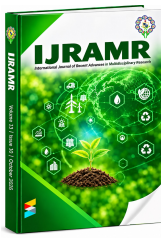
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REVIEW ARTICLE

COMPARATIVE EVALUATION OF INDOOR AIR QUALITY USING COMMON AIR PURIFYING PLANTS

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ABSTRACT

This study evaluates the air purification efficiency of three indoor plant species, Epipremnum aureum, Dypsis lutescens, and Dracaena trifasciata, under controlled residential conditions using low-cost analytical methods. The experiment was conducted over 21 days across five indoor rooms, including a control (no plants), three rooms with individual plant species, and one room with a combined plant system. Key indoor air quality parameters analyzed included particulate matter, carbon dioxide (CO_2), volatile organic compounds (VOCs), formaldehyde, and nitrogen dioxide (NO_2). Measurement techniques included petroleum jelly deposition and gravimetric leaf wash for particulate matter, limewater turbidity for CO_2, potassium permanganate oxidation for VOCs, Schiff reagent for formaldehyde, and the Griess–Saltzman method for NO_2. Results showed significant pollutant reduction in all plant-containing environments compared to the control. The combined plant system demonstrated the highest efficiency, achieving approximately 58–70% reduction in particulate matter and around 70–72% reduction in gaseous pollutants. Among individual species, Dypsis lutescens exhibited superior performance in particulate capture and overall pollutant reduction. The findings indicate that indoor plants can effectively improve air quality through natural filtration and absorption processes, with combined plant systems offering enhanced performance under practical indoor conditions.

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INTRODUCTION

Indoor air quality has become an increasingly important issue in environmental health research. Modern lifestyles involve spending a substantial portion of time inside buildings such as homes, offices, and educational institutions. As a result, the quality of indoor air plays a critical role in determining overall human health and comfort (7). Unlike outdoor environments where pollutants disperse more easily, enclosed spaces tend to accumulate contaminants over time. Indoor air pollution can originate from a variety of sources including building materials, furniture adhesives, cleaning agents, cooking emissions, and combustion activities (10). Many of these sources release gases and fine particles that remain suspended in indoor air for extended periods. Several major pollutants are commonly detected in indoor environments. These include gases such as Carbon Dioxide, Nitrogen Dioxide, and organic vapors belonging to the group known as Volatile Organic Compounds. Additionally, fine particulate matter consisting of dust, soot, and microscopic particles contributes significantly to indoor pollution (7). Exposure to these pollutants may produce several negative health effects. Elevated carbon dioxide levels can cause headaches and fatigue, while nitrogen dioxide exposure is associated with respiratory irritation and lung inflammation. Volatile organic compounds such as Formaldehyde may trigger allergic reactions, eye irritation, and long-term health risks when present in high concentrations (6,11). Particulate matter can penetrate the respiratory tract and worsen asthma or other respiratory disorders. Traditional approaches to controlling indoor air pollution include mechanical ventilation systems, air filtration units, and chemical purification technologies. However, these solutions may require expensive equipment and continuous energy consumption. In recent decades, researchers have explored the potential of biological systems, particularly plants, as natural air purification agents (9,8). Plants possess several mechanisms that allow them to interact with airborne pollutants. Leaves can capture particulate matter through surface deposition. Stomata may absorb certain gaseous pollutants during the process of gas exchange. Furthermore, microorganisms present in the soil surrounding plant roots can metabolize and break down various organic contaminants (4,5). This combined interaction forms a natural biofiltration system. One of the earliest investigations into plant-based air purification was conducted in the late twentieth century, commonly referred to as the NASA Clean Air Study. This research demonstrated that several common houseplants could remove pollutants such as benzene, formaldehyde, and trichloroethylene from sealed chambers (2).

Although later studies suggested that large numbers of plants may be required for substantial air purification in real buildings (1,8), the concept of plant-assisted air improvement remains scientifically relevant. Among the numerous plant species studied for air purification potential (3), certain indoor plants are frequently recommended because of their adaptability to indoor conditions and large leaf surface areas. The money plant is known for its rapid growth and climbing habit, allowing extensive leaf exposure. The areca palm produces multiple fronds that create a large surface area capable of capturing airborne particles. The snake plant is recognized for its tolerance to low light and minimal water requirements. Despite widespread public interest in plant-based air purification, many studies are conducted under laboratory conditions using specialized equipment (1,5). There remains a need for experiments that demonstrate air purification effects under realistic home environments using accessible methodologies. Such studies are particularly useful for educational purposes and for communities where advanced air monitoring devices are unavailable. The present study was designed to evaluate the air purification capabilities of three common indoor plants under controlled residential conditions. Instead of relying on expensive instrumentation, the experiment employed simple analytical methods that can be performed with basic laboratory materials. By comparing pollutant indicators in rooms with various plant arrangements, the study is focused to determine whether indoor plants produce measurable improvements in air quality.

Objectives of the Study: The primary objective of this research was to evaluate the ability of selected indoor plants to improve indoor air quality through reduction of airborne pollutants.

The specific objectives included:

- To compare particulate matter deposition in rooms containing different indoor plants.
- To evaluate carbon dioxide level variations using limewater turbidity analysis.
- To detect the presence of volatile organic compounds through chemical oxidation reactions.
- To analyze formaldehyde presence using colorimetric reagent testing.
- To measure nitrogen dioxide concentrations using passive chemical detection methods.
- To observe plant physiological responses such as growth rate, chlorosis and necrosis during pollutant exposure.
- To compare the air purification efficiency of individual plant species with a combination of multiple plants.

Hypothesis: The experiment was based on the hypothesis that indoor plants contribute to measurable improvements in indoor air quality by reducing pollutant indicators such as particulate matter, carbon dioxide, and volatile organic compounds (8). It was further hypothesized that rooms containing a combination of plant species would demonstrate greater pollutant reduction compared to rooms containing a single plant type.

MATERIALS AND METHODS

The experimental study was conducted in a residential indoor environment consisting of five separate rooms with comparable ventilation, lighting conditions, and spatial dimensions. Each room was designated for a specific plant arrangement in order to compare air quality parameters under similar environmental conditions. The plant species selected for the experiment were commonly available houseplants known for their adaptability to indoor environments. The selected species included the money plant, areca palm, and snake plant. Before beginning the experiment, all plants were acclimatized to their respective rooms for a period of twenty-four hours. During this adjustment period, the leaves were gently cleaned using distilled water to remove any previously accumulated dust. Soil moisture levels were also checked to ensure uniform watering conditions across all plants. Five experimental setups were established. One room served as the control environment without any plants. The remaining four rooms contained either a single plant species or a combination of all three plants. The experimental duration lasted twenty-one days, with observations recorded at weekly intervals.

Table 1: Five experimental rooms were designated as follows

Rooms	Setup Description
Control Room	No plants present
Room 2	Single money plant
Room 3	Single areca palm
Room 4	Single snake plant
Room 5	Combination

This arrangement allowed direct comparison between plant-containing rooms and the control environment.

Plant Selection and Preparation: Three commonly available indoor plant species were selected for the experiment because of their popularity in homes and their reported potential for improving indoor air quality (2,3).

The species included:

- Epipremnum aureum (Money Plant)
- Dypsis lutescens (Areca Palm)
- Dracaena trifasciata (Snake Plant)

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Image 1: Money Plant	**Image 2: Areca Palm**	**Image 3: Snake Plant**

Each plant was selected with the following criteria in mind:

- Healthy appearance without visible disease.
- Leaves of moderate and comparable size.
- Stable root structure within the potting soil.
- Similar growth stage to reduce biological variation.
- Before the start of the experiment, the plants were subjected to a preparation procedure to standardize their conditions.

Preparation Steps

- All plant leaves were gently cleaned using distilled water to remove any previously accumulated dust.
- Soil moisture levels were checked to ensure adequate hydration.
- Plant pots were inspected to confirm proper drainage.
- The plants were placed in their respective rooms for a 24-hour acclimatization period.
- This adjustment period allowed the plants to adapt to the new environment before observations began.

Experimental Duration and Observation Schedule

The experiment lasted 21 days. Major observations were recorded on the following days:

- Day 7
- Day 14
- Day 21

Some environmental tests required 24-hour exposure periods, meaning that reagent containers or sampling surfaces were placed in the rooms one day before observation. Environmental Parameters Analyzed. Several indoor air quality indicators were analyzed during the experiment. These included particulate matter, gaseous pollutants, volatile compounds, and plant physiological responses.

The pollutants evaluated in this study included:

- Particulate Matter
- Carbon Dioxide
- Volatile Organic Compounds
- Formaldehyde
- Nitrogen Dioxide
- Particulate Matter Analysis

Airborne particulate matter was evaluated using two complementary techniques.

Procedures

Petroleum Jelly Deposition Method: This technique was used to observe dust deposition from the air.

- Clean white sheets were coated with a thin layer of petroleum jelly.
- The sheets were placed horizontally in each room at a height of approximately one meter.

- Sheets remained exposed for a week.
- After exposure, visible dust accumulation was examined and recorded.
- The petroleum jelly captured suspended dust particles settling from the air.

Gravimetric Leaf Wash Technique: The gravimetric leaf wash method was used to determine the amount of dust accumulated on plant leaves.

- Leaves of approximately similar surface area were selected from each plant. Each leaf was washed with 50 mL of distilled water.
- The washing solution was filtered using pre-weighed filter paper.
- The filter paper was dried for 24 hours.
- Final weight was recorded using a digital weighing scale.

Dust mass was calculated as

Dust Mass = Final Filter Weight − Initial Filter Weight
This method provided quantitative measurement of particulate accumulation.

Carbon Dioxide Detection: Carbon dioxide levels were assessed using the limewater turbidity method. This method uses Calcium Hydroxide, which reacts with Carbon Dioxide to produce calcium carbonate.

- Five beakers containing limewater were prepared.
- One beaker was placed in each experimental room.
- The solutions were left exposed for 24 hours.
- The turbidity level of each solution was observed.
- Higher turbidity indicated higher carbon dioxide concentration.

VOC Detection: Volatile organic compounds were evaluated using a colorimetric oxidation method (1,5). The oxidizing agent used was Potassium Permanganate. When exposed to reducing organic vapors, the purple color of potassium permanganate fades or turns brown.

- Dilute potassium permanganate solution was placed in small containers.
- Containers were exposed to air in each room.
- After 24 hours, color intensity changes were observed.
- Greater discoloration indicated higher VOC presence.

Formaldehyde Detection: Formaldehyde vapors were analyzed using the Schiff reagent test (6,11). Schiff reagent reacts with aldehydes such as Formaldehyde to produce a magenta or pink coloration.

- Schiff reagent was placed in small glass containers.
- Containers were kept in each room for 24 hours.
- Color intensity was observed and recorded.

Nitrogen Dioxide Detection: Nitrogen dioxide detection was performed using the Griess–Saltzman passive method. This method produces a colored compound when exposed to Nitrogen Dioxide.

- Reagent-treated filter papers were prepared.
- Papers were exposed in each room.
- After exposure, color change was evaluated.

Plant Physiological Observations: Plant health was monitored weekly in order to determine whether pollutant exposure produced visible stress.

The parameters recorded included

- Leaf Chlorosis: Chlorosis refers to yellowing of leaves caused by reduction in chlorophyll.

- Leaf Necrosis: Necrosis refers to dead tissue appearing as brown or black spots.

- Growth Rate: Plant growth was measured through:
- Increase in plant height
- New leaf emergence

These observations helped determine whether indoor air conditions influenced plant health. Data Analysis of all observations collected during the experiment were organized into tables for comparison between rooms. For several parameters, average values were calculated across the three observation periods. Percentage reduction in pollutant indicators was determined by comparing plant rooms with the control room.

The formula used was:

Reduction (%) =(Control Value − Plant Value) / Control Value × 100

Observations: The observations obtained from the experiment indicated clear differences between the control room and rooms containing indoor plants. The findings from each experimental parameter are presented below.

Particulate Matter Deposition: Dust accumulation was measured through the petroleum jelly deposition technique and the gravimetric leaf wash method.

Petroleum Jelly Sheet Observation

Table 1. Petroleum Jelly Sheet Method

Room / Setup	Control	Money Plant	Areca Palm	Snake Plant	Combined Plants
Day 7 Initial (g)	5	5	5	5	5
Day 7 Final (g)	5.036	5.026	5.021	5.025	5.015
Day 7 Dust (g)	0.036	0.026	0.021	0.025	0.015
Day 14 Initial (g)	5	5	5	5	5
Day 14 Final (g)	5.038	5.027	5.022	5.026	5.016
Day 14 Dust (g)	0.038	0.027	0.022	0.026	0.016
Day 21 Initial (g)	5	5	5	5	5
Day 21 Final (g)	5.036	5.026	5.02	5.025	5.015
Day 21 Dust (g)	0.036	0.026	0.02	0.025	0.015

The petroleum jelly sheet placed in the control room showed the highest density of dust particles after exposure. In contrast, sheets placed in rooms containing plants showed visibly lower dust deposition.

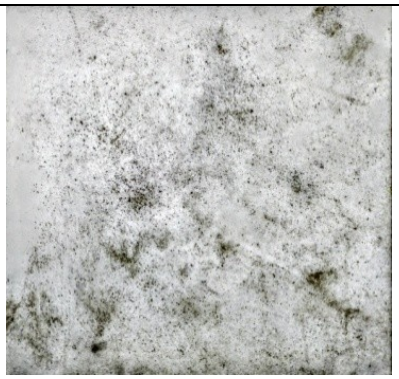

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Image: 4.1


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Image: 4.2


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Image: 4.3

(These images shows different extent of dust deposition on petroleum jelly sheets)

Table 2. Showing dust deposition , % dust accumulation relative to control , % reduction & performance rank.

Setup	Control	Money Plant	Areca Palm	Snake Plant	Combined Plants
Avg Dust (g)	0.0367	0.0263	0.021	0.0253	0.0153
% Dust Accumulation	100%	71.70%	57.20%	69.00%	41.70%
% Reduction	0%	28.30%	42.80%	31.00%	58.30%
Performance Rank	5	3	2	4	1

Among the individual plant species, the room containing Dypsis lutescens(Areca Palm) demonstrated the lowest particulate accumulation. The room containing the combined plant system exhibited the lowest overall dust deposition.
These observations suggest that plant leaves act as natural filters that capture airborne particles.

Gravimetric Leaf Wash Analysis: The gravimetric leaf wash method provided quantitative data on dust accumulation. Average dust mass collected from washed leaves showed the following pattern:

Table 3: Showing amount of dust collected on leaves.

Week	Room / Plant	Initial Weight (gm)	Final Weight (gm)	Dust Collected (gm)
Week 1	Control Room	1.12	1.15	0.03
	Money Plant	1.11	1.14	0.03
	Areca Palm	1.11	1.14	0.02
	Snake Plant	1.11	1.14	0.02
	Combined	1.12	1.13	0.01
Week 2	Control Room	1.12	1.15	0.03
	Money Plant	1.11	1.14	0.03
	Areca Palm	1.12	1.14	0.02
	Snake Plant	1.11	1.14	0.03
	Combined	1.12	1.13	0.01
Week 3	Control Room	1.12	1.16	0.04
	Money Plant	1.12	1.14	0.02
	Areca Palm	1.12	1.14	0.02
	Snake Plant	1.12	1.14	0.02
	Combined	1.12	1.13	0.01

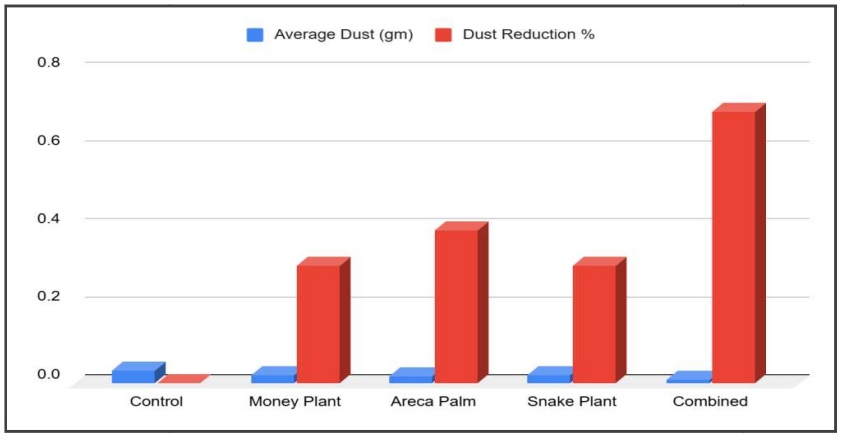

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Image: 5 collecting dust particles by filtration

The data indicates that the combined plant arrangement captured the highest amount of airborne dust particles.

Table 4: Percentage dust reduction relative to the control room was calculated as follows:

Room / Plant	Week 1 (gm)	Week 2 (gm)	Week 3 (gm)	Average Dust (gm)	Dust Reduction %	Interpretation
Control	0.03	0.03	0.04	0.033	0.00%	Highest Accumulation
Money Plant	0.02	0.03	0.02	0.023	30.30%	Moderate dust trapped
Areca Palm	0.02	0.02	0.02	0.02	39.40%	Good dust capturing
Snake Plant	0.02	0.03	0.02	0.023	30.30%	Moderate dust trapped
Combined	0.01	0.01	0.01	0.01	69.70%	Highest Dust Reduction



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Image 6: Graph showing average dust amount & dust reduction %

These findings confirm that plant leaves contribute significantly to particulate matter removal .

Carbon Dioxide Analysis: Carbon dioxide levels were evaluated using the limewater turbidity method. This test involved the reaction of Calcium Hydroxide with Carbon Dioxide, forming calcium carbonate precipitate that produces turbidity.

(Experimental observations were recorded twice a week)

Table 5. Table showing turbidity score for CO2 analysis throughout the experiment.

Week	Observation no.	Day	Plants / Control	Turbidity Score	Precipitate Remarks	Interpretation
Week 1	1st	3	Control	4	Thick white suspension	Highest CO2
			Money Plant	3	Moderate cloudiness	Moderate CO2 reduction
			Areca Palm	2	Light milky	Good CO2 reduction
			Snake Plant	3	Moderate milky	Moderate CO2 absorption
			Combined	2	Light milky appearance	Good CO2 reduction
	2nd	7	Control	4.5	Heavy milky appearance	Highest CO2
			Money Plant	3	Moderate cloudiness	Moderate Reduction
			Areca Palm	2	Light milky	Strong reduction
			Snake Plant	2.5	Moderate milky	Moderate Reduction
			Combined	1.5	Slightly milky	Good CO2 Reduction
Week 2	3rd	10	Control	4.5	Very thick fluid milky precipitate	Highest CO2 level
			Money Plant	3	Moderate cloudiness	Moderate Reduction
			Areca Palm	2	Light milky	Strong Reduction
			Snake Plant	2.5	Moderate milky	Moderate CO2 removal
			Combined	1.5	Slightly milky	Strong CO2 Removal
	4th	14	Control	5	Very thick milky precipitate	Maximum CO2
			Money Plant	3.5	Heavy milky appearance	Moderate Reduction
			Areca Palm	2	Light milky	Good CO2 absorption
			Snake Plant	2.5	Moderate milky	Moderate absorption
			Combined	1	Very light milky	Highest absorption
Week 3	5th	17	Control	5	Very thick fluid precipitate	Maximum CO2 level
			Money Plant	3.5	Moderate milky appearance	Moderate Reduction
			Areca Palm	2	Light milky appearance	Good CO2 Reduction
			Snake Plant	2.5	Light milky appearance	Moderate absorption
			Combined	1	Very light milky solution	Highest reduction
	6th (Final)	21	Control	5	Dense white fluid precipitate	Highest CO2 level
			Money Plant	3.5	Moderately milky	Moderate Reduction
			Areca Palm	2	Light milky solution	Strong absorption seen
			Snake Plant	2.5	Moderately light solution	Moderate absorption
			Combined	0.5	Slightly clear milky solution	Maximum CO2 removed


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Image 7: Showing limewater turbidity of the CaOH2 solution.

Observation results showed that limewater samples placed in the control room developed stronger turbidity compared to those in plant rooms.

Average turbidity scores were recorded as follows:

Table 6: Showing Overall CO2 Reduction %

Plants / Control	Avg. Score	CO2 Reduction Ability	Reduction %
Control	4.7	Zero (None)	0.00%
Money Plant	3.2	Moderately Low	31.90%
Areca Palm	2	High	57.40%
Snake Plant	2.5	Moderate Reduction	46.80%
Combined	1.3	Highest CO2 Reduction	72.30%

These results indicate that plants contribute to lowering indoor carbon dioxide concentration through photosynthesis.

Volatile Organic Compounds Detection: VOC presence was analyzed using the oxidation properties of Potassium Permanganate, which reacts with Volatile Organic Compounds (1,5).

Table 7: Scoring System (based on color of solution)

Score	Colour	Interpretation
0	Dark Purple (No Change)	Very low VOC present
1	Light Purple	Low extent of VOC
2	Faint Purple	Moderate amount of VOC
3	Light Brown	High amount of VOC
4	Brown / Colourless	Highest extent of VOC


图片

Image 8. Showing different colours of solutions after oxidation of KMnO4.

Table 8: Showing 3 weeks observations for VOCs detection

Rooms / Plants	Week 1 Score	Week 2 Score	Week 3 Score
Control Room	4	4	3
Money Plant	3	2	2
Areca Palm	2	2	1
Snake Plant	3	2	2
Combined	1	1	1

Discoloration intensity of the reagent solution served as a qualitative indicator of VOC concentration. Average color reduction scores were recorded as:

Table 9. VOC Reduction Percentage

Rooms / Plants	Avg. VOC Score	VOC Reduction %
Control Room	3.67	0%
Money Plant	2.33	36.50%
Areca Palm	1.67	54.50%
Snake Plant	2.33	36.50%
Combined	1	72.80%

These results suggest that plant-containing rooms experienced lower levels of volatile organic compounds compared to the control environment.

Formaldehyde Detection: Formaldehyde vapors were analyzed using the Schiff reagent test (6,11).The reagent reacts with Formaldehyde, producing a pink or magenta color.

Table 10. Scoring System (Based on Colour of Solution)

Score	Colour	Interpretation
0	Colorless	No formaldehyde detected
1	Very light Pink	Very low formaldehyde
2	Light Pink	Low extent
3	Pink	Moderate amt.
4	Dark Pink/Purple	High extent of formaldehyde

Table 11: Showing 3 weeks observations for Formaldehyde detection

Rooms / Plants	Week 1 Score	Week 2 Score	Week 3 Score
Control Room	4	3	3
Money Plant	3	2	2
Areca Palm	2	2	1
Snake Plant	3	2	2
Combined	1	1	1



Image 9: Showing different colour solutions for different extent of Formaldehyde

Table 12. Average Score and Percentage Reduction

Rooms / Plants	Avg. Formaldehyde Score	Reduction %
Control	3.33	0%
Money Plant	2.33	30%
Areca Palm	1.67	49.80%
Snake Plant	2.33	30%
Combined Plants	1	69.80%

Observation results indicated that the strongest color formation occurred in the control room. Plant rooms exhibited weaker color intensity, suggesting reduced formaldehyde presence (6,11). Among individual plant species, areca palm showed slightly greater reduction.

Nitrogen Dioxide Detection: Nitrogen dioxide levels were measured using the Griess–Saltzman passive detection technique. This method produces a colored compound when exposed to Nitrogen Dioxide. NO_2 Detection (using the Griess-Saltzman detection method)

Table 13. Scoring system (based on color)

Score	Coloration	Interpretation
0	Colourless / White	No detectable NO_2
1	Very light pink	Very low NO_2 level
2	Light pink	Low NO_2 level
3	Pink	Moderate NO_2 level
4	Dark pink / Reddish	High NO_2 level

Table 14: Showing 3 weeks observations for NO2 detection

Plant / Control	Week 1 Color	Score	Week 2 Color	Score	Week 3 Color	Score
Control	Dark Pink	4	Pink	3	Pink	3
Money Plant	Pink	3	Light Pink	2	Light Pink	2
Areca Palm	Light Pink	2	Light Pink	2	Very Light Pink	1
Snake Plant	Pink	3	Light Pink	2	Light Pink	2
Combined	Very faint pink	1	Very light pink	1	Very light pink	1

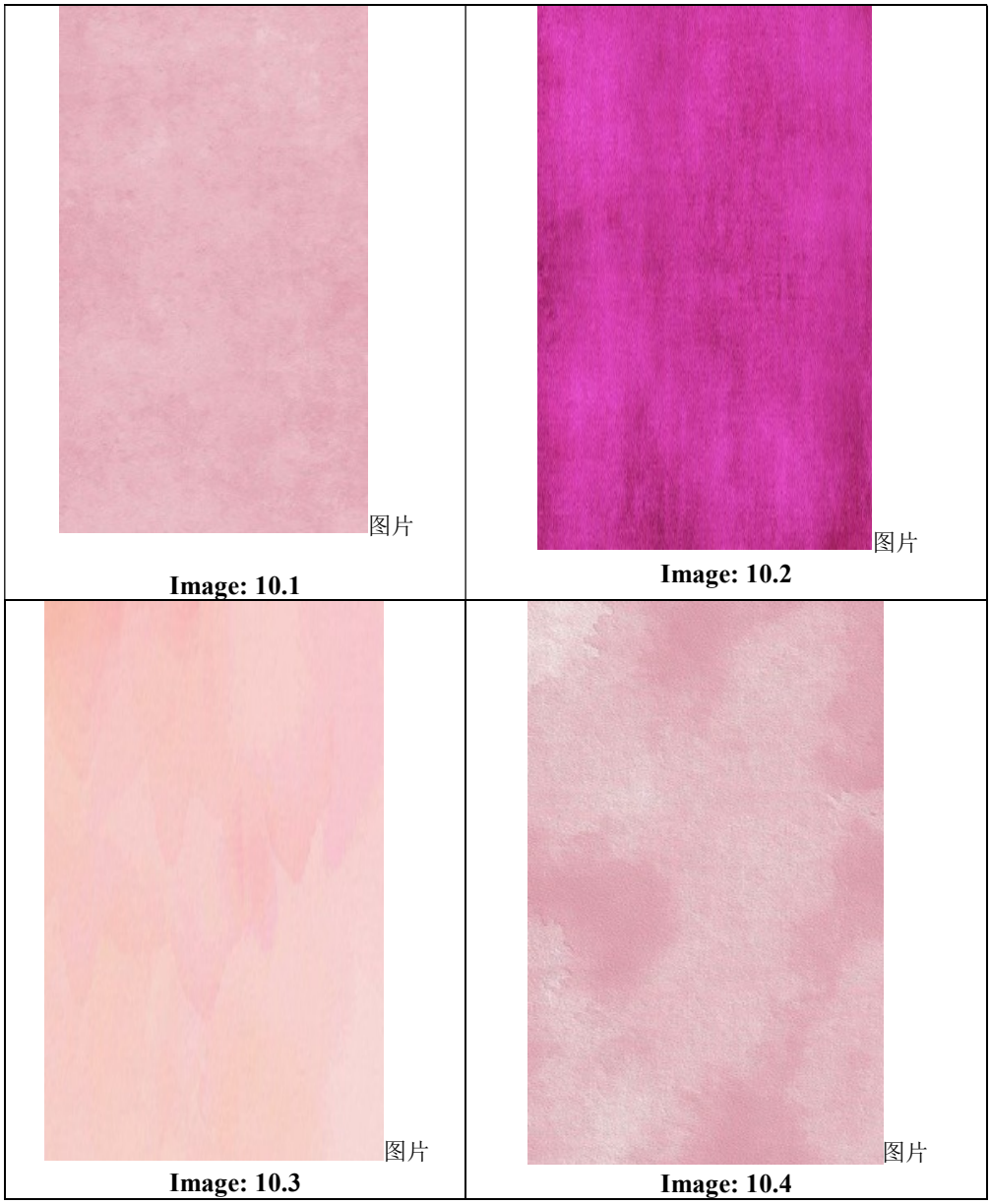


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Image: 10.3 **Image: 10.4**

(Image showing NO_2 Detection on filter paper using the Griess-Saltzman detection method)

Color intensity analysis revealed that the control room exhibited stronger coloration compared to plant rooms.

Table 14. Final Results & Interpretation

Plant / Control	Average Score	NO_2 Reduction %	Interpretation
Control	3.33	0%	Highest Pollution
Money Plant	2.33	30%	Moderate NO_2 removal
Areca Palm	1.67	49.80%	Strong NO_2 absorption
Snake Plant	2.33	30%	Moderate NO_2 removal
Combined	1	69.90%	Highest

The combined plant system again demonstrated the lowest observed nitrogen dioxide indicator levels.

Plant Physiological Observations: Plant health parameters were monitored to determine whether exposure to indoor pollutants affected plant growth or caused visible stress (8).

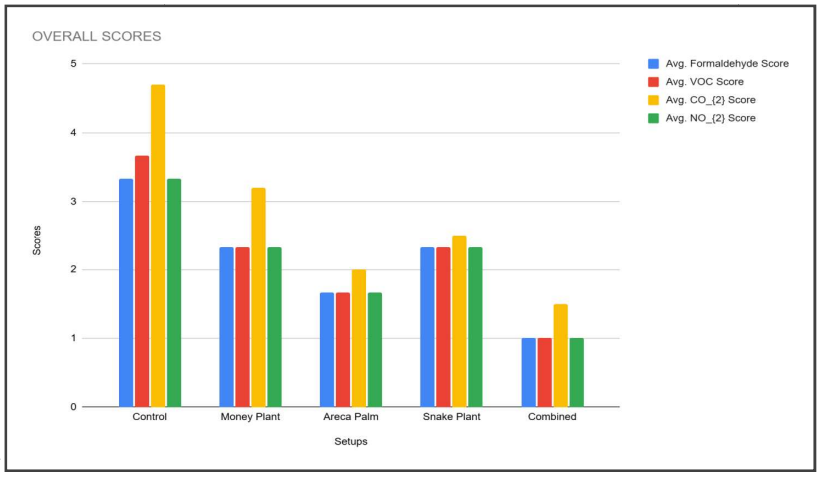
Table 15. Showing Average Growth Rate

Plants	Initial avg. Height(cm)	Final avg. Height(cm)	Growth (cm)	Visible new leaf
Money Plant	38	42	4	seen
Areca Palm	55	59	4	seen
Snake Plant	32	34	2	seen

Table 16. Showing Average Chlorosis and Necrosis score

Plants	Avg. Chlorosis Score	Avg. Necrosis Score	Interpretation
Money Plant	0	0	No stress seen
Areca Palm	0	0	Healthy response
Snake Plant	0	0	No visible damage

No significant symptoms of leaf chlorosis or necrosis were observed during the 21-day experimental period. All plants maintained healthy green leaves throughout the study.



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Image 11. Graph showing overall scores of semi-quantitative methods

DISCUSSION

- The findings of this study support the hypothesis that indoor plants contribute to improving indoor air quality through several natural processes (8).
- One of the most evident effects observed during the experiment was the reduction in airborne particulate matter. Plant leaves function as natural collectors of dust particles due to their surface texture and electrostatic interactions (8). The results obtained from the gravimetric leaf wash technique confirmed that leaves captured measurable quantities of dust particles from indoor air.
- The areca palm demonstrated particularly strong particulate capture ability. This may be attributed to the plant's multiple feathery fronds, which provide a large surface area capable of intercepting airborne particles.
- Carbon dioxide analysis also demonstrated lower turbidity levels in plant-containing rooms. Plants absorb carbon dioxide during photosynthesis and release oxygen as a byproduct. This natural process contributes to improved air quality in enclosed spaces (8).
- The detection methods for volatile organic compounds and formaldehyde also showed reduced pollutant indicators in rooms containing plants. Plants may absorb certain gaseous pollutants through stomatal uptake or through microbial degradation in the rhizosphere (4,5,6,11). Microorganisms present in the soil can metabolize organic compounds and convert them into less harmful substances (4,5).
- Nitrogen dioxide analysis also suggested lower concentrations in plant rooms. Although plants are not considered primary sinks for nitrogen dioxide, certain studies indicate that leaf surfaces may absorb small quantities of gaseous pollutants.
- The room containing the combined plant system consistently produced the best results across multiple parameters. This observation suggests that different plant species may complement each other in pollutant removal due to variations in leaf structure, metabolic activity, and surface area (3,8).
- These results are consistent with earlier studies such as the NASA Clean Air Study (2), which demonstrated the ability of common houseplants to remove several airborne pollutants in controlled environments (2). Later research has shown significantVOC reduction by the potted plants (1,4,5).

RESULTS AND CONCLUSION

- The experimental findings demonstrate that indoor plants significantly improve air quality under controlled residential conditions (8). Across all measured parameters, rooms containing plants consistently showed lower pollutant levels compared to the control environment.
- Particulate matter analysis revealed substantial dust reduction in plant-containing rooms, with the combined plant system achieving the highest reduction (~58–70%). Among individual species, Dypsis lutescens (areca palm) exhibited superior particulate capture efficiency, likely due to its larger leaf surface area. Carbon dioxide levels, assessed through turbidity

analysis, showed a maximum reduction of approximately 72% in the combined setup, indicating effective CO_2 absorption through photosynthesis.

- Similarly, gaseous pollutant analysis demonstrated notable reductions in volatile organic compounds (up to ~72.8%) (1,5), formaldehyde (~69.8%) (6,11), and nitrogen dioxide (~69.9%) in plant-containing environments. The areca palm showed comparatively better performance among individual species, while the combination of all three plants consistently produced the most effective results across all parameters. These reductions can be attributed to mechanisms such as stomatal uptake, adsorption on leaf surfaces, and microbial degradation in the rhizosphere (4,5,8).
- Plant physiological observations indicated no visible stress, with normal growth and absence of chlorosis or necrosis throughout the experimental period, confirming plant adaptability under indoor conditions.
- Overall, the study concludes that indoor plants function as effective, low-cost natural air purifiers capable of reducing multiple indoor pollutants (8,9). The combined use of different plant species enhances overall efficiency compared to individual plants (3). While not a complete substitute for advanced purification systems, indoor plants serve as a practical and sustainable supplementary solution for improving indoor air quality in residential environments (8).

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The author's declare that there is no conflict of interest regarding the publication of this manuscript.

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