies in Tamilnadu by Ragupathy et al. (2008) among the “Malasars” of Velliangiri holy hills and Ayyanar and Ignacimuthu (2011) among the Kani tribals in Tirunelveli hills, the only two investigations with quantitative assessment in Tamil Nadu that showed the average F_{ic} values, more than 0.70. Remarkably, high F_{ic} obtained in the present study for the two ailment categories viz., insecticidal uses (1.0) and cooling agent (0.85), indicating a higher level of consensus among the Irula healers for the usage of species for these categories. They commonly apply bark powder of the species, *Canarium strictum* and *Melia dubia* particularly in avoiding mosquito bites through topical application. The insecticidal property category was not included in standardized illness groupings by Cook

Table 3 Ethnobotanical consensus index for traditional medicinal plant use categories.

S. No.	Ailment category	Number of use-reports (N_{ur})	Number of taxa (N_t)	Informants' consensus factor (F_{ic})
1.	Circulatory system/cardiovascular diseases (CSCD)	14	8	0.46
2.	Cooling agent (CA)	8	2	0.85
3.	Dental care (DC)	6	4	0.40
4.	Dermatological infections/diseases (DID)	82	45	0.45
5.	Ear, nose, throat problems (ENT)	19	8	0.61
6.	Endocrinal disorders (ED)	31	28	0.10
7.	Fever (Fvr)	20	11	0.47
8.	Gastro-intestinal ailments (GIA)	50	30	0.40
9.	General health (GH)	23	9	0.63
10.	Genito-urinary ailments (GUA)	25	12	0.54
11.	Hair care (HC)	8	4	0.57
12.	Liver problem (LP)	8	3	0.71
13.	Poisonous bite (PB)	29	12	0.60
14.	Respiratory system diseases (RSD)	35	16	0.55
15.	Skeleto-muscular system disorders (SMSD)	54	29	0.47
16.	Insecticidal (IC)	2	2	1.00
Total		414	223	
				Average F_{ic} = 0.55

(1995). However, it was included in the present study, as the Irula tribes were commonly using these two species for their mosquito repellency very regularly. It may be explained that as the Walayar valley is situated in Palakkad gap of Western Ghats, rainfall through south-west monsoon is highly effective (ca. 1100 mm between June and September alone). This moist condition results in thick vegetations of various types and the wetted soil with dense plant formation becomes the favourable site for insects including mosquitos. Higher informant consensus was recorded by other workers also for certain ailment categories (Owuor and Kisangan, 2006; Black et al., 2007; Ragupathy et al., 2008; Ayyanar and Ignacimuthu, 2011; Venkatachalapathi et al., 2015). The high F_{ic} obtained may indicate that there may be some key phytochemical ingredients in these species which require further phytopharmacological analysis to validate the species scientifically. In our study, lower consensus factor was obtained for endocrinal disorders (F_{ic} 0.10) which includes only one illness, diabetes (Table 3). Logically, it may be the indicative of the lack of diabetic patients among the Irula communities of Walayar valley. However, no clinical data are made available for diabetics for the Irula tribals in Walayar area.

4.2. Fidelity level

Among the 146 plants used for medicinal purposes by the Irula tribal community, interestingly it has been determined that a high number of 100 species have obtained 100% fidelity and most of them were used for the treatment of single ailment category as per the informants (Table 1). This fact indicates that all these 100 species were the highly preferred plants for treating the illness of particular ailment category due to their high healing potential. In agreement with the present findings, the species viz., *Acacia nilotica*, *Acorus calamus*, *Cassia auriculata*, *Cissus quadrangularis*, *Tridax procumbens* and *Vitex negundo* available in Walayar landscape were already reported to have 100% fidelity in Tirunelveli hills (Ayyanar and Ignacimuthu, 2011).

5. Conclusion

This wide spectrum of usage of 146 plant species indicates their strong traditional knowledge on medicinal plants. The moderate, average F_{ic} value (0.55) reveals that the consensus on traditional knowledge on medicinal plants among the Irula healers of this landscape has not been shared adequately. However, consensus for certain illness categories viz., insecticidal property and cooling agent shows the effectiveness and reliability of the species viz., *Canarium strictum* and *Melia dubia*, and *Mimosa pudica* and *Sesamum indicum* on healing the respective ailment. Several new claims made in the study showed the unique knowledge of Irulas of this region on medicinal plants. Recognizing more species with high fidelity level and greater use value indicates the presence of rich varieties of phytoconstituents in these species. The species of high use value, new claims and greater fidelity level and the taxa on which higher consensus were obtained among the informants for using them in particular ailment category are suggested for further studies in the line of phytochemistry and pharmacology and hence to identify them for pharma industries.

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