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Determining Formaldehyde Phytoremediation Efficacy of Selected Ornamental Plants

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Abstract

In the recent past, deterioration of indoor air quality has become a serious concern due to the increased energy efficiency and reduced air exchange rate inside urban buildings. Volatile organic compounds (VOCs) are a major category of indoor air pollutants that can lead to adverse health outcomes such as headaches, allergies and asthma in those exposed for prolonged periods. Formaldehyde, the VOC used in the present study is a common contaminant of indoor air which originates from particle board, plywood, paper products, certain adhesives, tobacco smoke and other sources. The use of plants for the mitigation of indoor air pollution is viewed as a cost effective and eco-friendly method with untapped potential. The main objective of the present study was to determine the formaldehyde removal efficacy of selected plant species while investigating the mechanisms used by these plants in the removal process. The selected plant species were *Zamioculcas zamiifolia*, *Hedera helix*, *Dracaena sanderiana* and *Ficus* sp. Plants of the same age were used with three replicates from each species. Phytoremediation potential was assessed by exposing the plants for 24 hours to gaseous formaldehyde ($2.0~\mu L~L^{-1}$) in air tight chambers made of Plexiglass (an inert material for VOCs) with dimensions of 0.9 m height×0.58 m length×0.55 m width. Formaldehyde removal was measured using GC-MS and the result was expressed as removal percentages. Several leaf anatomical characters (cuticle thickness, epidermal thickness and mesophyll layer thickness), stomatal characters (stomatal density, stomatal index, guard cell length and potential conductance index) and physiological characters (stomatal conductance and photosynthetic rate) were measured to study the possible mechanisms involved in the formaldehyde removal process. The data were subjected to ANOVA and Pearson correlation test. According to the results obtained, *Ficus* sp. had the highest formaldehyde removal percentage (92.80%) while *Hedera helix* had the lowest (56.86%). The study further showed that stomatal density and stomatal conductance play a major role in formaldehyde removal by these plants while cuticle and epidermal thickness act as hindrances to this process. This conclusion was further confirmed by Pearson's correlation values in correlation analysis. The current study was carried out for 24 hours of exposure and it would be of interest to explore, the long term behavior of the plants through further studies. Overall, the results justify future studies on a cross-section of diverse plant species for formaldehyde removal efficiency to determine species with superior removal efficiencies for a better phytoremediation process.

Keywords: Phytoremediation, VOCs, Formaldehyde, GC-MS technology

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