WJPMR, 2026, 12(1), 31-36

Review Article

WORLD JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.wjpmr.com

Impact Factor: 6.842

ISSN (O): 2455-3301

ISSN (P): 3051-2557

Coden USA: WJPMBB

ANTIOXIDANT POTENTIAL OF AYURVEDIC HERBS AND FORMULATIONS IN RESPIRATORY HEALTH: A COMPREHENSIVE REVIEW

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DOI: https://doi.org/10.5281/zenodo.18084468

How to cite this Article: Dr. Sruthi K.1*, Dr. Mridul Ranjan2, Dr. Shalini Maurya3 (2026). Antioxidant Potential Of Ayurvedic Herbs And Formulations In Respiratory Health: A Comprehensive Review. World Journal of Pharmaceutical and Medical Research, 12(1), 31–36.

Article Received on 16/11/2025 **Article Revised on 05/12/2025** **Article Published on 01/01/2026**

ABSTRACT

Respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD) are strongly associated with oxidative stress, which contributes to airway inflammation, tissue damage, and disease progression. Antioxidants play a vital role in counteracting these effects and protecting pulmonary tissues. Ayurveda describes several herbs and formulations with potent antioxidant properties that may help maintain respiratory health. This review compiles evidence from classical Ayurvedic literature and contemporary research to identify and assess Ayurvedic drugs and formulations exhibiting significant antioxidant potential and respiratory benefits. The findings indicate that herbs such as *Haridra* (*Curcuma longa* L.), *Shunti* (*Zingiber officinale* Roscoe), *Haritaki* (*Terminalia chebula* Retz.), *Yashtimadhu* (*Glycyrrhiza glabra* L.), *Tulasi* (*Ocimum sanctum* L.), *Ashwagandha* (*Withania somnifera* L.), *Lasuna* (*Allium sativum* L.), *Palandu* (*Allium cepa* L.), and *Pippali* (*Piper longum* L.), along with classical formulations such as *Chyawanprasha*, *Sitopaladi Churna*, *Dashamoolarishtam*, *Shirishavaleha*, *Talisapatradi Churna*, and *Agastya Haritaki Rasayana*, exhibit marked antioxidant action. Current evidence suggests that these interventions can serve as adjuncts for the prevention and management of oxidative stress-mediated respiratory diseases. However, further well-designed clinical and experimental studies are required to substantiate these findings, establish standardized formulations, and clarify their underlying mechanisms of action.

KEYWORDS: Antioxidant activity, Oxidative stress, Ayurvedic herbs, Ayurvedic formulations, Asthma, COPD.

INTRODUCTION

Oxidative stress plays an important role in the development and progression of respiratory conditions such as asthma and chronic obstructive pulmonary disease (COPD), by driving inflammation, tissue injury in the lungs. The regulation of oxidative stress via antioxidant mechanisms is therefore a key strategy for safeguarding lung integrity and maintaining healthy respiratory function.[1]

Ayurveda describes several herbs and classical formulations with proven antioxidant activities that can support respiratory wellness. This review aims to analyze existing evidence on these Ayurvedic herbs and formulations and their potential benefits in preventing and managing respiratory disorders through their antioxidant mechanisms.

MATERIALS AND METHODS

A literature review was conducted using PubMed and Google Scholar to identify studies on Ayurvedic herbs and formulations with antioxidant effects relevant to respiratory health, including asthma and COPD. Keywords used included Ayurvedic herbs, Ayurvedic formulations, antioxidant activity, COPD, asthma, and respiratory health. Both classical Ayurvedic texts and

contemporary scientific publications were included. Studies were selected based on their relevance to antioxidant-mediated effects on respiratory function and disease prevention.

Respiratory diseases in Ayurveda

According to Ayurveda, breathing and respiratory health are mainly the function of *Pranavaha srotas* (Channels in the body which originate from the heart and carry and circulate vital life (*Prana*) throughout the body). Disruption in the physiology of breathing is considered *Shwasaroga* (Respiratory disease).[2] Different types of medications for *Shwasa* are available in Ayurvedic classics that are utilized as *Shodhana* (purifying process) and *Shamana* (pacifying process), which are safer and effective. It is specially advised to use drugs that are preferably *Kapha* (*Dosha* responsible for cohesiveness) and *Vata samaka* (Normalizing *Dosha* regulating movement and cognition), *Ushna* (hot), and *Vatanulomanam* (Normal course of Movement of *Vata*), as advised in the management of *Shwasa roga*.[3]

Role of Oxidation Reactions and Antioxidants in the Body

Oxidation reactions support different functions in the body and are an important part of life. But they produce oxygen free radicals which are highly reactive. Oxygen free radicals generally include reactive oxygen and nitrogen species which are produced in response to endogenous and exogenous stressors. They can be generated endogenously by mitochondria, phagocytic cells, and peroxisomes in response to inflammation, ischemia, infection, cancer, etc., while exogenously as a result of exposure to environmental pollutants, specific medications, chemicals, cooking, cigarette smoke, alcohol, radiation, etc.[4] Reactive oxygen species exhibit dual behavior, as these at moderate amounts show beneficial effects on the body, while at higher concentrations, they are harmful to the biological system. In excess, they produce disturbance in the equilibrium status of pro-oxidant/antioxidant reactions in the body and are responsible for several human diseases, including chronic inflammation and cancers.[5]

Role of Oxidation reactions and Antioxidants in the respiratory system

In the human body, the lungs are highly vulnerable to oxidative stress because they are exposed to a high-oxygen environment and are consistently exposed to environmental pathogens and pollutants.[6] In the pathogenesis of diseases in the airway, oxidative stress has a significant role. Smoking and air pollution are significant risk factors, especially for conditions like chronic obstructive pulmonary disease due to their contributions to oxidative and carbonyl stress.[7] Some studies also indicated that the treatment with mitochondrial-targeted antioxidants in patients with COPD (Chronic Obstructive Pulmonary Disease) reduces the cytokine production of airway smooth muscle cells.[8] Thus, antioxidants can be used to neutralize the damaging effects of free radicals and serve as a defense against reactive oxygen species.

Some of the commonly used Ayurvedic herbs and formulations that alleviate respiratory diseases, especially due to their antioxidant properties, are given below.

Haridra (Curcumin) *Curcuma longa* L.

Haridra is an Ayurvedic traditional herb widely used as a home remedy for different respiratory health conditions. In Ayurvedic classics, it is explained as the contents of different *Kasahara* (cough-relieving) and *Shwasahara* (dyspnea-relieving) *yogas* like *Vasistha Rasayana*.[9] *Haridradi dhoopa* is specially indicated for *Shwasa* patients.[10] In an experimental study in animal models, curcumin demonstrated preventive effects on respiratory diseases due to its antioxidant, immunomodulatory, and anti-inflammatory actions.[11] An increase in malondialdehyde, an end product of lipid peroxidation, is a marker of increased free radicals and is also indicative of oxidative stress.[12] *Curcuma longa* plant extracts decreased levels of malondialdehyde and nitric oxide but increased enzymatic antioxidants like thiol, superoxide dismutase, and catalase levels in conditions of oxidative stress.[13] Clinical evidence also shows its therapeutic effect on respiratory diseases.[14] By functioning as an antioxidant and lowering oxidative stress, it aids in managing respiratory diseases.

Shunti (Ginger) *Zingiber officinale* Roscoe

Shunti is also commonly used in home remedies for respiratory illnesses. In classics, it is included in a variety of formulations which are indicated for *Shwasa* and *Kasa* conditions like *Amritaprasa Ghrita*, *Kusmanda Rasayana*, etc.[15,16] Research shows that *Zingiber officinale* has proven antioxidant potential. It is found that the xanthine oxidase system is involved in the production of reactive oxygen species, like superoxide anion, and *Zingiber officinale* can inhibit its production.[17] Animal studies with plant extract also showed that it is efficient against ovalbumen-induced lung inflammation by controlling oxidative damage and thereby biochemical and histological injuries on lung tissues.[18] This makes ginger an option to be used for the prevention and control of respiratory illness.

Haritaki (*Chebulic myrobalan*) *Terminalia chebula* Retzius

Haritaki is a drug of significant importance and is described as one of the *Kasahara Dasaimani gana*(Group of ten *Kasahara* drugs).[19] It is shown that chebulic acid isolated from *Terminalia chebula* suppresses the reactive oxygen species generated due to ambient urban particulate matter. Such reactive oxygen species decrease mRNA and protein levels of junction molecules and destroy the barrier integrity in the pulmonary alveolar epithelium.[20] Thus, *Haritaki* can protect the integrity of the pulmonary alveolar junction and protect against adverse effects on lung functions.

Yashti Madhu (*Licorice*) *Glycyrrhiza glabra* L.
In *Bhavaprakasa*, *Yasthimadhu* is discussed in the *Haritakyadi Varga* and is described as a *Rasayana*(Rejuvenative therapy), and is indicated for treating *Shwasa* and *Kasa*.[21] In allergic inflammation of the airway induced by ovalbumin, 18β-Glycyrrhetinic acid in *Glycyrrhiza glabra* demonstrated protective function by blocking phosphorylation of NF-κB (nuclear factor kappa light chain enhancer of activated B cells) and enhancing the Nrf2 (nuclear factor erythroid 2 related factor 2)/HO-1 (heme oxygenase-1) pathway, which stimulates the production of antioxidant molecules, and thereby regulates the oxidative stress.[22] Thus, *Yashti Madhu* serves as an important treatment option for allergic inflammation of the airway and can be used effectively in conditions like bronchial asthma.

Tulasi (Holy Basil) *Ocimum sanctum* L.
Tulasi is a widely used home remedy for respiratory illnesses. In the Indian Materia Medica, its leaves are described as a treatment for bronchitis and other related conditions. In a murine model, *Ocimum sanctum* leaf extract showed potential antioxidative activity against oxidative damage induced by cigarette smoke.[23] Both in vivo and in silico findings indicate that it alleviates oxidative stress by changing the oxidative/antioxidative imbalance by downregulating Reactive Oxygen Species, malondialdehyde levels, nitric oxide, and myeloperoxidase, and upregulating total antioxidant, superoxide dismutase, catalase, and glutathione peroxidase activities.[24] Thus, *Tulasi* could be considered an effective preventive and therapeutic agent against respiratory conditions like COPD.

Ashwagandha (Indian Ginseng) *Withania somnifera* L.
Ashwagandha is a widely used Ayurvedic herb with action in different systems of the body. It is described as a *Balya* (strengthening) and *Vatahara* (Vata-pacifying) substance, and according to the *Nighantus*, it is specifically indicated for *Kasa*, *Shwasa*, and *Kshaya* (Consumptive disorder).[25,26] In the *Brihattrayis*, it is mentioned as an ingredient in various formulations for treating cough and respiratory disorders.[27] It is found that withanolides in *Withania somnifera* roots demonstrated substantial inhibitory activity against the proteins Angiotensin-Converting Enzyme 2 (ACE-2), Myeloperoxidase (MPO), which possess strong oxidative and inflammatory properties, and systemic inflammatory marker, Interleukin-6 (IL-6), causing a significant reduction in systemic oxidative stress.[12] This antioxidative potential of the plant contributes to improving lung functioning, quality of life, exercise tolerance, and reducing inflammation in patients with COPD.[28]

Lasuna (Garlic) *Allium sativum* L.
Lasuna is mainly indicated for *Vata Vyadhi* but is also prescribed for various other illnesses, including *Kasa*, as noted by Kashyapa.[29] The sulfur compound in garlic exhibits potential therapeutic benefits in managing inflammation and oxidative stress and can be used effectively in asthma treatment. Garlic compounds can act as direct antioxidants by scavenging free radicals and promoting the formation of glutathione. It also works by indirect mechanisms that cause an increase in the expression of endogenous antioxidant enzymes, as well as the downregulation of microRNAs associated with oxidative stress.[30] This antioxidant action of the drug can be used in the management of respiratory illness.

Palandu (Onion) *Allium cepa* L.
Onion juice is widely used in home remedies to treat coughs and other respiratory issues in children. In diet, they are used for *Deepana* and *Pachana* (Digestive and Carminative).[31] Animal studies conducted using bronchoalveolar lavage fluid showed that the extract of *Allium cepa* has antioxidant and immunomodulatory effects.[32] Treatment with plant extract also significantly improved total white blood cell count, total protein levels, nitrite levels, nitrate levels, and other oxidant and antioxidant biomarkers, and increased antioxidant markers in interstitial fibrosis and emphysema.[33] This effect makes it a good candidate for the management of different respiratory illnesses.

Pippali (Long Pepper) *Piper longum L.*
Pippali is a commonly utilized herb for respiratory ailments and is one of the ingredients in *Kasahara Dasaimani*.[19] Acharya Vagbhata especially mentions the use of *Pippali churna* in treating *Kasa*.[34] It is also a component of various *Kasa* and *Shwasa hara* formulations such as *Pippali Rasayana*, *Sitopaladi Churna*, and others.[35,36] Animal studies show that piperine in *Piper longum* can inhibit the infiltration of pro-inflammatory markers and reactive oxygen species in airways.[37] In patients suffering from chronic sulfur mustard-induced pulmonary complications, a combination of curcuminoids and piperine is found to reduce systemic oxidative stress and improve clinical symptoms and quality of life.[38] Thus, *Piper longum* can be a good therapeutic agent for COPD and other respiratory illnesses.

Chyawanprasha
Chyawanprasha is one of the most widely used Ayurvedic formulations, known for its *Rasayana* properties that promote rejuvenation and longevity. Among its various indications, it is particularly indicated in *Kasa* and *Shwasa roga*.[39] It is reported that *Chyawanprash* shows strong antioxidant activity, with the ethyl acetate extract exhibiting significant DPPH radical scavenging potential, comparable to that of ascorbic acid, indicating the presence of potent antioxidant constituents.[40,41]

Sitopaladi Churna
Sitopaladi Churna is widely utilized in the treatment of respiratory illnesses. Classical texts specifically indicate its use for conditions such as *Shwasa* and *Kasa*.[42] The phenolic compounds present in *Sitopaladi Churna*

demonstrate significant antioxidant potential in various in vitro free radical models by inhibiting the generation of superoxide and nitrites.[43]

Dashamoolarishtam

Dashamoolarishtam is a widely used *Arishta* preparation in traditional medicine, also indicated for respiratory conditions such as *Kasa* (cough) and *Swasa* (dyspnea).[44] An Invitro study shows that this formulation is known for its significant antioxidant properties, including free radical scavenging capabilities.[45]

Shirishavaleha

Shireesha (*Albizia lebbeck (L.) Benth.*) is widely used in Ayurveda for respiratory illnesses. It has been found that *Shirishavaleha* is effective in managing chronic conditions due to its antioxidant phytochemicals, which contribute to its overall therapeutic benefits.[46]

Talisapatradi Churnam

Talisapatradi Churnam is indicated in the treatment of *Swasa*, *Kasa*, *Jwara*, etc.[47] Invitro Research with antioxidant assays has concluded that the biomolecules present in it have antioxidant properties.[48]

Agastya Haritaki Rasayana

Agastya Haritaki Rasayana is a key formulation in the linctus form outlined by Vagbhata.[49] It is found that the polyphenols found in the *Agastya Haritaki Rasayana* may enhance plasma antioxidant capacity and protect from oxidative damage.[50]

DISCUSSION

The present review highlights the close relationship between oxidative stress and respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD). Excessive production of reactive oxygen and nitrogen species leads to inflammation, epithelial injury, and airway remodeling, contributing to the chronicity and severity of these disorders.[51,52] Therefore, controlling oxidative stress is an essential therapeutic approach for maintaining pulmonary integrity and preventing disease progression.

Evidence from Ayurvedic literature and recent studies supports that several Ayurvedic herbs and classical formulations possess notable antioxidant potential, thus helping to restore cellular balance and protect pulmonary tissues.

Among the herbs described, *Haridra*, *Shunti*, *Haritaki*, *Yashtimadhu*, *Tulasi*, *Ashwagandha*, *Lasuna*, *Palandu*, and *Pippali* have been consistently associated with the ability to neutralize free radicals and strengthen the body's internal defense systems. Their bioactive compounds, such as polyphenols, flavonoids, and alkaloids, act by scavenging reactive oxygen species, increasing the activity of enzymes like superoxide dismutase and catalase, and reducing lipid peroxidation. This leads to decreased airway inflammation and improved epithelial integrity, which together support better lung function.

The formulations reviewed, including *Chyawanprasha*, *Sitopaladi Churna*, *Dashamoolarishtam*, *Shirishavaleha*, *Talisapatradi Churna*, and *Agastya Haritaki Rasayana*, appear to act through combined phytochemical interactions. These mixtures contain antioxidant components that work synergistically to stabilize cellular redox balance, suppress inflammatory mediators, and enhance tissue repair mechanisms. Their multi-targeted nature provides sustained protection against oxidative stress, which is particularly valuable in chronic respiratory conditions where multiple pathways contribute to disease progression.

Overall, the data from classical texts and contemporary studies indicate that these herbs and formulations do not act on a single pathway but rather modulate several interconnected biochemical processes that maintain respiratory health. By reducing the harmful effects of oxidative stress, they help to prevent chronic inflammation, support detoxification, and improve immune response in the respiratory system. Although current findings are promising, further controlled studies are necessary to confirm their specific roles, determine optimal dosages, and ensure consistency across preparations.

CONCLUSION

The findings of this review highlight that oxidative stress plays a pivotal role in the pathogenesis and progression of respiratory disorders such as asthma and COPD. Ayurvedic herbs and formulations, with potent antioxidant properties, provide a promising complementary approach for mitigating oxidative damage, reducing inflammation, and supporting pulmonary health. By neutralizing free radicals and enhancing the body's defense mechanisms, these traditional remedies can aid in both prevention and management of oxidative stress–mediated respiratory diseases. Future studies should include carefully planned animal and human research to clearly understand how these herbs work, improve the quality and consistency of formulations, and confirm their benefits using modern scientific methods.

ACKNOWLEDGMENT- None.

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