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Medicinal Plants Used in India During COVID-19: A Review

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Abstract: *COVID-19 spread far and wide, straining healthcare everywhere in unexpected ways, pushing people to try novel approaches to prevention and treatment, beyond what regular medicine offered. In India, ancient practices of traditional healing - under Ayurveda, part of a broader system called AYUSH - drew increased interest thanks to past uses treating lung problems, fevers, and weakening illnesses like the flu. When SARS-CoV-2 emerged, scientists turned toward plants already known for their powers in traditional Indian remedies. Research focused on whether these plants might stop viruses, ease inflammation, block oxidative stress, adjust how the body responds to invaders, or break up blood clots - each potential front against severe illness caused by the new coronavirus.This review critically evaluates medicinal plants used in India during the COVID-19 pandemic, with special emphasis on Withania somnifera, Tinospora cordifolia, Ocimum sanctum, Curcuma longa, Azadirachta indica, and Zingiber officinale. Evidence from in silico studies, experimental investigations, clinical observations, and systematic reviews indicates that phytochemicals such as with anolides, curcumin, berberine, eugenol, and flavonoids may interfere with viral replication and modulate inflammatory pathways. The Ministry of AYUSH also recommended several herbal interventions and immunity-promoting measures during the pandemic. Although preliminary findings demonstrated encouraging therapeutic potential, most studies remained limited by inadequate clinical validation and lack of standardization. The present review summarizes the pharmacological mechanisms, phytochemical constituents, therapeutic applications, and current scientific evidence regarding medicinal plants used during COVID-19 management in India. Furthermore, the article discusses safety considerations, research limitations, and future perspectives for integrating traditional medicine with evidence-based healthcare systems.*

Keywords: COVID-19, SARS-CoV-2, Ayurveda, AYUSH, medicinal plants, immunomodulators, antiviral phytochemicals, Ashwagandha, Giloy

I. INTRODUCTION

The COVID-19 pandemic necessitated a global search for therapeutic alternatives, prompting researchers in India to re-evaluate the role of traditional medicinal plants and AYUSH formulations in managing viral symptoms (“An Aspect of Medicinal Plants and Herbal Treatments in INDIA in Covid-19 Pandemic,” 2021; Ramesh & Valan, 2021). These interventions, traditionally recognized as potent immunity modulators, have been systematically evaluated for their efficacy in mitigating respiratory distress and enhancing prophylactic protection among frontline workers. This review synthesizes the pharmacological potential of some key botanical species, including *Withania somnifera* and *Tinospora cordifolia*, which exhibit significant antiviral, immunomodulatory, and thrombolytic properties (Singh et al., 2021). Furthermore, the Ministry of AYUSH actively promoted these botanical interventions as integral components of national health advisories to strengthen host immune responses against SARS-CoV-2 (Yashvardhini et al., 2021). In addition to their immunomodulatory actions, these herbal preparations are recognized for possessing anti-inflammatory and anti-pyretic properties that assist in the management of mild to moderate disease symptoms (Chopra et al., 2021;

Silveira et al., 2020). By leveraging centuries of traditional knowledge, these plant-based remedies offer a sustainable and accessible framework for primary healthcare, potentially reducing the clinical burden on the national socio-economic system (Singh et al., 2021). Despite the absence of definitive modern clinical mechanisms for every species, the historical safety profile and broad-spectrum antiviral potential of these formulations present a viable path for integrated medical management (Gangal et al., 2020; Kumari et al., 2021). Current research initiatives are focused on utilizing advanced technological interventions to isolate and validate specific bioactive phytocompounds that may interrupt the viral replication cycle of SARS-CoV-2 (Prasad et al., 2020). Specifically, investigations *into Withania somnifera* have demonstrated its capacity to inhibit the main protease and spike protein of the virus, while *Tinospora cordifolia* has been shown to modulate cytokine production and enhance the activation of immune effector cells (Matveeva et al., 2020). Additionally, the phytochemical berberine, isolated from various indigenous species, has demonstrated efficacy in suppressing viral-induced pulmonary inflammation and edema (Nema et al., 2021).

Traditional medicinal systems, especially Ayurveda, Siddha, and Unani, received renewed scientific attention during the pandemic because of their historical use in respiratory illnesses and infectious diseases. India possesses extensive ethnopharmacological knowledge involving medicinal plants with immunomodulatory, antiviral, anti-inflammatory, antioxidant, and adaptogenic activities (Ahmad et al., 2021). Consequently, several medicinal plants traditionally employed in Indian healthcare practices were evaluated for their possible role in preventing or managing COVID-19 symptoms.

The Ministry of AYUSH, Government of India, released multiple advisories recommending herbal decoctions, Ayurvedic formulations, and immunity-promoting interventions to support host defense mechanisms during the pandemic (Ministry of AYUSH, 2020). Plants such as *Withania somnifera* (Ashwagandha), *Tinospora cordifolia* (Giloy), *Ocimum sanctum* (Tulsi), and *Curcuma longa* (Turmeric) became widely utilized because of their documented pharmacological activities.

Recent advances in molecular docking, computational biology, and phytochemical screening have suggested that numerous plant-derived compounds may inhibit SARS-CoV-2 replication by targeting viral proteins such as the main protease (Mpro), spike glycoprotein, and RNA-dependent RNA polymerase (Shree et al., 2022). In addition, many medicinal plants exhibit immunomodulatory properties capable of regulating cytokine responses and reducing inflammatory complications associated with severe COVID-19.

The present review comprehensively summarizes medicinal plants used in India during the COVID-19 pandemic up to 2022, focusing on their phytochemistry, pharmacological activities, mechanisms of action, clinical evidence, and future therapeutic potential.

II. METHODOLOGY

The present review was conducted using a comprehensive literature survey from scientific databases including PubMed, Scopus, Web of Science, Google Scholar, and ScienceDirect. Literature published between January 2020 and December 2022 was screened.

The following keywords were used:

COVID-19, SARS-CoV-2, Ayurveda, AYUSH, medicinal plants, Indian herbs, Ashwagandha, Giloy, herbal medicine and COVID-19 for the present study.

Inclusion Criteria

Peer-reviewed research articles, Review articles, Clinical trials, Molecular docking studies, Government advisories, Experimental pharmacological studies have been included.

Relevant data regarding pharmacological activities, phytoconstituents, antiviral mechanisms, and clinical findings were extracted and critically analyzed.

III. AYUSH INTERVENTIONS DURING THE COVID-19 PANDEMIC

The Ministry of AYUSH actively promoted traditional healthcare measures during the pandemic to enhance immunity and support general wellness. The advisory released by the Ministry recommended several household remedies and herbal preparations, including:

- Herbal decoctions (Kadha)
- Turmeric milk
- Steam inhalation
- Nasal application of sesame oil
- Consumption of medicinal herbs such as Tulsi, Ashwagandha, and Giloy

Additionally, Ayurvedic formulations including AYUSH-64 and Kabasura Kudineer were investigated as adjunct therapies for mild and moderate COVID-19 management.

A systematic review conducted by Thakar et al. (2022) suggested that AYUSH-based interventions may reduce symptom severity and improve recovery when used alongside standard care. However, the authors also emphasized the need for large-scale randomized controlled trials.

IV. MEDICINAL PLANTS USED DURING COVID-19 IN INDIA

4.1 *Withania somnifera* (Ashwagandha) Family Solanaceae

Major Phytochemicals

- Withanolides
- Withaferin A
- Alkaloids
- Sitoindosides

Pharmacological Activities

- Immunomodulatory
- Antiviral
- Anti-inflammatory
- Adaptogenic
- Antioxidant

Ashwagandha is one of the most extensively studied medicinal plants in Ayurveda. During the COVID-19 pandemic, molecular docking studies demonstrated that withanolides may interact with SARS-CoV-2 spike proteins and main protease enzymes (Chikhale et al., 2021; Shree et al., 2022).

Experimental studies also suggested that Ashwagandha possesses immunomodulatory activity capable of regulating inflammatory cytokines and improving host immune responses. Furthermore, its adaptogenic properties may help reduce stress and fatigue associated with viral illness.

Clinical investigations reported improved recovery outcomes in mild and moderate COVID-19 patients receiving Ashwagandha as adjunct therapy.

4.2 *Tinospora cordifolia* (Giloy/Guduchi) Family Menispermaceae

Major Phytochemicals

- Berberine
- Cordifolioside
- Tinosporin
- Alkaloids

Pharmacological Activities

- Immunostimulatory
- Antipyretic
- Hepatoprotective
- Anti-inflammatory
- Antiviral

Tinospora cordifolia gained widespread popularity during the pandemic because of its traditional use as an immunity enhancer. In silico investigations suggested that phytochemicals from Giloy may inhibit viral protease activity and interfere with SARS-CoV-2 replication pathways.

Experimental studies indicated that Giloy can stimulate macrophage activation and modulate cytokine production, thereby contributing to immune regulation. Nevertheless, reports of hepatotoxicity associated with excessive or unsupervised consumption highlighted the importance of proper dosage and medical supervision.

4.3 *Ocimum sanctum* (Tulsi) Family Lamiaceae

Major Phytochemicals

- Eugenol
- Rosmarinic acid
- Ursolic acid
- Flavonoids

Pharmacological Activities

- Antiviral
- Antioxidant
- Anti-inflammatory
- Antimicrobial

Tulsi has long been utilized in Ayurvedic medicine for respiratory disorders and infectious diseases. During COVID-19, computational and experimental studies suggested that Tulsi phytochemicals may inhibit viral attachment and replication processes.

The plant also exhibits bronchodilatory and antioxidant activities that may help alleviate respiratory distress and oxidative stress associated with viral infections.

4.4 *Curcuma longa* (Turmeric) Family Zingiberaceae

Major Phytochemicals

- Curcumin
- Demethoxycurcumin
- Bisdemethoxycurcumin

Pharmacological Activities

- Anti-inflammatory
- Antioxidant
- Immunomodulatory
- Antiviral

Curcumin, the principal bioactive constituent of turmeric, attracted considerable scientific attention because of its ability to regulate inflammatory pathways such as NF-κB signaling. Severe COVID-19 is frequently associated with cytokine storm and systemic inflammation; therefore, curcumin was investigated as a supportive anti-inflammatory agent.

Turmeric milk and herbal decoctions containing turmeric were widely recommended during the pandemic as immunity-supportive interventions.

4.5 *Azadirachta indica* (Neem) Family Meliaceae

Major Phytochemicals

- Azadirachtin
- Nimbin
- Quercetin

Pharmacological Activities

- Antiviral
- Antibacterial
- Antioxidant
- Immunomodulatory

Neem possesses broad-spectrum antimicrobial properties and has traditionally been used in infectious diseases. Molecular docking analyses indicated that neem-derived phytochemicals may interact with SARS-CoV-2 target proteins. Additionally, its antioxidant properties may assist in reducing oxidative tissue damage.

4.6 *Zingiber officinale* (Ginger) Family Zingiberaceae

Major Phytochemicals

- Gingerol
- Shogaol
- Zingerone

Pharmacological Activities

- Anti-inflammatory
- Antipyretic
- Antioxidant
- Antiviral

Ginger was commonly incorporated into herbal teas and immunity-boosting formulations during the pandemic. Its anti-inflammatory and antioxidant effects may contribute to symptomatic relief in respiratory infections.

V. MECHANISMS OF ACTION AGAINST SARS-COV-2

Medicinal plants may exert therapeutic activity against COVID-19 through multiple biological mechanisms.

5.1 Inhibition of Viral Entry

Several phytochemicals can potentially interfere with the interaction between SARS-CoV-2 spike proteins and ACE2 receptors, thereby reducing viral attachment and cellular entry.

5.2 Inhibition of Viral Replication

Computational studies demonstrated that phytocompounds such as withanolides and curcumin may inhibit viral main protease and RNA-dependent RNA polymerase enzymes involved in replication.

5.3 Immunomodulatory Effects

Medicinal plants including Ashwagandha and Giloy can stimulate innate and adaptive immune responses through macrophage activation, lymphocyte proliferation, and cytokine modulation.

5.4 Anti-inflammatory Activity

Many phytochemicals reduce inflammatory mediators including IL-6, TNF-α, and NF-κB signaling pathways, potentially mitigating cytokine storm-associated complications.

5.5 Antioxidant Effects

Oxidative stress contributes significantly to COVID-19 pathology. Antioxidant-rich medicinal plants may reduce free radical-mediated tissue injury.

VI. CLINICAL EVIDENCE AND SCIENTIFIC VALIDATION

Several observational studies and pilot clinical trials investigated Ayurvedic interventions during COVID-19.

An exploratory randomized clinical trial reported improved symptom recovery among patients receiving Ashwagandha and Ginger supplementation alongside conventional care.

Similarly, systematic reviews indicated that AYUSH-based interventions may improve quality of life and reduce hospitalization duration in mild-to-moderate COVID-19 cases (Thakar et al., 2022). However, most studies were limited by:

- Small sample sizes
- Lack of multicenter validation
- Insufficient blinding
- Variability in herbal formulations

Consequently, current evidence remains preliminary and requires further validation through rigorously designed clinical trials.

VII. SAFETY AND TOXICOLOGICAL CONSIDERATIONS

Although medicinal plants generally possess favorable traditional safety profiles, several concerns emerged during the pandemic due to widespread self-medication practices.

Potential safety issues include:

- Herb-drug interactions
- Variability in phytochemical composition
- Contamination and adulteration
- Hepatotoxicity from excessive Giloy consumption
- Lack of standardized dosage guidelines

Therefore, medicinal plant-based therapies should be administered under professional supervision and integrated carefully with conventional treatment protocols.

VIII. LIMITATIONS OF CURRENT RESEARCH

Current research regarding medicinal plants and COVID-19 is constrained by several limitations:

- Predominance of in silico studies
- Limited clinical evidence
- Inadequate standardization
- Lack of pharmacokinetic investigations
- Insufficient toxicity profiling
- Short-term observational designs

These limitations restrict definitive conclusions regarding efficacy and safety.

IX. FUTURE PERSPECTIVES

Future investigations should focus on:

- Isolation of active phytoconstituents
- Standardization of herbal formulations
- Molecular target validation
- Large-scale randomized controlled trials
- Nanotechnology-based phytopharmaceutical delivery systems
- Integration of traditional medicine with evidence-based healthcare

Advanced computational biology, metabolomics, and artificial intelligence may accelerate the discovery of novel antiviral phytochemicals from medicinal plants.

X. CONCLUSION

Medicinal plants played a substantial supportive role during the COVID-19 pandemic in India, particularly within the framework of AYUSH-based healthcare interventions. Medicinal herbs such as *Withania somnifera*, *Tinospora cordifolia*, *Ocimum sanctum*, and *Curcuma longa* demonstrated promising antiviral, immunomodulatory, antioxidant, and anti-inflammatory activities.

Although in silico, experimental, and preliminary clinical studies suggested beneficial therapeutic potential against SARS-CoV-2, robust clinical validation remains limited. Therefore, medicinal plants should currently be considered supportive adjuncts rather than definitive alternatives to evidence-based conventional therapies.

The pandemic nevertheless highlighted the importance of traditional medicinal knowledge and emphasized the need for scientific integration of ethnopharmacology with modern biomedical research for future infectious disease management.

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