Ethnobotanical documentation of medicinal plants used during COVID-19 by the Meitei Community in Manipur, India.

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Research

Abstract

Background: Medicinal plants played an important role during the COVID-19 by acting as an immune booster to protect our body against various ailments. The study's main objective was to document the traditional practice of medicinal plants during pandemic from the indigenous Meitei people of Manipur, India.

Methods: Information was collected as online questionnaire survey through "KoBotoolbox" software in 2 district of Manipur, populated by the Meitei community. We evaluate the indices such as UV, ICF and FL from the obtained data. The therapeutic activities of reported plants also retrieved from various databases as a secondary data.

Results: The findings showed a total of 40 plants belonging to 24 families having therapeutic importance against 10 different ailments. Zingiberaceae family was most dominated (6 sp.) followed by Lamiaceae (4 sp.) while leaves (60%) part were frequently used as fresh (65%). An oral route of administration (82.5%) was popularly used methods for consumption. *Zingiber officinale* scored favourable UV of 0.23 with the highest ICF value (0.85) was recorded for the treatment of fever and physical pain. The Fidelity Level ranges from 10 – 100%, *Centella asiatica* was the only species with 100% of FL report for curing of headache.

Conclusions: The present report is the first ethnomedicinal studies during COVID-19 from Manipur. The evaluation of data by different quantitative indices was useful to identify the valuable plants so that further research can be conducted to find out their phytochemistry and pharmacological activities. It may also help local plants and their traditional practices for conservation.

Keywords: COVID-19, India, Medicinal plants, Meitei people, Traditional practice

Background

COVID-19 is an infectious disease caused by a novel coronavirus which becomes pandemic, rapidly spreading all over the world infecting more than 242 million leading to 4.93 million deaths (WHO). Coronavirus belongs to a large family of *Corona viridae* in the order Nido virales, with four genera (Schwartz & Graham 2020). The name SARS-CoV-2 was given by The International Committee on Taxonomy of Viruses as its symptoms range from mild illness to severe acute respiratory syndrome (Pal *et al.* 2020). Coronaviruses possessed single positive-stranded RNA having the largest genome among all RNA viruses. The genome is packed through the nucleocapsid protein (N) inside a helical capsid varying from 26.2 to 31.7 kb in size and further enclosed by an envelope (McBride *et al.* 2014).

Scientists were in race to develop prophylactic therapy and vaccine from the emergence of Covid-19 in Wuhan, China in late December 2019 (Sharma *et al.* 2020). Since the 2nd wave of COVID-19 arrival, most of the developing countries such as Russia start producing vaccine to control this dreadful disease (Koirala *et al.* 2020). Unfortunately, at the time of experimentation, no therapeutic agents had been developed, although some vaccines were undergoing Phase III clinical trials. Since COVID-19 was spreading across the community and there were no approved drugs/vaccines to control the spread of coronavirus, we need to consider an alternative treatment based on natural herbal products to prevent SARS-CoV-2 infection (Aanouz *et al.* 2021). The secondary metabolites of some plants have also been reported to show antioxidant, antimicrobial, anti-inflammatory as well as antiviral activity and have been utilized for treating and preventing various illnesses and disorders including viral infections (Khan *et al.* 2020).

According to World Health Organization (WHO), there have been around 21,000 plants acknowledged worldwide for having therapeutic property, among which, 2500 varieties are available in India and around 150 species are already utilized commercially (Alagu *et al.* 2021). The Indian traditional systems of medicines like Ayurveda have mentioned numerous plants that contain certain chemical compounds that are applicable for the formulation of drugs (Gangal *et al.* 2021). According to Ayurveda, some medicinal plants such as *Phyllanthus emblica*, *Citrus lemon*, *Zingiber officinale, Curcuma longa, Azadirachta indica, Allium cepa, Tinospora cordifolia, Withania somnifera and Ocimum tenuiflorum* are a good source to strengthen immunity to confront this deadly virus (Chakraborty *et al.* 2020). Several researchers also reported many medicinal plants for exhibiting antiviral activity such as *Geranium sanguineum* for influenza virus, *Polygonum cuspidatum* for hepatitis B virus, *Guazuma ulmifolia, Pterocaulon sphacelatum*, and *Dianella longifoliais* for polio virus, *Rosa nutkana* and *Amelanchier alnifolia* for coronavirus, *Azadirachta indica* for dengue virus type II, smallpox, chickenpox and herpes viruses (Jassim & Naji 2003; Mukhtar *et al.* 2008).

Moreover, the consumption of herbal medicinal plants all over the world is increasing due to its scientifically proven to be effective and there is no adverse effect reported, whilst the chemical drugs are not safe for long term use due to their side effects (Kumar *et al.* 2012). Therefore, the use of natural products as an alternative therapy draws more attention (Mohammadi & Shaghaghi 2020). The herbal products contain active compounds that showed promising results in inhibition of the activity of pathogens. Such compounds like quercetin, asiatic acid, ascorbic acid, apigenin, catechin, curcumin, gingerol, brazilin, hesperidin, luteolin, myricetin, naringenin act as antioxidant that boost the immune system (Laksmiani *et al.* 2020).

During this pandemic, the options for common people were to protect themselves from this dreadful disease. Considering the health benefit of the medicinal plants, consuming plant-based nutrients such as vitamin A, B-complex, C, D, E and minerals like iron, calcium and zinc, etc. that are essential for the body to boost immunity are the priority and then being physically and mentally active may also help (Khabour & Hassanein 2021). On the other hand, the broad spectrum of mild to severe symptoms depending on the immunity of the infected person, therefore, to eliminate the virus and to interrupt the progression of reaching severe stages, specific acquired immune response is required (Shi *et al.* 2020).

Since the whole nation is under lockdown due to this pandemic and most of the hospitals and health care professions were busy dealing with the SARS-CoV-2 positive patients, and thus, the common population was looking for home remedies from their surrounding i.e., medicinal plants as the main sources. Henceforth, the aim of the present study was to document ethnomedicinal plants used by the Meitei communities during COVID-19 pandemic to prevent from different diseases.

Materials and Methods

Study area

Manipur state is located in the North Eastern Region (NER) of India, which is in the biodiversity hotspot of Indo-Burma region. Manipur is also called as the “land of jewel” for its unique geographical landscape with the valley region which is the major plain area of the state (10%) surrounded by the hills (90%) (Devi *et al.* 2020). There are 16 district of Manipur, and the present

survey is conducted in 2 districts namely Imphal east and Imphal west situated in the valley region, where the major indigenous community known as 'Meitei' resides (Panmei *et al.* 2019). Manipur is rich in diverse ethnic tribes with traditional knowledge of medicinal plant formulations. Similarly, Meitei communities also have strong herbal traditional methods prepared by the traditional healers called as "Meitei Maibas" since time immemorial (Khumbongmayum *et al.* 2005; Panmei *et al.* 2019). Moreover, many scholars had documented numerous medicinal plants commonly used for the treatment of various ailments in Manipur (Rajkumari *et al.* 2013; Devi *et al.* 2016) (Fig. 1).

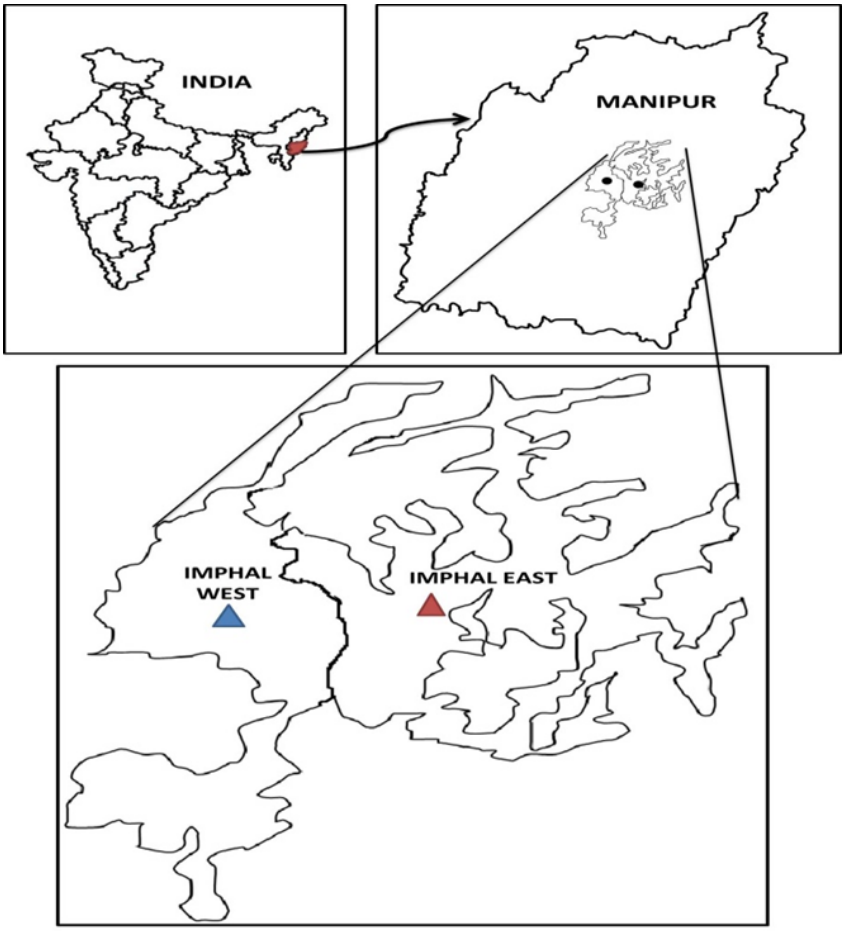

Figure 1. Maps of Imphal East and Imphal West of Manipur, India, showing the study area

Questionnaire and survey

The questionnaires were prepared based on the utilization and the importance of ethno medicinal plants to boost the immune system and to protect from various ailments during critical pandemic periods of COVID-19. The questionnaire included the socio-economic status of the informants and the important role made by the medicinal plants used for the well-being of human health during this critical situation of time. The survey was carried out to collect the data through online system in the month of June-September 2020 using the software called "KoBotoolbox" sharing the link through social media devices, since it was not possible to conduct the field-based survey due to the complete lockdown in India. The present study was conducted in the urban areas where hospital and medical facilities were adequate with population of formal education comparatively with the remote village areas to find out the importance of traditional medicinal plants being considered by the population of city areas.

The questions were mainly focused on the traditionally used of medicinal plants for treatment of various ailments and for the benefits of human health during the critical stage of pandemic period. In this survey, the name of the plants with the local name and its parts used, formulation, routes of administration, treatment of particular disease and collection of the plants data were recorded with full details (Ong *et al.* 2018). Other information such as how frequently the plants were used for medicinal purposes, from where they procured the knowledge about medicinal plants, whether the plants gave active therapeutic activity or any kind of adverse effect on body (Hu *et al.* 2020). The collected data was analysing by use of quantitative indices such as Use value (UV), Informant Consensus Factor (ICF) and Fidelity Level (FL). Furthermore; the

information of other therapeutic activities of reported plants were also retrieved from various databases as a review of literature (Asadi-Samani *et al.* 2017).

Use Value (UV)

The use value (UV) validates the significance of each plant known locally in that particular region (Gazzaneo *et al.* 2005; Mükemre *et al.* 2005). The UV was calculated using the formula;

$$UV = \sum \frac{\mathrm{Ui}}{n}$$

Where, U_i is the total number of particular plant species used by every informant and n is the number of informants.

Informant Consensus Factor (ICF)

ICF also known as Factor informant consensus (Fic) was used to find the consistency information about the plants species. The method was employed to determine the agreement of the informant's knowledge on each category of ailments in the region (Heinrich *et al.* 1998; Ayyanar & Ignacimuthu 2011). The ICF values were determined using the formula;

$$\mathrm{ICF} = \frac{Nur - Nut}{Nur - 1}$$

Where, N_{ur} denotes the number of reports used for a particular disease and N_{ut} denotes the number of plant species used by all the informants.

Fidelity Level (FL)

To evaluate the plant species used commonly for the treatment of specific disease by the informants of the region, we calculate the fidelity level by using the formula (Friedman *et al.* 1986; Rajakumar & Shivanna 2009).

$$\mathrm{FL} = \frac{Np}{N} \times 100$$

Where, N_p indicates the number of informants who used a plant for the treatment of specific ailment and N is the total number of informants who used medicinal plants for the treatments.

Results

Socioeconomic and demographic characteristics

The present investigation was carried out to find out the usefulness of the ethnomedicinal plants to keep human immune system protect from the contagious disease and treat various ailments during these deadly pandemic periods of COVID-19. A total of 100 respondents (male 47 and female 53) were provided the full clear details of survey conducted in our present study. The results revealed that people with formal education were more aware of the importance of medicinal plants and maximum of the respondents were claimed themselves as the indigenous common people of Meitei communities. The data also showed that the families with low income are more preferable to utilize the natural plant sources as medicine which was obtained from their kitchen garden and local market with low budget. There is also a report that the informants are mainly depends on medicinal plants for the maintenance of health in the form of raw which is a traditional knowledge taught by the elders of family members with less side effects. The socioeconomic and demographic results were mentioned in Table 1.

Table 1. Socioeconomic and demographic characteristics of respondents.

Indicator	Characteristics	Percentage
Gender	Male	47
	Female	53
Marital status	Single	73
	Married	27
Educational Qualification	University	73
	School	21
	Illiterate	6
Family Income	5-25K	41
	25-50K	31
	50-1L	19
	1L and above	9
Classified of the Informants	Indigenous common people	86

	Traditional healers	14
Source of medicinal plants?	Kitchen garden	46
	Local Market	23
	Forest	15
	Other	6
Expenditure on medicinal plants and herbal products?	Less than 100	43
	100-500	13
	500-1000	4
	1000 above	1
Preferable mode of Consumptions?	Raw	45
	Commercialized	17
	formulated by healers	9
Adverse effect reports?	Yes	8
	No	92
Purpose of using medicinal plants?	Maintenance of health	50
	Alternative of allopathic drugs	14
	Treat a chronic disease	14
	Cosmetic purpose	4
	Spiritual reason	3
Source of knowledge about medicinal plants and their uses Family?	Family member	50
	Traditional healer	16
	Electronic media	14
	Print media	20

Taxonomical reports

A total number of 40 medicinal plants belonging to 24 families were tabulated with scientific names, families, english names, local name, treatments of the ailments, Part used, Formulations, routes of administrations and their used values in table 2. The reported plant species were commonly planted and abundantly available in Imphal East and West district of Manipur. With report of 6 species family Zingiberaceae was the dominated over Lamiaceae (4 sp.) Rutaceae, Acanthaceae and Myrtaceae (3 sp.). Whereas Asteraceae and Apiaceae with 2 species followed by rest of the families having one species each shown in fig. 2.The reported plants and their scientific names were checked on www.theplantlist.org websites.

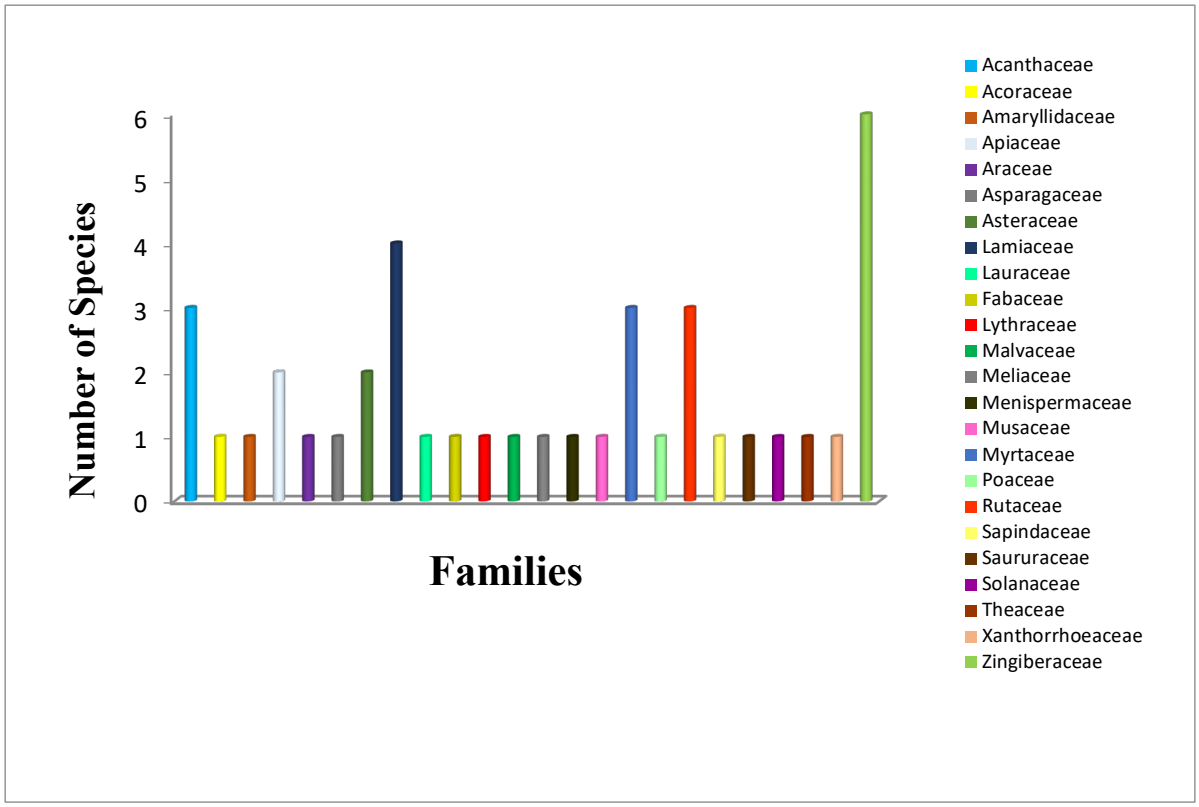

Figure 2. Number of plant species per botanical family.

Table 2. The ethno medicinal plants utilized by the people of Meitei community during the COVID-19 pandemic.

Scientific name	Family	English Name	Local name	Treatments of Ailments	Part used	Formulation and Route of administration	UV
Acorus calamus L.	Acoraceae	Sweet flag	Ok-hidak	Sore throat and Fever	Leaves, Flowers and Rhizome	Fresh; used for steam bath	0.02
Abelmoschus esculentus (L.) Moench	Malvaceae	Lady's fingers	Belendri	Diabetes	Fruits	Fresh; orally	0.01
Aegle marmelos (L.) Corrêa	Rutaceae	Beli fruit	Harikhagok	Stomach disorder, Blood pressure	Fruits	Fresh; orally	0.01
Allium sativum L.	Amaryllidaceae	Garlic	Chanam	coughing, fever, common cold	Roots	Fresh; orally	0.02
Aloe vera (L.) Burm.f.	Xanthorrhoea ceae	Barbados aloe	Ghrita-kumar	Skin care and cough	Stem	Fresh; Topically and orally	0.02
Alpinia galangal (L.) Willd.	Zingiberaceae	Lengkuas, greater galangal, and blue ginger.	Kanghoo	skin disease and ringworm	Rhizome	Fresh; topically	0.02
Alpinia officinarum Hance	Zingiberaceae	Galangal	Puleimanbi	Stomach disorder, fever and cough	Rhizome and stem	Fresh; orally	0.01
Andrographis paniculata (Burm.f.) Nees	Acanthaceae	Creat or green chiretta	Vubati	Fever, Mouth ulcer, Contraception	Leaves	Decoction; orally	0.01
Asparagus officinalis L.	Asparagaceae	Asparagus	Nung-ga-rei	Jaundice and dysentery	Roots and young stem	Decoction; orally	0.01
Azadirachta indica A.Juss.	Meliaceae	Neem tree or Margo satree	Neem	Skin disorder, Cough and cold, Digestion	Leaves	Fresh and paste; topical and in bath	0.07
Blumea balsamifera (L.) DC.	Asteraceae	Ngai camphor and sambong	Langthrei	Reduce blood pressure	Leaves	Fresh and extract; orally	0.02
Camellia sinensis(L.) Kuntze	Theaceae	Tea plant	Green tea	Antioxidants	Leaves	Fresh and dried; orally	0.01

Centella asiatica (L.) Urb.	Apiaceae	Indian pennywort or Asiatic pennywort	Peruk	Fever, stomach aches, headaches, allergies	Leaves and stem	Fresh and paste; orally	0.05
Citrus limon (L.) Burm.	Rutaceae	Lemon	Champra	Indigestion, stomach pain, antioxidant	Fruits	Fresh; orally	0.01
Cinnamomum tamala (Buch.-Ham.) T.Nees & Eberm.	Lauraceae	Indian Bay Leaf, Indian cassia, Indian cassia bark	Tejpata	Joint pain and diarrhoea	Barks and leaves	Decoction; orally	0.01
Clerodendrum colebrookianum Walp.	Lamiaceae	East Indian glory bower	Kuthapmana	Diabetes and high blood pressure	Leaves	Decoction/ boiled; orally	0.02
Colocasia esculenta (L.) Schott	Araceae	Taro	Paan	Antidotes, dysentry	Stem and roots	Fresh juice and Dried stem; Topically	0.01
Curcuma caesia Roxb.	Zingiberaceae	Black Tumeric	Yaimu	Fever, cold and cough	Rhizome	Dried; orally	0.02
Curcuma longa L.	Zingiberaceae	Turmeric	Yaingang	Skin care, stomach disorder	Rhizome and stem	Fresh and dried; orally and topically	0.04
Cymbopogon citratus (DC.) Stapf	Poaceae	Lemon grass	Lemon grass	Hair care	leaves	Boiled; topically	0.01
Elsholtzia blanda (Benth.) Benth.	Lamiaceae	Pleasant Himalayan Mint	Lomba	Inflammation fever and skin care	Leaves and fruits	Fresh and dried; orally and topically	0.01
Eryngium foetidum L.	Apiaceae	Long Coriander, Wild coriander,	awaphadigom	high blood pressure and stomach disorder	Leaves and roots	Decoction, fresh and paste; orally	0.02
Eucalyptus globulus Labill.	Myrtaceae	Southern blue gum	Nashik	Hair care	Leaves	Boiled; Topically	0.01
Gynura cusimbua (D.Don)S.Moore	Asteraceae	Hill Gynura	Tera-paibi	Stomach disorder	Leaves	Decoction; orally	0.01
Hedychium	Zingiberaceae	Butterfly	Takhellei-	Cough, fever	Rhizome and leaves	Boiled and paste; orally	0.01

coronarium J. Koenig		Ginger Lily,White Ginger Lily, Garland Flower	angouba	and tonic			
Houttuynia cordata Thunb.	Saururaceae	Chameleon Plant, lizard tail, heartleaf, fishwort	Toningkhok	Dysentery, stomach disorder	Leaves and Rhizome	Fresh; orally	0.01
Phlogacanthus jenkinsii C.B.Clarke	Acanthaceae	Malabar nut	Nongmangkha - Ashinba	Jaundice, cough and fever	Leaves	Decoction/Boiled; orally	0.01
Mentha spicata L.	Lamiaceae	Mint	Nungsihidak	Gastric and mouth ulcers, sinus, digestion	Leaves	Fresh and paste; orally	0.05
Mimosa pudica L.	Fabaceae	Touch-me-not	Kangphal- ikaithabi	Piles, Urinary tract infection, Allergic and jaundice	Leaves and roots	Decoction/ boiled, orally	0.01
Musa paradisiaca L.	Musaceae	Edible banana	Laphu	good blood purifier	Stem and roots	Fresh and paste; orally	0.01
Ocimum tenuiflorum L.	Lamiaceae	Holy basil/ Sacred basil.	Tulsi	Sore throat, fever, Pain and mouth freshening	Leaves	Fresh; orally	0.15
Phlogacanthus thyrsiformis (Roxb. ex Hardw.) Mabb.	Acanthaceae	---	Nongmangkha	Cough and Cold, Chest Congestion and low fever	Leaves and stem	Fresh and decoction; orally and steam bath	0.16
*Psidium guajava*L.	Myrtaceae	Guava	Pungtonmana	Diarrhoea and dysentry	Leaves and stem	Fresh; orally	0.02
*Punica granatum*L.	Lythraceae	pomegranate	Kamphoimana	Diarrhoea and dysentry	Leaves	Fresh and decoction; orally	0.01
*Sapindus trifoliatus*L.	Sapindaceae	Soapnut tree	Kekru	Fever, cold and cough	Roots	Dried; orally	0.01
Solanum virginianum	Solanaceae	Yellow berried	Leipungkhang	Fever and Ulcer	Fruits	Paste with Honey; orally	0.06

L.		nightshade					
Syzygium aromaticum(L.) Merr.&L.M.Perry	Myrtaceae	Clove	Long pan	Tooth ache	Flowers	Dried; topically	0.01
Tinospora cordifolia (Willd.) Miers	Menispermaceae	Giloy	Ningthou Khongli	Immune booster, purify blood,detoxify free radicals and also combat liver diseases	Stem and leaves	Fresh and dried; orally	0.03
*Zanthoxylum armatum*DC.	Rutaceae	Winged prickly ash	Mukthrubi	indigestion, cough and bronchitis	Leaves and seeds	Fresh; orally	0.01
Zingiberofficinale Roscoe	Zingiberaceae	Ginger	Sing	Sore throat, cold and cough and Fever	Rhizome	Fresh; orally	0.23

Uses of parts, Mode of formulation and administration

The most commonly used parts by the local people for the treatments were dominated by the leaves (60%) followed by the stem (25%), Rhizomes (20%), roots (17.5%), Fruits (12.5%) and lowest used parts were flowers only (5%). Further, the formulation made by the traditional people to consume was in the form of either raw or fresh (65%), decoction/boiled (30%), dried form (20%) and in the paste form (17.5%). Lastly, the routes of administration were commonly taken orally (82.5%) followed by topically in the skin (22.5%) and steam bath (7.5%) respectively, as shown in the table 2. and in figure. 3 & 4.

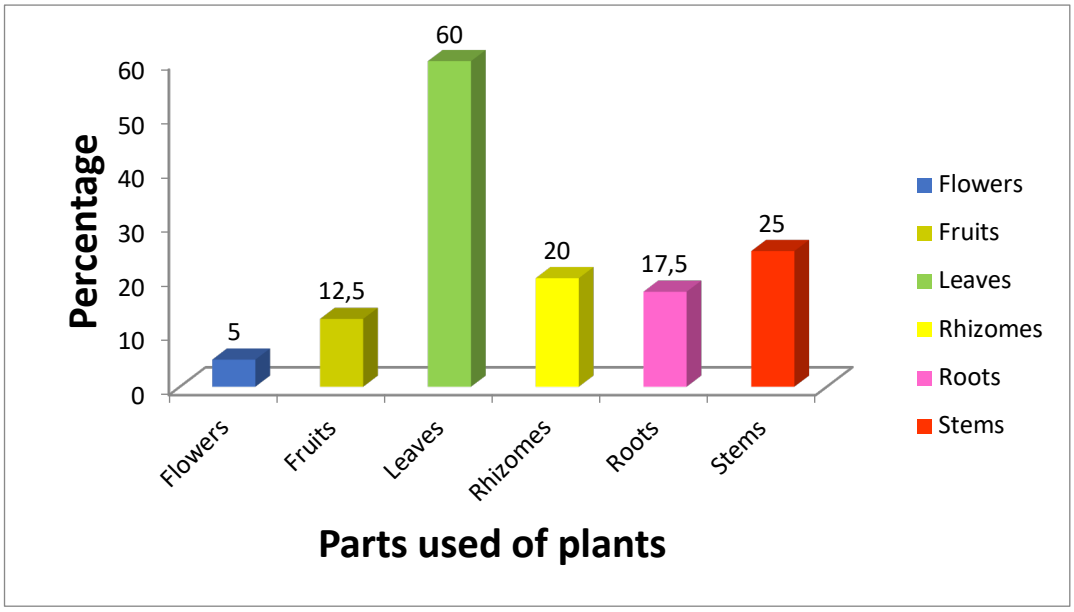

Figure 3. Used frequency of the different parts of plants.

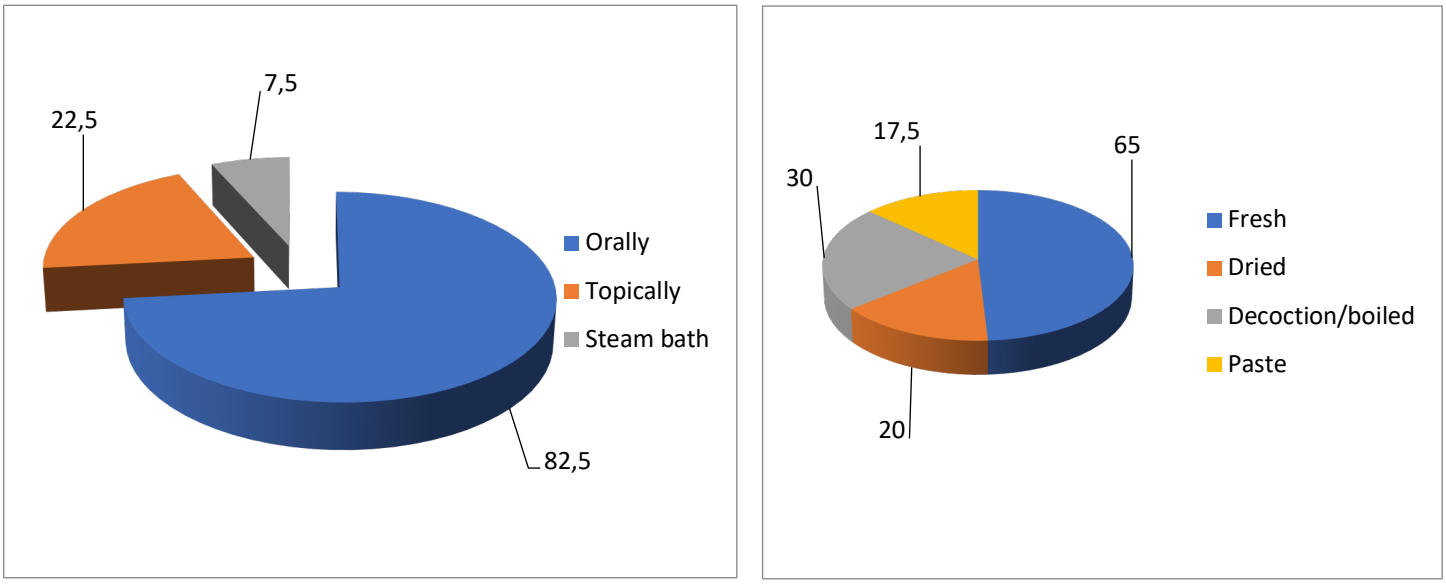

Figure 4. Frequency of routes of administration and the dosage form of preparation.

Data analysis

Use Value (UV)

Use Value (UV) which specifies the plant species with the most cited by the peoples. *Zingiber officinale* was the most favorable use value of 0.23 followed by *Phlogacanthus thyrsiformis* (0.16), *Ocimum tenuiflorum* (0.15), *Azadirachta indica* (0.07), *Solanum virginianum* (0.06), *Centella asiatica* and *Mentha spicata* with (0.05), *Curcuma longa* (0.04), *Tinospora cordifolia* (0.03) and the rest of the plants with 0.02 and 0.01 use values respectively shown in Table 2.

Informant Consensus Factor (ICF)

The study also reveals that the Meitei community had extensive knowledge of traditional medicinal plants for the treatment of various common diseases with clear identification of 10 major ailments categories. Fever and physical pain were the most commonly treated diseases by the local people with the highest ICF value of 0.85 followed by Respiratory disorder (0.83), Dermatological problems (0.70), Circulatory disorder (0.66), Gastrointestinal disorder (0.60), Cardiovascular disorder and diabetes with 0.50 followed by Immunodeficiency disorders and liver disorder with the lowest value of 0.40 respectively shown in Table 3.

Fidelity Level

Furthermore, the results also showed that the FL ranges from 10 – 100%; whereas *Centella asiatica* was the only reported species with 100% FL for the cure of headache. *Ocimum tenuiflorum* (68.18%) for pain, *Zingiber officinale* (51.11%) for sore throat, cold and cough, *Solanum virginianum* and *Tinospora cordifolia* were having 50 % of FL for mouth ulcer as well as immune booster, antioxidants and liver disorder. The lowest one was *Aegle marmelos* (10%) for the treatment of stomach disorder presented in table 4.

Table 3. Informant Consensus Factor (ICF).

Ailment category	N_{ur}	N_{ut}	ICF
Fever	76	12	0.85
Diabetes	3	2	0.50
Gastrointestinal disorder	41	17	0.60
Respiratory disorder	72	13	0.83
Dermatological problems	18	6	0.70
Cardiovascular disorder	5	3	0.50
immunodeficiency disorders	6	4	0.40
Circulatory disorder	4	2	0.66
Physical pain	22	4	0.85
Liver disorder	6	4	0.40

Table 4. Fidelity Level.

Scientific names	Ailment category	Np	N	Fidelity Level
Abelmoschus esculentus (L.) Moench	Diabetes	1	3	33
Aegle marmelos (L.) Corrêa	Stomach disorder	1	10	10
	Blood pressure	1	7	14.28
Azadirachta indica A.Juss.	Skin disorder	6	18	33.33
	Cough and cold	7	43	16.27
Centella asiatica (L.) Urb.	Fever	5	46	10.86
	Stomach disorder	5	10	50
	Headache	5	5	100
Mentha spicata L.	Gastric ulcers and digestion	5	13	38.46
Ocimum tenuiflorum L.	Sore throat	15	34	44.11
	Fever	15	46	32.60
	pain	15	22	68.18
Phlogacanthus thyrsiformis (Roxb. ex Hardw.) Mabb.	Cough and cold, Chest congestion	16	38	42.10
	Fever	16	46	34.78
Solanum virginianum L.	Fever	6	46	13.04
	Mouth ulcer	6	12	50
Tinospora cordifolia (Willd.) Miers	Immune booster and antioxidants	3	6	50
	Liver disorder	3	6	50
Zingiber officinale Roscoe	Fever	23	46	50
	Sore throat, cold and cough	23	45	51.11

Literature review

The present investigation has also included the review of the literature of the above listed 40 plants for their ethno pharmacological activities reported by previous researchers in table 5.

Table 5. Comparative studies of cited plants of our survey.

Scientific name	Biological activity
Acorus calamus L.	Antioxidant, anti-inflammatory, antimicrobial, anticonvulsant, immunomodulatory (Mukherjee *et al.* 2007; Balakumbahan *et al.* 2010; Rajput *et al.* 2014)
Abelmoschus esculentus (L.)Moench	Antidiabetic, antihyperlipidemic, immunomodulator (Sabitha *et al.* 2011; Sheu & Lai 2012; Durazzo *et al.* 2018)
Aegle marmelos (L.) Corrêa	Antimicrobial, antidiarrheal, analgesic, anti-inflammatory, anticancer (Arul *et al.* 2005; Maity *et al.* 2009; Manandhar *et al.* 2018)
Allium sativum L.	Antimicrobial, antioxidant, antidiabetic, insecticidal, anti-hypersensitive (Meriga *et al.* 2012; Hussein *et al.* 2017)
Aloe vera (L.) Burm.f.	Skin protectivity, anti-inflammatory, antioxidant, antimicrobial, immunomodulatory (Choi & Chung 2003; Steenkamp & Stewart 2007; Kumar *et al.* 2019)
Alpinia galangal (L.) Willd.	Antimicrobial, anti-inflammatory, analgesic, immunomodulator, hepatoxicity, neuroprotective (Chudiwal *et al.* 2010; Singh *et al.* 2011; Chouni & Paul 2018)
Alpinia officinarum Hance	Antioxidant, antimicrobial, antiproliferative,anticancer, antiosteoporesis, antiviral (Konno *et al.* 2011; Basri *et al.* 2017; Abubakar *et al.* 2018
Andrographis paniculata (Burm.f.) Nees	Anti-inflammatory, antipyretic, antipyretic, antibacterial, antioxidant, anti-diabetic (Sheeja *et al.* 2006; Niranjan *et al.* 2010; Dai *et al.* 2019)
Asparagus officinalis L.	Antioxidant, anti-dysentery, immune-modulatory, anti-tumour, anticoagulant, anti-inflammatory (Zhao *et al.* 2012; Iqbal *et al.* 2017; Guo *et al.* 2020)
Azadirachta indica A. Juss.	Anticrobial, anti-pyretic, anti-inflammatory, antiviral, namaticidal, antidiabetic (Okpanyi & Ezeukwu 1981; Atawodi & Atawodi 2009; Lokanatha *et al.* 2013)
Blumea balsamifera (L.) DC.	Antimicrobial, cytotoxicity, antitumour, antioxidant, antiplasmodial, anti-obesity (Sakee *et al.* 2011; Pang *et al.* 2014; Jiang *et al.* 2014)
Camellia sinensis (L.)Kuntze	Antioxidant, anti-obesity, anti-hypertension, antidiabetic, antimicrobial (Chen *et al.* 2008; Sharangi 2009; Sánchez *et al.* 2020)
Centella asiatica (L.) Urb.	Anti-inflammatory, anti-allergic, antimicrobial, antioxidant, anxiolytic, antiulcer (George & Joseph 2009; Gohil *et al.* 2010; Roy *et al.* 2013)
Citrus limon (L.) Burm.	Antioxidant, antiobesity, antimicrobial, anti-inflammatory, anticancer, antinociceptive, anxiolytic (Lopes *et al.* 2011; Campêlo *et al.* 2011; Klimek-Szczykutowicz *et al.* 2020)
Cinnamomum tamala (Buch.Ham.) T.Nees & Eberm.	Antidiarrhea, antioxidant, anti-inflammatory, antimicrobial, antidiabetic, gastroprotective (Rao *et al.* 2008; Eswaran *et al.* 2010; Sharma & Rao 2014)
Clerodendrum colebrookianum Walp.	Antioxidant, anticancer, hepatoprotective, anti-inflammatory, antipyretic, antihypertensivity (Narayanan *et al.* 1999; Lokesh & Amitsankar, 2012; Patel *et al.* 2014)
Colocasia esculenta (L.) Schott	Anti-helminthic, anti-inflammatory, antidiabetic, antimicrobial, anticancer, antihepatotoxic, antihypertensivity (Reyad-ul-Ferdous *et al.* 2015; Islam *et al.* 2018; Pawar *et al.* 2018)
Curcuma caesia Roxb.	Antimicrobial, analgesic, anti-inflammatory, anti-asthmatic, antioxidant, anticonvulsant (Baghel *et al.* 2013; Sawant *et al.* 2014; Borah *et al.* 2019)
Curcuma longa L.	Immunostimulatory, anti-parasites, anti-inflammatory, antioxidant, antidiabetic, hepatoprotective, anticancer (Araujo & Leon 2001; Yue *et al.* 2010; Krup *et al.* 2013)
Cymbopogon citratus (DC.) Stapf	Anti-inflammatory, antimicrobial, antioxidant, anti-hypoglycemic, diuretic, antitumour, anti-obesity (Carbajal *et al.* 1989; Shah *et al.* 2011; Ekpenyong *et al.* 2015)
Elsholtzia blanda (Benth.) Benth.	Anti-inflammatory, antimicrobial, anti-viral (Guo *et al.* 2012; Pudziuvelyte *et al.* 2020)
Eryngium foetidum L.	Antimicrobial, anti-inflammatory, analgesic, anthelmintic, anti-convulsant, antioxidant (Saenz *et al.* 1997; Paul *et al.* 2011; Singh *et al.* 2013)

Eucalyptus globulus Labill.	Anti-hypoglycemic, antibacterial, antioxidant (Jouad *et al.* 2004; Salari *et al.* 2006; Boulekbache-Makhlouf *et al.* 2013)
Gynuracu simbua (D.Don) S. Moore	Anti-ulcer, neuroprotective, anti-angiogenic (Ma *et al.* 2019; Tewari & Medhabati 2019; Ma *et al.* 2020)
Hedychium coronarium J.Koenig	Anti-inflammatory, antibacterial, antioxidant, anti-angiogenic, anti-allergic, cytotoxic (Endringer *et al.* 2014; Chan & Wong 2015; Ray *et al.* 2018)
Houttuynia cordata Thunb.	Anti-tumour, antiviral, anti-inflammatory, antiobesity, antimicrobial, antioxidant (Lu *et al.* 2006; Kumar *et al.* 2014)
Justicia adhatoda L.	Anti-inflammatory, antimicrobial, antitussive, anticancer (Dhankhar *et al.* 2011; Pandiyan *et al.* 2019)
Mentha spicata L.	Antioxidant, antibacterial, antihistaminic (Yamamura *et al.* 1998; Scherer *et al.* 2013)
Mimosa pudica L.	Diuretic, anticonvulsant, antioxidant, analgesic, anti-inflammatory, cytotoxicity, antidiabetic (Chowdhury *et al.* 2008; Azmi *et al.* 2011; Johnson *et al.* 2014)
Musa paradisiaca L.	Anthelminthic, antioxidant, diuretic, antimicrobial, antioxidant, hypoglycemic, anti-allergic (Loganayaki *et al.* 2010; Hussain *et al.* 2011; Imam & Akter 2011)
Ocimum tenuiflorum L.	Antimicrobial, antioxidant, immudomodulatory, hypoglycemic (Aggarwal & Mali 2015; Yamani *et al.* 2016)
Phlogacanthus thyrsiformis (Roxb. ex Hardw.) Mabb.	Analgesic, antioxidant, hyperlycemic, anti-inflammatory, hepatoprotetive (Gogoi *et al.* 2013; Phurailatpam *et al.* 2014; Das *et al.* 2015)
Psidium guajava L.	Antidiarrheal, antifungal, antioxidant,antipyretic, hepatoprotective, anticancer (Olajide *et al.* 1999; Gutiérrez *et al.* 2008; Mittal *et al.* 2010)
Punica granatum L.	Antimicrobial, antioxidant, anti-inflammatory, anti-cancer, anti-diabetic, anti-hepatoprotective (Lansky & Newman 2007; Jasuja *et al.* 2012; Usta *et al.* 2013)
Sapindus trifoliatus L.	Antimigraine, antinociceptive, anti- inflammatory (Arulmozhi *et al.* 2004; Arulmozhi *et al.* 2005a; Arulmozhi *et al.* 2005b)
Solanum virginianum L.	Antimicrobial, antioxidant, insecticidal, antitussive (Raja *et al.* 2014; Prashith *et al.* 2017) [133,134]
Syzygium aromaticum (L.) Merr. & L.M.Perry	Antioxidant, antibacterial (Mittal *et al.* 2014; Kumar *et al.* 2018)
Tinospora cordifolia (Willd.) Miers	Anti-cancer, antiulcer, digestivity, antipyretic, anti-inflammatory, antioxidant, immunostimulator (Sinha *et al.* 2004; Panchabhai *et al.* 2008; Upadhyay *et al.* 2010)
*Zanthoxylum Armatum*DC.	Anti-inflammatory, antioxidant, antinociceptive, hepatoprotective, analgesic, antimicrobial (Guo *et al.* 2011; Singh & Singh 2011; Brijwal *et al.* 2013)
Zingiber officinale Roscoe	Gastrointestinal effect, antioxidant, antimicrobial, anti-cancer, analgesic, anti-inflammatory, hypoglycemic (Ojewole 2006; Vendruscolo *et al.* 2006; Ashraf *et al.* 2017)

Discussion

The present finding indicates the strong bonding between the Meitei community and the traditional systems of medicine which was followed from generation to another generation. The female informants are more aware about the use of medicinal plants during the period of COVID 19; it shows that traditionally, the women are highly responsible for taking care of the family (Mogha, 2024). Additionally, our analysis also revealed the important relationship with the low budget family utilization of indigenous knowledge's to make prevention from different disease during the pandemic (Zamin *et al.* 2024). According to our study, most of the past literature for the use of medicinal plants by different ethnic communities of Manipur has focused on the hepatoprotective, anti-diabetes, cold cough, fever, diarrhea, antiviral and skin ailments (Sheikh *et al.* 2015; Devi *et al.* 2016; Panmei *et al.* 2019). However, the standardization of the crude drugs and the appropriate form of doses has not been reported so far.

A study conducted by Mahomoodally and Muthoorah (2014) reported about 61 plants and 17 animal resources for Chinese community based on the natural therapies in Mauritius. Another study was done by Ong *et al.* (2018) for the three chin groups of Myanmar which is the neighbouring international boundary with the Manipur state. They found 75 wild ethnomedicinal plants from 40 families with some common plants which are found abundantly in the present study like *Centella asiatica, Ageratum conyzoides, Oroxylum indicum, Clerodendrum sp., Solanum nigrum, Alpinia sp., Hedychium* spieces. Similarly, Rao *et al.* (2015) has also documented 197 plants from 87 families from Kathua district, J&K, India where, *Zingiber officinale, Ocimum tenuiflorum, Acorus calamus, Tinospora cordifolia, Aegle marmelos* were reported for the highest

use value by the informants. In the central part of India, Wagh and Jain (2018) also conducted the survey on Tribal community of Jhabua district which depends on the forest resources and reported 102 plant species from 38 families for the treatment of 37 different diseases.

Further, the above-mentioned results were supported by some earlier research Tugume *et al.* (2016) reported that leaves parts were the highest used by the people of Mabira Central Forest Reserve, Uganda with 68 %; where the formulations were in the form of decoction (29%) administered through oral route. Likewise, there was also a study about the use of medicinal plants by the traditional healers of the Lwamondo area, Limpopo province, South Africa. They reported that the main parts of the plants used were roots (44.5%), leaves (25.9%), bark (14.8%), whole plant (11%) and flowers (3.7%) in the form of boiling (Mahwasane *et al.* 2013). Furthermore, Chekole (2017) also showed that the indigenous people of Gubalafto District, Northern Ethiopia also practiced the same and having 110 preparations for oral routes of administration; usually made by crushing the fresh leaves or the different parts of the plants.

Moreover, a similar survey was conducted and reported that *zingiber* species were used commonly and found to be the highest use value by Pangkhua community, Bangladesh and Tengger tribe in Indonesia respectively (Faruque *et al.* 2019; Jadid *et al.* 2020). In addition to that a survey conducted by Tefera and Kim (2019) reported the similar kind of finding in case of disease category that the highest ICF value for fever with 0.91 in Hawassa Zuria District, Sidama zone, Southern Ethiopia. Similarly, a study made by Singh *et al.* (2020) also revealed the ICF values which ranged between 0.667 to 0.974 and the highest was in case of gastrointestinal and dermatological disorders in the population of Jasrota Hill, Western Himalaya. Fidelity Level (FL) denotes the plant species selected by the local people for the treatment of particular disorder and Centella asiatica was reported as the highest FL in Palamalai region of Eastern Ghats, India (Silambarasan & Ayyanar, 2015).

During this COVID-19 pandemic, the whole world was looking for the discovery of new drug against the treatment of SARS-CoV-2; and till the arrival of new drug or vaccine the peoples have the only option was to depend on the natural resources i.e., Medicinal plants to strengthen their immune system for protection from different complications. The importance of medicinal plants was taken into full attention by various health concern departments across the globe. It was reported that the medicinal plants (herbs) have the properties against viral infection; and thus, utilized to protect from various viral infection and to maintain the immune system of our body (Panyod *et al.* 2020). In the context of India, AYUSH recommended herbal tea named as Kadha prepared from basil, cinnamon, black pepper, dry ginger, resin and golden milk to be a protective measure from COVID-19 (Khanal *et al.* 2022).

Interestingly, Silveira *et al.* (2020) found some evidence-based studies about the positive response of 39 herbal medicines against the COVID-19 patients. They reported that *Althaea officinalis, Commiphora molmol, Glycyrrhiza glabra, Hedera helix* and *Sambucus nigra* were effective in 5 cases; whereas *Allium sativum, Andrographis paniculata, Echinacea angustifolia, Echinacea purpurea, Eucalyptus globulus* essential oil, *Justicia pectoralis, Magnolia officinalis, Mikania glomerata, Pelargonium sidoides, Pimpinella anisum, Salix* sp., *Zingiber officinale* in another 12 cases respectively. Moreover, Vandebroek *et al.* (2020) mentioned the importance and demands of medicinal plants during this dreadful pandemic period to protect against COVID-19. They also reported that ginger and turmeric were marketed as immune booster and started promoting herbal drugs as the alternative way to treat the virus. Out of 40 medicinal plants reported *Zingiber officinale* is the most commonly used during this pandemic by the Meitei Community therefore, this study recommends doing further research on phytochemistry and pharmacological evaluation.

Conclusion

The findings concluded the Meitei community has a utilizing the potential of traditional knowledge's of medicinal plants during the COVID 19 pandemic to protect from various kinds of ailments. The study reported 40 useful plants from diverse family and no new taxa were reported but this is first report of ethnomedicinal studies during the critical time from this region. Even though, there are different advanced approaches in the scientific and medical field, the people keep more faith in medicinal plants which have numerous medicinal properties with minor side effects comparatively with the synthetic compounds. Moreover, the traditional healers were also played a very crucial role in this pandemic without knowing the pros and cons of the virus. Hence we need to acknowledge as well as encouraged these traditional healers to keep on practicing the use of herbal medicine to treat different ailments in the society. The evaluation of data by different quantitative indices was useful to identify the valuable plants used in the region so that further research can be conducted to find out their chemical constituents and pharmacological activities. Overall, this study may popularize the use of local medicinal plants and their traditional practices which can raise the issues of conservation of valuable medicinal plants from

extinction. Lastly, the present survey highly recommends the toxicological and clinical evaluation to standardize the herbal drugs scientifically to reach up the formulation in the market.

Declarations

List of abbreviations: COVID-19- Corona Virus Disease 2019, WHO – World Health Organization, NER - North Eastern Region, UV - Use Value, ICF - Informant Consensus Factor, FL - Fidelity Level.

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