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Review Article

# Use of Plant Essential Oils and its Constituents in Corona Virus Therapeutics

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## Abstract

Present review article explains antiviral potential of essential oils more especially as an alternative treatment of coronavirus infection. This article emphasizes biological activity of major essential oil constituents and their future prospects for development of low toxic highly effective broad spectrum drugs. These could specifically inhibit virus entry into cells and target virus replication and show virucidal effect rather than they inhibit their development. More appropriate solution is to find protease inhibitors of COVID-19 that will be more appropriate drug molecule. Essential oils could serve as potential inhibitors of viral replication. There is a need of *in silico* studies of toxin molecules to find most appropriate target molecules to prepare more potent novel antiviral drugs to combat COVID-19 and future pandemics that may be caused by viruses. Hence, there is a need to explore and investigate plant origin active antiviral agents and use them for making highly effective drug formulations. Till the development of a vaccine natural plant products become available for treatment mainly immunity boosting for general public.

**Keywords:** Essential Oils; Virucidal Effects; Herbal Drug Formulations; Immunity Boosting; COVID-19

## Introduction

Viruses show unpredictable recurring outbreaks that causes devastating mortality, and great economic losses. Recent outbreak of Covid-19 viral infection evoked due to activation of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) posed a significant global threat and challenge to human health. Till the date virus has infected millions of people worldwide, and showing its high aggression in Europe and America, Brazil, India including several Asian and African countries as to thousands of fatalities have been noted. Earlier in November 2002 atypical pneumonia was evoked in Guangdong province of China, from where in next few weeks this disease spread in seven states of China. This is very unfortunate that China has misled the entire world and not given correct data about infected people and deaths occurred due to Covid-19. In fact, no real time data and satisfactory epidemiological information about emergence of disease was given by China till last of December 2019. This was resulted in unwanted delay in making control measures and start appropriate treatment. Due to international travel virus infection arrived and evoked in Spain, Italy, England, France, Germany and United States in first week of January. By end of March 2020 its infection rate got slow down, while India was still on war path and fighting against this deadly virus. Covid-19 pandemic imposed health emergency worldwide in modern human history [1].

Until now, no precise or appropriate treatment modality has been developed so far against this virus and only few antiviral drugs are prescribed to patients for treatment. Unfortunately, there

is a lack of potential antiviral drugs with its established antiviral efficacy that can finish inflammatory complications caused by SARs-CoV-2 virus [2]. Normally for fighting microbial infections broad spectrum antibiotic drugs are prescribed for treatment of infection and disease [3]. Only very few target specific effective antibiotics are available which work against a range of viruses [4]. Most of the antiviral drugs do not kill viruses but they inhibit their development or slow down viral replication. Antiviral drugs are available to treat HIV, herpes viruses, the hepatitis B and C viruses, and influenza A and B viruses. Besides, prescription and availability there is a possibility of development of viral resistance toward antiviral agents.

Medicinal plants produce a variety of chemical constituents with the potential to inhibit virus entry into host cell and its viral replication. These chemical constituents can effectively control variety of infectious agents including viruses [4]. Plant origin natural products mainly bio-molecules possess enough potential to fight against microbial infection and could be used as major sources of therapeutic agents for various infectious diseases. These could be used as alternative or additional treatment against so many viruses including SARS-CoV-2. Natural plant products possess multiple components can be used to develop potential 'multi-target drugs not only against viruses but fungi, bacteria and protozoans due its versatile effects [4]. Volatile essential oil constituents show antiviral, anti-inflammatory and immunomodulatory properties [2].

Essential oils possess ample disease curing potential against various pathogens. Few plant essential oils and its chemical constituents were found active against influenza; they reduce influenza infections and its spread [5]. These essential oils can be used to develop aromatic therapies for treatment of influenza virus infection. Essential oils are also used in inhalation therapy for treatment of respiratory diseases [5]. These are also provided in oral doses to treat gastrointestinal and acute respiratory infections caused by viruses. Inhalation of hot steam vapors of essential oils found highly beneficial in acute respiratory viral infections [6].

Essential oil capsules also provide instant relief to patients with viral respiratory diseases. Myrtol® capsules are available in the market. These are prepared by packing a mixture of essential oils of eucalyptus *Eucalyptus globulus*, sweet orange *Citrus sinensis,* myrtle *Myrtus communis* and lemon *Citrus limonum*. Tavipec® contain contains spike lavender *Lavandula latifolia.* Myrtol® capsule is prescribed for the treatment of virus generated acute bronchitis in humans. Both capsules are available in the market, are well tested, tolerated to patients, and show mild to moderate side-effects [5].

Essential oils are lipophilic in nature, penetrate through viral membranes and synergistically act on multiple stages of viral replication. Essential oil components also work as protease inhibitors of COVID-19 that will be more appropriate for blocking viral entry and replication in host cell [7]. There are few phytochemicals, viz. ursolic acid, carvacrol and oleanolic acid found in essential oil could work as potential inhibitors in regulating the Mpro protein's function and controlling viral replication [7]. These are used to treat virus diseases [8]. Hence, there is a need to explore and investigate plant origin highly active antiviral agents and use them for highly active drug formulations. But for evaluation of their effectiveness molecular docking studies are to be done to search novel molecules for more potent antiviral drugs to combat COVID-19 and future pandemics caused by viruses [8]. Till the development of a vaccine natural plant products become available for treatment mainly immunity boosting for general public [2]. In this review article antiviral potential of important constituents of essential oils has been searched with its possible mode of action. The aim of the present review is to find appropriate drug constituent for formulation for alternative treatment of coronavirus infection.

## Volatile constituents as anti-viral agents:

Essential oils are plant secondary metabolites mainly volatile products having diverse chemical structures with multiple therapeutic activities. These are complex mixtures of thousands of bio-organic compounds can be obtained/isolated by hydro distillation of aerial parts of plants. Essential oils work as strong antimicrobial agents show broad spectrum preventative effect against different viruses [9]. Most of the essential oils contain volatile constituents' monoterpenes and sesquiterpenes and phenylpropanoids, alcohols, ethers, aldehydes which are highly active against diverse groups of microbes [10]. These oil constituents display multiple biological activities such as anti-inflammatory, anti-oxidant, anti-cancerogenic, immunomodulatory, anti-rheumatic and antivirus [10]. *Santolina insularis* essential oil inactivates HSV-1 and HSV-2 viruses and stop cell-to-cell virus spread [11]. Similarly, *Leptospermum scoparium* (manuka oil) found effective against HSV-1 and HSV-2 [12]. Essential oils from anise, hyssop, thyme, ginger, camo-

mile and sandalwood oils showed inhibitory effects against herpes simplex virus type 2 [13]. Eucalyptus essential oil suppresses replication in adenovirus and a strain of mumps virus [14]. Germacrone showed antiviral activity against Pseudorabies virus PRV in the early phase of the viral replication cycle [15]. Few oils such as tea tree oil inhalation boost up immunity in experimental mice [16]. Alcoholic-aqueous extract of cinnamon decreased the viral titer of HSV-1 in culture with vero cells [17] (Table 1).

| Essential oil | Scientific name | Quantity used | Effectiveness and action |
|---|---|---|---|
| 1. Tea tree (EO) | *Melaleuca alternifolia* | 1 mL | Kill air borne influenza virus within 15 minutes, inhibits bacteria and fights infections |
| 2. Ginger (EO) | *Zingiber officinale* Rosc | 1 mL | biologically active anti-herpetic agents Modulate immune response to influenza |
| 3. Cinnamon leaf (EO) | *Cinnamomum zeylanicum* | 1 mL | Prevent pneumonia due to influenza virus , it strongly work against virus on surfaces or in air |
| 4. Clove bud (EO) | *Syzygium aromaticum* | 1 mL | Kill influenza virus on surfaces, it shows strong antiviral and antifungal properties and kill pathogens in air |
| 5. Mustard oil (edible) | *Brassica sinensis* | 1 mL | Relief from Cough and Cold, powerful anti-bacterial agent |
| 6. Eucalyptus oil (EO) | *Eucalyptus polybractea* | 1 mL | Eliminate airborne influenza droplets |
| 7. Peppermint (EO) | *Mentha piperta* | 1 mL | Reduces coughs, sinusitis, and throat infections |
| 8. Sweet orange (EO) | *Citrus sinensis* | 1 mL | Clears nasal passages and allows for steady breathing |
| 9. Rosemary (EO) | *Rosmarinus officinalis* | 1 mL | Nontoxic way to clean surfaces or air |

**Table 1**: Dose level of essential oils against different viruses *in vitro* assays.
Both effectiveness and output will depend on diffusion and inhalation capacity of person.

*Salvia fructicosa* and sandalwood essential oils showed anti-herpes activity [18,19]. More specifically, *Melaleuca alternifolia*, is used to treat recurrent herpes labialis virus [20]. Similarly eucalyptus oil, Australian tea tree oil [21], thyme oil [22] and manuka oil [12] showed inhibitory effects against HSV 1 and HSV 2 viruses. Phenylpropanes [23,34], triterpenes [25] and sesquiterpenes [26-28] also showed antiviral activity against different herpes viruses and rhinovirus. More often, sesquiterpenes, i.e. triptofordin C-2 inhibit virus replication [26]. Thus, only limited information about sesquiterpenes concerning the inhibition of the viral replication cycle and their mode of antiviral action is presently available. Thymol, as a dietary monoterpene, and a phenol derivative of cymene shows antivirus and anti-inflammatory activity [29]. Terpenes are curcumin found in tea, thyme, and citrus fruits are a Broad-Spectrum Anti-Zika Virus Inhibitor [30]. Curcumae Rhizoma-Sparganii Rhizoma essential oil shows anti-oxidative activity [31].

## Plant terpenoids

Plant terpenoids showed strong anti-viral activities against severe acute respiratory syndrome [32] and rhinovirus. Similarly, sesquiterpene coumarins inhibit cytomegalovirus [26] while phenylpropane inactivates HSV virus [33]. Isoborneol, a monoterpene stop glycosylation of viral proteins [34] and inhibit replication in severe acute respiratory syndrome coronavirus [28,32]. Various essential oil blends are also used for treatment of viral and fungal infection [35] (Table 1).

## Eugenin and eugenol

Eugenin isolated from *Syzygium aromaticum* and *Geum japonicum*, showed therapeutic effects against anti-herpes simplex virus [36]. Eugenol inhibits Ebola virus replication *in vitro* [36] (Table 1). Other essential oil components such as terpenes and terpenoids (1,8-cineole carvacrol), cinnamaldehyde and eugenol effectively target influenza virus. Eugenol, a phenylpropane inactivates herpes simplex virus [33]. Volatile components of *Mentha piperita, Ocimum tenuiflorum* (synonym *Ocimum sanctum* and *Schizonepe-*

*tae herba* were found effective against influenza virus [37-39]. These volatile oils attenuate influenza virus. Essential oils blends aid relief to respiratory system and do bronchodilation and dissolve mucus [2].

## Tea tree oil

Tea tree oil is produced by steam distillation of the *Malaleuca alternifolia leaves*. It is most appreciated usable essential oils commonly used for treatment of cough, sore throat, sinusitis, cold, influence and migraines. It was found effective against airborne influenza droplets [40]. *Melaleuca alternifolia* shows virucidal potential against enveloped viruses such as herpes simplex virus type 1 and type 2 *in vitro* [20,41]. It also shows strong anti-inflammatory and antiseptic activities (Table 1).

## Geranium and lemon oil

Geranium and lemon oil constituents i.e. citronellol, geraniol, and neryl acetate significantly down regulated ACE2 (angiotensin-converting enzyme) expression in epithelial cells of gut and bronchial lining of host [1]. Angiotensin-converting enzyme 2(ACE2) is a protein receptor that plays important role in corona virus entry into the cell. Essential oil components potentially inhibit virus antigen proteins at the host cell surface mainly prohibit virus entry. These active constituents interfere with the viral life cycle, slow down virus replication, and stop assembly, or discharge. These show broad-spectrum mechanisms of action [42] could be proved future frontline drug molecules for coronavirus therapeutics [43,44]. These could be used as alternative sources of therapeutic agents against virus-generated diseases (Table 1).

## Garlic essential oils

Garlic essential oils contain series of organo-sulfur compounds which *inhibited* host receptor angiotensin-converting enzyme 2 (ACE2) proteins in the human body. Both allyl disulfide and allyl trisulfide showed strongest anti-coronavirus activity. It successfully prevents the invasion of coronavirus into the human body [45] (Table 1). It may also act as a protease (PDB6LU7) protein to SARS-CoV-2 [45].

*Radix Bupleuri* (Chaihu) *essential oil* contains active ingredients i.e. triterpenoid saponins, polyacetylenes, flavonoids, lignans, fatty acids, and sterols which show anti-inflammatory, antiviral, hepatoprotective, neuroprotective and immunomodulatory effects [46]. *Momordica charantia* contains proteins, polysaccharides, flavonoids, triterpenes, saponins, ascorbic acid and steroids which showed antiviral activity [47]. Diarylheptanoids isolated from *Alpinia officinarum* rhizome showed anti-inflammatory, cytotoxic, anti-influenza virus, and anti-herpes simplex-1 virus activities [48] (Table 1).

## Ginger essential oil

Essential oil shows preventative effect against different viruses, and successfully inhibit virus entry into host cells because they load over ACE-2 receptor sites [9] Ginger essential oil (caprine) also shows strong antivirus activity against alpha herpes virus-1 and human herpes simplex viruses (HSV-1) [49] (Table 1). It was found highly effective against cell-free virus, and completely inactivate CpHV-1 [49].

## Clove

Clove (*Syzygium aromaticum*, Myrtaceae) contains glycosides, saponins, flavonoids, steroids, tannins, alkaloids, terpenes, sesquiterpenes, monoterpenes, hydrocarbon, and phenolic compounds. Oil also contains eugenol that shows analgesic, antiseptic properties and antimicrobial activities. But it causes skin and mucous membrane irritation. It is strong antioxidants and show potent anti-inflammatory, antibacterial, antiviral activity [23]. Eugenol inhibits viral replication at the initial stage and does direct inactivation of HSV-1 and HSV-2 viruses. It inhibits replication in intracellular and extracellular viruses [23]. Eugenin, a volatile compound isolated from *S. aromaticum* and showed antiviral activity. Various essential oil blends of clove oil are also used for treatment of viral and fungal infection [35] (Table 1).

## Oregano

Oregano essential oil contains carvacrol as a major constituent. It causes capsid disintegration and inhibits replication in different human and animal viruses *in vitro* [50]. It also acts against non-enveloped murine norovirus (MNV), a human norovirus. Carvacrol alone reduced the activity of murine norovirus (MNV) within 15 minutes of exposure [50]. Mild dose of oregano essential oil causes *dissolution* of the *HSV envelope* by treatment *in vitro* assays [51]. Oregano boosts the immune system and also acts as an antioxidant [11] (Table 1).

## Citrus oils

Citrus flavones are flavonoids which show wider health beneficial effects. Citrus fruits and juices contain most common flavones apigenin, diosmetin, luteolin, acacetin, chrysoeriol and their glycosides [52]. These show antimicrobial efficacy against viruses as they inhibit replication [53]. More often seeds of tropical fruits contain polyphenols, flavonoids, phenolic acid, and carotenoids [54]. These constituents exhibit excellent anti-virus activity against various human pathogenic viruses [54] (Table 1).

### Mint oil

*Mentha piperita* L. essential oil (EO) is an anti-pruritic, astringent, rubefacient and antiseptic agent [39]. It is used as an ethnomedicine that can assist in combating microbial infections or diseases [55]. *Mentha piperita* L. essential oil may become appropriate alternatives to "synthetic drugs because of its strong antiviral efficacy [56]. *M. piperita* and *M. officinalis* showed anti-IBV activity [57] (Table 1).

### *Thymus capitata*

*T. capitata* essential oil shows cytopathic effects and inhibit the viral replication by interfering with the early stages of viral adsorption in anti-erpes virus treatment [58] (Table 1).

### Cinnamon leaf oil

Essential oils (EOs) of *Cinnamomum zeylanicum* show strong antimicrobial activity [59]. Essential oil blends of *Cinnamomum zeylanicum*, *Daucus carota*, *Eucalyptus globulus* and *Rosmarinus officinalis* were found effective against H1N1 and HSV1 viruses [60] (Table 1).

### Rosemary oil

Rosemary essential oil *Rosmarinus officinalis* shows potential antiviral effects against herpes simplex viruses 1 and 2 (HSV-1 and HSV-2). *Rosmarinus officinalis* oil contains carnosol/carnosic and ursolic acids and effective against H1N1 and HSV1 viruses [60,61] (Table 1).

### Eucalyptus oil

*Eucalyptus globules* essential oil showed antiviral activity [62,63] against respiratory viruses [14]. Essential oils from eucalyptus *E. odorata* contains monoterpene compounds i.e. alpha-terpinene, gamma-terpinene, alpha-pinene, p-cymene, terpinen-4-ol, alpha-terpineol, thymol, citral and 1,8-cineole. These were found active against herpes simplex virus [21,64] (Table 1).

### Star anise oil

Star anise essential oil contains trans-anethole a phenylpropanoid and sesquiterpenes. These active constituents display antiviral activity against herpes simplex virus type 1 (HSV-1) *in vitro* [65]. These constituents inhibit virus replication at a very low dose *in vitro.* Another compound from star anise i.e. oregano was found highly active against herpes simplex virus - type 1 [51] (Table 1).

### Cruciferous vegetables

Cruciferous vegetables mainly broccoli, Brussels, sprouts and cabbage contain glucosinolates and β-D-thioglucosides (GSL) [66]. Bio-organic compounds from cruciferous vegetables contain benzyl isothiocyanate (BITC), phenethyl isothiocyanate (PEITC) and sulforaphane ([1-isothioyanato-4-(methyl-sulfinyl) butane], SFN). These show much potent anticancer and antivirus effects. These compounds restore NF-κB and its regulatory pathway to prevent cancer and tumor growth [66]. These compounds assist in repairing of DNA damage, stimulate cell cycle arrest and induce the programmed cell death. Sulforaphane isolated from broccoli seeds were found active against influenza A influenza A/WSN/33 (H1N1) virus *in vitro* culture [67].

### Common dietary herbs

The common black elderberry (*Sambucus nigra*) is used to cure flu virus infection. Echinacea (*Echinacea purpurea*) herb is used to enhance immunity. It shows improvement in cold and viral bronchitis. Flavonoids mainly catechins found in Green tea (*Camellia sinensis*) inhibit viral infections by blocking the actions of enzymes participate in virus replication. Green tea also effectively inhibits HIV, herpes simples and the hepatitis B virus replication [68]. Glycyrrhizin found in Liquorice reduces the replication of viruses and halts their ability to penetrate replicate inside healthy cells. It also found effective against HIV and viral hepatitis [69]. Olive (*Olea europea*) leaves contain elenoic acid and calcium elongate. Both are powerful inhibitors of virus reproduction including influenza, herpes, and polio and coxsackie viruses *in vitro* [70]. These substances block the generation of replication enzymes. *Spirulina platensis* contain calcium spirulan inhibits herpes simplex virus 1 attachment to human keratinocytes [71].

## Mechanism of antiviral action

Due to lipophilic nature of essential oils, these move across the cell wall and penetrate viral membranes and easily disrupt its integrity. Oil constituents interfere with the virus life cycle at multiple stages i.e. stop viral entry, and inhibit replication. Oil constituents bind to virus-specific host targets [72]. EO compounds polysaccharides, fatty acids associate to phospholipid layers make it permeable [73]. Essential oil constituents act synergistically interfere in virus pathways involved in replication [2]. They are potent antiviral agents and may provide relief of COVID-19 symptoms [74]. Most of the essential oil components mainly phenylpropanoids, sesquiterpenes, trans-anethole, eugenol, β-eudesmol, farnesol, β-caryophyllene and β-caryophyllene oxide, citronellol, geraniol, and neryl acetate directly target virus-infected cells [8]. Flavonoids mainly catechins, inhibit viral infections by delaying the synthesis of enzymes.

Essential oil and its components act both in liquid and vapor phases enveloped and non enveloped viruses. Oil components bind to envelope proteins of the influenza virus, namely enzymes HA hemagglutinin and neuraminidase. Oil components target the proteins related with virus cell proliferation and homeostasis. Oil components assist in DNA damage repairing, stimulate cell cycle arrest and induce the programmed cell death. Essential oils components might directly interact with key protein targets on SARS-CoV-2 and down regulate angiotensin-converting enzyme 2 (ACE2), found in epithelial cells of gut and bronchial lining of host [1]. Since, ACE-2 a host *cell* protein receptor plays important role in *virus* entry, *targeting* the precise receptor ACE2, therefore, oil constituents might have preventive effects to control COVID-19 *infection*.

Most of the essential oils showed either inhibitory effect to virus replication, block virus entry inside cell. Oil constituents permeabilize through cell wall and membrane and operate cytotoxicity. Therefore, various oil blends might show much better synergistic action against series of human pathogenic viruses. Oil blends can attenuate viruses and cut down infectivity. Oil constituent's cellular internalization may stop viral replication and keep expression of viral mRNAs on hold. Oil constituents can lower down expression of viral proteins; mainly do make inhibition of viral protein translation. But for knowing better targets and close interaction of essential oil components with virus molecules mainly enzymes i.e. protease, RNA-dependent RNA, polymerase ADP ribose phosphatase, endoribonuclease, spike protein binding domain and human angiotensin-converting enzyme molecular docking studies will be proved much fruitful.

## Symptoms, signs and pathogenesis

Flu like symptoms are fever, runny nose, sore throat, cough, headache, muscle aches, it is followed by severe pneumonia with high fever, chest pain, mucus precipitation, thick phlegm, lung damage due to cytokine burst. Flu is caused by influenza virus A or B while pneumonia is caused due to mixed infection of bacteria, fungi, viruses. Inflammation in bronchial walls in lungs, restricts the airways and causes mucus production, it is caused by RSV1 and Influenza A or B. Sepsis is an extreme stage of any infection, it occurs due to severe oxygen deficiency, quick cytokine bursts and exaggerated immune responses evoked all of a sudden. It results in multi-organ failure, tissue damage and imposes high risks of death. In lack of proper medical care it leads to a major cause of deaths occurring globally due to Covid-19 invasion. Sepsis accelerates in multiple virus infection either it is community spread or hospital-acquired. The worst affected organs due to sepsis are lungs, abdomen, bloodstream, and renal and genitourinary tracts. Sepsis is very difficult to diagnose because of non-specific symptoms, and the absence of fever in some cases.

## Steam inhalation therapy (SIT)

Essential oils are generally used in steam inhalation therapy (SIT) is absolutely natural. Inhalation of steam distillate prepared by mixing herbal products can successfully clear nasal air passage ways and refresh lungs. Strong vapors contain aromatic compounds also aid in inactivation of virus mainly flu viruses in air stream and air spaces. Steam vaporizer removes stuffy noses and coughs and ease congestion, patient can breathe better, provide silent sleep and relieve from distress. Electric steam vaporizers are also available that generate steady flow of warm, humidified air by simply switching on. These are proved highly useful in the bedroom overnight steam inhalation. Electric steam vaporizers maintain indoor humidity to healthy levels, especially in winters and remove off drying effects of central air-conditioning. These are an easy in handling and portable.

For generating scented steam various essential oil blends are used in indoor vaporizers to make air fresher (Table 2). Hot vapors or steam distillate of *Houttuynia cordata* inhaled control influenza virus infection. It also shows strong antivirus activity against her-

pes simplex virus type 1 (HSV-1) and human immunodeficiency virus type 1 (HIV-1) without showing cytotoxicity [75]. Hot vapors released in steam distillates contain methyl n-nonyl ketone, lauryl aldehyde, and capryl aldehyde that inactivate HSV-1, influenza virus and HIV-1 (Table 2). These distillates show virucidal activity against enveloped viruses by interfering with the function of virus envelope [75]. Menthol, a major essential oil component of mint (*Mentha* species) displays antispasmodic activity and improves lung function. Commercial nebulizers are available in the market; they are filled with blends of peppermint, eucalyptus, or rosemary essential oils. Inhalation of mixtures of flavors can easily refresh and assist in health promotion [76]. Steam distillates and moisturizes clear nasal and throat passages making them more comfortable (Table 2). Hot steam vapors rich in active aromatic compounds dissolute mucous, stops runny nose and fluid secretions. It assists in clearance of nasal passageways and easily expel out dry cough from lungs throat and blowing the nose. Inhalation of dry steams causes dilation of blood vessels, accelerate blood flow and improve overall circulation [77]. These also a**l**leviate soreness and inflammation of the throat, cause relaxation of throat and diaphragm muscles and reducing the cough reflex. Homemade inhalers work as nasal decongestants and ease in coughing [78].

| No. | Name of plant | Scientific name | Family | Chemical constituents | Effectiveness |
|---|---|---|---|---|---|
| 1 | Azwain or Ajwain | *Trachyspermum ammi* | Apiaceae | Essential oil contains thymol, gamma-terpinene, p-cymene, gamma terpinene, beta-pinene. Cymene | Anti-cough, congestion, germicide, anti-arthritis, and relieve from muscular-joint pain. |
| 2 | Holy Tulsi | Holy basil (*Ocimum tenuiflorum*) | Lamiaceae | Estragole, carvacrol, rosmarinic acid, oleanolic acid | Relieve muscular pain and swelling, improve survival rate, as an antioxidant. anticancer |
| 3 | Pepper | Long pepper (*Piper longum*) | Piperaceae | 1% volatile oil, 1.25% piperine and 40% starch | Improve appetite and digestion, cough cold, lung problems including asthma, bronchitis, and cough |
| 4 | Black pepper | Black pepper (*Piper nigrum*) | Piperaceae | Piperine, pinene, ocimene, Vitamin C, Vitamin A, flavonoids, carotenes | Anti-oxidants, anti-cancers and alleviate depression. **r**elieves cold and cough |
| 5 | Laung (clove) | *Syzygium aromaticum*. | Myrtaceae | Cetyl eugenol, beta -caryophyllene, vanillin, crategolic acid, tannins such as bicornin, gallotannic acid, methyl salicylate (painkiller), eugenin, kaempferol, rhamnetin, and eugenitin, triterpenoids | Boosting the immune system, antiseptic, anti-fungal, antibacterial, antioxidant, analgesic, anti -inflammatory |
| 6 | Chirayata or Swertia | *Gentiana chirayita* | Gentianaceae | Phelic acid, amarogentin, chiratin, chiratogenin, enicoflavine, gentianine, swertianin and swerchirin, resins, gum, carbonates and phosphates of potash lime and magnesia ash | Anti-cough, anti-inflammatory and reduces inflammation, anti-asthmatic and expectorant properties which can effectively treat asthma**,** tonic for liver, ends, fever |

| | | | | | |
|---|---|---|---|---|---|
| 7 | Ginger | *Zingiber officinale* Rosc | Zingiberaceae | Zingerone, shogaols, and gingerols with [6] -gingerol (1-[4'-hydroxy-3'-methoxyphenyl]-5 -hydroxy-3-decanone), enzyme zingibain is a cysteine protease α-zingiberene, ar-curcumene, β-bisabolene, β-sesquiphellandrene, zingiberol and zingiberenol, | Treating nausea, dysentery, heartburn, flatulence, and diarrhea, loss of appetite, infections, cough, and bronchitis. 6-gingerol and 6-shogaol exert anticancer activities against GI cancer. |
| 8 | Kareel fruit | *Capparis decidua* | Capparaceae | Stachydrine, β-carotene, Rutin, Isothiocynate, Glucosides, Hydrocarbons and Fatty acids. | Antmicrobial, laxative, astringent and hepatoprotective effect, vermifuge propertie |
| 9 | Curry tree leaves | *Murraya koenigii* | Rutaceae | Cinnamaldehyde, and numerous carbazole alkaloids, including mahanimbine, girinimbine, and mahanine. | Diarrhea, gastro-intestinal disorders, protect from air borne pathogens, leaf powder improves oral health and relieve kidney problems. |
| 10 | Dalchini | Cinnamon *Cinnamomum zeylanicum*, *and Cinnamon cassia*), | Lauraceae | Vital oils and other derivatives, such as cinnamaldehyde, cinnamic acid, and methyl cinnamate, eugenol, cinnamyl acetate. | Antimicrobial, anticancer, lipid-lowering, and cardiovascular -disease-lowering |
| 11 | Spear Mint or Pudina | *Mentha Arvensis Linn* | Lamiaceae | Menthol (27-51%), menthone (13-32%), isomenthone (2-10%), 1,8-cineole (5-14%), methyl acetate (2-4%), methofuran (2-12%), limonene (0.5-6%), pinenes (1.5-4%), germacrene (2.1-4.3%) and pulegone (0.1-1%) | Antimicrobial, anticancer, promot restful sleep, calming of digestive tract and alleviating indigestion, gas, and cramps. |

**Table 2:** Essential oils and its ingredients used to prepare steam distillate for controlling of dry cough, congestion, bronchial swelling, and breathing problems.

## Conclusion

Plant essential oils extracted from aromatic plants are widely used in therapeutics of flu viruses. Numerous *in vitro* studies have reported strong antiviral efficacy of essential oils and their chemical constituents as they block influenza activity. These were found effective against many viruses *in vitro.* Since essential oils and their components set multiple targets against viruses, they interfere in viral life cycle; inhibit virus entry into host cell and its replication. Due to their multiple therapeutic natures, these are considered as appropriate candidates for modern phytotherapy. Plant essential oils could be used to reduce influenza spread, but the next steps to develop aromatic therapies as influenza treatments is to conduct *in vivo* studies. Plant essential oils could be applied topically and are more preferable for antiviral treatment in patients. When used in steam distillate and inhaled these assist in clearance of air passageways and reduce lung inflammation, lung damage, and pneumonia. No more a single oil constituent might be applied as topical therapeutic agents in the treatment of recurrent herpes infection. Hope-

fully, use of various essential oil blends and its active constituents will prove therapeutically efficacious to control Covid-19 infection in comparison to synthetic drugs.

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