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The Comparison of the Electromagnetic Radiation (EMR) from Indoor Plants during Daytime and Nighttime using Frequency Detector

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***Abstract*- This research compares the electromagnetic radiation (EMR) from indoor plants during the daytime and nighttime using a frequency detector. The indoor plants involved are Dracaena Trifasciata (Snake Plant) and Epipremnum Aureum (Money Plant). Electromagnetic radiation (EMR) is the frequency (Hz) radiated by a living body and can be measured using a frequency detector. This preliminary investigation uses a handheld seven-segment monopole frequency detector to compare the EMR pattern with and without indoor plants during daytime and nighttime. The results show that the average EMR values for both plants and both time intervals increased during the presence of plants and returned to slightly lower than the normal EMR reading when the plants were removed.**

***Index Terms*—Dracaena Trifasciata, Epipremnum Aureum, money plant, electromagnetic radiation (EMR), indoor plant, frequency detector**

I. INTRODUCTION

Modern Malaysian society spends over 90% of their daily time indoors [1]. As a result, maintaining a cool and comfortable workplace and living room is critical. One way to achieve it is by simply looking at nature or being in natural settings can aid in increasing environmental comfort [2]. Many millennials nowadays like to have plants at home to create green areas reflecting nature and assist in de-stressing as well as to filter polluted air, which can improve health issues [3]. Furthermore, people frequently grow indoor plants to improve the air quality of the surroundings since indoor air pollution can be significantly worse than outdoor air pollution [4][5][6]. For a huge section of the world's population, poor indoor air quality (IAQ) is a serious health concern linked to between 65,000 and 150,000 deaths each year in the United States alone [7]. Poor IAQ not only harms people's lives, but it also costs $40 billion to $160 billion in economic losses [7].

Electromagnetic radiation, often known as aura, is a unique frequency field that radiates around living things such as the human body, animals and plants [8]. Researchers have demonstrated that suitable EMR can contribute to the treatment of several neurological illnesses by influencing the nervous system's functioning activity [9]. Money plants and snake plants have been widely studied by experts all over the world for their potential advantages to human physical and psychological health [5][7]. However, no information on the pattern of EMR emitted by these two famous plants has been discovered. As a result, the goal of this study is to investigate the EMR emitted by indoor plants in a room.

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II. LITERATURE REVIEW

A. Electromagnetic Radiations (EMR)

EMR is a type of electromagnetic radiation that surrounds living objects [8]. EMR has been shown to affect nervous system function, and proper EMR can aid in the treatment of various neurological illnesses [9]. EMR can propagate in the form of waves, however, unlike sound waves, it does not require a medium to travel. It indicates that the EMR can travel through both air and vacuum. The EMR is a space-based self-propagating wave caused by the vibration of an electrical charge. This vibration produces a wave that contains both electrical and magnetic components. These fields are perpendicular to each other because they follow the wave's path. This generated energy travels at the speed of light (3×10^8 m/s) until it interacts with other materials [10]. One way to measure EMR is by using a frequency detector, whereby a true real-time EMR can be observed. Previous studies on EMR employing frequency detectors have included comparing the auras of smokers and non-smokers, people with down syndrome and those without Down syndrome, and the link of EMR with BMI and human body condition. These studies have shown, among other things, that the frequency detector is capable of properly detecting changes in the EMR as a result of certain interventions. [11][12].

B. Frequency Detector (FD)

A handheld frequency detector (FD) that can accurately detect the frequency of both living and non-living things is widely used by other researchers [10][12]. This device has a filter that removes undesired frequency readings from the surroundings. The FD includes a seven-segment monopole antenna that is roughly one meter long when fully extended. The device can measure the frequency from 0.1MHz to 3GHz. Previous studies using this FD effectively measured the EMR difference between smokers and non-smokers. Aside from that, another study involving Down syndrome and non-down

syndrome people was carried out successfully and provided substantial results. [12][13].

C. Benefits of Indoor plants

The capacity of an indoor plant to induce a favorable perception is well documented [14]. Indoor plants have psychological, physiological, and cognitive benefits in addition to improving air quality [7]. Based on established studies, keeping an indoor plant in a room helps to a more positive and favorable environment [4]. Green plants are the primary carbon sink on the planet. Green shoots refresh the air in two complementary ways in the process of photosynthesis, taking in carbon dioxide and emitting oxygen, when given sufficient light intensities. The presence of the plant has caused a significant reduction in the symptoms of distress [15]. Indoor plants have been shown in studies around the world to have powerful air-cleaning abilities, lowering all forms of urban air pollutants, including those that are always found in larger quantities [16].

D. Epipremnum Aureum (Money Plant)

Money plant, Epipremnum Aureum, is a well-known indoor plant due to its ability to bloom in a variety of environments (Fig.1). Other common names for this plant are Silver Vine, Pothos, and Devil's Ivy.

Fig. 1. Epipremnum Aureum (Money Plant).

This plant is native to Southeast Asia, and its therapeutic and pharmacological qualities have previously been demonstrated in Guinea [17]. The money plant can help to minimize indoor pollution by eliminating benzene from the air [18]. Money plants are also good at removing other toxic properties like formaldehyde and carbon monoxide, thus they should be put near furniture [19]. The disk diffusion method was used to successfully research the uses of money plants to study their disinfectant characteristics, proving that money plant has the power to disinfect dangerous microbiological growth [20].

The two main studies conducted on money plants are to study their influence on human health conditions and how money plants can improve the environment [14] [21] [22] [23][24][25][26].

E. Dracaena Trifasciata (Snake Plant)

Dracaena Trifasciata is the scientific name for the famous snake plant, which was also previously known as Sansevieria Trifasciata (Fig. 2). The snake plant is a well-known ornamental plant with a significant economic interest [27].

Fig. 2. Dracaena Trifasciata (Snake Plant).

Snake plants are popular because they are long-lasting, easy to cultivate, and most significantly, they can survive low light levels. However, Snake plants prefer direct sunlight. Snake plants tend to spread quickly across a large area of their habitat [28]. Depending on the temperature, air movement, type of soil, and humidity, snake plants require 0.75 to 1.5 inches of water every week [29]. During the chilly season or rainy season, for example, the amount of water used can be reduced. They are tough plants that can thrive in conditions that most other plants cannot [28]. The presence of snake plants was used to monitor air quality using a commercial CO2 data logger, the Extech SD800, and an in-house created Arduino Uno based measurement system with several sensors. It is observed that when the plant was removed from the room, a sudden increase in volatile (VOC) such as NOX, NH3, smoke, and carbon dioxide was observed [26]. Snake plants are one of the factors that can help workers reduce stress and increase productivity. Blood pressure readings and questionnaires among workers after the presence of indoor plants, particularly snake plants, revealed their potential to lower stress and improve productivity [23]. The two main studies on snake plants are to see how they affect human health and how snake plants can help the environment [26].

III. METHODOLOGY

The flowchart of the research is shown in Fig. 3. It demonstrates how the process began with plant selection. Money Plant and Snake Plant were picked because of their environmental appropriateness and popularity. Then, the location of the plant is selected near the window so that the plants get enough sunlight. The plant is also located in a standard-sized room (approximately 10 square meters) and more than 5 meters away from electrical devices to avoid any disturbance on the EMR [30]. Next, the EMR data was collected (with plant, without plan, and with plant again) according to a specific protocol. The data is then used to produce synthetic data to get more data for accurate findings. The data is then analyzed before discussions and conclusions are made.

A. Data Collection

The EMR data was collected four times a day, at intervals of 1:00 pm to 2:00 pm, 4:30 pm to 5:30 pm, 7:00 pm to 8:00 pm, and 8:30 pm to 9:30 pm in a set time frame. These four time-frames were then divided into two sets which were daytime and nighttime reading. Fig. 4 shows the position of data collection. Point A, point B, and Point C were at a distance of two to five centimeters from the plant, whereas the other three points (D, E, F) were 15 centimeters

away from the plant. The final point, G, is at the center of the room. Furthermore, the data collected in the room without a plant is collected at the same points as if the room had a plant.

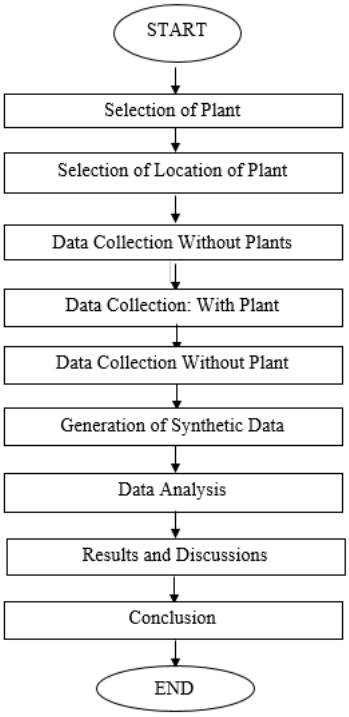

Fig. 3. Flowchart of the research.

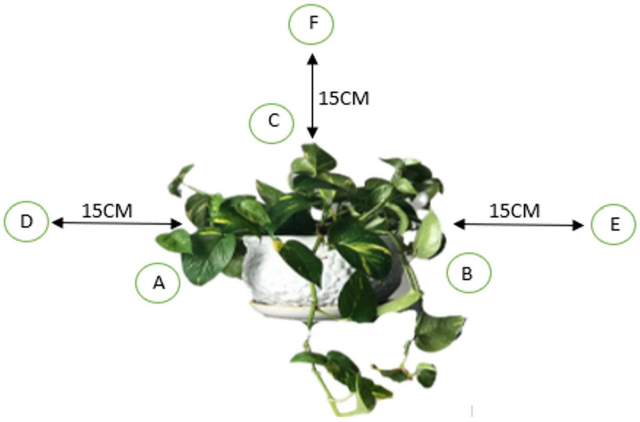

Fig. 4. Points for data acquisition.

B. Data Analysis

Fig. 5 shows the data analysis process. The FD was used to measure the EMR in terms of frequency readings in MHz. The data was keyed in the computer for data analysis using MATLAB and SPSS software. Lastly, the data is examined to discover the EMR patterns with and without the money plant.

Fig. 6 shows the flowchart of the data analysis. Initially, the raw data were used to generate synthetic data using MATLAB, to ensure 60 readings of data for each point at all-time intervals. Then, the mean, min, max, and variance of the data were calculated using SPSS software. Next, the boxplots were carried out to determine the outliers for each point. Lastly, the EMR graphs were plotted to establish the pattern of the EMR before, during, and after the presence of the indoor plants.

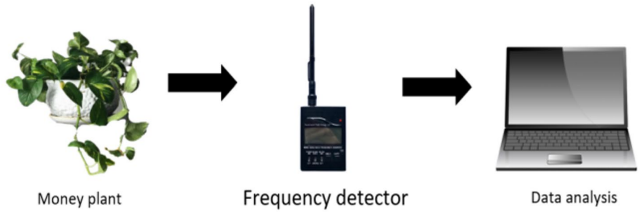

Fig. 5. Data analysis process.

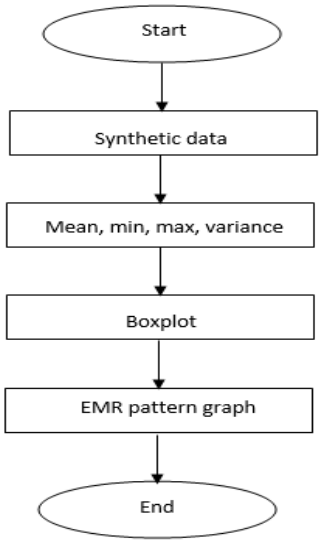

Fig. 6. Flowchart of data analysis.

IV. RESULTS AND DISCUSSION

The value of the EMR for both time intervals (daytime and nighttime) are divided into three parts:

A. The minimum and maximum
B. The average
C. The overall

A. The Minimum And Maximum Values

The maximum and minimum values of the EMR for Snake Plant and Money Plant were presented in Table I and Table II respectively. For the snake plant in Table I, the highest maximum value occurred in the presence of the plant, with readings of 81MHz and 71MHz respectively, for both time intervals. The lowest minimum EMR values were detected in the condition of without plant with values of 60MHz and 61MHz. This showed that the EMR values in the presence of the Snake Plant were higher compared to the condition without the plant.

TABLE I. MINIMUM AND MAXIMUM EMR VALUE FOR SNAKE PLANT

SNAKE PLANT(MHz)				
TIME	DAY TIME		NIGHT TIME	
	MAX	MIN	MAX	MIN
BEFORE	71	61	71	63
DURING	81	70	79	70
AFTER	68	60	66	61

TABLE II. MINIMUM AND MAXIMUM EMR VALUE FOR MONEY PLANT

MONEY PLANT (MHz)				
TIME	DAY TIME		NIGHT TIME	
	MAX	MIN	MAX	MIN
BEFORE	68	60	66	61
DURING	85	75	84	75
AFTER	66	58	70	61

Table II shows the minimum and maximum EMR value for Money Plant. The highest maximum value occurred in the presence of the plant, with readings the g of 85MHz and 84MHz, for daytime and night time respectively. The lowest minimum EMR values were detected in the condition of without plant with values of 58MHz and 61MHz. This showed that the EMR values in the presence of the Money Plant were higher compared to the condition without the plant. Another interesting observation is that the EMR values without the presence of plants (before and after) were very similar. Therefore, the EMR returned to the normal room condition value when the plant was removed.

B. The Average Values

Fig. 7 and Fig. 8 show the average EMR of Snake Plant for daytime and nighttime, respectively. In the daytime, the EMR value during the presence of Snake Plant increased for all the collected points. The highest average EMR reading is at point D with a value of 81MHz. Another observation is that the pattern of EMR reading is similar for all points where the value dropped after the plant was removed except for point G.

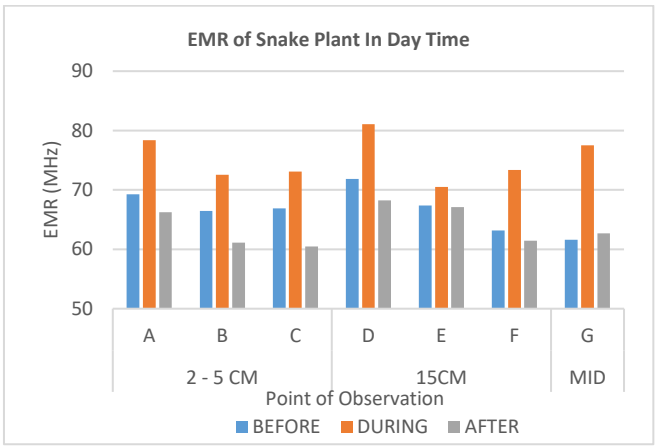

Fig. 7. EMR of Snake Plant in daytime.

Similarly, in the nighttime, the EMR value during the presence of Snake Plant increased for all the collected points as shown in Fig. 8. The highest average EMR reading is still at point D with a value of 79MHz, and the lowest at point E with the value of 70Mhz. Another observation is that the pattern of EMR reading is similar for all points where the value dropped after the plant was removed except for point F. The EMR pattern increases from without plant (before) to with plant (during). However, the value of EMR drops slightly lower than the initial value without the plant (before) compared to when the plant is removed (after).

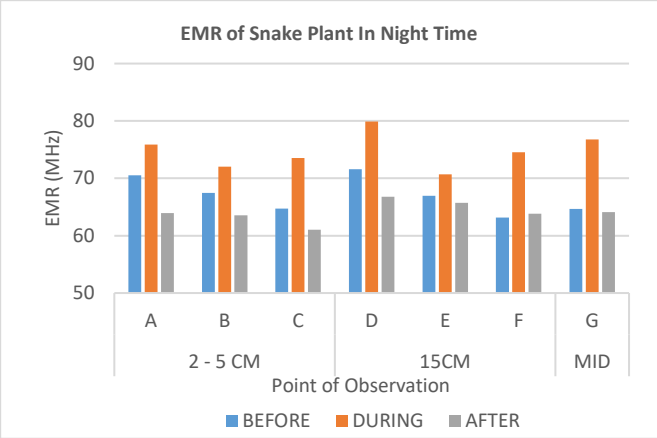

Fig. 8. EMR of Snake Plant in nighttime.

Fig. 9 and Fig. 10 show the average EMR of Money Plant for daytime and nighttime, respectively. In the daytime, the EMR value during the presence of the Money Plant increased for all the collected points. The highest average EMR reading is at point G with the value of 85MHz while EMR at point C is the lowest 75MHz. From the visual inspection, the pattern of EMR reading is similar for all points where the value dropped after the plant was removed except for point F. The EMR pattern increases from without plant (before) to with plant (during). However, the value of EMR drops slightly lower than the initial value without the plant (before) compared to when the plant is removed (after).

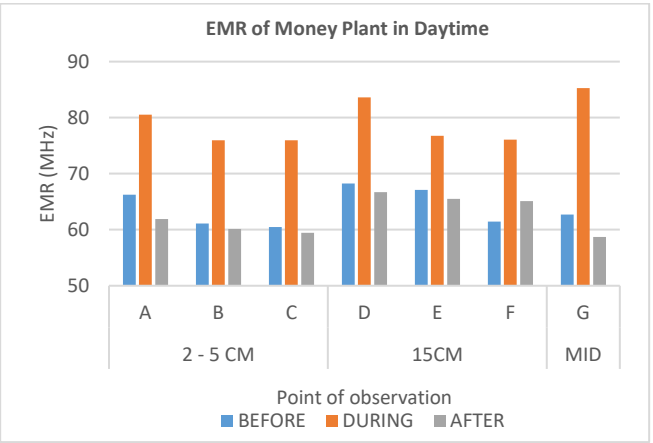

Fig. 9. EMR of Money Plant in the daytime.

Similarly, in the nighttime, the EMR value during the presence of the Money Plant increased for all the collected points as shown in Fig. 10. The EMR reading returned to its prior value when the Money Plant was removed from the

room. The highest average EMR reading is still at point G with a value of 85MHz and the lowest is at point F with a value of 75Mhz.

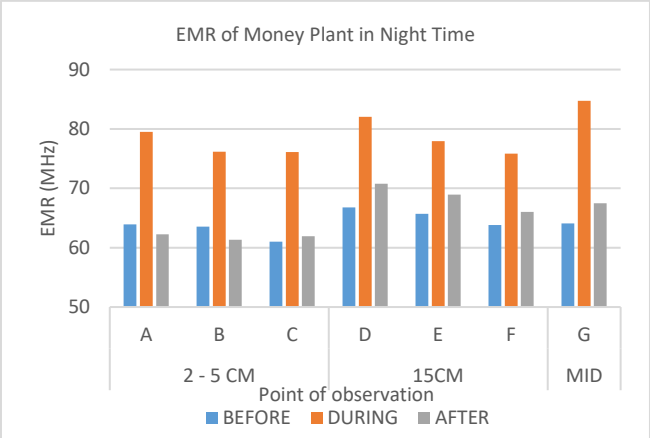

Fig. 10. EMR of Money Plant in the nighttime.

The overall observation from this part shows that the average EMR values for both plants and both time intervals show an increment during the presence of plants and return to slightly lower than the normal EMR reading when the plants were removed.

C. The Overall Values

Fig. 11 shows the overall EMR for the snake plant. It was observed that the EMR during the presence of the snake plant is higher than before and after its presence. The increment of EMR during the presence of snake plants has been proven regardless of whether it is during daytime or nighttime. After removing the snake plant from the room, the reading of EMR returned to its previous reading. For daytime, the EMR reading increased to 75MHz from 66MHz during the presence of the snake plant and it went back down to 63MHz after removing the snake plant from the room. As for nighttime, the EMR increases from 67MHz to 74MHz during the presence of the snake plant and decreases back to 64MHz after removing the plant from the room.

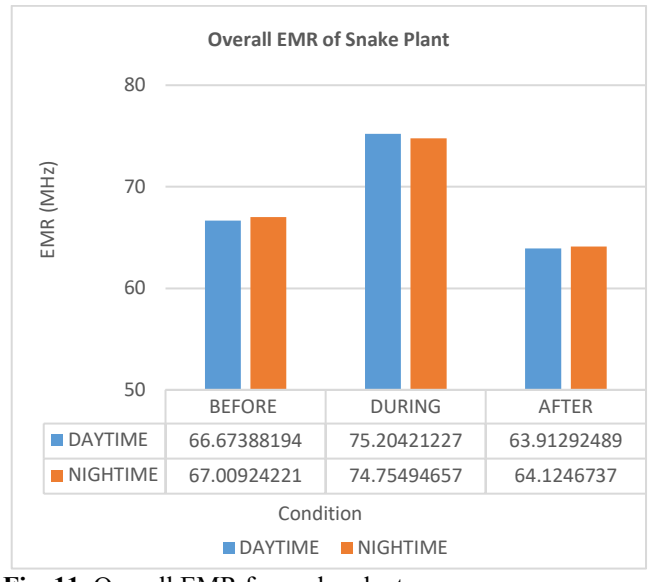

Fig. 11. Overall EMR for snake plant.

Fig. 12 shows the overall EMR for the money plant. Likewise, the EMR is higher during the presence of the Money Plant. The reading of EMR kind of returned to its prior reading when the money plant was removed from the space. When the money plant was present, the EMR value for the daytime increased from 63MHz to 79MHz, and it then decreased to 62MHz when the money plant was removed from the room. At night, the EMR raised from 64MHz to 78MHz before falling back to 65MHz after the money plant was removed.

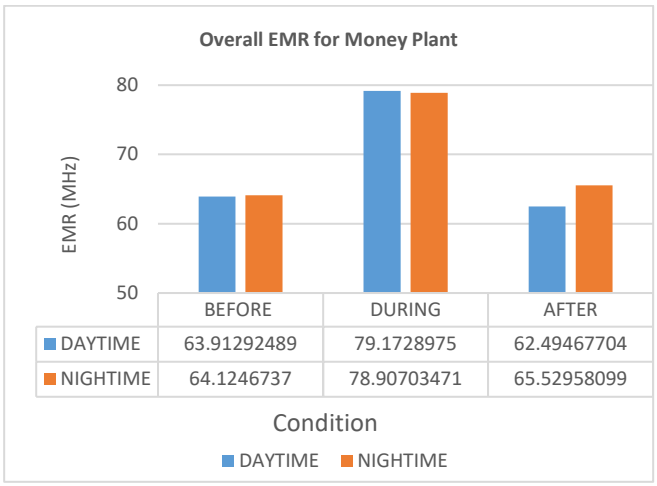

Fig. 12. Overall EMR for money plant.

V. CONCLUSION

The objective of this research has been successfully achieved which is to compare the EMR from Snake Plant and Money Plant during day time and night time using frequency detector. It can be concluded, from all the analysis, that the observation shows that the average EMR values for both plants and both time intervals increased during the presence of plants and returned to slightly lower than the normal EMR reading when the plants were removed. For the Snake Plant, the daytime increment was 12% while for the nighttime, the increment was 11%. Consequently, for the Money Plant, the increment was 19% for both time intervals. Another interesting observation is how the frequency detector was able to distinguish the changes in the EMR reading in the presence of plants. From previous studies, researchers found that indoor plants specifically Snake Plants and Money Plant were proven beneficial to humans and surroundings. Hence, this increment of EMR in the presence of indoor plants could be the cause of these positive effects.

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