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Implication of Medicinal and Aromatic Plants in Mitigating Air Pollution

Yogendra Kumar

Department of Botany, Government Degree College Nanauta, Saharanpur-247452, U.P
E-mail: ykpanchal4ever@gmail.com

Abstract

Medicinal and aromatic plants are not only valuable for their therapeutic properties but also exhibit significant potential in mitigating environmental pollution. Pollution is a global problem with severe adverse impacts on the environment and human health. A variety of air pollutants releases in the environment due to several natural processes and anthropogenic activities that ultimately imposes serious threats to human health and the environment. It is the need of hour to establish sustainable and reliable approach towards monitoring and controlling of air pollution. In recent time, biomonitoring of air pollution by using plants has emerged as an effective strategy as it is environment friendly, sustainable and cost effective in comparison with traditional physico-chemical methods. Some species of higher plants are very sensitive against some particular air pollutants and exhibit peculiar responses to pollutants by showing specific symptoms. These species can be widely used for the detection and monitoring of presence or absence of air pollutants. The use of air pollution-tolerant plant species for the development of green belt has become highly popular method for remediation of air pollution. This paper aims to present the significant role of plants in biomonitoring of air pollution.

Keywords: Air pollutants, biomonitoring, green belt, human health, sustainable approach

Introduction

Although several modern techniques have been developed with due course of time to mitigate air pollution, but many of these are expansive and sometimes causes secondary pollution. The use of air pollution-tolerant plant species is considered reliable, economical and sustainable approach towards monitoring as well as controlling of air pollution[1-4]. The prime objective of the present paper is to provide better understanding regarding the connection between air pollution and its mitigation by roadside plant species to facilitate the use and maintenanceof green belt area development for reducing the dispersion and concentration of air pollutants.

As far as public health is concerned, the air pollution has become a prominent environmental risk. The reduction in air pollution levels results in reducing the burden of disease at global level. According to the W.H.O, because of indoor and outdoor air pollution about 2 million deaths occurred in the world, mostly in developing countries[5].

Medicinal and aromatic plants have long been recognized for their therapeutic properties and cultural significance. These plants contain bioactive compounds with diverse chemical structures and biological activities, making them valuable resources for traditional medicine, pharmaceuticals, and personal care products[6]. Medicinal and aromatic plants possess unique physiological and biochemical characteristics that enable them to absorb, transform, and degrade pollutants. They act as natural filters, removing harmful substances from the environment and improving air, water, and soil quality. Pollution has severe fatal effects on human health, leading to respiratory disorders, cardiovascular diseases, and other health complications[7]. By reducing pollution levels, medicinal and aromatic plants indirectly contribute to improved public health outcomes, creating cleaner and healthier living environments.

Mechanisms involved in air purification

In recent years, the role of medicinal and aromatic plants in air pollution control has gained attention due to their unique properties and abilities to reduce detrimental effects of air pollutants[8]. These plants can contribute to air purification through various mechanisms, including:

Carbon Sequestration: Medicinal and aromatic plants play a crucial role in the process of carbon sequestration in which atmospheric carbon dioxide is captured and stored during photosynthesis. By absorbing carbon dioxide, these plants contribute to reduce green house gas emissions and mitigating the climate change impacts.

Several medicinal and aromatic plants have been identified for their air pollution control potential[9]. Here are some examples:

Hedera helix (English Ivy): This climbing plant is effective in reducing air borne mold spores and filtering out air borne particles, making it beneficial for individuals with respiratory conditions.

Aloe vera: Known for its medicinal properties, Aloe vera has the ability to absorband neutralize indoor air pollutants, including formaldehyde and benzene.

Spathiphyllum sp. (Peace Lily): Peace lilies have been found to be effective in reducing levels of indoor air pollutants, including benzene, ammonia and acetone.

Dypsis lutescens (Areca Palm): This palm species has been found to effectively remove indoor air pollutants, such as xylene and toluene, and increase indoor air quality.

Chlorophytum comosum (Spider Plant): Spider plant is well known for its ability to remove formaldehyde and xylene from indoor air, making them suitable for improving indoor air quality.

Particulate Matter Filtration: Medicinal and aromatic plants with dense foliage and hairy leaves can effectively capture and filter particulate matter (PM) from the air. The leaves act as natural filters, trapping airborne particles and reducing their concentration in the surrounding environment.

Absorption and Transformation of Gaseous Pollutants: Some medicinal and aromatic plants have the ability to absorb gaseous pollutants, such as volatile organic compounds (VOCs) and NOx, through their leaves and roots. These plants possess specialized enzymes and metabolic pathways that enable them to convert and metabolize these pollutants into less harmful forms.

Traditional Methods of Air Remediation

There are several traditional methods to improve indoor air quality.

HEPA filter: These filters grasp a variety of accumulated dust particles such as lead particles and brominate fire-retardant chemicals. HEPA (High Efficiency Particulate Air) filters give best results, when used with vacuum. They are also known as air purifiers, and are highly beneficial for the people having dust allergy, as they can capture large amount of biological and chemical allergens[10].

Mopping: It is one of the old traditional methods to clean all the dusts particles settled down on the floor surface that is left behind by vacuum cleaner. Due to the presence of water all the dust get stick to mobs fiber and provide the clean surface[10].

Ban on Smoking: As a result of smoking, there is emission of carbon monoxide, particulate matter and certain volatile organic compounds because of tobacco burning. It creates a foul smelling smoke which is harmful not only for the person who is smoking (active smoker) but also for the person who is not smoking (passive smoker) in house, as they inhale the same air. Thus, to avoid smoking in house can help in preventing many carcinogenic diseases[11].

Ventilation: Inside the house, many articles and activities such as nail paint, deodorant spray, cleaner, polishing, cooking etc. can release many VOCs that may results in many health problems. Proper ventilation helps in maintaining the air flow, proper windows, exhaust fans in kitchens and sunlight exposure in homes can be helpful in removing foul odor, germs and indoor polluted air, thus ensuring good health[11].

Salt Lamps: These lamps are made up of Himalayan Pink Salt, and can help in purification of indoor air. These lamps pull toxins from environment and neutralize them resulting in air purification. They works on the principle of hygroscopy and attract water molecules with toxins[12].

Beeswax Candles: Instead of using paraffin candles, the candles made up of bee wax can be a good alternative for purifying the air. They ionize the air to neutralize toxic compounds and other contaminants. Bee wax candles produce the ions which can combine with free floating chemical ions making them heavier and hence fall off to ground[12].

Activated Charcoal or Carbon filters: These filters are also used for air purification because of their adsorptive property. When air passes through these filters, the activated charcoal or carbon adsorbs all the contaminants present in the air and hence, the air gets purified[12].

Many of the methods stated above are in use since long back and they are highly effective. In present time, the pollution level is much higher because of urbanization and industrialization. Therefore, there is a need of some more efficient methods for improving the indoor air quality. These methods must be natural, less expensive, efficient and should require low maintenance.

Due to the limitation of traditional methods, a relatively newer and natural technique, known as bioremediation, has come in existence. This is a technique that uses organisms in order to remove or neutralize pollutants from contaminated air. This process of removal of pollutants from the air can be both in-situ and ex-situ. The detoxification, stabilization and removal of contaminants can be done by using natural, biological, chemical or physical activities of green plants. This is an eco-friendly, low cost, natural and solar energy driven process that is quite effective[13]. Precisely, the use of plant-based systems to lower the concentration or change the availability of pollutants in air, soil or water is commonly referred to as Phytoremediation[14]. A lot of research has been carried out on phytoremediation of soil and water but relatively fewer studies have focused on the ability of plants to take up pollutants from indoor air[13, 14].

A number of plant varieties have been identified that remove various pollutants from the air, including *Pelargonium domesticum*, *Ficus elastica* and *Chlorophytum comosum* that efficiently remove toxic benzene from the air. *C. comosum* also removes TCE[15]**.** Plants species such as *Hedera helix* and *Asparagus densiflorus* remove VOCs[4]. *Sansevieria trifasciata* (snake plant), *C. comsocum* (spider plant) and *Epipremnum aureum* are helpful in removal of ozone[16, 17].

According to various studies on indoor plants growing in soil and microorganism found in their surrounding soil environment, it was reported that bacterial counts were directly dependent on plants ability of removing pollutants. Bacterial isolates like *Alcaligenes*, *Bacillus, Myxococcus* and *Micrococcus* etc. were found in soil in which *Sansevieria trifasciata* commonly known as mother in law's tongue had been growing. Similarly, bacterial species such as *Curtobacterium, Aureobacterium, Pseudomonas, Streptomyces* and *Micrococcus* were found associated with the soil in which *Spathiphyllum sp.* (Peace Lily) were growing luxuriantly.

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