

# Harnessing Air Vaidya Herbal Dhoopa Fumes for COVID-19: A Compositional Analysis and Therapeutic Potential

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## Abstract

**Introduction:** The rapid and global spread of COVID-19 has highlighted the limitations of existing vaccines and treatments, underscoring the urgent need for safe, effective, and complementary preventive strategies. Ayurvedic medicine, with its time-tested traditional methodologies and herbal formulations, offers promising solutions. **Aim:** To evaluate the clinical efficacy and safety of the Air Vaidya Herbal Dhoopa (AVHD) stick, a traditional herbal fumigation formulation, against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). **Objectives:** To evaluate the safety and efficacy of Air Vaidya Herbal Dhoopa (AVHD) *in vivo* and to analyze its structural and elemental composition using advanced imaging techniques, including transmission electron microscopy and scanning electron microscopy with energy dispersive spectroscopy. **Conclusion:** The compositional and structural analysis revealed key bioactive components that support the antiviral potential of the formulation. The findings suggest that AVHD sticks could serve as a viable and integrative preventive approach in the management of SARS-CoV-2 infections, aligning with the principles of Ayurveda to enhance community health and resilience.

**Key words:** Air vaidya herbal dhoopa, Anti-viral, Ayurveda, Inhalation fumes, Scanning electron microscopy, Severe acute respiratory syndrome coronavirus-2, Transmission electron microscopy

## INTRODUCTION

Global public health is still substantially impacted by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections that caused the COVID-19 pandemic. Worldwide, numerous ongoing cases and deaths are associated with various strains of SARS-CoV-2.<sup>[1]</sup> In both the past and the present, Coronavirus outbreaks have affected both humans and animals, causing respiratory, intestinal, hepatic, and neurological problems.<sup>[2]</sup> In more severe cases, the infection can cause pneumonia, severe acute respiratory syndrome, kidney failure, and even death.<sup>[3-5]</sup> In most cases, the human coronavirus strains cause the common cold along with moderate, self-limiting upper respiratory tract infections. On the other hand, the advent of three deadly human beta coronaviruses, the SARS-CoV-2,<sup>[6]</sup> the Middle East respiratory syndrome coronavirus,<sup>[7]</sup> and the SARS-CoV-2,<sup>[8]</sup>

highlights the necessity to identify new treatment approaches for viral infections. The SARS-CoV-2 virus, belonging to the family Coronaviridae, contains a positive-sense single-stranded RNA genome and was first reported in late 2019 in China.<sup>[9]</sup> The disease manifests as either asymptomatic infection or mild to severe pneumonia with high morbidity. It has since been circulating worldwide, causing the global pandemic of COVID-19 with high infectivity and fatality rates. While SARS-CoV-2 adapts to new human hosts, it is susceptible to genetic evolution through the occurrence of mutations over time, giving rise to mutant variants that may differ from its original strains in certain ways. Several

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SARS-CoV-2 variants have been identified throughout this pandemic as variants of concern because of their potential harm to public health around the world.<sup>[10]</sup> Globally, over 600 million cases and 6.4 million deaths have been reported as of September 04, 2022, according to the World Health Organization. Given the severity of the pandemic, researchers from both academia and industry are striving to develop antiviral defenses against the virus.

Based on the signs and symptoms of COVID-19 according to Ayurveda, SARS-CoV-2 infection may be compared as one of the varieties of *Sannipataja Jwara* associated with cough, wherein three doshas/genomics, namely *Vata*, *Pitta*, and *Kapha*, get vitiated.<sup>[11-13]</sup> There is currently no evidence that the modern medical system can prevent or treat the ailment, but the time-tested ancient wisdom of Ayurveda can help with disease management and prevention.<sup>[14]</sup> To date, a growing range of sanitizers, disinfectants, nasal sprays, and other similar products have been utilized to restrict the entry of SARS-CoV-2 into the body system. However, scientific investigations of herbal inhalations and fumigations used in traditional processes such as Ayurveda remain unexplored. Ayurvedic physicians have used *Dhoopa* (inhalation of vaporized fumes) to treat *Sannipataja Jwara* (similar to SARS-CoV-2) and other infectious diseases for centuries.<sup>[15]</sup> Several ancient Ayurvedic texts refer to fumigation as *Dhoopana*, which utilizes herbs to disinfect the environment. Further, fumigation with herbal, mineral, and animal products has been prescribed to treat various bacterial infections and disorders of the central nervous system.<sup>[16,17]</sup> According to a meta-analysis, traditional Chinese fumigation combined with Western medicine improved diabetic peripheral neuropathy symptoms.<sup>[18]</sup> Homa is an age-old spiritual practice that has been described as a sort of *Dhoopana* (fumigation), whose heat and gases/fumes produced may sanitize the air and prevent the COVID-19 virus transmission from person to person.<sup>[11]</sup> Various herbs and drugs, including those in *Dashanga Dhoopana* as well as medications such as *Tulasi* (holy bacilli) and *Haridra* (turmeric), are used for fumigation.

In the present study, we, therefore, aim to assess the efficacy of the Ayurvedic formulation named Air Vaidya Herbal Dhoopa (AVHD) stick to determine its potential as a formulated agent against SARS-CoV-2 infection. A plant-based AVHD preparation is chosen for the current experiment. Numerous types of studies have demonstrated the antiviral, antibacterial, anti-inflammatory, and immunomodulating properties of the phytoconstituents found in this combination. Given that COVID-19 is one of the airborne infections and that the virus frequently enters the human body system through the nose and mouth, the gases released by the combustion of AVHD sticks may minimize airborne respiratory infections.<sup>[19]</sup> Therefore, the inhalation of AVHD fumes has been employed to diminish the coronavirus infection by inhalation through the nose and mouth.

## MATERIALS AND METHODS

### AVHD stick

The 15<sup>th</sup>-century Ayurvedic treatise *Vaidya Chintamani* outlines several *dhoopa* formulations for managing *Sannipataja Jwara*. Drawing inspiration from ancient texts, supported by contemporary antiviral research and pharmacological insights, the AVHD formula was meticulously designed and prepared using modern pharmaceutical advancements. This formulation aims to serve as a preventive measure to reduce the incidence of COVID-19. A detailed overview of the ingredients used in the preparation of AVHD is mentioned in Table 1.

### Structural and compositional analysis

The AVHD stick was burnt, and a standard copper transmission electron microscope (TEM) grid of diameter 3.05 mm was placed above it at a distance. The grid was held above for 2 min, such that the soot of the burning *dhoopa* stick settled on the copper grid. The copper grid with soot material was observed under a TEM (Model: Tecnai G2 20 TWIN, Company: FEI Company of USA (SEA) PTE, LTD). To further analyze the chemical composition of the soot material, energy dispersive spectroscopy (EDS) was done on the soot with the help of a scanning electron microscope (Model: EVO – scanning electron microscope MA15/18 Company: CARL ZEISS MICROSCOPY LTD. EDS: 51N1000 – EDS System). The soot for EDS analysis was collected on the inside surface of an earthen pot with a rugged surface after burning several *dhoopa* sticks inside an upside-down pot.

## RESULTS

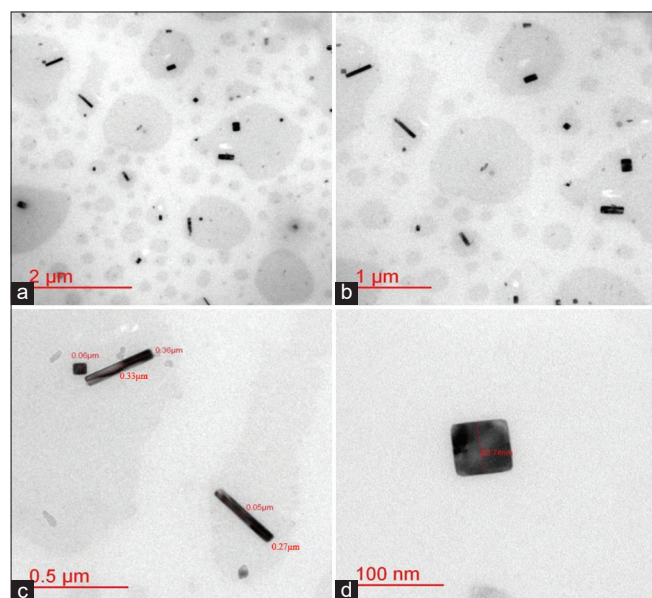
### Structural and compositional analysis

Figure 1 displays the bright-field TEM images obtained from the soot of the AVHD stick. It can be observed from the figure that the soot consists of numerous particles in the shape of rods and squares of nanometer sizes. Higher magnifications [Figure 1a-d] reveal the morphology, dimensions of the nano-rods, and squares. It can be observed that there are numerous nano-rods with lengths of 0.36–0.38  $\mu\text{m}$  and 0.05  $\mu\text{m}$  (50 nm) width. In addition, the nano-squares have nearly 60 nm side lengths. Such nanoparticles have a high surface and offer a large number of reaction sites.

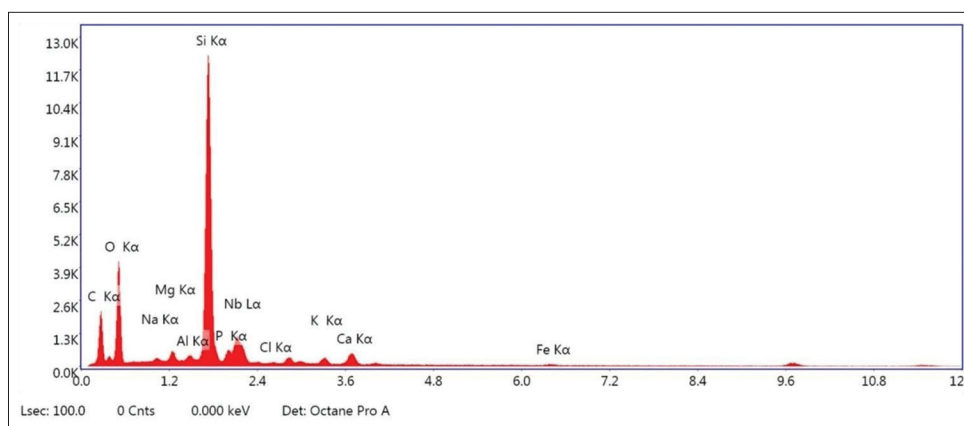
Further, the collected soot was analyzed under scanning electron microscopy for chemical composition using the EDS attachment. EDS, also referred to as electron probe X-ray microanalysis, involves the interaction of an electron beam with the atoms of various elements

**Table 1:** The ingredients along with the parts used, therapeutic activities supported by references, and their quantities in milligrams

S. No.	Scientific name	Ayurvedic/ common name	Part used	Therapeutic activity	By weight (mg)	References
1	<i>Shorea robusta</i> Gaertn.	<i>Raal</i>	Exudate	Antiviral (AV)	33.5	Dhawan, 2012
2	<i>Azadirachta indica</i> A. Juss.	<i>Neem</i>	Leaf	AV	53.6	Dhawan, 2012
3	<i>Adhatodavasica</i> Nees.	<i>Vasa</i>	Leaf	AV	20.1	Ayush, 2020
4	<i>Trachyspermumammi</i> (L.)	<i>Ajwain</i>	Fruit	AV	53.6	Roy <i>et al.</i> , 2015
5	<i>Curcuma longa</i> L.	<i>Haridra</i>	Rhizome	AV	67.0	Ayush, 2020
6	<i>Cymbopogon citratus</i> (DC.)	<i>Bhustrina</i> (Lemon grass)	Whole plant	AV	67.0	Ayush, 2020
7	<i>Acorus calamus</i> L.	<i>Vacha</i>	Rhizome	Antimicrobial (AM)	33.5	Kumar, 2014
8	<i>Ocimum sanctum</i> L.	<i>Tulasi</i>	Leaf	AV	67.0	Ayush, 2020
9	<i>Brassica campestris</i> Linn.	<i>PeeliSarso</i>	Seed	Antioxidant and AM	67.0	Bai <i>et al.</i> , 2014
10	<i>Santalum album</i> L.	<i>Chandana</i>	Heart wood	AM	20.1	Kumar <i>et al.</i> , 2006
11	<i>Vetiveriazizanioides</i> (L.)	<i>Ushira</i>	Root	AV	33.5	Saikia <i>et al.</i> , 2012
12	Purified <i>Commiphoramukul</i> Hook.	<i>ShuddhaGuggulu</i>	Exudate	AV	33.5	Chen <i>et al.</i> , 2021
13	<i>Cyperusscariosus</i> R.Br.	<i>Nagarmotha</i>	Rhizome	Anti-inflammatory and AM	13.4	Srivastava <i>et al.</i> , 2014
14	<i>Lawsoniainermis</i> L.	<i>Mehendi</i>	Leaf	AM	13.4	Gull <i>et al.</i> , 2013
15	<i>Valerianawallichii</i> DC.	<i>Tagar</i>	Rhizome	AV	20.1	Ganta <i>et al.</i> , 2017
16	<i>Styrax benzoin</i> Dryand.	<i>Lobandhoopa</i>	Exudate	AM	33.5	Bhatwalkar <i>et al.</i> , 2019
17	<i>Cinnamomumcamphora</i> L.	<i>Kapura</i> (Camphor)	Processed	AV	53.6	Chen <i>et al.</i> , 2013
18	<i>Litsea glutinosa</i> Lour.	<i>Jigat</i>	Wood	Immunomodulator and AV	100	Chen <i>et al.</i> , 2013
19	<i>Elettaria cardamomum</i> L.	<i>Ela</i>	Fruit husk	AM	150	El <i>et al.</i> , 2007
20	Clarified cow's butter	<i>Ghee</i>	Processed	Wound healing and AM	46.2	El <i>et al.</i> , 2007

**Figure 1:** Bright field transmission electron microscope images of Air Vaidya Herbal Dhoopa soot collected on a copper grid with increasing magnification through the sections (a-d) for better resolution

in the material under study. This interaction produces characteristic X-rays unique to each element. The analysis of these X-rays provides detailed information about the elemental composition of the material.<sup>[20]</sup> Figure 2 shows the corresponding spectrum of different elements present in the soot. Table 2 lists the various elements present in the soot and their respective weight fractions. It can be observed that silicon, calcium, and oxygen are present in major quantities in the *dhoopa* soot/fumes. As the soot was collected from the interior surface of an earthen pot, there could be an obvious chance of silicon contamination. Literature suggests that calcium-based channel blockers have anti-inflammatory properties. Reports also suggest that calcium produces vasodilation, which in turn reduces the inter-endothelial cell gaps, ultimately causing a reduced effusion and inflammation.<sup>[21]</sup> Oxygen desaturation is one of the most common symptoms in patients with COVID-19, which cannot be addressed immediately, even using techniques such as oxygen therapy. Oxygen inhalation significantly eases breathing by reducing resistance as it passes through the respiratory tract.<sup>[22]</sup>



**Figure 2:** Energy dispersive spectroscopy spectrum of elements present in Air Vaidya Herbal Dhoopa soot

**Table 2:** List of elements present in Air Vaidya Herbal Dhoopa soot obtained from EDS-SEM analysis, along with their weight percentage and atomic percentage

Element	Weight %	Atomic %
CK	30.66	45.09
OK	31.23	34.47
NaK	1.22	0.93
MgK	1.20	0.87
AlK	0.71	0.47
SiK	22.56	14.18
PK	1.86	1.06
NbL	6.75	1.28
ClK	0.22	0.11
KK	1.02	0.46
CaK	2.08	0.92
FeK	0.48	0.15

EDS-SEM: Energy dispersive spectroscopy-scanning electron microscopy

## DISCUSSION

Across the globe, scientists are investigating potential treatment options for COVID-19 from traditional systems of health care. Despite extensive research in recent years, no herbal medication has been conclusively proven to prevent COVID-19. However, Ayurveda, the traditional Indian system of medicine, emphasizes strengthening immunity through its rejuvenation therapy, *Rasayana*.<sup>[23]</sup> The use of traditional medicine in treating viral infections through the enhancement of the immune system is abundantly documented.<sup>[24]</sup> Traditional uses and scientific evidence on a number of medicinal herbs and their phytochemicals have indicated that these plants can serve as a novel source of natural products against lethal viral infections, with a particular focus on COVID-19.<sup>[25]</sup>

As per the Chinese and Indian traditions, many medicinal plants have been used for treating upper and lower respiratory

tract infections.<sup>[26,27]</sup> Each of these has some specific medicinal properties such as antiviral, antimicrobial, anti-inflammatory, immunomodulatory, and anti-oxidant activities. The AVHD stick was formulated by blending the specified parts of medicinal plants in precise proportions, as outlined in Table 1. The anti-viral and anti-inflammatory activity of the fumes of *Curcuma longa*, *Ocimum sanctum*, and *Azadirachta indica* present in the AVHD might have decreased the release of cytokines and chemokines.<sup>[26,28]</sup>

Other medicinal plants such as *Trachyspermum ammi*, *Litsea Glutinosa*, purified *Commiphora Mukul*, *Valeriana Wallichii*, *Adhatoda vasica*, *Cymbopogon Citratus*, and *Shorea Robusta* have shown antiviral activity either by blocking the entry of the virus into the epithelial cells or by inhibiting the humoral and cell-mediated immunity.<sup>[28]</sup> *Cyperus scariosus* and *Acorus calamus* extracts, components of AVHD, have also shown anti-inflammatory activity,<sup>[29]</sup> which might have blocked the induction of inflammatory factors caused by the new virions released into the plasma or may inhibit the activation of macrophages and dendritic cells. The combined effect of all these activities may possibly be behind the occurrence of a significantly lower incidence of COVID-19 symptoms.

## CONCLUSION

Recent efforts have focused on developing highly potent and effective formulations against COVID-19 using traditional medications. The clinical efficacy studies performed with both male and female volunteers showed that the Ayurvedic-formulated AVHD fumigation has efficacious preventive potential against the SARS-CoV-2 virus without causing adverse effects. The combination of medicinal plants in the fume stick showed a preventive effect by lowering the percentage of people in the intervention group who expressed COVID-19 symptoms after a month-long fumigation treatment. Furthermore, exposure of flies to AVHD fumes for 2, 5, and 10 min showed no difference in oxidative stress levels and larval fecundity. From the biochemical toxicity

study, it was concluded that AVHD fumes were not toxic to flies and served as natural antioxidants and exhibiting strong fitness components for egg laying.

When compared with control flies, the treatment had no effect on circadian locomotor activity rhythms or activity counts in *Drosophila*. Our research suggests that the use of AVHD sticks for fumigation therapy may serve as a preventive measure. With a traditional medicine approach using Ayurvedic herbal combination *dhoopa* therapy, we achieved a significant effect on preventing COVID-19 and provided *in vivo* evidence that AVHD sticks were capable of mitigating SARS-CoV-2 without adverse effects on physiology or morphology. Based on the original supporting data from this study, in conjunction with existing Ayurvedic traditional information, the potential of AVHD sticks in preventing COVID-19 will be explored further. Consequently, the *dhoopa* can rapidly be repurposed for use as a safe and highly effective prevention therapy for COVID-19.

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