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A Study on the effect of Snake Plants on Indoor Air Quality and Human Well-being in a Private Hostel in Aizawl, Mizoram

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Background: This study assessed the impact of snake plants on indoor air quality and human health in a private girls' hostel in Aizawl, Mizoram, for four months. Rooms such as kitchen, non-ventilated, and ventilated were sampled for formaldehyde (HCHO), total volatile organic compounds (TVOC), particulate matter ($PM_{2.5}$ and PM_{10}), temperature, and humidity. **Objective:** To evaluate the effect of snake plants on indoor air quality and residents' well-being in different rooms of the hostel. **Methodology:** Snake plants were added progressively from zero to three per room for every month. Measurements of HCHO, TVOC, $PM_{2.5}$, PM_{10}, temperature, and humidity were done weekly, residents' health, mood, and productivity were assessed using a structured questionnaire. **Aims and Objectives:** The study aimed to determine whether snake plants improve indoor air quality and promote human well-being, while also evaluating their effect on mold growth in different room conditions. **Results:** HCHO concentration was found highest in a non-ventilated room at 0.0675 µg/m³ and lowest in a ventilated room at 0.03 µg/m³. TVOC levels showed a varied from 0.28 mg/m³ in non-ventilated to 0.15 µg/m³ in ventilated rooms. Particulate matter ($PM_{2.5}$) showed a maximum of 60 µg/m³ in the kitchen but declined to 29.5 µg/m³ in ventilated rooms. Resident surveys on health related showed positively influences air quality and a mean mood rating of 3.33, work productivity of 3.0 on a 5-point scale. There was a strong positive correlation between relative humidity and mold growth at all rooms (Pearson's r = 0.872 & 0.914). C**onclusion:** These findings indicate that snake plants are an affordable, low-tech intervention for improving indoor air quality and limiting mold growth, thus promoting residents' health.

Keywords: Snake plants, indoor air quality, mold growth, human well-being, room condition.

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Introduction

Indoor air quality (IAQ) is an important factor which can have an influence on human health, comfort, and their productivity. Poor IAQ which can be characterized by pollutants such as formaldehyde (HCHO), total volatile organic compounds (TVOCs), and particulate matter ($PM_{2.5}$ and PM_{10}), has related to human health effects such as allergies and other chronic health[1 2]. In enclosed spaces like private hostels, where the building structure is initially design for housing is converted into private hostel partitioning many rooms where ventilation may be inadequate, these risks are heightened. Plants have placed as a natural air purifier which is capable of removing indoor pollutants through phytoremediation processes[3]. Among these, snake plants are the most common use for their resilience, low maintenance, and ability to survive in low-light environments common in indoor settings[4]. Snake plants able to absorb carbon dioxide even at night, potentially improving air quality by reducing CO_2 and certain harmful compounds[5]. Previous studies have shown that snake plants can reduce indoor air pollutant concentrations of formaldehyde, benzene, and other volatile organic compounds, thereby contributing to healthier indoor environments[6 7]. However, the extent to which these plants affect particulate matter and humidity regulation, particularly in area like private hostels remain underexplored.

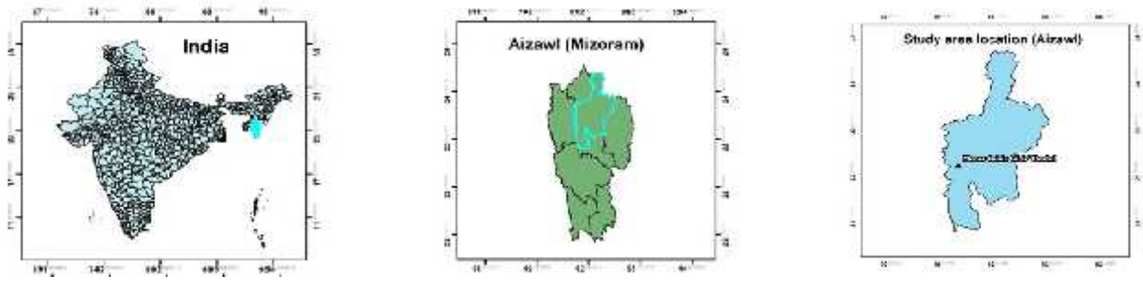
Furthermore, poor IAQ can negatively impact occupants' mood, stress, and productivity[8]. High humidity and poor ventilation can promote mold growth, poses additional health risks, including allergies and asthma[9 10]. Poor indoor air quality, such as PM 2.5, can impact human health in children and adults, such as respiratory diseases, allergies and Sick Building Syndrome (SBS), in those who are in a vulnerable stage[11, 12, 13]. Human health is greatly affected by indoor air quality, leading to respiratory diseases such as asthma and exacerbations[14]. Due to poor indoor air quality, humans can experience health deterioration and even disease transmission[15] and other health issues such as neuropsychiatric disorders, skin diseases, and chronic illnesses[16]. The private hostel is mainly occupied by students and job-hunting people. The air quality cannot be the best when occupying the room being served. This study aims to evaluate the effects of snake plants on IAQ, occupant well-being, humidity, and mold growth in different room conditions within a girls' hostel in Aizawl, Mizoram.

Objective

The objective of this study was to evaluate the effects of snake plants on indoor air quality, humidity, mold growth, and residents' well-being in different rooms of a private girls' hostel in Aizawl, Mizoram.

Materials and Methods

Study area: The study was conducted over a period of four-month, starting from April 2024 to July 2024 at Mom's Cabin Girls Private Hostel in Aizawl, Mizoram which is expressed in Fig. 1. Three separate rooms were selected based on their environmental conditions: a kitchen room which is used for cooking and food storage, a non-ventilated room with three persons accommodating with no windows or direct sunlight and purely relying on artificial lighting, and a ventilated room also accommodated by three persons with two windows available providing natural ventilation and sunlight.



Methods: The experimental period was divided into four consecutive months with a month interval before adding snake plants. During the first interval (first month), no snake plants were present in any room. One snake plant was added in each room during the second month, followed by two snake plants per room during third month, and finally, three snake plants per room in the last month which is the fourth month. Indoor air quality was monitored weekly in each room using an air quality monitoring device and placed at central location. The parameters measured are formaldehyde (HCHO), Total volatile organic compounds (TVOC), particulate matter with diameters less than 2.5 µm and 10 µm (PM2.5 and PM10), ambient temperature (°C), and relative humidity (%). To evaluate the effects of snake plants on the resident's well-being, six participants present in the study room, a questionnaire was assessed in terms of mood, stress, and productivity using a 5-point Likert scale. Mold presence was also assessed through questionnaire, which documented visible mold present on the walls, ceilings, and furniture, as well as related health symptoms among the residents. Mold growth was classified into five categories based on the estimated percentage of surface coverage: no mold (0–20%), minimal (21–40%), moderate (41–60%), high (61–80%), and extreme (81–100%).

Data Analysis: Descriptive statistics (means, medians, and standard deviations) were analyzed for the indoor air quality parameters. To evaluate the effects of snake plants on the pollutant levels, t-tests was conducted by comparing study areas with differing numbers of plants. Trend analysis was conducted to examine the changes in indoor air quality over time in

relation to the number of snake plants. Pearson correlation coefficients were done to assess the relationship between humidity and mold growth. ANOVA and multiple regression analyses were also done to determine the differences and predictive relationships among humidity, mold growth, snake plant quantity, and room ventilation status. Statistical significance was set at $p < 0.05$. All analyses were performed using standard statistical software packages.

Results

Table 1 shows the distributions of indoor air pollutants across the study areas, and its descriptive statistics. The "No Ventilation Area" recorded the highest formaldehyde (HCHO) and TVOC concentrations, whereas the "Ventilation Area" showed the lowest levels, indicating the effectiveness of proper ventilation[17, 18]. $PM_{2.5}$ and PM_{10} levels were highest in the kitchen area, likely due to cooking, and lowest in the ventilated area, reflecting established patterns[21]. Temperature remained consistent throughout the study areas, though ventilated rooms were slightly cooler. Humidity was highest in the "No Ventilation Area," while kitchen humidity varied, possibly due to moisture from cooking[22].

Table-1: Mean ± standard deviation of indoor air pollutants by room type

Parameter	Kitchen area	No ventilation area	Ventilation area
HCHO	0.053 ± 0.014	0.056 ± 0.014	0.051 ± 0.016
TVOC	0.235 ± 0.062	0.242 ± 0.064	0.223 ± 0.063
$PM_{2.5}$ (µg/m³)	50.6 ± 20.6	48.7 ± 16.8	45.4 ± 19.6
PM_{10} (µg/m³)	57.3 ± 23.5	55.8 ± 19.2	52.4 ± 24.5
Temperature (°C)	26.0 ± 0.8	26.2 ± 0.8	26.0 ± 0.5
Humidity (%)	63.1 ± 9.5	64.6 ± 9.1	61.6 ± 12.6

Table 2 shows that increasing the number of snake plants consistently reduced indoor air pollutants such as HCHO and TVOC levels. For instance, in the kitchen area, HCHO dropped from 0.06 ppm (1 plant) to 0.04 ppm (no plants), and TVOC also significantly decreased in non-ventilated areas. $PM_{2.5}$ and PM_{10} levels decreased when three plants were placed, but slightly rebounded without plants, indicating partial mitigation. Temperature remained constant, while humidity reduction in kitchens suggests that plants can moderate indoor moisture, though results vary[26].

Table-2: Effect of snake plant number on indoor air quality across different room types (Mean ± SD)

Room type	Snake plants	HCHO	TVOC	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	Temperature (°C)	Humidity (%)
Kitchen	0	0.046 ± 0.003	0.189 ± 0.009	51.0 ± 26.3	56.8 ± 30.6	25.8 ± 0.8	49.0 ± 3.7
	1	0.062 ± 0.017	0.265 ± 0.072	60.0 ± 21.1	70.0 ± 22.5	26.3 ± 0.8	66.3 ± 8.2
	2	0.057 ± 0.011	0.238 ± 0.047	45.5 ± 14.3	52.8 ± 17.7	26.8 ± 0.5	64.3 ± 1.7
	3	0.048 ± 0.007	0.204 ± 0.029	35.5 ± 20.1	40.8 ± 23.6	26.0 ± 1.0	70.3 ± 4.6
No ventilation	0	0.046 ± 0.004	0.194 ± 0.017	43.3 ± 17.3	49.8 ± 19.4	26.0 ± 1.0	47.5 ± 1.3
	1	0.067 ± 0.014	0.286 ± 0.060	57.8 ± 22.1	65.8 ± 22.0	26.5 ± 0.6	64.0 ± 5.7
	2	0.058 ± 0.010	0.247 ± 0.043	45.3 ± 7.6	51.5 ± 8.6	26.3 ± 0.5	66.0 ± 2.4
	3	0.048 ± 0.009	0.197 ± 0.037	42.5 ± 12.2	49.0 ± 15.3	25.5 ± 0.6	72.0 ± 4.1
Ventilation	0	0.037 ± 0.003	0.152 ± 0.009	29.5 ± 6.9	33.5 ± 9.1	25.8 ± 0.5	40.5 ± 6.2
	1	0.065 ± 0.018	0.272 ± 0.081	58.8 ± 19.8	67.5 ± 23.1	26.0 ± 0.0	63.8 ± 7.7
	2	0.054 ± 0.012	0.226 ± 0.049	46.0 ± 20.1	52.8 ± 23.3	26.0 ± 0.0	62.8 ± 2.6
	3	0.046 ± 0.006	0.194 ± 0.020	35.3 ± 16.7	40.3 ± 19.7	26.0 ± 0.0	69.8 ± 5.5

The combined results of the well-being survey and the Pearson correlation between humidity and mold growth across the three study areas are presented in Table 3. From the questionnaire, the mean mood was 3.33 (moderately positive), stress was 4.00

on a 5-point scale, and mean productivity was ~3.00 (SD = 0.63), suggesting adaptation to indoor conditions with possible underlying cognitive strain.

Table-3: Participant Well-Being Scores and Humidity and Mold Correlation

Participant Group	Mean ± SD			Pearson correlation (Humidity and Mold)
	Mood	Stress	Productivity	
Kitchen Area	3.33 ± 1.51	4.00 ± 1.67	3.00 ± 0.63	0.872
Non-Ventilation Area	3.33 ± 1.51	4.00 ± 1.67	3.00 ± 0.63	0.882
Ventilation Area	3.33 ± 1.51	4.00 ± 1.67	3.00 ± 0.63	0.914

Discussion

The findings indicate that proper ventilation and snake plants can effectively reduce indoor air pollutants and improve IAQ. This finding also aligns with the study conducted by You et al. (2022), who reported a substantial VOC reduction (>30%) through increased in ventilation[19,20], and Aydogan and Montoya[22] found that snake plants absorb HCHO more effectively than some air purifiers. Sokhal and Narayan[23] also reported that snake plants maintain HCHO absorption longer than other indoor plants[24-25]. The study also shows a relationship between indoor air quality, humidity, and mold growth. Strong positive correlations ($r \approx 0.87–0.91$) confirm that elevated humidity fosters mold development, consistent with Environmental Protection Agency (EPA) guidelines recommending indoor relative humidity below 60% to control mold growth[29]. High humidity above 70% can accelerate mold occurrence[30, 31]. Residents' well-being survey data suggest that poor IAQ, particularly $PM_{2.5}$ and VOC exposure, may impair cognitive function, elevate stress, and affect mood and productivity. While mean productivity remained moderate (~3.00), prolonged exposure to poor IAQ could lead to acute effects on cognitive performance and psychological stress[27-28]. Overall, these results indicate that snake plants, combined with proper ventilation, offer an affordable and low-tech intervention to improve indoor air quality, reduce mold growth, and support human well-being in enclosed Hostel environments.

Conclusion

Snake plants are effective, low-maintenance natural air purifiers which is capable of reducing the level indoor air pollutants like HCHO and TVOCs according to room conditions. They also help in regulating indoor humidity and potentially limiting mold growth, which is a common problem in poorly ventilated area. While they do not statistically significant in reducing the particulate matter, snake plants serve as an environmentally friendly and cost-effective especially in resource limited area. Incorporating snake plants in indoor environments, especially in home structure converted into a private hostel with restricted ventilation, could improve the indoor air quality and residents' well-being. However, adequate ventilation still remains the best option and essential. Studies should further explore long-term health outcomes and optimize plant placement for maximum benefit.

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