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IMMUNITY BOOSTER PLANTS FROM TRADITIONAL KNOWLEDGE IN NORTH INDIAN PLAINS TO MITIGATE COVID-19 INFESTATION

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As pandemic, COVID-19 continues to spread across the country, this is stressful for everyone. COVID-19 is an infectious disease caused by a novel Coronavirus (SARS-CoV-2) which affects the respiratory system in human beings with symptoms such as fever, cough, body pain, and difficulty in breathing in serious cases. It is a fact that prevention is better than cure and it is the first line of defence from infection. Traditional knowledge and practices which are very helpful to boost our body's immune system for the prevention of viruses are discussed in this paper. In this crisis, the traditional knowledge including culture and ethnomedicinal plants has long been and continues to be one of the strengths of indigenous communities. Further, many traditional healers, scientists, clinicians, experts have discussed various traditional herbs, which might be very effective against COVID-19. Ayurveda has spoken of very potent immune-booster plants such as *Allium sativum, Andrographis paniculata, Ocimum tenuiflorum,Tinospora cordifolia, Withania somnifera,*etc. These medicinal plants are also used in AIDS, respiratory diseases, influenza, and other viral diseases. In this paper, a total of 24 traditional medicinal plants have been discussed that play a key role to boost our defence system against novel coronavirus. The aim of this paper is to bring awakening in society for the adoption of indigenous traditional knowledge and researches to encourage preventive use of medicinal plants against COVID-19.

Keywords:COVID-19,Immune system, Indigenous, Medicinal plants, Traditional.

Corona virus disease 2019 (COVID-19) as a life-threatening disease is caused by severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) that is accounted as a global public health concern (Mirzaie *et al.* 2020). The SARS-CoV-2 belongs to the subgenus Sarbeco virus and mostly resembles a bat coronavirus, with which it shares 96.2% sequence homology (Chan *et al.*2020). Like other coronaviruses, SARS-CoV-2 particles are spherical and have proteins called spikes protruding from their surface. These spikes latch onto human cells, then undergo a structural change that allows the viral membrane to fuse with the cell membrane. Corona viruses cause a lot of disorders, including respiratory, enteric, hepatic, and neurologic diseases (Singhal 2020). Although the WHO said: "There is no specific medicine recommended to prevent or treat the novel corona virus till now" (Prajapati *et al.* 2020). Natural plant products and their derivatives have potential activities in the treatment of viral infections (Denaro *et al.* 2020). Indian, Chinese, and Iranian traditional medicine, suggests some herbs for prevention, treatment, and rehabilitation of the diseases including COVID-19 (Mirzaie *et al.* 2020). Inhibition of viral replication is considered as a general mechanism of herbal extracts. The search for new compounds with antiviral activity has often been unsatisfactory due to viral resistance along with viral latency and recurrent infection in immune-compromised patients (Sumithira *et al.* 2012). The Ministry of Ayush, India has already released the self-care guidelines for preventive health measures and boosting immunity with special reference to respiratory health using traditional ayurveda and natural herbs (Ayush). The antiviral effects of medicinal plants have played a tremendous role at different stages of viral growth (Akram *et al.* 2018). The World Health Organization (WHO) reported that 4 billion people (80% of the world's population) use herbal medicines for some aspect of primary health care (Fabricat *et al.* 2001). Indian medicinal herbs are a promising field for the treatment of various illnesses (Gomathi *et al.* 2020).Medicinal plants have been recognized as potential drug candidates because they possess drug-like properties (Bernhoft 2010). Indian traditional medicine is one of the oldest treatments in human history and Ayurveda,

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Siddha, Unani, Yoga, Naturopathy, and Homeopathy play an important role in treating various diseases. Approximately, 2500 medicinal plant-based formulation has been used in Indian traditional medicine. Since a lot of Indian medicinal plants showed antiviral, anti-oxidant, and anti-cancer activities that it may be important to consider their precise activities (Gomathi *et al.* 2020). Such traditional knowledge is often an important part of their cultural identity. However, traditional knowledge on the use of medicinal plants and the techniques of making many herbal formulations have declined over the past few decades due to a lack of awareness and spread of allopathic medicines (Kala 1998). At a time of worldwide anxiety, it is imperative to find long-term solutions to prevent the transmission of such pandemics. So, it's time for all the citizens to join hands together to fight against coronavirus by practicing self-hygiene and social distancing (Balachandar *et al.* 2020).

METHODOLOGY

The traditional knowledge of plants was collected from the traditional healers, elderly and experienced people, vaidyas and local people. Each traditional information was undertaken through questionnaires and diagnostic interviews for generating the required information on medicinal plants. The questionnaire present personal information of the informants and all plants' detail with medicinal properties. The updated information of medicinal plants that had an inhibitory effect against COVID-19 is gathered from Science Direct, Research Gate, Pub Med. Identification of medicinal plants was done by the morphological characters, consulted with the experts and taxonomist. The plants were recorded alphabetically by scientific name, common name, family, part used, bioactive compounds and mode of preparation.

RESULTS AND DISCUSSIONS

Ethnomedicinal plants taken in this paper are mostly involved in improving and boosting immunity. The knowledge of such plants which boost immunity directly or indirectly is very essential for people so that they may change their food habits by involving species and herbs in their diet. Natural herbs that contain many phytochemicals in the form of alkaloids, flavonoids, terpenoids, polysaccharides lactones, and glycoside products are responsible for altering immunomodulatory properties. These plants have the capability to combat the infection of the SARS-CoV2 by their bioactive compounds. These 24 plant species are discussed alphabetically in Table 1 and photographs of some important plant part used are given in Plate 1 (Fig. 1-6).

Abutilon indicum (L.)Sweet imparts strength and improves immunity. According to the work of Rajeshwari *et al.*2018 ethanolic and aqueous extract of leaves are taken to boost immunity, roots for curing fever, arthritis, and seeds for cough. The work matches with the traditional use of the plant. It contains flavonoids (quercetin), saponins, alkaloids and phenolic compounds. (Dushputre *et al.* 2010). Flavonoids, triterpenoids are used to strengthen immunity against viruses (Kumar *et al.* 2012).

Allium sativum L. is an overall health stimulant. It is useful in fever, respiratory disorders, and relieves cold. It improves the strength and immunity of the body and helps in clearing and opening body channels. The most important sulfur constitutes (~ 82%) of garlic are thiosulfinates (allicin), S-allyl cysteine sulfoxide (alliin), ajoenes (E- and Z-ajoene), vinyldithiins (2- vinyl-(4H) -1,3-dithiin, 3-vinyl-(4H)-1,2-dithiin), and diallyl (di and tri) sulfide. Some other alliin-derived organosulfur compounds (OSCs) are S-allyl-cysteine, S-allyl-mercapto cysteine, and N-acetylcysteine (El-Saber *et al.* 2020). This matches the findings of Weber *et al.* 1992 and Keyaerts *et al.* 2004 where the fresh and powdered bulb is used to enhance immunity against different viruses including HSV-1,2 (Herpes simplex

virus), HRV-2 (Human rhinovirus), Vaccinia virus, VSV (Vesicular stomatitis virus), and SARS.

Aloe vera (L.) Burm. f. is an immune stimulator and strengthens the immune system. It is also known as a wonder drug. The active chemical constituents of *A.vera* include anthraquinones, polysaccharides, chromones and enzymes. Anthraquinones and chromones are responsible for anti-cancer and anti-inflammatory properties. This belief conforms with the work of Sahu *et al.* 2013, Kumar *et al.*2012 and Hegazy *et al.* 2012. They proved that the gel extract of leaves is used to boost immunity and is used against cancer, cough, cold, asthma, HBV and HCV.

Andrographis paniculata (Burm. f.) Nees (Plate 1, Fig.1) is bitter in taste and used to enhance immunity and as an anti-cold and flu remedy. It also matches with the work of Shah *et al.*2013 and Liu *et al.*2020 where an extract of the whole plant is used for cold, cough, viral fever and against SARS-CoV and likely SARS-CoV-2. It was noted that phytochemicals of *Andrographis paniculata* such as Andrographolide (AGP1), 14-deoxy 11,12-didehydro andrographolide (AGP2), Neoandrographolide (AGP3) and 14-deoxy andrographolide (AGP4) are involved against SARS-COV and SARS-CoV-2 (Liu *et al.* 2020a) (Wu *et al.* 2020)(Kumar *et al.* 2012).

Asparagus racemosus Willd. is used in strength and immunity promoting group of herbs. It is also in conformity with the work of Kumar *et al.* 2012 and Singla *et al.* 2014 where they used the powdered root to cure epilepsy, enhance immunity, hypertension, and viral infection. The main compound is steroidal saponins, alkaloids, flavonoids, dihydrophenanthrene and furan derivatives. Twenty-nine steroidal saponins and 3-0- [α-Lrhamnopyranosyl- (1 → 2) -α-L-rhamnopyranosyl- (1 → 4) -O-β-D-glucopyranosyl] 25(S)-spirosta-3β oil are found in *A. racemosus* which in oral administration has the potential to synthesize antibody and enhance the immune response produced by cells in animals that damage the immune system. Shatavarin VI and Shatavarin VII are reported specified. *A.racemosus* (1S, 2R, 3S, 8S, 9S, 10S, 13S, 14S, 16S, 17R, 22R, 25R) - 21-nor-18β, 27 α-dimethyl-1β, 2β, 3β-trihydroxy25-spirost- 4-en-19β-oic acid has been reported to have immunostimulant properties.

Azadirachta indica A. Juss is used to treat malaria and as a blood purifier. The decoction of roots is also used to cure the fever. The findings of Dubey *et al.* 2014 match with the classical treatment. Leaf aqueous extract is used against HIV/AIDS, cancer, boost immunity, treat hypertension and viral infection. Neem oil is used to cure asthma. The chemical constituents of Neem include azadirachtin, 7-desacetyl-7-benzoyl azadiradione, 17-hydroxy azadiradione, 7-desacetyl-7-benzoyl gedunin, nimbin, nimbiol and polyphenolic flavonoids(Alzohairy 2016).
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Boerhavia diffusa L. is having valuable medicinal properties and is found in folklores and classical literature. It occupies a reputed position in the indigenous medicinal system. Eupalitin-3-O-β-D-galactopyranoside, Boerhavine, Quercetin 3-O-rhamnosyl (1 →6) etc. are the compounds of B. diffusa. The smoke of dried leaves is used in the treatment of bronchial asthma. It is an excellent expectorant in the form of leaf decoction. It matches with the work of Sasi Kala et al., 2009 and Awasthi *et al.* 2006 where they showed that leaves of B. diffusa are decorated with ginger leaf and black pepper for bronchial asthma and root extract used to treat viral diseases. The Ayurvedic name of B. diffusa is Punarnava which means becoming new.

Camellia sinensis (L.) Kuntze has been cultivated for thousands of years and its leaves are used medicinally. The health benefits of drinking tea have been known since ancient times. It has antiviral properties against the influenza virus, zika virus, hepatitis B virus,

and SARS virus (Carneiro *et al.* 2016, Mahmood *et al.* 2016). L-theanine, promote the immune system in fighting infection by microbes (Barooah 2020). Theaflavin-3, 30-digallate (TF3) displayed inhibition effects against viral infection (Chen *et al.* 2005), also has many health benefits particularly modulating both adaptive and innate immune system functions (Min *et al.* 2015, Saeed *et al.* 2017). Green Tea, Black Tea, and Haritaki plant extract are as potential therapeutic candidates for SARS-CoV-2 infection (Upadhyay *et al.* 2020).

Citrus limon (L.) Osbeck is extremely useful to relieve cough and soothes the mucosa of the throat. According to Ayurveda Lemon is hot in nature and medical news today states that lemon juice with hot water is used to strengthen immunity and the same are the findings of Chaturvedi *et al.* 2016 where they proved that lemon juice is used to cure cold, cough, sore throat, cancer and asthma. The phytochemicals present in citrus peel are flavonoids, saponins, steroids, terpenoids, tannins and alkaloids. Arya *et al.* 2011 had reported that Auraptene showed immunomodulatory activities.

Curcuma longa L. (Plate 1, Fig.2) is one of the very useful Ayurvedic herb. It is used in many forms. Turmeric is an auspicious drug in Indian tradition. It is also used to worship Gods and Goddesses. It has been the best old home remedy to fight cold, cough, seasonal disorders, wounds, skin diseases. According to Mazumder *et al.* 1995 and many other scientists, the rhizome is used to boost the immune system, treat hepatitis virus, influenza virus, ZIKV (Zika virus), CHIKV (Chikungunya virus), HIV, HSV-2 (Herpes simplex virus-2), HPV (Human papillomavirus) which is similar to the work of classical Ayurveda scientists. Turmeric has many bioactive compounds such as curcumin and two other carotenoids called demethoxycurcumin (DMC) and bisdemethoxycurcumin (BDMC) besides volatile oils, proteins, carbohydrates, and resins (Elengoe 2020).

Euphorbia hirta L. is an ayurvedic herb used in the treatment of asthma, bronchitis, diarrhea, dysentery in the form of powder or juice. The decoction of the fresh herb is used as a gargle. The herb is used in Kapha disorders and bronchial asthma in form of decoction. Afzelin (I), quercitrin (II), and myricitrin (III) are isolated from the methanolic extract of *E. hirta*. According to Kumar *et al.* 2010 the whole plant is used for respiratory ailments, and the work of Gyuris *et al.* 2008 proved to treat HIV-1, HIV-2, SIV mac 251 viruses.

Ficus benghalensis L. is used in traditional medicine for the treatment of many diseases. Aerial root, bark, tender leaf, and latex are used for the treatment of different health problems like inflammation, fever, microbial infection, etc. *F. benghalensis* represents the presence of elements such as quinic acid, palmitic acid, methyl ester, ergosterol acetate and α-amyrenyl acetate that exhibit antioxidant activities. Most compounds show potential anti-inflammatory and anti-cancer activity. Lupenyl acetate and α-amyrenyl acetate were found to be in very high amounts (representing 35.4% and 16.34% respectively) in methanol extract. It is used in the forms of decoction, powder, or milky latex. Now it is proved by the findings of Khan *et al.* 2008 and Verma *et al.* 2015 that aqueous extract of aerial roots is used to boost immunity and treat cancer, asthma, and microbial diseases. It is an immune stimulator plant.

Glycyrrhiza glabra L. (Plate 1, Fig.3) is a medicinal herb used in various ayurvedic medicines and other traditional systems of medicine. For centuries, it has been used as traditional medicine for cough infection, sore throat digestive problems, etc. Dried roots are used as a good expectorant, expels phlegm from the lungs, and treats respiratory diseases. It provides good strength and immunity used in the form of decoction or powder. According to Fiore *et al.* 2008 and Feng Yeh *et al.* 2013 the

root is used to treat SARS-related coronavirus, HIV, respiratory syncytial virus, vaccinia virus, arboviru and vesicular stomatitis virus. Glycyrrhizin and β-glycyrrhetinic acid are the major components of *G. glabra* which are thought to have the potent immunomodulatory properties. The pharmacologic perspective of glycyrrhizin-a triterpene saponin can be a potential phytochemical against COVID-19 (Mukherjee *et al.*2014) (Mitra *et al.* 2012).

Mangifera indica L. is an ancient folk remedy to treat several disorders such as hypotension, asthma, anemia etc. Mangiferin is one of the most important bio compounds present in almost all parts of the *Mangifera indica.* The alcoholic extract of stem bark was reported to possess immunomodulatory activity through cell-mediated as well as humoral immunity (Mukherjee *et al.* 2014).

Nigella sativa L. (Plate 1, Fig.4) is used in treating asthma, diarrhoea, and high cholesterol levels. Some findings including treatment of asthma, cancer, and enhanced immunity are mentioned by Srinivasan 2018. Barakat *et al.* 2013 also mentioned that oil is used to treat HCV. *N. sativa* extract contains several important active sites like Thymoquinone (TQ), thymohydroquinone (THQ), dithymoquinone, thymol, carvacrol, α and β-pinene, d-limonene, d-citronellol and p-cymene volatile oil of the seed also contains p-cymene, carvacrol, t-anethole, 4-terpineol and longifolene. Black cumin seed have two different forms of alkaloids. Isoquinoline alkaloid includes: nigellicimine, nigellicimine n-oxide and pyrazol alkaloid includes: nigellidine and nigellicine. The nutritional compositions of *N. sativa* are vitamins, carbohydrates, mineral elements, fats and proteins that include eight or nine essential amino acids. Seed performance of *N. sativa* Thymoquinone varies and depends on the type of target (Forouzanfar 2014).

Ocimum tenuiflorum L. or holy basil is used for ages in Ayurveda for its diverse healing properties. Kapha Vinashini, Krumihara, and Shwasahara mean that plant is the best antiviral herb useful in the treatment of asthma, chronic respiratory disorders, and allergies. It is useful in cough, cold, and sinusitis. Fresh leaves or juice is used as an immunity booster in the form of tulsi, ginger, and lemongrass tea. Its regular use will increase the immunity of the body. This ancient belief matches with the work of Rege *et al.* 2014 and Chiang *et al.* 2005 where they used it against ADV (Adenoviruses), HSV (Herpes Simplex), Dengue, HIV-1, Hepatitis Virus, EnteroVirus71 and CVB(Coxsackievirus)1. Alcoholic extract and its component essential oils such as eugenol, cavacrol, derivatives of ursolic acid, apigenin were studied for their immunomodulatory activity.

Phyllanthus emblica L. is used to promote immunity against many viral infections. Just like Holy basil if Amla is taken daily, will help in enhance immunity. It is used to cure fever, cold, and cough. Seeds of the fruits are used in the treatment of asthma and bronchitis. Alcoholic extract of the fruit is anti-viral.The fruit is beneficial and used in Chyawanprash.The phytochemicals of *P. emblica* are gallic acid, ellagic acid, 1-O galloyl-beta-D-glucose, 3,6-di-Ogalloyl-D glucose, chebulinic acid, quercetin, chebulagic acid, corilagin, 1,6- di-O - galloyl beta D glucose, 3 Ethylgallic acids (3 ethoxy 4,5 dihydroxy benzoic acid) and isostrictiniin etc. Its fruit juice contains the highest amount of vitamin C (478.56 mg / 100 mL) (Jain *et al.* 2015).It conforms with the work of Dasaroju *et al.* 2014 which shows that fruit is used to boost immunity, restorative, treat cold, fever, and influenza A virus.

Phyllanthus amarus Schumach. & Thonn. is used to treat cold, cough, fever, inflammation of spleen and liver, asthma, and chronic respiratory disorders. The decoction of the whole plant is used to improve immunity and pulmonary tuberculosis (TB). The major class of bioactive compounds are alkaloids, flavonoids, lignans, sterols, tannins, triterpenes

Plate1(Fig. 1-6): Some effective Traditional medicinal plants that can enhance the immunity and fight against SARS-CoV-2 and other Viruses**1-** *Andrographis paniculata* (Burm. f.) Nees; **2-** *Curcuma longa* L.;**3-** Dried roots of *Glycyrrhiza glabra* L.;**4-** Seeds of *Nigella sativa* L.;**5-***Piper nigrum* L.**6-***Withania somnifera* (L.) Dunal

and volatile oils has been isolated. Lignans like phyllanthin and hypophyllanthin, flavonoids like quercetin were isolated from the leaves of *P. amarus (Meena et al. 2018)*. Ethanol extract is used to cure HCV (Hepatitis C virus) and Dengue Virus is proved by Wahyuni *et al.* 2019 and Lee *et al.* 2013.

Piper nigrum L. (Plate 1, Fig. 5) is an important herb of indigenous traditional knowledge. Fruit of *P. nigrum* is useful in the treatment of Asthma, chronic respiratory disorders, Alzheimer's disease (AD), Parkinson's disease, arthritis allergies and decreased sputum production. It is used in treating recurrent fever. It is used as a bio enhancer in Ayurveda. The fruit is used for bronchitis and viral infections are in conformity with the work of Mair *et al.* 2016. Piperine is an amide alkaloid derived from the fruits of the black, white and long pepper extracts. It has been reported to have different types of biological and pharmaceutical therapeutic effects, such as anti-inflammatory, anti-viral, analgesic, anti-convulsant and anti-cancer (Elengoe 2020).

Punica granatum L. soothes the throat with cough and increases immunity of the body. It is a rich source of many antioxidant, vitamins like A, B5, E and C, polyphenols, tannins, anthocyanins, and potassium which have a positive health effect on the body proved by Bhowmik *et al.* 2013. *P. granatum* extracts showed antioxidant, antiperoxidative, antibacterial, inflammation, and antitumor, hepatoprotective, antiarthrogenic, and antidiarrhoeal properties. It improves health and boost the immune system (Patel *et al.* 2021).

Solanum nigrum L. is used to treat fever, cough, asthma, and anti-aging and tissue rejuvenation. Infusion of leaves and fruit juices are given in different potencies to treat cough, asthma, nausea and fever. The ethanol extract of berries in *S. nigrum* revealed the presence of tannins, alkaloids, phenols, steroids, carbohydrates, flavonoids and saponins. In addition to these some other proteins and phytosterol crude polysaccharides, gentisic

Table-1: List of Traditional medicinal plant species that enhance the immunity and might inhibit the SARS-CoV-2 and other Viruses

No.	Botanical name	Common Name	Family	Bioactive compounds	Part used / medicinal usage
1.	***Abutilon indicum* (L.) Sweet**	Kanghi	Malvaceae	Flavonoids, triterpenoids (Kumar *et al.* 2012)	Ethanolic, aqueous extract of leaves is used for boosting immunity, roots for curing fever and seeds for cough.
2.	***Allium sativum* L.**	Lehsun	Amaryllidaceae	Diallyl Sulphide (DAS) (Elengoe,2020)	The fresh and powdered bulb is used to boost immunity and cure cold and viral diseases.
3.	***Aloe vera* (L.) Burm. f.**	Ghritkumari	Asphodelaceae	Anthraquinone glycosides (Kumar *et al.* 2012)	Leaf gel extract is used for boosting immunity, treating cough, viral diseases and asthma.
4.	***Andrographis paniculata* (Burm. f.) Nees**	Kalmegh	Acanthaceae	Diterpenes (Kumar *et al.* 2012)	The extract of the whole plant is used to treat cough, cold and viral fever.
5.	***Asparagus racemosus* Willd.**	Shatavari	Asparagaceae	Saponins, Sitosterols, Sapogenins (Singla *et al.* 2014)	The powdered root is used for epilepsy and viral infection. It also enhance immunity.
6.	***Azadirachta indica* A. Juss.**	Neem	Meliaceae	Nimbidin, Oil (Patel *et al.* 2021)	Aqueous leaf extract is used for treatment of cancer , cold, dengue, microbial diseases, asthma and boost immunity
7.	***Boerhaavia diffusa* L.**	Punarnava	Nyctaginaceae	Eupalitin-3-*O*-β-D galactopyranoside (Mukherjee *et al.*2014)	The decoction of leaves is used for treating bronchial asthma, root for viral diseases and enhance immunity.
8.	***Camellia sinensis* (L.) Kuntze**	Chai	Theaceae	L-theanine (Barooah, 2020)	The plant extract is used for enhancing immunity and curing viral infection.
9.	***Citrus limon* (L.) Burm. f.**	Nimbu	Rutaceae	Auraptene, Flavonoids (Arya *et al.*2011)	Lemon juice is used for strengthening immunity and treating cold, cough, sore throat, cancer and asthma.
10.	***Curcuma longa* L.**	Haldi	Zingiberaceae	Curcumin (Elengoe,2020)	The rhizome is used for enhancing immunity and curing viral diseases.
11.	***Euphorbia hirta* L.**	Dudhi	Euphorbiaceae	Quercitol, Myricitrin, Gallic acid(Kumar *et al.* 2012)	The whole plant is used for respiratory ailments and viral infection.
12.	***Ficus benghalensis* L.**	Bargad	Moraceae	Phenolics(Mukherjee *et al.*2014)	The aqueous extract of aerial roots boost immunity, treat cancer, asthma and microbial diseases.
13.	***Glycyrrhiza glabra* L.**	Mulethi	Fabaceae	Glycyrrhizin,β-Glycyrrhetinic acid(Mukherjee *et al.*2014)	Dried roots for treating cough and viral diseases.

14.	***Mangifera indica* L.**	Aam	Anacardiaceae	Mangiferin(Mukherjee *et al.* 2014)	Alcoholic extract of stem bark for boosting immunity and curing asthma.
15.	***Nigella sativa* L.**	Kalonji	Ranunculaceae	Thymoquinone, Oil (Elengoe,2020)	The seeds are used for asthma problems, cancer, viral diseases and boost immunity.
16.	***Ocimum tenuiflorum* L.**	Tulsi	Lamiaceae	Essential oils such as eugenol, cavacrol, derivatives of ursolic acid, apigenin(Kumar *et al.* 2012)	The decoction of the whole plant for cold, cough, viral infection.
17.	***Phyllanthus emblica* L.**	Amla	Phyllanthaceae	Ascorbate (Patel *et al.* 2021)	The fruits are used for boosting immunity, restorative, cold, fever, viral infection.
18.	***Piper nigrum* L.**	Kali Mirchi	Piperaceae	Piperine (Elengoe,2020)	Unripe fruit for bronchitis, viral infections.
19.	***Punica granatum* L.**	Anar	Puniacaceae	Tannins, Vit. C(Mukherjee *et al.* 2014)	Fruit juice for cancer, boost immunity, arthritis, microbial diseases.
20.	***Solanum nigrum* L.**	Makoi	Solanaceae	Polysaccharide(Patel *et al.* 2021)	The decoction/juice of berries for cough, respiratory tract infections, microbial diseases.
21.	***Terminalia chebula* Retz**	Choti Harad	Combretaceae	Tannins(Patel *et al.* 2021)	Aqueous dried fruit extract used to enhance immunity, viral diseases
22.	***Tinospora cordifolia* (Willd.) Hook. f. & Thomson**	Giloye	Menispermaceae	Alkaloidal constituents such as berberine, tinosporic acid(Mukherjee *et al.* 2014)	Leaves and stem decoction used for fever, viral diseases and to boost immunity.
23.	***Withania somnifera* (L.) Dunal**	Ashwagandha	Solanaceae	Withanolide (Patel *et al.* 2021)	The powdered roots boost immunity, cure asthma, bronchitis, Parkinson's, Alzheimer's, viral diseases.
24.	*Zingiber officinale* Roscoe	Adrak	Zingiberaceae	6-Gingerol (Elengoe,2020)	The decoction of rhizome for treating cold, cough and enhance immunity.

acid, luteolin, apigenin, kaempferol, anthocyanidin have also been reported. According to Rani *et al.* 2017 and Yu *et al.* 2004 juice of the fruit is used to cure cancer, boost immunity, arthritis, microbial diseases, and HIV (Human immunodeficiency virus).

Terminalia chebula Retz possesses anti-bacterial and antiviral activities. *T. chebula* fruits afforded four immunodeficiency virus type 1 (HIV-1) integrate inhibitors, gallic acid and three galloy glucoses. Their galloyl moiety plays a major role in inhibition against the 3'-processing of HIV-1 integrase of the compounds (Ahn *et al.*2002). Chebulagic acid and punicalagin from the fruit of *T. chebula* have the potential to inhibit the activity of different viruses, such as human

cytomegalovirus, HCV, dengue virus, measles virus, and respiratory syncytial virus (Nigam *et al.* 2020). Li *et al.* 2020 observed chebulagic acid as Novel Influenza Viral Neuraminidase inhibitor. *T.chebula* acts as a potential inhibitor against SARS-CoV-2 (Siddiqui *et al.* 2020).

Tinospora cordifolia (Willd.) Hook. f. & Thomson is also commonly called Amrita. It originated from the divine nectar Amrit. It is a common and very valuable medicinal plant in the Indian system of medicine. It makes immunity strong and helps in fighting viral and bacterial diseases. It has rejuvenation power. It is useful in fever, asthma, bronchitis, cough, and cold. The stem of *T. cordifolia* is used as a decoction and can be mixed with other herbs as well. It is rich in antioxidants. It is antipyretic and has antiviral properties as well. The work of Estari *et al.* 2012 is a strong supporter of the treatment of HIV 1. Sharma *et al.* 2015 showed its immunity-boosting properties.The main components of *T. cordifolia* are Tinosporic acid, Magnoflorine, berbeine, Tinosporon, Tinosporides and Cordifelone.

Withania somnifera (L.) Dunal (Plate 1, Fig.6) is a powerful gift of nature and Ayurveda. It is useful in fever, cold, cough, and respiratory tract infections. In a collaborative study of DAILAB at the Indian Institute of Technology (IIT), Delhi it is revealed that Ashwagandha has emerged as a potential drug against COVID-19. It increases the natural ability of the body to fight against viruses. Herbal combination with other strong antiviral herbs makes a good herbal tea. Kumar *et al.* 2011, Grover *et al.* 2011 and Jana *et al.* 2018 proved through their laboratory studies that powdered root is used to boost immunity, treat HSV (Herpes simplex virus), asthma, bronchitis, Parkinson's, and Alzheimer's diseases. The major biochemical constituents of Ashwagandha are alkaloids (isopellertierine, anaferine), steroidal lactones (withanolides, withaferin), saponins containing an additional acyl group (sitoindoside VII and VIII), and withanolides with a glucose at carbon 27 (sitonidoside XI and X). Withanolides and withaferin A, which are attributed to the extraordinary pharmacological effect of Ashwagandha (Patel *et al.* 2021).

Zingiber officinale Roscoe is an ancient panacea for modern times. It is universal and versatile herb. Gingerols are the major active components in the fresh rhizome (Hoffman, 2007). The volatile oil components consist mainly of sesquiterpenehydrocarbons, predominantly zingeberene (35%), curcumene (18%) and farnesene (10%) (Govindarajan 1982). It is useful in the digestive, respiratory, and circulatory channels. Ginger is a wonderful cough remedy. It helps in treating throat disorders, cough, bronchitis, tuberculosis, dyspnoea, fever, vomiting, indigestion, and heart diseases. These ancient healing rhizome properties is in confirmity with the work of Qaiser *et al.* 2018, Shakya *et al.* 2015, and Srivastav *et al.* 2020. 6- gingerol possess anti-inflammatory, anti-viral, anti-bacterial, anti-diabetic, anti-oxidant and anti-cancer effects.

CONCLUSIONS

The present study observes that traditional ayurvedic text is full of ethnomedicinal plants recommended for various therapeutic uses in form of folklores and treasure of knowledge of traditional healers. Now a days, indigenous traditional knowledge is lacking among the young generation and they believe only in allopathic fast treatments with various side effects. Thus, there is a need to spread awareness among people to protect indigenous traditional and ethnomedicinal plant knowledge for the future generation. The study involved 24 plant species available having potential Immunomodulatory properties with phytochemical compounds. The mode of preparation is the extract, decoction, powder, juice, oil, or fresh leaves as a whole. The highest proportion of medicinal plants are used to treat fever, cold, cough, viral diseases, respiratory disorders and enhance immunity.

Some dry and powdered form herbal medicines are still used in the Indian kitchen as spices. *Curcuma longa* is commonly used in food preparation as a spice and a coloring agent. It is known to have antioxidant, anti-inflammatory, and anti-tumor properties (Qaiser *et al.* 2018). Ginger has been used as a spice for over 2000 years (Bartley *et al.* 2000). *Glycyrrhiza glabra* and *Allium sativum* have an inhibitory effect on SARS-CoV replication and then they can be considered as a promising drug candidate for COVID-19 (Keyaerts *et al.*2004). *Abutilon indicum* had shown antimouse coronavirus activity (Vimalanathan *et al.*2009). *Punica granatum, Boerhavia diffusa,* and *Allium sativum* have inhibitory effects on ACE and can be used as a potential anti-COVID-19 drug candidate (Hussain *et al.*2018). *Ocimum tenuiflorum* and *Solanum nigrum* have an inhibitory effect on the reverse transcriptase of HIV and can be investigated for SARS-CoV-2 (Yu, Y.-B., 2004). *Andrographis paniculata* (Kalmegh) present in South Asia has a strong treating capacity of viral respiratory infections in Ayurvedic and other medicinal systems (Yarnell, 2018; Arora *et al.* 2011; Coon *et al.* 2004) and involved in the pathogenesis of SARS-COV and likely SARS-CoV-2 as well (Liu *et al.* 2020a, 2020b). *Nigella sativa* has some compounds which may inhibit COVID-19 (Bouchentouf *et al.* 2020). *Piper nigrum* can help in the fight against COVID-19 which is also a respiratory tract infection (Mair *et al.* 2016).

These drugs have many pharmacological activities such as antioxidant, anti-inflammatory, Anti-cancer, Anti-viral, Immunomodulator activity, etc. Thus, many scientists, clinicians, and researchers are trying to make effective drugs for the treatment of COVID-19 like deadly diseases.These traditional medicines have an inhibitory effect against viral diseases, so may have the ability to fight against COVID-19.

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