



## Documentation of medicinal plants used by the local people for the prevention of COVID-19 in Tiruvannamalai District, Tamil Nadu, South India

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### Abstract

During the COVID-19 pandemic, there is an upsurge on the use of medicinal plants for prevention. Various herbal products, traditional medicines, food supplements and yoga practices have been recommended to improve the immunity of the people. This work focuses on documentation of medicinal plants used by the local people for the prevention of COVID-19 in Tiruvannamalai district, Tamil Nadu, India. The medicinal plants used by the village people for the prevention of COVID 19 were documented between December 2020 and February 2021. The informants were recruited by interviewing the elderly people in a village and they were recruited regardless of age, gender, education or residence. In this study, the medicinal uses of 29 species belonging to 21 families were documented from the village people of Tiruvannamalai district. Important medicinal plants which have been used extensively by the people in the study area are: *Allium sativum*, *Andrographis paniculata*, *Curcuma longa*, *Glycyrrhiza glabra*, *Ocimum tenuiflorum* and *Zingiber officinale*. The scientific knowledge on these species was discussed in detail. This study stressed the need of efforts to conserve the biodiversity as well as traditional knowledge for the betterment of humanity.

**Keywords:** SARS-Co-V2, siddha system of medicine, Tamil Nadu, India

### Introduction

As on March, 2021, COVID-19 affected 124 million people globally; in India 11.73 million people were affected and among them 0.86 million people were from Tamil Nadu. In Tiruvannamalai district, 19,587 cases were reported with COVID-19. This pandemic has caused severe global socioeconomic disruption. The main modes of the transmission of this disease are by aerosols produced during coughing, sneezing or talking. Clinical features of COVID-19 have similarity with influenza (Ainane, 2020) [2]. The clinical spectrum of COVID-19 ranges from mild upper respiratory tract illness to severe acute respiratory distress, multiple organ failure and death (Zhou *et al.*, 2020) [43]. Generally, the patients experience fatigue, headache, diarrhea, and lymphopenia. Aged population with cardiometabolic diseases has increased risk of infection with COVID-19.

Biodiversity offers huge benefits to mankind like food, shelter, medicine, etc., and also has aesthetic, cultural and recreational values. Plants have been in human use since time immemorial for the management of various diseases. Herbs have been used by all cultures throughout history; In India, the history of medicinal plants usage is about 4000 years old. Still about 80% of the people in the developing countries depend on medicinal plants for their primary health care (Ghosh, 2003) [19]. In less developed countries, the percentage of population depending on traditional medicine goes higher (Farnsworth *et al.*, 1985) [16]. This knowledge has been deteriorating rapidly with the destruction of tropical forests since about 90% of medicinal plants are collected from the wild (Balick, 1996; Ved *et al.*, 2005; McNeely *et al.*, 2001) [9, 41, 30]. India has rich biodiversity and one among the twelve major diversity

centers; however the growing demand created a high pressure on the existing resources. Several workers were reported the utility of plants for the treatment of various diseases by the different tribal and rural communities inhabiting in various regions of Tamil Nadu (Shanmugam *et al.*, 2011; Nandagopalan *et al.*, 2011; Maruthupandian and Mohan, 2010; Ayyanar *et al.*, 2008, 2010; Shanmugam *et al.*, 2009; Arunachalam *et al.*, 2009) [37, 32, 29, 8, 38, 6].

During the COVID-19 pandemic, there is an upsurge on the use of medicinal plants for prevention. Research is going on to discover effective therapeutic modalities; the people in countries like India and China tend to consume traditional remedies for the prevention of COVID-19. This positivity has led to explore traditional remedies which can be consumed along with conventional treatment (Lim *et al.*, 2021) [28]. Various herbal products, traditional medicines, food supplements and yoga practices have been recommended to improve the immunity of the people. Various traditional medicines like *Ayush Kwath*, *AYUSH-64*, *Triyaq-e-Araba*, *Kabasura Kudineer*, *Nilavembu Kudineer*, etc. have been recommended by the Government for prevention of the spread of COVID-19 among containment zones and frontline workers (Ahmad *et al.*, 2021) [1]. Besides these formulations, many formulations are being consumed by the public for the prevention of COVID-19. This work focuses on documentation of medicinal plants used by the local people for the prevention of COVID-19 in Tiruvannamalai district, Tamil Nadu, India.

### Methodology

#### Study Area

The study area is located in North Tamil Nadu between 12°00' to 12°52' N latitude and 78°39' to 79°45' E longitude (Fig. 1). This district has 6190 km<sup>2</sup>, divided into 12 blocks

and has a mixture of rural and urban populations. According to 2011 census, nearly 80% of the population lives in rural area. Literacy rate of this district was 83.11 (male) and 65.32% (female), which is little lower than that of the state.

Agriculture is the major source of revenue in rural parts; this district has 417 health sub-centers, 114 primary health centers, 20 hospitals and one Government medical college for providing medical service.

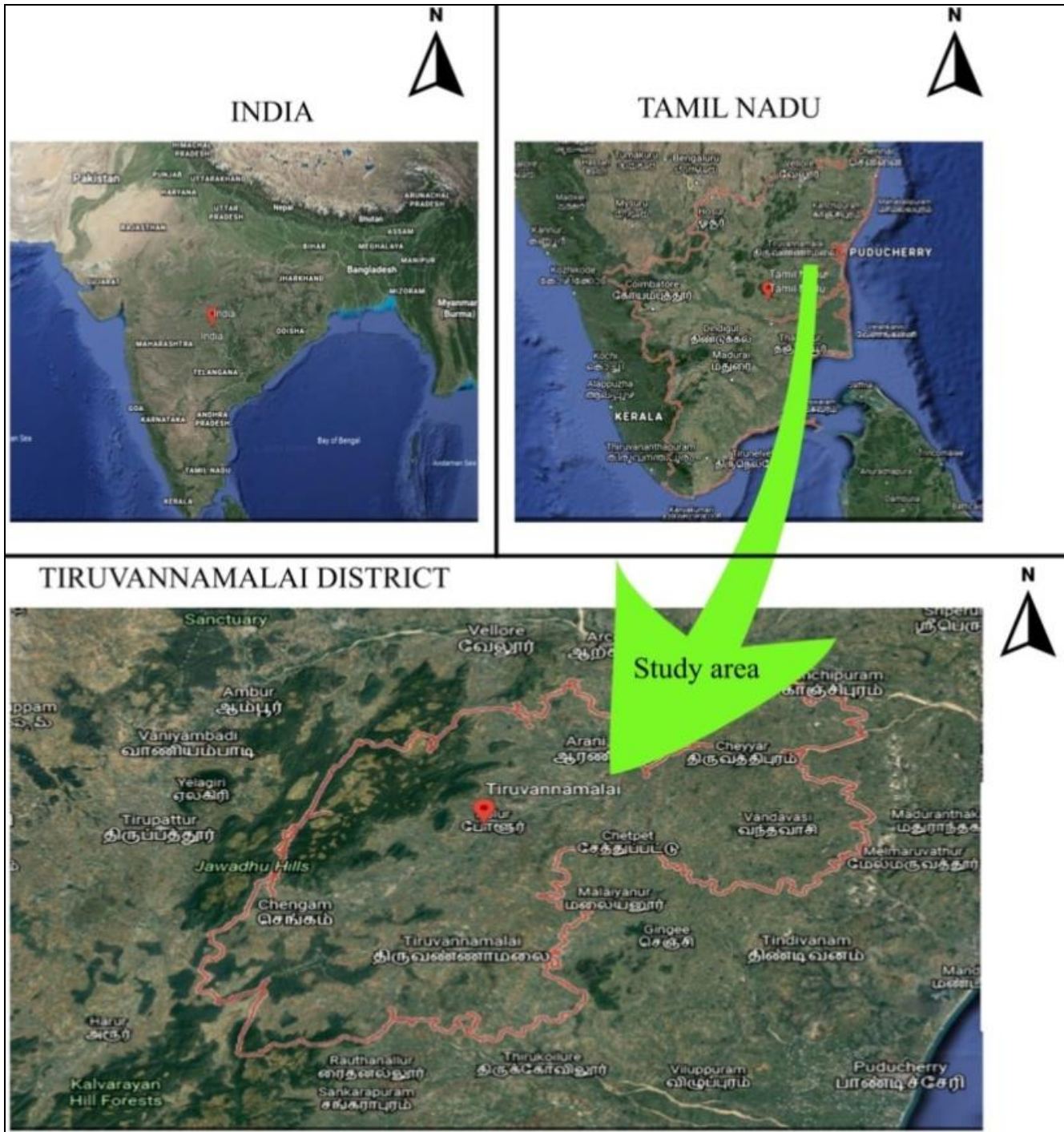


Fig 1: Map showing the location of the study area, Tiruvannamalai district in Tamil Nadu, India

**Interviews**

The medicinal plants used by the village people for the prevention of COVID 19 were documented between December 2020 and February 2021. The informants were recruited by interviewing the elderly people in a village and they were recruited regardless of age, gender, education or residence. The purpose of the study was explained to the informants and prior informant consent was obtained. Then formal interviews were conducted regarding their experience with COVID-19 (Fig. 2). The plants used by the

informants to prepare the drugs, parts used, mode of preparation, dose and duration were documented. The informants were taken to the field for plant collection; they were requested to show the plants and representative samples were collected.

The binomial names for the species were fixed using local floras (Gamble, 1997; Nair and Henry, 1983; Hery *et al.*, 1989; Hery *et al.*, 1987) [18, 31, 22, 23] and the valid correct names were confirmed with a website (<http://www.theplantlist.org>).



Distribution of *Kabasura kudineer* for the prevention of COVID-19 among public



*Acalypha indica* L.



*Evolvulus alsinoides* (L.) L.



*Alpinia speciosa* Schum.



*Ocimum tenuiflorum* L.



*Piper betle* L.



**Fig 2:** Traditional medicines used for the prevention of COVID-19

### Results and Discussion

Indian system of traditional medicine is one of the oldest systems of traditional medicine and has an important role in catering global healthcare needs. Besides documented formulations of codified traditional systems of medicine, many undocumented formulations are being used by the traditional healers. They are often unnoticed and their translational potential are often underestimated (Yuan *et al.*, 2016) [42]. The principles, diagnosis and treatment strategies of these systems may be ambiguous to the conventional medicinal systems, but they might have potential clues for the discovery of novel leads with desired pharmacological effect (Parasuraman *et al.*, 2016) [34]. The use many of the plant derived drugs match with its traditional usage (Fabricant and Farnsworth, 2001) [15]; and the safety of these compounds are remarkably higher than that of first-to-human chemicals. The efficacies of many conventional antivirals are unsatisfactory (Sumithira *et al.*, 2012) [39] and non-specific to the viruses (Jiang *et al.*, 2015) [25]. In such scenario, medicinal plants with number of related phytochemicals offer better production and a unique platform for the discovery of novel scaffolds (Akram *et al.*, 2018) [3].

In this study, the medicinal uses of 29 species belonging to 21 families were documented from the village people of Tiruvannamalai district. Their botanical name, family, vernacular name, parts used and their mode of usage are given in Table 1. Acanthaceae was represented with highest number of species, followed by the other families. The villagers used diverse parts of the medicinal plants to prevent them from COVID-19. It includes leaf, roots, bark, seed, fruit, flower, stem, etc. Leaves were highly used by the informants followed by the roots and other parts. Important medicinal plants which have been used extensively by the people in the study area are: *Allium sativum*, *Andrographis paniculata*, *Curcuma longa*, *Glycyrrhiza glabra*, *Ocimum tenuiflorum* and *Zingiber officinale*.

Spices are one of the most important medicinal as well as food components; with a wide array of its active ingredients like allicin, curcumin, gingerol, piperine, etc. they provide many health benefits. They also have antioxidant potential through various mechanisms and they were known to

activate Nuclear Factor (erythroid-derived 2)-Like 2 (Nrf2) protein and Transient Receptor Potential (TRP) pathway (Bousquet *et al.*, 2020) [10]. Upregulation of Nrf2 inhibited nuclear factor-kappa b (NF- $\kappa$ B) pathway and the production of proinflammatory cytokines like IL-6, IL-8, and TNF- $\alpha$  which causes the inflammation in the lungs during COVID-19 (Bousquet *et al.*, 2021) [11]. Similarly, activation of TRP ameliorate several symptoms of COVID-19, like cough, nasal obstruction, pain, vomiting, diarrhea, and loss of smell and taste (Talavera *et al.*, 2020) [40].

*Allium sativum* (garlic) is an important spice over the globe and used as a medicine in different cultures. Treatment with garlic significantly reduced *Dermatophagoides pteronyssinus* (Der p)-induced asthma and it downregulated various proinflammatory cytokines in experimental mice. In *D. pteronyssinus* elicited A<sub>549</sub> cells, the treatment with garlic extract significantly inhibited the inflammation through suppression of IL-6/PI3K/Akt/NF- $\kappa$ B pathway (Hsieh *et al.*, 2019) [24]. Diallyl disulfide, the active constituent of garlic inhibited inflammation through P/neurokinin 1 receptor (SP/NK1R) signaling as well as the NF- $\kappa$ B pathway (Kumar and Tamizhselvi, 2020) [26]. S-allyl-L-cysteine, another active ingredient of garlic was show to reduce inflammation in bleomycin-induced pulmonary fibrosis by down regulating TNF- $\alpha$ , iNOS, IL-6, and IL-12p35 (Nie *et al.*, 2019) [33].

*Curcuma longa* (turmeric) belongs to Zingiberaceae family and is an important Indian traditional medicine. Various pharmacological properties like antiviral, anti-inflammatory, antiarthritic, anticancer properties of curcumin was reported in the literature and it has been known as the 'Golden nutraceutical' (Kunnumakkara *et al.*, 2017) [27]. In influenza virus A (IAV) infection, the treatment with curcumin relieved pneumonia by ameliorating cytokine storm. The treatment with curcumin was shown to inhibit the elevation of various proinflammatory cytokines like IL-6, MCP-1 and TNF- $\alpha$  (Han *et al.*, 2018) [20]. In a rat model of pulmonary inflammation, the treatment with curcumin significantly lowered the inflammation through inhibiting cox-2/PGE2/IL-8 pathway (Dong *et al.*, 2015) [12]. *Zingiber officinale* (Ginger) is also belongs to the family Zingiberaceae; various pharmacological properties like

antitumor, antiinflammatory, antioxidant, etc., were reported for ginger (Haniadka *et al.*, 2013) [21]. The anti-inflammatory effect of 6-shogaol was reported in 7, 12-dimethylbenz[ $\alpha$ ]anthracene induced mice model (Annamalai and Suresh, 2018) [5].

*Ocimum tenuiflorum* (Sacred basil) is one of the most sacred and medicinal plants of India; it belongs to the family Lamiaceae. Its antimicrobial, antioxidant, gastroprotective effects were reported in the literature (Eftekhari *et al.*, 2019a) [13]. Its extract was shown to lower airway inflammation; the treatment also improved the immunity of the ovalbumin-sensitized rats. The treatment with *O. tenuiflorum* significantly decreased various inflammatory markers like IL-4, IgE and Phospholipase A2 (PLA2) in the bronchoalveolar lavage fluid (Eftekhari *et al.*, 2019b) [14]. *Andrographis paniculata* belongs to the family Acanthaceae

and its beneficial effect on the treatment of liver diseases, fever, common cold, chicken pox, malaria, inflammation were reported in the literature. *In silico* predictions indicated that the active ingredients of *Andrographis paniculata* like andrographolide and dihydroxy dimethoxy flavone, significantly bound in the active site of SARS CoV-2 main protease with least binding energy (Rajagopal *et al.*, 2020) [36]. In a clinical study, the treatment with *Glycyrrhiza glabra* to 36 patients presenting chronic asthma improved the parameters of pulmonary function; this effect is comparable with that of prednisolone (Al-Jawad *et al.*, 2012) [4]. The ethanol extract of *Glycyrrhiza glabra* significantly lowered the in mast cells degranulation like prednisolone (Patel *et al.*, 2017) [35]; similarly the antiviral effect of *Glycyrrhiza glabra* was also reported in the literature (Fiore *et al.*, 2008) [17].

**Table 1:** Medicinal plants used by the village people for the prevention of COVID-19

S.No	Name & Family	Common name	Parts used	Mode of preparation	Dose & Duration	Symptoms treated
1.	<i>Acacia pennata</i> (L.) Willd. Fabaceae	<i>Kāṭṭu cikai</i>	Stem	The juice of the stems are given with honey	5 - 10 mL., once in the morning for three days	Bronchitis
2.	<i>Acalypha indica</i> L. Euphorbiaceae	<i>Kuppaimēṅi</i>	Leaves	The leaves are crushed, heated and fomented on the chest	Once a day, when needed	Bronchitis
3.	<i>Allium sativum</i> L. Alliaceae	<i>Pūṅṭu</i>	Bulbs	Crushed garlic cloves are boiled in milk and consumed	50-75 mL., twice a day	Cough
4.	<i>Andrographis paniculata</i> (Burm.f.) Wall. ex Ness Acanthaceae	<i>Nilavēmpu</i>	Aerial parts	The aerial parts are made into decoction with turmeric, pepper and ginger.	50 mL., twice a day for week	Fever
5.	<i>Andrographis paniculata</i> (Burm.f.) Wall. ex Ness Acanthaceae	<i>Nilavēmpu</i>	Aerial parts	The aerial parts are powdered with <i>Vetiveria zizanioides</i> Nash., <i>Plectranthus vettiveroides</i> (Jacob) Singh & Sharma, <i>Santalum album</i> L., <i>Trichosanthes cucumerina</i> L., <i>Cyperus rotundus</i> L., <i>Zingiber officinale</i> Roscoe, <i>Piper nigrum</i> L. and <i>Mollugo nudicaulis</i> Lam.	2-5 g., powder is made into decoction and consumed twice a day	Fever
6.	<i>Azadirachta indica</i> A.Juss Meliceae	<i>Vēmpu</i>	Bark, Leaves	Barks are chopped and made as decoction. The infusion of the leaves with turmeric is sprayed for sanitizing the places	30 mL., Twice a day for three days	Fever
7.	<i>Calotropis gigantea</i> R.Br. Apocynaceae	<i>Arukku</i>	Flowers	The flowers are crushed well with clove and pepper; this mixture is sun dried and mixed with equal amount of sugar	500 mg., twice a day for three days	Wheezing
8.	<i>Cinnamomum camphora</i> (L.) J.Presl Lauraceae	<i>Karpūram</i>	Camphor	Camphor is mixed with equal amounts of borneol and menthol. This oil is applied externally on the chest	As and when required	Bronchitis
9.	<i>Cinnamomum zeylanicum</i> Blume Lauraceae	<i>Ilavangappattai</i>	Barks	Crushed barks are made into decoction and consumed with honey	25-30 mL., twice a day	Cough
10.	<i>Curcuma longa</i> L. Zingiberaceae	<i>Mañcaḷ</i>	Rhizomes	Turmeric powder is boiled in milk with pepper and consumed	50-75 mL., once a day for three days	Cough, immune enhancer
11.	<i>Cyperus rotundus</i> L. Cyperaceae	<i>Kōraikkilāṅku</i>	Rhizomes	The rhizomes are powdered and consumed with honey	0.5-1 g., Twice a day for five days	Bronchitis, Immune boosting
12.	<i>Eclipta prostrata</i> (L.) L. Asteraceae	<i>Karicalāṅkaṅṅi</i>	Leaves	The leaf juice is mixed with sesame oil; boiled under small flame and filtered	5-10 mL., twice a day with milk	Bronchitis
13.	<i>Evolvulus alsinoides</i> (L.) L. Convolvulaceae	<i>Viṣṇukiranti</i>	Whole plants	The plants are made into decoction and consumed	30-50 mL., Twice a day, for 5 days	Fever
14.	<i>Glycyrrhiza glabra</i> L. Fabaceae	<i>Atimaturam</i>	Roots	The roots are powdered with <i>Piper cubeba</i> and consumed	1-2 g., with milk, twice a day	Cough
15.	<i>Justicia adhatoda</i> L. Acanthaceae	<i>Āṭātōṭai</i>	Leaves	The leaves are made into decoction with <i>Alpinia speciosa</i> Schum., <i>Glycyrrhiza glabra</i> L., pepper and turmeric and consumed	30-50 mL., Twice a day for three days	Bronchitis
16.	<i>Mukia maderaspatana</i> (L.) M. Roem. Cucurbitaceae	<i>Mucukucukkai</i>	Leaves	The leaves are made as soup with garlic cloves, pepper and salt and consumed	50 mL., once a day, thrice a week	Bronchitis, Cough
17.	<i>Nigella sativa</i> L. Ranunculaceae	<i>Karuñcīrakam</i>	Seeds	The seeds are eaten raw	2-3 g., once in the morning, twice a week	Immune enhancer
18.	<i>Ocimum tenuiflorum</i> L.	<i>Tuḷaci</i>	Leaves	The leaves are made into decoction with pepper	25-30 mL., twice a	Fever, Cough

	Lamiaceae			and ginger; consumed with honey	day	
19.	<i>Oldenlandia umbellata</i> L. Rubiaceae	<i>Impurāl</i>	Whole plants	The plants are crushed, boiled in milk, filtered and consumed.	20-30 mL., twice a day for a week	Bronchitis
20.	<i>Pavonia zeylanica</i> (L.) Cav. Malvaceae	<i>Cittāmuṭṭi</i>	Roots	The roots are crushed and made into decoction with ginger and consumed.	25-30 mL., twice a day for three days	Fever
21.	<i>Pimpinella anisum</i> L. Apiaceae	<i>Cōmpu</i>	Fruits	The fruits are boiled in water and the decoction is given orally	50 mL., twice a day, till cure	Wheezing
22.	<i>Pinus roxburghii</i> Sarg. Pinaceae	<i>Cīmai tēvatāru</i>	Leaves	The leaves are made as decoction ginger, pepper, long pepper, <i>Alpinia speciosa</i> Schum. and <i>Glycyrrhiza glabra</i> L. The decoction is consumed with honey	30-50 mL., Twice a day for five days	Bronchitis, Cough
23.	<i>Piper betle</i> L. Piperaceae	<i>Verrilai</i>	Leaves	The leaves are crushed with <i>V. negundo</i> leaves, garlic cloves and pepper and made into a decoction.	25-30 mL., twice a day for five days	Fever
24.	<i>Plectranthus amboinicus</i> (Lour.) Spreng. Lamiaceae	<i>Karpūravallī</i>	Leaves	The leaves are made into decoction and consumed with honey	25-30 mL., twice a day	Bronchitis, Fever
25.	<i>Solanum trilobatum</i> L. Solanaceae	<i>Tūtuvēlai</i>	Leaves	The leaves are crushed, made into soup and consumed with food	50 mL., Once a day, for three days	Bronchitis, immune booster
26.	<i>Tinospora sinensis</i> (Lour.) Merr. Menispermaceae	<i>Cīntil</i>	Stems	Matured stems with pepper are made into decoction and consumed.	30-50 mL., Twice a day for three days	Immune boosting
27.	<i>Vitex negundo</i> L. Acanthaceae	<i>Nocci</i>	Leaves	The leaves are crushed with pepper and consumed. The leaves are boiled in water and the steams are inhaled.	0.25-0.5 g., twice a day with warm water	Fever
28.	<i>Withania somnifera</i> Dunal Solanaceae	<i>Amukkarā</i>	Roots	The roots are boiled in milk, sun dried and powdered	0.5-1 g., with milk, once a day for 10 days	Immune booster
29.	<i>Zingiber officinale</i> Roscoe Zingiberaceae	<i>Cukku</i>	Dried rhizomes	The rhizomes are crushed and made as a tea with coriander seeds, pepper corns and long pepper.	25-30 mL., once a day	To strengthen immune system

## Conclusion

This study indicated that the medicinal plants are still catering the primary healthcare needs of major population and being one of the major sources for the discovery of novel drugs. The phytochemical constituents of the medicinal plants and their medicinal properties were recorded in the last few decades by a number of workers. Such studies on the survey and documentation of medicinal and aromatic plants are essential to add the armamentarium of biomedicine. This study highlighted the importance of conserving the biological diversity and associated traditional knowledge. Various conservation methods were mentioned in the past by various workers are many of them are being tried. These methods include protection of wild species *in situ*, cultivation in botanical gardens and collection of germplasm for establishment of germplasm banks, public information campaigns and others. This study stressed that further efforts to conserve the biodiversity and traditional knowledge are essential for the potential application of the biodiversity for the betterment of humanity.

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