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Indoor plants: A solution for indoor air pollution

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Abstract

Air pollution in India is a serious problem which affects the human health. There are many types of air pollution but indoor air pollution is very serious and dangerous to human health. Indoor air pollution is a huge, often overlooked issue, particularly in countries like India, where rapid urbanization, industrialization, and population growth are contributing to worsening air quality. People often don't realize how much indoor environments can be contaminated, not just by outdoor pollutants that enter, but by indoor sources like cooking fumes, cleaning products, and building materials. It's also alarming how many health problems are linked to poor indoor air quality, such as respiratory issues, headaches, and even long-term diseases like asthma, cardiovascular issues, and cancer. One of the most effective and natural ways to combat indoor air pollution is by using air-purifying plants. These plants help absorb harmful chemicals, increase oxygen levels, and improve overall air quality. Air-purifying plants naturally remove toxins from the air, inspire creativity and focus, increase mental health, serve as natural humidifiers, and bring life to a home.

Keywords: Air pollution, disease, toxin, Air purifier

Introduction

Air pollution has caused major concern over the world due to its widespread nature, damage to our environment and potential health risk to humans. There are many types of air pollution but indoor air pollution is very serious and dangerous to human health. Indoor air pollution refers to chemical, biological and physical contamination of indoor air. Indoor air pollutants range from biological contaminants like mild and bacteria to chemical pollutants, including toxic gases and volatile organic compounds (Bandeali et.al 2021)^[1]. Like outdoor pollution, indoor air pollution might not always be apparent. It could stem from everyday household products, construction materials, or our methods to keep indoor environments comfortable. For example, poor ventilation can trap pollutants inside, and something as mundane as cooking can release harmful particles into the air. Indoor air pollution can be much higher than outdoor levels due to limited ventilation. The lack of fresh air circulation means pollutants can accumulate quickly, leading to higher concentrations. This can be exacerbated in energy-efficient buildings where airflow is minimized to conserve energy. The immediate health impact can be more profound, leading to headaches, fatigue, respiratory issues, and long-term chronic illnesses.

According to the World Health Organization (WHO), approximately 3 billion people worldwide still rely on solid fuels such as waste wood, charcoal, coal, dung, and crop residues for cooking and heating. These fuels are often burned on open fires or traditional stoves, releasing a significant amount of air pollutants, including sulfur dioxide (SO₂), nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM) (WHO, 2014)^[15]. In poorly ventilated spaces, these pollutants can accumulate to hazardous levels, posing serious health risks to the inhabitants. In addition to combustion sources, indoor environments are also affected by anthropogenic sources such as wooden construction materials, oil-based paints, scented decorative items, and even some types of indoor plants, all of which can emit volatile organic compounds (VOCs) at varying concentrations. Some indoor air pollutants like NO_x, SO₂, ozone (O₃), and PM are common to both indoor and outdoor air, and may also infiltrate from outdoor sources (Wayon, 2004)^[12].

These pollutants can be inorganic, organic, biological, or even radioactive in nature. With a large portion of the population spending most of their time indoors, improving indoor air

Quality has become a critical area of research. While extensive research has focused on outdoor air pollution, indoor air quality especially in densely populated countries like China, India, and the United States requires greater attention and dedicated research to develop effective mitigation strategies.

Types of Indoor Air Pollutants

There are numerous types of indoor air pollutants that originate from various sources within homes and office buildings. Some of these pollutants are generated indoors, while others infiltrate from the outdoor environment and become trapped due to poor ventilation (Sharma S *et al* 2022) ^[10]. Below are some of the most common indoor air pollutants, along with their sources and associated health effects

- 1. Particulate Matter (PM_{2.5} and PM₁₀):** Fine particulate matter, especially PM_{2.5} and PM₁₀, is often present at elevated levels indoors. These particles originate from sources such as cooking, burning candles or incense, and smoking. Due to the confined nature of indoor spaces, these particles can quickly accumulate, leading to poor air quality.
- 2. Volatile Organic Compounds (VOCs):** VOCs are typically more concentrated indoors than outdoors, emitted by products such as cleaning agents, paints, varnishes, adhesives, and synthetic furnishings. Activities like painting or frequent cleaning without proper ventilation can significantly increase VOC levels. Exposure to VOCs may result in symptoms such as headaches, dizziness, fatigue, and long-term effects with prolonged exposure.
- 3. Toxic Gases (e.g., Carbon Monoxide and Radon):** Carbon monoxide (CO) and radon are two of the most dangerous indoor air pollutants. CO can accumulate from unvented gas stoves, heaters, or faulty appliances, and is especially hazardous due to its odourless and colorless nature. Radon, a naturally occurring radioactive gas, can enter buildings through cracks in the foundation. Both gases pose serious health risks,

including the potential for fatal poisoning in the case of carbon monoxide.

The impact of these air pollutants on human health depends on several factors, including toxicity, concentration, and duration of exposure. Health effects can vary widely among individuals. One common condition associated with poor indoor air quality is Sick Building Syndrome (SBS), in which occupants experience symptoms such as irritation of the eyes, nose, and throat, skin problems, headaches, and allergies. Interestingly, these symptoms often subside after the person leaves the affected building (Wargocki *et al*, 2000) ^[11].

Role of Indoor Plants in Overcoming Air Pollution

Indoor air pollution is a growing concern due to modern lifestyles, closed environments, and the use of synthetic materials. Air-purifying plants are natural, eco-friendly solutions that help combat this problem. These plants improve indoor air quality by absorbing harmful pollutants and converting carbon dioxide into oxygen through photosynthesis. Research has shown that different plants are effective at removing specific toxins such as benzene, formaldehyde, carbon monoxide, and xylene (Wolverton, 1993; Chauhan *et al*, 2017; Corneo, J J *et al* 1999, Kobayashi *et al*, 2007; Yoo, 2006; Papinchak, Heather L, 2009; Wood and Ronaldo A, 2006; Pottorff, L 2010, Han K T and Ruan L., 2020 ^[2, 4, 5, 7, 16, 8, 13, 9, 6].

Materials & Methods

Plants absorb pollutants through their leaves and roots. Microbes in the soil also play a key role in breaking down harmful substances. This dual action results in cleaner air and increased oxygen levels, benefiting individuals with respiratory conditions and allergies. There are diverse number of indoor plants in Rohtak region of Haryana but we selected some important indoor plants with maximum benefits in overcoming indoor pollution and identified them with earlier published literature and data are shown in table 1.

Table 1: There is a list of important Air-Purifying Indoor Plants with their uses

S. No	Plant Name	Botanical Name	Family	Benefits (Pollutants removed)
1.	Bamboo Palm	<i>Chamaedorea seifrizii</i>	Arecaceae	Benzene, Formaldehyde
2.	Gerbera Daisy	<i>Gerbera jamesonii</i>	Asteraceae	Benzene
3.	Peace Lily	<i>Spathiphyllum wallisii</i>	Araceae	Formaldehyde, Carbon Monoxide
4.	Spider Plant	<i>Chlorophytum comosum</i>	Asparagaceae	Formaldehyde, Xylene, Benzene, Carbon Monoxide
5.	Mass Cane Plant	<i>Dracaena massangeana</i>	Asparagaceae	Formaldehyde
6.	Rubber Tree	<i>Ficus elastica</i>	Euphorbiaceae	Formaldehyde, Carbon Dioxide
7.	Lemon Button Fern	<i>Nephrolepis cordifolia</i>	Nephrolepidaceae	General toxins
8.	Pothos	<i>Epipremnum aureum</i>	Araceae	Benzene, Formaldehyde, Xylene, Toluene, Carbon Monoxide
9.	Creeping Velvet	<i>Philodendron gloriosum</i>	Asteraceae	Formaldehyde
10.	Parlor Palm	<i>Chamaedorea elegans</i>	Araceae	Benzene, Trichloroethylene
11.	Aloe	<i>Aloe vera</i>	Liliaceae	Benzene, Formaldehyde
12.	Broad Lady Palm	<i>Rhapis excelsa</i>	Arecaceae	Ammonia, Benzene, Nitrogen Oxide, Formaldehyde, Xylene, Toluene
13.	Fittonia 'Frankie'	<i>Fittonia argyroneura</i>	Acanthaceae	Toluene, Benzen, Trichloroethylene
14.	Ficus	<i>Ficus benjamina</i>	Moraceae	Formaldehyde, Xylene
15.	Flamingo Lily	<i>Anthurium andraeanum</i>	Araceae	Ammonia, Toluene, Xylene, Formaldehyde
16.	ZZ Plant	<i>Zamioculcas zamiifolia</i>	Araceae	CO ₂ , Toxic Gases
17.	Pot Mum	<i>Chrysanthemum morifolium</i>	Asteraceae	Benzene, Formaldehyde,
18.	Dragon tree	<i>Dracaena marginata</i>	Asparagaceae	Trichloroethylene, Xylene, Toluene, Ammonia
19.	Sword fern	<i>Nephrolepis exaltata</i>	Dryopteridaceae	Xylene, toluene and benzene
20.	Snake Plant	<i>Dracaena trifasciata</i>	Asparagaceae	purifying air by releasing oxygen at night

Conclusion

Interior plants will increasingly be used in indoor areas as people's awareness of sustainability grows. Total volatile organic compounds, Particulate matter, and oxidants and irritants are some of the several elements that make up indoor pollution. Furthermore, as most of society spends most of its time indoors, the current research is essential to improving indoor air quality. It is necessary to conduct more research on the selection of indoor plant species based on their morphological, anatomical, and physiological characteristics that have the potential to phytoremediate air. This will ensure that indoor living has positive health benefits and will promote learning, productivity, and quality of life. This work sheds light on the significance of this understanding, particularly in light of its implications for human health.

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