



## Review Article

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# Potentiality and possibility of Medicinal Plants on Ayurvedic Principle in prevention and treatment of COVID-19

Binay Sen<sup>1\*</sup>

<sup>1</sup> Assistant Professor, Department of Dravyaguna, Faculty of Ayurveda, Institute of Medical Sciences; Banaras Hindu University, Varanasi-221005 (UP), India

## ABSTRACT

The novel coronavirus disease 2019 (COVID-19) is a pandemic health emergency, caused by the severe acute respiratory syndrome corona virus-2 (SARS-CoV-2). Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people and those with underlying some medical problems are more likely to develop serious illness. Considering different classical and contemporary viewpoints, the newly identified COVID-19 can be categorized under *agantuja vyadhi* (exogenous disease) by inception, caused by *bhoota* (organisms), and transforming to *nija* (endogenous) leading to disequilibrium of *kapha*, *vata*, and *pitta doshas* and manifestation of clinical features of mainly *pranavaha* (cardio-pulmonary system), *rasavaha* (cardio-vascular system) and *raktavaha* (vascular and RES) *srotas dushti* (vitiation of channels). In Ayurveda, for a new disease, the treatment principle is designed on the basis of the nature of the disorder, etiology and location. Hence *rasayana* drugs for epidemic disease, disinfectants for microorganism, *dosha* (mainly *kapha* and *vata*) pacifying drugs and disease-location specific treatment i.e *deepana* (stomachic), *pachana* (digestive), *shwasahara* (anti-dyspnea) and *kasahara* (anti-cough) are being discussed in this paper. Apart from this, potential of *mukhavaishadyakara* (mouth cleansing agent), *patimarsha-nasya* (nasal smearing), *krimighna* (anti-viral), *vishaghna* (anti-toxic) and *kshara* (alkali) *dravya* (medicinal plants) are being highlighted as these groups of drugs are effective in subsiding *kapha*, *vata*, killing microorganism and protecting *ojas* (immunity) by virtue of their broad spectrum pharmacodynamic properties.

**Keywords:** Coronavirus, *Rasayana*, *Shwasahara*, *Vishaghna*, *Krimighna*, *Kshara*.

## INTRODUCTION

The novel coronavirus disease 2019 (COVID-19), caused by the Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), is in the midst of worldwide panic and global health concern since December 2019 [1]. As of 26<sup>th</sup> May, 2020, the World Health Organization (WHO) has reported 5,404,512 laboratory confirmed and 343,514 death cases worldwide [2]. In India, as on 27<sup>th</sup> May, 2020, the total confirmed cases figured to 1,47,429 with 4,337 deaths [3]. At this time, there are no specific vaccines or treatments for COVID-19. Various drugs are being developed at an extremely quick pace and new targets are being identified every day, and numerous drugs are also undergoing clinical trials. Researchers are very curious about how to provide the best protection to the public before a vaccine can be made available [4].

The Ministry of AYUSH has introduced measures to manage the outbreak of COVID-19 through different preventive and prophylactic measures. Out of which improving the immunity and simple remedies based on the symptoms have been focused and subsequently issued advisory on immune boosting measures and common medicinal plants used in symptoms like COVID-19 [5]. Ministry also invited short term research plan proposal from the AYUSH scholars in this regard [6]. The Central government of India has planned to conduct population-based study to collect evidences of AYUSH interventions [7]. In international set up, WHO has also launched "Solidarity", an international clinical trial to help find an effective treatment for COVID-19 [8].

Despite worldwide efforts to control it, the pandemic is continuing to spread and hence there is sought from the different scientific communities for Indian medicinal plants as potential drugs for prophylaxis and treatment of COVID-19. In this paper, an effort has been made to explore the potentiality and possibility of some medicinal plants in prevention and treatment of COVID-19.

## MATERIALS AND METHODS

An extensive literary search of Brihat-trayee (Charaka Samhita, Sushruta Samhita and Ashtanga Samgraha/Ashtanga Hridaya) along with commentaries, literatures on medicinal plants has been conducted to collect classical references of potential medicinal plants (drugs) and disease similarity on Ayurvedic principle to correlate COVID-19. Multiple databases (Science Direct, PubMed, Google Scholar) were also

\*Corresponding author:

Dr. Binay Sen

Assistant Professor, Department of Dravyaguna, Faculty of Ayurveda, Institute of Medical Sciences; Banaras Hindu University, Varanasi-221005 (UP), India  
Email: senbinay[at]bhu.ac.in

reviewed for the related published works. Relevant health advisories, guidelines and information on COVID-19 issued by different national and international health organization/ agencies were also consulted and considered for preparing this review article.

### Etio-pathogenesis

It is caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). The COVID-19 virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness [9].

Study reported that patients infected with COVID-19 showed higher leukocyte numbers, abnormal respiratory findings, and increased levels of plasma pro-inflammatory cytokines [10]. The main pathogenesis of COVID-19 infection as a respiratory system targeting virus was severe pneumonia, RNAemia, combined with the incidence of ground-glass opacities, and acute cardiac injury. Significantly high blood levels of pro-inflammatory cytokines and chemokines were noted in patients with COVID-19 infection [11].

### Symptoms

People with COVID-19 have had a wide range of symptoms ranging from mild symptoms to severe illness. Symptoms may appear 2-14 days after exposure to the virus. People with these symptoms may have COVID-19:

- Fever or chills
- Cough
- Shortness of breath or difficulty breathing
- Fatigue
- Muscle or body aches
- Headache
- New loss of taste or smell
- Sore throat
- Congestion or runny nose
- Nausea or vomiting
- Diarrhea [12].

In Ayurveda, it is referred that the diseases are innumerable and nomenclature to all disease is not possible. The reason behind that same vitiated *dosha* causes various disorders according to variation in etiology and location [13, 14]. Considering different classical and contemporary viewpoints, the newly identified COVID-19 can be categorized under *agantuja vyadhi* (exogenous disease) by inception, caused by *bhoota* (organisms) [15, 16], and transforming to *nija* (endogenous) causes disequilibrium of *kapha, vata* and *pitta doshas* [17]. The analysis of clinical manifestation and ongoing disease progression, the COVID-19 may be considered as *vata-kapha pradhana tridoshaja vyadhi* that mainly involves *pranavaha, rasavaha, raktavaha srotas* and the disease located to the respiratory system. The overall picture of the newly identified disease could be presented in Ayurvedic viewpoint as shown in the Table (Table.1, Table.2).

**Table 1:** Showing inter-correlation of pathogenic components

Sl.No.	Pathogenic markers (Modern medicine)	<i>Srotas dushti</i>	<i>Dosha</i> involved
		Ayurvedic viewpoint	
1	Respiratory changes (pneumonia, opacities)	<i>Pranavaha</i> [18]	<i>Pitta</i> and <i>Kapha</i>
2	Higher leukocytes, increased pro-inflammatory cytokines and chemokines	<i>Raktavaha</i> and <i>Rasavaha</i> [18, 19]	<i>Pitta</i>

**Table 2:** Showing inter-correlation of symptom with pathogenic component

Sl.No.	Symptoms	<i>Dosha</i> responsible	<i>Srotas dushti</i>
1.	Fever	<i>Pitta</i>	<i>Rasavaha</i> [18, 20]
2.	Chills	<i>Vata</i> [21]	-
3.	Cough	<i>Vata</i> and <i>Kapha</i>	<i>Pranavaha</i> [18]
4.	Shortness of breath or difficulty breathing	<i>Vata</i> and <i>Kapha</i>	<i>Pranavaha</i> [18]
5.	Fatigue	-	-
6.	Muscle pain or body aches	<i>Vata</i>	<i>Rasavaha</i> [18, 20]
7.	Headache	<i>Vata</i> [22]	-
8.	New loss of taste	<i>Vata</i>	<i>Rasavaha</i> [18, 20]
9.	New loss of smell	<i>Vata</i> [23]	-
10.	Sore throat	<i>Kapha</i> [24]	-
11.	Congestion or runny nose	<i>Tridosha</i>	<i>Pratishyaya</i> [25]
12.	Nausea or vomiting	<i>Kapha</i>	<i>Annavaha, Rasavaha</i> [18, 20]
13.	Diarrhea	<i>Tridosha</i>	<i>Purishavaha</i> [18]

### Treatment Protocol

Treatment provided to the affected individuals is mainly symptom based, and the seriously ill individuals are provided with organ support [26, 27]. It is also suggested to take all possible measures to prevent and slow down transmission of COVID-19 virus. Since the development of vaccines and drugs will take at least a few months, drugs which have been proven to be safe for humans can be repurposed to treat this disease. The majority of the drugs used for treatment worldwide by the modern medicine falls under any of the antiviral drugs, antimalarial drugs, anti-HIV drugs, anti-inflammatory drugs and monoclonal antibodies [1]. The Ministry of AYUSH, India has issued an advisory on coronavirus, focusing on prevention through lifestyle modification, dietary management, prophylactic interventions for improving the immunity and simple remedies based on presentations of the symptoms. The AYUSH approach to manage the outbreak broadly comprise of three components namely preventive and prophylactic, symptom management of COVID-19 like illnesses and add on interventions to the conventional care. Common medicinal plants useful in similar symptoms like *Tulsi (Ocimum sanctum)*, *Guduchi (Tinospora cordifolia)*, *Ginger (Zingiber officinale)* and *Turmeric (Curcuma longa)* are also referred [5]. The Ministry also notified to undertake short term research in prophylactic measures, intervention during the quarantine,

asymptomatic and symptomatic cases of COVID-19, public health research, survey, and laboratory based research to generate evidence [6]. The 'Ayush Kwath' consists of *Tulsi (Ocimum sanctum)*, *Dalchini (Cinnamomum zeylanicum)*, *Shunthi (Zingiber officinale)* and *Maricha (Piper nigrum)*, is another initiative which has been promoted for commercial manufacturing by ASU drug manufacturers as an immunity boosting measures in the wake of COVID-19 outbreak [28]. As there is no recognized and approved treatment for COVID-19 worldwide, the medicinal plants described in Ayurveda have the potential owing to their time tested use, large number of classical references, scientific publications and fundamentals of drug mechanism.

### Ayurvedic Principle of medicinal plants selection

Ayurveda imparts knowledge about the *dravya* (drugs of plant, animal and mineral origin) along with their properties and actions [29]. It is stated that the best physician is who knows the external and internal application, combination and rational administration of the *dravya* according to place, time and individual constitution of the person [30, 31]. The drug is effective due to its intrinsic composition (*dravya-prabhava*), properties (*guna-prabhava*: by virtue of *rasa*, *guna*, *vipaka* and *veerya*) and both combined together [32]. The *rasa* (special sense of taste), *guna* (property), *vipaka* (biological transformation), *veerya* (potency) and *prabhava* (specific potency) are the main pharmacodynamic properties by which a drug exerts its action [33]. For a new disease, the treatment principle is designed on the basis of *prakriti* (nature), *samutthana* (etiology) and *adhishtana* (location) of the disorder [34]. Hence, selection of a single drug or group of drugs should be considered after examining the nature of the disorder; epidemic, etiology; the *bhoota*-microorganism being the origin with subsequent involvement of *tridosha* and location; the respiratory system. For an epidemic diseases, use of *rasayana* drugs [35], disinfectants for microorganism [36] along with use of *dosha* (mainly *kapha* and *vata*) pacifying drugs and disease-location specific treatment i.e *deepana* (stomachic), *pachana* (digestive), *shwasahara* and *kasahara* will be effective in this condition. Apart from this, potential of *mukhavaishadyakara*, *patimarsha-nasya*, *krimighna*, *vishaghna*, *dhoopana* and *kshara dravya* are being highlighted as these groups of drugs are effective in subsiding *kapha*, *vata*, killing microorganism and protecting *ojas* (immunity) by virtue of their broad spectrum of pharmacodynamic properties.

### Deepaniya (stomachic)-Pachaniya (digestive) Dravya

The drug that stimulates digestive fire and promotes gastric secretion for digestion known as *deepana* and *pachana* respectively [37]. *Katu* and *Tikta rasa* possess stimulant and digestive property [38, 39]. *Agni* (the body/ metabolic fire) plays important role in *jatharagni-paka* (gastrointestinal digestion) and *bhootagni* as well as *dhatwagnipaka* (cellular metabolism) [40, 41, 42]. Lifespan, strength, health, immunity, vital breath etc depend on normal body-fire and its derangement leads to disease condition [43]. Therefore the maintenance of *agni* is important to boost up immunity and reserve the vital breath in COVID-19 patients. Some drugs of *deepaniya mahakashaya* and *pippalyadi gana* like *Pippali (Piper longum Linn.)*, *Maricha (Piper nigrum Linn.)*, *Shunthi (Zingiber officinale Roxb.)*, *Jeeraka (Cuminum cyminum Linn.)*, *Chitraka (Plumbago zeylanica Linn.)*, *Hingu (Ferula narthex Boiss)* and *Ativisha (Aconitum heterophyllum Wall)* [44, 45] can be listed in this category.

### Rasayana (immunity boosting) Dravya

With the practice of *Rasayana*, one attains longevity, regains youth, vitality and vigour, get sharp memory, intelligence, freedom from disorders, excellence of lustre, complexion, optimum strength of physique and sense organs [46]. It is anti-ageing [47], increases body immunity against diseases [48], also curative to all psycho-somatic diseases [49] and one of the major treatment protocols for epidemic diseases [35]. *Ojas* is referred as *bala* [50], and in the present context, immunity boosting by *yuktikrita bala* [51] can be considered, which is obtained by proper diet, behaviors and use of *rasayana dravyas* [52]. Modern researchers have proved that medicinal plants listed as *Rasayana* possess adaptogenic properties, non-specifically activate the reticulo-endothelial system (RES) and other components of the immune system as well [53, 54]. *Rasayana* act as antioxidant, anti-stress, anti-inflammatory, anti-microbial, vaccine adjuvant and confer immunity against diseases [55]. In the selection of *rasayana*, it is to be kept in mind that the drugs preferably should have anti *kapha-vata*, *shwasa-kasahara* property so that effective in respiratory problems in the patient of COVID-19. *Bhallataka (Semecarpus anacardium Linn.)* [56], *Pippali* [57], *Vidanga (Embelia ribes Burm)* [58], *Ashwagandha (Withania somnifera Linn.)* Dunal [59, 60], *Punarnava (Boerhavia diffusa Linn.)* [61], *Gokshura (Tribulus terrestris Linn.)* [62], *Lashuna (Allium sativum Linn.)* [63] are few examples in this category. *Sarvopaghata-shamaniya* (pacifying all afflictions) *rasayana*, like *Yasthimadhu (Glycyrrhiza glabra Linn.)* *Amalaki (Embilica officinalis Gaertn)*, *Guduchi* [64], *Vidari (Pueraria tuberosa DC.)* [65] and *medha-ayushkamiya* (desiring for intellect and longevity) *rasayana* like *Chitraka* [66], *Vacha (Acorus calamus Linn.)* [67], *Vasaka (Adhatoda vasica Nees)* [68] may also be considered.

### Shwasaha (anti-dyspnea) and Kasahara (anti-cough) Dravya

These groups of drug have particular affinity to the respiratory system and used in dyspnoea, cough chest tightness, haemoptysis and other associated symptoms of respiratory system [69, 70]. *Shwasa* and *kasa* are *kapha* and *vata* predominant [71, 72] and the drugs used in these conditions pacify *kapha* and *vata doshas*. Drugs like *Draksha (Vitis vinifera Linn.)*, *Shringi (Pistacia integerrima Stewart ex Brandis)*, *Kantakari (Solanum surattense Burm.f.)*, *Shathi (Hedychium spicatum Buch-Ham)*, *Pushkaramoola (Inula racemosa Hook.f.)*, *Tulasi (Ocimum sanctum Linn.)* and *Kasamarda (Cassia occidentalis Linn.)* from the groups of *Kasahara* [73], *Shwasahara mahakashaya* [74] and *Surasadi gana* [75] may be selected.

### Mukhavaishadyakara (mouth cleansing) Dravya

Transmission of COVID-19 infection mainly occurs through coughing or sneezing where infectious droplets of variable size, may be inhaled resulting in human to human transmission. The active compounds from naturally occurring medicinal plants destroy the microbes by releasing inactivating chemicals, contact inhibition or immobilization [4]. *Mukhavaishadyakara dravya* could be a prophylactic remedy for COVID-19 as refereed in the chapter on "Anagatabadha-pratishedha" (prevention of future ailments) [76]. In this category, chewing *Tamboola (Piper betle Linn.)* with *Karpoora (Cinnamomum camphora Nees & Eberm)*, *Jaatiphala (Myristica fragrans Houtt)*, *Kankola (Piper cubeba Linn.f.)*, *Lavanga (Syzygium aromaticum (Linn.) Merr.& Per.)* and *Katuka ( Hibiscus abelmoschus Linn.)* are mentioned. These drugs are stated to alleviate diseases of throat and excessive salivation, cleanse oral cavity,

pleasing [77, 78] and effective against microorganism [79]. These drugs could be evaluated for any protective role in the transmission of virus from throat or upper respiratory tract.

### **Pratimarsha-nasya (nasal smearing) Dravya**

Among the *nasya* (nasal therapy), *pratimarsha-nasya* (smearing the nostrils with oil) may be advocated in this condition. It is applied through one's finger dipped into oil on to the nasal mucosa every day morning and night without expelling it out. It provides firmness to the healthy person [80]. Recently, the Indian government gave similar recommendations that instilling two drops of sesame oil in each nostril every morning can be used to prevent the new coronavirus [81]. Different studies suggested that applying oil on to the nostrils prevent direct contact and binding of virus onto the surface of nasal mucosa [82], causing destabilization of the bilayer of viral envelopes [83] and capable of significantly suppressing the coronavirus replication due to the fatty acids [84]. Thus this may prevent human-to-human transmission and to the lower respiratory tract as well [82]. It is also reported that coconut oil and its derivatives lauric acid (a fatty acid) and monolaurin (a metabolite) having antiviral activity against the novel coronavirus [85]. In view of above findings, a new use of *Apamarga* (*Achyranthes aspera* Linn.) in form of *kshara tail*, which is *tikshna* (sharp), *ushna* (hot) property [86], the drug of choice for nasal therapy [87] and being *kshara* (alkali) by nature may be helpful in destroying virus outer lipid membrane. *Neemba* (*Azadirachta indica* A. Juss), *Atasi* (*Linum usitatissimum* Linn.), *Kampillaka* (*Mallotus philippinensis* Muell Arg), *Karanja* (*Pongamia pinnata* Pierre) and *Sarshapa* (*Brassica campestris* Linn. Var. sarson Prain) oil may also be investigated because of their *ushna* property and *kapha-vata* pacifying and *krimihara* (anti-microbial) action [88].

### **Kshara (alkali) Dravya**

Study reported that chloroquine and hydroxychloroquine, an anti-malarial drug is undergoing multiple trials to assess if it can be used to treat COVID-19. It works by increasing alkalisation in parts of the cell where the virus is present, thereby inhibit replication of the SARS coronavirus [89, 90, 91] and hence possibility of such mechanism to be ruled out in SARS Cov-2. In Ayurveda, *kshara* (alkali) has been praised as supreme to the entire sharp and subsidiary instrument [92]. It possesses *katu* (pungent), *ushna* (hot), *tikshna* (sharp) properties and actions like *pachana* (digestive), *vilayana* (dissolving), *shodhana* (cleansing), *lekhana* (scraping), alleviates all the three *doshas* etc. [93]. It could be used in two ways- locally and orally as *pratisaraniya* and *paniya kshara* respectively [94]. By virtue of its properties and actions and the hypothesis supported by modern researches, *kshara* could be good alternative in new drug discovery. *Apamarga*, *Bibhitaka* (*Terminalia bellirica* Roxb.), *Vasaka* and *Kadali* (*Musa paradisiacal* Linn.) [95] are few drugs could be selected on the basis of their properties and actions related to respiratory system.

### **Dhoopana (fumigating) Dravya**

Studies reported that physical contact with wet and contaminated objects should be considered in dealing with the virus as route of transmission. The public services and facilities should provide decontaminating reagents for cleaning hands on a routine basis [96]. Coronavirus is sensitive to various disinfectants, including diethyl ether, 75% (v/v) ethanol solution, chlorinated disinfectants, fatty solvents such

as peracetic acid and chloroform [82]. *Bhootopaghata* (invasion of organism) is described one of the causes of *Ojas-kshaya* (loss of immunity) [97]. For the purpose of decontamination, some drugs are described in Ayurveda under the heading of *rakshoghna* (disinfectant) may be used in the form of *dhoopana* (fumigation) [98]. *Guggulu* (*Commiphora mulul* (Hook ex. Stocks) Engl.), *Agaru* (*Aquilaria agallocha* Roxb.), *Sarjarasa* (Exudates of *Shorea robusta* Gaertn.), *Vacha*, mixed with salt, leaf of *Neemba* and ghee are designated in this purpose [36].

### **Vishaghna (anti-toxic) Dravya**

The qualities of *visha* [99, 100] is contrary to *ojas* [101, 102] and thus diminishes the strength (*ojas*) of the body and may endanger life [103]. Hence, the *vishaghna dravya* has to be explored for their anti-viral and immunity boosting potential. The drugs like *Shirisha* (*Albizia lebeck* Benth.), *Shleshmataka* (*Cordia dichotoma* Forst.f.), *Haridra* (*Curcuma longa* Linn.), *Nirgundi* (*Vitex negundo* Linn.), *Indrayava* (seed of *Holarrhena antidysenterica* (Linn.) Wall), *Saptaparna* (*Alstonia scholaris* R.Br.), *Kalamegha* (*Andrographis paniculata* Nees), *Ela* (*Elettaria cardamomum* Maton), *Dalchini* (*Cinnamomum zeylanicum* Breyne), *Tejapatra* (*Cinnamomum tamala* Nees & Eberm), *Kumkuma* (*Crocus sativus* Linn.) and *Nagkeshara* (*Mesua ferrea* Linn.) of *Vishaghna mahakashaya* [104], *Aragvadhadi* [105], *Rodhradi* [106], *Arkadi* [107], *Eladi* [108] *gana* may be investigated.

## **DISCUSSION**

The COVID-19, is caused by the SARS-CoV-2, a pandemic disease and challenging global health concern at present time. There is no pharmaceutical product has yet been shown to be safe and effective for the treatment of COVID-19 and different clinical trials for drugs and vaccine are in the pipeline. A number of medicines have been suggested as potential investigational therapies, many of which are now being or will soon be studied in clinical trials, including the 'Solidarity', launched by the WHO. Since ancient times, Indian herbs have been used as a treatment and prevention in viral respiratory infections and boosting up immune system as well. Holistic approach of AYUSH systems of medicine gives focus on prevention through lifestyle modification, dietary management, prophylactic interventions for improving the immunity and simple remedies based on presentation of the symptoms. Indian medicinal plants have been in use since the antiquity as documented in *Vedas*, having lots of possibilities and potentials in the management of the pandemic COVID-19 in terms of prevention, cure or add-on therapy. It is possible to explore the phyto-compounds that could help to alleviate the infection too. Hence, by repurposing the medicinal plants, based on available classical references for noble treatment options can be designed for preventing and mitigating COVID-19. While selecting a single drug or group of drugs for a newly disease, the principles of Ayurveda should be considered. In Ayurvedic view point, the COVID-19 is an exogenous disease caused by *bhoota* (SARS-CoV-2), and on due course vitiates *tridosha* particularly *kapha* and *vata* with involvement of *pranavaha*, *rasavaha* and *raktavaha srotas* leading to pulmonary involvement in particular and other systems in general. In this context, the word '*bhoota*' may be interpreted as organisms [109]. Agni plays an important role in digestion and cellular metabolism, responsible for strength, health, immunity, vital breath and its derangement leads to disease condition. Therefore the maintenance of *agni* by using *deepaniya* and *pachaniya dravyas* are important to boost immunity and reserve the vital breath in COVID-19 patients. The *Rasayana* drug is one

of the measures for fighting epidemic diseases and providing passive immunity (*yuktikrita-bala*). As postulated, *Vyadhikshamatwa* (immunity), which depends on the *ojas*, antagonizes the strength of disorders and prevent it. In context of *rasayana*, it is noteworthy to mention that there is no disorder which is not ameliorated by *Bhallataka rasayana* quickly<sup>[110]</sup>. Similarly, *Lashuna rasayana* has been appreciated to use almost in all season except *sharada ritu* (autumn season) especially when there is predominance of *kapha* and *vata*<sup>[111]</sup>. Since, the COVID-19 outbreak in India prevailing during the seasons as stated, and there is strong association of *kapha* and *vata dosha*, and thus this kind of *rasayana* to be explored. As the disease primarily involve respiratory system, the drugs effective in both upper respiratory (mouth, oropharynx and naso-pharynx) and lower respiratory system to be evaluated. It is reported that before reaching lower respiratory tract, the corona virus lodged in the mucous of oral cavity, naso-pharynx and oropharynx (upper respiratory tract). Hence, the use of *mukhavaishadyakara* and selective *pratimarsha-nasya* (nasal smearing) *dravya* may be effective to prevent further progression as well as transmission of virus. Study supported the efficacy of sesame oil, coconut oil as nasal application, but no study has yet been reported for alkali based oil (*kshara-taila*) of *Apamarga* or other plants categorized in the alkali group or *taila-varga*, having *ushna*, *kapha-vata* pacifying properties and *krimihara* (anti-microbial) action. These groups of drugs should be studied for anti-viral and immune modulating activity on upper respiratory tract in COVID-19 patients. For lower respiratory involvement, *shwasahara* and *kasahara* drugs would be effective. These drugs are mostly having *ushna veerya* and *kapha-vata* pacifying properties and hence antispasmodic (spasm caused by *vata*), anti-secretory (secretion and thick mucus plugs due to *kapha*), reduce viscosity, cause broncho-dilatation and thin copious bronchial secretion by virtue of *ushna veerya*. The *kshara* (alkaline) drugs should have advantage over other drugs due to their specific properties- *ushna* (hot), *tikshna* (sharp) and actions- *pachana* (digestive), *vilayana* (dissolving), *shodhana* (cleansing), *lekhana* (scraping). By virtue of its properties and actions and the hypothesis supported by modern researches, *kshara* could be good alternative in new drug discovery against COVID-19. It has already been postulated that chloroquine and hydroxychloroquine increase intra-cellular alkalisation, and thus cause inhibition of the SARS coronavirus replication. Thus the efficacy and safety profile of local (*pratisaraniya*) in upper respiratory system and oral (*paniya*) application of *kshara* is to be investigated if any structural or functional damage cause to virus. *Bhootopaghata* (invasion of micro-organism) is described one of the causes of loss of immunity<sup>[97]</sup> and hence the different studies stressed on the patients immunity in the progression of the disease severity. Use of disinfectants by *dhoopana* (fumigation) of beds etc.<sup>[112]</sup> is one of the preventive measures of human-to-human transmission of COVID-19. As *Vishaghna* (anti-toxic) drugs are counteracting the deleterious effect of poison which imparts negative effect on *ojas*, the cause of immunity in Ayurveda. Hence, *vishaghna dravya* has to be explored for their anti-viral and immunity boosting potential against COVID-19. Further, considering the status of *doshas*, the drug(s) to be selected from same group or other groups, may be used separately or combined together<sup>[113]</sup> for safe and effective use in COVID-19 patients.

## CONCLUSION

The medicinal plants mentioned in this paper have multifaceted pharmacological properties and actions. They possess either or

combined of *deepaniya*, *pachaniya*, *kapha-vata-hara*, *kasa-shwasahara*, *vishaghna*, *bhootaghna* and *krimighna* actions. It can be ethical to use the above drugs clinically on the basis of classical references and as there is no proven effective treatment exists for COVID-19 till now. But, the new use of *kshara*, as nasal therapy should be studied to establish its safety, efficacy, risks, and benefits. The different groups of the drugs are being discussed for their possibility and potentiality in clinical use or new drug discovery on the basis of Ayurvedic principle to prevent, treat and add-on therapy to conventional medicines including vaccine in coming days for the infection of the COVID-19.

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