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# Herbal medicine approach to relieving dyspnea: A narrative review of efficacy and mechanisms

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**ABSTRACT**

Dyspnea, a distressing symptom characterized by difficult or labored breathing, can be caused by a variety of underlying processes, including respiratory and cardiovascular problems. Despite advancements in medicine, a need remains for more effective dyspnea therapies. Herbal therapy has emerged as a viable approach in this field, with potential therapeutic benefits. The purpose of this narrative review is to assess the efficacy of herbal medication in reducing dyspnea. A comprehensive search was undertaken without time constraints utilizing Google Scholar, PubMed, and Scopus databases up to December 2024 to collect relevant clinical trials. Herbal medicine (*Allium sativum* L., *Carum copticum* (L.) Benth. & Hook.f., *Crocus sativus* L., *Curcuma longa* L., *Eucalyptus globulus* Labill., *Mentha × piperita* L., *Nigella sativa* L., *Rosmarinus officinalis* L., *Thymus vulgaris* L., and *Zataria multiflora* Boiss.) and their main components have been shown to reduce dyspnea through multiple mechanisms of disease, including anti-inflammatory, bronchodilatory, and anti-oxidant properties. The findings indicate that herbal remedies may be a useful complement or alternative therapy for managing dyspnea. It could be concluded that herbal therapy offers an effective approach to managing dyspnea, providing a natural and potentially beneficial option for people experiencing respiratory distress. More research and clinical trials are needed to understand the exact mechanisms of action and maximize the use of herbal therapies in the treatment of dyspnea.

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## Introduction

Dyspnea, commonly known as shortness of breath, is a distressing symptom that can significantly impact a person's quality of life. It may show across a spectrum of disorders, from heart failure and pulmonary embolism to respiratory disorders like asthma and chronic obstructive pulmonary disease (COPD) (1, 2). Dyspnea can induce discomfort, anxiety, and fear, limiting an individual's capacity to engage in physical activities and consequently impacting their overall well-being (3, 4) (Figure 1).

The underlying mechanisms of dyspnea are complicated and extensive. It can originate from a mismatch between the body's demand for oxygen and its ability to provide it, producing a cascade of physiological responses that involve the respiratory and cardiovascular systems. Impaired gas exchange, increased respiratory drive, and altered lung mechanics all contribute to the experience of breathlessness (5).

Methods used to assess dyspnea in humans include pulmonary function tests (PFTs), which evaluate lung function parameters such as forced expiratory volume in one second ($FEV_1$) and forced vital capacity (FVC). These tests provide useful information about the respiratory capabilities of individuals and their relation to dyspnea (6, 7). Furthermore, exercise testing and arterial blood gas analysis are used to assess and define the severity of dyspnea and its

influence on daily activities (8). Understanding the relationship between these physiological parameters and dyspnea perception enables a better understanding of the symptoms and suggests treatment strategies tailored to each individual.

Current dyspnea treatments primarily focus on addressing the underlying causes, alleviating symptoms, and restoring respiratory function. However, there remains an urgent need to develop new and more effective treatment options for this common condition.

In recent decades, researchers have increasingly focused on herbal medicine for the treatment of various diseases (9-12), including dyspnea (13) and other respiratory disorders (14-16). Additionally, according to the World Health Organization (WHO), 11% of medications come from plants, and 80% of people worldwide use phytochemistry to meet their basic health-related needs (17).

Traditional folk medicine has historically used a wide range of herbs and natural remedies to treat respiratory and breathing problems (18-20). Avicenna's "Canon of Medicine" (Al-Qanun fi al-Tibb) mentions various plants that have beneficial effects on respiratory disorders, including dyspnea. Avicenna classified plants according to their medical characteristics and frequently prescribed them for a variety of diseases, including respiratory disorders. Avicenna believed that several plants, including saffron (*Crocus sativus* L.) and garlic (*Allium sativum* L.),

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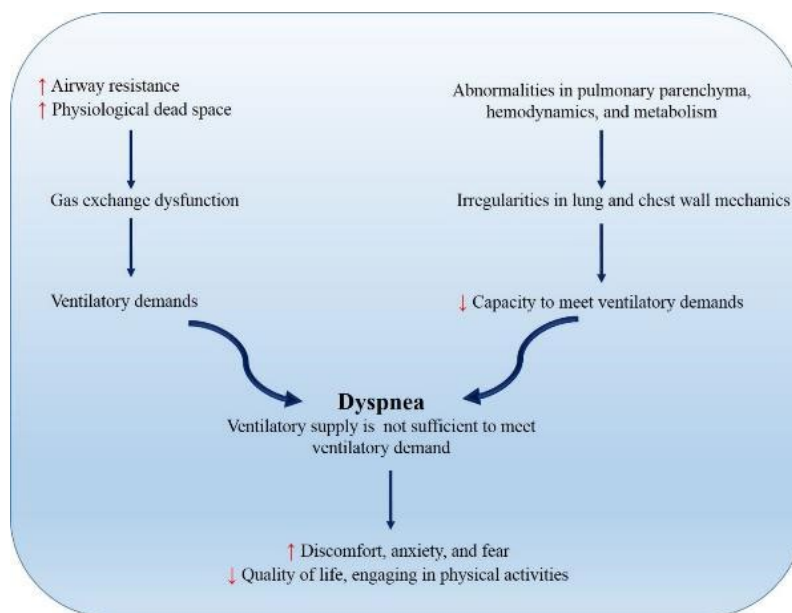
**Figure 1.** Pathophysiology and effect of dyspnea on individual's life

had significant advantages on the respiratory system (21). Similarly, Mohammad Hossein Aghili Khorasani's "Makhzan al-Adwiya" (22) and "Tohfat al-Momenin" (23) contributed to the discourse of herbal medicine by describing a variety of botanical medicines and their applications in Persian medications. Indian medicine has long utilized herbs like turmeric (*Curcuma longa* L.) for their expectorant properties to alleviate respiratory congestion (24). These diverse herbal remedies from ancient medical systems reflect a profound understanding of the therapeutic properties of plants in managing respiratory disorders, underscoring the universal reliance on botanical medicine for respiratory health across various cultures and civilizations.

Pharmacological studies also illustrated that plants such as *Allium cepa* L. (25), *C. sativus* L. (26), *Ocimum basilicum* L. (27), *Portulaca oleracea* L. (28), and *Zataria multiflora* Boiss. (29) have long been used for their supposed respiratory advantages, which include anti-inflammatory, bronchodilatory, and expectorant properties.

The primary objective of this narrative review is to assess the efficacy of herbal medicine in treating dyspnea and to elucidate the various mechanisms by which these herbal therapies operate. By evaluating the therapeutic properties of herbal treatments, this review aims to identify alternative and complementary methods for managing dyspnea, potentially offering safer and more effective solutions for individuals with respiratory issues. The present review not only aims to improve our understanding of the potential of herbal treatments but also to pave the way for a broader approach to alleviating breathing problems, attracting researchers to design and formulate strategies that improve the safe integration of herbal remedies into medicine, bridging the gap between laboratory research and clinical use.

**Methods**

To gather relevant information, an organized search was undertaken on Google Scholar, PubMed, and Scopus without time limits until December 2024. The search terms used were "herbal remedies," "breathing difficulties," "dyspnea," "shortness of breath," "breathlessness," "respiratory distress," "forced vital capacity," "FVC," "forced expiratory volume in one second," "$FEV_1$," "pulmonary function tests," "PFTs," "herbal medicine," and "natural remedies."

The selection of relevant articles was conducted manually by a single reviewer, ensuring consistency in identifying studies related to herbal interventions for dyspnea. No automation tools were used in the screening or extraction process. The inclusion criteria covered peer-reviewed papers investigating the mechanisms and efficacy of herbal therapies in respiratory conditions, with a focus on English-language publications (at least the abstract). Studies unrelated to herbal treatments for dyspnea, non-peer-reviewed research, and articles falling outside this scope were excluded. The selection process followed a structured approach to ensure relevance and quality (Figure 2).

***Risk of bias consideration***

Since this is a narrative review, a formal risk-of-bias assessment was not conducted. However, the quality of studies was evaluated based on peer-review status,
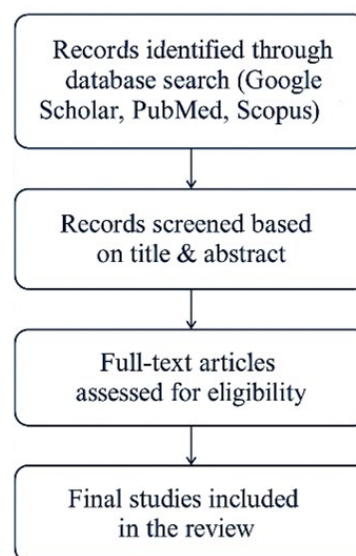


**Figure 2.** Study selection process for the narrative review on herbal remedies for dyspnea

relevance to herbal therapy for dyspnea, and study design considerations to ensure meaningful synthesis of findings.

## Herbal interventions for dyspnea

The effects of various medicinal plants, their derivatives, and other natural products on dyspnea were investigated, and most of these substances showed promising results. The effects of most natural products on dyspnea and the possible mechanism(s) are provided in this review.

### Allium sativum L. (Garlic)

The Amaryllidaceae family includes garlic, formally known as *Allium sativum* L. (*A. sativum*), which is native to Asia but is now widely cultivated in regions such as China, Egypt, Europe, and Mexico. This plant is widely consumed in Iran, where traditional medicine uses its leaves, flowers, and bulbs. *A. sativum* is used externally to treat eczema, scabies, premature graying of the hair, inflammation associated with tetanus, and lung inflammation. It is also used to cure fever and coughing (30). Modern research has also revealed its advantageous properties, including anti-oxidant, immunomodulatory (31), anti-inflammatory (32), antimicrobial (33), and antitumor (34). The following section will explore the influence of garlic on dyspnea.

### The effects of A. sativum powder

The effectiveness of garlic powder in improving arterial oxygenation and dyspnea was examined in a study that involved subjects with hepatopulmonary syndrome. Patients self-administered garlic powder capsules daily, and

assessments of arterial blood gases (ABG) and dyspnea were performed every 4–8 weeks. The findings indicated that 40% of participants experienced significant improvements, with at least a 10 mmHg rise in arterial oxygen pressure ($PO_2$) or a reduction in the alveolar-arterial gradient. Additionally, all six subjects who responded to garlic reported less exertional dyspnea (35). Likewise, children with hepatopulmonary syndrome received garlic powder capsules as part of a study to examine the effect of oral garlic on arterial oxygen pressure. Ten boys and five girls comprised the study cohort. They had a variety of underlying diseases, including presinusoidal portal hypertension, autoimmune hepatitis, cryptogenic cirrhosis, and biliary tract atresia. The findings showed that the mean arterial oxygen pressure ($PaO_2$) increased by 10 mmHg in 53.3% of the patients, and $PaO_2$ values of responders were significantly improved compared to those of non-responders. These results imply the effect of oral garlic supplements administration in children with hepatopulmonary syndrome on improving oxygenation and reducing dyspnea (36) (Table 1).

A trial was conducted on non-critically ill COVID-19 patients who received either Gallecina capsules or a placebo along with remdesivir for five days or until discharge. At discharge, parameters such as arterial oxygen saturation ($SaO_2$) and respiratory symptoms were identical between groups, but body temperature was considerably lower in the Gallecina group. On days 3 and 4, as well as upon discharge, the Gallecina group required significantly less supplementary oxygen. Although there was no substantial improvement in clinical status by day 6, Gallecina did

**Table 1.** Effect of *Allium sativum*, *Carum copticum*, and *Crocus sativus* on dyspnea

| Compound | Study design | Doses/Duration | Results | Ref. |
|---|---|---|---|---|
| *A. sativum* powder | 15 participants with HPS | 6 months, PO | ↑ $PO_2$ <br> ↓ Alveolar-arterial gradient, exertional dyspnea | (35) |
| Dried *A. sativum* | 15 children with HPS | 1 g/1.73 m², 5 months, PO | ↑ Mean arterial oxygen pressure, $PaO_2$ | (36) |
| *A. sativum* capsules (Gallecina) | 72 non-critically ill COVID-19 patients | 90 mg, three times a day, 5 days, PO | ↓ Body temperature, supplementary oxygen | (37) |
| *A. sativum* | 20 Healthy overweight adult | 3-4 g, PO | ↑ FEF25-75% <br> ↓ FVC, $FEV_1$ | (38) |
| *A. sativum* powder | 22 patients with pulmonary tuberculosis | 5 g, three times a day, 7 days, PO | ↓ Pulmonary tuberculosis signs and symptoms | (39) |
| *C. copticum* boiled extract | 15 asthmatic patients | 0.125, 0.25 ml/kg of 10 g% boiled extract, PO | ↑ PFTs values | (45) |
| Dried *C. sativus* stigma | 80 individuals with mild/moderate allergic asthma | 50 mg, twice a day, 8 weeks, PO | ↑ FEF, FVC, $FEV_1$, $FEV_1$/FVC ratio <br> ↓ hs-CRP, anti-HSP70 concentrations | (59) |
| Dried *C. sativus* stigma | 80 samples with mild/moderate persistent allergic asthma | 100 mg, 8 weeks, PO | ↑ Sleep quality, activity levels <br> ↓ Use of salbutamol spray, frequency of shortness of breath, severity of asthma | (60) |
| Crocin | 23 COPD patients | 30 mg, 12 weeks, PO | ↑ Total antioxidant capacity, 6MWD <br> ↓ Blood NF-κB levels, total oxidant status | (62) |
| Crocin | 57 participants with COPD | 15 mg, twice a day, 12 weeks, PO | ↑ IL-6 levels, 6MWD, $FEV_1$, $FEV_1$/FVC <br> ↓ Serum TNF-α levels | (63) |

6MWD: 6-Minute walk distance; COPD: Chronic obstructive pulmonary disease; COVID-19: Coronavirus disease 2019; FEF: Forced expiratory flow; FEV1: Forced expiratory volume in 1 second; FVC: Forced vital capacity; HPS: Hepatopulmonary syndrome; hs-CRP: High-sensitivity C-reactive protein; HSP70: Heat shock protein 70; IL-6: Interleukin-6; NF-κB: Nuclear factor Kappa B; PO.: Per Os (by mouth); $PaO_2$: Partial pressure of oxygen in arterial blood; PFTs: Pulmonary function tests; $PO_2$: Partial pressure of oxygen; TNF-α: Tumor necrosis factor-alpha

demonstrate a significant decrease in oxygen requirements on various days, indicating prospective advantages in COVID-19 patients who are not critically ill (37).

In a study of healthy, overweight adults without respiratory illnesses, the effects of exercise and garlic supplements on lung function were evaluated. Standard methods were used to measure peak expiratory flow rate (PEFR), $FEV_1$, FVC, and Forced Expiratory Flow at 25-75% (FEF25-75%). Garlic consumption was found to substantially decrease FVC and $FEV_1$, maintain PEFR, and significantly raise FEF25-75% (38).

The purpose of a study was to determine whether garlic powder may help reduce the signs and symptoms of pulmonary tuberculosis. Participants were divided into two groups: a treatment group and a control group. Tuberculosis signs and symptoms were monitored using observation sheets and standard operating procedures. Following the administration of garlic powder, statistical analysis showed a significant reduction in pulmonary tuberculosis signs and symptoms (including night sweats, cough with phlegm, fever, cough mixed with blood, chest pain, dyspnea, etc.). In contrast, there was no significant difference in tuberculosis symptoms in the control group (39).

Research on the effects of garlic supplements in various respiratory conditions has shown promising results. While these findings are promising, larger trials with more rigorous controls are needed to confirm these effects and further explore the specific mechanisms underlying the benefits of garlic in respiratory disorders. Future research should focus on identifying bioactive compounds in garlic, potential interactions with standard treatments, optimal dosages, and long-term effects for a comprehensive understanding of garlic supplementation in respiratory conditions.

### *Carum copticum (L.) Benth. & Hook.f. (Ajowan)*

*Carum copticum* (L.) Benth. & Hook.f. (*C. copticum*), commonly known as "Ajowan," is grown around the world, particularly in places like Iran and several Indian states. In the past, *C. copticum* has been used for a variety of medical conditions, including abdominal tumors, bloating, diarrhea, decreased appetite, stomach discomfort, dyspnea, and fatigue (40). In addition to these applications, it has antifungal (41), anti-oxidant, immunomodulatory, anti-inflammatory (42), bronchodilatory (43), and antibacterial (44) properties.

#### *Effects of C. copticum extract*

A study compared the bronchodilatory effects of a boiling extract of *C. copticum* with theophylline and a placebo in individuals with asthma. Specific airway conductance (sGaw) and PFT measures revealed that the *C. copticum* extract significantly raised PFT values over a range of time periods, with effects similar to those of theophylline but at lower concentrations. The bronchodilatory impact started after 30 min, peaked at 23 to 32% in PFTs between 90 and 120 min, and then began to decline after 150 min, which was similar to the theophylline effect. PFT results were not significantly altered by the placebo (45) (Table 1). These results highlight the potential therapeutic effects of *C. copticum* in treating asthma symptoms (including dyspnea) by indicating that it has a significant bronchodilatory impact on asthmatic airways comparable to theophylline at the concentrations examined.

### *Crocus sativus L. (Saffron)*

*C. sativus* is a perennial plant that is primarily grown in Iran and belongs to the Iridaceae family (46). In addition to being used as a food coloring and spice, saffron has been

extensively utilized by traditional medicine as a stomachic agent, stimulant, nerve relaxant, expectorant, eupeptic, diaphoretic, anticatarrhal, carminative, antispasmodic, and aphrodisiac (47). It has also been indicated to have anti-oxidant (48, 49), anti-inflammatory and immunoregulatory (50), bronchodilatory (51, 52), antiapoptotic (53), autophagy regulatory (54), neuroprotective (55), renoprotective (47, 56), hepatoprotective (57), and hypnotic (58) properties. The subsequent section will delve into the impact of saffron on dyspnea.

#### *Effects of C. sativus extracts*

The effects of saffron supplementation on spirometry tests, high-sensitivity C-reactive protein (hs-CRP), and anti-heat shock protein 70 (anti-HSP70) were examined in a clinical experiment with patients who had mild to moderate allergic asthma. The patients were divided into two groups at random and treated for eight weeks. One group received saffron capsules daily, while the other group received a placebo. Spirometry parameters, hs-CRP, and anti-HSP70 levels were measured before and after the intervention. The findings showed that hs-CRP and anti-HSP70 concentrations were significantly lower in the saffron supplement group than in the placebo group. Furthermore, spirometry testing revealed notable improvements in the saffron group's forced expiratory flow (FEF), FVC, $FEV_1$, and $FEV_1$/FVC ratio (59). It was investigated how saffron affected several parameters in patients with mild to moderate allergic asthma. Participants were randomized to either the control (placebo) group or the intervention (saffron) group. When compared to the placebo group, the results showed that patients in the saffron group experienced significant improvements in their clinical symptoms, including reduced use of inhaled salbutamol, decreased frequency of shortness of breath, improved sleep quality, and increased activity levels. Furthermore, the saffron group showed a significant reduction in the severity of their asthma. In addition, saffron supplementation significantly decreased triglycerides, low-density lipoprotein cholesterol, and systolic and diastolic blood pressure when compared to the placebo. Additionally, eosinophil and basophil counts of the saffron group exhibited a declining trend (60).

An investigation focused on using a neural network modified by a genetic algorithm to develop a clinical prediction system for assessing the effects of *C. sativus* supplements on individuals with allergic asthma. The model was intended to predict the effectiveness of saffron supplements on different asthma risk variables and the level of alleviation in asthma patients using data from men and women with mild to moderate allergic asthma. According to the results, the system performed exceptionally well, achieving an accuracy of over 99% for both the training and testing datasets. High accuracy levels were demonstrated by the neural network's ability to forecast the influence on important factors such as hs-CRP, anti-heat shock protein, and spirometry metrics ($FEV_1$/FVC ratio, FVC, $FEV_1$, and FEF25%-75%) (61).

#### *The effects of C. sativus constituents*
*Crocin*

A clinical trial involving COPD patients with the following conditions: one- clinical criteria such as cough, sputum, shortness of breath, and two- spirometric findings $FEV_1$/FVC < 70%, $FEV_1$ < 80%, was designed to assess the impact of crocin supplementation on various parameters. A control group that received a placebo was compared with

the intervention group that received crocin. The findings showed that crocin supplementation increased total anti-oxidant capacity while decreasing blood levels of nuclear factor kappa B (NF-κB) and total oxidant status. According to the 6-minute walking distance test (6MWD), patients also demonstrated greater exercise ability (62).

A study aimed to assess the preventative effects of crocin supplementation on interleukin (IL)-6, tumor necrosis factor-alpha (TNF-α), exercise capacity, and PFTs in COPD patients (with chronic dyspnea). The patients were divided between an intervention group that received crocin and a placebo group. By raising blood IL-6 levels, crocin supplementation had preventative effects and led to notable improvements in PFTs and 6MWD as compared to the placebo group. Additionally, toward the end of the research, crocin intervention resulted in a significant decrease in serum TNF-α levels (63).

In the context of dyspnea, studies on saffron and crocin supplementation showed potential results for respiratory diseases. Saffron decreased symptoms and asthma severity in allergic asthma patients, which influenced spirometry metrics. Crocin increased anti-oxidants, reduced inflammation, and improved exercise in dyspneic COPD patients, demonstrating anti-inflammatory properties while enhancing pulmonary and exercise function. These data highlight the efficacy of saffron and crocin as adjuvant treatments for addressing dyspnea-related respiratory diseases. Future research should prioritize large-scale randomized controlled trials to validate these findings, explore the underlying mechanisms of saffron and crocin effects, and investigate the therapeutic efficacy of crocin in treating dyspnea in patients. Furthermore, examining the synergistic effects of existing medications with saffron/crocin, as well as formulation strategies to improve absorption, could present new possibilities for optimizing treatment outcomes in respiratory disorders associated with dyspnea. Furthermore, additional research into neural network modeling for predicting therapy responses in dyspnea has the potential to enhance individualized respiratory care.

### *Curcuma longa L. (Turmeric)*

Turmeric belongs to the Zingiberaceae (ginger) family and is an evergreen herbaceous plant. It is widely grown throughout Asia. The rhizome, a thick, meaty underground stem encircled by the bases of old leaves, is a component of turmeric that may have therapeutic use. The turmeric plant has long been used in traditional medicine as a natural antiseptic, disinfectant, anti-inflammatory, and painkiller. It is also frequently used to heal skin irritations, promote gut flora, and aid with digestion. Additionally, it has been used as an easily accessible antiseptic for burns, bruises, and cuts throughout South Asia (64). Pharmacological investigations unveiled its anti-inflammatory (65), anti-oxidant (66), antiproliferative (67), antiasthmatic (68), immunomodulatory (69, 70), antiallergic (71), bronchodilatory (72), and antidote (73) properties. The effect of *Curcuma longa* (*C. longa*) on dyspnea will be covered in detail in the next section.

### *Effects of C. longa constituents*
### *Curcumin*

Patients with mild to moderate bronchial asthma were evaluated for the safety and effectiveness of curcumin as a supplementary treatment. Individuals were randomly assigned to one of two groups, with Group A receiving regular asthma treatment and Group B receiving the same treatment plus daily curcumin for a month. Curcumin supplements significantly improved mean $FEV_1$ values, suggesting the bronchodilatory effect and its effect on dyspnea (74). This effect was also supported by the findings of an experimental study (75).

The effects of curcumin on patients with chronic bronchial asthma were examined. Obesity and asthma frequently coexist because of systemic inflammation and airway restrictions. Patients were divided into two groups: one group received standard asthma treatment alone, while the other group received the same treatment plus curcumin for two months. The results showed that the $FEV_1$ and $FEV_1$/FVC ratio of the curcumin group had significantly increased. After therapy, curcumin supplementation resulted in a drop in the neutrophil count but no change in the total white blood cell count. Body mass index and leptin levels, however, did not significantly differ between the two groups (76).

It was investigated whether curcumin supplements were beneficial for those with chronic bronchial asthma. Two groups of patients with a diagnosis of chronic bronchial asthma were established. Group 2 received the same treatment plus curcumin, whereas group 1 received standard asthma treatment. $FEV_1$ level and the percentage of predicted $FEV_1$ did not substantially differ between groups at the beginning of the study or two months later. Following treatment, $FEV_1$ increased significantly in group 1 and highly significantly in group 2. The value of FVC was considerably higher in both groups after treatment. There were no apparent group variations in the FVC values. After therapy, the FVC and the $FEV_1$/FVC ratio of group 2 were significantly increased. Although there was no significant difference between the groups, the peak expiratory flow (PEF) value rose considerably in both groups after treatment. Furthermore, IL-6 levels in group 2 patients were significantly lower than those of group 1 patients. Nevertheless, following the supplement, the superoxide dismutase (SOD) level in neither group changed significantly (77).

Curcuminoids, which include bisdemethoxycurcumin, curcumin, and demethoxycurcumin, were found to have significant clinical effects on markers of pulmonary function and systemic inflammation in a randomized double-blind placebo-controlled pilot study that involved male subjects with chronic sulfur mustard-induced pulmonary complications. For four weeks, the subjects received either a placebo or curcuminoids. The $FEV_1$/FVC ratio improved more with curcuminoids than with placebo, even though $FEV_1$ and FVC stayed similar between groups. The modulation of several inflammatory mediators, such as IL-6 and IL-8, TNF-α, transforming growth factor-β (TGF-β), hs-CRP, calcitonin gene-related peptide (CGRP), substance P, and monocyte chemotactic protein-1, was also considerably more affected with curcuminoids than with placebo (78).

A clinical trial was designed to find out how nanocurcumin affected the inflammatory cytokines in COVID-19. In December 2019, the coronavirus, commonly referred to as COVID-19, in Wuhan, China, became a global epidemic and public health emergency with a high rate of morbidity and fatality (79). IL-1β, IL-6, TNF-α, and IL-18 levels were significantly higher in COVID-19 patients than in healthy controls. Following nano-curcumin

administration, IL-1β gene expression and secretion levels, as well as IL-6 expression and secretion in serum and supernatant, significantly decreased. Nevertheless, neither TNF-α levels nor IL-18 messenger ribonucleic acid (mRNA) expression was impacted by nano-curcumin. Fever, cough, and dyspnea were among almost every clinical manifestation that showed substantial improvement in the nano-curcumin group following treatment (80).

The effectiveness and safety of an oral nano-curcumin formulation were evaluated in outpatient COVID-19 patients with mild to moderate symptoms in a triple-blind, randomized, placebo-controlled clinical trial. The formulation of nanocurcumin or a placebo was administered to patients at random. All symptoms (including dyspnea) improved faster in the therapy group, except for sore throat, with significant improvements in taste and smell disturbances, cough, and chills. Furthermore, the treatment group had lower CRP serum levels and considerably greater lymphocyte counts than the group receiving a placebo at the end of the trial (81).

In moderately obese menopausal women, the effects of moderate-volume-high-intensity interval training with nano-curcumin supplementation, low-volume high-intensity interval training, and moderate-volume high-intensity interval training were compared with respect to physical performance, muscular fitness, respiratory function, and cardiovascular hemodynamics. After eight weeks, the results demonstrated that moderate-volume-high-intensity interval training and low-volume-high-intensity interval training therapies significantly increased oxygen pulse and $VO_2$max. Muscular fitness and physical performance metrics, such as running distance, sit-to-stand test, muscle quality index, quadriceps strength, and hand grip strength, improved with moderate-volume-high-intensity interval training, both with and without nano-curcumin, as compared to baseline. In contrast to low-volume-high-intensity interval training, moderate-volume-high-intensity interval training demonstrated increased FVC. According to the study, moderate-volume-high-intensity interval training, particularly when combined with nano-curcumin supplementation, is a safe and efficient method for improving physical performance and cardiorespiratory fitness in obese menopausal women. Both low-volume-high-intensity interval training and moderate-volume-high-intensity interval training can be time-efficient methods to improve these outcomes (82).

The frequency of curcumin-rich curry consumption and a number of health outcomes were investigated over an average follow-up time of 11.6 years in a prospective cohort study. According to the study, consuming more curcumin-rich curry showed a beneficial correlation with certain health indicators. It is interesting to note that there were non-linear correlations with variables like COPD prevalence and $FEV_1$/height$^2$ (83) (Table 2).

Several major findings emerged from clinical trials that investigated the effects of curcumin on respiratory

**Table 2.** Effect of *Curcuma longa* and *Eucalyptus globulus* on dyspnea

| Compound | Study design | Doses/Duration | Results | Ref. |
|---|---|---|---|---|
| Curcumin | 60 mild/moderate bronchial asthma | 500 mg, 30 days, PO | ↑ Mean $FEV_1$ values<br>↓ Airway obstruction | (74) |
| Curcumin | 40 asthmatic participants | 750 mg, twice daily, two months, PO | ↑ $FEV_1$ and $FEV_1$/FVC ratio<br>↓ Neutrophil count | (76) |
| Curcumin | 23 patients with chronic bronchial asthma | 750 mg, twice a day, 2 weeks, PO | ↑ $FEV_1$, predicted FVC, $FEV_1$/FVC ratio, PEF values<br>↓ IL-6 levels | (77) |
| Curcuminoids | Male patients with chronic SM-induced pulmonary complications | 500 mg, TID, weeks, PO | ↑ $FEV_1$/FVC ratio<br>- $FEV_1$ and FVC stayed similar between groups | (78) |
| Nanocurcumin | 40 individuals with COVID-19 | 160 mg, 14 days, PO | ↓ IL-1β and IL-6 gene expression and secretion levels, fever, cough, dyspnea | (80) |
| Nanocurcumin | 60 mild/moderate COVID-19 participants | 40 mg, twice a day, 2 weeks, PO | ↑ Lymphocyte counts<br>↓ Respiratory symptoms (e.g., dyspnea) | (81) |
| Nanocurcumin | 53 moderately obese menopause women | 40 mg capsules, twice a day, twice a week, 8 weeks, PO | ↑ Oxygen pulse and $VO_2$max by both methods<br>↑ Muscular fitness ↑ FVC<br>↑ Physical performance and cardiorespiratory fitness | (82) |
| Curcumin | 4551 adults | Curcumin-rich curry consumption | - Non-linear correlations with variables like COPD prevalence and $FEV_1$/height$^2$ | (83) |
| *E. globulus* essential oil | 15 individuals with post-COVID syndrome | Nebulized three drops, twice/day, 4 weeks | ↓ Anxiety, back pain, dyspnea | (89) |
| Nebulized *E. globulus* solution | 70 intubated patients | 4 ml (5%) 3 times a day since intubation, 3 days | ↑ $PaO_2$, $SaO_2$<br>↓ PIP | (90) |
| Cineole | 242 stable COPD patients | 200 mg, PO, 3 times/day, 6 months | ↑ PFTs, quality of life<br>↓ Severity, duration, and frequency of dyspnea | (91) |
| Cineole | 247 asthmatic patients | 200 mg, PO, 3 times/day, 6 months, | ↑ PFTs, quality of life<br>↓ Asthma symptoms, dyspnea | (92) |

COPD: Chronic obstructive pulmonary disease; COVID-19: Coronavirus disease 2019; CRP: C-reactive protein; PFTs: Pulmonary function tests; FEV1: Forced expiratory volume in 1 second; FVC: Forced vital capacity; IL: Interleukin; PO: Per Os (by mouth); $PaO_2$: Partial pressure of oxygen in arterial blood; PIP: Peak inspiratory pressure; $SaO_2$: Arterial oxygen saturation; $VO_2$: Oxygen consumption

diseases, with a specific emphasis on dyspnea. Curcumin supplementation was found to significantly improve lung function indices such as $FEV_1$ and $FEV_1/FVC$ ratio, indicating reduced airway obstruction and increased respiratory efficiency in individuals with bronchial asthma and pulmonary complications. Notably, in COVID-19 patients, nano-curcumin resulted in significant reductions in dyspnea as well as lower levels of inflammatory cytokines. Furthermore, curcumin administration in chronic bronchial asthma patients enhanced $FEV_1$ levels and alleviated dyspnea. These findings support the ability of curcumin to manage dyspnea and improve respiratory function in a variety of respiratory diseases.

When discussing the characteristics of these studies, the inclusion of placebo-controlled designs and objective outcome measures provides strong evidence of curcumin's efficacy in treating dyspnea and related respiratory symptoms. However, limitations such as varying doses, sample sizes, and treatment periods between studies make direct comparisons and generalization difficult. Future research directions may include standardizing curcumin formulations, investigating long-term safety profiles, developing personalized dosing strategies based on dyspnea severity, and elucidating the molecular mechanisms underlying the beneficial effects of curcumin on dyspnea in respiratory-related diseases. Furthermore, novel scientific concepts may include evaluating the impact of curcumin on dyspnea-specific quality-of-life metrics, conducting larger-scale trials in diverse patient populations, and investigating synergies between curcumin and traditional respiratory treatments to optimize dyspnea management and improve respiratory health outcomes.

### Eucalyptus globulus Labill. (Eucalyptus)

The enormous and durable *Eucalyptus globulus* Labill. (*E. globulus*) tree, also referred to as southern blue gum, was discovered for the first time on the island of Tasmania in 1792. It belongs to the Myrtaceae family, one of the larger genera (84). Anti-oxidant, antimicrobial (85), analgesic (86), anti-inflammatory (87), and bronchodilator (88) properties have been demonstrated for the *E. globulus*. The following section will provide more detailed information on how *E. globulus* affects dyspnea.

#### Effects of E. globulus extracts

In a study, the effects of eucalyptus aromatherapy oil on anxiety, back pain, and dyspnea in patients with post-COVID syndrome—a condition marked by persistent symptoms that remain for more than 12 weeks after infection and have no other explanation—were examined. Using eucalyptus oil, anxiety, back discomfort, and dyspnea all considerably decreased (89).

The effects of nebulized eucalyptus on arterial blood gases and physiological markers in patients with mechanical ventilation were explored. Patients were divided into control and nebulized eucalyptus groups. While the control group received saline alone, the nebulized eucalyptus group was administered eucalyptus diluted in saline. The Glasgow Coma Scale, arterial blood gas levels, and ventilator settings were tracked. After three days, the nebulized eucalyptus group $PaO_2$, $SaO_2$ increased, and peak inspiratory pressure (PIP) significantly decreased, although the results initially showed no differences between the groups (90).

#### Effects of E. globulus constituents
#### Cineole (Eucalyptole)

The effects of cineole were examined in a multicenter, double-blind, placebo-controlled study with individuals who had stable COPD. During the winter, patients were randomized to receive either cineole or a placebo. Cineole significantly decreased the primary outcomes, which included the severity, duration, and frequency of exacerbations. These findings were further confirmed by secondary outcomes, such as improvements in dyspnea, lung function, and quality of life (91). Cineole was used as a concurrent treatment for asthma patients in a double-blind, placebo-controlled multicenter study. Cineole or a placebo was administered to the patients. When compared to the placebo group, the cineole-treated group showed a substantial improvement in the primary outcome measures, which evaluated lung function, asthma symptoms, and quality of life. The Asthma Quality of Life Questionnaire, $FEV_1$, and asthma symptoms were among the individual outcome measures that also demonstrated statistical significance (92) (Table 2).

A series of investigations on the medicinal potential of eucalyptus and its ingredient, cineole, revealed promising results. These data demonstrate the beneficial effects of eucalyptus and cineole in controlling respiratory symptoms, probably through their mucolytic, broncho-dilating, and anti-inflammatory properties. While the studies employed strong methodologies, future research may investigate optimal dosages, long-term effects, and underlying mechanisms to enhance the understanding and application of eucalyptus-based therapies for a broader range of respiratory conditions.

### Mentha × piperita L. (Peppermint)

Native to Europe, *M. piperita* is an herbaceous, aromatic perennial that is grown in northern Asia, Canada, North Africa, the United States, and many other countries (93). Numerous pharmacological effects, including antiallergic (94), antibacterial (95), anticancer (96), anti-inflammatory (97), anti-oxidant (98), and antiasthmatic (99), are present in its extracts and essential oil. In the following section, a detailed exploration of the impact of *M. piperita* on dyspnea will be provided.

#### Effects of M. piperita essential oil

The effect of consuming peppermint essential oil on the physiological parameters and exercise performance of healthy male students over a ten-day period was examined by supplementing mineral water + peppermint essential oil. Blood pressure, heart rate, and spirometry measures like FVC, PEF, and peak inspiratory flow (PIF) were measured before and after the supplementation period. A treadmill-based exercise test utilizing the Bruce protocol with metabolic gas measurement was provided to the individuals. PEF, FVC, PIF, exercise performance measures (power, work, and time to exhaustion), and respiratory gas analyzer parameters ($VO_2$ and $VCO_2$) all showed notable improvements following supplementation (100).

In a randomized crossover design, healthy subjects completed a graded maximal activity test ten days after consuming either peppermint essential oil or a control. For expired gas characteristics and performance metrics, there was no considerable difference between the control and peppermint essential oil trials. Likewise, resting cardiopulmonary parameters did not alter from one visit to

**Table 3.** Effect of *Mentha piperita* on dyspnea

| Compound | Study design | Doses/Duration | Results | Ref. |
|---|---|---|---|---|
| *M. piperita* essential oil | 12 healthy male students | 0.05 ml, 10 days, PO | ↑FVC, PEF, PIF, exhaustion, VO₂, VCO₂ | (100) |
| L-menthol | 11 normal participants | 300 mg in 250 ml total respiratory space | ↓ Respiratory discomfort, VAS values | (102) |
| L-menthol | 64 patients | 3 ml 1% l-menthol solution | ↑ PEF <br> ↓ Coughing and dyspnea | (103) |
| L-menthol | 28 COPD patients | - | ↓ Air hunger, anxiety, breathing discomfort, fear, and breathing effort | (104) |
| L-menthol | Chronic breathlessness syndrome | Circular patch with a diameter of 15 mm | ↓ Dyspnea on exertion | (105) |
| L-menthol | 13 male runners | 0.01% solution, 25 ml | ↑ Running time, breathing comfort, dyspnea threshold, endurance capacity | (106) |

COPD: Chronic obstructive pulmonary disease; FVC: Forced vital capacity; PO.: Per Os (by mouth); PaO₂: Partial pressure of oxygen in arterial blood; PEF: Peak expiratory flow; PIF: Peak inspiratory flow; VAS: Visual analog scale; VCO₂: Carbon dioxide production; VO₂: Oxygen consumption

the next (101) (Table 3).

### Effects of *M. piperita* constituents
#### L-menthol

A study intended to determine how L-menthol nasal inhalation affected healthy people's ventilation and respiratory discomfort during loaded breathing. When breathing through devices with flow-resistive and elastic loads, participants used a visual analog scale (VAS) to score their level of respiratory discomfort. During both forms of loading, inhaling L-menthol significantly reduced respiratory discomfort, as evidenced by a notable drop in VAS values. Without changing ventilation or breathing patterns, this effect was noted. When flow-resistive loading was compared to elastic loading, the VAS ratings decreased more noticeably during the former. Inhaling air with a strawberry taste had no effect on ventilation, breathing patterns, or VAS scores, indicating that smell was not a factor in the alleviation of respiratory discomfort (102).

The impact of inhaling a 1% L-menthol solution as a premedication for fiberoptic bronchoscopy was examined in relation to the frequency of cough and the irritation of the tracheobronchial mucosa in a blinded, randomized, and placebo-controlled trial. For the standard scent, the placebo group received 0.05% L-menthol, while the verum group was administered 1% l-menthol solution. PEF was measured both before and after inhalation, bronchoscopists evaluated mucosal irritation, and cough frequency was monitored during fiberoptic bronchoscopy. With no significant difference between groups, patients reported less coughing and dyspnea after undergoing fiberoptic bronchoscopy compared to before. Although the tolerability of fiberoptic bronchoscopy did not improve, 1% L-menthol inhalation significantly raised PEF (103).

The effects of olfactory stimulation by L-menthol on the neural respiratory drive and different dimensions of dyspnea caused by inspiratory resistive loaded breathing in patients with COPD were investigated. An L-menthol-scented patch was utilized to deliver L-menthol, and a strawberry-scented patch served as the placebo. Breathing through inspiratory resistance caused dyspnea, and the multidimensional dyspnea profile was used to measure the condition. L-menthol considerably reduced air hunger, anxiety, breathing discomfort, fear, and physical and mental breathing effort in COPD patients during inspiratory resistive loaded breathing; however, it did not affect neural respiratory drive or breathing patterns. L-menthol did not considerably enhance the affective aspect of dyspnea in the control group despite lowering air hunger, unpleasantness, and mental breathing effort (104).

The effect of L-menthol olfactory stimulation in reducing exertional dyspnea in patients suffering from chronic breathlessness syndrome was examined. Two groups, A and B, participated in the 6MWT. Group B performed the tests in reverse order, with group A using a surgical mask (placebo) for the first test and L-menthol for the second. According to the results, dyspnea in group A during the second 6MWT under the L-menthol condition significantly decreased. Furthermore, there was a significant difference in the modified Borg scale gain between the L-menthol and placebo treatments (105).

The effect of administering L-menthol on the endurance exercise capacity of male runners was evaluated. Participants underwent three distinct trials—water intake, L-menthol mouth rinse, and L-menthol ingestion—in random sequences every five min while running on treadmills at fixed intensities of their anaerobic thresholds until exhaustion. Before and after running, the dyspnea threshold against external inspiratory resistance was measured, and breathing comfort was evaluated after fluid intake. The results demonstrated a large effect size and a significantly longer running time when L-menthol was consumed as opposed to water. At exhaustion, breathing comfort was much higher when L-menthol was consumed than when water was consumed. Following a run, the dyspnea threshold dropped when water was consumed, but it stayed high when mouthwash and L-menthol were consumed, suggesting a significant difference. Consuming L-menthol improved running-related breathing comfort, increased endurance capacity, and maintained the dyspnea threshold against external inspiratory resistance after intense running, indicating that L-menthol may help endurance athletes perform better during exercise and have more comfortable breathing (106).

Research on peppermint essential oil and L-menthol yielded interesting findings regarding their effects on respiratory function and exercise performance. The use of peppermint essential oil improved pulmonary function and exercise performance in healthy individuals, while L-menthol inhalation significantly reduced respiratory discomfort during loaded breathing without affecting ventilation. L-menthol has also been shown to reduce cough frequency, increase PEF, and alleviate dyspnea in individuals with COPD and chronic breathlessness syndrome. Furthermore, L-menthol consumption improved running-

related breathing comfort, endurance capacity, and the dyspnea threshold in male runners during intense activity. These findings indicate that both peppermint essential oil and L-menthol may influence respiratory sensations via sensory processes. While the studies had strengths, such as controlled designs and a wide range of outcome measures, shortcomings, such as limited sample sizes and short-term assessments, were identified. Future plans include performing large-scale clinical trials to validate these effects, further researching the underlying mechanisms, and determining ideal dosages and delivery methods for future therapeutic applications in respiratory health and exercise physiology.

*Nigella sativa L. (Black seed)*

*Nigella sativa* L. (*N. sativa*), a spicy seed from the Ranunculaceae family, is often known as black seed or black cumin. This multipurpose seed has been used for millennia in China, Syria, Turkey, Pakistan, and India as a natural cure for illnesses such as depression, heart disorders, hepatotoxicity, neurotoxicity, and renal toxicity, in addition to being a spice and food preservative. Thymoquinone is a major component in *N. sativa* (107). Modern pharmacological investigations have illustrated its anti-inflammatory (108), anti-oxidant (109), antiasthmatic (110), bronchodilatory (111), antiallergic, and immunomodulatory (112) properties. Detailed coverage of the impact of *N. sativa* on dyspnea will be provided in the following section.

*Effects of N. sativa extracts and essential oil*

A case report described a rare incidence of exogenous lipoid pneumonia caused by consuming *N. sativa* seed oil. The patient, a 50-year-old man, reported consuming *N. sativa* oil for tonification for an extended period (8 bottles of 500 ml, 8 months). He had a history of persistent coughing, sputum production, and worsened dyspnea upon exertion. Routine blood tests and cultures revealed no abnormalities, even though the physical examination showed bilateral lung crackles; the imaging investigations indicated honeycomb fibrosis, bilateral basal interstitial disease, and thoracic distension, and the lung function tests were normal. A blackish lavage fluid with fat globules, suggestive of lipid aspiration, and a high macrophage count were seen during bronchoscopy (113). This instance highlights the importance of diagnosing exogenous lipoid pneumonia in patients with atypical respiratory symptoms and considering uncommon causes, such as the use of *N. sativa* oil.

A clinical trial investigated the effect of boiling the extract of *N. sativa* on adult patients' asthma over the course of three months. Patients were randomized to receive the *N. sativa* extract in the study group and a placebo solution in the control group. In comparison to the first visit, asthma symptoms (e.g., coughing, wheezing, and tightness) in the study group showed significant improvements in symptom frequency, wheeze, and PFT values throughout the second and third visits, with additional improvements noted at the third visit. By the end of the trial, every symptom in the study group was noticeably better than those in the control group. Additionally, whereas medication use remained constant in the control group, it declined in the research group (114) (Table 4).

An investigation was conducted into the bronchodilatory effects of boiled extract of *N. sativa* on asthmatic patients' airways. The extract significantly raised all measured PFTs over the majority of periods. However, compared to theophylline, the increase in $FEV_1$, maximal mid-expiratory

flow (MMEF), and maximal expiratory flow ($MEF_{50}$) produced by both dosages of the boiling extract was much smaller. Additionally, the increase in $MEF_{75}$ and $MEF_{25}$ caused by the lower extract dosages was much less than that caused by theophylline. The bronchodilatory effect of the extract began at 30 min, similar to that of theophylline, and decreased 150 min after administration, just as theophylline did. Furthermore, at 30 min after administration, the effects of both extract dosages were noticeably less noticeable than those of salbutamol (115).

In an investigation, the broncho-relaxant effects of *N. sativa* were assessed in individuals with chronic bronchial asthma. Patients received *N. sativa* after clinical evaluations, pulmonary function testing, and serum electrolyte studies. The results showed that this plant significantly reduced asthma attacks and improved $FEV_1$ and FVC compared to the control group (116).

The effectiveness of *N. sativa* oil supplementation on clinical and inflammatory markers in asthmatic patients was examined. The *N. sativa* oil group showed a substantial decrease in blood eosinophils and a significant improvement in the mean score on the Asthma Control Test (ACT) when compared to the placebo group. With *N. sativa* oil supplementation, there was a positive trend toward improvement in $FEV_1$ (117).

It was investigated how *N. sativa* supplementation affected airway inflammation and airflow restriction in patients with partially controlled asthma. In addition to maintenance inhalation medication, the *N. sativa*-1 and *N. sativa*-2 groups were administered 1 and 2 g/day of *N. sativa*, respectively, whereas the control group received a placebo. The *N. sativa*-2 group showed significant increases in $FEV_1$ and $FEF_{25-75}$ at 6 and 12 weeks. At 6 and 12 weeks, PEF variability in the *N. sativa*-1 and *N. sativa*-2 groups was significantly lower than in the controls. After 12 weeks, both *N. sativa* groups showed a significant drop in blood immunoglobulin E (IgE) and fractional exhaled nitric oxide (FeNO) levels. Furthermore, both *N. sativa* dosages significantly improved the ACT score at 6 and 12 weeks and raised blood interferon-gamma (IFN-γ) levels at 12 weeks. There were noticeably fewer exacerbations in the *N. sativa*-1 group (118).

The preventive effects of a boiling aqueous extract of *N. sativa* seed on chemical war victims with respiratory symptoms, comprising breathlessness, cough, wheezing, and chest tightness, were examined. The victims were divided into study and control groups, and each day, they were given either a placebo or the extract. PFTs, wheezing, and respiratory symptoms were evaluated three times. When compared to the first visit, the symptoms of the study group and PFT levels significantly improved at the second and third visits, with even more improvements noted at the third. There were significant differences between the study and control groups, with the study group showing better results (119).

In patients with mild to moderate COPD with symptoms such as coughing, exercise intolerance, shortness of breath, and wheezing, the possible advantages of *N. sativa* oil supplementation on PFTs, inflammation, and oxidant-anti-oxidant markers were examined. Patients were randomized to either the *N. sativa* oil group, which received additional *N. sativa* oil, or the control group, which received regular medication alone. Anti-oxidants such as catalase (CAT), glutathione peroxidase (GPx), glutathione (GSH), SOD, vitamin C, and E were significantly higher in the *N. sativa* oil group, while oxidative and inflammatory markers like IL-

**Table 4.** Effect of *Nigella sativa*, Rosmarinus *officinalis*, and *Thymus vulgaris* on dyspnea

| Compound | Study design | Doses/Duration | Results | Ref. |
|---|---|---|---|---|
| *N. sativa* SBAE | 29 asthmatic patients | 15 ml/kg of 0.1 g%, PO boiled extract, 3 months, | ↑PFTs, FVC, MMEF | (114) |
| *N. sativa* SBAE | 15 asthmatic patients | 50, 100 mg/kg, PO | ↑ PFTs <br> ↓ Extract effects on PFTs compared to theophylline | (115) |
| Boiled *N. sativa* seed | 18 chronic asthmatic patients | 100 mg/kg, 21 days, inhalation | ↑ FEV₁%, FVC <br> ↓ Asthma attacks | (116) |
| *N. sativa* oil | 60 Asthmatic patients | 500 mg, twice daily, 4 weeks, PO | ↑ ACT score, FEV₁ <br> ↓ Blood eosinophils | (117) |
| *N. sativa* oil | 76 patients with partially controlled asthma | 1, 2 g/day, 3 months, PO | ↑ FEV₁ and FEF 25-75%, PEF, 6 and 12 weeks | (118) |
| *N. sativa* SBAE | 40 chemical war victims | 0.375 ml/kg/bw, PO (50 mg/ml extract), 2 months | ↑PFTs, FVC, FEV₁ <br> ↓Wheezing, coughing | (119) |
| *N. sativa* oil | 91 COPD patients | 1 g, twice daily, 3 months, PO | ↑CAT, GPx, GSH, SOD, vitamin C, and E, PFTs <br> ↓IL-6, TBARS, TNF-α | (120) |
| *N. sativa* plus vitamin D3 | 120 COVID-19 patients, mild/moderate | *N. sativa*: 900 mg <br> vitamin D3: 2,000 IU, 2 weeks, PO | ↓ symptoms (cough, dyspnea, fatigue) | (121) |
| *R. officinalis* leaves extract | 44 asthmatic patients resistant to routine treatments | 50 ml (each one ml contained 200 mg herbal extract), three times a day, for a month, PO | ↑ ACT scores <br> ↓ Coughing, sputum production, wheezing, exhaled air nitric oxide | (137) |
| *R. officinalis* hydroalcoholic extract | 77 COPD patients | 500 mg, twice a day, 2 months, PO | ↑ gains in IADL after controlling for OSA | (138) |
| 1,8-cineol | 32 steroid-dependent asthmatic patients | 200 mg, three times a day, 12 weeks, PO | ↓ Daily prednisolone dose <br> Absence of ↓ prednisone on PFTs | (139) |
| *T. vulgaris* powder | 60 mild to moderate asthma-exacerbated child | 20 mg/kg, three times a day, for a week, PO | ↑ FEV₁ <br> ↓Activity-induced cough | (146) |
| *T. vulgaris* oil | COVID-19 patients | Three times a day, 5 days, inhalation | ↑ SPO₂ <br> ↓Cough, shortness of breath, respiratory rate | (147) |

ACT: Asthma control test; CAT: Catalase; COPD: Chronic obstructive pulmonary disease; COVID-19: Coronavirus disease 2019; FEF: Forced expiratory flow; FEV1: Forced expiratory volume in 1 second; FVC: Forced vital capacity; GPx: Glutathione peroxidase; GSH: Glutathione; IADL: Instrumental activities of daily living; IL-6: Interleukin-6; MMEF: Maximal mid-expiratory flow; OSA: Obstructive sleep apnea; PO: Per Os (by mouth); PCR: Polymerase chain reaction; PEF: Peak expiratory flow; PEFR: peak expiratory flow rate; PFTs: Pulmonary function tests; SBAE: Seed boiled aqueous extract; SOD: Superoxide dismutase; SPO₂: Peripheral oxygen saturation; TBARS: Thiobarbituric acid reactive substances; TNF-α: Tumor necrosis factor-alpha

6, protein carbonyl, thiobarbituric acid reactive-substances (TBARS), and TNF-α were much lower. Furthermore, when comparing the *N. sativa* oil group to the control group and baseline levels, notable improvements in PFTs were reported (120).

The purpose of a study was to investigate how *N. sativa* (Baraka®, Pharco Pharmaceuticals, Cairo, Egypt) and vitamin D3 (Davalindi®, Medical Union Pharma, Cairo, Egypt) alone and combined supplemental treatments affected the viral clearance and symptom relief of COVID-19 patients throughout a 14-day follow-up period. Four groups were randomly assigned to mild to moderately ill COVID-19 patients: one group received *N. sativa*, another received vitamin D3, a third received both supplements, and a control group. The *N. sativa*-vitamin D3 combination, when used in conjunction with standard COVID-19 therapy, was found to reduce symptoms and speed up viral clearance considerably. Within days after starting treatment, patients in this combination treatment group notably alleviated their cough, dyspnea, fatigue, headache, and rhinorrhea. Additionally, on days 7 and 14, the combination group outperformed the other groups in terms of negative polymerase chain reaction (PCR) test findings (121).

Thymoquinone investigations in rats demonstrated harmful effects (including symptoms such as diarrhea, dyspnea, and hypo-activity) after oral doses, whereas an unusual case report emphasized exogenous lipoid pneumonia caused by a patient's excessive ingestion of *N. sativa* seed oil revealing symptoms like persistent coughing, worsened dyspnea upon exertion, and bilateral lung abnormalities. Clinical research on *N. sativa*, on the other hand, has produced consistently favorable results in terms of controlling dyspnea, reducing asthma symptoms, lowering drug dependence, and demonstrating preventive and bronchodilatory effects in various patient groups. Despite these hopeful findings, constraints such as small sample sizes, limited follow-up periods, and potential biases in study design may limit the generalizability of the results. Future research could focus on optimizing *N. sativa* dosages, investigating its long-term effects, elucidating its mechanisms of action in respiratory diseases, and examining potential interactions with existing asthma medications to enhance patient care and outcomes.

### *Rosmarinus officinalis* L. (Rosemary)

*Rosmarinus officinalis* L. (*R. officinalis*), the scientific name for rosemary, is a perennial plant belonging to the Lamiaceae family. Traditional medicine has long used rosemary to treat a wide range of illnesses, such as rheumatic pain, depression, gastrointestinal disorders, epilepsy, headaches, hysteria, exhaustion, anxiety, pain management, spasms, stomachaches, and respiratory disorders (122). In

addition, physio-pharmacological investigations revealed its antiapoptotic (123), anti-inflammatory (124, 125), antidote (126, 127), anti-obesity (128), cardioprotective (129, 130), antirheumatic (131), antinociceptive (132), antidepressant (133), bronchodilatory (134), and neuroprotective (135, 136) properties. The subsequent section will delve into a thorough analysis of the influence of *R. officinalis* on dyspnea.

### Effects of R. officinalis extracts

In a study evaluating the effect of leaf extract on asthmatic patients who were not responding to conventional therapies, clinical symptoms (including coughing and dyspnea), spirometry data, exhaled nitric oxide levels, and ACT scores were evaluated. *R. officinalis* ameliorated clinical symptoms such as coughing, sputum production, and wheezing. The study found that ACT scores and nitric oxide levels in the exhaled air were significantly improved (137).

The effects of rosemary hydroalcoholic extract on the activities of daily living (ADLs) of patients with COPD were examined. While the control group received placebo capsules, the intervention group was administered rosemary capsules. Before and after the intervention, ADLs were assessed using the Lawton Instrumental Activities of Daily Living (IADL) and the London Chest Activity of Daily Living scale (LCADL). Regarding changes in ADL scores, there were no appreciable variations between the two groups. It is interesting to note that the intervention group outperformed the control group in terms of gains in IADL after controlling for obstructive sleep apnea (OSA) (138).

### Effects of R. officinalis constituents
#### 1,8-cineol (Eucalyptole)

In a study, patients with steroid-dependent bronchial asthma were randomized to receive either 1,8-cineol or a placebo. Every three weeks, the dosage of oral glucocorticosteroids was progressively decreased. The study demonstrated the steroid-sparing effect of 1,8-cineol by showing a substantial decrease in the daily prednisolone dosage in the active treatment group compared to the placebo group. Reducing prednisone by 2.5 mg every three weeks did not have a significant effect on PEFR or lung function in the active therapy group, nor did it increase the regular use of salbutamol. However, following the first prednisolone reduction, PEFR considerably decreased in the placebo group, which resulted in a large rise in the usage of salbutamol. After the 2.5 mg prednisolone reduction, the placebo group showed noticeably greater dyspnea scores than the active treatment group, even though dyspnea scores did not differ substantially between the groups before the glucocorticosteroid reduction (139) (Table 4).

The examined studies on herbal interventions in dyspnea management offer valuable insights. Rosemary leaf extract demonstrated efficacy in alleviating asthma symptoms, including dyspnea, while also improving ACT scores and reducing exhaled nitric oxide levels. In COPD patients, rosemary hydroalcoholic extract did not notably affect activities of daily living but showed potential benefits in instrumental activities of daily living, which could indirectly impact dyspnea. Additionally, 1,8-cineol displayed a steroid-sparing effect in severe asthma, reducing prednisolone dosage without exacerbating dyspnea or compromising lung function. These findings suggest that herbal remedies, such as rosemary and 1,8-cineol, may hold promise in managing dyspnea associated with respiratory conditions. Future well-controlled trials should further investigate their mechanisms of action and long-term effects on dyspnea to establish their role in dyspnea management strategies.

### Thymus vulgaris L. (Thyme)

*Thymus vulgaris* L. (*T. vulgaris*), thyme, also called "garden thyme," is a fragrant perennial blooming plant that is a member of the *Lamiaceae* family. Despite being indigenous to Southern Europe, *T. vulgaris* is reported to be found worldwide. Due to its antibacterial and therapeutic effects, the herb was mainly used to treat wounds. Ancient Europeans used its aerial parts for fumigation and to cure skin and respiratory illnesses, demonstrating the anti-infective properties of the plant (140). Current research has also confirmed its pharmacological effects, including anti-inflammatory, anti-oxidant (141), immunomodulatory (142), bronchodilatory (143), antimicrobial (144), and antitumor (145) properties. The effects of *T. vulgaris* on dyspnea are discussed in the next section.

### Effects of T. vulgaris powder and essential oil

A study examined how *T. vulgaris* influenced coughing in children with mild to moderate asthma exacerbations aged 5 to 12 years. Participants were divided into control and intervention groups. While the control group received standard medical treatment along with a placebo syrup, the intervention group received *T. vulgaris* powder in addition to standard medical care. Activity-induced cough was significantly reduced after the intervention, and a statistically significant difference was observed between the groups. However, there was no statistically significant decrease in wheezing or dyspnea. While $FEV_1/FVC$, PEF, and $FEF_{25-75}$ of the vital capacity (FEF25-75%) did not show significant variations between the groups, spirometry data showed a significant difference in $FEV_1$ after the intervention (146).

The purpose of a study was to evaluate how thyme oil aromatherapy affected the hemodynamic markers, vital signs, and symptoms of COVID-19 patients. While the control group received standard medical treatment, patients in the experimental group inhaled thyme oil. Findings showed that thyme oil significantly alleviated symptoms such as diarrhea, dizziness, cough, headache, loss of appetite, muscle and joint pain, secretion, shortness of breath, and weakness. Although there were improvements in runny nose, nausea and vomiting, and loss of taste and smell, these modifications were not of statistical significance. Thyme oil had a significant favorable effect on pH management and $CO_2$ levels, and it also raised $SaPO_2$, maintained blood pressure, and significantly decreased respiratory rate, pulse rate, and body temperature (147).

In brief, *T. vulgaris* showed potential in reducing cough and improving lung function in children with asthma. At the same time, thyme oil aromatherapy demonstrated probable advantages in alleviating symptoms and stabilizing vital signs in COVID-19 patients. Further research is warranted to explore the mechanisms of action and optimize the use of these interventions for respiratory conditions.

### Zataria multiflora Boiss.

*Zataria multiflora* Boiss. (*Z. multiflora*), a thyme-like plant in the *Lamiaceae* family grows wild only in central Afghanistan, southern Iran, and Pakistan. The aerial parts of *Z. multiflora* are not only a popular culinary herb, but they are also used in traditional medicine for their antidiarrhea, anthelmintic, carminative, analgesic, and antibacterial effects (148). Recent pharmacological studies have highlighted other biological characteristics of this herb, including antiasthmatic (16), neuroprotective (149, 150), anti-oxidant, antibacterial (151), spasmolytic (152),

bronchodilatory (153), and anti-inflammatory (154) properties. The following section discusses the effects of *Z. multiflora* on dyspnea.

*The effect of Z. multiflora extracts*

In a study, the effects of *Z. multiflora* on wheezing in asthmatic patients, $FEV_1$, and plasma nitrite levels were examined. Three groups of asthmatic patients were randomly assigned: two treatment groups that received varying dosages of *Z. multiflora* and a placebo group. Comparing the *Z. multiflora*-treated groups to the baseline, the results showed a significant decrease in daytime and exercise-related wheeze. Furthermore, following treatment, nitrite levels dramatically dropped in the *Z. multiflora* high-dose group, while $FEV_1$ markedly increased in these groups. On the other hand, during the course of the study, the examined parameters showed very little change in the placebo group (155).

The effects of *Z. multiflora* on oxidative stress, cytokine levels, PFTs, and clinical symptoms (chest wheeze, night cough, and wheeze) in asthmatic patients were examined. Three groups of asthmatic patients were studied: two groups received *Z. multiflora* extract treatment, and the third group received a placebo. When compared to baseline, the clinical symptoms and PFTs of the *Z. multiflora* groups at months one and two showed notable improvements. Furthermore, following treatment with both doses of the extract at month two, improvements in oxidative stress, cytokine levels, and gene expression were noted in comparison to baseline (156).

The purpose of a study was to evaluate the bronchodilatory effect of a *Z. multiflora* hydro-ethanolic extract in individuals with asthma. PFTs were performed before and at different intervals (15, 30, 60, 90, 120, 150, and 180 min) following the administration of the extract to patients with asthma and theophylline syrup to a few other patients. According to the primary outcome measures, the *Z. multiflora* extract considerably raised all PFT values between 30 and 180 min after treatment, which was comparable to the effect of theophylline. The effects of theophylline decreased 150 min after administration, whereas the extract-enhanced PFT values sharply dropped 180 min later. After administering the medication, there was no significant difference in PFT values between the extract and theophylline at baseline, 30 min, or 180 min (153). The bronchodilatory effect of the plant indicated in the above study was supported by an experimental study showing the relaxant effect of the plant on tracheal smooth muscle (16, 157-159).

The purpose of a research was to find out how *Z. multiflora* affected PFTs in veterans who had been exposed to sulfur mustard gas 27–30 years earlier. Veterans were allocated into two groups, each receiving varying dosages of *Z. multiflora* and a placebo group. MDA levels dropped in the treated groups, also total and other white blood cell counts significantly decreased. Anti-oxidant markers such as thiol, SOD, and CAT also significantly increased. The treated groups showed a significant improvement in PFTs, such as FVC and PEF, as compared to the placebo group (160).

Moreover, significant improvements in respiratory symptoms and serum cytokine levels were noted in a study examining the effects of *Z. multiflora* extract on veterans exposed to sulfur mustard gas more than 20 years ago. Patients were divided into two treatment groups, each receiving varying doses of *Z. multiflora* extract, and a placebo group. In both trial phases, the treated groups showed elevated $FEV_1$ values, along with notable improvements in respiratory symptoms, including nighttime cough, exercise-induced cough, and chest wheezing. Additionally,

compared to the placebo group, the treated groups' serum levels of inflammatory markers such as epidermal growth factor (EGF), monocyte chemotactic protein 1 (MCP-1), TNF-α, and vascular endothelial growth factor (VEGF) substantially decreased (161).

A study examined the effect of *Z. multiflora* in patients who had been exposed to sulfur mustard for a long time. Participants were separated into three experimental groups, a placebo group, and two other groups, each receiving different doses of *Z. multiflora* extracts and a placebo group at random. The findings showed that, in comparison to the baseline, serum levels of IL-2, IL-6, and IL-8 dropped, whereas levels of IL-10 and IFN-γ significantly rose in the treatment groups. PFT indices such as MMEF and MEF25, 50, and 75 also demonstrated notable improvements in the treatment groups (162) (Table 5).

The purpose of a study was to evaluate how *Z. multiflora* affected the clinical symptoms, PFTs, oxidative stress, and CRP levels of COPD patients. Three groups of patients were formed, two of which received *Z. multiflora* extract and one of which received a placebo. In comparison to baseline values, the results showed significant improvements in sputum production in the higher *Z. multiflora* group and clinical symptoms, including chest wheezing and dyspnea, in the *Z. multiflora* groups at 1 and 2 months after treatment. Furthermore, following two months of treatment with *Z. multiflora* groups, $FEV_1$ demonstrated a notable improvement. After two months of medication, the levels of malondialdehyde (MDA) and nitrite were considerably lower than baseline in the higher *Z. multiflora* group. The thiol contents and the SOD and CAT activities in the higher *Z. multiflora* group in both extract-treated groups significantly rose at month two in comparison to baseline, as well as CRP levels in both treated groups significantly decreased at the end of the trial in comparison to baseline (163). The effects of *Z. multiflora* on asthmatic patients described in the above clinical studies are supported by various experimental results indicating the effects of the plant on an animal model of asthma (164-168).

Furthermore, the effects of *Z. multiflora* extract on respiratory symptoms, PFTs, and inflammatory cytokines in patients with COPD were examined. Three groups of COPD patients were established: two groups received varying doses of *Z. multiflora* extract, and the third group received a placebo. Serum levels of TNF-α and IL-8 were found to have significantly decreased following two months of extract treatment. PFT parameters, such as FVC and FEV1, also showed improvements during the course of treatment. Following a month of treatment with the higher dose, PEF increased noticeably. Following one and two months of treatment with both doses of *Z. multiflora*, there was a noticeable amelioration in respiratory symptoms such as cough, chest tightness, and dyspnea as compared to baseline values (169).

Another clinical trial evaluated PFTs, respiratory symptoms, inhaled bronchodilator medication use, and hematological variables to determine the effectiveness of *Z. multiflora* in patients with COPD. Three groups of patients were randomly assigned: two groups received varying dosages of *Z. multiflora* extract, and the third group received a placebo. The findings showed that after receiving *Z. multiflora* treatment, $FEV_1$ values significantly improved. When compared to baseline values, respiratory symptoms significantly decreased after 1 and 2 months of

**Table 5.** Effect of *Z. multiflora* on dyspnea

| Compound | Study design | Doses/Duration | Results | Ref. |
|---|---|---|---|---|
| *Z. multiflora* extract | 40 asthmatic patients | 5, 10 mg/kg, 2 months, PO | ↑ FEV$_1$% | (155) |
| | | | ↓Wheezing, nitrite levels | |
| *Z. multiflora* extract | 36 asthmatic patients | 5, 10 mg/kg, 2 months, PO | ↑ PFTs | (156) |
| | | | ↓Clinical symptoms, oxidative stress | |
| *Z. multiflora* extract | 18 asthmatic patients | 20 mg/kg, PO | ↑PFT values between 30 and 180 min | (153) |
| *Z. multiflora* extract | 47 veterans exposed to SM | 5, 10 mg/kg, 2 months, PO | ↑ PEF, serum thiol, SOD, CAT, FVC | (160) |
| | | | ↓ MDA, WBC | |
| *Z. multiflora* extract | 34 veterans exposed to SM | 5, 10 mg/kg, 2 months, PO | ↑ FEV$_1$ values | (161) |
| | | | ↓ Cough, chest wheezing, EGF, MCP-1, TNF-α, VEGF | |
| *Z. multiflora* extract | 34 veterans exposed to SM | 5, 10 mg/kg, 2 months, PO | ↑ IL-10, IFN-γ, MMEF, MEF25, 50, 75 | (162) |
| | | | ↓Serum levels of IL-2, IL-6, IL-8 | |
| *Z. multiflora* extract | 45 patients with COPD | 3, 6 mg/kg, 2 months, PO | ↑ FEV$_1$, thiol, SOD, and CAT | (163) |
| | | | ↓ Sputum, chest wheezing, dyspnea, MDA, nitrite, CRP levels | |
| *Z. multiflora* extract | 41 patients with COPD | 3, 6 mg/kg, 2 months, PO | ↑ FVC, FEV$_1$, PEF | (169) |
| | | | ↓Serum levels of TNF-α and IL-8, cough, chest tightness, dyspnea | |
| *Z. multiflora* extract | 45 patients with COPD | 3, 6 mg/kg, 2 months, PO | ↑ FEV$_1$ values | (29) |
| | | | ↓Respiratory symptoms, inhaled bronchodilator use, and WBC | |
| | | | counts | |
| Carvacrol | 40 asthmatic patients | 1.2 mg/kg, 2 months, PO | ↑ FEV$_1$% | (155) |
| | | | ↓ Wheezing, nitrite levels | |
| Carvacrol | 20 patients exposed to SM | 3.6 mg/kg, 2 months, PO | ↑ PEF, serum levels of thiol, SOD, CAT | (175) |
| | | | ↓ WBC, MDA level | |
| Carvacrol | 20 patients exposed to SM | 1.2 mg/kg, three times a day, 2 months, PO | ↑ IL-10 and IFN-γ levels, IFN-γ/IL-4 ratio, MMEF, MEF25, MEF50, MEF75 | (176) |
| | | | ↓ IL-2, IL-4, IL-6, IL-8 levels | |
| Carvacrol | 21 patients exposed to SM | 1.2 mg/kg, three times a day, 2 months, PO | ↑ FEV$_1$ | (177) |
| | | | ↓ Chest wheeze, cough and wheeze, TNF-α, EGF, VEGF, and MCP-1 levels | |
| Carvacrol | 30, 40 healthy subjects | 2 mg/kg, a month, PO | ↑ FEV$_1$ | (183, 184) |

CAT: Catalase; COPD: Chronic obstructive pulmonary disease; CRP: C-reactive protein; EGF: Epidermal growth factor; FEV1: Forced expiratory volume in one second; FVC: Forced vital capacity; IFN-γ: Interferon-gamma; IL: Interleukin; MCP-1: Monocyte chemotactic protein 1; MDA: Malondialdehyde; MEF: Maximal expiratory flow; MMEF: Maximal mid expiratory flow; PO: Per Os (by mouth); PEF: Peak expiratory flow; PFTs: Pulmonary function tests; SM: Sulfur mustard; SOD: Superoxide dismutase; TNF-α: Tumor necrosis factor-alpha; VEGF: Vascular endothelial growth factor

extract administration. By the end of the study, the use of inhaled bronchodilator medications in the extract-receiving groups had considerably reduced. Additionally, 1-2 months following extract therapy, a decrease in total white blood cell counts relative to baseline values was noted. After two months of treatment, compared to month one, neutrophil levels significantly dropped in the groups who received *Z. multiflora* extract (29). Various experimental studies evaluating the effect of *Z. multiflora* extract on animal models of COPD are in line with the results of the above clinical findings (170, 171).

*Effect of Z. multiflora constituents*
*Carvacrol*
The effect of carvacrol on wheezing, FEV$_1$, and plasma nitrite levels in asthmatic patients was the goal of an investigation. Two groups of asthmatic patients were assigned: one for carvacrol and the other for a placebo. FEV$_1$, nitrite levels, and wheezing during the day and exercise were measured three times. Comparing the carvacrol-treated groups to the baseline, the results showed a significant decrease in daytime and exercise-related wheeze. Additionally, after therapy, nitrite levels dramatically dropped in the carvacrol groups, and FEV$_1$ greatly increased in these groups. On the

other hand, during the course of the study, the examined parameters showed very little change in the placebo group (155). The effects of carvacrol on the animal model of asthma were indicated in experimental studies, which supported the above clinical findings (167, 172-174).

The effects of carvacrol on PFTs, hematological indices, and oxidant/anti-oxidant biomarkers in individuals with lung disorders caused by exposure to sulfur mustard gas 27–30 years ago were investigated. Patients were divided into two groups: one received carvacrol, and the other received a placebo. The findings showed that, after two months, PEF in the carvacrol-treated group was considerably higher than baseline. Additionally, following months one and two, the levels of thiol, SOD, and CAT increased substantially in the carvacrol-treated group, whereas the total white blood cell count, neutrophil count, and MDA levels significantly dropped (175).

Important results were found in a study assessing the effects of carvacrol on patients exposed to sulfur mustard. Serum levels of ILs and IFN-γ changed significantly after receiving carvacrol for two months. In particular, IL-10 and IFN-γ levels rose in month two, but IL-2, IL-4, IL-6, and IL-8 levels significantly decreased in months one and two when compared to baseline. In month two, the IFN-γ/IL-4 ratio

also improved. Furthermore, in comparison to the baseline, the PFTs of the carvacrol-treated group, which included MMEF and maximum expiratory flow at 25, 50, and 75% of vital capacity ($MEF_{25}$, $MEF_{50}$, and $MEF_{75}$), showed notable improvements in months one and two (176).

Likewise, patients with a history of sulfur mustard exposure lasting more than 20 years were assigned to either a placebo or a carvacrol-treated group in a research study to examine the effects of carvacrol on inflammatory markers and respiratory symptoms. At baseline and one and two months after the start of treatment, serum levels of TNF-α, MCP-1, VEGF, EGF, $FEV_1$, and respiratory symptoms such as chest wheeze, night wheeze, night cough, and cough and wheeze during exercise were measured. The results showed that the $FEV_1$ of the carvacrol group increased significantly at month two when compared to baseline, and that this improvement continued from month one to month two. In comparison to baseline, respiratory symptoms, chest wheeze, and night wheeze greatly decreased in months 1 and 2, but only in month 2 did night cough and cough and wheeze during exercise significantly decrease. Additionally, TNF-α, EGF, and VEGF levels of the carvacrol group dropped at months 1 and 2 in comparison to baseline, whereas MCP-1 levels only markedly declined at month 2 in comparison to baseline (177).

Several clinical trials have examined the effects of *Z. multiflora* and carvacrol on a variety of respiratory disorders, with promising findings. *Z. multiflora* improved PFTs, decreased respiratory symptoms, and altered inflammatory markers and oxidative stress levels, most likely due to its anti-inflammatory, anti-oxidant, and immunomodulatory properties. While these studies developed useful information, they had limitations such as small sample sizes and short durations. Future plans include conducting larger, multicenter trials with more extended follow-up periods to evaluate efficacy and safety, investigating optimal doses and formulations, assessing interactions with existing therapies,

and exploring the exact biochemical pathways involved in greater detail. The consistent findings highlight the potential of *Z. multiflora* and carvacrol as therapeutic agents for respiratory diseases, suggesting the need for additional research in this area.

## Possible mechanisms of action

Dyspnea is influenced by various physiological processes, such as oxidative stress, inflammation, and immune dysregulation. Herbal treatments have emerged as promising strategies for treating dyspnea by targeting these major pathways.

1. Oxidative stress and dyspnea: Oxidative stress, or an imbalance between ROS generation and anti-oxidant defenses, is a major cause of respiratory distress (178). In disorders such as COPD and asthma, increased oxidative stress causes airway inflammation and decreases lung function, worsening dyspnea (179) (Figure 3). The herbs reported in this review are high in anti-oxidants, which scavenge ROS, reduce oxidative damage, and protect respiratory tissues, thereby reducing dyspnea symptoms.

2. Inflammation and dyspnea: Chronic inflammation in the airways is a hallmark of respiratory disorders and a major cause of dyspnea. Inflammatory mediators trigger airway narrowing, mucus hypersecretion, and tissue remodeling, all of which can worsen breathing problems (180) (Figure 4). These herbs possess strong anti-inflammatory properties, which inhibit pro-inflammatory cytokines and enzymes, thereby reducing airway inflammation and improving respiratory function in dyspneic situations.

3. Immuno-dysregulation and dyspnea: Abnormal immunological responses can lead to chronic inflammation in the respiratory system, exacerbating dyspnea. Immunomodulation is crucial for restoring immunological balance and preventing excessive inflammation, which can lead to respiratory distress. These herbs have immunomodulatory effects that regulate immunological responses, modify inflammatory pathways, and reduce
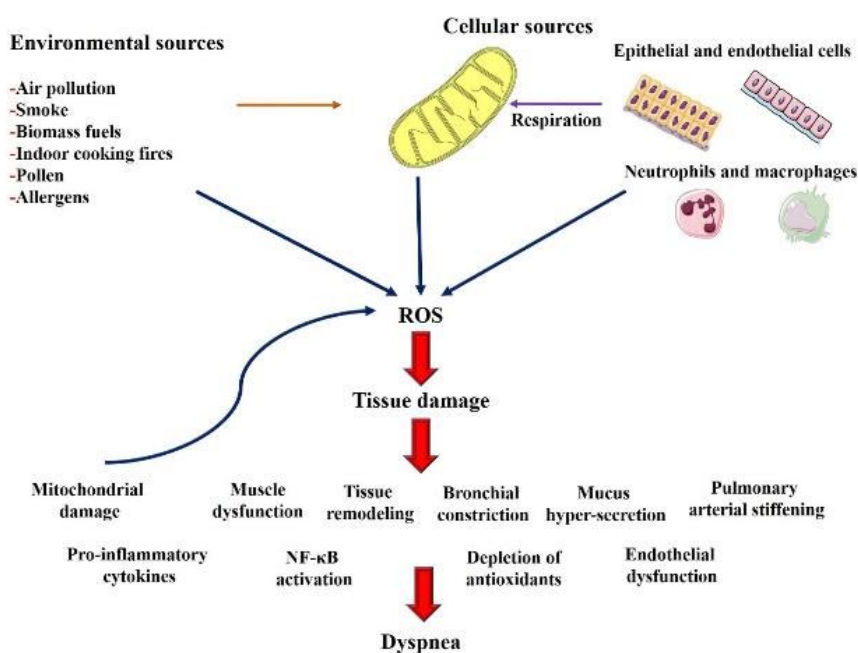


**Figure 3.** Impact of oxidative stress on dyspnea induction (Images from https://smart.servier.com and https://www.freepik.com)
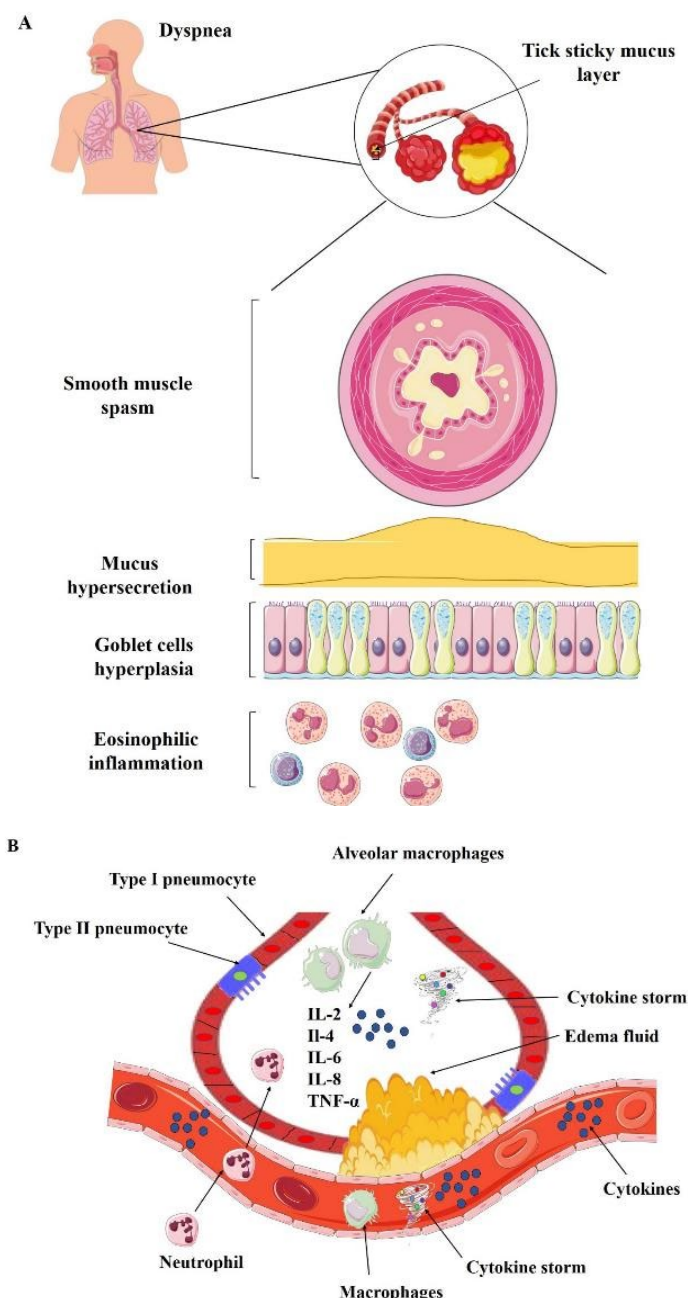
**Figure 4.** Impact of inflammation and immune dysregulation on dyspnea induction in A: Respiratory tract and B: Alveolus and pulmonary capillaries (Images from https://smart.servier.com and https://www.freepik.com)

airway hyper-responsiveness, providing relief for dyspnea (181, 182).

Finally, the anti-oxidant, anti-inflammatory, and immunomodulatory effects of herbal treatments present a comprehensive and integrative approach to managing dyspnea. By addressing the underlying mechanisms associated with respiratory distress, these herbs offer a promising opportunity for improving respiratory health outcomes and enhancing the quality of life for individuals suffering from breathing difficulties.

**Future perspectives**

In the future, the field of herbal treatments for respiratory disorders, which address dyspnea, presents a complex web of possibilities and challenges that require investigation and

clarification. The current level of research reveals several important future perspectives:

1. The development of standardized procedures for the application of herbal remedies in the treatment of dyspnea is an essential area for progress. To guarantee safety and repeatability throughout research and clinical practice, precise recommendations on doses, formulations, and quality control procedures are crucial.

2. Exploring the fundamental mechanisms of herbal therapies can provide novel opportunities for treating dyspnea and respiratory symptoms. By identifying the molecular targets and processes involved, researchers may establish a path for the development of targeted and effective treatments.

3. Longitudinal studies that focus on the long-term safety and efficacy of herbal therapies are critical for determining their long-term benefits and potential side effects. This research can shed light on the long-term efficacy of treatments and help clinicians make better decisions.

4. Investigating the synergistic effects of herbal therapies in conjunction with conventional treatments shows promise for increasing therapeutic outcomes and symptom management. Investigating the best combinations and dose regimes can lead to individualized and effective treatment strategies.

5. Future research should focus on patient-centered outcomes and preferences to tailor interventions to individual needs and experiences. Applying a patient-centered approach can improve treatment adherence, satisfaction, and overall quality of care.

6. Collaborations among academics, physicians, herbalists, and other healthcare professionals can promote a comprehensive and integrated approach to dyspnea management. Interdisciplinary efforts may encourage innovation and improve patient outcomes by bringing together various knowledge and viewpoints.

By following these future perspectives and doing research in these areas, the field of herbal treatments for dyspnea in respiratory disorders has the potential to revolutionize respiratory care. The future of herbal therapies in conventional respiratory healthcare practices appears to be bright, owing to thorough scientific study, teamwork, and a consistent commitment to improving patient well-being.

**Limitations and future directions**
*Limitations of the evidence*

While this review synthesizes findings on herbal interventions for dyspnea, several limitations should be acknowledged. The included studies vary in design, sample size, dosage, and treatment duration, making direct comparisons challenging. Additionally, some studies lack standardized methodologies, which may affect the consistency of reported outcomes. Further high-quality clinical trials with well-defined protocols are needed to validate the efficacy and safety of herbal therapies.

*Limitations of the review process*

This review was conducted as a narrative synthesis, relying on published peer-reviewed studies rather than a systematic assessment with formal risk of bias evaluations. The selection of articles was performed manually by a single reviewer, which, while structured, may introduce selection bias. Additionally, non-English studies were excluded, which could limit perspectives from different research

communities.

### *Implications for practice, policy, and future research*

Herbal medicine presents a promising complementary approach for dyspnea management, offering potential bronchodilatory, anti-inflammatory, and anti-oxidant effects. However, to facilitate clinical integration, standardized formulations, dosage optimization, and long-term safety evaluations are necessary. Future research should focus on large-scale, randomized controlled trials that explore synergistic effects with conventional treatments and address potential interactions. From a policy perspective, further regulatory frameworks are required to ensure quality control, accessibility, and safety in herbal therapeutics.

## Conclusion

Based on the narrative review on herbal remedies for alleviating dyspnea in respiratory conditions, it is evident that various herbal interventions show promising potential in managing dyspnea and improving respiratory health outcomes (Figure 5). Research on *A. sativus* supplements, *C. copticum*, *C. sativus*, crocin, curcumin, *E. globulus*, *M. piperita* essential oil, L-menthol, *N. sativa*, *R. officinalis* extract, 1,8-cineol, *T. vulgaris*, *Z. multiflora*, and carvacrol has provided valuable insights into their efficacy in addressing dyspnea and related respiratory symptoms. These herbal remedies exhibit diverse mechanisms of action, including bronchodilatory, anti-inflammatory, anti-oxidant, and immunomodulatory properties that contribute to their therapeutic effects.

While the trials show promising effects, limitations such as different dosages, sample sizes, and treatment durations prevent direct comparisons and generalizability. Future

research should focus on larger randomized controlled trials with standardized methodologies, investigating optimal dosages, long-term safety profiles, and potential interactions with conventional treatments in order to improve understanding and application of herbal remedies in respiratory care.

Addressing these research gaps and investigating the synergistic effects of herbal interventions with existing therapies presents a significant opportunity to optimize dyspnea management strategies, improve respiratory health outcomes, and provide personalized care for people with respiratory problems. The findings highlight the potential of herbal remedies as helpful supplemental therapies in the management of dyspnea and respiratory disorders.

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## Authors' Contributions

MH B conceptualized and supervised. M GR contributed to writing the manuscript.

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

## Declaration

During the preparation of this work, the author(s) used ChatGPT and Quillbot to rephrase to reduce plagiarism and improve the language and grammar. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the
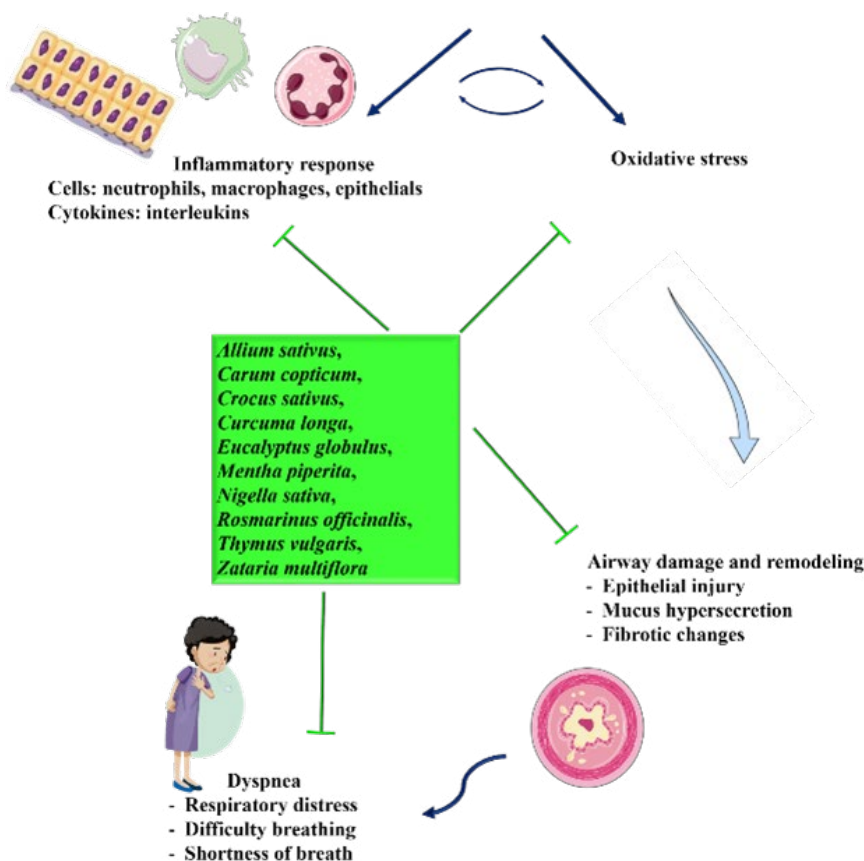


**Figure 5.** Therapeutic effects of herbal medicines on dyspnea (Images from https://smart.servier.com and https://www.freepik.com)

publication.

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