



International Journal of Herbal Medicine

Available online at www.florajournal.com



E-ISSN: 2321-2187
P-ISSN: 2394-0514
IJHM 2016; 4(1): 01-11
Received: 02-11-2015
Accepted: 05-12-2015

Ganesh K. Jaganathan
Institute of Biothermal
Technology, University of
Shanghai for Science and
Technology, Shanghai 200093.

Truong Huynh Thanh Hoa
Department of Food Science and
Technology, University of
Shanghai for Science and
Technology, Shanghai 200093.

Bao-lin Liu
Institute of Biothermal
Technology, University of
Shanghai for Science and
Technology, Shanghai 200093.

Ethnobotanical survey of Irular tribes in Pillur valley, Coimbatore, Tamil Nadu (India)

Ganesh K. Jaganathan, Truong Huynh Thanh Hoa, Bao-lin Liu

Abstract

An ethnobotanical survey was conducted to secure information available on the use of medicinal plants by the Irular tribes inhabiting Pillar Valley, Coimbatore, Tamil Nadu (India) during March 2011 to May 2013. Ethno medicinal information was gathered through interviews and group discussions with 7 randomly selected informants and field trips. Informant consensus factor (ICF) and Use Value (UV) were determined. The study revealed an extensive use of 85 species distributed in 39 families for treating more than 65 ailments. These ailments were grouped in to a total of 14 categories. Herbs were the most commonly used. More than half of the formulations were prepared from leaves. The results of the ICF analysis showed that there was a great consensus in the use of plants for treatment of various ailments, least agreement was witnessed for animal/poisonous bite (PB) and Ear, nose, throat (ENT) category and a high agreement was seen for liver problems (LP) and cooling agent (CA). A total of 33 species were found to have use value of at least 1 or above. This study emphasized the importance of plant remedies still being utilized by the Irular community residing in Pillar Valley, Coimbatore, and Tamil Nadu. Unfortunately, the traditional healers are decreasing sharply in the study area. Nevertheless, many of the remedies reported here are new claims with high use values, stressing the urgent need for in-depth future studies of many unnoticed cultures, as the knowledge once lost will be lost forever.

Keywords: Irulars, ethnobotany, informant consensus factor (ICF), use value (UV), indigenous knowledge.

1. Introduction

Indigenous groups offer intuitive traditional plant-based knowledge on healthcare depending on locally available resources^[1-3]. This traditional treasure of knowledge hoarded for centuries largely by trial and error methods have been passed to subsequent generation orally. This enriched knowledge is currently viewed as extremely indispensable source of information to develop plant-based medication for various diseases^[4, 5]. Plants identified with medicinal properties are extensively used directly as folklore medicine or indirectly utilized in modern drug manufacturing^[6]. These plants contain numerous biological substances, particularly secondary metabolites and essential oils that are believed to act as the potential cure to various genetic and chronic disease/disorders in humans^[7]. Because of their safety, easy availability, economical and high effectiveness with negligible side-effects, plants are widely used as therapeutic medicine in the livelihoods of nearly 80% of the population of developing countries worldwide^[8, 9]. In particular, a majority of population living in rural area can only afford to traditional medicine, making it even more valuable. Even today some of the health problems that are considered complex by the wide-spread accepted western/modern medicine find a fruitful remedy with plant-based treatment.

India is mega-diverse in vegetation and the history of identifying and using medicinal plant in the form of systemic medicine stretches back to 5000 B.C^[10]. It is estimated that India harbors roughly about 15 percent (3000 – 3500) medicinal plants, out of 20,000 medicinal plants recorded worldwide^[11]. Such endowment of flora must have led to the development of ancient Indian medical systems namely: the Ayurveda, the Siddha and the Unani or Graeco-Arabic medicine that are officially practiced throughout the country even today. In addition, several time-tested indigenous treatments also exist in various isolated communities especially in tribal population^[12-17]. It has been estimated that there are 6,737 crore tribal people residing in 537 tribal groups throughout the country (Indian census–2001). Traditional healers in India are believed to have knowledge of using 2500 plant species, of which roughly about 100 species are more often used^[13,18]. However, the crucial knowledge of which plant is valuable to therapeutic medicine is disappearing at an alarming rate because of modernization and an uninterested young generation^[1].

Correspondence
Ganesh K. Jaganathan
(jganeshe@gmail.com)
Institute of Biothermal
Technology, University of
Shanghai for Science and
Technology, Shanghai 200093.

Given the recent rush in understanding the value of traditional medicines, there have been many organized studies in this direction that particularly focus on documenting the plants with medicinal value. The state Tamil Nadu ($8^{\circ}5' N$) situated on the eastern side of the Indian peninsula is particularly known for its enriched bio-diversity and ancient ethnic history. Previous and ongoing exploration works clearly reveal that the ethnic and tribal groups of the state have enormous knowledge on medicinal plants [7, 11, 14, 16, 19-22]. In particular, some of the earlier ethnobotanical studies on Irular tribal communities have depicted their extensive knowledge on using medicinal plants as health remedies [17, 23-26]. Despite this, many Irular community within the state are either less explored or unexplored. In light of this, we considered an exploration of Irular community residing in Pillur Valley and its surrounding area of Coimbatore district, Tamil Nadu is worthwhile. A previous study on this area has dealt with the edible plants of the Irular tribes inhabiting this region [27]. However, to the best of our knowledge, studies identifying the medicinal plants in this area are lacking. Thus, the present work reports the results of ethnobotanical survey conducted in Pillur Valley, Coimbatore, Tamil Nadu.

2. Methods

2.1 Study area

The Western Ghats, a discontinuous chain of valley mountains located on the western side of the peninsular India is approximately 1600 km long (North-South direction) extending from Tapti river valley in Gujarat to Kanyakumari in Tamil Nadu [16]. The present study was conducted in Pillur

Valley, situated in the Western Ghats of Coimbatore, Tamil Nadu (Fig. 1). The study site can be accessed by roads from Karamadai, through Vellingadu, situated approximately about 40 km from Coimbatore International Airport. Geographically, the study area lies approximately between $11^{\circ} 0'$ latitude and $76^{\circ} 0'$ longitude. The study area is a mixture of deciduous thorny forest at lower elevation and increase in elevation transforms to ever green forest located in contiguous with the Western Ghats belonging to Kerala. The biodiversity of this region is enormous with myriad number of indigenous shrubs and trees. The climate is highly moderate and rainfall is mostly received from northeast monsoon ranging from 1200 to 1500 mm. The majority of people inhabiting in the study area are Irulars. This aboriginal group constitutes the most tribal population settled in Tamil Nadu, India. It is believed that they belong to Negrito race which is one of the six main ethnic groups of India [28]. Few decades before, they had been living in deep forests of Western Ghats as hunter gatherers and because of the establishment of forest conservation reserves and in hopes of finding employment they were forced to migrate to neighboring villages. Irulars are commonly recognized from their dark complexion along with curly hair. The people inhabiting in the study area speak Tamil and few other language including Kannada (dialect). During the study, we observed that they live in many small hamlets. The main occupations of the Irulars settled in the study area are agriculture (workers) mostly during the sowing and harvest period, honey collection and trapping snakes for venom. More information on the study site and Irulars living in this area can be found in Rasingam (2012).

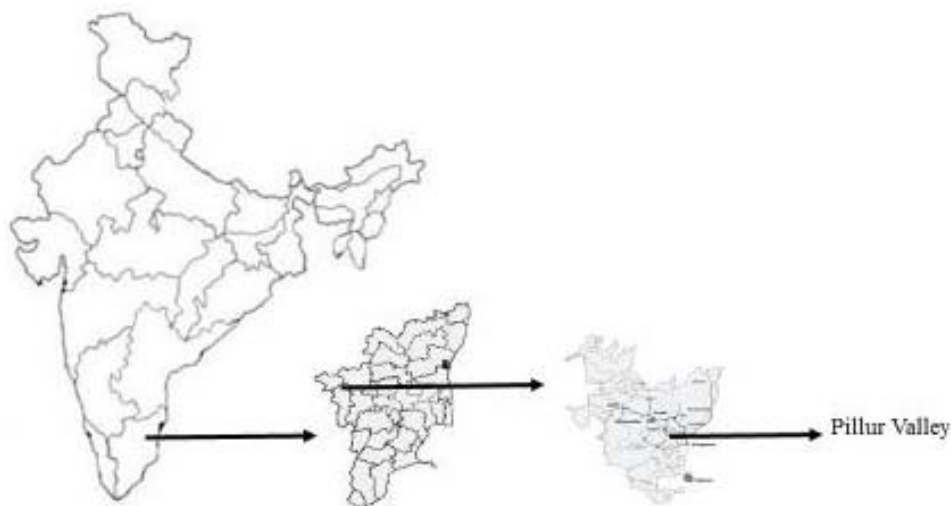


Fig 1: Location of the study area.

2.2. Selection of informants

Information on medicinal plants were obtained through a series of field surveys conducted over two year from March 2011 to May 2013 in the study area. A preliminary survey was conducted prior to the factual data collection with traditional healers and some elder people, who still practice the indigenous medicine in the area identified through a door to door interview. Judgmental selections were made and a total of 7 participants (3 traditional medicinal practitioners and 4 individuals) were selected for the study, of which 5 were male and 2 were female. All the selected informants have been living in the study area since their birth and given importance in all the ceremony. Except traditional medicinal practitioners, other informants were either agriculturalists or honey collectors and sellers. Not surprisingly, all the participants

were aged between 37 and 82 years and young generation showed no interest in knowing the value of medicinal plant. Before collecting data, all the participants were clearly stated the purpose and their willingness to participate in this study was sought.

2.3 Ethnobotanical data collection method

The main method of data collection included interviews: personal (or group) discussion in their local language following the method outlined by Jain [29]. In general, each interview lasted approximately for 2 to 3 hours, whenever possible; the conversation with the participants was recorded. Some of the diseases described by the informants (e.g. mumps, burisitis etc.) were apparently cross-checked by a modern medical doctor. Field trips (on 23 different days) were

organized incorporating at least 4 of the participants to collect and name the specimens. The informants collected the plants mostly by visually inspecting the leaf, stems and flowers. For few species, smelling and tasting of the plant parts were also attempted. All the specimens were carefully collected and preserved as herbarium specimens for future reference. The collected plants were identified by refereeing to Flora of the Presidency of Madras [30] and an excursion flora of Central Tamilnadu [31]. Whenever identification was obscured, the specimens were sent to Botanical Survey of India (Southern Regional center), Coimbatore for authentic verification. Vernacular name is also presented and family identification follows that of Mabberley [32]. Although a questionnaire approach was initiated during the early stage of the study, with exception of only two participants, all of the participants were

illiterate. Consequently, we did not use any questionnaire in our study. For most of the species listed here, mode of application was either verbally understood or the participants were asked to prepare to its final form or both.

2.4 Ailment categories

The ailments treated using plants were categorized into following 14 categories (Table 1). These categories were gastro-intestinal ailments (GIA), cardiovascular problems (CP), genitor-urinary ailments (GUA), fever and chickenpox (Fvr), skeleton-muscular system disorders (SMSD), animal/poisonous bite (PB), cooling agent (CA), hair care (HC), endocrinal disorders (ED), respiratory problems (RP), dermatological disease (DD), eye, ear, nose, throat (ENT), liver problem (LP) and dental, oral care (DOC).

Table 1: Ailment categories and corresponding disease included in each category

Ailment categories	Diseases included	Irulars term
Animal/poisonous bite (PB)	Snake bite Dog bite Bee sting	Pambu kadi Naai kadi Theni kotu
Cardiovascular problems (CP)	Blood purifier Strengthening of heart Blood pressure Memory power	Ratha suthigaripu Idaya valimai Ratha kothipu Gnayabaga sakthi
Cooling agent (CA)	Body heat	Udal ushnam
Dental and oral care (DOC)	Mouth ulcer Canker sores Tooth pain Worms in tooth	Vaai pun Vella pun Pallu vazhli Sotha pallu
Dermatological disease (DD)	Bleeding wounds Heat burns Red scar left after fire burns Cracks in legs Cuts General skin care Psoriasis Seborrheic dermatitis Eczema Clearing scars left after chicken pox Stop bleeding Sun burn Acne Thorn induced wound.	Ratha kayam Sooddu kayam Thee kaya thalumbu Kaal vedipu Saaru kayam Thool viyadi Sori Uooral tholarchi Sirangu Ammal thalumbu Ratham nika Verkuru Parru Mul kayam
Ear, nose, throat (ENT)	Ear pain Sour throat Tearing Redness in eye Watering Epidemic parotitis (mumps) Throat pain.	Kaadu vazhli Thondai karakarapu Kaan eruchal Kaan sivapu Thanivadithal Manangati mariyatha Thondai vazhli
Endocrinal disorders (ED)	Diabetes mellitus	Sakari viyadi
Fever (Fvr)	Chicken pox Fever	Ammal Kaichal
Gastro-intestinal ailments (GIA)	Intestinal ulcer Acidity Stomach pain Vomiting Constipation Indigestion Dysentery Piles Gastric problems kill worms in stomach	Kudal pun Pulipu yeppam Vayuthu vazhli Vaandi Malachikal Ageranam Bead Moolam Vaayuvu Vayuthu poochi
Genito-urinary ailments (GUA)	Kidney stone Swelling testicles Problems of menopause Infertility in male	Siruneeraga kaal Virai veekam Maadaividai prachanai Aanmai kuraivu
Hair problems (HP)	Hair growth Greying of hair Dandruff Head lice General hair care	Mudi valarchi Sembatai mudi Podugu Peen Mudi paramaripu

	Hair loss	Mudi udirthal
Liver problem (LP)	Jaundice Remove excess bile content in body	Manjal kamalai Pitham
Respiratory problems (RP)	Cold Cough Asthma Bronchitis	Sali Irumal Ilapu Kavam
Skeleton-muscular system disorders (SMSD)	Head ache Giddiness Leg pain Back pain Rheumatism Arthritis bursitis	Thala vazhli Nadukam Kaal vazhli Muthugu vazhli Mootu vaadam Mootu veekam Mootu theimanam

2.5 Data analysis

Informant consensus factor (ICF)

Informant consensus factor (ICF) was calculated to evaluate if there was a consensus in the knowledge of plants used in the ailment group between healers in the study area. The ICF was calculated using the following formula [33].

$$ICF = \frac{N_{ur} - N_t}{N_{ur} - 1}$$

Where, N_{ur} is the number of use citations in each ailment category and N_t the number of species used in the given category. The final value of this product can be anywhere between 0 and 1. A high value (close to 1) reflects a high consensus meaning a few species are used by a large proportion of people. In contrast, a low value indicates that there is no consensus on the species used for treating particular ailments. According to Trotter and Logan [34], plants with high ICF values are more likely to serve as a better antidote when compared to plants with less ICF values.

Use value (UV)

The relative importance of each species used in the study area was quantitatively evaluated following the method developed by Phillips *et al.* [35].

$$UV = \frac{\sum U}{n}$$

Where, UV is the use value of species; U is the number of use-reports cited for a particular species and n is the total number of informants interviewed. In general, UV is high, if there are more use-report citations (when there are more uses and all the informants agree with it) for a given species and low when there are few reports.

3. Results and discussion

Medicinal plants

Table 2 provides the botanical name, family, vernacular name, plant parts used and disease or illness treated along with the mode of application for 85 species (arranged in alphabetical order) used by the Irular community dwelling in Pillur Valley, Coimbatore, Tamil Nadu. These species were scattered in 39 families and belonged to 74 genera. The dominant family exploited by the locals was Leguminosae (10 spp.), followed by Apocynaceae (5 spp.), Salicaceae (5 spp.), Labiate (5 spp.) Acanthaceae (5 spp.) and Cucurbitaceous (3 spp.). The families Moracinae and Rutaceae had three species each. Likewise, families namely Amaranthaceae, Composite, Euphorbiaceae, Lythraceae, Phyllanthaceae, Sapindaceae and Verbenaceae had two species each. The remainder of 21

families contained one species each. The majority of plants identified in this survey were herbs (43.46%), although shrubs (23.48%) and trees/tree parts (22.38%) also play a significant role in treating various diseases (Figure 2). However, other forms of plants used by Irulars include climbers (7%), Grass (2%) and aquatic species (1%). The finding that more herbs are used in folklore medicine in the study area is in line with the previous results reported on the same [23-26] and other community living within the state [14-16] or elsewhere [36,37]. This unanimity in result suggests that herbs are the most frequently used plant forms by people of Western Ghats. This could be due to the fact that herbs grow readily well in moderate climate and also that they can be easily accessed. Furthermore, evidence is mounting that the biodiversity of herbaceous plants are rich in the vicinity of indigenous groups residing in Western Ghats, Tamil Nadu, India [14, 38]. Some of the species reported in this study, have been recorded in selected earlier studies conducted on the same tribal groups on different locations, e.g. Palamalai [23], Red hills [24], Marudamalai [25], Kodiakkarai Reserve Forest [17]. As discussed by Ragupathy and New master [17], the identification of ethno taxa being used by Irulars is highly complex and we agree with this view based on our field work. However, it should be pointed out that the use of some plant species reported in those earlier studies is different from the results presented here. To quote one example, Umapiya [23] disclosed the use of *Aegle marmelos* leaves in curing dyspepsia, but this species was used against diabetes mellitus in the present study area. Despite such contrasting results - which are not uncommon in the burgeoning ethnobotany text, our study was able to identify novel uses of many species. These include *Albizia amara*, *Phyla nodiflora*, *Nelumbo nucifera*, *Punica granatum*, and *Tabernaemontana divaricata*.

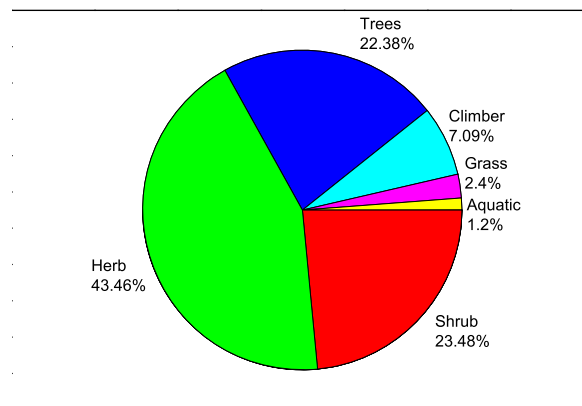


Fig 2: Percentage of life-forms identified to have ethnobotanical importance.

Table 2: List of plants identified in the study. The use value (UV), family, vernacular name, parts used, aliment category, mode of application and preparation of these plants in its final form are summarized.

Botanical name	Use value (UV)	Family	Vernacular name	Parts used	Ailment category	Mode of application	Preparation
<i>Abrus precatorius</i> L.	0.57	Leguminosae	Kundumani	Root	RP (cold and cough)	Oral	Decoction
<i>Abutilon indicum</i> (L.) Sweet	0.43	Malvaceae	Thuthi	Leaves	GIA (piles and constipation)	Oral	Paste
<i>Acalypha indica</i> L.	1.57	Euphorbiaceae	Kuppaneni	Leaves and stem	RP (cold, bronchitis, asthma) GIA (intestinal ulcer)	Oral	Paste
<i>Achyranthes aspera</i> L.	0.29	Amaranthaceae	Nayuruvi	Leaves and stem	PB (dog bite)	Topical	Paste
<i>Aegle marmelos</i> (L.) <u>Corrêa</u>	0.43	Rutaceae	Vilva maram	Fruit	ED (Diabetes mellitus)	Oral	Powder
<i>Aerva lanata</i> (L.) Schult.	0.43	Amaranthaceae	Sirupeelai	Leaves	GUA (kidney stone)	Oral	paste
<i>Albizia amara</i> (Roxb.) Boivin	1.43	Leguminosae	Arappu	Leaves and stem	RP (cold, cough, sinus and asthma) HP (general hair care)	Nasal Topical	powder Paste
<i>Allium cepa</i> L. var. <i>aggregatum</i>	0.71	Alliaceae	Chinna vengayam	Bulbs	FVR (chicken pox)	Topical	Raw
<i>Allium sativum</i> L.	1.29	Alliaceae	Vellopoundu	Bulbs	DD (skin rashes and psoriasis) ENT (ear pain) PB (bee sting)	Topical Topical Topical	Paste Raw Paste
<i>Aloe vera</i> var. <i>chinensis</i>	0.71	Asphodelaceae	Sothu kathazhai	Leaves	GIA (gastric problems, indigestion, intestinal ulcer and vomiting)	Oral	Raw
<i>Andrographis lineata</i> Nees.	0.57	Acanthaceae	Siriyangai	Leaves	ED (diabetes mellitus)	Oral	Powder
<i>Andrographis paniculata</i> Nees	0.57	Acanthaceae	Periyangai	Leaves	ED (diabetes mellitus)	Oral	Powder
<i>Anisomeles malabarica</i> (L.) R. Br.	0.71	Labiatae	Paeimirrattai	Leaves	GIA (dysentery)	Oral	Paste
<i>Areca catechu</i> L.	0.57	Palmae	Pakku	Seeds	DD (wounds, cuts and fire burn)	Topical	Paste
<i>Aristolochia bracteolata</i> Lam.	0.57	Aristolochiaceae	Aaduthinnappalai	Leaves	PB (snake bite)	Topical	Paste
<i>Azadirachta indica</i> A. Juss.	0.43	Meliaceae	Vembu	Leaves	ENT (mumps)	Topical	Paste
<i>Bauhinia racemosa</i> Lam.	0.57	Leguminosae	Aathi	Leaves and bark	GIA (piles and intestinal ulcer)	Oral	Paste
<i>Boerhavia diffusa</i> L.	0.29	Nyctaginaceae	Saranda	Leaves	GIA (indigestion and gastric problems)	Oral	Paste
<i>Borassus flabellifer</i> L.	1.43	Palmae	Panai	Fruit	DD (sunburn and acne) CA (body heat)	Topical Oral	Raw Raw
<i>Caesalpinia bonducella</i> (L.) Roxb.	0.57	Leguminosae	Kalarchikai	Fruit	GUA (swelling testicles)	Oral	Powder
<i>Calotropis gigantea</i> (L.) W. T. Aiton.	1	Apocynaceae	Erukkalam	Leaves and stem	DD (thorn induced wound)	Topical	Raw
<i>Cardiospermum halicacabum</i> L.	0.86	Sapindaceae	Mudakkittaan	Leaves and stem	SMC (arthritis, anterior knee pain syndrome and bursitis)	Oral	Paste
<i>Cassia angustifolia</i> Vahl	0.29	Leguminosae	Nilavarai	Leaves	GIA (dysentery, piles and constipation)	Oral	Decoction
<i>Cassia auriculata</i> L.	1.86	Leguminosae	Aavaram poo	Flower	ENT (sour throat) SMC (head ache and giddiness) CP (blood purifier and strengthening heart)	Oral Oral Oral	Decoction Decoction Decoction
<i>Catharanthus roseus</i> (L.) G. Don	0.43	Apocynaceae	Nithyakalyani	Leaves	ED (diabetes mellitus)	Oral	Powder
<i>Centella asiatica</i> (L.) Urb	1	Umbelliferae	Vallarai	Leaves	CP (blood pressure and memory power)	Oral	Paste
<i>Cinnamomum verum</i> J. Presl.	0.29	Lauraceae	Lavangai	Bark	GUA (infertility in male)	Oral	Decoction
<i>Cissus quadrangularis</i> L.	0.86	Vitaceae	Pirandai	Stem	GIA (stomach pain, constipation, vomiting and intestinal ulcer)	Oral	Paste
<i>Citrus limon</i> (L.) Burm.f.	1.57	Rutaceae	Ezlumichai	Whole fruit	HP (dandruff) DD (skin rashes)	Topical Topical	Raw Raw
<i>Coccinia grandis</i> (L.) J. Voigt	0.71	Cucurbitaceae	Kovai keerai	Leaves	GIA (dysentery and vomiting)	Oral	Paste
<i>Cocculus cordifolius</i> (Willd.) DC.	0.57	Menispermaceae	Seenthilkodi	Leaves	ED (diabetes mellitus)	Oral	powder
<i>Cynodon dactylon</i> (L.) Pers.	1.57	Gramineae	Arugampul	Leaves	ED (diabetes mellitus) CP (blood pressure)	Oral Oral	Juice Juice
<i>Cyperus rotundus</i> L.	0.43	Cyperaceae	Koraikilangu	Tuber	SMC (leg pain, joint pain and back pain)	Oral	Powder
<i>Dodonaea viscosa</i> Jacq.	1	Sapindaceae	Virali	Leaves and stem	SMC (rheumatism, arthritis and bursitis)	Topical	Paste
<i>Eclipta alba</i> L. ex B.D. Jacks	0.86	Compositae	Karisalangani	Leaves	HP (hair growth and greying of hair)	Oral	Paste
<i>Eucalyptus globulus</i> Labill.	1.71	Myrtaceae	Thaila maram	Leaves	RP (cold, asthma, bronchitis) SMC (head ache)	Nasal Nasal	Raw Raw
<i>Eugenia caryophyllata</i> Thunb.	0.71	Myrtaceae	Kirambu	Flower bud	DOC (tooth pain and worms in tooth) DD (general skin care and psoriasis)	Oral Oral	Powder Paste
<i>Euphorbia hirta</i> L.	1.14	Euphorbiaceae	Amman pacharisi	Leaves	GIA (stomach pain)	Oral	Paste
<i>Evolvulus alsinoides</i> L.	0.29	Convolvulaceae	Vishnukirandthi	Leaves	CP (strengthening of heart) RP (cold, asthma and bronchitis)	Oral Oral	Powder Powder
<i>Ficus benghalensis</i> L.	0.43	Moraceae	Aala maram	Fruit	GUA (impotency in male)	Oral	Powder

<i>Ficus religiosa</i> L.	0.71	Moraceae	Arasa maram	Bark	DD (bleeding wound, heat burns and red scar left after fire burns)	Topical	Powder
<i>Ficus retusa</i> L.	0.71	Moraceae	Athi mathuram	Bark	DD (Swelling and wounds)	Topical	Powder
<i>Glinus lotoides</i> L.	0.57	Molluginaceae	siruserupadai	Leaves	GUA (kidney stones)	Oral	Powder
<i>Glycyrrhiza glabra</i> L.	0.71	Leguminosae	Athimaduram	Leaves	RP (cold and cough) ENT (throat pain)	Oral Oral	Paste Paste
<i>Gymnema Sylvestre</i> R. Br.	0.57	Apocynaceae	Sirukurinjan	Leaves	ED (diabetes mellitus) PB (snake bite)	Oral Topical	Paste Paste
<i>Hemidesmus indicus</i> (L.) R.Br.	1	Apocynaceae	Nanari	Root	CA (body heat)	Oral	Decoction
<i>Hygrophila spinosa</i> T.Anderson	0.71	Acanthaceae	Neermuli	Leaves	GUA (kidney stone)	Oral	Paste
<i>Indigofera caerulea</i> Roxb.	0.43	Leguminosae	Avuri	Leaves	GIA (piles and constipation)	Oral	Paste
<i>Justicia adhatoda</i> L.	1	Acanthaceae	Adathodai	Leaves	RP (cough, bronchitis and asthma) FVR (fever)	Topical Topical	Paste Paste
<i>Kedrostis foetidissima</i> Cogn.	0.86	Cucurbitaceae	Appakovai	Leaves	DD (seborrheic dermatitis and eczema)	Topical	Paste
<i>Lantana indica</i> Roxb.	0.43	Verbenaceae	Unni	Leaves	PB (snake bite)	Oral	Decoction
<i>Lawsonia inermis</i> L.	1.29	Lythraceae	Maruthani	Leaves	LP (remove excess bile content in body) DD (cracks in foot)	Topical Topical	Paste Paste
<i>Leucas aspera</i> Link.	0.71	Labiatae	Tumbai	Leaves	RP (cold and asthma)	Topical	Paste
<i>Momordica charantia</i> L.	2	Cucurbitaceae	Pavaka	Fruit	ED (diabetes mellitus) GIA (kill worms in stomach)	Oral Oral	Raw Raw
<i>Moringa oleifera</i> Lam.	1	Moringaceae	Murangai	Seeds	GUA (impotency in male)	Oral	Raw
<i>Mukia maderaspatana</i> (L.) M. Roemer	1	Cucurbitaceae	Musumukai	Leaves	RP (cold and asthma) GIA (piles)	Oral Oral	Paste Paste
<i>Murraya koenigii</i> Spreng.	1.57	Rutaceae	Karuvopilai	Leaves	GIA (indigestion and stomach pain) HP (hair loss)	Oral Topical	Raw Raw
<i>Musa acuminata</i> Colla.	1	Musaceae	Vaalai	Stem	GUA (kidney stones)	Oral	Raw
<i>Nelumbo nucifera</i> Gaertn	0.14	Nelumbonaceae	Thamarai	Flower	CP (strengthening of heart)	Oral	Paste
<i>Ocimum americanum</i> L.	1	Labiatae	Naai-thulasi	Leaves	RP (cold, cough and bronchitis)	Oral	Paste
<i>Ocimum basilicum</i> L.	1	Labiatae	Thiniru pathri	Leaves and flower	DD (skin rashes and clearing scars left after chicken pox) PB (bee sting)	Topical Topical	paste paste
<i>Ocimum sanctum</i> L.	1	Labiatae	Thulasi	Leaves and stem	RP (cold, cough and bronchitis)	Oral	Raw
<i>Oxalis corniculata</i> L.	0.57	Oxalidaceae	Puliyarai	Leaves	GIA (stomach pain, indigestion and vomiting)	Oral	Decoction
<i>Pergularia daemia</i> (Forssk.) Chiov.	0.29	Apocynaceae	Veeliparuthi	Leaves	GUA (problems during menopause)	Oral	Paste
<i>Phyla nodiflora</i> (L.) Greene,	0.86	Verbenaceae	Poduthalai	Leaves	HP (dandruff and head lice)	Topical	Powder
<i>Phyllanthus amarus</i> Schumach. & Thonn.	1	Phyllanthaceae	Keelaneli	Root	LP (jaundice)	Oral	Paste
<i>Phyllanthus emblica</i> L.	0.86	Phyllanthaceae	Nellikkaai	Fruit	GIA (constipation and indigestion)	Oral	Raw
<i>Piper betle</i> L.	1.43	Piperaceae	Vethalai	Leaves	GIA (indigestion and appetizer) RP (cold in children)	Oral Oral	Raw Raw
<i>Plectranthus amboinicus</i> (Lour.) Spreng.	1.29	Labiatae	Karpporavali	Leaves	RP (cold, asthma and bronchitis) SMC (head ache)	Nasal Nasal	Juice Juice
<i>Punica granatum</i> L.	0.29	Lythraceae	Maadulai	Fruit shell	GIA (stomach pain and indigestion)	Oral	Powder
<i>Sesbania grandiflora</i> (L.) Pres.	0.71	Leguminosae	Agathi	Leaves	DOC (mouth ulcer and canker sores)	Oral	Raw
<i>Solanum erianthum</i> D. Don.	0.43	Solanaceae	Sundai	Fruit	GIA (dysentery and indigestion)	Oral	Raw
<i>Solanum nigrum</i> L.	1.14	Solanaceae	Sukkuti keerai	Leaves and Fruit	GIA (intestinal ulcer) DOC (mouth ulcer)	Oral Oral	Raw/cooked Raw/cooked
<i>Solanum trilobatum</i> L.	1	Solanaceae	Thuthuvulai	Leaves	RP (cold, cough and bronchitis)	Oral	Raw
<i>Solanum xanthocarpum</i> Schrad.	0.86	Solanaceae	Kandankathiri	Fruit	DOC (tooth pain) SMC (rheumatism)	Oral Oral	Powder Paste
<i>Spermacoce hispida</i> L.	0.57	Rubiaceae	Nathaisoori	Leaves	GUA (kidney stones)	Oral	Powder
<i>Syzygium cumini</i> (L.) Skeels	0.14	Myrtaceae	Naaval maram	Seeds	ED (diabetes mellitus)	Oral	Powder
<i>Tabernaemontana divaricata</i> G.Don	0.29	Apocynaceae	Nandiyavattai	Flower	ENT (tearing, redness in eye and watering)	Topical	Raw
<i>Terminalia chebula</i> Retz.	0.43	Combretaceae	Kadukkai	Seed shell	GIA (acidity, stomach pain and vomiting)	Oral	Powder
<i>Trachyspermum ammi</i> Sprague.	1	Umbelliferae	Omam	Seeds	GIA (constipation and indigestion)	Oral	Raw
<i>Tribulus terrestris</i> L.	0.57	Zygophyllaceae	Nerinji	Thorns , Root	GUA(kidney stones)	Oral	Powder
<i>Tridax procumbens</i> L.	1	Compositae	Vettukkaya thazhai or thatha-thalai vetti poo	Leaves and stem	DD (cuts, bleeding and wounds)	Topical	Juice
<i>Vitex negundo</i> L.	1	Labiatae	Nochi	Leaves	RP (cold, cough and asthma) SMC (head ache)	Nasal Nasal	Raw Raw
<i>Wattakaka volubilis</i> Stapf.	1	Apocynaceae	Perukurinjan	Leaves	DD (bleeding wound in diabetes patients)	Oral	Decoction
<i>Withania somnifera</i> (L.) Dunal.	0.14	Solanaceae	Amukira kilangu	Tuber	SMC (Rheumatism)	Oral	Paste

Disease treated

In this study, plant remedies were recommended for 65 different types of ailments and other health problems such as scars left after fire burn or chicken pox (Table 1; Table 2). It was observed that most number of remedies were prescribed for gastro-intestinal ailments (GIA) including intestinal ulcer (5 species), stomach pain (6 species), vomiting (5 species), constipation (6 species), indigestion (9 species), dysentery (4 species), piles (5 species), gastric problems (3 species), and kill worms in stomach (1 species) (Table 2). More herbal remedies were prescribed for cold (15 species), cough (9 species), asthma (10 species and bronchitis (8 species) grouped under respiratory problems (RP). Similar to the results reported here, previous studies have also noted a wide-spread medication existing on gastro-intestinal ailments and respiratory problems in the tribes dwelling Western Ghats [14, 16, 23]. A total of 8 remedies from 8 species were suggested for diabetes mellitus. According to World Health Organization (WHO) 180 million people worldwide are suffering from diabetes and it is projected that this number will have doubled, by 2030. The risk of every Indian becoming diabetic is increasing several folds. The identification of 8 species used as curatives in diabetes mellitus holds promise in treating diabetes. It appears that all Irular community surveyed to date, have some knowledge in treating diabetes mellitus [17, 23, 26]. Taken together, these results imply that diabetes, gastro-intestinal ailments (GIA) and respiratory problems (RP) are the most common illness affecting Irulars and not surprisingly an enriched knowledge exists in treating those ailments. The results summarized in Table 2 affirm the treatments available for several common health issues such as fever (2 species), cardiovascular problems (5 species), body heat (2 species), liver problems (2 species) and problems associated with ear, nose and throat (5 species). In spite of treatment, traditional healers and other local people believe that chicken pox is a sign of 'God' invading in to human body. Although, treatment in many cases involves using bulbs of *Allium copal*. Var. *aggregation* the form of chain, supplements such as tender coconut and *Borassus flabellifer* were common. In addition, a handful of *Azadirachta indica* leaves are used to gently brush the body more than five times a day. In other cultures, leaf paste of *A. indica* is applied topically to cure chicken pox [1]. It is important to note that the local traditional healers also are in the opinion that patients with chicken pox should not eat any food, other than rice and milk. Ample remedies were prescribed for various ailments of genitor-urinary ailments (GUA). Most of them were to cure kidney stones (6 species). Amongst these six species, majority of informants approve the juice of *Musa acuminata* as the priority medication. Although, this species is not known to be of prevalent use in other community groups, several species, for example, *Equisetum hymnal* [39], *Larrea tridentata* [39], *Serjania triquetra* [39], *Scoparia dulcis* [40], *Tribulus terrestris* [40] have been detailed to cure kidney stones. It is important to note that folklore remedies are available to treat infertility, testicle problems and menopause problem. These ailments have been scarcely discussed in ethnobotany literature [14]. However, in a recent study, Upadhvay *et al.* [37] discussed the use of *Ficus religiosa* in treating infertility in male. Our study also found many species used against hair related problems, grouped as hair problems (HP). According to the informants, head lice and dandruff are almost seen in every individual once in their life time leading to serious problems, such as skin rashes and sleeplessness. Most of the healers suggest the use of *Phyla nodiflora* as the remedy. In fact, the Tamil name of this

species '*poduthalai*' is derived from its potential in cleaning dandruff and head lice (*podugu* = dandruff; *thalai*= leaves). In South Travancore, people use the leaves of this plant for removing dandruff [41]. Leaves of *Albizia amara* were powdered and used as an herbal hair wash agent by all Irulars in the study area. More pleasingly, the present work has witnessed a noteworthy number of species possibly used as remedies in treating several skin related problems. Examples include *Borassus flabellifer* has been used to treat sunburn and acne, *Ficus religiosa* has been used in the case of heat burns, *Justicia adhatoda* has been used against skin rashes and *Kedrostis foetidissima* has been used to cure seborrhic dermatitis, eczema and (all) skin problems in both children and adults (Table 2). A comparison of these species with other published literature strongly suggest that the claims of using *Ficus religiosa* and *Kedrostis foetidissima* against skin diseases are little. Moreover, formulations to clear scars left after fire burns and chicken pox using *Ficus religiosa* and *Ocimum basilicum* respectively appears to be new claims. Most of the traditional medical practitioners in the study area agree that the dog bite is very common. Treatment for dog bite is generally given with *Achyranthes aspera* and *Ocimum basilicum*. Similarly, snake and other poisonous insects (e.g. scorpion) bite is treated using *Aristolochia bracteolata*, *Gymnema sylvestre*, *Achyranthes aspera* and *Lantana indica*, but the ICF values for this category was low (see below). Recovery from bee sting is attempted with *Allium sativum* and *Ocimum basilicum*. However, most preparations for PB involve either the use of turmeric or limestone. While the particular reason behind this is unclear, traditional healers generally admit that the formulations do not work without these two additives. Other studies have also noted the use of *Achyranthes aspera*, *Gymnema sylvestre* in treating poisonous bites in Tamil Nadu [42]. Samy *et al.* [42] mentioned the use of *Ocimum sanctum* and *O. americanum* against snake bite. Our research has identified the usage of *Ocimum basilicum* for dog bite.

Given the current life style of Irular community, joint problems especially in leg (arthritis, anterior knee pain syndrome, rheumatism) are often seen in elder people. Numerous species including *Solanum xanthocarpum*, *Cyperus rotundus*, *Dodonaea viscosa*, and *Cardiospermum halicacabum* are frequently used as remedies. Rojas *et al.* [43] reported the presence of smooth muscle relaxing compounds in *Dodonaea viscosa* potentially curing joint pain. Other species *Cardiospermum halicacabum* have been known to be in practice for curing rheumatism [1, 17].

Informant consensus factor (ICF)

The highest ICF value amongst various ailment categories is the cooling agent (CA). All the informants agree with the use of *Borassus flabellifer* and *Hemidesmus indicus* against body heat resulting in a high ICF value of 0.92. The ICF value for liver problems (LP) was also higher compared to other categories. This category included only *Lawsonia inermis* and *Phyllanthus amarus*, but had 12 use-citations, explaining the reason for higher ICF value of 0.91 (Table 3). Such high ICF value for liver problems, particularly jaundice has been reported in some of the earlier studies [14, 44, 45]. Given increase in studies documenting the use of *Phyllanthus amarus*, treating jaundice with high ICF observed across many cultures, it is becoming explicit that *P. amarus* contains some key phytochemical substance, thus phytopharmacological analyses are deemed necessary to standardize the dose. The average ICF vales of all categories used in this study was 0.79 (Table

3). This result is in high agreement with Ragupathy and Newmaster [17], who found a high ICF value ranging between 0.70 and 1.00 on various ailment category, amongst the Irulars of kodiakkarai Reserve Forest, India. The results of the present study illustrate that there were three categories with more than 50 use-citations viz. GIA (92 or 19.17% of total citations, 22 or 20% of the total species); DD (77 or 16.04% of the total citations, 12 or 10.91% of the total species) and RP (76 or 15.83% of the total citations, 16 or 14.55% of total species). The ICF values of GIA, DD and RP are 0.77, 0.86 and 0.8 respectively. In an earlier study Ayyanar and Ignacimuthu [14] reported 81 use-report from 26 species for dermatological disease/infection and 70 use-reports from 21 species for gastro-intestinal disease with high ICF values in Kanitribals in Tirunelveli hills of Western Ghats. Other ailment categories including Skeleton-muscular system disorders (SMSD), Hair problems (HP), Genito-urinary ailments (GUA) and Endocrinal disorders (ED) also had high ICF value of 0.78, 0.85, 0.73 and 0.77 respectively, similar to the results observed in previous studies [14, 44, 45]. The least ICF value of 0.69 was

observed for animal/poisonous bite (PB) and ear, nose, throat (ENT). This result contradicts the high ICF values obtained for snakebite around the world [46]. However, similar to our results a low ICF values for snake bite has been documented in few studies. The lack of consensus in treating snake bite can be observed throughout Irular community. With the exception of *Andrographis paniculata* and *Leucas aspera*, all other species were reported to be effective against snake bite only once, i.e. approved by only few or one informant(s) of a particular group [23, 24, 26]. The low ICF value of ENT may have several rational explanations. While all the informants approve the treatment for ear pain using *Allium sativum*, eye problems were treated by different remedies. Since all of them are effective, each informant continues using it, and no knowledge exchanged amongst those healers. Even though, if a species is used by many indigenous groups, there is a more likelihood that plant materials of species have some form of substance actually acting on human body, we call for further research to validate the claims proposed in this study.

Table 3: Informant consensus factor (ICF) by categories of ailments.

Ailment category	Use citation	(%) All use citations	Number of species	(%) All use species	ICF
Animal/poisonous bite (PB)	17	3.54	6	5.45	0.69
Cardiovascular problems (CP)	20	4.17	5	4.55	0.79
Cooling agent (CA)	14	2.92	2	1.82	0.92
Dental and oral care (DOC)	15	3.13	4	3.64	0.79
Dermatological disease (DD)	77	16.04	12	10.91	0.86
Ear, nose, throat (ENT)	14	2.92	5	4.55	0.69
Endocrinal disorders (ED)	32	6.67	8	7.27	0.77
Fever (Fvr)	8	1.67	3	2.73	0.71
Gastro-intestinal ailments (GIA)	92	19.17	22	20	0.77
Genito-urinary ailments (GUA)	38	7.92	11	10	0.73
Hair problems (HP)	28	5.83	5	4.55	0.85
Liver problem (LP)	12	2.5	2	1.82	0.91
Respiratory problems (RP)	76	15.83	16	14.55	0.8
Skeleton-muscular system disorders (SMSD)	37	7.71	9	8.18	0.78

Species use values

The species use value was 1 or above for 33 species. *Momordica charantia* was found to be the most commonly used species with highest use value of 2 (14 use-citations from 7 informants). This species has been used both against diabetes mellitus and to kill the worms in intestine, and all the informants agree with these uses. The popularity of using *Momordica charantia* as an anti-diabetic agent has also been documented in myriad earlier studies [47, 48]. Species with high use value recorded in the present study include *Cassia articulate*, *Acalypha indica*, *Citrus lemon*, *Cynodon dactylon*, *Murraya koenigii*, *Albizia amara*, *Borassus flabellifer*, *Piper beetle*, *Allium sativa*, *Lawsonia inermis*, *Plectranthus amboinicus*, *Euphorbia hirta* and *Solano nigrum*. Although some of these species are extensively utilized in folklore medicines of different tribal groups, few species are found to be less frequently reported, e.g. *Albizia amara*. Another reason for high use values detected on various new species might also be inclined to the novel uses identified for those species. For example, to the best of our knowledge, utilization of *Albizia amara* leaves against cold, cough and asthma has never been reported, but 5 traditional healers interviewed agree with this property. Three species namely *Nelumbo nucifera*, *Syzygium cumini* and *Withania somnifera* had the lowest use value (0.14). These species received only one use-citation each, from

three different informants. However, all these species are used as remedies in other cultures. For example, *Nelumbo nucifera* has been used as an antidote for snake bite [49]. In Kancheepuram, Tamil Nadu, stem bark and fruits of *Syzygium cumini* are utilized to treat swelling and body heat [1]. Similarly, Jeeva *et al.* [40] reported the use of *Withania somnifera* roots in treating rheumatism and painful swellings. The low availability of these species in the study area could possibly be the reason for low UV [50].

Parts of plants used

Clearly, the most common used plant part as a curative agent was leaf (53.65%) (Fig. 3). A casual search of ethnobotany studies published in the Western Ghats [14, 16, 23-25, 51] and around the world reflects the frequent use of leaf in folklore medicine [52, 53]. The reason behind the extensive use of leaf is probably attributable to their easy availability throughout the year compared to other counterparts, e.g. flowers, fruits, seeds etc., which are only available few months or in particular season. In addition, leaves can be easily collected than other underground parts [54]. The second commonly used plant part was fruit (11.7%). Many fruits listed here can be collected and saved for later use. As a result, the collection and use of those fruits is apparently promising. Indeed, a previous study on Irular community settled in the same study area revealed a

high number of wild edible fruit consumption [27], supporting the argument that continuous availability of fruit parts all-round the year. Similar to earlier reports published in Irular community, other plant parts used in traditional medicine include seeds, root, bark, flower, stem, bulbs, tuber and flower bud, but they are less frequently used (Figure 3). In many species, two parts of the plants are used either combined to treat a particular ailment or a single plant part of a given species is used for different illness. For example, leaves and flowers of *Ocimum basilicum* are used together in treating skin rashes or dog bite. In contrast, bulbs of *Allium sativum* is used against skin rashes, ear pain and bee sting. In almost all previous studies, similar pattern have been identified [1, 14, 16, 36, 38]. According to informants, the plant parts were either used fresh, shade-dried or sun-dried. The duration of drying varies between species and practitioners. There was no evidence of storing the plants for future use, and all the preparations were made out of freshly collected specimens. When dried plant parts are used, they are carefully collected and dried by the healers.

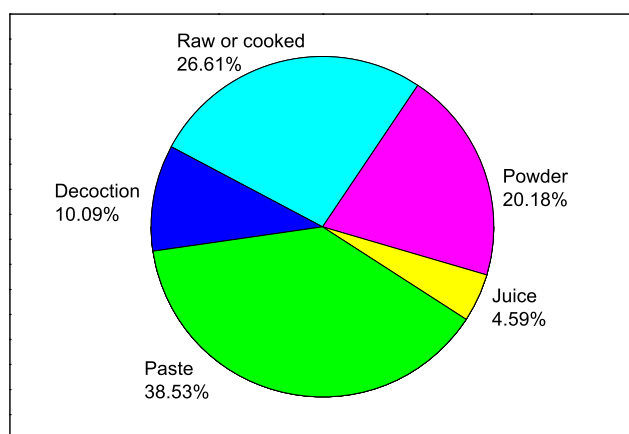


Fig 3: Percentage of plant parts used in preparing remedies.

Mode of application

Based on the data collected, the preparation of plant parts for administration was assembled in to five categories namely raw or cooked, decoction, paste, juice and powder (Figure 4). Healers generally preferred to prepare remedies in the form of paste (38.53%). Paste was prepared by grinding fresh or shade/sun dried plant parts in milk or water. For example, *Dodonaea viscosa*, where leaves are grinded in the presence of milk not water. Identical trend of using more plants in the paste forms has been reported in numerous previous studies of Irular community [26] and elsewhere [44, 55]. About 26% of the plants were used raw or cooked for food, followed by powder (20%) and decoction (10.09%). Only 5% of the species were given in the form of juice. Some of the species described in Table 1, required additional herbal substances to prepare it to ready-to-use form. One such important substance often used by Irulars in the study area is turmeric. Based on the information available, the use of turmeric can be more frequently seen in formulations prepared for treating bee sting and skin rashes. Some informants have been using *Kedrostis foetidissima* with turmeric in treating ailments of cattle including cow and goat. Likewise, the use of limestone in formulations prepared for bee sting was also identified. The administration routes of the remedies prepared were mainly oral (67%), topical (25%), nasal (6%) and direct pouring in to ear (1%). This observation is in accordance with most of the previous studies conducted elsewhere [14, 36, 53]. Most of the formulations prepared as paste and powder is internally taken

with water, cow or goat's milk, honey and eaten with rice, as seen in earlier studies [14, 55]. The general oral administration in children is frequently aided with honey. In some taxa, for example *Solanum nigrum* the leaves cooked with onion and coconut are eaten with rice. There were two types of nasal administration observed. Firstly, in *Plectranthus amboinicus*, 3-4 drops of juice is poured directly in to the nose. On the other hand, leaves of *Eucalyptus globulus* are boiled in hot water and the vapor is inhaled (Irulars term: *aavipudithal*). A less frequently practiced, yet effective method is to burn the leaves in fire and the smoke is inhaled directly (Irulars term: *pugaipudithal*). Leaves of *Albizia amara* are used in this manner. When *Allium sativum* used against the ear pain are differently prepared. For this, bulbs are boiled in castor oil, the residue is filtered and only few drops of oil are poured directly in to ear.

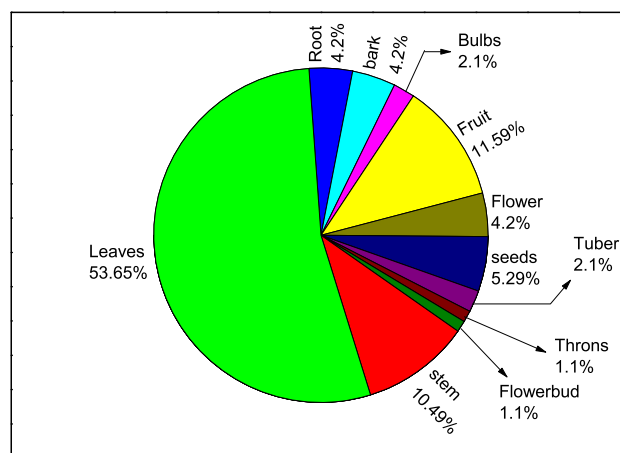


Fig 4: Different mode of formulation administered by Irulars. The values indicate percentage of each mode.

Dosage

Most of the informants including the traditional healers were found to have known little about the dosage. In general, the prescribed dosage tends to be seemingly arbitrary and there seems to be no standardized dosage prescriptions. However, most of the informants interviewed agree that the dose prescriptions increase with the severity of disease and age. While some articulated that the constant use of dose and increasing the number of intake as the best way to increase the amount of intake, others believe keeping the number of intake constant with increasing the amount given in each dose. Such confounding patterns in dosage also exist in folklore treatments throughout the world [16, 36]. Despite this, almost all treatments were given once (71%) a day. Some of them were given twice (11%) or thrice (6%). Besides, more than 95% of the healers revealed that the acquisition of this knowledge is orally transmitted from their parents, only very few participants reported a self-trial and error method (only for 3 species). No informant is willing to disclose this information to the locals. All the participants took part in this study had known of no side-effects due to the formulations prescribed, although few admit over-dosing had led to vomiting, throat pain and stomach pain. Nevertheless, these side-effects were settled to normal in few days without any additional medication.

4. Conclusion

In conclusion, the ethnobotanical survey conducted in the Irular community inhabiting in Pillur Valley, Coimbatore, Tamil Nadu, India, over two years registered 85 taxa that

possess medicinal values. These species have been used in treating various ailments. In particular, our research has identified many novel claims. Many of the Irulars living in Pillur Valley rely immensely on the folk medicine, although modern medicine facilities have been made accessible. The cost of receiving this treatment is almost one tenth of a percent compared to modern medicine. Furthermore, herbal medicines and healers are available locally. Unfortunately, as universally observed, the invaluable knowledge is exceedingly limited to traditional healers and few elderly people living in the local community. These traditional healers are decreasing sharply, posing serious threat to the loss of this precious knowledge.

5. Acknowledgement

We are grateful to many Irulars of the study state, who eagerly participated in this survey and disclosed their valuable knowledge. We are indeed pleased to thank Mr. Senthil Kumar our local contact, who helped in establishing contact with them, provided transport and accommodation during field visit, without him the project would not have been completed. Financial support from NSFC (Grant No.51076108), and the Shanghai Dongfang Scholars Program is gratefully acknowledged.

6. References

- Muthu C, Ayyanar M, Raja N, Ignacimuthu S. Medicinal plants used by traditional healers in Kancheepuram District of Tamil Nadu India., *Journal of Ethnobiology and Ethnomedicine*. 2006; 2(43):1-10.
- Duraipandiyan V, Ayyanar M, Ignacimuthu S. Antimicrobial activity of some ethnobotanical plants used by Paliyar tribe from Tamil Nadu, India. *BMC complementary and alternative medicine* 2006; 6(35):1472-1476.
- Schippmann U, Leaman DJ, Cunningham A. Impact of cultivation and gathering of medicinal plants on biodiversity: global trends and issues: Global Trends and Issues. Inter-Department Working Group on Biology Diversity for Food and Agriculture, FAO, Rome, Italy, 2002.
- Fabricant DS, Farnsworth NR. The value of plants used in traditional medicine for drug discovery. *Environmental health perspectives* 2001; 109:69-75.
- Patwardhan B, Vaidya AD, Chorghade M. Ayurveda and natural products drug discovery. *Current Science Bangalore* 2004; 86:789-799.
- Alagesabopathi C. Ethnobotanical studies on useful plants of Kanjamalai Hills of Salem district of Tamil Nadu, Southern India. *Archives of Applied Science Research* 2011; 3:532-539.
- Ayyanar M, Sankarasivaraman K, Ignacimuthu S, Sekar T. Plant species with ethnobotanical importance other than medicinal in Theni district of Tamil Nadu, Southern India., *Asian Journal of Experimental Biological Science*. 2010; 765-771.
- Akerele O. Nature's medicinal bounty don't throw it away. *World Health Forum* 1993; 390-395.
- Chhetri D, Parajuli P, Subba G. Antidiabetic plants used by Sikkim and Darjeeling Himalayan tribes India., *Journal of Ethno pharmacology*. 2005; 99(2):199-202.
- Uniyal SK, Singh K, Jamwal P, Lal B. Traditional use of medicinal plants among the tribal communities of Chhota Bhangal, Western Himalaya, *Journal of Ethnobiology and Ethno medicine* 2006; 2, <http://www.ethnobiomed.com/content/2/1/14>.
- Shanmugam S, Rajendran K, Suresh K. Traditional uses of medicinal plants among the rural people in Sivagangai district of Tamil Nadu, Southern India., *Asian Pacific Journal of Tropical Biomedicine*. 2012; 2:S429-S434.
- Alagesabopathi C. Ethnomedicinal plants and their utilization by villagers in Kumaragiri Hills of Salem district of Tamilnadu, India. *African Journal of Traditional, Complementary, and Alternative Medicines*. 2009; 6(3):222-227.
- Verma S, Singh S. Current and future status of herbal medicines. *Veterinary world* 2008; 1:347-350.
- Ayyanar M, Ignacimuthu S. Ethnobotanical survey of medicinal plants commonly used by Kani tribal in Tirunelveli hills of Western Ghats, India., *Journal of Ethno pharmacology*. 2011; 134:851-864.
- Ignacimuthu S, Ayyanar M, Sankarasivaraman K. Ethnobotanical study of medicinal plants used by Palmyra tribal in Theni district of Tamil Nadu, India. *Fitoterapia* 2008; 79(7):562-568.
- Ignacimuthu S, Ayyanar M, Siva Raman SK. Ethnobotanical investigations among tribes in Madurai District of Tamil Nadu (India). *Journal of Ethnobiology and Ethno medicine*. 2006; 2(25). <http://www.ethnobiomed.com/content/2/1/25>.
- Ragupathy S, New master SG. Valorizing the 'Ireless' traditional knowledge of medicinal plants in the Kodiakkarai Reserve Forest, India. *Journal of Ethnobiology and Ethno medicine* 2009; 5(10). <http://www.ethnobiomed.com/content/5/1/10>.
- Sheng-Ji P. Ethnobotanical approaches of traditional medicine studies: some experiences from Asia. *Pharmaceutical biology* 2001; 39(1):74-79.
- Banu NL, Sreeja S, Pinky V, Prakash J, Jasmine AJ. Medicinal plants used by the rural people of Kattathurai, Kanyakumari district, Tamilnadu. *Journal of Basic and Applied Biology* 2007; 1(4):18-22.
- Ayyanar M, Sankarasivaraman K, Ignacimuthu S. Traditional herbal medicines used for the treatment of diabetes among two major tribal groups in South Tamil Nadu, India. *Ethnobotanical leaflets* 2008; 12:276-280.
- Shanmugam S, Annadurai M, Rajendran K. Ethno medicinal plants used to cure diarrhea and dysentery in Pachalur hills of Din Digul district in Tamil Nadu, Southern India., *Journal of Applied Pharmaceutical Science*. 2011; 1(8):94-97.
- Shanmugam S, Ramer S, Ragavendhar K, Raman than R, Rajendran K. Plants used as medicine by Paliyar tribes of Shenbagathope in Virudhunagar district of Tamil Nadu., *Journal of Economic Taxonomy*. 2008; 32(2):922-929.
- Umapriya T, Rajendran A, Aravindhan V, Thomas B, Maharaja M. Ethnobotany of Irular tribe in Palamalai Hills, Coimbatore, Tamil Nadu. *Indian Journal of Natural Products and Resources*. 2011; 2(2):250-255.
- Bosco FG, Arum gam R. Ethnobotany of irular tribes in red hills, tamilnadu, India. *Asian Pacific Journal of Tropical Disease*. 2012; 2(2):S874-S877.
- Senthil Kumar M, Gurumoorthi P, Janardhanan K. Some medicinal plants used by Irular, the tribal people of Marudhamalai hills, Coimbatore, Tamil Nadu. *Natural Product Radiance* 2006; 5(5):382-388.
- Revathi P, Parimelazhagan T. Traditional knowledge on medicinal plants used by the Irula Tribe of Hasanur Hills, Erode district, Tamil Nadu, India. *Ethnobotanical leaflets* 2010; 136-160.
- Rasingam L. Ethnobotanical studies on the wild edible

- plants of Irula tribes of Pillur Valley, Coimbatore district, Tamil Nadu, India. *Asian Pacific Journal of Tropical Biomedicine*. 2012; 2:S1493-S1497.
- 30 Fuchs S. Aboriginal tribes of eastern India. New Delhi, Cosmo Publications, 1973.
 - 31 Jain SK. Ethnobotany in modern India. Photo morphology 2001; 51(3):39-54.
 - 32 Gamble J. The Flora of the Presidency of Madras London, Adlard & Sons Ltd 1935.
 - 33 Matthew KM. An excursion flora of central Tamilnadu, India CRC press 1995.
 - 34 Mabberley DJ. Moberly's plant-book a portable dictionary of plants, their classification and uses Cambridge Univ PR 2008.
 - 35 Heinrich M, Ankle A, Frei B, Weimann C, Sticher O. Medicinal plants in Mexico Healers' consensus and cultural importance. *Social Science and Medicine* 1998; 47:1859-1871.
 - 36 Trotter RT, Logan MH. In *Plants in indigenous medicine & diet: bio behavioral approaches* (Eds Etkin N L & Bedford H) Redgrave Publishing Company, 1986; 91-112.
 - 37 Phillips O, Gentry A, Reynel C, Wilkin P, Galvez-Durand B. Quantitative ethnobotany and Amazonian conservation. *Conservation biology* 1994; 8:225-248.
 - 38 Mesfin F, Demissew S, Teklehaymanot T. An ethnobotanical study of medicinal plants in Wonago Woreda, SNNPR, Ethiopia, *Journal of Ethnobiology and Ethno medicine*. 2009; 5(1).
<http://www.ethnobiomed.com/content/5/1/28>.
 - 39 Upadhyay B, Dhaker AK, Kumar A. Ethno medicinal and ethno pharmacy-statistical studies of Eastern Rajasthan, India, *Journal of Ethno pharmacology*. 2010; 129(1):64-86.
 - 40 Ayyanar M, Ignacimuthu S. Traditional knowledge of Kani tribal in Kouthalai of Tirunelveli hills, Tamil Nadu, India, *Journal of Ethno pharmacology*. 2005; 102(2):246-255.
 - 41 Navarro V, Villarreal ML, Rojas G, Lozoya X. Antimicrobial evaluation of some plants used in Mexican traditional medicine for the treatment of infectious diseases, *Journal of Ethno pharmacology*. 1996; 53(3): 143-147.
 - 42 Jeeva S. Weeds of Kanyakumari district and their value in rural life, *Indian Journal of Traditional Knowledge*. 2006; 5(4):501-509.
 - 43 Jeeva G, Jeeva S, Kingston C. Traditional treatment of skin diseases in South Travancore, southern peninsular India, *Indian Journal Traditional Knowledge*. 2007; 6(3):498-501.
 - 44 Samy RP, Thwin MM, Gopalakrishnakone P, Ignacimuthu S. Ethnobotanical survey of folk plants for the treatment of snakebites in Southern part of Tamilnadu, India, *Journal of Ethno pharmacology*. 2008; 115(2):302-312.
 - 45 Rojas A, Cruz S, Ponce-Monster H, Mata R. Smooth Muscle Relaxing Compounds from *Dodonaea viscosa*. *Planta media* 1996; 62(2):154-159.
 - 46 Ragupathy S, Steven NG, Maruthakkutti M, Velusamy B, Ul-Huda MM. Consensus of the Malabar's traditional aboriginal knowledge of medicinal plants in the Velliangiri holy hills, India, *Journal of Ethnobiology and Ethno medicine*. 2008; 4(1).
<http://www.ethnobiomed.com/content/4/1/8>.
 - 47 Panda Kumar P, Chellappandian M, Mutheeswaran S, Ignacimuthu S. Consensus of local knowledge on medicinal plants among traditional healers in Mayiladumparai block of Theni District, Tamil Nadu, India, *Journal of Ethno pharmacology*. 2011; 134(2):354-362.
 - 48 Owuor BO, Kiangu DP. Kenyan medicinal plants used as antivenin: a comparison of plant usage. *Journal of Ethnobiology and Ethno medicine*. 2006; 2:1.
<http://www.ethnobiomed.com/content/2/1/7>,
 - 49 Scartezzini P, Speroni E. Review on some plants of Indian traditional medicine with antioxidant activity, *Journal of Ethno pharmacology*. 2000; 71:23-43.
 - 50 Krawinkel MB, Kedging GB. Bitter gourd (*Momordica charantia*) a dietary approach to hyperglycemia. *Nutrition reviews* 2006; 64:331-337.
 - 51 Sandhya B, Thomas S, Isabel W, Shenbagarathai R. Ethno medicinal plants used by the Valayan Community of Piranmalai hills (Reserved forest), Tamil Nadu, India- A Pilot study, *African Journal of Traditional, Complementary, and Alternative Medicines*. 2006; 3:101-114.
 - 52 Rokaya MB, Münzbergová Z, Timing B. Ethnobotanical study of medicinal plants from the Humla district of western Nepal, *Journal of Ethno pharmacology* 2010; 130:485-504.
 - 53 Ragupathy S, New master SG. *Journal of Ethnobiology and Ethno medicine*, *Journal of Ethnobiology and Ethno medicine*. 2009; 5:10.
 - 54 Mahesh P, Srinivasan B, Shivanna M. Medicinal plant wealth of local communities in some villages in Shiroma District of Karnataka, India, *Journal of Ethno pharmacology*. 2005; 98:307-312.
 - 55 Teklehaymanot T, Giddy M. Ethnobotanical study of medicinal plants used by people in Zegie Peninsula, Northwestern Ethiopia. *Journal of Ethnobiology and Ethno medicine* 3:12.
<http://www.ethnobiomed.com/content/3/1/12>, 2007.
 - 56 Giddy M, Asfaw Z, Woldu, Z. Medicinal plants of the Mein it ethnic group of Ethiopia An ethnobotanical study, *Journal of Ethno pharmacology*. 2009; 124:513-521.
 - 57 Poonam K, Singh GS. Ethnobotanical study of medicinal plants used by the Taungya community in Terai Arc Landscape, India. *Journal of Ethno pharmacology*. 2009; 123:167-176.