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COVID-19 pandemic: The important role of Indian medicinal plant

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Abstract

The world was in under an emergency situation due of the COVID-19 pandemic, caused by a novel coronavirus (SARS-COV-2). It was first diagnosed on 31st December 2019, in Wuhan, Hubei province, China and affected in >200 countries. This virus has swept the world, infected more than 82022480 persons and killed over 1791243 lives worldwide and has created mass hysteria in its wake. WHO had declared the COVID-19 outbreak as a pandemic. Specific drugs and vaccine against this virus were discovered, but mostly the patients were being treated symptomatically. Hence, an efficient international attentiveness of plan is necessary to the prediction and prevention. Some Indian medicinal plants have shown beneficial effects on mild and ordinary COVID-19 patients. Polysaccharides are significant component in this purpose. This review focuses on Indian traditional medicine such as medicinal plant extracts as promising approaches against COVID-19.

Keywords: COVID-19; SARSCoV-2; Indian medicinal plants

1. Introduction

Coronaviruses, belong to the subfamily Orthocoronavirinae, in the family Coronaviridae, order Nidovirales, and realm Riboviria (Groot et al., 2011; International Committee on Taxonomy of Viruses, 2010). The name Corona originated from the Latin word corona, meaning "crown" or "wreath" because of appearance of crown-like spikes on the outer surface of the virus. The size of coronaviruses ranges from approximately 27 to 34 kilobases (diameter ranging from 80 to 120 nm) and contain a single-stranded RNA as the nucleic acid with a lipid envelope decorated with club shaped projections (Fig. 1; Chakraborty, & Maity, 2020; Prasad et al., 2020; Shereen et al., 2020). Coronaviruses are a collection of allied viruses that cause diseases in mammals and birds. Till now six coronavirus species are known to cause human disease. Human coronaviruses were first exposed in the late 1960s (Kahn, Jeffrey; McIntosh, Kenneth, 2005). Other family members of coronaviruses have been identified, including SARS-CoV in 2003, HCoV NL63 in 2004, HKU1 in 2005 and MERS-CoV in 2012.

SARS-CoV-2 is a new strain of coronavirus first identified in Wuhan, Hubei Province, China, in December 2019 that has not been previously identified in humans, hence it was initially called 2019 Novel Corona virus (Zhou et al., 2020). Later on Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) is the name given to it. The disease associated with SARS-CoV-2 was named as COVID-19, following the World Health Organization (WHO) best practice external icon for naming of new human infectious diseases. Here 'CO' stands for 'corona,' 'VI' for 'virus,' and 'D' for disease. With the current information available, it is suggested that the route of human-to-human transmission of SARS-CoV-2 is either via respiratory droplets or via contact (Chan et al., 2020). It may so happen that, if any person touches a surface or object that already contains viable virus on it, and touches his/her own mouth, nose, or possibly eyes, the virus may spread through the mucus membrane and infect the person.

Diagnosis of other coronaviruses like 229E, NL63, OC43, or HKU1 is not the same as a COVID-19 diagnosis. Unlike other coronaviruses, patients with COVID-19 need to be evaluated and cared for differently. Coronavirus disease 2019 (COVID-19) is a respiratory illness that can spread from person to person. The clinical spectrum ranges from mild disease with non-specific signs and symptoms of acute respiratory illness such as fever, cough, fatigue, shortness of breath, to severe pneumonia with respiratory failure and septic shock (Russell, Millar, & Baillie, 2020; Wang, Wang, Ye, & Liu, 2020). It has also been reported that many infected patients remain asymptomatic. The World Health Organization (WHO) has officially labeled the outbreak of COVID-19 a global Pandemic on 11thMarch 2020. As per the latest update of WHO on 30th December 2020, COVID-19 had spread in more than 200 countries & territories, and approximately 1791243 people had died after contracting the respiratory virus out of nearly 82022480 confirmed cases (WHO, 2020). It posed enormous threat to global public health.

India is the gold mine of herbal and different plant medicine (Dubey et al., 2004; Joshi, Joshi, Dhiman, 2017). These are used for variety of diseases including hypertension and many of them are unexplored for its phytopharmacological uses (Aggarwal et al., 2011; Somanadhan et al., 1999; Vaghasiya, & Chanda, 2009). Majority of people are used traditional Indian medicine due to less-cost, easier availability and without any side-effect. Plant extracts and molecules isolated from them have previously shown

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inhibitory effects on ACE (Wagner et al., 1991). As COVID-19 cases continue to rise across the world, the Ministry of AYUSH government of India, published an advisory suggesting that the use of alternative medicinal plants might act as immunity booster against COVID-19). In general polysaccharides are the main active elements of Indian traditional medicinal plant (Maity et al., 2019; Ojha et al., 2008). Low toxicity, high molecular mass, branching configuration and conformation of polysaccharides and also chemical modification are the major factors influencing their different biological properties. The present review was summarizes the published data of traditional medicinal plant for possible treatment of COVID-19.

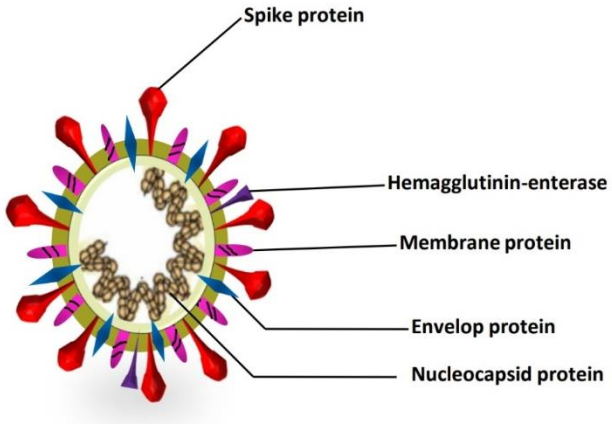

Fig.1 Structure of coronavirus

2. The bioactive plant polysaccharides with the possibilities to combat against Covid-19

Different potential bioactive plant polysaccharides may be treating in COVID-19 due to the biological benefits such as immunomodulatory activity, anti-inflammatory activity, antioxidative activity etc. A D-glucan was isolated from the hot aqueous extract of mature pods (fruits) Moringa oleifera (sajina) (Mondal et al., 2004). These polysaccharides showed significant macrophage activation through the release of nitric oxide on mouse monocyte cell line. A water soluble heteropolysaccharide was isolated from hot water extract of the stems of Amaranthus tricolor Linn. (Amaranthus gangeticus L.) and consist of L-arabinose, methyl-D-galacturonate, D-galactose, and 3-O-Ac-L-rhamnose in a molar ratio of nearly 1:1:1:1 (Sarkar et al., 2009). An aqueous extract of this plant inhibits the proliferation of liver cancer cell line (HcpG2), breast cancer cell line (MCF-7), and also colon cancer cell line (Caco-2) (Sani et al., 2004). A heteropolysaccharide was extracted from the gum (Katira) of Cochlospermum religiosum and found to consist of D-galactose, D-galacturonic acid and L-rhamnose in a molar ratio 2:1:3 (Ojha et al., 2008). This gum was use in cough, diarrhoea, dysentery, pharyngitis, gonorrhoea, syphilis and trachoma (Kirtikar et al., 1998). Hot aqueous extract of pods of Moringa oleifera contains D-galactose, 6-O-Me-D-galactose, D-galacturonic acid, L-arabinose, and L-rhamnose in a molar ratio of 1:1:1:1:1 (Roy et al., 2007). Its leaves and fruits are edible, and possesses pharmacological activity toward blood pressure and also useful to increase the flow of bile (Chopra et al., 1958; Nadkarni et al., 1954). A heteropolysaccharide (SMPS) was isolated from the aqueous extract of the green (unripe) fruits of Solenum melongena (Brinjal) and contains D-galactose, D-methyl galacturonate, 3-O-acetyl D-methyl galacturonate, and L-arabinose in a molar proportion of nearly 1:1:1:1. This molecule showed splenocyte and thymocyte activations (Ojha et al., 2009). The leaves are useful in cholera, bronchitis, asthma, and fever (Prajapati et al., 2003). A water-soluble polysaccharide was isolated from the green fruits of Capsicum annuum and found to consist of 3-O-acyl-L-rhamnose, D-methyl galacturonate, 6-O-methyl-D-galactose in a molar proportion of nearly 1:2:1 (Mondal, Das, Maiti, Roy, Islam, 2009). It showed potent anti-complementary activity and antioxidant activity (Paik et al., 2003; Chopra et al., 1958). It used as a tonic for the heart and stomach stimulant and also used as a drug in India as a counter-irritant (Chopra, Nayer, & Chopra, 1956; Huang et al., 1994). Aqueous extract of the corm of Amorphophallus campanulatus was found to contain D-galactose, D-glucose, 4-O-acyl-D-methyl galacturonate, and L arabinose in a molar ratio 2:1:1:1 (Das et al., 2009a). This heteropolysaccharide showed splenocyte activation. The corm also used in the treatment of acute rheumatism, boils and ophthalmia (Chopra, Nayer, & Chopra, 1956; Kapoor, 2005).

A water-soluble dietary fiber was isolated from Chalcumra (Benincasa hispida) fruit and found to contain D-galactose and D-methyl galacturonate in a molar ratio of 2:1 Das et al., (2009b). The B. hispida exhibits anti-inflammatory and antiulcer activities (Grover, Rathi, Vats, 2000; Grover, Adiga, Vats, Rathi, 2001; Ramesh et al., 1989). Psidium guajava (Guava) is a significant medicinal plant. Its water-soluble polysaccharide (PS-I) was found to contain 2-O-methyl-L-arabinose, 2-O-acetyl-D-galactose, and D-methyl galacturonate in a molar ratio of approximately 1:1:1 (Mandal et al., 2009). Extracts of leaves shows antidiabetic, hypertensive, and antimicrobial effects (Lutterodt et al., 1999; Oh et al., 2005; Ojewole, 2005). Aqueous extract (PS-I) of the unripe (green) tomatoes (Lycopersicon esculentum) consists of rhamnose, arabinose, and galactose in the molar ratio of nearly 1:2:4 (Chandra, Ghosh, Ojha, Islam, 2009). It has medicinal uses for the treatment of rheumatism, severe headache, toothache, burns, scalds and sunburn (Chiej, MacDonald, 1984; Duke, Ayensu, 1985). A water-soluble polysaccharide was isolated from the rhizomes of Curcuma zedoaria, and found to consist of D-glucose, D-galactose, L-arabinose, D-methyl galacturonate, L-rhamnose with a molar ratio of nearly 1:1:1:1:1 (Nandan et al., 2011). It was used as traditional medicine for the improvement of blood circulation, menstrual flow, abdominal cramps and rheumatic pain and also shows anti-cancer and antioxidant properties (Maeda et al., 1984; Ruby et al., 1995; Srivastava et al., 1995). Caesalpinia bonduc (Nata Karanja) is an important medicinal plant widely found in coastal region of India (Kapoor, 2005). A water-soluble arabinan was extracted from endosperm of Caesalpinia bonduc and found to consist of T-Araf, (1→5)-Araf, (1→2,5)-Araf, and (1→2,3,5)-Araf in a relative ratio of approximately 3:2:1:1 (Mandal et al., 2011). Various extracts of leaf and Seed showed antimicrobial, antidiabetic, antipyretic, analgesic, and adaptogenic properties and also used as a potent antifilarial drug (Archana et al., 2005; Chakrabarti et al., 2005; Gaur et al., 2008; Kannur et al., 2006). Manilkara zapota L. (Sapodilla) was cultivated throughout India and its hot water extract consist of 3-O-acyl-L-rhamnose, L-arabinose, 3-O-acetyl-D-methyl galacturonate in a molar

Table 1

Bioactive polysaccharides in Indian medicinal plant

Source	Molecular weight (Da)	Optical rotation $[\alpha]^t_D$	Monosaccharide composition	Biological function	Reference
Lagenaria siceraria	1.67x 10^5	+105.38 (c 0.084, water, 25 ºC)	D-methyl galacturonate: 2-O-methyl-D-xylose: D-xylose=1:1:1		Ghosh et al., 2008
	78,000	+11.6 (c 0.68, water, 25 ºC)	methyl-α-D-galacturonate: 3-O-acetyl methyl-α-D-galacturonate: β-D-galactose = 1:1:1	This polysaccharide showed cytotoxic activity in vitro against human breast adenocarcinoma cell line (MCF-7).	Ghosh et al., 2009
Moringa oleifera	1.96x 10^5	+93.2 (c 0.86, water, 25 ºC)	D-galactose: 6-O-Me-D-galactose: D-galacturonic acid: L-arabinose: L-rhamnose = 1:1:1:1:1		Roy et al., 2007
Solenum melongena	1.92 x 10^5	+128.33 (c 0.87, water, 25 ºC)	Gal:Arab=3:1	It showed splenocyte and thymocyte activations	Ojha et al., 2009
Moringa oleifera	70000	+108.03 (c 0.82, water, 25 ºC)	Glucan	It showed immunoenhancing activities	Mondal et al., 2004

Phaseolus vulgaris L.	1.8×10^5	+112.0 (c 0.86, water, 25 ^oC)	D-galacturonic acid: D-galactose: L-arabinose = 2:2:1	It showed splenocyte, thymocyte activation as well as antioxidant activities	Patra et al., 2012
Litsea glutinosa	1,75,000	+ 36.5 (c 0.85, water, 25 ^oC)	Xyl:Arab=1:3	This molecule showed strong splenocyte, thymocyte, and macrophage activations	Das et al., 2013
Caesalpinia bonduc	62000	+21.78 (c 0.15, Water, 28.6 ^oC)	Glc:Ara=6:7	This molecule showed splenocyte, thymocyte, and macrophage activations	Mandal et al., 2013
Momordica charantia	2×10^5	+168.9 (c .098, H_2O, 29.8 ^oC)	D-galactose : D-methyl galacturonate = 1:4	It showed immunoenhancing activities and also exhibited potent antioxidant activities.	Panda et al., 2015
Andrographis paniculata	1.49×10^5	+26.5 (c 0.85, H_2O, 31 ^oC)	D-xylose: 2-methoxy D-xylose : L- arabinose= 3:1:1	APPS possess ferrous ion chelating activity, superoxide radical scavenging activity, and hydroxide radical scavenging activity	Maity et al., 2019

Table 2

AYUSH recommended Indian medicinal plant for COVID-19 treatment

Indian medicinal plant	**Trade name**	**TIM system**	**Recommended usage**	**Helpful against**
Preventive and prophylactic				
Tinospora cordifolia	Samshamani Vati	Ayurveda	Twice a day with warm water for 15 days	Fever, Immuno-modulatory,
Andrograhis paniculata	Nilavembu Kudinee	Siddha	Decoction 60 ml. twice a day for 14 days	Viral Fevers Including Dengue
Cydonia oblonga *Zizyphus Jujube* Cordia myxa	Behidana Unnab Sapistan	Unani	Twice a day for 14 days	Antioxidant activity, Immuno-modulatory, antiallergic, smooth muscle relaxant activity and Anti-influenza activity
Arsenicum album 30	Arsenicum album 30	Homoeopathy	Daily once in empty stomach for three days. The dose should be repeated after one month by following the same schedule.	Effective against COVID-19; Macrophages activator.
Symptom management of COVID-19 like illnesses				
AYUSH-64		Ayurveda	02 tablets twice a day	Malaria
Agasthya Hareetaki		Ayurveda	05 gm twice a day with warm water	Immunomodulatory, and upper respiratory

				infections
Anuthaila	Sesame oil	Ayurveda	02 drops in each nostril daily in the morning	Respiratory infections
Nilavembu Kudineer	Kaba Sura Kudineer	Siddha	Decoction 60m1 twice a day	Pyretic and Anti bacterial effect
Adathodai Manapagu		Siddha	Syrup 10 ml twice a day	Fever and cold
Btyonia alba	Btyonia	Homoeopathy	Tablets as prescribed by physician	Reduce lung inflammation
Rhus toxico dendron	Rhus tox	Homoeopathy	Tablets as prescribed by physician	Viral infections
Atropa belladonna	Belladonna	Homoeopathy	Tablets as prescribed by physician	Asthma and chronic lung diseases
Bignonia sempervirens	Gelsemium	Homoeopathy	Tablets as prescribed by physician	Asthma
Eupatorium perfoliatum	Eupatorium perfoliatum	Homoeopathy	Tablets as prescribed by physician	Respiratory symptoms
Add on Interventions to the conventional care				
Vishasura kudineer		Siddha	Decoction 60 m1 twice a day	Fever
Kabasura kudineer		Siddha	Decoction 60 m1 twice a day	Fever, cough

Table 3

Indian medicinal plant which might inhibit the SARS-CoV-2 and other Viruses.

Name of plant	Function	Traditional use	Reference
Sphaeranthus indicus Linn.	Anxiolytic, neuroleptic, hypolipidemic, immunomodulatory, antioxidant, anti-inflammatory, bronchodialatory, antihyperglycemic and hepatoprotective activities	Mental illness, hemicrania, jaundice, hepatopathy, diabetes, leprosy, fever, pectoralgia, cough, gastropathy, hernia, hemorrhoids, helminthiasis, dyspepsia and skin diseases.	Galani et al., 2010; Vimalanathan et al., 2009
Cissus quadrangularis	COX activity, different ntioxidant activity, anti-inflammatory activity, cytotoxicity	-	Shaikh, Pund, Gacche, 2016
Plumbago zeylanica	COX activity, different ntioxidant activity, anti-inflammatory activity, cytotoxicity	-	Shaikh, Pund, Gacche, 2016
Terminalia bellarica	COX activity, different ntioxidant activity, anti-inflammatory activity, cytotoxicity	-	Shaikh, Pund, Gacche, 2016
Allium sativum	Viral replication	SARS-CoV	Keyaerts et al., 2007
Terminalia chebulla	COX activity, different ntioxidant activity, anti-	-	Shaikh, Pund, Gacche, 2016

	inflammatory activity, cytotoxicity		
Vitex trifolia	anti-inflammatory and anti-tumor properties	asthma	Liou et al., 2018
Acacia catechu	Antioxidant potential, Inhibition of Cell Viability, Anti-Mycobacterium activity	Tuberculosis (TB)	Tawde, Gacche, Pund, 2012
Boerhavia diffusa Linn.	-	Jaundice, asthma, rheumatism, nephrological disorders, ascites, anemia, and gynecological disorders.	Mishra et al., 2014
Ailanthus excelsa	Antioxidant potential, Inhibition of Cell Viability, Anti-Mycobacterium activity	Asthma	Anon, 1986; Tawde, Gacche, Pund, 2012
T. zeylanicus	antioxidant activity	influenza (H1N1)	John et al. 2015
Aegle marmelos	Antioxidant potential, Inhibition of Cell Viability, Anti-Mycobacterium activity	Tuberculosis (TB), Asthma, cough, bronchitis	Dastur, 1962; Kirtikar, Basu, 1935; Tawde, Gacche, Pund, 2012
Cynodon dactylon Linn	antioxidant activity	neurodegenerative diseases	Auddy et al., 2003
Andrographis paniculata	Antioxidant potential, Inhibition of Cell Viability, Anti-Mycobacterium activity	Tuberculosis (TB), cough, liver injury; SARS-COV	Kabeeruddin, 1937; Tawde, Gacche, Pund, 2012; Liu et al., 2020

Datura metel	Antioxidant potential, Inhibition of Cell Viability, Anti-Mycobacterium activity	Asthma	Tawde, Gacche, Pund, 2012
Cassia fistula L.	Immunomodulatory, antioxidant, hepatoprotective	-	Rahmani, 2015
Nilavembu Kudineer	Antiviral activity	dengue and chikungunya virus	Jain et al., 2018
Pedalium murex	Histopathological effects	Zika virus	Ishwarya et al., 2017
Rheum australe D. Don	Antimicrobial, antioxidative, anti-inflammatory	-	Pandith et al., 2018
Glycyrrhiza glabra	Antiviral effects	SARS	Cinatl et al., 2003; Fiore et al., 2008
Sida cordifolia Linn	antioxidant activity	neurodegenerative diseases	Auddy et al., 2003
Holoptelea Integrifolia	antioxidant, anti-inflammatory, antidiabetic and antibacterial activities		Kumar et al., 2019a,b
C. fenestratum	antioxidant activity	influenza (H1N1)	John et al. 2015
Viola odorata L.	Anti-microbial, anti-fungal	-	Parsley et al., 2018
Evolvulus alsinoides Linn	antioxidant activity	neurodegenerative diseases	Auddy et al., 2003

proportion of nearly 1:1:1 (Mondal, Das, Roy, Islam, 2012). It was used in diarrhea and peludism (Anjaria et al., 2002). Arabinoxylan isolated from rice bran was use as a sensitize human leukemic cells to death receptor (CD95)-induced apoptosis and also possesses the chemo-sensitizing activity against human breast cancer cells (Ghoneum & Gollapudi, 2003; Ghoneum & Gollapudi, 2008). The resources, structural features, and different biological activities of the other medicinal plant polysaccharides were displayed in Table 1.

3. Indian traditional medicinal plants and their possible effect on COVID-19

India being rich in biological diversity often been referred to as the "Medicinal Garden of the world''. India has several systems of traditional medicine, which are being practiced for years together (Ravishankar and Shukla, 2007). This includes Ayurveda, Yoga, Unani, Siddha and Homeopathy (Adhikari, & Paul, 2018). The ministry claimed that 'AYUSH KWATH' formulation can help boost the immune system, the body's first line of defense against bacteria and viruses and recommended four medicinal herbs commonly used in every Indian kitchen - Tulsi (Ocimum sanctum), Dalchini (Cinnamomumzeylanicum), Sunthi (Zingiber officinale), and Krishna Marich (Piper nigrum) (AYUSH, 2020a, b).The Ministry of AYUSH recommended Indian preventive and immunity-enhancing medicinal plants for COVID-19 are shown in Table 3 (AYUSH, 2020c, d). Plant extracts of many cure drugs are used for the treatment of liver disorders (Grabley, Thiericke, 1999). In India a number of medicinal plants are used in liver hepatoprotective drugs in modern medicine such as Punarnava (Boerhaavia diffussa), Arjuna (Terminalia arjuna Rob), kutki (Picrorrhiza Kurrao), Chirata (Swertia chirayita), Amla (Emblica officinalis), Milk thistle (Silybum marianum L.), Shatavari (Asparagus racemosus), Dandelion (Taraxacum officinale), Saffron (Crocus sativus), Nettle (Urtica parviflora), Jatamansi (Nardostachys jatamansi), Fire flame bush (Woodfordia Fruticosa), Kapur Kachri (Hedychium spicatum), Daruharidra (Berberis aristata) (Chaudhary, & Pal, 2011). Six Indian traditional folk medicinal plants such as C. diurnum, O. sanctum, C. papaya, S. villosum, V. negundo, C. inerme are shows antibacterial activity (Bhattacharjee et al., 2011). Patil et al (2011) reported that different Indian medicinal plants such as Benincasa hispida, Beta vulgaris, Caesalpinia bonducella, Citrullu colocynthis, Coccinia indica, Eucalyptus globules, Ficus bengalenesis, Gymnema sylvestre, Hibiscus rosasinesis, Ipomoea batatas, Jatropha curcus, Mangifera indica, Momordica charantia, Morus alba, Mucuna pruriens, Ocimum sanctum, Pterocarpus marsupium, Punica granatum, Syzigium cumini, Tinospora cordifolia, Trigonella foenum graecum shows antidiabetic activities. Mickymaray et al (2016) reported that Indian medicinal plants such as Acalypha indica L. (A. indica), Aerva lanata (L.) Juss. ex Schult. (A. lanata), Clerodendrum inerme (L.) Gaertn., Pergularia daemia (Forsk.) Chiov. and Solanum surattense Burm. f. possessed significant antibacterial activity. Singh et al (2013) reported that Indian medicinal plants like Abelmoschus manihot (L.), Anacyclus pyrethrum DC, Argyreia nervosa, Asparagus racemosus, Asteracanta longifolia, Blepharis edulis Linn., Chenopodium album, Chlorophytum borivilianum, Crossandra infundibuliformis Linn., Curculigo orchioides Gaertn., Leptadenia reticulate Linn., Mimosa pudica Linn., Mucuna pruriens Linn., Nymphaea stellata, Ocimum gratissimum, Paederia foetida Linn., Piper guineense, Polygonatum verticillatum, Spilanthes acmella, Syzygium aromaticum, Tinospora cordifolia, Turnera aphrodisiaca shows aphrodisiac potential. The medicinal plants, Ocimum sanctum, Ocimum gratissimum, Aegle marmelos, and Adhatoda vasica exhibits antibacterial activity (Prasannabalaji et al., 2012). C. fenestratum, T. zeylanicus, E. singampattiana, V. altissima, S. minor, D. albiflorus, S. nux-vomica, C. swietenia, H. isora, A. paniculata, W. tinctoria, C. pedata, S. oblonga and S. reticulata medicinal plants were shows antioxidant activity and use as a drug influenza (H1N1) virus (John et al., 2015). Scartezzini, and Speroni (2000) reported that seven Indian traditional medicinal plants (Emblica officinalis L., Curcuma longa L., Mangifera indica L., Momordica charantia L., Santalum album L., Swertia chirata Buch-Ham, Withania somnifera (L.) Dunal) shows antioxidant activities. Different type of medicinal plants are used in Indian traditional medication are shown in table 3.

4. Summary and future prospects

It is a challenging task for the world, and also for India to stop COVID-19 from spreading. Till the development and application of the vaccine to the entire population, the people in general have no other option than to survive with SARS-CoV-2. Research and development sectors of govt and private research institutions should be encouraged. Intake of certain immune modulating plant derived materials may also effectively protect from the virus to a certain extent. Ayurveda has diverse class of herbs and formulations against each disease. Indian herbal medicine with 1000 years' experience in the prevention of pandemic and endemic infectious diseases, which are also use as a alternative medicine to controlling of patients with COVID-19 infection. Polysaccharides are use in vaccine production already reported, as they are non-toxic, less-cost, easier availability and without any side-effect (Han et al. 2019; Liu et al. 2016; Lindsey, Armitage, Kampmann, & de Silva, 2019; Moreno-Mendieta et al., 2017). So, our main focus is to develop polysaccharide-based COVID-19 drugs/vaccines. At last, it has become a universal challenge for the scientists to discover exact antidote of this extremely infective disease.

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