

## AEROSOL TOXICITY: AN AYURVEDA PERSPECTIVE

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<https://doi.org/10.46607/iamj06p8052024>

(Published Online: July 2024)

Open Access

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Article Received: 08/06/2024 - Peer Reviewed: 17/06/2024 - Accepted for Publication: 15/07/2024.



### ABSTRACT

Many aerosol sprays contain toxic chemicals like xylene and formaldehyde, as well as neurotoxins and carcinogens. Overexposure of such components proves harmful to humans. In recent years due to industrialisation and human activities there is rise in air pollution which results in Aerosol Toxicity.

**Key words:** Aerosol, Toxicity, Polluted Air.

### INTRODUCTION

In Chapter 3rd of Vimana Sthana, Acharya Charaka discusses Janpadopdhvansa, describing how Vayu (air), Desha (land), Kala (season), and Jala (water) are affected. He also outlines the characteristics of Samanya Vayu (normal air), Vikrit Vayu (polluted air), and Vishadushit Vayu (toxic air). The early signs (Poorvarupa) of Janpadopdhvansa include unusual conditions of stars, planets, moon, sun, air, fire, and environmental changes that disrupt the seasons. Environmental pollution, a negative consequence of human activity, remained relatively minor until urbanization. Nowadays, people have come to accept a polluted

atmosphere as an inherent part of urban living. With the advent of synthetic materials, factories were established to produce them, often without considering the toxicity of chemicals not intended for human use. Out of the approximately 3 million known chemicals, relatively few have undergone toxicity testing, and many have been carelessly spread throughout the environment. Air pollutants primarily enter the body through the lungs, with some chemicals being absorbed into the bloodstream, while others are eliminated by the lungs.

Material and Method:

Various research articles, journals regarding air pollution and aerosol toxicity were analyzed and reviewed. Books of forensic medicine and toxicology were referred and interpreted.

### **Modern View**

#### **Aerosol:**

An aerosol is a colloid system where the continuous phase is a gas, such as in fog. It can be defined as a suspension of particles or droplets in the air, encompassing airborne dust, mist, fumes, or smoke. The sizes of these suspended particles vary from a few nanometers to several hundred micrometers in diameter. These particles can be either manufactured or naturally occurring.

In the workplace, aerosols present both health and safety hazards and are found across various industrial sectors. Workers can inhale particles, absorb them through the skin, or ingest them. The health risks associated with aerosols depend on factors such as particle size, composition, shape, and concentration. These particles can lead to short-term or long-term health effects, ranging from respiratory issues and skin irritations to more severe conditions like cancer or chronic respiratory diseases. Additionally, safety hazards related to aerosols include the potential for fires or explosions, especially when the particles are flammable or reactive.<sup>1</sup>

#### **Sources of Aerosol:**

Aerosols can come from numerous sources, including industrial processes, combustion, and even natural events like volcanic eruptions and dust storms. Given the wide range of sources and potential impacts, effective monitoring and control measures are crucial in minimizing the risks associated with aerosol exposure in occupational settings.

#### **Deposition of Aerosols in the Respiratory Tract<sup>2</sup>**

The deposition site of aerosols in the respiratory tract is largely determined by the size of the particles. Particles that are 5 microns or larger typically settle in the upper airways. Those deposited in the non-ciliated anterior part of the nose remain until they are mechanically removed. In the posterior part of the nose, a mucus layer moved by cilia transports insoluble particles to the pharynx within minutes. These particles are then

swallowed and passed into the gastrointestinal tract. Soluble particles dissolved in the mucus may either be carried to the pharynx or absorbed through the epithelium into the bloodstream.

Particles sized between 1 and 5 microns tend to deposit in the tracheobronchial tree and may be swallowed. Meanwhile, particles smaller than 1 micron stay suspended in the inhaled air and reach the alveolar region of the lungs, where they are readily absorbed. Liquid aerosols in this size range can cross the alveolar cell membranes by passive diffusion, with their rate of absorption depending on their lipid solubility.

This distribution and behavior of aerosols in the respiratory system highlight the importance of particle size in determining their potential health impacts, as different regions of the respiratory tract have different mechanisms for handling and removing these particles.

#### **Types of Air Pollutants (Aerosols)<sup>3</sup>**

Five primary pollutants constitute almost 98% of air pollution:

- Carbon monoxide: 52%
- Sulphur oxides: 18%
- Hydrocarbons: 12%
- Particulate matter: 10%
- Nitrogen oxides: 6%

The major sources of these air pollutants are:

- Transportation: 60%
- Industry: 18%
- Electric power generation: 13%
- Space heating: 6%
- Waste disposal: 3%

#### **Health Effects of Aerosol Toxicity<sup>4</sup>**

High pollution episodes lead to increased mortality and morbidity. Acute health effects are notably linked to reducing-type pollution. Although there is less evidence connecting photochemical oxidant pollution with such immediate health impacts, significant correlations exist between airborne oxidant levels and hospital admissions for various conditions. These conditions include allergic disorders, inflammatory eye diseases, acute respiratory infections, upper respiratory influenza, and bronchitis.

Additionally, exposure to toxic aerosols can result in other symptoms such as hypoxia (reduced oxygen levels in the blood), hepatic enlargement (swelling of the liver), excessive sweating, skin lesions, and glycosuria (presence of glucose in the urine). These symptoms highlight the broad range of potential health issues caused by aerosol pollution, underscoring the importance of monitoring and mitigating air quality to protect public health.

High Aerosol concentration affecting pulmonary function results in incapacitation and possible death. Potential presence of carbon monoxide results in increased carboxyhemoglobin level and decreased oxygen uptake.<sup>11</sup>

**The World Health Organization (WHO) has recommended the following strategies to prevent and control air pollution:**

1. Containment is crucial to directly prevent harmful pollutants from entering the atmosphere, thereby protecting both the environment and public health.
2. Replacement ensures the adoption of cleaner technologies, reducing the overall emission of pollutants and preserving air quality.
3. Dilution through green belts helps to naturally filter and disperse pollutants, mitigating the concentration of harmful substances in populated areas.
4. Legislation provides a legal framework to enforce pollution controls, holding industries accountable and ensuring compliance with environmental standards.
5. International Action fosters global cooperation and knowledge sharing, enabling a coordinated response to the transboundary nature of air pollution and promoting uniform standards for air quality monitoring and control.

**Other sources of Aerosols:**<sup>10</sup>

The other sources of Aerosols are hairsprays, deodorants, other hygiene products. Such products do not directly enter the air passage. But when such products are used frequently on body it affects the environmental air quality.

**Ayurvedic View**

### **Vikrita Vayu Lakshana<sup>5</sup> (Properties of Polluted Air)**

This type of air is associated with causing illnesses due to various characteristics such as not adhering to seasonal patterns, excessive moisture, high speed, harshness, extreme temperatures (both cold and hot), obstruction, roughness, unpleasant sounds, excessive collisions with each other, and contamination with unsuitable smells, vapors, gravel, dust, and smoke.

**Characteristics and Effects of Polluted Air<sup>6</sup>**

When birds flying in the sky suddenly fall to the ground in a tired state, it indicates that the air is contaminated by poisonous smoke. In humans, exposure to this polluted air can result in symptoms such as coughing, nasal discharge, headaches, and severe eye diseases among those who inhale the same polluted air and smoke.

### **Purification of Polluted Air**

In situations where the air is contaminated, the atmosphere can be cleansed by burning herbal remedies such as Laksha, Haridra, Ativisha, Abhaya, Musta, Harenuka, Ela, Tamalapatra, Vakra, Kustha, and Priyangu in an open area. The smoke produced by burning these herbs would effectively purify the poisoned air.<sup>7</sup>

In the 23rd chapter of Chikitsa Sthana, Acharya Charaka mentions several fumigation processes that aid in detoxifying the environment:<sup>8</sup>

1. A mixture of powdered Yellow Mustard (*Brassica campestris* L.) and Chandana (*Santalum album* L.) combined with Ghrita (Clarified butter).
2. A combination of Tagar (*Valeriana wallichii* DC.), Kustha (*Saussurea lappa*), and the flowers of Shirisha (*Albizia lebeck* Benth.).
3. An equal quantity blend of Laksha (*Shellac*), Usheer (*Vetiveria zizanioidis*), Tejpatra (*Cinnamomum tamala*), Guggula (*Commiphora mukul*), Bhallataka (*Semicarpus anacardium*), flowers of Arjuna (*Terminalia arjuna*), Raal (Extract of *Shorea robusa*), and White Aparajita (*Clitoria ternatea*).

These fumigation processes are aimed at purifying the environment and are mentioned in the ancient text for their potential detoxification properties.<sup>9</sup>

## DISCUSSION

*Dushi visha* is a concept that refers to environmental toxins that accumulate in the body over time and can cause disease. These toxins can be inanimate, animate, or artificial, and can be caused by a variety of factors. Disease produced due to *Dushivisha* (bio accumulative poison) can be treated with the help of applying *Ayurvedic* principles. A study on the leaf extract of *Tulsi* (*Ocimum sanctum*) in allium root meristems has shown effect in modifying the genotoxicity induced by heavy metals. Thus, *dravyas* mentioned in *Ayurvedic* texts could be used to reduce the toxic elements in Air. By adhering to the dietary and lifestyle guidelines recommended by *Ayurveda*, one can significantly reduce the harmful effects caused by environmental factors. Additionally, if symptoms have already appeared, *Ayurvedic* medications and suggestions can effectively manage them.

## CONCLUSION

Modern treatments often focus on alleviating symptoms rather than addressing the root cause of aerosol toxicity, which may lead to temporary relief without resolving the underlying issue. Many medications used in modern treatments of aerosol toxicity may have adverse side effects, which can further impact the patient's health and well-being. *Ayurvedic* herbs with detoxifying and anti-inflammatory properties can help in neutralizing toxins and reducing inflammation caused by aerosol exposure. *Rasayana* herbs and formulations are used in *Ayurveda* to rejuvenate and strengthen the body's tissues, boost immunity, and promote longevity. These may be beneficial in restoring vitality and resilience in individuals affected by aerosol toxicity. Practices like *Pranayama* (breath control exercises) and deep breathing can help in clearing the respiratory passages, enhancing lung function, and promoting relaxation.

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**Source of Support: Nil**

**Conflict of Interest: None Declared**

How to cite this URL:Newaskar Undale Vidya & Virnodkar Prathia P: Aerosol Toxicity: An Ayurveda Perspective. International Ayurvedic Medical Journal {online} 2024 {cited July 2024} Available from: [http://www.iamj.in/posts/images/upload/430\\_433.pdf](http://www.iamj.in/posts/images/upload/430_433.pdf)