

ORIGINAL ARTICLE

Herbals as natural immunity boosters: some observations from native people of Kerala

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ABSTRACT

Formulation of new effective anti-coronaviral drugs and therapies is important and currently, there is no established pharmacological strategy for the prevention and/or treatment of the coronavirus infection. The present study deals with the survey on the immunity enhancing plant species practiced by the local people, which improve the health and immune system. They believe that strengthen the immunity naturally with the help of medicinal plants/herbs. Herbals contain a pool of secondary metabolites which can enhance the immunity. Immunity refers body's ability to identify and resist large numbers of infectious and potentially harmful pathogens enabling the body to prevent or resist diseases and inhibit organ and tissue damage via multiple mechanisms. For overcoming viral issues, the different plant parts such as root, stem, leaf, flower, seeds, fruits and their crude extracts that have been used in the Indian traditional system of medicine and have clinical proven activity. In the present investigation, a survey was conducted to collect information about the use of traditional medicinal plants for immunity boosting. The survey has reported 132 plants belonging to diverse families and 42 species were validated scientifically connected with immunity. Major tribal communities interviewed were Kurumba, Muduga, Irula, Kattu Naiken & the local crude drug practicing people of the area. Mode of usage of the different species was also reported. Fabaceae species was found to be of high frequency in terms of its use, followed by Lamiaceae. It is high time to provide awareness and training to conserve the herbals from extinction from the wild habitats through the local gram panchayath.

Key words: Tribal, Immunity, COVID-19, ethno-botanical survey, herbals, plant parts

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INTRODUCTION

World Health Organization (WHO) recorded that approximately 67% of the global population depends upon local herbal remedies for the health care of its people. In fact, medicinal plants are the aboriginal healers of mankind. They not only provided food and shelter but also crude drugs to cure many ailments. Ethnic medicine or traditional medicine, has always existed in diverse forms in different civilizations like Ayurveda & siddha (India), Egyptian, Western, Chinese, Kampo (Japan) and Greco-Arab or Unani-Tibb (South Asia). Globally, herbal drugs are currently being resurveyed through extensive search on different zones and their medicinal features [1].

Diseases of pandemic class are of global issue in the present century, to cause substantial morbidity regardless of extensive medical innovations. Anti-viral treatments have been distraught because of mutant nature of virus enough to reduce the drugs targeting viral components [2]. Globalization, climate change and fast urbanization has led to contagious outbreak by rising or re-emergence of viruses, posing disaster menace towards communal health and safety, specifically in such unprecedented times where there are no potential vaccines available. For the last few centuries, the earth has ventured the incidence of catastrophic viral disorders like Severe Acute Respiratory Syndrome, Middle East Respiratory Syndrome, dengue and chikungunya within human beings [3]. Stringari *et al.*, [1] reported that COVID-19 was the third potent disease of animal origin, which is prevailing in almost four corners of the world by

getting initiated from a single place. Nearly, 213 countries of the entire earth have been affected in less than 90 days by this pernicious virus.

Clinically, plants as immunomodulators is categorized into immunoadjuvants i.e., enhance the vaccine efficacy - immune stimulants (modulators of the immune response). It has been recorded that they are exploited as selectors between cellular and humoral helper T1 (Th1) and helper T2 cells (Th2), immunoprotective, immunodestructive, and reagenic (immunoglobulin E (IgE)) versus IgG type immune responses—posing a real challenge to vaccine designers [4]. Immunostimulants are non-specific enhancer of body's resistance to infection. They function via innate and adaptive immune responses. In healthy people, they serve as prophylactic and promoter agents, i.e., as immunopotentiators, by enhancing the basic level of immune response. In the individual with impairment of immune response, they are expected to act as immunotherapeutic molecules [5]. Immunosuppressants are structurally and functionally heterogeneous drugs, which are often concomitantly administered in combination regimens to treat different organ transplant rejection and autoimmune diseases [6].

Ayurveda is the vital tradition practiced from time immemorial in India, Sri Lanka and other countries. It has a sound. Atharvaveda (1200 bc), Charak Samhita and Sushrut Samhita (1000–500 bc) are the philosophical and experimental basis that give narration of over 700 herbals. Many herbals used in the Indian traditional system devoted to enhancement of the body's resistance have attracted the attention of biologists globally. Diverse medicinal plants exhibit not only immunomodulatory potentialities but also with antioxidant, antiasthmatic, antiarrhythmic, antiinflammatory, hepatoprotective, antidiabetic, hypocholesterolemic, antimicrobial, cardiogenic, diuretic, and anticancer powers.

Saba Farooq and Zainab Ngain [7] reviewed that plants based natural products as alleged remedies for viral infection. Phytochemicals from many plant extract have been documented for antiviral features. *Stephania tetrandra* of Menispermaceae showed the presence of bis-benzylisoquinoline alkaloids such as fangchinoline, tetrandrine and cepharanthine reported to inhibit protein expression, repress infectivity, and inhibit the replication of coronavirus in human and virus-induced host reappearance. In India, traditional practices based on garlic, cardamom, pennyroyal, liquorice, pepper, turmeric, tragacanth and hedge nettle have been alleged for an effective cure against COVID-19. Curcumin, derived from turmeric, is widely used for potential COVID-19 treatment due to stronger interaction with protease enzyme as compared to other phytochemicals like pepper, pennyroyal and tragacanth. In this juncture, the present survey was undertaken to document the immune-modulating potential plants used by the native practicing people and tribals of the remote areas of Palakkad.

MATERIAL AND METHODS

Sampling area, informants and data gathering

Silent valley is located in the Nilgiri hills, between 11°03' to 11°13' N (latitude) and 76°21' to 76°35' E (longitude), has a core area of 89.52 km² (34.56 sq mi), which is surrounded by a buffer zone of 148 km² (57 sq mi). The climate is tropical with summer rains constituting the bulk of the precipitation. Average minimum temperature varies from 8° to 14°C and average maximum temperature varies from 23° to 29°C. The hottest months are April and May when the mean temperature is 23 °C and the coolest months are January and February when the mean temperature is 18o C. Annual average rainfall is 2717 to 4543 mm.

The ethnobotanical survey was conducted from November 2020 to February 2021. It was planned to trace immune modulating plants used by the native crude drug practicing people and tribals such as Kurumba (Thudukki), Muduga (Karuvara), Irula (Mukkali) and Kattu Naiken (Mundakulam) who have adequate knowledge in ethnic therapeutic practices. The native experts in traditional medicine in the outer skirts of Silent valley hamlets were interviewed and discussed. 16 tribal and 34 native people were included in the survey. Aged and experienced people on use of traditional medicinal plants were prioritized for consideration.

Oral interviews and discussions by interviewer from each informant were recorded. Data were also collected using questionnaires in their local dialect. Traditional medicines used for promoting immunity were gathered from the tribal and native practicing indigenous medicines. Most interviews were arranged by native people familiar with tribal and who could communicate with the tribal communities. Questionnaires were used to collect information from the informants. The questionnaires used included mainly plant name, parts of the plants used, mode of preparation and application. Each such information was validated thrice with different people from different localities. The common names of plants and dosage or mode of administration were documented from the field.

RESULTS AND DISCUSSION

The study focused mainly on herbals for immunity booster uses reported by the tribal/native people from the outer skirts of Silent valley, Palakkad. The present investigation enlisted 132 plants were used for immunity booster (Table 1). Maximum medicinal species were reported from Fabaceae followed by Lamiaceae (Table 2). Among the species, 42 of them were validated scientifically (Table 3). *Andrographis paniculata*, *Azadirachta indica*, *Moringa oleifera*, *Psidium guajava*, *Ocimum sanctum*, *Piper nigrum*, *Zingiber officinale*, *Curcuma longa* were commonly used by the people for multiple of treatments. The secondary metabolites present in the plants may be the possible reason for their therapeutic efficacies.

Leaves (75) were the most frequently used plant parts, followed by roots (30) and fruits (23) (Fig. 1). The major mode of preparation is infusion (42) followed by boiled singly (35) and others (59) (Fig.2.). Preparations were made with water, honey, alcohol, lime water, and milk as solvent. The mode of administration was mostly oral. Most of the reported species were herb which was followed by tree and climber. Most of the plants are wild and some are cultivated, whereas others are both cultivated and wild (Table 1). The species like *Allium cepa*, *A. sativum*, *Costus speciosus*, *Emblica officinalis*, *Curcuma longa*, *Zingiber officinale*, *Artemisia annua* and *Vitex negundo* were the most frequently cited in study area.

The present study reports the usage of these ethnomedicinal plants, but needs to be validated by pharmacological studies. Some proven immune boosting plants may exert their action through their polyphenols/alkaloids/flavonoids/anthocyanins etc. The study highlighted the pivotal role of traditional herbal medicine for the treatment of viral issues in the local areas of Silent valley. Ethnobotanical survey is useful for researchers and pharmaceutical companies for further studies on isolation, purification and identification of the lead compounds, which can be formulated into immune boosting drugs. The purified drugs can be subjected to preclinical and clinical trials for further validations.

The coronavirus disease is highly transmittable with no effective antiviral therapy to combat the infection [1]. However, in the present survey, the obtained data highlighted the role of cultivated spices and wild herbs in the treatment of COVID-19. The survey has been conducted to identify the various home remedies used during COVID-19, which include many such spices and herbs.

As per the survey data, most people using ginger, clove, cinnamon, black pepper, and tulsi as main ingredients in drug preparation. It was noticed that cinnamon, ginger extracts, black pepper, tulsi, and turmeric play vital role against SARSCoV- 2 (COVID-19) and other such pathogenic infections, which was also validated by recent studies mentioned in the Table 3. The obtained knowledge was authenticated by Vaghasiya et al., [8], for example the usage of *Ocimum sanctum* for immunomodulatory activity. Firoj et al., [9] recorded the use of nearly 12 herbals species increased the level of helper T cells as well as natural killer cells, which helps fight against viral infection. *O. sanctum* is recorded in the Ayurveda for curing pain, pneumonia, diarrhea, cough, and fever which are the common symptoms of COVID-19. *Piper nigrum* infusion provides relaxation from sinusitis and nasal congestion, which were also the common syndromes of COVID-19 [2]. Ashish Singh et al., [10] reviewed that flavonoids in pepper, induces the body's immunity constantly due to its antiviral mode of action. Rajagopal et al., [11] also recommended the intake of black pepper and ginger in a daily diet as it may resist the coronavirus replication. According to the tribal data, intake of Amla/wild lemon as the source of vitamin C for enhancing immunity is ideal.

Flower et al., [12] documented that the clinical trial in the USA among 167 patients with sepsis-related ARDS indicated that uptake of 15 g/day of vitamin C for 4 days may reduce the mortality in these patients. The three hospitals in Hubei, China clinical trial on patients with confirmed SARS-CoV-2 infection in the ICU validated the same i.e., high-dose intravenous vitamin C (12 g of vitamin C/50 mL every 12 h for 7 days) provided defensive effect without any side effects in critically COVID-19 patients [13].

According to the Indian spices export data, 23% of spice exports was enhanced during the COVID-19 pandemic compared with 2019. The Indian spices includes pepper, ginger, turmeric, coriander, cumin, fennel, fenugreek, nutmeg, spice oils cardamom, and mint products to USA, UK, Germany, France, Italy, Canada, Australia, UAE, Iran, Singapore, China, and Bangladesh, which confirms the potential medicinal role of spices of India globally. do Rosário and de Siqueira[3] also accounted the importance of Indian medicinal species as drug. Saba Farooq and Zainab Ngain [7] recorded that the natural drugs were potential for treatment for Coronavirus diseases. Babich *et al.*, [14] reviewed that medicinal plants Strengthen Immunity during a Pandemic outbreaks. Cohen [15] reviewed *Ocimum sanctum* as magical herb for all reasons. Kalikar *et al.*, [16] recorded the immunomodulatory effect of *Tinospora cordifolia* extract in human immunodeficiency virus positive patients.

Table 1. Checklist of immunity booster plants used by the tribals & local people

Sl.No.	Binomial	Family	Parts used
1	<i>Andrographis macrobotrys</i> Nees	Acanthaceae	Leaves and Stem
2	<i>Rungia pectinata</i> (L.) Nees	Acanthaceae	Leaves and Roots
3	<i>Hemigraphis crossandra</i> (Steud.) Bremek.	Acanthaceae	Leaves
4	<i>Thunbergia fragrans</i> Roxb.	Acanthaceae	Leaves
5	<i>Justicia procumbens</i> L.	Acanthaceae	Leaves and Roots
6	<i>Andrographis paniculata</i> Burm.f) Nees	Acanthaceae	Whole plant
7	<i>Adhatoda vasica</i> Nees	Acanthaceae	Leaves
8	<i>Desmos lawii</i> (Hook.f. & Thomson) Saff.	Annonaceae	Leaves
9	<i>Milusa tomentosa</i> (Roxb.) Finet & Gagnep.	Annonaceae	Fruits
10	<i>Amaranthus dubius</i> Mart. ex Thell.	Amaranthaceae	Leaves
11	<i>Amaranthus tricolor</i> L.	Amaranthaceae	Leaves
12	<i>Amaranthus hypochondriacus</i> L.	Amaranthaceae	Leaves and Seeds
13	<i>Aerva lanata</i> (L.) Juss.	Amaranthaceae	Whole plant
14	<i>Achyranthes aspera</i> L.	Amaranthaceae	Whole plant
15	<i>Allium sativum</i> L.	Amaryllidaceae	Bulbs
16	<i>Allium cepa</i> L.	Amaryllidaceae	Bulbs and Leaves
17	<i>Mangifera indica</i> L.	Anacardiaceae	Leaves and Fruits
18	<i>Spondias indica</i> (Wight & Arn.) Airy Shaw & Forman	Anacardiaceae	Fruits
19	<i>Centella asiatica</i> (L.) Urb.	Apiaceae	Leaves
20	<i>Cuminum cyminum</i> L.	Apiaceae	Seeds
21	<i>Trigonella foenum graecum</i> L.	Apiaceae	Leaves and Seeds
22	<i>Pimpinella anisum</i> L.	Apiaceae	Seeds
23	<i>Carum carvi</i> L.	Apiaceae	Seeds
24	<i>Alstonia venenata</i> R. Br.	Apocynaceae	Roots and Fruits
25	<i>Cryptolepis buehnanii</i> R.Br. ex Roem. & Schult.	Apocynaceae	Roots and Stem
26	<i>Dracaena terniflora</i> Roxb.	Asparagaceae	Roots
27	<i>Artemisia annua</i> L.	Asteraceae	Leaves
28	<i>Conyza bonariensis</i> (L.) Cronq.	Asteraceae	Leaves and Flowers
29	<i>Echinacea angustifolia</i> DC.	Asteraceae	Leaves, Stem and Roots
30	<i>Senecio scandens</i> Buch.-Ham. ex D.Don	Asteraceae	Whole plant
31	<i>Vernonia amygdalina</i> Delile.	Asteraceae	Leaves
32	<i>Impatiens balsamina</i> L.	Balsaminaceae	Leaves and Flowers
33	<i>Basella alba</i> L.	Basellaceae	Leaves
34	<i>Stereospermum kunthianum</i> Cham.	Bignoniaceae	Leaves, Bark and Roots
35	<i>Capparis tomentosa</i> Lam.	Capparidaceae	Roots
36	<i>Cannabis sativa</i> L.	Cannabaceae	Leaves and Seeds
37	<i>Carica papaya</i> L.	Caricaceae	Leaves and Fruits
38	<i>Combretum collinum</i> sub sp. elgonense (Exell) Okafora	Combretaceae	Leaves
39	<i>Terminalia chebula</i> Retz	Combretaceae	Fruits
40	<i>Kalanchoe densiflora</i> Rolfe.	Crassulaceae	Leaves
41	<i>Cucurbita maxima</i> Duchesne.	Cucurbitaceae	Flowers, Fruits and Seeds
42	<i>Momordica charantia</i> L	Cucurbitaceae	Fruits and Roots
43	<i>Momordica dioica</i> Roxb. ex Willd.	Cucurbitaceae	Fruits, Leaves and Roots
44	<i>Momordica sahyadrica</i> subsp.anamalayana K.J.John.,K. Pradheep et Krishnaraj subsp. nov.	Cucurbitaceae	Fruits and Leaves
45	<i>Cyperus rotundus</i> L	Cyperaceae	Rhizome
46	<i>Jatropha curcas</i> L.	Euphorbiaceae	Whole plant
47	<i>Manihot esculenta</i> Crantz.	Euphorbiaceae	Leaves, Seeds and Roots
48	<i>Acacia torta</i> (Roxb.) Craib	Fabaceae	Leaves, Roots and Stem
49	<i>Cassia occidentalis</i> L	Fabaceae	Leaves and Seeds
50	<i>Mimosa diplotricha</i> C.Wright	Fabaceae	Leaves and Roots
51	<i>Albizia odoratissima</i> (L.f) Benth.	Fabaceae	Bark
52	<i>Xylocarpus xylocarpa</i> (Roxb.) W.Theob.	Fabaceae	Leaves and Seeds
53	<i>Crotalaria heyneana</i> Graham ex Wight & Arn.	Fabaceae	Leaves
54	<i>Alysicarpus vaginalis</i> Linn. DC.	Fabaceae	Roots
55	<i>Crotalaria humifusa</i> Benth.	Fabaceae	Leaves
56	<i>Pongamia pinnata</i> (L.) Pierre.	Fabaceae	Roots

57	<i>Pterocarpus marsupium</i> Roxb.	Fabaceae	Leaves, Bark, Stem and Flowers
58	<i>Crotalaria mysorensis</i> Roth.	Fabaceae	Leaves and Flowers
59	<i>Spatholobus roxburghii</i> Benth.	Fabaceae	Leaves and Stem
60	<i>Crotalaria retusa</i> L.	Fabaceae	Whole plant
61	<i>Tephrosia pulcherrima</i> (Baker) Gamble.	Fabaceae	Leaves
62	<i>Desmodium heterocarpon</i> (L.) DC	Fabaceae	Roots
63	<i>Teramnus labialis</i> (L.f) Spreng.	Fabaceae	Leaves
64	<i>Desmodium heterophyllum</i> (Willd.) DC	Fabaceae	Roots
65	<i>Uraria rufescens</i> (DC.) Schindl.	Fabaceae	Leaves
66	<i>Desmodium pulchellum</i> (L.) Benth.	Fabaceae	Leaves, Roots and Flowers
67	<i>Desmodium triquetrum</i> (L.) DC	Fabaceae	Leaves
68	<i>Desmodium triangulare</i> (Retz.) Merr.	Fabaceae	Leaves
69	<i>Vigna pilosa</i> (Willd.) Baker.	Fabaceae	Leaves and Roots
70	<i>Vigna trilobata</i> (L.) Verdc.	Fabaceae	Whole plant
71	<i>Vigna wightii</i> Bedd.	Fabaceae	Leaves
72	<i>Erythrina indica</i> Lam.	Fabaceae	Leaves
73	<i>Entada rheedei</i> Spreng.	Fabaceae	Seeds
74	<i>Mucuna pruriens</i> (L.) DC.	Fabaceae	Seeds
75	<i>Tamarindus indica</i> L.	Fabaceae	Leaves, Fruits and Seeds
76	<i>Glycyrrhiza glabra</i> L.	Fabaceae	Root and Rhizome
77	<i>Caesalpinia sappan</i> L.	Fabaceae	Stem
78	<i>Ocimum sanctum</i> L.	Lamiaceae	Whole plant
79	<i>Leucas zeylanica</i> (L.) W.T.Aiton	Lamiaceae	Whole plant
80	<i>Acrocephalus hispidus</i> (L.) Nicolson & Sivad.	Lamiaceae	Leaves
81	<i>Leucas hirta</i> (B.Heyne ex Roth) Spreng.	Lamiaceae	Whole plant
82	<i>Leucas indica</i> (L.) R.Br. ex Sm.	Lamiaceae	Leaves
83	<i>Anisochilus carnosus</i> (L.f) Wall	Lamiaceae	Leaves
84	<i>Gomphostemma heyneanum</i> Wall ex.Benth.	Lamiaceae	Leaves
85	<i>Ocimum basilicum</i> L.	Lamiaceae	Leaves
86	<i>Callicarpa tomentosa</i> (L.) L.	Lamiaceae	Leaves
87	<i>Vitex altissima</i> (L.)f.	Lamiaceae	Leaves
88	<i>Vitex negundo</i> L.	Lamiaceae	Leaves, Seeds and Roots
89	<i>Cinnamomum verum</i> J. Presl.	Lauraceae	Bark
90	<i>Aloe vera</i> (L.) Burm.f.	Liliaeae	Leaves
91	<i>Abutilon indicum</i> (L.) Sweet	Malvaceae	Leaves and Flowers
92	<i>Sida cordifolia</i> L.	Malvaceae	Whole plant
93	<i>Azadirachta indica</i> A. Juss.	Meliaceae	Leaves and Seeds
94	<i>Tinospora cordifolia</i> (Willd.) Miers	Minispermaceae	Root, Stem and Leaves
95	<i>Morus alba</i> L.	Moraceae	Fruits, Roots and Leaves
96	<i>Ficus arnottiana</i> (Miq.) Miq.	Moraceae	Bark, Seeds and Fruits
97	<i>Ficus nervosa</i> B.Heyne ex Roth	Moraceae	Leaves
98	<i>Ficus drupacea</i> Thunb.	Moraceae	Fruits and Roots
99	<i>Moringa oleifera</i> Lam.	Moringaceae	Leaves, Roots, Seed, Bark, Fruit, Flowers and Immature Pods
100	<i>Psidium guajava</i> L.	Myrtaceae	Fruits and Leaves
101	<i>Syzygium cumini</i> (L.) Skeels	Myrtaceae	Bark
102	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	Myrtaceae	Flower buds and Leaves
103	<i>Osbeckia malabarica</i> (Hook. f.) Cogn.	Melostomaceae	Flowers
104	<i>Nyctanthes arbor-tristis</i> L.	Oleaceae	Flowers
105	<i>Passiflora edulis</i> Sims	Passifloraceae	Leaves and Fruits
106	<i>Sesamum indicum</i> L.	Pedaliaceae	Seeds
107	<i>Bridelia micrantha</i> (Hochst.) Baill	Phyllanthaceae	Bark, Leaves and Roots
108	<i>Flueggea virosa</i> (Roxb. ex Willd.) Royle	Phyllanthaceae	Roots and Fruits
109	<i>Phyllanthus emblica</i> L.	Phyllanthaceae	Fruits
110	<i>Plantago major</i> L.	Plantaginaceae	Leaves
111	<i>Piper nigrum</i> L.	Piperaceae	Fruits and Leaves
112	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	Whole plant
113	<i>Salomonina ciliata</i> (L.) DC.	Polygalaceae	Roots
114	<i>Portulaca oleracea</i> L.	Portulacaceae	Whole plant
115	<i>Rubia cordifolia</i> L.	Rubiaceae	Roots
116	<i>Geophila repens</i> (L.) I.M.Johnst.	Rubiaceae	Leaves and Fruits

117	<i>Ophiorrhiza mungos</i> L.	Rubiaceae	Roots
118	<i>Naringi crenulata</i> (Roxb.) Nicolson	Rutaceae	Whole plant
119	<i>Aegle marmelos</i> (L.) Corrêa	Rutaceae	Leaves and Fruits
120	<i>Withania somnifera</i> (L.) Dunal.	Solanaceae	Roots and Fruits
121	<i>Solanum nigrum</i> L.	Solanaceae	Fruits
122	<i>Santalum album</i> L.	Santalaceae	Stem
123	<i>Urtica dioica</i> L.	Urticaceae	Leaves and Roots
124	<i>Lantana camara</i> L.	Verbenaceae	Leaves and Flowers
125	<i>Zygophyllum fabago</i> L.	Zygophyllaceae	Leaves
126	<i>Curcuma longa</i> L.	Zingiberaceae	Rhizome
127	<i>Boesenbergia pulcherrima</i> (Wall.) Kuntze	Zingiberaceae	Leaves and Rhizome
128	<i>Globba ophioglossa</i> Wight.	Zingiberaceae	Rhizome
129	<i>Costus speciosus</i> (J.König) Sm.	Zingiberaceae	Leaves and Rhizome
130	<i>Zingiber neesianum</i> (J.Graham) Ramamoorthy	Zingiberaceae	Rhizome
131	<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Rhizome
132	<i>Curcuma zedoaria</i> (Christm.) Roscoe	Zingiberaceae	Rhizome

Table 2. List of plants under various Families used

Family	Number of species
Acanthaceae	7
Annonaceae	2
Amaranthaceae	5
Amaryllidaceae	2
Anacardiaceae	2
Apiaceae	5
Apocynaceae	2
Asparagaceae	1
Asteraceae	5
Balsaminaceae	1
Basellaceae	1
Bignoniaceae	1
Capparidaceae	1
Cannabaceae	1
Caricaceae	1
Combretaceae	2
Crassulaceae	1
Cucurbitaceae	4
Cyperaceae	1
Euphorbiaceae	2
Fabaceae	30
Lamiaceae	11
Lauraceae	1
Liliaeae	1
Malvaceae	2
Meliaceae	1
Minispermaceae	1
Moraceae	4
Moringaceae	1
Myrtaceae	3
Melostomaceae	1
Oleaceae	1
Passifloraceae	1
Pedaliaceae	1
Phyllanthaceae	3
Plantaginaceae	1
Piperaceae	1
Poaceae	1
Polygalaceae	1
Portulacaceae	1
Rubiaceae	3
Rutaceae	2

Solanceae	2
Santalaceae	1
Urticaceae	1
Verbenaceae	1
Zygophyllaceae	1
Zingiberaceae	7

Sl.No	Name of the Plant	Family	Parts used	Mode of usage	Used by the Tribe/Native people	Validated scientifically
1.	<i>Psidium guajava</i>	Myrtaceae	Whole plant	Aqueous extract	Kattu Naiken & locals	Antiviral (IF H5N1), antimicrobial activity
2.	<i>Glycyrrhiza glabra</i>	Fabaceae	roots & rhizomes	Aqueous extract	Kurumba, Muduga, & locals	Antiviral, antimicrobial, antioxidant, antitumor activity
3.	<i>Curcuma longa</i>	Zingiberaceae	Roots	Aqueous extract	Kurumba, Muduga, Irula, Kattu Naiken & locals	Antiviral activity (IF H5N1), prevention
4.	<i>Artemisia annua</i>	Asteraceae	Whole plant	Aqueous extract	locals	Antiviral activity (SARS-CoV)
5.	<i>Syzygium aromaticum</i>	Myrtaceae	Flower buds	Aqueous extract	Muduga, Irula, Kattu Naiken & locals	antimicrobial, anti-fungal, anti-viral, an-ti-inflammatory, cytotoxic, analgesic, anesthetic activities, antioxidants
6.	<i>Withania somnifera</i>	Solanaceae	root and the leaves	Aqueous extract	Kurumba, Muduga, Irula, Kattu Naiken & locals	cell-mediated immunity
7.	<i>Cuminum cyminum</i>	Apiaceae	seeds	Aqueous extract	Kurumba, Muduga, Irula, Kattu Naiken & locals	immunomodulator
8.	<i>Piper nigrum</i>	Piperaceae	fruits	Aqueous extract	Kurumba, Muduga, Irula, Kattu Naiken & locals	anti-inflammatory, antioxidant, anti-bacterial & fever reducing actions but immune system
9.	<i>Trigonella foenum graecum</i> L.	Apiaceae	seeds	Aqueous extract	Kurumba, Muduga, Irula,	hypcholesterolaemic, effects, Anti-inflammatory
10.	<i>Cinnamomum verum</i>	Lauraceae	bark	Aqueous extract	Kurumba, Irula, Kattu Naiken & locals	Antioxidant & antiviral
11.	<i>Allium cepa</i>	Amarydillaceae	Bulb	Aqueous extract	Irula, Kattu Naiken & locals	Antiviral activity IFA H1N1)
12.	<i>Allium sativum</i>	Amarydillaceae	Roots	Aqueous extract	Kurumba, Muduga, & locals	Roots Antiviral activity (IFA—H1N1)
13.	<i>Caesalpinia sappan</i>	Fabaceae	wood	Aqueous extract	Kurumba, Muduga, & locals	Antiviral activity (IFA—H1N1, H3N2, H9N2)
14.	<i>Andrographis paniculata</i>	Acathaceae	Leaves	Aqueous extract	Kurumba, Muduga, Irula,	Antiviral activity (IF H5N1)
15.	<i>Tinospora cordifolia</i>	Menispermaceae	Whole plant	Aqueous extract	Kurumba, Muduga, Irula,	Anti-viral
16.	<i>Ocimum sanctum</i>	Lamiaceae	Whole plant	Aqueous extract	Kurumba, Muduga, Irula, Kattu Naiken & locals	Antioxidant Anti-viral
17.	<i>Zingiber officinale</i>	Zingiberaceae	Rhizome	Aqueous extract	Kattu Naiken & locals	NF-kB Suppressor
18.	<i>Pimpinella anisum</i>	Apiaceae	leaves	Aqueous extract	Kurumba, Muduga, Irula, Kattu Naiken & locals	antiviral and immune-stimulating
19.	<i>Carum carvi</i>	Apiaceae	seeds	Aqueous extract	Kattu Naiken & locals	antiviral and immune-stimulating
20.	<i>Ocimum basilicum</i>	Lamiaceae	Whole plant	Aqueous extract	Kurumba, Muduga & locals	antiviral and immune-stimulating

21.	<i>Emblica officinalis</i>	Phyllanthaceae	fruits	Aqueous extract	Kurumba, Muduga, Irula, & locals	vitamin c, calcium antiviral
22.	<i>Azadirachta indica</i>	Meliaceae	leaves	Aqueous extract	Irula, Kattu Naiken & locals	Immunomodulators
23.	<i>Aloe vera</i>	Asphodelaceae	leaves	Aqueous extract	Irula, Kattu Naiken & locals	immune and cardiovascular system
24.	<i>Adhatoda vasica</i>	Acanthaceae	leaves	Aqueous extract	Kurumba, Muduga,	inhibit DTH reactivity, increased the percentage neutrophil adhesion, promoting increased phagocytic activity
25.	<i>Aegle marmelos</i>	Rutaceae	bark	Aqueous extract	Kurumba, Irula, Kattu Naiken	stimulates immune system
26.	<i>Carica papaya</i> L.	Carricaceae	Fruits	Aqueous extract	Kurumba, Muduga, Irula & locals	down regulates IL-4, IL-5, eotaxin, TNF- α , NF- κ B, and iNOS levels thus exhibits anti-inflammatory effect
27.	<i>Cassia occidentalis</i> L.	Fabaceae	leaves	Aqueous extract	Irula, Kattu Naiken & locals	anti-asthmatic potential by decreasing mRNA expression of Th1/Th2 cytokine in lung tissue
28.	<i>Cynodon dactylon</i>	Poaceae	Whole plant	Aqueous extract	Kurumba, Muduga, & locals	significant increase in antibody
29.	<i>Jatropha curcas</i> L.	Euphorbiaceae	Leaves, roots	Aqueous extract	Irula, Kattu Naiken & locals	ameliorated both cellular and humoral antibody response
30.	<i>Solanum nigrum</i> L.	Solanaceae	seeds	Aqueous extract	Kurumba, Muduga & locals	increment in the percentage of CD4+ T lymphocyte and a decrease in the percentage of CD8+ T lymphocyte of tumor
31.	<i>Vitex negundo</i> L.	Verbanaceae	leaves	Aqueous extract	Kurumba, Muduga, locals	inhibits HIV-1 reverse transcriptase activity
32.	<i>Abutilon indicum</i> L.	Malvaceae	Aerial parts	Aqueous extract	Kattu Naiken & locals	stimulatory effect on T lymphocytes.
33.	<i>Achyranthes aspera</i> L.	Amaranthaceae	Root	Aqueous extract	Kurumba, Muduga, locals	cytokine based immunomodulatory
34.	<i>Cyperus rotundus</i> L.	.Cyperaceae	Rhizome	Aqueous extract	Kattu Naiken & locals	humoral-mediated immunity by stimulating B and T cell proliferation
35.	<i>Nyctanthes arbor-tristis</i>	Oleaceae	Leaves, flowers and seeds	Aqueous extract	locals	splenocytes proliferation and increased production of cytokines, especially IL-2 and IL-6
36.	<i>Momordica charantia</i>	Cucurbitaceae	Leaves	Aqueous extract	Muduga, Irula, Kattu Naiken	neutrophils and macrophages stimulates
37.	<i>Pongamia pinnata</i> L.	Faboideae	seeds	Aqueous extract	Kurumba, Muduga,	immune cell signaling events needed for continued recruitment of neutrophils
38.	<i>Plantago major</i>	Plantaginaceae	Whole plants, seeds	Aqueous extract	Kurumba, Muduga, Irula, Kattu Naiken & locals	anti-HSV-1, anti-HSV-2 and anti-ADV-3 activities.
39.	<i>Santalum album</i>	Santalaceae	Stem	Aqueous extract	, Kattu Naiken & locals	inhibited cell proliferation, nitric oxide production and CD14 monocyte
40.	<i>Terminalia chebula</i> Retz.	Combretaceae	Fruits	Aqueous extract	Irula, Kattu Naiken & locals	increase in humoral antibody titer and delayed-type hypersensitivity
41.	<i>Sida cordifolia</i> L.	Malvaceae	Seeds	Aqueous extract	Kurumba, Irula, Kattu Naiken	reduction of T-cell precursor
42.	<i>Sesamum indicum</i> L.	Pedaliaceae	Seed	Aqueous extract	Muduga, Irula & locals	suppress cellular immunity with the domination of Th2 responses

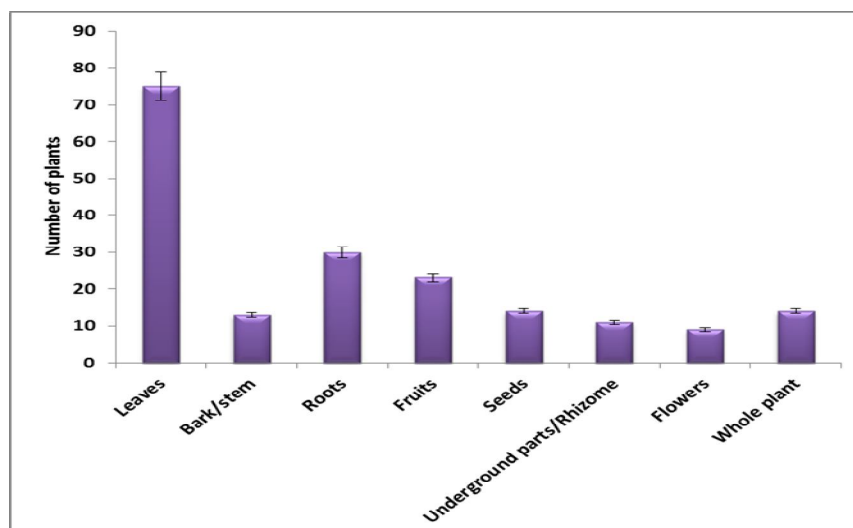


Figure 1. The various plant parts used by the practicing people

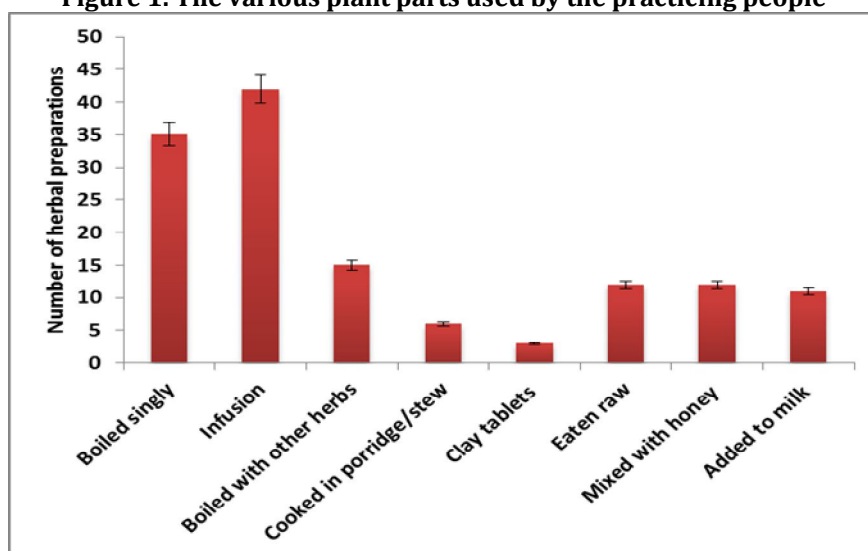


Figure 2. The preparation of herbal medicines by the practicing people

CONCLUSION

In the present ethno-botanical survey revealed the relationship of humans with the nature in terms of medicinal plants especially for their health care. Tribals and native people in this region use these traditionally available plants for health and believe that these are easily available, less expensive and have no side effects. The present situation of ethnic knowledge regarding to immune boosting plants is gradually disappearing from the country side due to deforestation, tourism impact on natural vegetation of these region, population growth and heavily construction and also due to global warming. Scientific policies have to be implemented to conserve the local wild plants. Farmers and local communities should be addressed in the cultivation of herbals at least on their barren land. During the present survey of plant species related with the medicinal value provides comprehensive information of the immune alleviation properties of the species. Based on the data it can be ascertained that the Silent valley outer skirts area has high potential of herbal species. Therefore there is an urgent need to educate and bring awareness in the local communities, through workshops and training programs about the need of medicinal plants and their conservation.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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