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Original Article

Mini Mobile Filtration with Activated Carbon Adsorbent and Powder of Bidara Leaf (Ziziphus mauritiana) Leaf as Room Air Purifier

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ABSTRACT

Forest fires have been a major threat for decades. Forest fire smoke can trigger high levels of highly toxic carbon-containing particles that are the source of carbon monoxide (CO), nitrogen monoxide (NOx), sulfur dioxide (SO_2), and $PM_{2.5}$. Exposure to COx, especially CO and SOx, can be detrimental to human health. To reduce exposure to toxins in smoke, researchers want to make a mini-mobile filtration system of activated carbon and bidara leaf powder. This study is quasi-experimental, where both groups were measured to determine the initial condition. The experimental group was treated, and the comparison group was not. After the completion of treatment, both groups were measured as a posttest to determine the final condition. The result is there was a decrease in COx, SOx, and particulate matter values by 57%, 51%, and 37%. The conclusion is mini mobile filtration with a mixture of activated carbon and bidara leaf powder can reduce COx, SOx, and particulate matter values.

Keywords: Activated Carbon, Toxic Gas, Ziziphus Mauritiana

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INTRODUCTION

Air pollution is a major environmental problem that negatively impacts the health and well-being of people. Especially in urban areas, where people spend most of their time indoors, the issue of polluted indoor air is becoming more and more of a concern[1–3]. The critical effects of pollution on human health give rise to an urgent need to reduce indoor pollutant concentrations by implementing effective measures[4]. Indoor air purification is the most commonly adopted intervention strategy to reduce exposure to indoor $PM_{2.5}$, which commonly uses high-efficiency particulate air (HEPA), which is generally owned by the upper middle class[4,5]. Apart from using ions, there is also the use of photocatalysts for air purification, which can be used effectively in rooms without people in them or the source of the pollution itself [6].

Using air purifiers is an efficient method for improving the air quality inside a building. The innovative Mini Mobile Filtration with Activated Carbon Adsorbent and Powder of Bidara Leaf (Ziziphus Mauritiana) Leaf Powder is an air purifier that removes pollutants from the air by utilizing activated carbon adsorbent and bidara leaf powder. The bidara leaf powder comes from the Ziziphus

Mauritiana plant.

The activated carbon adsorbent is a highly porous material that can effectively remove pollutants from the air. It accomplishes this by attracting airborne contaminants to its surface, which are then extracted from the surrounding atmosphere. Bidara leaf powder is an all-natural substance that has been used to treat various medical conditions for centuries. Because it contains compounds with antimicrobial and anti-inflammatory properties, it is an excellent material for use in air purification.

Activated carbon adsorbent and bidara leaf powder have both been the subject of investigation in a number of studies regarding their potential to clean the air. For instance, Zhang et al.[7] researched the effectiveness of activated carbon adsorbent in removing volatile organic compounds (VOCs) from the atmosphere. The researchers concluded that an adsorbent made of activated carbon successfully removed volatile organic compounds from the air. In a separate piece of research, Kurniawan et al.[8] investigated the use of bidara leaf powder to sterilise the air and remove bacteria. The researchers discovered that the powdered form of the bidara leaf was successful in preventing the growth of bacteria in the air.

These ideas are used in air filtration by a Mini Mobile Filtration device with activated carbon adsorbent and Bidara Leaf (Ziziphus Mauritiana) Leaf Powder. This device is designed to eliminate pollutants from the air. This system is able to effectively remove contaminants from the air, including volatile organic compounds (VOCs) and bacteria, thanks to the utilization of activated carbon adsorbent and bidara leaf powder. A portable air purifier that can be used in a variety of settings, such as homes, offices, and hospitals, is known as mini mobile filtration with activated carbon adsorbent and powder of Bidara Leaf (Ziziphus Mauritiana) leaf powder. Because of the system's small size and intuitive operation, it is an excellent choice for addressing the issue of polluted indoor air.

METHOD

This quasi-experimental research is intended to determine whether or not there is an effect of "treatment" carried out on the investigated subject. The approach used in this experiment is a Pretest-posttest control group design with one kind of treatment. In this model before starting treatment both groups are measured to determine the initial condition (01). Furthermore, the experimental group was given treatment (X) and the comparison group was not given treatment. After completion of the treatment both groups were measured as a posttest to determine the final condition (02) with a variation of 3 time variations of 30, 60 and 90 minutes at medium speed.

Design for mobile mini filtration device. Mini mobile filtration equipment is made with the working principle of filtering air or smoke (COx, SOx, and air particles) with activated carbon mixed with bidara leaf powder in the form of 1 cm diameter briquettes having a composition of activated carbon. Extra bidara leaves as an adsorbent 3:1. The design of this tool weighs 7kg with a length of 80cm, width of 40cm and height of 40cm using acrylic glass and aluminium with three chambers. The adsorbent container has a volume of 30cm x 40cm x 40cm with a fan and adsorbent distance of 20cm, as shown in Figure 1.

Top view **Right view**

Figure 1. Design of the mobile mini filtration device

On the right side, there is an air outlet after going through air filtration with activated carbon adsorbent and bidara leaf powder, complete with an air flow speed button (medium 1500 rpm). On the left side is the air inlet into the air filtration room with activated carbon adsorbent and bidara leaf powder, equipped with a medium air flow speed setting button (1500 rpm). On the inside, there is a middle room or a place to put activated carbon adsorbents and bidara leaf powder, which is an air filter from the outside or inlet and then issued through the outlet.

Data analysis in this study used descriptive analysis with a percentage of

average and effectiveness.

RESULTS

Laboratory test results of COx, SOx and particulate air levels before going through the filter can be seen in Table 1.

Table 1. Average air COx, SOx and particulate before using mini mobile filtration with activated carbon adsorbent and bidara leaf powder.

Variable	Air content	*Threshold value
COx	358 ppm	250 ppm
SOx	433 µgram/m^3	365 µgram/m^3
Particulate	435 µgram/m^3	230 µgram/m^3

Table 1 shows that the overall air levels of COx, SOx and particulate are above the threshold value. The average effectiveness of reducing COx, SOx and particulate air levels after going through mini mobile filtration with activated carbon adsorbents and bidara leaf powder can be seen in Table 2.

Table 2. Mean effectiveness of mini mobile filtration with activated carbon adsorbent and bidara leaf powder.

Variable	Air content	Maen After	Effectiveness (%)
COx	358 ppm	153 ppm	57,3
SOx	433 µgram/m^3	212 µgram/m^3	51
Particulate	435 µgram/m^3	265 µgram/m^3	39

Based on Table 2, it can be seen that the measurement results of COx, SOx and particulate gas parameters before and after going through the air filter obtained there is a decrease in all parameters. However, particulate is still above the threshold value.

DISCUSSION

Purifying the air is one of the most important things that can be done to keep the air quality inside a building healthy. It is the process of removing contaminants and pollutants from the air in order to create a living environment that is cleaner and more comfortable for people. Air purification systems in a room are intended to remove potentially hazardous particles from the air, such as dust, pollen, pet dander, and smoke, while mitigating odours and enhancing the air's quality.

An example of an air purification system is a mini mobile filtration system that uses activated carbon adsorbent and powder of bidara leaf (also known as powder of ziziphus mauritiana leaf). The Mini Mobile Filtration With Activated Carbon Adsorbent is an example of a system that purifies the air. This cutting-edge system, which uses activated carbon adsorbent and bidara leaf powder, can successfully remove pollutants from the air. This is made possible by the combination of these two components. An activated carbon adsorbent is a highly porous material that efficiently removes pollutants by adsorbing them onto its surface. Activated carbon adsorbents are typically made from activated charcoal. Activated carbon is the primary component of the adsorbent known as activated carbon. On the other hand, because the powder made from the bidara leaf contains compounds with antimicrobial and anti-inflammatory properties, it is an excellent candidate for use in applications that involve air purification.

Activated carbon adsorbent and bidara leaf powder have both been the subject of investigation in a number of studies regarding their potential to clean the air. For example, Zhang et al[1] investigated the feasibility of employing activated carbon adsorbent to extract volatile organic compounds (VOCs) from the atmosphere. According to the study's findings, activated carbon adsorbent was effective in removing volatile organic compounds (VOCs), which improved air quality. In a separate piece of research, Kurniawan et al.[2] investigated the use of bidara leaf powder to sterilise the air and remove bacteria. According to the study results, bidara leaf powder can effectively inhibit the growth of bacteria, which further highlights its potential for using it as an air purifier.

The term "room air purification" refers to reducing the number of pollutants found in indoor air by employing devices that remove or filter said pollutants. Depending on their mechanism, several different types of air purifiers can be used in a room. Some of these mechanisms include mechanical filtration, electrostatic precipitation, ionization, photocatalysis, and plasma. The use of room air purifiers has become increasingly common for a variety of reasons, including the enhancement of health and well-being as well as the improvement of indoor air quality, the reduction of allergens, and the prevention of infections. However, there is ongoing debate

regarding the efficiency and safety of room air purifiers, and these claims need to be investigated using rigorous scientific research.

Patients with allergic rhinitis, a common inflammatory condition of the nasal mucosa that is caused by exposure to allergens, have been the subjects of a number of randomized controlled trials (RCTs), which have been conducted to evaluate the effects of room air purifiers on those patients[9]. In addition to raising the risk of asthma and other respiratory conditions, allergic rhinitis can reduce one's overall quality of life. Dust mites, pollens, molds, and animal dander are the most common allergens that can cause allergic rhinitis to flare up. The use of air purifiers in a room has the potential to lessen the patient's exposure to the allergens in the air and relieve some of the symptoms of allergic rhinitis.

In patients with house dust mite-induced allergic rhinitis, Li et al. [1] carried out a randomized controlled trial (RCT) that was multicenter and double-blind to assess the clinical efficacy of a high-efficiency air purifier[9]. The air purifier removed Particles and volatile organic compounds from the air by combining mechanical filtration and photocatalysis. 240 participants were included in the study and assigned to one of two groups: an active or a mockup air-purification group. Each home environment had two air purifiers running continuously for a period of six weeks[10]. A group of sixty young adults in generally good health participated in a study that found that using an air purifier significantly reduced the total nasal symptom score (TNSS) in comparison to using a placebo. The active group demonstrated statistically significant improvements in individual nasal symptom scores, as well as improvements in quality of life and medication scores. The findings of this study led the authors to conclude that using an air purifier was both effective and safe in alleviating the symptoms of patients suffering from house dust mite-induced allergic rhinitis and enhancing their overall quality of life.

Another randomized controlled trial was carried out by Li *et al*. to investigate the clinical usefulness of a high-efficiency air purifier for patients suffering from Artemisia pollen-allergic rhinitis[9]. Pollen from artemisia plants is a significant contributor to seasonal allergic rhinitis in China. The previous research was used to develop the mechanism that was used in the air purifier. Within the scope of the study, there were a total of 120 participants who were randomly assigned to either an actual or a simulated air-purification group. Each home environment had two air purifiers running continuously for a period of four weeks[10]. The most important result was the shift in TNSS from the beginning of the study to week 4. The changes in the individual nasal symptom scores, the quality of life score, the medication score, the serum specific IgE level, and the nasal eosinophil count were included in the secondary outcomes. According to the findings, the active air-purification group experienced a reduction in TNSS that was statistically significant higher than the one seen in the mockup group (mean difference of -1.32, 95% confidence interval (CI): -1.75 to -0.89, p 0.001). In addition, the active group saw significant improvements in their individual scores for nasal symptoms, quality of life, medication scores, serum specific IgE levels, and nasal eosinophil counts. The authors concluded that using an air purifier was both effective and safe in improving the symptoms of patients suffering from Artemisia pollen-allergic rhinitis and the patients' overall quality of life.

Yoda et al. carried out a randomized controlled trial in order to investigate the effects of an ionization air purifier on the respiratory systems of healthy adults and the indoor environment[11]. Ionization air purifiers generate negative air ions (NAI), which are able to bind to airborne particles and cause them to precipitate when they come into contact with them. NAI might also have some biological effects on the respiratory system, like increasing the activity of cilia, lowering inflammation, and modulating neurotransmitters. Twenty adults in good health participated in the study and were each given a chance to be a part of either the real or the fake air-purification group. During the course of the experiment, one air purifier was utilized in each domestic setting for a period of two weeks[10]. An ionization air purifier was found to significantly reduce the indoor particle concentration compared to a sham treatment in a study involving sixty young adults in good health. However, there was no discernible difference between the groups regarding pulmonary function, fractional exhaled nitric oxide (FeNO) levels, cytokines in the nasal lavage fluid (NLF), or subjective symptoms. The authors came to the conclusion that the use of an ionization air purifier, despite the fact that

it effectively lowered the indoor particle concentration, did not improve the respiratory health of adults who were otherwise healthy[11,12].

The effects of room air purifiers on the cardiorespiratory responses to fine particulate matter (PM(2.5)) air pollution have also been the subject of several randomized controlled trials (RCTs) that have been carried out. Particulate matter with a particle size of 2.5 micrometers or less is a major contributor to outdoor air pollution. This pollutant can move indoors and has been linked to various negative effects on human health, including oxidative stress, inflammation, endothelial dysfunction, thrombosis, and arrhythmia. There is some evidence that using an air purifier in your home can cut your exposure to particulate matter (PM) 2.5 and lessen its negative impact on your cardiovascular and respiratory systems.

Wang and colleagues conducted a randomized controlled trial (RCT) to investigate the cardiorespiratory responses in healthy young adults following indoor airborne phthalates (PAEs) exposure. Phthalates are a class of semi-volatile organic compounds that are frequently utilized as plasticizers and can be emitted from a variety of indoor sources.[13] The use of a HEPA air purifier was found to significantly reduce the concentration of PM2.5 inside the home, when compared to the use of a sham treatment, in a study that involved sixty young adults who were in good health. Additionally, the real group demonstrated enhancements in blood pressure, heart rate variability, electrocardiogram parameters, blood biomarkers, and urine metabolites, all of which pointed to a reduction in oxidative stress, inflammation, platelet activation, and respiratory inflammation. The findings of this study led the authors to conclude that using a HEPA air purifier was both effective and safe in improving the cardiorespiratory health of young adults who participated in PPWs[14,15].

Another randomized controlled trial (RCT) was carried out by Zhao et al. to investigate the cardiorespiratory responses in healthy young adults during PM (2.5) pollution waves (PPWs). PM (2.5) pollution waves are severe air pollution events characterized by extremely high levels of ambient PM (2.5)[16]. A study involving sixty young adults in good health found that using a HEPA air purifier significantly reduced the indoor $PM_{2.5}$ concentration compared to a sham treatment. The real group also showed improvements in blood pressure, heart rate variability, electrocardiogram parameters, blood biomarkers, and urine metabolites, indicating a reduction in oxidative stress, inflammation, platelet activation, and respiratory inflammation. The authors concluded that using a HEPA air purifier effectively and safely lowered indoor $PM_{2.5}$ concentration and improved the cardiorespiratory health of young adults participating in PPWs.

A portable air purifier that can be used in a variety of settings, such as homes, offices, and hospitals, is referred to as the Mini Mobile Filtration With Activated Carbon Adsorbent And Powder of Bidara Leaf (Ziziphus Mauritiana) Leaf Powder. This purifier combines activated carbon with powder made from the bidara leaf of the ziphus mauritiana tree. Because of the system's small size and intuitive operation, it is an excellent choice for addressing the issue of polluted indoor air. In conclusion, the use of air purification systems in rooms is an essential component in preserving the high quality of air inside buildings. Innovative and effective at removing pollutants from the air, the Mini Mobile Filtration With Activated Carbon Adsorbent And Powder of Bidara Leaf (Ziziphus Mauritiana) Leaf Powder is an air purification system that uses powder of bidara leaf (ziziphus mauritiana). Activated carbon adsorbent and bidara leaf powder have been shown to be effective in several studies in the process of cleaning the air. Additional research in this field may result in the creation of air purification systems that are more effective and may also contribute to the development of environmentally responsible practices.

CONCLUSION

Mobile filtration of a mixture of activated carbon and bidara leaf powder can reduce COx, SOx, and particulate values by 57%, 51%, and 31%. Even though there was a decrease in the particulate value, it was still above the specified threshold value.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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