Journal of Advances and Scholarly Researches in Allied Education
Vol. 18, Issue No. 2, March–2021, (Special Issue), ISSN 2230-7540

A Review on Phytoremediation of Indoor Air Pollution

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Abstract – Air pollution in India is a serious issue with the major sources being fuel wood and biomass burning, fuel adulteration, vehicle emission and traffic congestion. Traditional fuel (fuel wood, crop residue and dung cake) dominates domestic energy use in rural India and accounts for about 90% of the total. In urban areas, the traditional fuel constitutes about 24% of the total. Several physical methods are available for purification of air quality but all are expensive and require special equipment for their function. Planting of tree and shrubs for combating pollution and improvement of environment is a cheap and effective way and well recognized throughout the world.

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INTRODUCTION

Presence of pollutants in indoor air is known as indoor air pollution. It can be traced back to Prehistoric Times when man started using fire for the cooking, lightning and protection from animals. Fire led to high level of indoor air pollution, the evidence of which is found in prehistoric Caves indoor air pollution has been included in the top 5 risks to public health as per USPA. It has been found that the level of indoor air pollutants is 10 times more than its level outside and the concentration of pollutants has also been known to exceed permissible limits.

There are various sources and types of indoor air pollutants. Production and behavior of pollutants in the indoor environment is affected by the temperature humidity, pressure and direction of wind outside. The 69% of total population of India depends on solid fuels including biomass, wood dung, coal and agriculture wastes to meet their basic energy needs. Burning solid fuels produces high levels of indoor air pollution typical 24 hr level of PM in bio mass using air range from 300-3000 micro/m^3 by comparison the who air quality guidelines recommend a limit for daily average PM is 50 micro/m^3. Owing to this recent concern and increasing death rate due to respiratory disorders, studies were conducted to cheek the phytoremediation efficiencies of indoor plants and surprising results were noted. Indoor plants generally absorbed pollutant with the help of tiny pores in their leaves. There are two pathways for trapping these pollutants either move to root zone, where they are broken down by soil microbes or move to vacuole. Some benefits of plants as indoor air purifier are listed below:

- ► Gives us oxygen to breath.
- ► Aid aesthetic and biological comfort to interiors space.
- ► Increase relative humidity.
- ► Decrease particulate matter accumulation.
- ► Volatile photochemical released by plant leaves appears to be highly effective in controlling airborne microbe and molds in indoor air.

Indoor air pollution is the degradation of indoor air quality by harmful chemicals. The principal sources of indoor air pollution are combustion building material and bioaerosols. While heavy metals, volatile organic matter particulate matter and tobacco smoke are considered major indoor pollutants in developed countries. In India out of 0.2 billion people using fuel for cooking, 49% use firewood, 8.9% caw dung cake, 1.5% coal, 2.9% kerosene, 28.6% LPG, 0.1% electricity, 0.4% biogas and 0.5% any other means.

The incomplete combustion products of biomass fuels include suspended particulate matter. Co, poly-aromatic hydrocarbons, poly-organic matter, HCHO etc, which have adverse effect on health. The combustion of coal results in production of oxides of sulfur, Arsenic and Fluoride. pollutants such as aldehyde. Volatile and semi volatile organic compounds are produced from pain varnishes cosmetics Biological pollutants like molds, pollen and Infectious agents produced in mattresses carpets and humidifier too pollute indoor air.

Table: List of some common air pollutant and their sources

S. No.	Pollutants	Sources
1	Formaldehyde	Adhesives, ceiling tiles, Draperies, Fabrics floor covering, Grocery bags, paints & varnishes.
2	Xylene/Toluene	Ceiling tile, printers, paints, floor covering, chipboard stains and varnishes, wall covering
3	Benzene	Printers, wall covering, printers
4	Ammonia	Bioeffluents, cleaning products, printer, photocopies
5	Alcohols	Adhesive, carpeting, cleaning products, wall covering stains and varnish
6	Acetone	Bioeffluents, cosmetics preprinted paper forms. Correction fluids, nail polish remover
7	Biological pollutants	-

LIST OF SOME INDOOR AIR PURIFYING PLANTS

1. Aloe vera:- Botanical Name- ***Aloe barbadensis***

► It helps in filtering benzene formaldehyde. Carbon di oxide and carbon mono oxide that comes from carpets and curtains.

2. Spider Plant:- Botanical Name- ***Chlorophytum comosum***

► The plant fights against carbon mono oxide, formaldehyde and benzene which come from detergents, paints furniture, wax, thinner and other things.

3. Snake plants:- Botanical Name- ***Sansevieria trifasciata***

► Plant helps in absorbing formaldehyde, trichloroethylene xylene toluene and benzene from household articles.

4. Areca palm/Bamboo palm:- Botanical Name- ***Dypsis lutescens***

► It is one of the best plant to cope up pollutants like benzene formaldehyde trichloroethylene, xylem and toluene.

5. Warnock Dracaena:- Botanical Name- ***Dracaena marginata***

► It combats pollutants that come with paint detergents, varnishes and oil.

6. Gerber Daisies:- Botanical Name -***Gerbera Jamesonii***

► Helpful in absorbing carbon mono oxide and benzene.

► Plant gives off O_2 at nights.

7. Bamboo palm:- Botanical Name - ***Chamadorea seifrizii***

► A natural humidifier, helps in eliminating carbon mono oxides, xylene benzene and formaldehyde.

► Non toxic

8. Lady paln:- Botanical Name - ***Rhapis excels***

► It helps in eliminating carbon mono oxide from incomplete combustion of fossil fuel from kitchen.

9. Peace lilies:- Botanical Name – ***Spathiphyllum***

► It is one of the best plants for removing common household toxics.

► Toxic to cats, dogs and children.

10. Rubber plant:- Botanical Name- ***Ficus robusta***

► It controls pollution caused by carbon mono oxide trichloroethylene.

PHYTOREMEDIATION MECHANISM:

- Phytoextraction
- Phytostabilization
- Phyto-transformation
- Phytostimulation
- Phytovolatization
- Rhizofiltration

LIMITATIONS:

There are few limitation regarding use of plants as air purifier:-

- There exists tolerance limit of every pollutant.
- Phytoremediation is a seasonal process (during winter season plants grow slowly).
- Not as effective for site with high pollutant concentration.

- Slower than conventional methods.

CONCLUSION

Air pollution is one of the major problems affecting the environment today. Pollutants can be both primary and secondary. Air pollutants can pollute both the indoor and outdoor environment. Use of indoor plants for detoxification and degradation of air pollutants is one of the cheapest and sustainable methods for control of indoor air pollution. Plants absorb pollutants from indoor air into their leaves with the help of tiny pores called stomata and then translocate them to their root. In the root zone these pollutants are consumed by microbe present in soil. All plants are not tested for their ability to clean indoor air pollution and those who are tested not found equally effective in combating air pollution. Few suggestion for efficient removal of indoor air pollution are listed below:

- Proper ventilation is necessary to reduce the average household pollution.
- Guidelines and standard for measurement of indoor air quality should be followed.
- The pollutants on which not much work is done should be identified and focused and worked upon.
- Switching from wood, dung and charcoal to efficient modern fuels such as kerosene, LPG and biogas would bring out indoor pollution.
- Work should be done on large number of plants combating indoor air pollutants.
- There should be inclusion of indoor air quality information in university and school curriculum.
- Develop transgenic line at a faster pace to enhance the process of phytoremediation.

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