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COVID-19: Environment concern and impact of Indian medicinal system

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**ABSTRACT**

The COVID-19 outbreak has came in existence in late December 2019 at Wuhan, China. It is declared as an epidemic by WHO. The rationale of this study is to provide the details regarding prevention, environment concern, social economic consequences, and medicines for COVID-19. Social distancing, screening, lockdown, use of mask and application of sanitizer or soap at regular time interval is the best prevention against COVID-19. The “oral-feces” transmission of COVID-19 is threat to environment. Improper disposal of medical/biomedical and human waste may harm the total environment. Nitrifying-enriched activated sludge i.e. NAS approach can play important role to clean the environment compartments like sludge and waste. COVID-19 has shown impact on social and economic life, but there is no alternate until the drug discovery. In medicine or treatment of COVID-19 point of views, an integrated approach between modern and traditional medicine system may ensure an early prevention of further viral spread. Based on the symptoms of COVID-19, list of herbs and drugs of Indian Medicine System has been searched and reported. To develop the potential drug against COVID-19, the detailed experimentation and clinical trials to be performed for future prospective.

1. Introduction

Coronavirus-2 has detained the whole world and declared as an epidemic by World Health Organization (WHO). Coronavirus came in existence in late December 2019 at Wuhan, China. It is an analogue to viral pneumonia and later identified as novel coronavirus pneumonia instigated by novel coronavirus [1]. In taxonomy point of view, Coronavirus is severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). It is single strand RNA based virus and belongs to β – coronavirus having diameter from 80 to 120 nm (Fig. 1) [2]. Based on the recent studies, coronavirus might originate from bat (96.2 % similarity) and the potent intermediate host of SARS-CoV-2 is Pangolin [2,3]. The SARS-CoV-2 has relatively high transmissibility than other β – coronavirus viruses due to higher Basic Reproduction Number [3].

On 24 April 2020, data reported by WHO presented that, the first case was reported in 12 December 2019, and till date 2831915 cases are reported to be infected by this virus which results in 197318 deaths and 807037 has been recovered [4]. On same day, 24530 cases were reported from India with death of 780 individuals with 5408 recovered patients (Fig. 1) [4]. COVID-19 has shown its harsh effects among the European countries including USA, Spain, Italy, France and Germany. Initially China and Italy were the hot spots but currently majority of cases and deaths are in USA with 31.71 % case rate (Fig. 1). It posed a pandemic effect not only to public health but also to world economy. Some positive and negative effects have been seen on environment during this outbreak. It’s a totally new virus and prevention is the best way till the development of drug or vaccine. The aim of the current study is to compile the effects of outbreak on environment. This study includes socio-economic effects and search of drugs and preventive methods like lockdown, social distancing, and sanitization.

2. Transmission of SARS-CoV-2 and impact on environment

One ml of sputum of SARS-CoV-2 has been described to contain approximately 10^9 viral copies [5]. Transmission through close contact is the common way for transmission of SARS-CoV-2. Some studies reported that transmission via aerosol is also a way of transmission [6]. In contrast to this, scientists detected SARS-CoV-2 in the urine, saliva, gastrointestinal and stool samples. Based on computational bioinformatics evidences, it indicates that digestive tract might be a potential route of this infection [3,6]. Consistently, the RNA of this virus was detected in gastrointestinal cells of COVID-19 affected patients [7].
Moreover, it was also detected in conjunctival secretions and tears of covid-19 patients [8,9].

3. SARS-CoV-2 impact on environment

The “oral-feces” transmission of COVID-19 is threat to environment. Detection of SARS-CoV-2 in the human feces is an alarming threat where it can spread to whole compartments of environment through the sewage sludge and waste water [10,11]. There are various countries having more population below the poverty lines and they can’t afford toilets. The detection of SARS-CoV-2 in the human feces and transmission may cause the drastic consequences for the countries having larger slum areas [11]. The bigger problem with slum areas is to maintain of social distancing where area are overcrowded and five or more persons are staying in single room. If virus is not eradicated on early stage it may cause the drastic results. If virus spread on large scale, whole compartments of environments to be rebooted which is impossible task. The environment compartments like surface and ground water, sewage sludge, animals, solids and sediments, waste water, and crops will be effected where depth screening to be required on the transmission of virus to total environment [12]. Improper disposal of hospital waste may spread SARS-CoV-2 so waste management including hospital waste and sewage sludge will be the hot area of future research.

There are few well-known approaches to clean the environmental compartments including waste management [13–25]. Techniques like nitrifying-enriched activated sludge (NAS) approach [26–30], microorganisms based approach [31–33] and conventional activated sludge (CAS) approaches [27–29,30] are most effective to clean the environment. Nitrifying-enriched activated sludge (NAS) approach is considered as best technique for treatment of wastewater and sludge. NAS approach is 2.5 times better than conventional activated sludge (CAS) [26]. NAS approach increase the lifetime (two times) of membrane bioreactors. As wastewater contain low carbon/nitrogen ratio so NAS approach decrease the foul smell and enriched nitrifiers population in membrane bioreactors [26–30].

4. Effect of climatic conditions on SARS-CoV-2

Environmental conditions like temperature pH and humidity are the major factors to access the efficiency of the microorganisms. Under variable climatic conditions, mutation of microorganisms is the other threat [34]. Variable mutagenic capability depends upon several factors, including the fidelity of viral enzymes that replicate nucleic acids. RNA viruses are known for higher mutation rate, upto million times higher than their hosts. As, SARS-CoV-2 is a RNA virus mutate through RNA dependent polymerase (RdRp). Pachetti et al., (2020) has found 8 mutations of SARS-CoV-2 where 5 mutations were found in Europe and 3 mutations were observed in North America. In England (UK), RdRp based mutations were found with median of 3 points mutations (range 2–5 at p value < 0.001). An amino acid composition changing mutation in RdRp were noticed in Italy (Lombardy) with median of 1 points mutations (range 0–3 at p value < 0.001). They has suggest that the virus is evolving and European, North American and Asian strains might coexist, each of them characterized by a different mutation pattern [34].

Fig. 1 exhibited that in comparison to Asian countries, virus become more lethal in European countries [35]. It may be due to the mutation SARS-CoV-2 with change in the climatic conditions. It has been reported that SARS-CoV-2 has mutate itself as per climatic conditions into two forms i.e. L type strain (∼ 70 %) and S type strain (∼ 30 %) [35]. S type virus strain is the mutation form of original L type strains of SARS-CoV-2. S type strain is considered as less lethal than L type of strain [36]. Overall, around 3–4 % is noticed in the mutated strains of SARS-CoV-2. Jahangiri et al. (2020) has performed a study on Iran cities and they reported that there is no relation between temperature and transmission of COVID-19 [37]. They recommended that provinces with populations more than 1.7 millions to inspect in depth to eradicate the COVID-19 [37]. There are various other studies revealed no correlation among the humidity and temperature and transmission of COVID-19 [38–42].

5. Some positive and negative environmental and socio-economic aspects of COVID-19

There are few positive aspects of COVID-19 where environment is becoming pure day by days. Due to lockdown, air quality and noise pollution is decreased consequently total environment is improving. Rivers and sea beaches are becoming neat and clean due to lockdown conditions [43]. The emission of green house gases was found significantly low after the time of World War II which is due the effects of lockdowns [43,44]. It has been reported that the air quality was improved where 55 % particulate matter decreased in India during first lockdown period of 21 days [44]. Monserrate et al., (2020) has reported an environmental study of 367 cities of China. They reported that due to quarantine and lockdowns, NO2 was reduced by 22.8 μg/m3 and 12.9 μg/m3 in Wuhan and China, respectively. PM 2.5 fell by 1.4 μg/m3 in Wuhan but decreased by 18.9 μg/m3 in 367 cities [43]. Sharma et al., (2020) has reported that the concentrations of six criteria pollutants, PM10, PM2.5, CO, NO2, ozone and SO2 during mid March to mid April 2017–2020 in 22 cities covering different regions of India [44]. Overall, around 43, 31, 10, and 18 % decreases in PM2.5, PM10, CO, and NO2 in India were observed during lockdown period compared to previous years. While, there were 17 % increase in O3 and negligible changes in SO2. The air quality index reduced by 44, 33, 29, 15 and 32 % in north, south, east, central and western India, respectively [44]. The other positive aspect learned from COVID-19 was that every country is trying its best to uplift the healthcare services. Various countries have opened new hospitals especially dedicated to the COVID-19 [4,45]. Various countries have strengthened their traditional medicine system to fight against COVID-19. Work from home culture was adopted by various companies which is entirely new culture and new lesson learned from COVID-19.

The major negative aspect of COVID-19 is the social distancing, which may leads to anxiety and frustration [46]. The psychosomatic traits like anxiety and frustration can disturb the immune and COVID-19 has been noticed in patients with weak immune system [47,48]. In the era of 21st century everyone was living fast life and they enjoy their weekends with friends which is curtailed due to lockdowns and social distancing. Unsocial behavior of human is also observed during the outbreak where a rat race for N95 masks was observed [4,45]. Black marketing was noticed due to excess demand of personal protection care equipment was noticed [49]. Attack on COVID worriers was also noticed, consequently, Indian government has to pass the special bill for...
the protections of COVID warriors (https://www.indiatoday.in/india/story/central-govt-ordinance-to-protect-medical-staff-covid19-coronavirus-1669784-2020-04-22). The second and biggest loss is the economic loss which is 2.7 trillion USD [49]. Economy of each country that is being fighting against COVID-19 is worst. COVID-19 may create millions of jobless peoples and cause poverty [43]. The picture of economic backwardness of Asian and African countries will be more drastic than European countries [43]. Also, record downfall was observed in the waste management where recycling sector is blindered totally [43,49]. After lockdown the waste management may become the problem to environment where extra efforts would be required from the governments. The improvement in the air quality, noise pollution, and decrease in the green house gases are the good sign but if waste management is not solved properly the virus can spread through the waste to environment that will be a worst situation to tackle and may cause other problem to total environment.

6. Persistence and inactivation of coronaviruses by disinfectant agents

It has been reported that the major mode of transmission of SARS-CoV-2 is the “faecal-oral” transmission [10]. To prevent the further transmission of virus applications of hand rubs or hand washing and sanitization of environment is an important aspect. As per recent reports, human coronavirus has lifetime from 2 h to 9 days on different surfaces of materials like glass, metal, wooden, and plastic [8,9]. Coronaviruses life-time might be reduced at higher temperature i.e. more than 30 °C and lower humidity i.e. less than 30 %. Recent report revealed that ethanol (60–95 %), 1-propanol (70–95 %) and 2-propanol (65–95 %) can inactivate the coronaviruses strains/ isolates SARS-CoV & Middle East Respiratory Syndrome (MERS-CoV) within 1 min with log10 value from 2.7 to 5.5 [5,8,9]. Glutaralddehyde (0.5 %) can inactivate the coronaviruses strains/ isolates SARS-CoV within 2 min with log10 value more than 4.0. Povidone iodine (0.23–7.5 %) can inactivate the coronaviruses strains/ isolates SARS-CoV and MERS-CoV within 30 s to 5 min with log10 value more than 3.0. They reported that glutaralddehyde (0.5–2.5 %), formaldehyde (0.7–1 %) and combination of 2-propanol (45 %) with 1-propanol (30 %) is also effective against various virus strains [5,9].

Kevin-Tyan et al., 2018, reported that three surface disinfectants sodium Dichloroisocyanurate (0.5 %) sodium hypochlorite (0.5 %), & calcium hypochlorite (0.2 %), are capable to deactivate the coronavirus [50]. In addition, these surface disinfectant have antimicrobial potential against three strains viz. *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Vibrio cholera* [50]. It is reported that disinfectant agents like ethanol (> 60 %), sodium hypochlorite (0.1 %) and hydrogen peroxide (0.5 %) can deactivated it within 1 min. Ochwooto et al., (2015) has check the antibacterial potential of market based hand sanitizers on three strains viz., *Pseudomonas aeruginosa* (ATCC 27853), *Staphylococcus aureus* (ATCC 25923) and *Escherichia coli* (ATCC 25922). They reported that 50 % hand sanitizers having ethanol as active ingredient have shown significant antibacterial activities [51].

In chemistry and chemical properties point of views, ethanol is superior over other alcohols. Ethanol is known as green solvent having minimum environmental hazards [52]. So ethanol based sanitizers could be a better option having concentration more than 60 %. Also, ethanol is superior over other disinfectant reported in various study due to its lower skin irritation. Antimicrobial feature of ethanol based sanitizers make them more attractive choice [51,52]. Ethyl alcohol is the only solvent having miscibility in polar and non-polar solvents so it can inactivate hydrophilic and lipophilic microorganisms like fungi, bacteria, viruses etc. The most feasible explanation of the mode of action of ethyl alcohol is the denaturation of protein of microorganisms where alcohol destroys the dehydrogenases of microorganisms. It is reported that inactivation of microorganisms increase when the mixture of ethyl alcohol and water is applied [53].

The choice of components for the WHO-recommended handrub formulations takes into account cost constraints and microbialic activity [54,55]. To produce final concentrations of ethanol 80 % v/v, glycerol 1.45 % v/v, and hydrogen peroxide 0.125 % v/v for 833.3 mL ethanol (purity 96 %), 833.3 mL; 41.7 mL hydrogen peroxide (purity 3 %), and 14.5 mL glycerol (purity 98 %) into a 1000 mL graduated flask. Makeup the final volume upto 1000 mL with distilled water or water that has been boiled and cooled, shake the flask gently to mix the content till homogeneous mixture. In above method, ethanol can be replaced with isopropyl (with a purity of 99.8 %), 751.5 mL to prepare the isopropyl based hand sanitizer. It has been noticed that sometime manufactures add the coloring agents to make the formulations more attractive. It is quite cleared that hand sanitizers are equally effective without any coloring agents. The choice of coloring agents should be natural one, instead of addition of dyes and other toxic compounds [54–56]. These synthetic coloring agent may be carcinogenic, even these cause the skin problems including skin cancer.

Bleach or Sodium hypochlorite (0.1 – 0.5 %) may be used to deactivate coronaviruses on various surfaces and same is recommended by [4,45]. Sodium hypochlorite is very cheap chemical and easily available in market. Chemistry and chemical properties of bleach sodium hypochlorite should be known before its application. Bleaching agents are effective and strong disinfectant with antimicrobial activities [54]. The active ingredient in bleaching powder is sodium hypochlorite which is highly effective in killing fungi, Viruses and bacteria including influenza virus [54,56]. Diluted bleach household products disinfect within 10–60 min of contact time with these microbes, and is recommended and proven as disinfectant in health-care sectors [57]. However, it irritates mucous membranes, the airways and the skin, and readily decomposes under sunlight exposure. It is highly reactive in nature and form toxic complexes with other compounds. Therefore, it should be used with precautionary measures i.e. proper ventilation and consistent with relevant safety guidance and occupational health [57]. Improper and excessive use of bleaching agents, including deviation from recommended dilutions (either weaker or stronger), may increase toxicity to health care workers and different ecosystems [54]. Overall, ethanol is green solvent and sodium hypochlorite is cheapest chemical also both can deactivate the coronaviruses within one minutes and same is expected in case of SARS-CoV-2.

7. Medicines against COVID-19

The present pandemic condition Covid-19 is an extremely new challenge to all medical science, since no vaccine or established treatment is available for this disease. Researchers are going on very spectrally in this direction still it’s not possible to say that up to when a standard and authentic treatment will be available for the humanity. An integrated approach has been used by China to eradicate or curb this SARS-CoV-2. During COVID-19, on 85 % patients, China has used their traditional medicines along with allopathic drugs [58].

7.1. Allopathic drugs for COVID-19

There is no sure therapy is used for COVID-19. There are various perused antiviru and antiviral drugs were used against COVID-19. Various countries and their pharmaceutical firms are trying to find the vaccine or drug for COVID-19. Drugs like lopinavir, remdesivir, oseltamivir, ganciclovir, ribavirin, chloroquine, hydroxychloroquine favi-piravir, nelfinavir, arbidol, remdesivir and galidesivir are being examined by various countries for COVID-19 treatment [59,60]. The combination of remdesvir and chloroquine, and tenofovir disoproxil and lamivudine is reported as effective against COVID-19. The combination of lopinavir and ritonavir has shown positive response on the COVID-19 patients [61,62].
7.2. Indian traditional medicines with the possibilities to combat against Covid-19

Indian traditional medicine system which includes Ayurveda, Siddha, Unani, Yoga, Naturopathy and Homeopathy can treat wide class of diseases. Indian medicine system is more than 5000 years old and well documented system [63–70]. The major sources of drugs of Indian Medicine System are plants, minerals and animal products. About 25,000 plant based formulations have been used in folk remedies in Indian medicine [71]. Since the inception of allopathic system, traditional medicine system was ruined day by day consequently the translational prospective are habitually misjudged.

To tackle the situation, preventive as well as therapeutic approach for COVID-19 suggested by Ministry of AYUSH is under Table 1. List of drugs/ herbs/ plants suggested by Ministry of AYUSH at three levels namely, Preventive and Prophylactic, Symptomatic Management for COVID-19 and Add on interventions to the conventional care are explained under Table 1. Drug suggested under Table 1, exhibited the medicinal functions like anti-viral, anti-inflammatory, anti-microbial, immunomodulatory, respiratory infections, fever, cough and cold [72–78].

As like modern system, under Table 1 prevention is mentioned as prime most step. Traveler screening, social distancing and use of mask (N95 preferably for hospital staff) are the most significant steps mentioned in advisory of modern and traditional medicinal system. It has been reported that traveler screening is depends upon the contact history with COVID-19 patient and incubation time. The social distancing and applications of mask may prevent large society for long time with minimum transfer of disease [45]. In Indian Medicine System, additional preventive steps are also mentioned like fumigation (doopan) and sanitization of natural herbs like Azadirachta indica, Cinnamomum camphora (L.), Lauraceae, Hymenaea verrucosa Gaertn., Leguminosae, Santalum album L., Santalaceae, Rosa damascena Herrm., Rosaceae, etc. [75–85].

It has been reported that SARS-CoV-2 mainly transmitted through nose and throat [86,87]. Herbs of Indian Medicine System like Crocus sativus L., Emblica officinalis, Ocimum sanctum, Tinospora cordifolia, Curcuma longa L., Trachyspermum ammi, Piper longum and Zingiber officinalis may reduce the risk of throat infection and kill microorganisms [65–78]. Application of Glycyrrhiza glabra, Trachyspermum ammi, and honey are well mentioned in Ayurveda for throat infection [85,88]. Rhezones of Zingiber officinalis and seeds of Piper nigrum with honey have wide applications for throat infection [79–85,89]. Glycyrrhiza glabra, Trachyspermum ammi, Zingiber officinalis and Piper nigrum have antivirus activities and may be helpful for COVID-19 prevention also [75–83,88,89]. To inhibit the virus attack through nose application of sesame oil into the nostrils is advised under Table 1. Though mechanism of action is not mentioned, but in chemistry point of view low surface tension of sesame oil and hydrophobic nature [90]. Viscous nature of oil make the flow of virus droplet typical and due to hydrophobicity, droplets capture in the nostrils. So simultaneous processes might not allow the virus to pass to throat and respiratory system. Application of oil prepared in Ficus religiosa leaves through nostrils may reduce the transmission of virus. This is the hypothetical concept and more research is required to establish the mode of action of sesame oil, coconut oil, anu tailed etc. into the nostrils [90]. Recently, it has been reported that transmission through nose is the major way of virus transmission and in future administration of drug or vaccine through nose will be more effective [87].

7.3. Treatment possibilities with ayurveda: immunity boosting

Ayurveda is a very renowned and ancient traditional medicinal system of India which has been practised over thousands of years. It provides both preventive and curative aspect of treatment for most of the diseases. The concept of treatment of Ayurveda for any illness is to balance the three body humors (Vata, Pitta and Kapha), to optimize the Ojas (immunity level) by correcting the Agni (metabolism) by which further enhancing the Dhatu Sarata (quality of body tissue at different level). As mentioned by Sushruta without the vitiation of any of three Dosha no disease can emerge so it is advised to treat the disease with the characteristic symptoms of the relevant Dosa (Sushruta). Along with the prevention, Ayurveda has the potency to manage the patho-physiological conditions of the patient infected with Covid-19 having mild
to moderate symptoms [70–83].

Though till now no vaccine has been developed against Covid-19 and the modern system of medicine is trying to manage only on symptomatic base line of treatment with available antiviral drugs, intensive care is being provided to the patient in advanced stage. Till date more than 2332568 cases are confirmed across the world out of them 600115 are recovered and total 160791 are dead. If we see the data, approximately 79 % cases are recovered with or without medication where 17 % cases have mild symptoms and 4–5 % cases are critical [4]. This indicates the role of immunity against the disease where more than 75 % cases existing in case of COVID-19 [91,92]. This is the core area where Ayurveda can really impact hard. To boost the immunity, an advisory was issued by the ministry of AYUSH under the guidance of sixteen eminent traditional doctors (https://www.ayush.gov.in/docs/123.pdf). Studies revealed that stress can disturb the immune system which is known as psychoneuroimmunology effect [93]. Psychoneuroimmunology is a scientific term where stress and emotional disorders disturb the immunity and leads to infection [93]. Mental stress can disturb the respiratory system [47]. Due to COVID-19 pandemic large population including corona warriors (health workers, police, paramedical staff etc.) and corona patients are under stress [43]. Rajkumar, (2020) explained that the preventive steps mentioned in advisory of AYUSH ministry has its own Psychoneuroimmunology effects and having scientifically validated positive response which are as [46,48]:

- Yoga practice leads to physical fitness. Drinking of lake-warm water will act as cleansing agent for body.
- Use of nutrient rich cumin, garlic and turmeric will promote the health.
- Ayurvedic Rasayana like chyawanprash has body rejuvenation effects.
- Use of herbal tea ( Ocimum sanctum leaves 4 parts, Cinnamomum zeylanicum stem bark 2 parts, Zingiber officinale Rhizome 2 parts and Piper nigrum fruits 1 parts) is a specific remedy for cough.
- Golden milk (turmeric in milk) is healthy drink where golden color symbolizes health and prosperity.
- Use of sesame oil or coconut oil or ghee is healing agent with coolant properties. Gargling with oil and Trachyspermum ammi extract has positive responses in throat infections.
- Use of clove powder with brown sugar or honey is traditional therapy for throat infection. Inhalation of mint has positive response in respiratory disease.

The mechanism behind the above positive responses is the control of psychoneuroimmunological responses of body like reduction of anxiety, depression, stress retort, monoamine function and parasympathetic activities etc. [46–48,83].

7.4. Major herbs and formulations in Indian medicine system for COVID 19

There is wide class of Indian medicinal plants having potential to cure variety of illness. Few of them commonly used Indian medicinal plants involved in respiratory diseases are mentioned under Table 2 having immunomodulatory, anti-inflammatory, anti-microbial, anti-virus, anti-pyretic, and anti-pneumonia activities. In Ayurveda there are diversity of herbs and formulation for immunomodulatory effects like Mangifer indica, Withania somnifera, Shilajit, Emblica officinalis, Ocimum sanctum, Tinospora cordifolia, Curcuma longa L., Piper longum and Boerhaavia diffusa, of which Tinospora cordifolia and Ocimum sanctum have been extensively studied [68–83]. Ayurveda has wide class of herbs and advanced medicines for antipyretic and anti-inflammatory disease [80,83]. Various invitro studies has revealed that Indian medicinal plants like Allium sativum [68], Andrographis paniculata [74], Clerodendrum inerme Gaertn [94], Glycerrihiza glabra [88], Sphaeranthus indicus [95,96], Strobilanthes callosa [83], Strobilanthes cusia [73], Vitex trifolia [73,97] and Zingiber officinale [82,89] are potent against the

| Plant/Herb                  | Function                                  |
|-----------------------------|-------------------------------------------|
| Glycyrrhiza glabra          | Immunomodulatory, Anti-inflammatory, Anti-viral, Cough and Cold |
| Alstonia scholaris L.       | Immunomodulatory Anti-viral, and Bronchial infections |
| Pieris bina, roaa           | Immunomodulatory Anti-viral and Bronchial infections |
| Swertia chirata             | Immunomodulatory and Bronchial infections |
| Casalpina cristia           | Anti-viral activity, Immunomodulatory and Bronchial fever |
| Abutilon indicum            | Immunomodulatory function |
| Cinnamom                    | Immunomodulatory, Anti-inflammatory, Anti-microbial |
| Curcuma longa L.            | Immunomodulatory, Anti-inflammatory, Cough and Cold |
| Emblica officinalis         | Immunomodulatory, Anti-inflammatory, Anti-viral |
| Indigoforantciscia          | Immunomodulatory, Anti-inflammatory |
| Piper Nigrum L.             | Immunomodulatory, Anti-inflammatory, Anti-virus |
| Tinospora cordifolia        | Immunomodulatory, Anti-inflammatory, Anti-virus, Antipyretic |
| Withania somnifera          | Immunomodulatory, Anti-inflammatory, Anti-virus, Antipyretic |
| Achyranthes aspera          | Anti-viral activity |
| Achillia mellefolium        | Protects upper respiratory tract from viral infections |
| Aapiangraveolens            | Anti-bacterial and anti-viral agent |
| Borassusflabellifer         | Pulmonary infections: anti-bacterial and anti-viral activity |
| Cymbopogon citratus         | Anti-viral infections |
| Casalpinanoboudac           | Treated for asthma (Anti-bacterial and anti-viral agent) |
| Calotropis gigantea         | Anti-bacterial and anti-viral agent |
| Coccus sativus              | Treated for asthma and cough |
| Euphorbia hirta             | Anti-bacterial and anti-viral agent |
| Ocimum sanctum              | Anti-viral, Anti-inflammatory, Anti-microbial, Immunomodulatory |
| Solanum natures             | Anti-viral activity |
| Syzygium aromaticum         | Anti-viral and Anti-inflammatory activity |
| Trachyspermum Ammi          | Anti-viral and Anti-microbial activity |
| Thymus linearis             | Anti-viral activity |
| Cayratiaapadata             | Anti-inflammatory activity |
| Cayratiaapadata             | Anti-inflammatory activity |
| Eugenia singapamattiana     | Anti-inflammatory activity |
| Salacia reticulata          | Anti-inflammatory activity |
| Strychnos minor             | Anti-inflammatory activity |
| Strychnosaxx vocma          | Anti-inflammatory activity |
| Santalum albus              | Anti-inflammatory of the lungs |
| Vitex altissima             | Acts against acute inflammation |
| Wrightianictoria            | Anti-inflammatory activity |
| Yuthog's Bamboo             | Anti-inflammation of the lungs and respiratory tract |
| Zingiber officinale         | Anti-viral activity, Immunomodulatory and Bronchial infections |
| Hippapharaoconoides         | Eliminate phlegm, cough, improve digestion |
| Mucuna pruriens X. strumianum | Anti-pneumonia drug |
| Piper longum                | Anti-pneumonia drug |
| Solanum torum               | Treated for cough |
| Morus laevigata Wall. Brandis | Treated for cough |
| Geranium wallchianum        | Treated for cough |
| Micromeriabiflora          | Treated for cough and bronchitis |
| Prumila denticulata Sm.     | Treated for cough and bronchitis |

Severe Acute Respiratory Syndrome coronavirus (SARS-CoV). It has been reported that these herbs can inhibit or suppress or reduce the virus (SARS-CoV) growth through the inhibition of protein replication of SARS-CoV. These herbs and/or their formulations may show some effects against the SARS-CoV2.

The main symptoms of the COVID-19 patients are fever, dry cough, pneumonia, throat infection, body ache, respiratory diseases etc [1–4].

The major cause of infection is the weak immune system.
words, stronger the immune less chances of infections. So, there is need to build immune first. In Indian Medicine of System, there is wide list of immunomodulatory herbs and formulations [68–83]. Notably, as per the symptoms of the COVID-19, in Ayurvedic Formulary of India, wide class of herbs and its advanced formulations has been mentioned for curing related ailments like body ache (angamarda), chronic cough (jirna kasa), chronic fever (jirna jvara), pneumonia (svasana jvara), throat infection (gala visa), and respiratory diseases (swasana roga). Major formulations include Amritarista, Amritarishta Kadha, Amritottara Kashaya, Ashwagandha Churna, Ayush 64, Bilwadi Vatti, Chatturthaka Jvararahara Kwath, Chayawanprash, Dasmularishta, Dhanwantra Vatti, Draksharishta, Ekotharavrudhima, Godanti Bhasma, Guduchi Vatti, Haridrakhanda, Kanthakari Avaleha, Lavagadi Vatti, Lakshmilasaa Rasa, Mahasudarshan Kadha, Mahasudarshan Ghanvati, Mrityunjaya Rasa, Pathyadi, Kashayam, Pippali Churna, Pravalanchodrayada, Sameerapanaaaga Rasa, Sanjeevani Vatti, Siphaladali Churna, Talisadi Churna, Tribhuvana Kiriti Rasa, Vaikrantabadda Ras, Vayoshadi Vatti, and Yastimadhu Vatti [68–83]. List of above mentioned herbs and drugs are also recommended by the maximum Ayurvedic physician in an online survey conducted by Panda et al. (2020). More than 100 Ayurvedic physician has contributed in this survey and they suggested medicine based on their clinical experiences [77].

8. Conclusion and future perspectives

COVID-19 is an extremely new challenge to medical science. No correlation among the humidity and temperature and transmission of COVID-19 was noticed. The main example is Iran where COVID-19 at its peak point even at hot environment. The main recommendation is the screening and prevention of most populated areas. It is a smart virus enable to mutate itself L or S type which is the important factor while its peak point even at hot environment. The main recommendation is correlation among the humidity and temperature and transmission of COVID-19, in Ayurvedic Formulary of India, wide class of herbs and its advanced formulations has been mentioned for curing related ailments like body ache (angamarda), chronic cough (jirna kasa), chronic fever (jirna jvara), pneumonia (svasana jvara), throat infection (gala visa), and respiratory diseases (swasana roga).

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