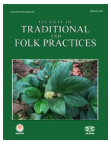
Volume 09 (01 & 02) December 2021, 35-53
ISSN 2278- 5906
http://jtfp.jntbgri.res.in



Journal of Traditional and Folk Practices

Ethnobotanical assessment of medicinal plants used by *Kurumba* ethnic group of Nilgiri district, Tamil Nadu, India

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Received: 15 February 2021 Accepted: 30 March 2021

Abstract

The Nilgiri district, Tamil Nadu, India is rich both in terms of ethnology and biodiversity. The indigenous knowledge system (IKS) of the Nilgiri district has a long history and is deeply rooted in the lives of ethnic communities. The knowledge transfer within a community occurs orally from one generation to another. The objective of the present study is to record the ethnobotanical knowledge and quantitatively evaluate the consensus of the IKS associated with the *Kurumba* ethnic group of the district. Ethnobotanical explorations were carried out from February 2019 to January 2020 in three taluks of the district, which covers all the major *Kurumba* settlements. The data were collected using semi-structured questionnaires and face to face interviews with 77 informants. 88 medicinal plant species belong to 47 families and 78 genera were documented. The most dominant families in the study are Lamiaceae (8 species), Solanaceae (7 species), Asteraceae (5 species), Euphorbiaceae and Rutaceae (4 species each). Therapeutic usage of plant taxa were recorded, which was further substantiated by specimen collection and taxonomic identifications. The quantitative indices of the data were analyzed using the informant consensus factor (F_{IC}). The plant usage pattern was described by categorizing ailments into 16 groups. The F_{IC} values were highest for ailment categories like cardiovascular, antifertility, venom inflammation, swellings and liver problems (F_{IC} = 1.00). Henceforth, the present study is a pioneering work that establishes a complete regional database of the IKS on medicinal plant taxa used by the community. The data provides scope for carrying out further phytochemical and pharmacological investigations.

Keywords: Indigenous knowledge, *Kurumba*, Nilgiris

1. Introduction

The indigenous medicinal practices are being carried out across the globe by several ethnic communities from the beginning of human enlightenment. As stated by Harshberger (1896) the term ethnobotany was officially recognized for documenting the association of plants with the ethnic groups. The search for potential active principle is more productive if the plants are selected on their ethnobotanical history than through a random analysis (Jain and Mudgal, 1999). In India, a lot of scopes exist for new drugs of plant origin with a rich plant biodiversity and several tribal communities with enormous knowledge in the field of folk medicine (Boomibalagan *et al*., 2013).

The Nilgiri district is well known for its floristic and ethnic diversities. The ethnic communities are well versed with indigenous knowledge acquired from their ancestors. Among the various indigenous communities such as *Irula, Toda, Kattunayaka, Kota*, *Kurumba* and *Paniya* residing in the region, *Kurumba'*s are the least ethnobotanically studied group. This is mainly because

of their shy nature and selection of remote areas for their settlements from the mainstream. The tradition and culture of these indigenous communities primarily depended on forest resources. Since conveyance and communication facilities in the majority of the settlements are not meeting the mainstream standards, IKS plays a vital role among these communities for the primary healthcare system. The most common ailments reported from the region are associated with gastrointestinal problems followed by skin inflammations, malnutrition issues like anemia, wounds and the common cold.

Various attempts have been carried out to tap this IKS associated with the region. (Abraham, 1991; Angannan, 1999; Rajan *et al.*, 2001; Murugesan *et al*., 2005; Emmanuel and Rajan, 2013; Deepak and Gopal, 2014; Sathyavathi and Janardhanan, 2014). Most of these studies are focused on documentation but lacks the consensus analysis for an IKS pertaining to specific community. Thus, in the present study, our main objective is to develop a comprehensive regional database of IKS for the *Kurumba* community-dwelling in the Nilgiri district. The study is a pioneering work carried out on any indigenous communities in the area, which evaluates the consensus analysis. This validation process will support the efficacy claim by the traditional practitioners of the *Kurumba* community. The study provides an opportunity for further research activities like identification and isolation of active principle from these medicinal taxa. Such ethnobotanical documentation and validation will also help in resolving the issues related to Intellectual Property Rights (IPR) and compensation for loss of rich biodiversity resources, thereby contributing to the upliftment of the community in large through ABS policies (Access Benefit Sharing) (Farnsworth, 1994).

In recent times the impact of modernization and land reforms in the Nilgiri district accelerated the deterioration of this knowledge. The rapid expansion of the tourism industry in the region has led to the displacement of the indigenous population to a large extent and in turn paved the way to the gradual vanishing of indigenous culture and biodiversity (Pushpangadan, 1995). Another alarming concern is the attitudinal shifts among *Kurumba* youths. Most of them are not much interested to practice these traditional systems of medicine as an occupation, as they are remunerated more in the industrial sector in the nearby towns (Parthasarathy, 2007). Thus, the present research becomes a need of the moment for the conservation of these IKS with concerning the *Kurumba* ethnic group of the Nilgiri region.

2. Materials and methods

2.1. Study area

The present research is carried out in the Nilgiri district of Tamil Nadu, the southern state of India. The district is situated in the north-western part of Tamil Nadu state with an average Mean Sea Level of 2000 m in altitude and covers a total area of 2,543 km^2. The district lies between 11°10ˈN and 11°45ˈN latitude and 76°14ˈE and 77°2ˈE longitude (Fig. 1). The district is bounded by Western and Eastern Ghats. Topographically the district is classified into Nilgiri plateau, Sigur plateau, Nilgiri-Waynad plateau and outer slopes facing the plains. The region is mainly covered by lateritic soil and red sandy soil. Red loams also exist in small patches (Venkataramanan and Vasu, 1982). A tropical warm climate prevails in the higher regions of Nilgiris. Because of the higher altitude, the district has a low temperature which is further lowered down due to the excessive moisture content in the atmosphere, resulting from the exhalation by the vegetation. During the day, the temperature reaches 22.1°C in summer to 5.1°C in winter. The district receives rainfall mainly from the northeast and southwest monsoons (Subburaj, 2008). The district has several small perennial streams originating from various peaks. The prime rivers irrigating the district are Bhavani flowing in the south-west direction and Moyar in the eastern direction (Vivekananthan et. al, 1997). The Nilgiris forms a unique pattern of forest vegetation of its own, known as "Sholas" a term that originated from the *Kurumba* dialect word '*Solai'*. The valley is comprising of the wide spread of grasslands along with numerous isolated woodlands. The word "Nilgiris" means "Blue Mountains". The name 'Neelagiri' was first cited by the native communities dwelling in the plains since the entire range of evergreen vegetation is covered by a blue mist (Emmanuel and Rajan, 2013). 'Nilgiri Biosphere Reserve' (NBR) is an integral part of the Nilgiri district. NBR is the first biosphere reserve declared in India under the Man and Biosphere Programme (MBP) (Daniels, 1992).

Fig. 1. Location map of study area (source: Maps of India)

2.2. Ethnobotanical survey

The ethnobotanical explorations were carried out from February 2019 to January 2020, in nine tribal settlements at three taluks of Nilgiri district. Based on the inputs from the headsmen, the informants were identified from each settlement. In the present study, a totally 77 informants were interviewed in their local dialect "Tamil". The data collection also included demographic profiling like gender, age of the informants when they initially started the traditional healing practice, occupational status and sources of income. The ethical guidelines prescribed by the International Society of Ethnobiology (Anonymous, 2006, accessed on July 2018, http://ethnobiology.net/code-of-ethics/) were followed in the documentation of the data (Fig. 2a & b). During field visits, various issues were conversed in a superficial way to understand how the community operates as a whole (Martin, 1995). It is often a difficult task to winning the trust in each settlement since the informants usually value this indigenous information as a secret treasure and are reluctant to share it with outsiders. Our consistent visits and camps during auspicious occasions like marriages and ceremonies helped us to build a healthy relationship with the community. During the survey, informants preferred individual meetings in private as they were not comfortable sharing the information in larger groups. The informants accompanied us to the field for identification and collection of the medicinal plants. Data on indigenous knowledge on medicinal plants were gathered through interviews using modified semi-structured questionnaires(Dilip Kumar and Janardhana, 2012).

Fig. 2. The process of documentation of ethnobotanical information

2.3. Plant identification

Consistent field survey was executed in different habitats. During these guided visits specific therapeutic plants cited by the informants were photographed and collected. Collection and herbarium preparation was made by following the process described in Methods and Approaches in Ethnobotany (Jain, 1989). The following plant identification manuals were used to validate the taxonomical identity of the plant taxa: The Flora of Presidency of Madras (Gamble, 1959), The Flora of Tamil Nadu Carnatic (Mathew, 1983), The Flora of South Indian Hill Station (Fyson, 1932) and Flowering Plants of Kerala (Nayar *et al.*, 2006). The botanical names of the plant taxa were verified online using the "The Plant List" website (http://www.theplantlist.org). The voucher specimens of the plant taxa have been deposited in the herbarium of the Regional Institute of Education (RIE), Mysore.

2.4. Data analysis

For the substantive interpretation, the entire raw data was systematically presented in the following sequence: botanical identity, family, local name, life form, part used, uses, preparations and application. MS office 2007 was used for two-dimensional graphical representations for interpreting the demographic profiling of *Kurumba* informants like age category, age when started the healing practice, mentorship and source of income.

2.5. Informant consensus analysis

The informant consensus factor (F_{IC}) was calculated to understand the extent of homogeneity in the data shared by the informants (Canales *et al*., 2005). The F_{IC} values (close to 1) are considered higher if there is a clear selection standard among the community or if data is exchanged between informants. The F_{IC} values will be low (near 0) if plants are chosen at random or if informants do not share the information about their use (Heinrich *et al*, 1998). This F_{IC} analysis provides the relevance of the plant species for carrying out further screening of bioactive compounds. The F_{IC} value is calculated by using the following formula:

$$F_{IC} = N_{ur} - N_t / (N_{ur} - 1)$$

where N_{ur} is the number of individual plant use reports for a particular illness category, and N_t is the total number of species used by all informants for this illness category.

3. Results and discussion

3.1. Traditional knowledge and gender

In the present study, 77 informants from three taluks were interviewed (Table;1). It was observed that 90% of the healers were men. The plant usage patterns are distinct among women and men. Because women are mainly associated with the treatment of ailments related to females such as fertility and menstrual complications (Cheikhyoussef *et al*., 2011). The plant usage pattern mainly depends on the source from

where primary knowledge acquisition started initially for male and female healers. During our interaction, it was understood that most of the women didn't get any formal training from their parents regarding the medicinal plants rather they have acquired it through constant observation of healing practices carried out by their father and grandparents. At the same time, the males usually got formal training and are often taken to the field for the collection of medicinal plants. Similar gender distinctiveness in the knowledge transfer was reported in the medicinal plant usage by the local people of Dek island in Ethiopia (Teklehaymont, 2009).

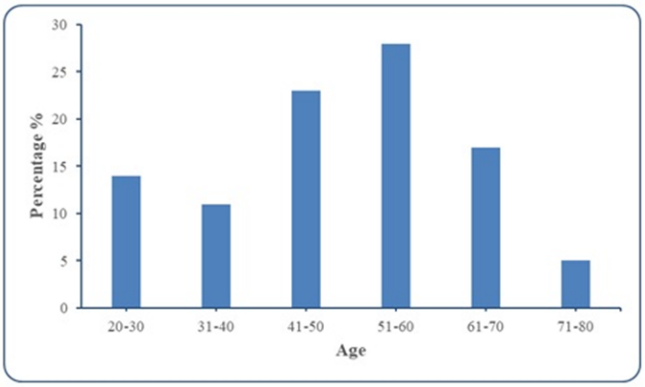

Fig. 3. Percentage of informants by age category in the *Kurumba* community

Table 1. Demographic profiling of *Kurumba* informants from the study area

Sl. No.	Name of the taluk	Name of the *Kurumba* settlements	Gender groups		Total number of informants
			Males	Females	
1	Coonoor	Vellaricombai	15		15
		Pambalacombai	8	2	10
		Veeracombai	6		6
		Bellaathicombai	9	2	11
2	Kundah	Kothugalcombai	4	1	5
		Kinnakorai	12		12
		Chengalcombai	11		11
3	Kotagiri	Maralacombai	5		5
		Masanacombai		1	1
Total			**71**	**6**	**77**

3.2. Traditional knowledge and age

Most of the experienced informants belonged to the age group of 50-60 years (Fig. 3). It was also observed that the majority of the informants who were acquired formal knowledge about the traditional healing at their teenage period. This indicates that the knowledge transfer takes place at an early age of the individual. Later with a consistent field experience, the individual is raised to the status of a healer in the *Kurumba* community (Fig. 4). Similar observations were also reported by Shapi et. al, 2009, in their pilot study of indigenous knowledge in the Oshikoto region. At the same time, few informants acquired the skill of healing at their 30s and 40s , mainly because they felt that this could be an additional source of income during their free time.

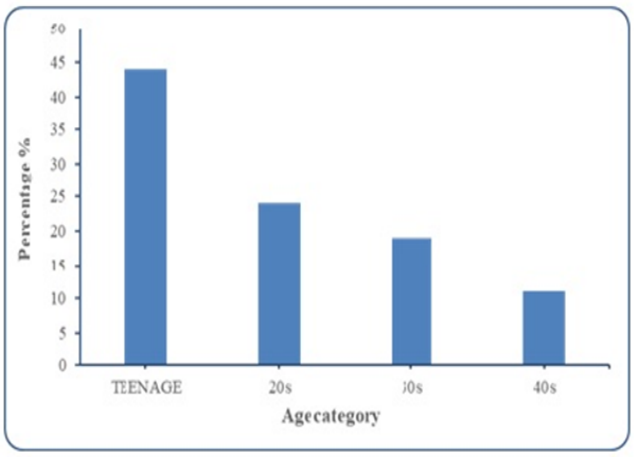

Fig. 4. Age when the *Kurumba* informants started healing in the study area

3.3. Traditional knowledge and mentorship

In the present study, 23 informants indicated that they became healers because of the mentoring from their grandfather, while 11 of the informants became healers due to the influence of their grandmother. These results point to the fact that the grandparents of the community play a pivotal role in the knowledge transfer process when compared to their parents. This is mainly because of the close emotional bonding between grandparents and their grandchildren than his or her children (Fig. 5). It was noticed that the children mostly accompany the grandparents during the plant collection and the administration of medicinal preparation. This process in turn creates an interest among these younger generations. A major category of informants (16 members) got mentored through another healer. During our interaction, it was noted that sometimes an experienced healer will keep an assistant for himself, gradually this person gets trained and becomes an independent healer (Shapi *et al*., 2009). To a certain extent, mothers have also played an important role in the promotion of indigenous knowledge since mothers are often alone at home to handle the medical emergency related to their family members. Hence they are aware of some home remedies as first aid, which has influenced the children to take up these practices.

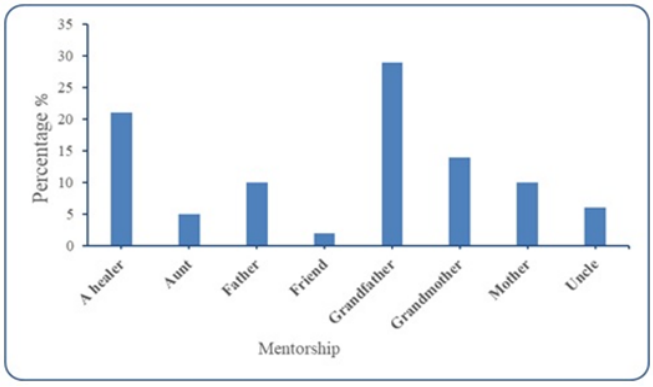

Fig. 5. Various people played a mentorship role in passing the traditional knowledge

3.4. Traditional knowledge and occupation

The traditional healing practice is widely recognized as an occupation in the Nilgiri region. The study points out that 27% of the informants identify themselves as shepherds. At the same time, these informants have a vast knowledge about medicinal plants and their distribution. This is mainly due to the easy accessibility of the flora since they visit the forest areas and hilly tracts more often. They also support the other healers from the settlement by gathering the required plant parts from the forest. But these informants are not ready to accept traditional healing as their primary occupation (Fig. 6). Twenty-two percent of informants confirmed themselves as traditional medicinal practitioners. These people usually treat people within or outside their community for various diseases. Around 19 % of informants depend on the sales of non-timber products like honey, wild fruits, rhizomes, etc. in the local markets as their primary occupation. Some informants reported small-time farming activities (15%) and daily wage labor works (12%) in the construction fields or tea estates as their source of income. This proves that a considerable section of people continued to make primary income sources using medicinal plants. Hence a scientific validation on the efficacy of this healing system can help in the promotion of this practice. Similar conclusions were reported from the African regions (Leffers, 2003). As per the 1978 World Health Organization (WHO) report, an estimated 3.5 billion people across the globe depend on medicinal plants for their primary health care needs. Thus, there is a significant economic interest in the development of indigenous medicines and the application of medicinal plants for various therapeutic uses (Azaizeh *et al*., 2003).

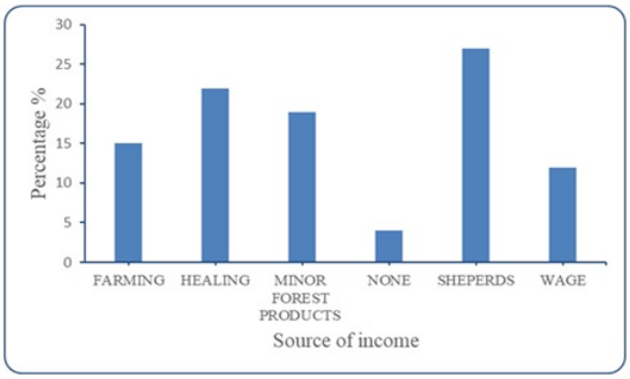

Fig. 6. Depicting the source of income of the informants

3.5. Life form details of the cited medicinal plants

The informants reported 88 medicinal plants comprised of herbs (62 species), shrubs (14 species), trees (10 species) and climbers (2 species) represented in Fig. 7. The study identified 88 species spread across 47 families. The families with the highest number of species were Lamiaceae (8 species), Solanaceae (7 species), Asteraceae (5 species), Euphorbiaceae and Rutaceae (4 species each). Lamiaceae and Asteraceae species are also frequently referred in the IKS of different other communities in the study area. This is due to the wide therapeutic properties associated with their aromatic components such as phenylpropanoids, monoterpenes and sesquiterpenes. These components are also responsible for broad pharmacological activities including antimicrobial properties. Similar

usage pattern in plant families are reported in the *Malasars* community of Velliangiri hills, Tamil Nadu (Raghupathy *et al*., 2008), the fishing community of Praia do Sono, Paraty, Rio de Janeiro, Brazil (de Brito and de Senna-Valle, 2011) and ethnobotanical survey in central Abyan governorate, Yemen (Mohamed Al-Fatimi, 2019) Fig. 8. Some of the plant species which are regularly cited by the healers are *Centella asiatica* (L.) Urb., *Curcuma longa* L., *Cymbopogon citratus* L., *Oxalis corniculata* L., *Phyllanthus amarus* Schum. & Thonn, *Piper nigrum* L., *Ocimum basilicum* L., *Plumbago zeylanica* L., *Rubia cordifolia* L., *Tinospora cordifolia* (Willd.) Miers, *Tridax procumbens* L. and *Vitex negundo* L. Similar plant use pattern was reported in the ethnobotanical study of medicinal plants of Debre Libanos Wereda, Central Ethiopia (Getaneh and Girma, 2014). Common plant species like *Gymnema hirsutum* W&A., *Berberis tinctoria* Lesch., *Piper nigrum* L., *Tinospora cordifolia* (Willd.) Miers, *Rubia cordifolia* L., *Physalis minima* L., *Polygonum punctatum* Book. Ham. and *Oxalis corniculata* L. were becoming difficult to locate in the study area. This is mainly due to the impact of overgrazing, over-exploitation of pesticides and weedicides and other developmental activities. However, these species are still available in the adjoining reserve forests under NBR and Silent Valley (Daniels, 1992).

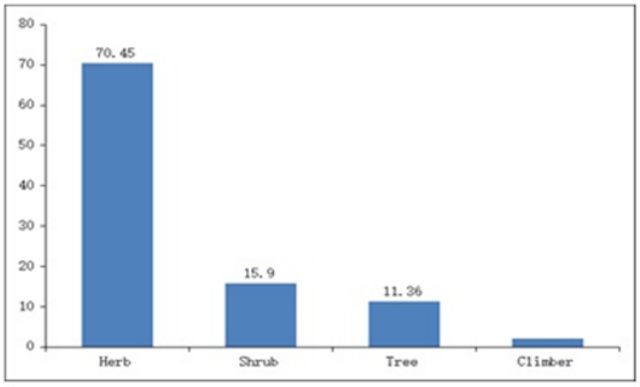

Fig. 7. Percentage distribution of medicinal plant species according to the life form

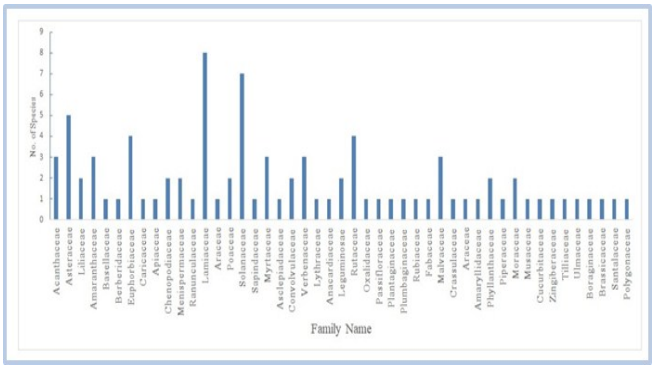

Fig. 8. Distribution of species in different plant families

3.6. Plant parts used and mode of preparation

Traditional healers of the *Kurumba* community exhibited a diversified plant part usage depending upon the type of disease which needs to be treated. The study documented the usage of different plant parts like leaves, fruits, whole plant, stem, bark, root, tuber, rhizome, seed, flower and twig by the *Kurumba* community. The usage of leaves (52 species) was more prominent followed by fruit (11 species), entire plant (09 species), stem (07 species) and bark (06 species) (Fig. 9). Similar outstanding usage of leaves was mentioned in the ethnomedicinal practices of other indigenous communities like *Todas* (Rajan, S. *et al*., 2005) and *Kotas* (Rajan and Sethuraman, 1991). At the same time, there are conflicts of opinions regarding the commonly used plant parts among other ethnic groups like *Kattunayakas* of Madumalai region (Udayan *et al*., 2006), *Irulas* of Bolampatty valley (Kalaiselvan and Gopalan, 2014). These communities prefer stem and bark respectively over leaves for their medicinal preparations. According to the conservational aspects, greater application of leaves by the ethnic groups causes negligible damage to the plant in comparison to other plant parts and ensures the feasible long-term utilization of plant resources.

According to *Kurumba* system, the mode of crude drug preparation is broadly categorized into 11 different forms. The most widely administered form of crude drug preparation is poultice (23.86%) which is primarily obtained from the leaves (Plate 1). Followed by fresh plant paste is another common crude drug (20.45%) which is usually prepared from leaves or the whole plant. Crushed juice of leaves (17.04%) is also a frequently administered mode of crude drug preparation (Fig. 10) Similar trend was reported in the medicinal preparations of other indigenous communities like *Paliyar* and *Malayali* communities of Tamil Nadu (Ignachimuthu *et al*., 2006; Senthilkumar *et al*., 2013). This similarity in the preparations helps the researchers to develop a suitable procedure for the isolation of active compounds for further biochemical and pharmacological studies.

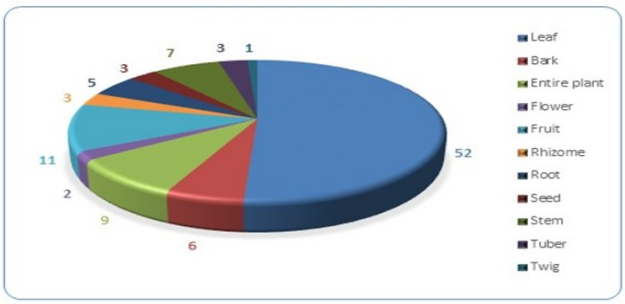

Fig. 9. Pie-chart showing the number of medicinal plant parts used by the *Kurumba* healers

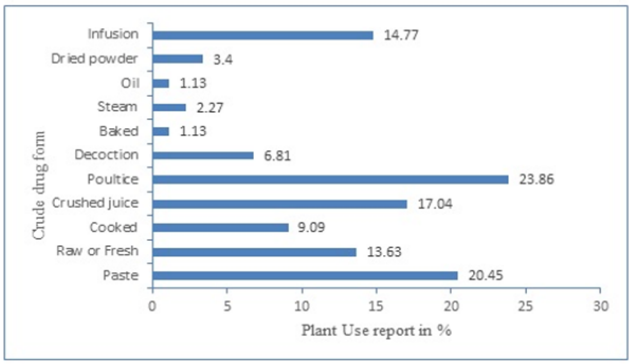

Fig. 10. Crude drug preparation and plant usage

In *Kurumba* system majority of the medicinal preparations are administered topically (48.4%) followed by oral (45.5%) and a few combinations of oral and topical (3.4%). Most of the medicinal preparation for dermatological issues is administered topically and issues related to digestion, acidity, dietary issues are routed orally. A similar trend in the mode of administration was observed among the medicinal practices of other communities like *Todas* (Rajan *et al*., 2005), *Kotas* (Rajan *et al*., 1991), *Irulas* (Murugesan *et al*.,2005), *Kattunayakas* (Rajan *et al.,* 2003) residing in the study area. These similarities strengthen the view of inter-ethnic knowledge transfer between the two closely associated communities sharing a common geographical region.

3.7. Types of diseases treated

The traditional healing system of the Nilgiri region is deeply connected among the lives of indigenous communities residing in the study area (Parathasarthy, 2001). The informants revealed that the *Kurumba* community follows well-established healing procedures (Deepak and Gopal, 2014 a.). According to the *Kurumba* IKS, 61 different types of ailments are treated as described by the informants (Table 2). The common diseases frequently addressed by the *Kurumba* healers are gastrointestinal issues, skin diseases, cuts and wounds and common cold (Deepak and Gopal 2014 c.). Few studies have suggested that ailments at the domestic level such as oral issues (Tapsoba and Deschamps, 2006), gastrointestinal problems (Fawole *et al*., 2009), wound healing and skin inflammations (Saikia *et al*., 2006) can be managed without an expert healer. The entire ailments were broadly classified by following the International Classification of Primary Care (ICPC) (http://www.who.int/classifications/icd/adaptations/icpc2/en/). A total of 16 ailment categories were listed as follows: (1) Gastro intestinal (GI); (2) Fever and Headache (FH); (3) Muscular and skeletal (MS); (4) Weakness and dizziness (WD), (5) Cuts and Wounds (CW); (6)

Plate 1. a-c. Healer preparing bark decoction; e-h. Preparation of leaf paste

Respiratory Problems (RP); (7) Cardiovascular (CV); (8) Antifertility (AF); (9) Skin inflammation (SI); (10) Venom inflammation (VI); (11) Swellings (SW), (12) Neurologic (NE), (13) Infection and inflammations (II); (14) Dietary Supplements (DS); (15) Oral care (OC); (16) Liver Problems (LP). The ICPC is associated with ethnomedical factuality since the categories are established based on the observations of informants for a particular ailment and not based on the clinical research (Staub *et. al*., 2015) as depicted in Fig.11.

The maximum number of plant taxa are used for treating GI problems (28 plant species), followed by SI (19 plant species). The increased occurrence of GI and SI diseases among the *Kurumba* community can be attributed to the unhygienic living conditions, frequent consumption of alcohol, use of wild meat and unsafe drinking water. Many of the settlements in the study area do not have proper sanitation and drinking water facilities. Various other studies reported that the GI issues are common among other indigenous communities like *Adi* tribes of Dehang-Debang biosphere reserve of Arunachal Pradesh (Kagyung *et al*., 2010), inhabitants of the Shigar Valley, Balistan region of Karakorum range, Pakistan (Abbas *et al*., 2017) and *Zeliangrong* ethnic group of Manipur (Panmei *et al*., 2019). This is primarily because of the lack of proper implementation of various government schemes. Thus, the study can provide an insight for the authorities to plan and implement proper welfare schemes for the improvement of basic amenities in these settlements.

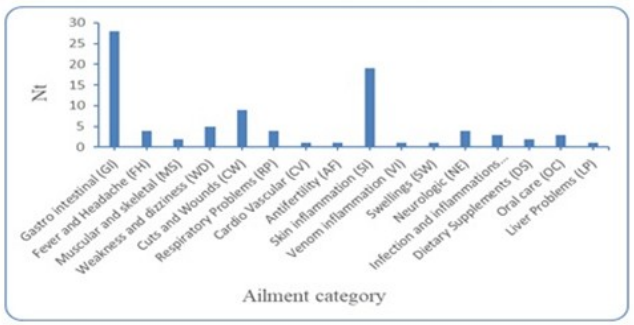

Fig. 11. Status of medicinal plant parts used for various ailments

3.8. Ethno medico documentation

The documented medicinal uses of each plant is enumerated systematically for each ailment in the following order: the botanical name of the medicinal taxa, family, voucher number, local name, life form, part used, preparation, application and medicinal uses (Table 2). The plant species are arranged in alphabetical order for easy understanding.

Plate 2. a. *Berberis tinctoria* Lesch. L.; b. *Bidens pilosa* L.; c. *Cassia fistula* L.; d. *Colocasia esculenta* (L.) Schott.;. e. *Curcuma longa* L.; f. *Cymbopogon citratus* L.; g. *Datura stramonium* L.; h. *Dodonea viscosa* L.; i. *Euphorbia hirta* L.

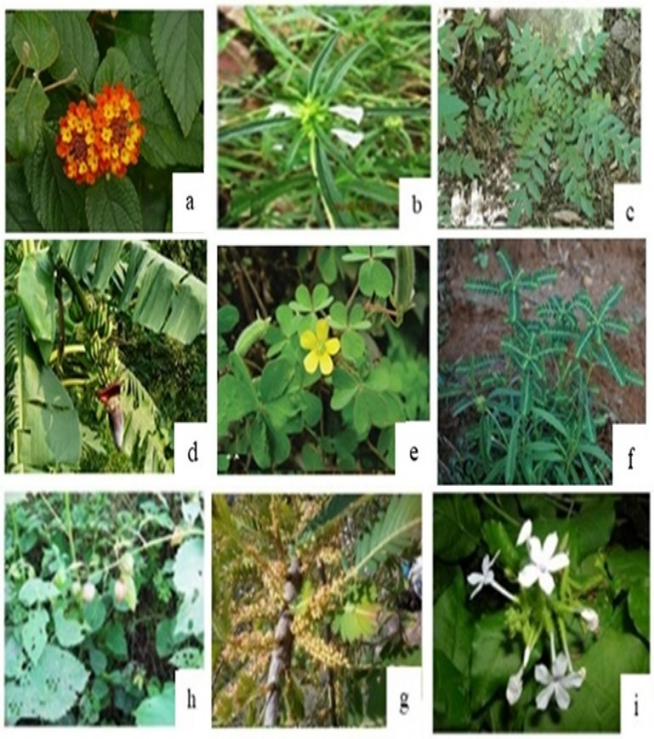

Plate 3. a. *Lantana camera* L.; b. *Leucas aspera* L.; c. *Murraya koenigii* L.; d. *Musa paradisiaca* L.; e. *Oxalis corniculata* L.; f. *Phyllantus embelica* L.; g. *Phyllantus amarus* Schum. & Thonn.; h. *Physalis minima* L.; i. *Plumbago zeylanica* L.

Table 2. List of medicinal plants used by *Kurumba* tribes of Nilgiri district, Tamil Nadu

Sl. No.	Botanical name/ Family/ Voucher specimen	Local name (in *Kurumba* dialect)	Life form	Part used	Uses	Mode of preparation	Application
1	*Achyranthes aspera* L.; Amaranthaceae; RIE4010	*Orumani*	Shrub	Leaf	Inflammations formed in the digestive tract	Cooked	Oral
2	*Adhatoda vasica* Nees; Acanthaceae; RIE4012	*Adatoda*	Shrub	Leaf	Bodyache, Asthma	Steam	Topical
3	*Ageratum conyzoides* L.*;* Asteraceae; RIE4023	*Betta gida*	Shrub	Leaf	Cut and wound	Poultice	Topical
4	*Allium sativum* L.; Amaryllidaceae; RIE4034	*Velluli*	Herb	Rhizome	Dry cough	Raw	Oral
5	*Aloe vera* (L.) Burm.f.; Liliaceae; RIE4044	*Sotru kattrazhai*	Herb	Leaf	Hair and skin problems	Poultice	Topical
6	*Alternanthera sessilis* L.; Amaranthaceae; RIE4045	*Nilakeera*	Herb	Leaf	Diarrhea	Cooked	Oral
7	*Amaranthus gangeticus* L.; Amaranthaeceae; RIE4046	*Keera*	Herb	Entire Plant	Carminative and Constipation	Cooked	Oral
8	*Artemisia nilagirica* (C.B.Clarke) Pamp.; Asteraceae; RIE4047	*Manikoland*	Herb	Leaf, Stem	Myiasis in humans and animals	Poultice	Topical
9	*Basella rubra* L.; Basellaceae; RIE4048	*Vazhalle*	Herb	Leaf	Fever and Healthy digestion	Cooked	Oral
10	*Berberis tinctoria* Lesch.; Berberidaceae; RIE4049, Plate 2.a	*Jakkala*	Shrub	Leaf, Stem	Dysentry and Bloating	Juice	Oral
11	*Bidens pilosa* L.; Asteraceae; RIE4055, Plate 2.b	*Katu kunni*	Herb	Leaf	White patches appearing exclusively on the legs	Poultice	Topical
12	*Breynia rhamnoides* Muell.; Euphorbiaceae; RIE4055	*Poolan*	Shrub	Root, Leaf	White patches appearing all over the body	Poultice	Topical

13	*Carica papaya* L.; Caricaceae; RIE4011	*Poppilli mara*	Tree	Fruit, Leaf	Constipation; Dengue fever	Cooked and Poultice	Oral and Topical
14	*Cassia fistula* L.*;* Leguminaceae; RIE4012, Plate 2.c	*Konnei*	Tree	Bark	Stomach infection	Decoction	Oral
15	*Centella asiatica* (L.) Urb.; Apiaceae; RIE4013	*Kutire gondh*	Herb	Leaf	Acidity	Paste	Oral
16	*Chenopodium ambrosioides* L.; Chenopodiaceae;RIE4017	*Jaregida*	Herb	Whole Plant	Intestinal cramps; Body odour	Juice and Poultice	Oral and Topical
17	*Chenopodium murale* L.; Chenopodiaceae; RIE4019	*Maratha*	Herb	Leaf	Fever; Body ache post fever	Poultice	Topical
18	*Cissampelos pareira* L.; Menispermaceae; RIE4022	*Kodibatale*	Herb	Leaf	Headache, Gastritis	Poultice	Topical
19	*Citrus aurantium* L.; Rutaceae; RIE4025	*Eravae kai*	Tree	Fruit	Digestion and hemorrhoids	Infusion	Oral
20	*Clematis gauriana* Roxb. ; Ranunculaceae; RIE4027	*Meenae*	Shrub	Leaf, Stem	Minor cuts and skin diseases	Poultice	Topical
21	*Cocos nucifera* L.; Arecaceae; RIE4066	*Theangamara*	Tree	Fruit	Paralysis	Infusion	Topical
22	*Coleus malabaricus* Benth.;Lamiaceae; RIE4026	*Periya tulasi*	Herb	Leaf	Asthma	Steam	Inhaled
23	*Coleus parviflorus* Benth.; Lamiaceae; RIE4077	*Nila*	Herb	Tuber	Itching and blisters appearing on the skin	Poultice	Topical
24	*Colocasia esculenta* (L.) Schott.; Araceae; RIE4068, Plate 2.d	*Chembu*	Herb	Leaf Rhizome	Blisters appearing on skin	Infusion	Topical
25	*Curcuma longa* L.; Zingiberaceae; RIE4030, Plate 2.e	*Manjal*	Herb	Rhizome	Skin irritations and for healthy skin	Poultice	Topical

26	*Cymbopogon citratus* L.; Poaceae; RIE4020, Plate 2.f	*Karppura pul*	Herb	Leaf	Healthy digestion and diarrhea	Juice	Oral
27	*Datura stramonium* L.; Solanaceae; RIE4021, Plate 2.g	*Ummathen*	Herb	Leaf, Fruit	Arthritis and piles	Grinded Paste	Topical
28	*Dodonea viscosa* L.; Sapindaceae; RIE4028, Plate 2.h	*Manantha*	Shrub	Leaf	Bone fracture in humans and cattle	Fresh	Topical
29	*Eucalyptus polybractea* R. T. Baker; Myrataceae; RIE4067	*Karpura mara*	Tree	Leaf, Bark	Ring worm infection	Poultice and Infusion	Topical
30	*Euphorbia hirta* L.; Euphorbiaceae; RIE4035, Plate 2.i	*Amanpacharasi*	Herb	Leaf, Latex	Hemorrhoids and anal fissures; Pimples	Fresh and latex	Topical
31	*Ficus infectoria* Roxb.; Moraceae; RIE4036	*Selakai*	Tree	Fruit	Vitamin supplement	Raw	Oral
32	*Ficus racemosa* L.; Moraceae; RIE4050	*Athikai*	Tree	Fruit	Good eye sight	Raw	Oral
33	*Grewia aspera* Roxb.; Tiliaceae; RIE4024	*Dadachi maram*	Tree	Bark	Diarrhea	Infusion	Oral
34	*Gymnema hirsutum* W&A.; Asclepiadaceae; RIE4031	*Sakara sedi*	Tree	Leaf	Diabetes	Infusion	Oral
35	*Hibiscus rosa- sinensis* L.; Malvaceae; RIE4032	*Chembarathi*	Shrub	Fruit	Good hair growth and relaxes headache	Crushed with coconut oil	Topical
36	*Ipomoea alba* L.; Convolvulaceae; RIE4052	*Velutha*	Shrub	Leaf	Skin problems like irritations or itching	Poultice	Topical
37	*Ipomoea staphylina* Roem & Sch.; Convolvulaceae; RIE4059	*Miningae*	Shrub	Tuber	Diarrhea	Crushed juice	Oral
38	*Jatropha curcass* L.; Euphorbiaceae; RIE4075	*Kotamuth*	Tree	Bark	Health tonic	Infusion	Oral
39	*Lantana camera* L.; Verbenaceae; RIE4081, Plate 3.a	*Parale gida*	Shrub	Fruit	Skin inflammation caused due to fungi	Crushed juice	Topical

40	*Lantana indica* Roxb.; Verbenaceae; RIE4033	*Judukai*	Shrub	Leaf	Intestinal cramp	Juice	Oral
41	*Lawsonia inermis* L.; Lythraceae; RIE4041	*Mylangi*	Shrub	Leaf	Infected wounds	Paste	Topical
42	*Leucas biflora* (Vahl.) R.Br., Lamiaceae; RIE4086	*Kadu thumbae*	Herb	Entire Plant	Skin inflammations caused by some poisonous insects	Paste in coconut oil base	Topical
43	*Leucas aspera* L.; Lamiaceae; RIE4037, Plate 3.b	*Thumbae*	Herb	Leaf	Vomiting and severe dehydration	Juice	Oral
44	*Lycopersicon esculentum* Mill.; Solanaceae; RIE4062	*Takkali*	Herb	Leaf	Relieve from headache	Paste	Topical
45	*Mangifera indica* L.; Anacardiaceae RIE4078	*Manga mara*	Tree	Leaf, Fruit	Oral problems, Vitamin supplement	Raw/Fresh	Topical and Oral
46	*Melothria maderaspatana* L. Cogn Cucurbitaceae; RIE4080	*Solapushni kai*	Herb	Twig	Prolonged cough	Crushed juice	Oral
47	*Mimosa pudica* L.; Leguminosae; RIE4079	*Thotta surungi*	Herb	Young Leaf	Pain related to bone	Paste	Topical
48	*Murraya koenigii* L.; Rutaceae; RIE4085, Plate 3.c	*Karivepilla*	Shrub	Leaf	Skin inflammations	Infusion	Topical
49	*Musa paradisiaca* L.; Musaceae; RIE4052, Plate 3.d	*Vazha pazham*	Tree	Fruit, Stem	Dietary supplement	Raw/Cooked	Oral
50	*Nasturtium indicum* DC.; Brassicaceae; RIE4039	*Kadge*	Herb	Root	Infections of ear	Baked and Crushed juice	Internal
51	*Ocimum basilicum* L.;Lamiaceae; RIE4053	*Kadu tholasi*	Herb	Entire Plant	Bee sting	Paste	Topical
52	*Oryza sativa* L.; Poaeace; RIE4087	*Arisi (Kanji)*	Herb	Seed	Dehydration and indigestion	Cooked to soup consistency	Oral
53	*Oxalis corniculata* L.; Oxalidaceae; RIE4061, Plate 3.e	*Puli sare*	Herb	Leaf	Stomach ulcer and diarrhea	Cooked/Raw	Oral

54	*Passiflora foetida* L.; Passifloraceae; RIE4060	*Potul*	Shrub	Leaf	Skin inflammation caused by insects	Juice	Topical
55	*Phyllanthus amarus* Schum. &Thonn.; Phyllanthaceae;RIE4065, Plate 3.g	*Kelar nelli*	Herb	Whole Plant	Detoxification of the body and jaundice	Juice mixed in goat milk	Oral
56	*Phyllanthus embelica* L.; Phyllanthaceae; RIE4054, Plate 3. f	*Kadu nelli*	Tree	Bark	Hepatitis and Dysentery	Decoction	Oral
57	*Physalis minima* L.; Solanaceae; RIE4088, Plate 3.h	*Kupanthi*	Herb	Fruit	Fruits are consumed for proper digestion	Raw along with salf and pepper for taste	Oral
58	*Piper nigrum* L.; Piperaceae; RIE4069	*Kadu kurumulagu*	Shrub	Fruit	Common cold and fever	Juice/Dried powdered in infusion form	Oral
59	*Plantago lanceolata* L.; Plantaginaceae; RIE4040, Plate 4.a	*Nila keere*	Herb	Leaf	Skin infections appearing on the leg	Juice	Topical
60	*Plectranthus nilgherricus* Benth.; Lamiaceae;RIE4064	*Sone gida*	Herb	Leaf	Heal bruises	Paste	Topical
61	*Plumbago zeylanica* L.; Plumbaginaceae; RIE4014, Plate 3.i	*Nage chedi*	Herb	Stem, Leaf	Antifertility agent	Dried powdered	Oral
62	*Polygonum punctatum* Book. Ham. Polygonaceae; RIE4070	*Gondh*	Herb	Entire Plant	Arthritis	Poultice	Topical
63	*Psidium guajava* L.; Myrtaceae; RIE4063	*Koyyapazham*	Tree	Fruit, Leaf	Diarrhea; Strengthening tooth and gum	Decoction and Raw/Fresh	Oral
64	*Ricinus communis* L.; Euphorbiaceae; RIE4051	*Amanaku*	Herb	Seed, Leaf	Dysentery; Headache	Oil from the seeds in small quantity and Poultice	Topical
65	*Rosmarinus officinalis* L.; Lamiaceae; RIE4041	*Rosmary*	Herb	Leaf	Detoxification	Decoction and Infusion/ Raw	Oral
66	*Rubia cordifolia* L.; Rubiaceae; RIE4015	*Maral*	Shrub	Leaf	Burns	Paste	Topical
67	*Ruta graveolens* L.; Rutaceae; RIE4056, Plate 4. b	*Aruvadam*	Shrub	Leaf	Stomach cramps; Skin inflammations.	Poultice/Infusion	Topical

68	*Santalum album* L.; Santalaceae; RIE4071	*Sannamara*	Tree	Seed, Heart wood	Healthy skin; Body ache	Oil forms the base for many medicinal formulations/Dried powdered	Topical
69	*Shuteria vestita* W&A.; Fabaceae; RIE4076	*Kadu belaga*	Shrub	Leaf	Skin blisters	Poultice	Topical
70	*Sida rhombifolia* L.; Malvaceae; RIE4018, Plate 4. c	*Kal gadale*	Herb	Leaf	Laceration	Paste	Topical
71	*Sigesbeckia orientalis* L.; Asteraceae; RIE4084	*Nadukadachi*	Herb	Leaf	Wounds; Insect bites	Paste	Topical
72	*Solanum denticulatum* Blume.; Solanaceae; RIE4072	*Periya midinje*	Herb	EntirePlant	Headache	Poultice	Topical
73	*Solanum indicum* L.; Solanaceae; RIE4053	*Sunda maram*	Herb	Root, Leaf	Toothache; Antidote	Crushed juice/Poultice	Topical
74	*Solanum nigrum* L.; Solanaceae; RIE4051, Plate 4. e	*Sutti keere*	Herb	Leaf	Health tonic; Body ache	Paste	Oral
75	*Solanum verbascifolium* L.; Solanaceae; RIE4041, Plate 4. d	*Pithemaram*	Tree	Bark	Diarrhea	Juice from fresh/Dried bark.	Oral
76	*Syzygium aromaticum* L.; Myrtaceae; RIE4056	*Longh*	Tree	Flower buds	Toothache; Throat inflammation	Fresh/Dried powdered	Oral
77	*Thunbergia tomentosa* Wall; Acanthaceae; RIE4073	*Devagida*	Herb	Entire Plant	Eye infections	Paste	Topical
78	*Thymus vulgaris* L.; Lamiaceae; RIE4064	*Thyme seddi*	Herb	Leaf	Health tonic	Decoction	Oral

79	*Tillaea pentandra* Royle ex Edgew.; Crassulaceae; RIE4082	*Kichamina*	Shrub	Leaf	Wounds	Paste	Topical
80	*Tinospora cordifolia* (Wild) Miers; Menispermaceae; RIE4040	*Amrithavalli*	Shrub	Leaf	Skin infections	Infusion	Oral
81	*Todalia asiatica* Lamk.; Rutaceae; RIE4083	*Midinje*	Shrub	Leaf, Stem	Vomiting and reduces dehydration	Paste	Oral
82	*Trema orientalis* Bl.; Ulmaceae; RIE4073	*Omimaram*	Tree	Bark	High blood pressure	Infusion	Oral
83	*Trichodesma zeylanica* R.Br. Boraginaceae; RIE4057	*Jalke maram*	Tree	Root	Skin diseases	Paste	Topical
84	*Tridax procumbens* L.; Asteraceae; RIE4015, Plate 4. g	*Rail goodu*	Herb	Leaf	Laceration	Fresh/ Poultice.	Topical
85	*Tunbergia alta* Bojer Ex. Sims; Acanthaceae; RIE4016	*Nasae*	Herb	Root	Infections related to nails	Paste	Topical
86	*Urena lobata* L.; Malvaceae; RIE4058, Plate 4. h	*Koddi thuthi*	Herb	Root	Rheumatism	Poultice	Topical
87	*Urginea indica* Kunth.; Liliaceae; RIE4043	*Neelakhezhang*	Herb	Tuber	Small boils appearing on the skin in the leg region	Juice	Oral
88	*Vitex negundo* L.; Verbenaceae; RIE4042, Plate 4. i	*Aroghya seddi*	Herb	Leaf	Healthy skin and used as an anti-ageing agent	Decoction	Oral

Plate 4. a. *Plantago lanceolata* L.; b**.** *Ruta graveolens* L.; c. *Sida rhombifolia* L.; d. *Solanum verbascifolium* L.; e. *Solanum nigrum* L.; f. *Tinospora cordifolia* (Wild) Miers; g. *Tridax procumbens* L.; h. *Urena lobata* L.; i. *Vitex negundo* L.

3.9. Informant consensus

The F_{IC} was analyzed for various ailment categories reported by the *Kurumba* informants of the Nilgiri district. The result exhibited a high level of consensus among the informants regarding the usage of the medicinal plants. The F_{IC} value for ailments groups like CV, AF, VI, SW, DS and LP were high (total consensus=1.00) whereas NE, CW, SI and WD exhibited relatively lesser values (mean F_{IC}= 0.80) as depicted in the table 3. The results indicate the probable presence of active principle in the plant taxa expressed by the informants for the treatment of various ailments. These results are in agreement with earlier reports like *Santalum album* L. used for the treatment of hypertension by the indigenous communities of Dindigul district (Karunyal and Andrews, 2010), application of *Ruta graveolens* L. by *Irula* tribes of Chengal Combai Nilgiris for curing stomach ache and vomiting (Murugesan *et al.,* 2005),*Centella asiatica* (L.) Urb.*, Basella rubra* L. and *Oxalis corniculata* L. used for the treatment of various gastrointestinal problems by the *Irular* tribes of Kolli hills (Bosco and Arumugam, 2012), *Curcuma longa L.* (skin inflammation), *Tridax procumbens L.* is used as a paste for treating the minor wounds by the *Malayali* tribes of Koli hill of eastern ghats (Xavier *et al.,* 2014), *Phyllantus amarus* Schum. & Thonn. used for treating jaundice by the traditional healers of Kanchipuram district (Chellaiah *et al.,* 2006, Ezuruike and Prieto, 2014), *Plumbago zeylanica* L. (Raghupathy *et al.,* 2008) and *Vitex negundo* L. used for treating weakness by the healers of Pachamalai hills (Rajadurai *et al.,* 2009). These similarities in the healing process

Table 3. Informant consensus factor (F_{IC}) for various ailment categories

Ailment	Number of taxa (Nt)	Number of use reports (Nur)	F_{IC}
Gastro intestinal (GI)	28	185	0.85
Fever and Headache (FH)	4	27	0.86
Muscular and skeletal (MS)	2	14	0.92
Weakness and dizziness (WD)	5	19	0.77
Cuts and Wounds (CW)	9	34	0.75
Respiratory Problems (RP)	4	14	0.77
Cardio Vascular (CV)	1	7	1.00
Antifertility (AF)	1	11	1.00
Skin inflammation (SI)	19	76	0.76
Venom inflammation (VI)	1	8	1.00
Swellings (SW)	1	13	1.00
Neurologic (NE)	4	13	0.75
Infection and inflammations (II)	3	17	0.87
Dietary Supplements (DS)	2	36	0.97
Oral care (OC)	3	19	0.88
Liver Problems (LP)	1	31	1.00

indifferent region by various indigenous communities across Tamil Nadu supports the relevance of the *Kurumba* healing practices of the region. At the same time, the usage of the bark of *Berberis tinctoria* Lesch. for GI problems and *Dodonea viscosa* L. leaves for bone fractures are exclusively mentioned in *Kurumba* system. Hence the documentation of these traditional medicinal practices of *Kurumba* tribes plays a pivotal role in searching new bioactive compounds.

4. Conclusion

The study revealed the rich diversity of medicinal knowledge of *Kurumba* tribes of Nilgiri district, Tamil Nadu. Although few ethno botanists have contributed to the documentation process of IKS from the Nilgiri district, the present study primarily focuses on consensus analysis. Every ethnobotanical exploration adds new information on medicinal plant used to the existing practices. This indicates that the vast ethnic and floristic diversity of the study area is still unexplored. Hence the present work of documentation and validation of IKS associated with the *Kurumba* community becomes more relevant, thereby helping the policymakers to plan many conservational strategies for medicinal flora which is quickly vanishing due to the advent of modernization. The medicinal properties of some of the plant taxa such as *Berberis tinctoria* Lesch.*,Todalia asiatica* Lamk.*,Sigesbeckia orientalis* L. and *Shuteria vestita* W&A. are still unexplored. The ethnomedicinal practices of these plants can pave way for the bio prospecting of new drug development. The standardization in ethno pharmacological procedures of *Kurumba* practices as well as the toxicities of some of the commonly consumed plants need to be evaluated. Even though *Kurumba* ethnic group share common geographical boundaries with various other indigenous communities and exhibit few similarities in the plant species cited, some unique medicinal preparations and their applications were established through this study.

Acknowledgements

The authors are grateful to all the traditional medicinal practitioners of the *Kurumba* tribes of Nilgiri for supporting the study by sharing their knowledge and Mr. Sudhakar who accompanied us during the field visits. Authors are also thankful to the Department of Science Education, Regional Institute of Education, Mysore and to the Department of Studies in Botany, the University of Mysore for their guidance and support in terms of providing infrastructure.

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