REVIEW DERLEME

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# Potential Use and Effects of Essential Oils in SARS-CoV-2 (COVID-19): Traditional Review

## Uçucu Yağların SARS-CoV-2'de (COVID-19) Potansiyel Kullanımı ve Etkileri: Geleneksel Derleme

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**ABSTRACT** Severe acute respiratory syndrome-coronavirus-2 (SARS-COV-2), a new type of beta coronavirus that emerged in Wuhan, China, and caused a pandemic, was declared coronavirus disease-2019 (COVID-19) by the World Health Organization on February 12, 2020. Natural remedies from plants have been used traditionally for thousands of years. The global interest in drug development from natural products has grown tremendously. The interest in essential oils, which attract attention with their rich and original content, is increasing in this direction. It is thought that essential oils, which are effective against various microorganisms, may help treat COVID-19 due to their anti-inflammatory, immunomodulatory, bronchodilator, antibacterial, and antiviral properties. This review briefly describes the current biology, epidemiology, and clinical aspects of COVID-19 and essential oil's activity on SARS-COV-2 by considering its effectiveness in this field. It has been observed that most of the studies on this subject consist of in silico and in vitro studies. In this context, molecular docking studies have come into prominence. However, in vivo and clinical studies of essential oils with notable antiviral-antibacterial effects must be increased. Therefore, essential oils and their active components will be promising potential drug candidates against COVID-19, and their numbers will potentially grow. In conclusion, the present review is focused on the most common and well-known essential oils available on the pharmaceutical markets, which show visible activities, especially against enveloped viruses, including COVID-19.

**Keywords:** Antiviral agents; COVID-19; essential oils; eucalyptol

**ÖZET** Çin'in Wuhan eyaletinde ortaya çıkarak pandemiye sebep olan yeni bir beta-koronavirüs türü olan şiddetli akut solunum sendromu-koronavirüs-2 [severe acute respiratory syndrome-coronavirus-2 (SARS-COV-2)], Dünya Sağlık Örgütü tarafından, 12 Şubat 2020 tarihinde koronavirüs hastalığı-2019 [coronavirus disease-2019 (COVID-19)] olarak ilan edildi. Bitkilerden elde edilen doğal ilaçlar, geleneksel olarak yıllardır kullanılmaktadır. Doğal ürünlerden ilaç geliştirmeye yönelik küresel ilgi, son yıllarda büyük oranda artış göstermektedir. Zengin ve özgün içerikleri ile dikkat çeken uçucu yağlara olan ilgi de bu doğrultuda giderek artmaktadır. Çeşitli mikroorganizmalara karşı etkili olan uçucu yağların antiinflamatuar, immünomodülatör, bronkodilatör, antibakteriyel ve antiviral özellikleri nedeniyle COVID-19 tedavisinde faydalı olabilecekleri düşünülmektedir. Bu derlemede, COVID-19'un mevcut biyolojisi, epidemiyolojisi ile çeşitli klinik yönleri kısaca anlatılmış ve bu alan etkili görülerek ön plana çıkmış uçucu yağlardan bahsedilmiştir. Bu konudaki çalışmaların büyük kısmının in silico ve in vitro çalışmalarından oluştuğu görülmüştür. Bu bağlamda moleküler docking çalışmaları ön plana çıkmaktadır. Ancak güçlü antiviral-antibakteriyel etkili uçucu yağlar başta gelmek üzere, in vivo ve klinik çalışmaların da artırılması gerektiği düşünülmektedir. Bu sayede uçucu yağlar ve etkili bileşenlerinin COVID-19'a karşı potansiyel ilaç adayları olabilecekleri umut edilmektedir. Mevcut incelemenin verileri, farmasötik pazarda mevcut olan ve özellikle zarflı virüslere karşı gözle görülür aktiviteler gösteren en yaygın ve çok bilinen uçucu yağlara dair bilgi vermek için odaklanmıştır.

**Anahtar Kelimeler:** Antiviral ajanlar; COVID-19; uçucu yağlar; ökaliptol

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Coronaviruses (CoV) are a group of zoonotic and enveloped ribonucleic acid (RNA) viruses that often cause respiratory and gastrointestinal tract infections and can infect various animal species along with humans.[1,2] On February 12, 2020 [coronavirus disease-2019 (COVID-19)], the World Health Organization gave the severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2)-caused illness the official name COVID-19.[3] The largest pandemic since the influenza outbreak in 1918 is the COVID-19 epidemic.[4] The COVID-19 epidemic was traced to an animal market in the Chinese city of Wuhan's Hubei region, even though the first coronavirus infection was reported in a cat.[5-7]

CoV belong to the taxonomic Coronavirinae family and consist of alpha ($\alpha$), beta ($\beta$), gamma ($\gamma$), and delta ($\delta$) CoV.[3,8] While α- CoV and $\beta$-CoV infect mammals, γ-CoV and δ-CoV generally prefer birds and fish. The viruses Middle East respiratory syndrome-coronavirus (MERS-CoV), SARS-CoV, and SARS-CoV-2 are $\beta$-CoV.[2,3,9]

The genomic structure of SARS-CoV-2 is 79-95% similar to SARS-CoV and approximately 50% to MERS-CoV, which's why it was called "SARS-CoV-2".[10] This situation has highlighted several medications used to treat RNA viruses like SARS-CoV and MERS-CoV.[3] Future COVID-19 treatments, however, should be worried about the rapid evolution of SARS-CoV-2 mutations. The prominent mutants are called "Alpha (UK), Beta (South Africa), Gamma (Brazil), Delta (India), and Omicron (South Africa)".[11,12]

Within the scope of this compilation, PubMed (United States National Library of Medicine, USA), Science Direct (Elsevier, Netherlands), Google Scholar (Google, USA) databases, *etc*., were used to search the scientific journals, especially paying attention to current sources (sources of the last ten years have been looked through, including September 2023, but primarily focusing on the most directly related ones). Even though there is general information about COVID-19, which is still a current and dangerous disease, there are some treatment strategies today. However, this review will discuss some promising essential oils, especially as a remedy for this disease.

## STRUCTURE AND MECHANISM OF ACTION OF SARS-COV-2

So far, COVID-19 therapies have targeted the structure and mechanism of the SARS-CoV-2 virus to find novel therapeutic medicines for the prevention and treatment of COVID-19.[13] The SARS-CoV-2 virus has nucleocapsid (N), spike (S), envelope (Z), and membrane (M) proteins as principal proteins in structures.[1,3] S proteins bind to host receptors by forming spikes on the viral surface.[3,9,14,15] These protrusions formed by the S protein on the virus surface give CoV the crown-like appearance that refers to the name.[3,16] The S protein consists of S1 and S2 domains. As the virus penetrates the host cell, the S1 domain of the virus attaches to a particular cell surface receptor through the receptor binding domain (RBD); the S2 domain combines the host cell with its viral membrane and transfers its genome to the host cell.[3,17]

The SARS-CoV-2 cell receptor, known as the angiotensin converting enzyme-2 (ACE-2) receptor, is one of the determinant factors of the virus contagiousness.[18] SARS-CoV and SARS-CoV-2 have the ACE-2 cell receptor, but SARS-CoV-2 has a higher affinity for the receptor, making it more invasive.[19] SARS-CoV-2 synergistically binds to the ACE-2 receptor with the host's transmembrane serine protease-2 (cell surface protein) and enters the cells. After that, viral protein translation forms the virus in the host cell, matures, and is released into circulation.[3,10,15]

## TREATMENT STRATEGIES IN SARS-COV-2

ACE-2 is widely present in the body, especially in the lungs, including the kidneys, intestines, cardiovascular system, central nervous system, and adipose tissue.[20] This wide distribution of ACE-2 leads to multi-organ failure in COVID-19 patients. Although the respiratory system is SARS-CoV-2's primary target, the fatality rate from COVID-19 is 1.7 times higher in patients with cardiovascular illness than in those with chronic respiratory disease, which is also related to this situation.[21-23] For this reason, preventing the S protein from binding to ACE-2 receptors is one of the main goals in the treatment of COVID-19.[24] The cytokine storm that develops with the release of proinflammatory cytokines such as tumor

necrosis factor-α, interleukin-1 (IL)-1, and IL-6 in the host cell is an abnormal host immune response.[10,13] Although cytokines are proteins responsible for immunity, inflammation, and hematopoiesis, they can accumulate in various organs of some patients whose immune system is overstimulated and may cause tissue damage.[25] This shows that in treating COVID-19, there must be high levels of attention to identifying the occurrence of cytokine storms.

The drugs used to treat COVID-19 are expected to prevent the SARS-CoV-2 virus from entering the cell and multiplying.[10] However, the current drug treatment for COVID-19 is based on the reuse of already existing drugs.[3] The mutation in 46 amino acids of the S protein of the Omicron variant is worried about future SARS-CoV-2 mutations.[12,26]

## ANTIVIRAL ACTIVITIES OF ESSENTIAL OILS

Essential oils from different plant species are a rich source of therapeutic agents with prominent bioactive components such as phenolic, terpenic, and others known as effective towards various pathogens.[27] There is proof that various bacteria, including viruses, resist essential oils.[28] Because of their anti-inflammatory, immunomodulatory, bronchodilator, antibacterial, and antiviral effects, essential oils and their constituents are believed to help treat COVID-19. Significantly, the antiviral activities of essential oils are their ability to break down viral membranes easily due to their lipophilic nature and to interfere with the virus's life cycle by affecting host-virus connections.[3,29,30] Synergistic interactions between essential oils and synthetic antiviral agents have also been reported in some publications.[31] In light of current information, many approaches based on essential oils and their components have been proposed for treating COVID-19 and might become strong medication candidates.[32,33]

## EFFECTS OF ESSENTIAL OILS ON SARS-COV-2

The molecular docking studies demonstrated that essential oils inhibit the S protein of SARS-CoV-2 binding with ACE-2 receptors. Molecular docking studies are *in silico* technique that predicts interactions between proteins and molecules. These studies play an essential role in accelerating the drug development process.[34] These studies show that some constituents of essential oils are potent against SARS-CoV-2.[35]

The aromatic plants and essential oils used for thousands of years have medicinal value worldwide.[36] Moreover, the beneficial effects of essential oils will be proven for respiratory symptoms caused by COVID-19.[31,36] In addition, the anti-inflammatory effects of essential oils may also be helpful in the loss of the senses of taste and smell, which are considered the symptoms of the disease.[37]

Herbal products are an important source of herbal medicines and other medicines. Essential oils demonstrated various pharmacological activities, including antiviral activity are suggested to have potential effects against SARS-CoV-2. Due to their lipophilicity, essential oils can easily penetrate the viral membrane and cause rupture of the viral membrane. Moreover, this structural feature of essential oils has a holistic effect on the body by affecting the limbic system.[33,38] Current information is that the safe use of essential oils will give positive results in the treatment of COVID-19 (Figure 1).[33]

## EXAMPLES OF ESSENTIAL OILS CONSIDERED EFFECTIVE IN SARS-COV-2

### EUCALYPTI AETHEROLEUM/EUCALYPTUS ESSENTIAL OIL

***Plant:*** *Eucalyptus globulus* L.

#### *Family: Myrtaceae*

*Eucalyptus* essential oil and its active ingredient, 1,8-cineol (Eucalyptol), have bronchodilator and mucociliary effects and are recommended for the symptomatic treatment of various respiratory disorders.[37] In clinical studies, the anti-inflammatory and analgesic effect of inhalation of 1,8-cineol blocks the release of cytokines. The antiviral effects of *Eucalyptus* essential oil have been proven *in vitro* against many viruses, including influenza A (H1N1), herpes simplex viruses (HSV-1 and HSV-2), and enveloped mumps viruses.[33] Molecular docking studies by Sharma and Kaur revealed that a complex was

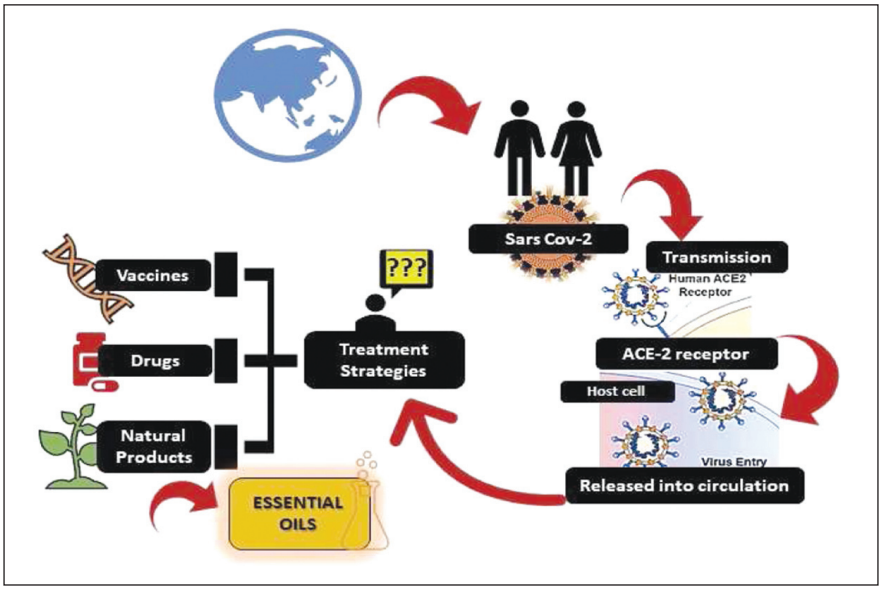


**FIGURE 1:** Summary representation of COVID-19 and related cycle.
ACE-2: Angiotensin converting enzyme-2.

formed between 1,8-cineol and jensenone Mpro (coronavirus main protease).[39,40] In addition, active components of *Eucalyptus* essential oil, especially toruatone, bind effectively to the S protein of COVID-19.[41] In addition, Panikar et al. reported in their molecular docking study that *Eucalyptus* essential oil especially 1,8-cineole could be used as a potential inhibitor against COVID-19.[42]

## CINNAMOMI CAMPHORAE AETHEROLEUM/

## *CINNAMOMUM CAMPHORA ESSENTIAL OIL*

***Plant:*** *Cinnamomum camphora* L. Presl.

### *Family: Lauraceae*

The essential oil is obtained from the barks, leaves, and fruits of the Camphor tree known as *C. camphora.*[24] Although the essential oil is rich in camphor, it also contains 1,8-cineol at a higher concentration (at least 45%), more than the camphor concentration.[24,43] similar to *Eucalyptus* essential oil.[29] *C. camphora* essential oil has analgesic, anti-inflammatory, and antispasmodic properties besides antiviral effects against various viruses. The main compounds, 1,8-cineole and camphor, have been known for their antiviral effects.[44] Moreover, camphor has been used successfully as a remedy for COVID-19 symptoms and has been shown to inhibit the S-glycoprotein of SARS-CoV-2.[45,46]

## AMOMI TSAO-KO AETHEROLEUM/

## *AMOMUM TSAO-KO/LANXANGIA TSAOKO ESSENTIAL OIL*

***Plant:*** *Amomum tsao-ko* Crevost & Lemarié

### *Family: Zingiberaceae*

In Traditional Chinese Medicine, this plant treats respiratory system diseases, stomachache, and malaria.[47] The name of the plant is etymologically related to the Greek-Latin word *amomum* (ἄμωμον/ἀμώμη), meaning "oriental spice plant".[48,49] *Amomum tsao-ko* is also known as Chinese black cardamom in the literature and can be translated into Turkish as "Siyah Çin kakulesi" (Black Chinese cardamom).[50] Similar to *Eucalyptus* essential oils, the dominant component of *A. tsao-ko* essential oil is 1,8-cineole.[47,48] Cui et al. explained the antioxidant and antibacterial activity of *A. tsao-ko* essential oil.[47] Liu et al. observed that *A. tsao-ko* essential oil has an excellent binding relationship with RBD on the COVID-19 *Omicron* variant and inhibits ACE-2, and it was suggested that its essential oil would be beneficial in preventing COVID-19.[12]

## ALLII SATIVI AETHEROLEUM/ GARLIC ESSENTIAL OIL

***Plant:*** *Allium sativum* L.

### *Family: Amaryllidaceae*

Organosulfur compounds with antioxidant, antimicrobial, antifungal, and anticancer activities may be found in *A. sativum* essential oil.[51,52] The biological activity of the *A. sativum* essential oil depends on the amount of sulfur atoms, and there is a linear relationship between the amount of sulfur atoms and the biological activity.[51] Thuy et al. determined allyl disulfide (28.4%), allyl trisulfide (22.8%), allyl (E)-1-propenyl disulfide (8.2%), allyl methyl trisulfide (6.7%) and diallyl tetrasulfide (6.5%) as the main components in the essential oil of *A. sativum*. The essential oil strongly interacted with ACE-2 and Mpro in the molecular docking study. The most potent activity was found in allyl disulfide and allyl trisulfide, and there were synergistic interactions in the antiviral activities of other components.[53]

## NIGELLAE SATIVAE AETHEROLEUM/ BLACK CARAWAY SEED ESSENTIAL OIL/ *BLACK CUMIN SEED ESSENTIAL OIL*

***Plant:*** *Nigella sativa* L.

### *Family: Ranunculaceae*

The essential oil of *N. sativa* seeds has important therapeutic effects on diabetes, cardiovascular disorders, and many bacterial-viral infections.[54] The antibacterial activity of *N. sativa* essential oil significantly inhibits the growth of Gram (+) bacteria.[55] Antioxidant, anti-inflammatory, antimicrobial, and anticonvulsant activities of thymoquinone as the main component in *N. sativa* essential oil have been found to be active against cytokine storm.[55,56] The essential oil's primary components, thymoquinone, di-thymoquinone, and hydroxy-thymoquinone, had encouraging *in vitro* efficacy on SARS-CoV-2.[57] Esharkawy et al. observed the significant antiviral activity of thymoquinone by binding to the virus receptor and the *in vitro* anti-SARS-CoV-2 activity of hydroxy-thymoquinone at non-cytotoxic nanomolar concentrations.[57]

## LIMONIS AETHEROLEUM/LEMON ESSENTIAL OIL

***Plant:*** *Citrus limonum* L.

### *Family: Rutaceae*

*C. limonum* essential oil and its main component, limonene, have antioxidant, antimicrobial, anticarcinogenic, and anti-inflammatory effects.[58] A previous study evaluated the inhibitory effects of various essential oils on ACE-2. The *C. limonum* essential oil [limonene (73.0%), $\gamma$-terpinene (9.2%), and $\beta$-pinene (8.6%)] exhibited potent inhibition on ACE-2 without any cytotoxicity.[59] In this study, the HT-29 cell line was used to examine the inhibitory effects of essential oils on the ACE-2, and citronellol and limonene in lemon essential oil were found to be highly effective.[59] Torres Neto et al. examined the inhibitory effects of several essential oils on the ACE-2 with the HT-29 cell line. *C. limonum* (*C. lemon*) essential oil has been found to be reasonably active against the SARS-CoV-2 delta variant, which may be responsible for the existence of (*E*)-anethole, eugenol, limonene $\beta$-pinene, and citronellol.[58]

## PELARGONII AETHEROLEUM/ GERANIUM ESSENTIAL OIL

***Plant:*** *Pelargonium graveolens* L'Hér

### *Family: Geraniaceae*

*Pelargonium* essential oil showed antioxidant, antifungal, antimicrobial, anti-inflammatory, and spasmolytic effects.[60] Senthil Kumar et al. determined citronellol (27.1%), geraniol (21.4 %), and neryl acetate (10.5%) as the major components of *Pelargonium* essential oil. As a result of this study, citronellol, geraniol, limonene, and neryl acetate strongly suppressed ACE-2.[59] Another study by Torres Neto et al. also demonstrated that *P. graveolens* essential oil exhibited marked activity against the delta variant of SARS-CoV-2.[58]

## THYMI AETHEROLEUM/THYME ESSENTIAL OIL

***Plant:*** *Thymus vulgaris* L.

### *Family: Lamiaceae*

*T. vulgaris* has been used in folk medicine for treating gastrointestinal system and respiratory tract diseases with its expectorant, antitussive, and an-

timicrobial effects.[61] The main chemical components of *T. vulgaris* essential oil are thymol and carvacrol, besides *p*-cymene (8.41%), *γ*-terpinene, caryophyllene, spathulenol, germacrene D, *β*-phenyl alcohol, and *δ*-terpineol.[30,43] Antibacterial and antifungal effects of the essential oil were observed against Gram(+) & Gram(-) bacteria and fungal strains.[62] In *in silico* studies, carvacrol and thymol were found to be effectively binding to Mpro of SARS-CoV-2.[63,64] Borugă et al. showed strong antimicrobial properties of *Thymus* essential oil.[65] Thyme essential oil has been known for its antiseptic, astringent, anthelmintic, disinfectant, and anti-inflammatory activities, besides its effects on respiratory diseases such as pertussis and bronchitis.[29,66]

A clinical study was conducted with thyme used in traditional Persian medicine in Iran. The participants were randomly split into two groups in a randomized clinical study with 83 COVID-19 patients in the hospital. In contrast, one group served as the control group, and the other group received *T. vulgaris* essential oil thrice daily, 5 mL of the syrup or essential oil only for seven days, which is supplied from a pharmacy company for seven days used under supervision and with ethical permissions. Two questionnaires regarding their symptoms were administered to the patients before and at the end of the study. According to the findings, individuals who used the essential oil had symptom improvement, including chest discomfort, coughing, and fever. Besides, differences in blood urea nitrogen, neutrophil, and lymphocyte counts were also observed in patients, and these findings were interpreted as clinical improvement.[66]

*T. vulgaris* essential oil was examined for its ability to combat SARS-CoV-2 in the air in recent research by Şakalar and Ertürk, and it was found to be effective both in solution and in the air. Moreover, in 60 minutes, thyme essential oil at a 1/1000 dilution (v/v) in the solution eliminated more than 99.99% of the SARS-CoV-2 present in the solution. According to experiments on air disinfection in a 30 m3 room, 40 mL of essential oil killed more than 99.99% of SARS-CoV-2 in the air, while 20 mL of essential oil eliminated 90.88% of the virus in 60 minutes.[67]

## LAURI AETHEROLEUM/LAUREL ESSENTIAL OIL

***Plant:*** *Laurus nobilis* L.

### Family: Lauraceae

The main components of *L. nobilis* essential oil were determined as 1,8-cineol (68.82%), 1-(*S*)-α-pinene (6.94%), and *R*-(+)-limonene (3.04%).[68] Antinociceptive, anti-inflammatory, and analgesic activities of *L. nobilis* essential oil have been reported in some studies.[69] Loizzo et al. reported that *L. nobilis* essential oil inhibits replication of SARS-CoV *in vitro*, whose genetic structure is 96% identical to SARS-CoV-2.[70] In a molecular docking study, nine compounds found in *L. nobilis* essential oil were found to have high affinities for Mpro. Lauruside-5, a sesquiterpene, has been highlighted as the most viable prospect among these chemicals as a possible Mpro inhibitor. The same study also analyzed the impact of COVID-19, using samples collected from different regions in Italy. Accordingly, in the Southern areas with more forests per capita, the severity of the pandemic was much lower. However, the authors stated that the Mediterranean climate and diet may also affect these results.[71]

## THE ROLE OF ESSENTIAL OILS IN THE LOSS OF ODOR DUE TO SARS-COV-2

Loss of smell is one of the common side effects of COVID-19.[4,11] ACE-2, and transmembrane protease serine 2 are expressed to varying degrees in the upper respiratory tract; therefore, these regions are thought to be places where SARS-CoV-2 can easily attach.[11] Inhaling antimicrobial and anti-inflammatory essential oils is estimated to be beneficial.[11] Le Bon et al. applied an olfactory test to 72 patients with COVID-19 who lost their sense of smell about five weeks after their loss of smell. Test results showed that 27 patients (37.5%) developed permanent smell loss. They suggested that the odor training with oral corticosteroid treatment significantly improved odor loss due to COVID-19.[72]

## THE ROLE OF ESSENTIAL OILS IN FATIGUE DUE TO SARS-COV-2

According to the meta-analysis results (21 meta-analyses, 47,910 participants aged 17-87), 80% of COVID-19 patients progress with long-term symp-

toms, and fatigue seems first among these symptoms.[37] 42 young and healthy women who had been experiencing fatigue for at least 5 months that had not been present before COVID-19, participated in a randomized, double-blind, placebo-controlled study to assess the effects of Longevity™, a proprietary blend of essential oils made by Young Living Essential Oils (Lehi, Utah, USA), on fatigue. The intervention group in the study was given a 15 mL bottle containing a mixture of essential oils of *T. vulgaris*, *C. sinensis*, *Eugenia caryophyllus*, and *Boswellia carterii* were instructed to breathe in the fragrance twice daily for 15 minutes in the morning, and the evening. As a result of the study, it was observed that this essential oil mixture significantly improved fatigue when used regularly for two weeks.[38]

### THE OTHER STUDIES

Bahl et al., in a molecular docking study investigating the effects of polyherbal Sudarshan AV and Elixir AV (SAV and EAV) essential oil blends used in Ayurveda on COVID-19, found that *β*-ocimene, eugenol, *p*-cymene and thymol, especially cinnamaldehyde and geranium, combined with S protein well inhibited ACE. In the study mentioned above, the SAV-EAV essential oil mixture (FEO; SAV & EAV) was also conducted with male golden Syrian hamsters infected with SARS-CoV-2. The results stated that using this polyherbal essential oil mixture before and after infection improved the course of the disease.[73] Pelvan et al. have developed an oral/throat spray formulation with the essential oils of *Salvia triloba*, *Origanum onites*, *Mentha piperita*, *C. limonum*, and *P. graveolens* for prophylactic use in SARS-CoV-2 infection. The formulation was examined using Vero E6 cells, and the antiviral, antimicrobial, anti-inflammatory, and analgesic effects were confirmed. The spray was observed to be non-cytotoxic and rendered 85% of the SARS-CoV-2 virus titer present at a 1:640 dilution inactive after 140 hours of incubation with the virus.[74] An essential oil mixture of *Thymbra capitata*, *Salvia fruticosa*, and *Origanum dictamnus* showed 80% antiviral effects on SARS-CoV-2 in a cell culture study using VERO cells. After evaluating the clinical effectiveness of this essential oil blend, significant improvement was observed in mild COVID-19 symptoms.[75]

## CONCLUSION

Essential oils are very well-known therapeutic agents, especially in infectious diseases, with phytochemical compositions for medicinal properties used worldwide, with complex structures in their contents. Therefore, all the properties of this natural herbal product mentioned above, especially its lipophilic nature, make it a potentially effective candidate against SARS-CoV-2. This phenomenon is also supported by potential future drug candidates against COVID-19.

This review reported the most well-known essential oils with promising potential activities to eliminate COVID-19. The antiviral components in essential oils are employed as potential drug targets for preventing and treating COVID-19. The studies with essential oils suggest that the most repeated essential oils were *E. globulus*, *C. camphora*, *Amomum tsao-ko*, *A. sativum*, *N. sativa*, *P. graveolens*, *C. limonum*, *T. vulgaris*, and *L. nobilis*. In this context, eucalyptol, carvacrol, and thymol have been found to be the most remarkable agents for anti-SARS-CoV-2 activity in the essential oil composition. In addition, the results showed that essential oils are also helpful for loss of smell and fatigue after experiencing COVID-19. Despite the promising effects of essential oils in COVID-19, most of the available information is based on data from *in silico* and *in vitro* studies. Molecular docking studies, which have attracted great interest in recent years, are important in directing compounds that may be new drug molecules. However, the lack of *in vivo* studies is why there is insufficient evidence for the safety of essential oils in clinical use. In addition, immunodeficiency or misdirection of the immune response can cause tissue damage by increasing viral replication and overactive immune responses, leading to immunopathological conditions. Consequently, more well-thought-out *in vitro*, *in vivo*, and clinical research has been suggested to establish the ideal dosage and therapeutic effectiveness of using essential oils in COVID-19. Eventually, the current review provides information on the most potentially effective common essential oils against enveloped viruses and highlights their proposed activity against SARS-CoV-2.

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*No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.*

### *Authorship Contributions*

***Idea/Concept:*** *Alev Önder;* ***Design:*** *Alev Önder, Eda Avcı;* ***Control/Supervision:*** *Alev Önder;* ***Data Collection and/or Processing:*** *Eda Avcı;* ***Analysis and/or Interpretation:*** *Eda Avcı, Alev Önder;* ***Literature Review:*** *Eda Avcı;* ***Writing the Article:*** *Eda Avcı;* ***Critical Review:*** *Alev Önder.*

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