



Ayurvedic approach of some indigenous flora in curbing sars-cov-2 infection: I. traditional spices as immunity booster for covid-19 patients

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Abstract

COVID-19 (Corona virus diseases 2019) pandemic or Corona virus pandemic, is an existing global pandemic. It is caused by Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2). Its first ever case was reported in December, 2019 in Wuhan, China. This SARS-CoV-2 is currently affecting more than 221 countries and territories around the globe and has infected more than more than 324,273,148 people have been found to be infected by SARS-CoV-2 till 15th January, 2022. As per the report of Worldometers, over 5,547,144 deaths and 265,323,593 recovered cases recorded globally with hardest hit on India with over 485,780 fatalities due to COVID-19 by 15th January, 2022. Although, more than a dozen vaccines have been approved around the world, many more are in the list of development, but with such a high spreading rate of infection, it is very difficult to vaccinate people in a short time and hence the need of medicinal/herbal plants comes into existence, which can play a very important and significant role in decreasing the risk of COVID-19. In this article, authors have discussed about 7 traditional spices that were helpful in boosting of the immune response among COVID-19 patients. Thus the adoption of the tradition herbal spices as immunity booster in the form of oral pills, powder or decoction is an urgent necessity to improve the immunity against COVID-19 and other associated diseases.

Keywords: traditional spices, covid-19, sars-cov-2, indigenous flora, immunity booster, decoction

Introduction

The world is currently facing a very tough and miserable situation due to the immense spread of the novel corona virus i.e., SARS-CoV-2. The WHO (World Health Organization) has announced this outbreak a Public Health Emergency of International Concern on 30th January, 2020 and later on a pandemic on 11 March, 2020 (Upadhyay *et al.*, 2020a) [36]. In India, COVID-19 case was first reported in Kerala during late January, 2020 (Upadhyaya *et al.*, 2020b) [37]. Since the since the day of eruption, number of infected cases rising continuously, and there are over 36.849 million confirmed cases identified on 15th January, 2022 as per the report of Worldometers. Out of that, more than 34.938 million completely recovered and discharged from the hospital, >0.485 million lost their life and >1.425 million active cases occurring in India right now on dated 15th January, 2022. In fact, India is on second position in the list of maximum number of cases among those 221 COVID-19 affected countries with an eruption of 3rd wave during late 2021. The mortality rate of COVID-19 infection is found to be very high especially, in case of elder people and in the patients those having a pre-existing health issues like cancer, diabetes, respiratory disorders etc. (Dan *et al.*, 2020; Yadav *et al.*, 2021) [6, 39]. The commercially available antiviral medicines include remdisavir, ribavirin, ritonavir, lopinavir either alone or with the combination of chloroquine, hydroxychloroquine, and interferon-alpha are found to have effective potential in treating SARS-CoV-2 infection even during the absence of the vaccines and also in the present time when more than a dozen vaccines have already been approved around the globe as of 15 April, 2021 (Dan *et al.*, 2020; Jha *et al.*, 2020; Sood *et al.*, 2020; Tuli *et al.*, 2021; Upadhyay *et al.*, 2021) [6, 12, 31, 34, 35]. But it is difficult to vaccinate people with such a pace of increasing rate of infection in a short period of time and people may have to wait for their chance to get vaccinated. Even though as per the report, the fully vaccinated peoples may also infected by the most recently identified Omicron variant of SARS-CoV-2. Thus, people must have the ability to give a fight against this deadly virus by boosting their immune system and one can easily boost the immune system by using medicinal /herbal resources in daily life (Kumar *et al.*, 2020) [16]. Thus the people may be prevented from the risk of this COVID-19 infection, morbidity, and mortality. As the medicinal plants consist of important bioactive constituents and phytochemicals which possess antiviral, anti-inflammatory, antibacterial, antifungal, anti-oxidant, anti-diabetic, properties along with profound immune boosting agents, that might be highly helpful in curbing the COVID-19 situation and further spreading of the causative agents (Kumar *et al.*, 2020) [16].

The coronavirus disease 2019 (COVID-19) is caused by a novel corona virus known as Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2) (Kumar *et al.*, 2020; Upadhyay *et al.*, 2020a, b) [16, 36, 37]. This SARS-CoV-2 is an enveloped, non-segmented and positive sense RNA (single stranded RNA) virus. The size of virus ranged between 65 to 125 µm with crown-like spikes all over on its outer surface like those of SARS-CoV and MERS-CoV (Cheng *et al.*, 2019; Lu *et al.*, 2020) [4, 17]. It causes a serious infection in the respiratory tract of humans and affects both the upper respiratory tract i.e., throat, nose, sinuses, lower respiratory tract and lungs that ultimately leads to death in later phase (Cheng *et al.*, 2019; Shereen *et al.*, 2020) [4, 29]. The infection encountered from animals like bats and fellow humans which can easily further transmitted from person to person through small respiratory droplets either by coughing, sneezing or due to close interactions among people (Sood *et al.*, 2020; Stadnytskyi *et al.*, 2020) [31, 33]. Later on these droplets can be transmitted either by inhaling or it can contaminates different surfaces and become a secondary source of infection when other people touched these infected surfaces and then touch their nose, mouth or eyes and this cycle goes on in the same manner (Dan *et al.*, 2020; Upadhyay *et al.*, 2020a,b) [6, 36, 37]. Boosting the immunity of body along with the strategic vaccination is an utmost necessity to prevent and control the further rapid spread, morbidity and mortality due to this deadly corona virus associated (Srivastava *et al.*, 2020) [32]. One of the most promising and trusted remedy against this SARS-CoV-2 is the development of safe and effective. In fact, as of 18th February 2021, about seven different vaccines have been already approved around the globe and vulnerable people in all countries are on the top priority list for vaccination. India has also begun its vaccination drive against this deadly virus on 16th January, 2021 after the approval of COVAXIN and Covishield by Government of India with the aim of providing vaccines pan-India free of cost (Tuli *et al.*, 2021; Upadhyay *et al.*, 2021) [34, 35]. The continuous effort of Indian Government has been appreciated by WHO and till 15th January, 2021, India has successfully administered more than 1,56,02,51,117 vaccine doses so far (MoHFW, 2022) [20]. But as the number of cases is increasing and right now, 3rd wave of infection has been started. Hence there is a need to think on a permanent solution by boosting immunity status through consumption of some natural plant based resources in our daily or routine life. Therefore, the role of medicinal spices in this pandemic period is of utmost importance and can be highly beneficial in strengthening system and may prevent from the risk of COVID-19 infection and its further spread.

Medicinal Spices: Profound Immunity Booster

There are several important medicinal spices known to be as profound source of traditional medicines, immunity booster and might be possible to play a pivotal role against SARS-CoV-2 infection and current COVID-19 pandemic: *Allium sativum* L. (Garlic), *Piper nigrum* L. (Black pepper), *Curcuma longa* L. (Turmeric), *Zingiber officinale* Roscoe (Ginger), *Nigella sativa* L. (Black cumin), *Syzygium aromaticum* L. (Clove), and *Cinnamomum verum* L. (Cinnamon) (Table 1).

- a. ***Allium sativum* L. (Garlic):** Garlic or Lahsun is a bulb grown perennial flowering plant with linear, flat, solid leaf blade known for its important role in the history of mankind and native to Central Asia and North-Eastern Iran. Usually it has been used as seasoning and flavouring agent worldwide. The garlic bulb is principally used as an excellent medicine and well evident in history since the human civilization. There are lots of sulphur-based bioactive compounds, essential oils including include S-allyl cysteine, alliin, ajoene, diallyl polysulfides, vinylthiophene as well as few non-sulphur compounds like saponins, flavonoids present in garlic and responsible for its peculiar fragrance, taste, pharmaceutical, medicinal and immunity booster potential. These and also consist of (Fredotović and Puizina, 2019; El-Saber Batiha *et al.*, 2020) [9, 8]. Thus garlic is loaded with nutrients that bestow to the protection, preservation, and enhancement of overall human health through its antioxidant, antibacterial, antiviral, anti-inflammatory and anticancer potential. The garlic is known to be an excellent immune booster efficacy against various bacteria, viruses and fungal pathogens (Donma and Donma, 2020; El-Saber Batiha *et al.*, 2020) [7, 9, 8]. The profound antiviral potential of garlic may be capable of reducing the drastic effects of cold, flu and COVID-19 infection as well. It is also evident that, garlic is helpful in boosting of immune health by stimulating leukocytes such as NK cells (natural killer cells) and macrophages (Donma and Donma, 2020) [7]. Therefore, authors wish to propose that garlic may be very effective against SARS-CoV-2 infection and morbidity in COVID-19 patients.
- b. ***Piper nigrum* L. (Black pepper):** Black pepper or Kaalimirch known as “*King of spices*” is a climber, flowering plant, principally cultivated for its fruit, peppercorn and native to South India (Joshi *et al.*, 2018) [14]. The fruits with single seed are round, berry like, green at first but turned red on ripening. These fruits are further dried on ground and most commonly used as a spice and seasoning in most of the cooking preparations and as traditional medicine since ancient age round the world. The pepper plant comprises immense phytochemicals (about 600 in numbers) including lignans, terpenes, alkaloids, amides and neolignans etc. The phytochemicals exhibits diverse biological and medicinal properties like antiviral, antibacterial, antipyretic, antioxidative, anti-inflammatory qualities (Ahmad *et al.*, 2012; Joshi *et al.*, 2018) [1, 14]. There are varieties of secondary metabolites available in the kaalimirch that helps in the immune boosting of body as well. The principal alkaloid components such as piperine and piperamides have antiviral properties, most especially in opposition to those causative to the respiratory tract infection (Vasavirama and Upender, 2014; Mair *et al.*, 2016; Pandey *et al.*, 2020) [38, 18, 22]. Therefore, the current exploration giving a line to think about black pepper and its regular use can be very much helpful in promoting immunity against the corona virus infection.

- c. ***Curcuma longa* L. (Turmeric):** Turmeric or Haldi, is a perennial, rhizomatous, flowering herb and native to the Indian subcontinent and Southeast Asia. The profusely branched, yellowish rhizome with a warm, bitter, earthy, mustard like aroma can be used either raw or in powder form as a coloring and flavoring agent or dye worldwide. The medicinal purposes of haldi in Ayurveda since ancient times well addressed time to time. The important phytochemical constituents of turmeric are diarylheptanoids like curcumin, demethoxycurcumin, and bisdemethoxycurcumin along the major essential oils groups including germacrone, turmerone, zingiberene and atlantone (Chanda and Ramachandra, 2019) ^[2]. The turmeric has excellent potential to cure different types of diseases because of its anti-inflammatory, antiseptic and antifungal properties. Therefore, traditionally, it is applied topologically for relieving wound ache and can be consumed through hot milk as well. Turmeric is used in the treatment of severe hemorrhage, wound healing, hematuria, jaundice, and skin diseases. The antiviral properties of haldi is well documented, therefore it can be consumed on daily basis as an excellent home remedy against virus infection because it helps in natural cleansing of respiratory tract, congestion, bronchial pain, breathing problems thereby relieving patients suffering from cough, cold, flu and associated issues in COVID-19 patients (Rajagopal *et al.*, 2020) ^[24]. The curcumin, present in turmeric as a chief constituent, is very helpful in enhancing the immunity system, and antiviral activities against the COVID-19 as well due to its inhibitory role towards virus genetic material replication that leads to a decrease in the viral load (Rattis *et al.*, 2021) ^[25]. Thus, this review recommends that turmeric may be very beneficial against the COVID-19 virus and helpful to strengthen the immune system as well.
- d. ***Zingiber officinale* Roscoe (Ginger):** Ginger or Adarak is a perennial, creeping, flowering plant with tuberous stem, native to Southern China, Southeast Asia and India. It is widely cultivated for its rhizome and appreciably used as spice, condiment to flavour dishes and medicinal purposes since traditional era. The chief phyto-biochemical constituents of ginger comprise volatile oils (1-3% of total weight) responsible for its unique flavour and aroma, along with zingiberene, zingerone and 6-gingerol. These ingredients contribute to its profound antibacterial, antifungal, antiviral, anti-inflammatory, antioxidant and immune boosting potential (Gunathilake and Rupasinghe, 2015; Mao *et al.*, 2019) ^[10, 19]. Thus, the ginger helps in escalating the metabolic activities, promotes the body to get rid of toxicity and protect the body against detrimental impacts of pathogenic microbes, bacteria, fungi virus and other associated diseases. In comparison to dried ginger, the fresh ginger rhizomes or tubers have more antiviral activity against Human Respiratory Syncytial Virus (HRSV) induced plaque formation and stimulate mucosal cells to produce IFN-beta that can be expected to help reduction of the viral infection than that of dried ginger (Chang *et al.*, 2013) ^[3]. The biochemical-cum-pharmaceutical compounds available in adarak may curb or flatten the graph of COVID-19 infection by suppressing the spike glycoprotein in the SARS-CoV-2 and the enzyme ACE2 (angiotensin converting enzyme 2) in the host, as both being important factors to enables the cell entry of SARS-CoV-2 (Pandey *et al.*, 2020; Jafarzadeh *et al.*, 2021) ^[22, 11]. Therefore, authors wish to recommend the routine consumption of adarak or ginger may be very obliging in immunity boosting and diminution of COVID-19 infection.
- e. ***Nigella sativa* L. (Black cumin):** The black caraway, black cumin, black seed, kalojeera, kalonji, nigella or kalanji is an annual flowering plant, fruits larger with inflated capsule number of seeds, native to Eastern Europe, Western Asia and famous for its spices as well as medicinal significance. The black cumin contains flavonoids, terpenes, phytosterols, tannins, phenolic compound, alkaloids, saponine, fatty acid and volatile oils. The principal phytochemical component dealing its pharmaceutical and therapeutic properties are terpenes like thymoquinone along with caryophyllene, 1-4 cyclohexadiene, carvacrol, longifolene; alkaloids like nigellidine, nigellicine, nigellicimine and alpha-hederin (Khan and Afzal, 2016) ^[15]. The antiviral, antipyretic, anti-inflammatory, anticoagulant, antihypertensive, antiobesity, antidiabetic, antiulcer and immunomodulatory potential of black cumin has been well documented. The black cumin has been well addressed for its broad therapeutic properties and helpful in treatment of diverse health issues including diabetes, anorexia, jaundice, gastrointestinal problems, asthma, cough, fever, bronchitis and influenza (Zahra *et al.*, 2019) ^[40]. The oil and seeds have been reported to possess antiviral activity against variety of deadly virus such as hepatitis C virus (HCV) and human immunodeficiency virus (HIV) (Molla *et al.*, 2019) ^[21]. In various studies nigellidine, alpha-hederin, thymohydroquinone, thymoquinone present in black cumin has established inhibitory potential against SARS-CoV-2 because of predominant binding affinity to inflammatory molecular targets and protease 6LUZ, ACE2 and IR42 (Salim and Nouredinne, 2020) ^[28]. Thus, the daily consumption of black cumin supplies the active biochemical compounds to fight against corona virus in the COVID-19 patients with comorbid condition.
- f. ***Syzygium aromaticum* L. (Clove):** Clove or Laung is an evergreen tree with crimson clustered flowers and native to the Maluku Islands in Indonesia. The clove plant is generally cultivated for its flower buds used as spices to adjoin flavour and aroma in variety of food preparations and also for therapeutic applications since ancient times. The laung plants are known for its prosperity of proteins, carbohydrates, vitamins, riboflavin, niacin, dietary fibres and essential minerals. The important phenolic constituents of clove includes eugenol, thymol, gallic acid, eugenol acetate, betacaryophyllene and have antioxidant, antitumor, anti-inflammatory, antiviral, antibacterial and antifungal properties (Cortés-Rojas *et al.*, 2014) ^[5]. Clove is very much used in cosmetics, pharmaceuticals, medical, and curing dental issues. The isobiflorin, biflorin and eugenin obtained from clove known for its excellent antiviral property against Dengue virus protease and herpes

virus strains by inhibiting polymerase enzymes (Saleem *et al.*, 2019) [27]. As for as its role against COVID-19 infection, clove has significantly used along with cinnamon, ginger, black pepper, garlic, neem and basil to improve the immunity especially in COVID-19 patients (Pandey *et al.*, 2020; Rehman *et al.*, 2020; Singh *et al.*, 2021) [22, 26, 30]. The kaempferol during docking showed affinity to binding pocket of the main protease of SARS-CoV-2 with the active site residues like Cys145 and His41 (Rehman *et al.*, 2020) [26]. Thus, clove also plays a very important role against this COVID-19 infection.

Table 1: Ethnomedicinal properties and immunity booster potential of phytochemicals in traditional spices.

Common Name	Botanical Name	Phytochemicals	Ethnomedicinal Properties
Garlic or Lahsun	<i>Allium sativum</i> L. (Asparagales: Amaryllidaceae)	Alliin; Alicin; (E)-ajoene; Allyl sulphide; (Z)-ajoene; 1,2-vinyldithiin	Antioxidant, antibacterial, antiviral, anti-inflammatory, anticancer, immune booster properties by inducing WBCs (NK cells, macrophages) and anticovid-19 potential.
Black pepper or Kaalimirsch	<i>Piper nigrum</i> L. (Piperales: Piperaceae)	Piperine; Feroperine; Pipertipine; 9-(1,3-benzodioxol-5-yl)-1-(1-pyrrolidinyl)2E,4E,8E-nonatren-1-one; Piperoleine A; Piperlylin; Dehydropiperonaline; Piperamide; Pipernonaline; N-trans-feruloylpiperidine; 1,1-[-(1,3-benzodioxol-5-yl)-6-[(1E)-2-(1,3-benzodioxol-5-yl)ethenyl]-3-cyclohexene-1,2-diyl]-bis-[1-(1-piperidinyl)methanone]	Antiviral, antibacterial, antipyretic, antioxidative, anti-inflammatory, immune system boosting, antibronchial infection and anticovid-19 qualities.
Turmeric or Haldi	<i>Curcuma longa</i> L. (Zingiberales: Zingiberaceae)	Curcumin; Cyclocurcumin; Demethoxycurcumin; Curlone; Bisdemethoxycurcumin; Curcuphenol; Turmerone	Anti-inflammatory, antiseptic and antifungal (skin disease), analgesic, wound healing, antihemorrhagic, antiviral, anti jaundice, antihematuria, immunity boosting and anticovid-19 activities by inhibiting virus RNA replication.
Ginger or Adarak	<i>Zingiber officinale</i> Roscoe (Zingiberales: Zingiberaceae)	Zingerone; 6-Gingerol; Paradol; Phellandrene; Zingiberene; 6-shagaol	Antibacterial, antifungal, antioxidant, anti-inflammatory, antiviral (against HRSV by IFN-beta synthesis in mucosal cells), immune boosting and anticovid-19 potential by suppressing spike glycoprotein and ACE2.
Black caraway or Black cumin	<i>Nigella sativa</i> L. (Ranunculales: Ranunculaceae)	Thymoquinone; Carvacrol; Caryophyllene, Longifolene; 1-4 cyclohexadiene; Alpha-hederin; Nigellicine; Nigellidine; Thymohydroquinone; Nigellcimine	Antiviral (HCV and HIV), antipyretic, anticoagulant, anti-inflammatory, antihypertensive, antiobesity, antiulcer, antidiabetic, immunomodulatory and anticovid-19 potential because thymoquinone showed predominant binding affinity to SRAS-CoV-2 inflammatory molecular targets, protease 6LUZ, ACE2 IR42, and HCQ.
Clove or Laung	<i>Syzygium aromaticum</i> L. (Myrtales: Myrtaceae)	Eugenol; Thymol; Gallic acid; Eugenol acetate; Eugenin Betacaryophyllene; Isobiflorin; Biflorin; Kaempferol	Antioxidant, anti-inflammatory, antitumor, antidengue, antibacterial, antifungal, antiviral properties and anticovid-19 potential because kaempferol showed affinity to protease of SARS-CoV-2 active site residues like Cys145 and His41.
Cinnamon or Dalchini	<i>Cinnamomum verum</i> L. (Laurales:	Cinnamaldehyde; Cinnamic acid; Tenufolin; Pavetannin C1; Eugenol	Antiparasitic, antidiabetic, antiviral, antioxidant, anti-inflammatory, gastroprotective,

	Lauraceae)		antihypertensive, antitumor, immunomodulatory, antimicrobial and anticovid-19 potential because docking showed affinity to SARS-CoV-2 main protease and spike protein 6LUZ.
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g. *Cinnamomum verum* L. (Cinnamon): Cinnamon tree or Dalchini is a small, evergreen, perennial flowering, plant famous for its unique special aroma and native to Sri Lanka. Almost every parts of cinnamon have economic significance, but the outer bark most commonly used as spice, flavouring and medicinal purposes. The cinnamon well known due to its antiparasitic, antidiabetic, antihypertensive, antioxidant, anti-inflammatory, antimicrobial, antiviral, antitumor, gastroprotective and immunomodulatory properties (Joerg *et al.*, 2010) [13]. It is a most common traditional medicine and helpful in curing microbial infections, common cold, influenza, diabetes, upset stomach, gas, spasms, menstrual discomfort and stimulate appetite as well. Eugenol is the main component of leaf oil while cinnamaldehyde in bark oil. The *in silico* docking studies of 48 cinnamon compounds against target enzyme of corona virus has been done (Prasanth *et al.*, 2021) [23]. Among these, the tenufolin has the most excellent docked score with SARS-CoV-2 main proteases, however pavetannin C1 showed greatest docked score with SARS-CoV-2 spike protein (6LUZ) (Rehman *et al.*, 2020; Prasanth *et al.*, 2021; Singh *et al.*, 2021) [26, 23, 30]. Therefore, on the basis of explored data so far, authors wish to recommend cinnamon has the potential to boost immunity and helpful to fight against COVID-19 infections.

Conclusion

The traditional spices are used as pain reliever by topological applications, ointment, medicinal purposes against several metabolic, physiological issues, pathogens and vector borne diseases since ancient times and well documented in Vedas, Granthas and religious books as well. All these traditional and known spices comprising immense phytochemicals responsible for its profound antiviral, antifungal, antibacterial, antiparasitic, antioxidant, antiobesity, anti-inflammatory, analgesic, antihypertensive, antidiabetic, hepatoprotective, anti jaundice, gastroprotective, renoprotective, antihematuria, antiulcer, antiseptic, wound healing, antihemorrhagic, antitumor, anticancer and immunomodulatory potential. Therefore, in the ongoing COVID-19 pandemic circumstances, the routine and recommended consumption of these traditional spices may be extremely advantageous in reducing the rate SARS-CoV-2 infection, curbing or flattening the graph of infected population by modulating and boosting primary health and immune system. Thus, authors wish to recommend that, the daily and prescribed consumption of these traditional spices may play a key role in management of COVID-19 situation by keeping the country and world population immuned, healthy and fit.

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Conflicts of Interest

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