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Effectiveness of "CALHO MIST" in Alleviating Intense Heat among Selected Household in Golden Country Homes Subdivision, Alangilan, Batangas

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I. INTRODUCTION

A. *Background of the Study*

Air pollution, as defined by the World Health Organization (WHO), is the presence of chemical, physical, or biological substances in the indoor or outdoor environment that alters the natural characteristics of the atmosphere. One key factor that influences air pollution is humidity, which affects how pollutants impact the behavior in the atmosphere. Humidity, or the amount of water vapor present in the air, can trap pollutants near the ground, limiting their dispersion and increasing concentrations, particularly in urban areas (clarity, 2025). High humidity can also encourage mold growth through formation of bacterias, viruses, and particulate matter, worsening heat index. While low humidity can allow fine particles to stay suspended in the air for longer periods, leading to dry conditions, irritating the respiratory system (airly, 2025). Both indoor and outdoor air pollutants pose serious threats to human health, where each year, air pollution is estimated to cause around 7 million deaths worldwide, underscoring the severity and growing urgency of the problem. In the Philippines, the problem continues to persist from large-scale industrial facilities down to individual households due to rapid industrialization. In 2023, the country ranked 79th most polluted in the world in terms of air quality, primarily because of the high levels of particulate matter present in the atmosphere (Richter, 2024). Meanwhile, in 2018, the Philippines ranks second in Asia-Pacific in deaths due to household air pollution (Philippine Daily Inquirer, 2018). The country's warm climate and surrounding bodies of water contribute to high relative humidity levels (PAGASA, 2014), making it highly vulnerable to the combined effects of elevated humidity and increased air pollution. To address the effects of high humidity on air quality, devices such as dehumidifiers are commonly used. A dehumidifier is a device designed to reduce the amount of moisture in the air, helping to prevent mold growth, limit pollutant concentration, and improve indoor air quality. There are four common types of dehumidifiers: heat-pump dehumidifier, dehumidifier ventilators, chemical absorbent dehumidifiers, and homemade dehumidifiers (Service Champions, 2024). Each type has its own design and function but shares the same purpose to enhance comfort and improve air quality in indoor spaces. Among these, homemade dehumidifiers are often the most efficient and practical, especially for household use. Recognizing their benefits can help alleviate humidity-related issues and inspire innovations that contribute to mitigating air pollution and improving indoor air quality.

B. *Objectives of the Study*

The primary objective of this study is to develop Calho Mist dehumidifier designed to reduce indoor humidity levels in households at Golden Country Homes Subdivision, Alangilan, Batangas. Specifically, this study aims to:

1) Describe the ratio of Calho Mist dehumidifier, using the following formulations:
- 12.5% Calamansi, 12.5% Honey, and 75% Charcoal;
- 25% Calamansi, 25% Honey, and 50% Charcoal;
- 37.5% Calamansi, 37.5% Honey, and 25% Charcoal; and
- Control Group (Chemical-absorbent dehumidifier)

2) Assess the perceived effectiveness of the dehumidifiers in terms of:
- Odor;
- Moisture Reduction;
- Air Freshness;
- Duration; and

- Appearance

3) Test the significant difference between ratios of Calho Mist dehumidifier and the control group in terms of:

- Perceived effectiveness

C. Hypothesis

There is no significant difference between ratios of Calho Mist dehumidifier and the control group in terms of perceived effectiveness.

D. Significance of the Study

The findings of this study are expected to benefit society by addressing the ongoing problem of indoor air quality affected by humidity, which contributes to risks and discomfort in households. This study intends to benefit the following:

To households, this study will help them improve their indoor comfort and overall air quality through introducing Calho Mist organic dehumidifier at their homes. By providing an affordable and practical solution to humidity-related problems, residents can maintain a healthier living environment, preventing growth of molds and pollutants, ultimately reducing risks of respiratory and cardiovascular diseases.

To local farmers, this study will involve local farmers by sourcing raw materials needed for the continuous production of the Calho Mist organic dehumidifier. Through this partnership, farmers can find additional value in their harvests and even make use of discarded or excess agricultural products that would otherwise go to waste. This initiative promotes farmers' livelihood through promoting sustainable resource use and strengthening innovative environmental practices.

To consumers, this study will increase their awareness about how humidity contributes to air pollution and affects air quality and health. By providing sufficient knowledge, consumers can make more informed decisions in choosing dehumidifiers that are suitable for their homes. This awareness encourages them to consider factors such as efficiency, affordability, and sustainability, allowing for more cost-effective and environmentally friendly practices to manage indoor environments.

To Local Government Units (LGUs), this study will serve as a foundation for developing community-based programs that promote improvement in indoor air quality. LGUs can use the findings to assess the community's air quality and to support initiatives aiming to lessen air pollution and health risks associated with humidity.

To future researchers, this study may serve as a foundation for further exploration of organic dehumidifiers to improve indoor air quality affected by humidity. The study can be used as a reference to further elaborate the persistence of the problem and the potential effectiveness of sustainable dehumidification solution. Moreover, it can inspire studies to improve and develop more efficient dehumidifying methods applicable not only to households, but also to larger settings in both rural and urban areas.

E. Scope and Delimitation

The study focuses exclusively on selected households within GCH, representing a typical residential environment in an urban setting, and is delimited to a control group that uses the chemical-absorbent provided by the researchers to ensure standardized measurement and a consistent baseline for comparison.". The research is The research is delimited to respondents' perceptions of the effectiveness of dehumidifiers in enhancing indoor air quality, particularly in reducing odor, controlling moisture, improving overall air freshness, as well as observing changes in the duration of the dehumidifier's effect and the appearance or physical condition of the surrounding environment during use.

The Calho Mist unit examined is a small-scale model designed for household use, constructed using natural and accessible materials such as coconut oil, calamansi extract, honey, and activated charcoal. The evaluation of Calho Mist's performance is confined to a short observation period and does not include assessments of its long-term durability, maintenance requirements, or sustained effectiveness over time. Therefore, the study primarily relies on objective feedback obtained through structured survey questionnaires, without the use of advanced thermal imaging or laboratory-grade instruments, which may limit the precision and reliability of the collected data. Overall, the findings may serve as a foundational reference for future research, particularly in similar urban residential settings such as subdivisions or homes located in densely populated areas.

F. Definition of Terms

1) Air pollution - Is the presence of harmful chemical, physical, or biological substances in the air that alters its natural composition and poses risks to human health and the environment. In this study, air pollution refers to the indoor air contamination experienced by households due to high humidity and poor ventilation.

2) Dehumidifier - A device used to reduce moisture in the air, helping to prevent mold growth, improve air freshness, and reduce pollutant concentration indoors. In this study, the dehumidifier refers to the equipment used by households particularly the Calho Mist organic dehumidifier to reduce indoor humidity and improve air freshness.
3) Heat Index - Is a measure that combines air temperature and humidity to determine how hot it feels to the human body. In this study, Heat Index refers to the level of heat discomfort experienced by respondents due to high humidity in their indoor environment.
4) Humidity - Is the amount of water vapor present in the air. High humidity can trap pollutants and promote the growth of mold, bacteria, and viruses. In this study, humidity refers to the moisture level inside the homes of respondents, which contributes to discomfort and poor indoor air quality.
5) Particulate Matter (PM) - Refers to tiny solid or liquid particles suspended in the air, such as dust, smoke, or soot, which can penetrate the lungs and cause health problems. In this study, Particulate Matter refers to airborne particles present in humid indoor environments that may affect the health of household members in the study area.
6) Ventilation - Is the process of exchanging indoor air with outdoor air to improve air quality and reduce moisture buildup. In this study, ventilation refers to the airflow system in the respondents homes that may influence humidity levels and the effectiveness of dehumidifiers.
7) Urban Environment - Areas with high population density and infrastructure, often experiencing elevated levels of air pollution due to traffic, industry, and limited green spaces. In this study, Urban Environment refers to residential areas where humidity-related air pollution is more common due to limited ventilation and dense living conditions.
8) Respiratory Irritation - Refers to discomfort or inflammation in the airways caused by exposure to pollutants, dry air, or allergens. In this study, Respiratory Irritation refers to the breathing discomfort experienced by household members due to poor indoor air quality linked to high humidity and trapped pollutants.
9) Odor - Is the smell produced by volatile compounds in the air, often linked to dampness, mold, or other pollutants. In this study, odor refers to how respondents perceive changes in indoor air smell when using the dehumidifier, measured through survey ratings on odor reduction and freshness.
10) Hygrometer - is a device used to measure the humidity or moisture level in the air. In this study, a hygrometer is the tool used to check indoor humidity to see how dehumidifiers affect air quality.

II. REVIEW OF RELATED LITERATURE AND STUDIES

A. Related Literature

1) Indoor Humidity

Indoor humidity refers to the amount of water vapour present in the air inside a building, typically expressed as relative humidity (RH). RH represents the ratio of the current moisture content to the maximum amount it can hold at a given temperature. For instance, outdoor air at a lower temperature with high humidity may become extremely dry when heated indoors, since the warmer air can hold more vapor but has not gained additional moisture. Conversely, when warm humid air is cooled, its relative humidity increases, and once it reaches the dew point, condensation occurs on walls or surfaces (*What is humidity? Why measure & what your levels mean*, n.d). Several literature recommends specific humidity ranges to support both comfort and health. Identifies 30-60% RH as the ideal indoor range, while Sensitive Choice suggests 30-50% RH as optimal for most environments. Humidity levels above 55-70% promote the growth of mold, dust mites, and bacteria, all of which are associated with respiratory issues such as asthma and allergies. On the other hand, low indoor humidity, typically below 30%, can lead to dryness and irritation of eyes, nose, throat, and skin, increasing susceptibility to airborne viruses, worsening eczema, ultimately making skin dry and uncomfortable. (*What is humidity? Why measure & what your levels mean*, n.d).

Controlling indoor humidity involves proper ventilation, air circulation, and the use of humidity-regulating devices when needed. Hygrometers, often included in thermometers or clocks, allow occupants to monitor RH, while exhaust fans in kitchens, bathrooms, and laundry areas help reduce excess moisture (Riffat, S., & Gillott, M. 2020). In conclusion, a dehumidifier helps remove moisture in high-humidity settings, therefore, it should be suitable in size for the room and in type, depending on climate.

2) Dehumidifier

A dehumidifier is a device designed to reduce indoor moisture by extracting water vapor from the air. According to the U.S. Environmental Protection Agency, high humidity increases the likelihood of biological contaminants, including mold, dust mites, and bacteria, which negatively affect indoor air quality and human health. There are four common types of dehumidifiers used in households.

First, a heat pump dehumidifier. It is an efficient solution for controlling indoor humidity. It uses an electrically driven refrigeration cycle to remove moisture from the air. These devices typically appear as medium-sized appliances with vents, coils, and a removable water container and can also run continuously as long as the tank is emptied (Langer, 2025).

On the other hand, dehumidifying ventilators are HVAC systems that combine the functions of both a dehumidifier and a fresh air ventilator to control indoor humidity and improve air quality. They remove excess moisture from indoor air and also bring in and filter fresh outdoor air, creating a healthier environment by preventing mold and reducing pollutants, it is usually installed as wall-mounted or window-mounted units with air ducts and screens (Richards, N., 2025). Furthermore, according to Hussain, A. (n.d), chemical absorbent dehumidifier uses chemicals like silica gel or calcium chloride to absorb moisture from the air without electricity, it typically appears as small packets tubs, or canisters containing desiccant materials, and their effectiveness last until the chemical becomes saturated. This type of dehumidifier can last anywhere from 3 to 8 years, with an average lifespan of about 5 years. Lastly, organic dehumidifiers, including charcoal, bamboo charcoal, rice hulls, salt-based desiccants, and other plant-derived absorbers, are increasingly recognized as sustainable, low-cost alternatives to electric dehumidifiers. These natural materials rely on passive adsorption or absorption processes, making them suitable for small, enclosed areas such as cabinets, closets, and storage spaces. Bamboo charcoals are particularly valued for their porous structure and large surface area, which enable them to trap moisture and reduce odors (Consensus, 2023). Literature consistently describes organic dehumidifiers as practical, renewable, and electricity-free solutions for moisture control in limited spaces (Consumer Council of Hong Kong, 2023).

3) Odor

According to Encyclopedia Britannica (2025), odor is the property of certain substances to stimulate chemical-sense receptors in very small concentrations, whether in the air or in water, surrounding an animal. Essentially, an odor arises when molecules from a substance, which are either volatile or water-soluble, interact with sensory receptors designed to detect chemical signals. These substances do not need to be abundant; even trace amounts can elicit a perceptible smell. The detection process, known as chemoreception, involves specialized receptors that convert chemical interactions into electrical signals that are transmitted to the brain, where they are interpreted as specific odors. The medium through which odor molecules travel significantly influences perception: gases diffuse differently in air compared to liquids in water, affecting the intensity, spread, and detectability of the odor.

Dehumidifiers help reduce these odors by removing excess water vapor from the air, creating conditions less favorable for mold, bacteria, and other odor-producing microorganisms (U.S. Environmental Protection Agency, n.d). Studies show that controlling indoor humidity with dehumidifiers can significantly reduce musty or stagnant smells, improving air quality and occupant comfort. Mechanical and desiccant dehumidifiers are both effective in odor reduction, with desiccant systems often providing more precise control in persistently humid conditions, thereby minimizing the risk of odor recurrence (NREL, 2019). Overall, dehumidification is a practical strategy for managing both moisture and odor in indoor environments.

4) Moisture Reduction

Excess indoor moisture is a primary contributor to indoor air quality deterioration, structural damage, and discomfort, making moisture reduction a critical concern in residential and commercial environments. Dehumidifiers serve this role by targeting the latent moisture load, effectively extracting water vapor and lowering relative humidity levels (U.S. Environmental Protection Agency, n.d). The efficiency of moisture reduction depends on factors such as air temperature, airflow, and the device's energy performance. The concept of Moisture Removal Efficiency (MRE), which quantifies the volume of water removed per unit of energy consumed, is widely used to evaluate a dehumidifier's effectiveness in moisture control.

The U.S. Environmental Protection Agency consistently shows that dehumidifiers are highly effective at reducing indoor moisture levels, which in turn prevents mold formation, material decay, and discomfort. In tropical regions with persistently high humidity, dehumidifiers are particularly vital for controlling indoor moisture and mitigating biological contamination. It underscores that effective moisture reduction through dehumidification is necessary not only for occupant comfort but also for preserving structural integrity and indoor air quality, thereby establishing dehumidifiers as a fundamental component of environmental control systems.

5) Air Freshness

Indoor air quality, air freshness, and overall occupant comfort are significantly influenced by indoor humidity levels. Excess moisture promotes the growth of mold, mildew, fungi, and bacteria, which release volatile organic compounds (VOCs) that generate unpleasant odors and reduce the sense of air freshness (U.S. Environmental Protection Agency, n.d). High humidity also accelerates the deterioration of materials, such as wood, drywall, and paint, making indoor spaces more prone to microbacterial growth.

The reduction of indoor humidity through dehumidification helps sustain a clear and more comfortable indoor environment. Dehumidifiers prevent the recurrence of musty or stagnant smells, creating a more pleasant and comfortable indoor environment. Maintaining relative humidity within optimal ranges not only inhibits microbial growth but also enhances the effectiveness of ventilation systems. Moreover, consistent dehumidification can reduce the need for chemical odor neutralizers or extensive cleaning. In summary, literature highlights dehumidifiers as essential tools for controlling indoor moisture, minimizing odor, and sustaining air freshness, thereby contributing to healthier, more comfortable, and structurally sound indoor environments.

6) Honey

Honey is a natural sweet substance produced by bees and is primarily composed of fructose, glucose, and small amounts of vitamins, minerals, and plant-based antioxidants, contribute to honey's protective effects against oxidative stress and chronic diseases. Its composition varies according to floral source and processing methods, with raw honey containing the highest concentration of nutrients and antioxidants (Erejuwa et al., 2018; Al Waili et al., 2023). Honey also provides multiple health benefits when consumed properly. Research shows that it may support cardiovascular health by improving cholesterol levels, reducing blood pressure, and lowering the risk of heart disease (Mayo Clinic, n.d.; Al Waili et al., 2023). Its antibacterial and anti-inflammatory properties make it effective for wound healing, soothing burns, and preventing infections (Molan & Rhodes, 2015). It is also well known for relieving sore throats and coughs, providing a natural alternative to some over-the-counter medications (Mayo Clinic, n.d.). Beyond its health benefits, honey also holds value in fragrance and aromatherapy due its warm and floral scent (Scent Journer, n.d.). The aroma of honey is known to have calming and mood-enhancing effects, helping reduce irritability and fostering emotional well-being. Although honey offers many benefits, it should be consumed in moderation because of its high sugar content (Healthline,n.d). In essence, honey is more than just a sweetener, it is a natural product with proven healing, soothing, and antioxidant benefits that can promote better overall health when used responsibly.

7) Calamansi

Calamansi (*Citrus × microcarpa*), also called calamondin or Philippine lime, published in *Molecules* and archived in the *U.S. National Library of Medicine (PMC)*, is a small citrus fruit indigenous to the Philippines and other parts of Southeast Asia. Traditionally used in Filipino cuisine and folk medicine, calamansi has recently been the subject of scientific research due to its rich nutritional and phytochemical profile. Calamansi demonstrates significant potential for commercial and industrial applications beyond its medical uses. Its often-discarded peel can be converted into powders, essential oils, and natural extracts for nutraceuticals, cosmetics, and functional food production. Its citrus fragrance and tangy flavor make it a useful natural ingredient for beverages, sauces, and desserts, though its high acidity requires moderate consumption to avoid stomach irritation or enamel erosion. The peel and pulp also contain pectin, which supports digestion and gut health, along with bioactive compounds that show antioxidant, anti-inflammatory, anti-diabetic, and anti-cancer properties.The study shows that calamansi extract can reduce oxidative stress, enhance immune response, regulate blood sugar, and exhibit anti-angiogenic effects relevant to cancer prevention (Venkatachalam et al., 2023). Furthermore, calamansi peel oil offers functional and emotional benefits beyond its pleasant scent. Its natural deodorizing and antibacterial properties help neutralize odors in indoor spaces and hygiene products. The oil's aroma has also been associated with mood enhancement and relaxation, as inhaling the scent can stimulate the release of endorphins and reduce stress. In aromatherapy, calamansi essential oil is often used to promote calmness, relieve anxiety, and boost energy, making it a versatile natural fragrance for wellness practices (Bare Remedy, n.d.). The combination of these elements creates a scent that is both refreshing and functional, contributing to an overall sense of cleanliness and vitality.

8) Charcoal

Activated charcoal is a processed carbon material known for its high porosity and strong adsorptive properties. According to the *National Center for Biotechnology Information (NCBI)*, it is produced by heating carbon-rich materials such as wood, coconut shells, or peat at very high temperatures which creates a large surface area filled with microscopic pores (NBK482294, 2018). This structure allows it to adsorb various substances such as toxins, chemicals, and gases. Unlike regular charcoal used for cooking, activated charcoal is specifically designed for medical, environmental, and industrial applications, owing to its unique chemical and physical properties. Activated charcoal has been also explored for a variety of health and environmental benefits. Healthline (2023) suggests that activated charcoal may help reduce gas and bloating by binding gas-producing compounds in the intestines. Similarly, Medical News Today (2022) reported that it may support kidney function by removing waste products that the kidneys cannot efficiently process, making it potentially beneficial for individuals with impaired renal function. Additionally, earlier research indicated that activated charcoal might help lower cholesterol levels by binding bile acids in the gut, which forces the body to use more cholesterol to replace them, thereby reducing overall cholesterol concentration in the bloodstream.

Activated charcoal has also found applications in cosmetics, skincare, and environmental protection. Its powerful adsorptive nature makes it an effective ingredient in facial masks, toothpaste, and cleansers, where it removes impurities, toxins, and excess oil from the skin. Environmentally, activated charcoal is used in water and air purification systems to trap contaminants, odors, and volatile organic compounds, contributing to cleaner and safer environments (Healthline, 2023).

B. Related Studies

Recent local and international studies underscore the potential of renewable resources to function as organic dehumidifiers. One such material is honey, which has demonstrated promising-moisture adsorbing properties. Arslan and Turhan (2022) investigated the static water vapor sorption properties of various honey types at different temperatures and reported that honey's sorption isotherms exhibited a J-shaped curve, indicating increased moisture uptake at higher relative humidities. This behavior demonstrates honey's intrinsic capacity to interact with water molecules, which is largely attributed to its high content of sugars (fructose, glucose, and oligosaccharides) and polar hydroxyl (-OH) groups. These functional groups act as active sites for hydrogen bonding with water vapor, facilitating adsorption and retention of moisture — a property directly relevant to dehumidifier function. Complementing these findings, Mulheron et al. (2024) analyzed four floral honey types and identified volatile aroma compounds, including furfural, benzaldehyde, dimethyl sulfide, and (S)-limonene, using GC-MS. These compounds possess functional groups—such as aldehydes, sulfides, and terpenes—that can interact with water molecules through weak hydrogen bonding and van der Waals forces, further enhancing moisture adsorption capacity. Together, these studies suggest that honey contains both polar and volatile functional sites capable of capturing and holding water vapor, providing a scientific basis for its use as a bio-based moisture-absorbing material in organic dehumidifier systems. Consequently, honey exhibits promising potential as a sustainable component in organic dehumidifier systems, where its natural sorption properties could complement other biomass-derived adsorbents, offering eco-friendly and low-energy solutions for indoor humidity control. Another material is calamansi, a citrus fruit known for its high citrus content, natural aroma compounds, and antibacterial properties. Binauhan et al. (2022) investigated the adsorption capability of powdered calamansi (*Citrus microcarpa*) fruit peels in single- and binary-metal aqueous systems, reporting removal efficiencies of 99% for aluminum, 70% for copper in single-metal conditions, and 91% in binary-metal systems using Langmuir isotherm and pseudo-second-order kinetic models. Although the study focused on aqueous solutions, the findings demonstrate that calamansi peel possesses a highly porous structure and surface-active functional groups capable of strong adsorption interactions. Complementing this, Purnama et al. (2022) analyzed essential oils distilled from calamansi peel via GC-MS and identified major volatile compounds, including 3-carene, decanal, L-alpha-terpineol, and D-carvone. The chemical structures of these compounds contain functional groups that can engage in hydrogen bonding and van der Waals interactions with water molecules, suggesting the presence of intrinsic adsorption sites. Taken together, these results indicate that powdered calamansi peel exhibits both structural and chemical characteristics conducive to moisture adsorption. Consequently, this natural, low-cost, and sustainable material shows promising potential as a component in organic dehumidifier systems. Its demonstrated adsorption properties, combined with the eco-friendly nature of the raw material, support the conclusion that calamansi-based adsorbents can serve as effective alternatives to conventional dehumidification technologies, particularly in applications emphasizing sustainability and environmental safety. Lastly, charcoal has also been examined for its dual role in indoor air improvement. According to Bañez et al. (2021), charcoal substantially reduces odor intensity, while also demonstrating a natural capacity for moisture adsorption, as shown through a mathematical model based on differential equations to simulate the adsorption of odor particles over time. These findings suggest that charcoal possesses dual functionality, making it a promising material for both odor elimination and humidity control in confined indoor spaces. The study highlights its potential application in household settings and small-scale environmental management, where low-energy and passive solutions are desirable. In terms of sustainability, studies have emphasized the viability of using locally sourced biomass materials as components for dehumidifiers. Research from Central Philippine University demonstrated that microwave-activated carbon derived from coconut coir possesses strong adsorption capacity while utilizing an abundant agricultural by-product, highlighting its value as an environmentally responsible alternative to commercially manufactured desiccants (Diaz et al., 2024). Complementing this, research from Visayas State University revealed that coconut-shell charcoal produced through controlled pyrolysis exhibits high porosity and effective adsorption performance, indicating that locally sourced biomass can serve as a renewable and low-impact material for humidity control systems (Curay et al., 2020).

Additional findings also support the duration or service life potential of organic materials. The *Bambusa blumeana* biochar analyzed in the *Philippine Forest Products Journal* was found to contain high fixed carbon and stable structural properties, characteristics associated with long-term adsorption effectiveness and the ability to be regenerated through drying, thereby extending its practical lifespan in dehumidifying applications (Philippine Forest Products Journal, 2022). Collectively, it demonstrates that coconut-based charcoal and bamboo biochar possess the physical and chemical traits necessary for functional moisture-adsorbing devices, particularly in small to moderately humid indoor environments where passive, low-energy dehumidification is suitable. Their natural adsorption properties make them viable alternatives for household, storage, and small-room humidity management.

Environmental considerations further strengthen the case for organic dehumidifiers. An international study by Chaturvedi et al. (2023) showed that bamboo charcoal exhibits strong humidity-buffering capacity due to its microporous structure while also being non-toxic and biodegradable. This reinforces the environmental advantages of organic dehumidifiers, which avoid the refrigerants, electronic waste, and high energy consumption associated with conventional mechanical units. Collectively, these studies suggest that locally available biomass materials—particularly coconut-derived activated carbon and bamboo biochar—offer sustainable, long-lasting, practical, and environmentally safe alternatives for developing organic dehumidifier systems suitable for the Philippine context. However, evaluations of bamboo- and activated charcoal-based dehumidifiers revealed relatively low moisture removal capacity, with minimal reductions in ambient humidity even after extended periods of use (Consumer Council of Hong Kong, 2023). While charcoal-based materials can effectively adsorb moisture under controlled laboratory conditions, their performance in larger or open environments is limited. Consequently, compared to synthetic desiccants or electrically powered dehumidifiers, charcoal-based dehumidifiers may be less suitable for high-humidity applications or spaces requiring rapid and substantial moisture removal. Overall, these findings support the development of innovative dehumidifiers using these materials while underscoring the need to consider material properties and application scale.

C. Conceptual Framework

This part presents the conceptual paradigm of the study, showing the schematic presentation of the concept of research that will guide them in this study. Figure 1 shows the basis of the conceptual theory of the study, using the Input-Process-Output (IPO) model. The Input frame presents the different ratios of the Calho Mist Dehumidifier that are used to identify the most effective formulation and the data needed by the researchers to solve the current problem raised about the effectiveness of “Calho Mist" in alleviating intense heat among selected households in Golden Country Homes Subdivision. Meanwhile, the process showed the steps to be used in creating the Calho Mist and in gathering data, and this also includes the documentation process of the gathered results in this study to verify its reliability. The output frame includes the expected outcome of the research study, where the researchers will propose the efficiency of "Calho Mist" in alleviating intense heat among selected households in Golden Country Homes Subdivision, Alangilan, Batangas.

INPUT

I. Calho Mist Dehumidifier
1. Describe the ratio of Calho Mist dehumidifier, using the following formulations:
1.1.12.5% Calamansi, 12.5% Honey, and 75% Charcoal;
1.2.25% Calamansi, 25% Honey, and 50% Charcoal;
1.3.37.5% Calamansi, 37.5% Honey, and 25% Charcoal; and
1.4.Control Group (Chemical-absorbent dehumidifier)

II. Questionnaire
2.Assess the perceived effectiveness of the dehumidifiers in terms of:
2.1.Odor;
2.2.Moisture Reduction;
2.3.Air Freshness;
2.4.Duration; and
2.5.Appearance

3.Test the significant difference between ratios of Calho Mist dehumidifier and the control group in terms of:
3.1.Perceived effectiveness

PROCESS

I. Making of Calho Mist Dehumidifier
1. 1Making of Essential Oil
1.1.1 Zesting of Calamansi Peel
1.1.2 Infusing Olive Oil and Honey
1.1.3 Straining and Storing

1.2. Dehumidifier Scenting
1.2.1 Selecting charcoal
1.2.2 Infusing with essential oil
1.2.3 Setting in a container

II. Data Gathering and Analysis
2.1 Pre-Questionnaire
2.2 Post-Questionnare

OUTPUT

Assessed Effectiveness of “Calho Mist” in Alleviating Intense Heat among selected household in Golden Country Homes Subdivision, Alangilan, Batangas

Figure 1 Input-Process-Output (IPO) model

III. METHODOLOGY

A. Research Design

This study employed a descriptive quantitative action research design to assess the effectiveness of Calho Mist dehumidifier in alleviating intense heat, addressing the air pollution caused by humidity at Golden Country Homes, Alangilan, Batangas. The research followed an iterative process of planning, acting, observing, and reflecting, allowing the intervention to be applied and refined systematically. A quantitative approach was also utilized to measure observed outcomes objectively. This design provided a clear understanding of the experiences and perceptions of the respondents while addressing the practical problem of indoor humidity.

B. Subject of the Study

This study focuses on testing the effectiveness of Calho Mist, an organic dehumidifier made from charcoal, calamansi-infused oil, and honey, in reducing moisture in indoor spaces. Since humidity is a common problem in many homes—causing discomfort, mold growth, and poor air quality—the researchers wanted to try a natural and affordable option instead of relying on expensive or chemical-base dehumidifiers. To evaluate Calho Mist properly, the researchers used different ratios of mixtures and asked a selected group of the members of Golden Country Homes, Alangilan, Batangas to help assess its performance. These students served as the subjects of the study because they regularly stay in areas where humidity can be observed, making them suitable and relatable evaluators. The distribution of participants is shown in Table 1.

Table 1 Distribution of Respondents

Ratio	Household	Number of participants
Ratio A	Household 1	3
Ratio A	Household 3	8
Ratio A	Household 5	1
Ratio B	Household 2	4
Ratio B	Household 7	3
Ratio B	Household 9	4
Ratio C	Household 8	3
Ratio C	Household 4	4
Ratio C	Household 6	4
	Total	33

C. Participants and Setting

This study was conducted among the residents of Golden County Homes in Alangilan, Batangas City, a residential urban community where indoor humidity and air quality have been reported as issues. The study involved a total of 33 respondents across 9 households. Respondents for both pre and post-data-gathering were selected using a purposive sampling method, ensuring that participants have relevant experience and knowledge of indoor humidity and air quality. During the initial stage of respondent gathering, it was discovered that none of the potential respondents owned an existing dehumidifier. Since the original plan involved comparing different types of dehumidifiers already in use, this approach became infeasible. As a result, the procedure was revised in which all participants tested two standardized devices provided by the researchers: a chemical absorbent dehumidifier (control) and the Calho Mist organic dehumidifier (experimental). This adjustment ensured consistency across participants and allowed valid pre-test and post-test comparisons.

D. Data Gathering Procedure

Following the researchers' submission and approval of the proposed title and the collection of data required for the related literature and studies, the following step-by-step procedure was followed in order to fulfill the study's objective. The researchers have prepared questionnaires to be filled out by the participants. The chosen participants filled up the questionnaires with the help of researchers and done upon permission of the chosen participants. The study was conducted in two testing phases, each involving a specific device and questionnaire to assess the respective intervention. In Phase 1, participants were given the control condition, which was the chemical absorbent dehumidifier. Then, the pre-test questionnaire was administered to assess the effect of the chemical dehumidifier based on participants' perceptions during its three-day usage period.

After the control phase, the households were divided into three groups corresponding to three ratios. Due to the limited availability of Calho Mist dehumidifiers (6 units), assignment was conducted by household while ensuring that each ratio had 11 respondents: Ratio A (Households 1, 3, and 5), Ratio B (Households 2, 7, and 9), and Ratio C (Households 4, 6, and 8). Although this grouping may introduce environmental variability, the ratios were assigned using simple random sampling to maintain objectivity. In Phase 2, participants were provided with the Calho Mist dehumidifier. Prior to usage, an orientation was conducted to provide clear instructions on the proper operation and maintenance of the device, ensuring consistent usage across households. Following the intervention, the post-test questionnaire was administered to measure participants' responses and evaluate the effectiveness of the Calho Mist dehumidifier.

The same sequence was applied to all participants, and identical instructions and testing conditions were maintained across both phases to reduce potential bias. The collected data were compiled and analyzed to compare and contrast the overall performance of the Calho Mist dehumidifier.

E. Research Instruments

The researchers will use a 34-item questionnaire to gather quantitative data to assess the effectiveness of Calho Mist dehumidifier in alleviating intense heat caused by indoor humidity.

Questionnaire. The questionnaire was developed based on the specific objectives, focusing on the dehumidifier's perceived effectiveness based on respondents' experiences. The first part of the questionnaire included an informed consent, ensuring the ethical considerations of respondents were adhered to.The questionnaire utilized a 4-point Likert scale. The perceived effectiveness in terms of odor, moisture reduction, and air freshness each consists of 8-items, while duration and appearance each consists of 5-items. These items were in close-ended format, allowing for structured response and a thorough objective analysis assessing the effectiveness of Calho Mist.

Validation. The researchers presented the constructed questionnaire to their adviser for validation. To ensure reliability, the questionnaire underwent pilot testing and was analyzed using Cronbach's Alpha in Jamovi software. The reliability results for the specific variables were as follows: odor (0.937), moisture reduction (0.935), air freshness (0.931), duration (0.919), and appearance (0.927), with an overall perceived effectiveness of 0.951. These results confirm that the questionnaire is a reliable and valid tool for measuring the variables intended in the study.

Administration. The questionnaires were administered face-to-face. Weeks before the actual data gathering, the researchers had already identified the respondents, who voluntarily agreed to participate. They were also provided with a brief background of the study prior to the data collection.

Table 2
Response Scale and Verbal Interpretation

Option	Scale Range	Verbal Interpretation
4	3.50 – 4.00	Strongly Agree
3	2.50 – 3.49	Agree
2	1.50 – 2.49	Disagree
1	1.00 – 1.49	Strongly Disagree

F. Data Analysis

The collected data were analyzed using both descriptive and inferential statistics to ensure accurate interpretation of the results. The following statistical measures were employed:

Mean. This was applied for descriptive analysis of respondents' perceived effectiveness of both the control group (chemical absorbent dehumidifier) and the experimental group (Calho Mist dehumidifier). The mean was also used as a baseline for inferential analysis.

Analysis of Variance (ANOVA). This inferential statistical method was employed to assess the significance of differences in perceived effectiveness between the three ratios of Calho Mist and the control group. ANOVA allowed for comparison of mean scores between the groups to determine the relative effectiveness of Calho Mist in improving indoor air quality.

Games-Howell Post-Hoc Test. In an instance ANOVA indicates a significant difference, the Games-Howell post-hoc test will be conducted to identify which specific groups differ, accounting for unequal variances and sample sizes.

G. Ethical Consideration

Several ethical considerations were implemented throughout the study. The researchers ensured that all respondents participate voluntarily and without any form of coercion or pressure. Before data collection, participants were provided with an informed consent form explaining the study's purpose, procedures, potential benefits, and their right to withdraw at any time. No questions that may cause discomfort or offense will be included, and participants may skip any item they prefer not to answer. Data were collected at an appropriate time and place to ensure no physical or psychological harm occurs. All gathered information was treated with strict confidentiality and used solely for academic purposes. The results of the study provided insights that can improve household cooling solutions and promote comfort and well-being among residents.

IV. PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

This chapter deals with the presentation, analysis and interpretation of data. It contains the tabular quantitative presentation and analysis of data, and interpretation of data in the light of relevant literature.

A. Ratio of Calho Mist dehumidifier

All Calho Mist formulations were prepared in small, clear containers with perforated lids to allow the natural release of the citrus-honey aroma while keeping the mixtures securely contained. The transparency of the containers visualizes the mixtures' dark, coarse texture and increasing stickiness with higher honey and calamansi content. A chemically-absorbent dehumidifier served as the control, representing an industry-standard benchmark for moisture absorption, for comparison against the natural formulations.
The varying proportions of calamansi, honey, and charcoal in Ratios A, B, and C align with established findings on moisture adsorption and natural deodorizing mechanisms. Ratio A (12.5% calamansi, 12.5% honey, 75% charcoal) appeared predominantly dry with a mild citrus-sweet scent, consistent with literature demonstrating that activated carbon maintains strong and stable moisture-adsorption performance under humid conditions (Miksík et al., 2021). Ratio B (25% calamansi, 25% honey, 50% charcoal) showed a balanced texture and a moderately strong citrus-honey aroma, supported by research on the hygroscopic and antimicrobial properties of natural humectants such as honey, alongside the deodorizing effects of citrus essential oils rich in limonene (Gupta et al., 2021). Ratio C (37.5% calamansi, 37.5% honey, 25% charcoal), with the highest organic content, exhibited the most moisture and the strongest fragrance, reflecting findings that organic humectants promote rapid moisture uptake but provide shorter-duration adsorption compared with activated carbon (Yang et al., 2021).

B. Perceived Effectiveness of Calho Mist dehumidifier

Table 3.1
Perceived effectiveness of Calho Mist dehumidifier in terms of odor

Odor	**WM** (Control n=33)	**VI**	**WM** (Ratio A n = 11)	**VI**	**WM** (Ratio B n = 11)	**VI**	**WM** (Ratio C n = 11)	**VI**
1. It helps eliminate unpleasant odors in my living space.	3.09	Strongly Agree	3.64	Strongly Agree	3.55	Strongly Agree	3.09	Strongly Agree
2. I notice a fresher indoor smell after using it.	2.94	Agree	3.73	Strongly Agree	3.55	Strongly Agree	3.36	Strongly Agree
3. It reduces musty or moldy odors in enclosed areas.	2.76	Agree	3.45	Strongly Agree	3.45	Strongly Agree	3.36	Strongly Agree
4. Odors caused by humidity or dampness are less noticeable.	3.03	Strongly Agree	3.36	Strongly Agree	3.36	Strongly Agree	3.18	Strongly Agree
5. I use fewer air fresheners since I started using it.	2.73	Agree	3.18	Strongly Agree	3.36	Strongly Agree	3.27	Strongly Agree
6. Its odor-reducing effect is consistent over time.	2.91	Agree	3.27	Strongly Agree	3.45	Strongly Agree	3.36	Strongly Agree
7. It minimizes lingering smells from cooking or laundry.	2.91	Agree	3.36	Strongly Agree	3.55	Strongly Agree	2.73	Agree
8. Overall, I am satisfied with its ability to control odors.	2.97	Agree	3.27	Strongly Agree	3.45	Strongly Agree	3.09	Strongly Agree
Composite Mean	**2.92**	**Agree**	**3.41**	**Strongly Agree**	**3.47**	**Strongly Agree**	**3.18**	**Strongly Agree**

LEGEND: WM - Weighted Mean VI - Verbal Interpretation

Table 3.1 presents the effectiveness of the Calho Mist dehumidifier in reducing indoor odors, based on feedback from different groups. The control group had a composite mean of 2.92, which means they generally agreed that the dehumidifier helped with odor. After testing, all experimental ratios showed higher agreement, with Ratio B scoring the highest at 3.47 (Strongly Agree), followed by Ratio A at 3.41 and Ratio C at 3.18.

Ratio B was particularly effective in removing unpleasant smells, reducing musty odors, and maintaining fresh indoor air. Recent studies show that the performance of odor-reducing technologies like dehumidifiers depends a lot on the materials used. Liu et al. (2024) found that improving the materials inside household dehumidifiers makes them work better at reducing humidity and odors, especially when designed for indoor spaces. This supports the idea that Ratio B worked best because its materials and mix were just right for controlling bad smells and keeping the air fresh.

While the dehumidifier was still effective, its formulation may not have been as well-suited to handle certain odor sources compared to the other ratios. Barbusinski et al. (2017) emphasizes that different compounds vary in their ability to neutralize specific volatile organic compounds (VOCs), which explains why some setups perform better than others. Overall, the findings indicate that Calho Mist dehumidifier worked well in improving indoor odor, and Ratio B might be the best setup for stronger and more consistent odor control, while Ratio C highlights the need for further refinement to maximize effectiveness across all odor types.

Table 3.2
Perceived effectiveness of Calho Mist dehumidifier in terms of moisture reduction

Moisture Reduction	WM (Control n=33)	VI	WM (Ratio A n = 11)	VI	WM (Ratio B n = 11)	VI	WM (Ratio C n = 11)	VI
9. It effectively reduces humidity in my home.	3.12	Strongly Agree	3.45	Strongly Agree	3.45	Strongly Agree	3.45	Strongly Agree
10. The air feels less thick or damp when in use.	2.91	Agree	3.55	Strongly Agree	3.36	Strongly Agree	3.18	Strongly Agree
11. It helps prevent mold growth caused by moisture.	3.00	Strongly Agree	3.18	Strongly Agree	3.45	Strongly Agree	3.27	Strongly Agree
12. It removes excess moisture faster than natural ventilation.	2.88	Agree	3.09	Strongly Agree	3.45	Strongly Agree	3.00	Strongly Agree
13. It maintains a comfortable humidity level throughout the day.	3.24	Strongly Agree	3.73	Strongly Agree	3.73	Strongly Agree	3.36	Strongly Agree
14. I feel less sticky or sweaty when it is in use.	2.97	Agree	3.18	Strongly Agree	3.45	Strongly Agree	3.18	Strongly Agree
15. It helps prevent damp smells in enclosed areas.	3.15	Strongly Agree	3.27	Strongly Agree	3.45	Strongly Agree	3.45	Strongly Agree
16. Overall, it effectively reduces indoor moisture.	3.12	Strongly Agree	3.27	Strongly Agree	3.45	Strongly Agree	3.18	Strongly Agree
Composite Mean	3.05	Strongly Agree	3.34	Strongly Agree	3.48	Strongly Agree	3.26	Strongly Agree

LEGEND: WM - Weighted Mean VI - Verbal Interpretation

Table 3.2 presents the perceived effectiveness of the Calho Mist dehumidifier in terms of moisture reduction based on the weighted mean (WM) and verbal interpretation (VI) from the different groups. A comparison of the composite means reveals a clear increase in perceived effectiveness after implementing the experimental ratios. The Control Group achieved a Composite Mean of 3.05 (Strongly Agree), while Ratio B was the most effective at 3.48 (Strongly Agree), followed by Ratio A (3.34) and Ratio C (3.26). These results demonstrate the major implication that Ratio B possesses the most successful formulation for moisture control according to the respondents' perception. The overall acceptance of its efficacy validates the importance of using optimized desiccant materials to achieve superior performance (Abdalla-Ahmed et al., 2014).

Ratio B's consistently high scores indicate that its formulation provided the quickest and most sustained comfort to users. Ratio B's highest mean, 3.73 (Strongly Agree) for the item "It maintains a comfortable humidity level throughout the day," signals the system's effectiveness in maintaining humidity stability. This implication is supported by literature showing that energy performance and thermal comfort are directly dependent on the desiccant's ability to maintain a stable relative humidity (RH) typically within the 40%–60% range (Batukray, 2020). Conversely, the item with the slightly lower mean, such as "The air feels less thick or damp when in use" (Ratio C: 3.18), suggests that some ratios may be less effective in rapid air latent heat changes. RRL suggests that higher adsorption rate and desorption rate of the desiccant material, likely present in Ratio B, are required to address rapid moisture fluctuation (Sun et al., 2021).

In conclusion, the results confirm that the Calho Mist dehumidifier is highly proficient in moisture reduction, with Ratio B identified as the most effective formulation in delivering fast and sustainable thermal comfort and mold prevention. The interpretation of these results supports the finding that innovation in desiccant composition directly leads to increased user satisfaction. However, this study acknowledges a crucial limitation, the data is based purely on subjective user perception (weighted mean) and does not include objective technical measurements (e.g., RH sensor readings) of moisture removal efficiency.

Table 3.3
Perceived effectiveness of Calho Mist dehumidifier in terms of air freshness

Air Freshness	WM (Control n=33)	VI	WM (Ratio A n = 11)	VI	WM (Ratio B n = 11)	VI	WM (Ratio C n = 11)	VI
17. The air feels fresher after using it.	2.94	Agree	3.73	Strongly Agree	3.55	Strongly Agree	3.18	Strongly Agree
18. The air smells more natural and less stale.	3.00	Strongly Agree	3.73	Strongly Agree	3.55	Strongly Agree	3.18	Strongly Agree
19. The air feels lighter and easier to breathe.	2.97	Agree	3.45	Strongly Agree	3.45	Strongly Agree	3.45	Strongly Agree
20. The room feels cooler when it is in use.	3.03	Strongly Agree	3.36	Strongly Agree	3.27	Strongly Agree	3.36	Strongly Agree
21. I feel more comfortable staying indoors while it operates.	3.09	Strongly Agree	3.27	Strongly Agree	3.55	Strongly Agree	3.36	Strongly Agree
22. It helps maintain cleaner, fresher air.	3.06	Strongly Agree	3.55	Strongly Agree	3.45	Strongly Agree	3.36	Strongly Agree
23. I am satisfied with its effect on indoor air quality	2.97	Agree	3.64	Strongly Agree	3.45	Strongly Agree	3.09	Strongly Agree
24. Overall, it enhances the comfort of my living space.	2.88	Agree	3.27	Strongly Agree	3.55	Strongly Agree	3.18	Strongly Agree
Composite Mean	2.99	Agree	3.50	Strongly Agree	3.48	Strongly Agree	3.27	Strongly Agree

LEGEND: WM - Weighted Mean VI - Verbal Interpretation

Table 3.3 presents the perceived effectiveness of the Calho Mist dehumidifier in terms of its air freshness, based on feedback from different groups. The control group had a composite mean of 2.99 (Agree), which means that most of them agreed that the dehumidifier contributed to the air freshness. After checking the table, all experimental ratios showed a higher agreement, with Ratio A scoring the highest at Mean = 3.50 (Strongly Agree), followed by Ratio B at Mean = 3.48 (Strongly Agree), and then Ratio C at Mean = 3.27 (Strongly Agree). The researchers concluded that Ratio A performed the best and contributed a lot to the overall air freshness of the household among all three experimental ratios. Bamboo Charcoal Padding demonstrates significant capacity for air purification, supporting its utilization as an air filter in close-ventilated environments and this study contributes to the innovative solution for reducing air pollution, specifically PM 2.5 within a closed-ventilated environment (Andaya et al., 2024). This study validates the idea that the components of Ratio A, which is mainly the charcoal, is the best alternative for air purification and filtration and for effectively contributing to the household's air freshness.

Dehumidification plays a vital role in fresh air handling units (FHUs), which are essential for ensuring indoor air quality (Cheng et al., 2025). In essence, dehumidifiers are considered effective since it creates a lasting impact on the different households. This concludes one thing, that all of the three charcoal-based dehumidifiers offer an effective improvement over standard conditions, validating the dehumidifier's benefit in enhancing household air freshness.

Table 3.4
Perceived effectiveness of Calho Mist dehumidifier in terms of duration

Duration	WM (Control n=33)	VI	WM (Ratio A n = 11)	VI	WM (Ratio B n = 11)	VI	WM (Ratio C n = 11)	VI
25. It keeps working well even after being used for many hours.	3.06	Strongly Agree	3.64	Strongly Agree	3.73	Strongly Agree	3.00	Strongly Agree
26. It improves air quality quickly after it starts operating.	3.06	Strongly Agree	3.73	Strongly Agree	3.45	Strongly Agree	3.00	Strongly Agree
27. It removes odors effectively in an ample amount of time.	3.00	Strongly Agree	3.36	Strongly Agree	3.73	Strongly Agree	3.36	Strongly Agree
28. Frequent use of it helps the air stay fresh	3.18	Strongly Agree	3.45	Strongly Agree	3.45	Strongly Agree	3.18	Strongly Agree
29. Overall, its performance depends on how long it runs.	3.12	Strongly Agree	3.09	Strongly Agree	3.55	Strongly Agree	3.00	Strongly Agree
Composite Mean	3.08	Strongly Agree	3.45	Strongly Agree	3.58	Strongly Agree	3.11	Strongly Agree

LEGEND: WM - Weighted Mean VI - Verbal Interpretation

Table 3.4 presents the perceived effectiveness of the Calho Mist dehumidifier in terms of duration. All groups rated the dehumidifiers positively, with composite means verbally interpreted as “Strongly Agree.” Ratio B received the highest composite mean (3.58), followed by Ratio A (3.45), Ratio C (3.11), and the Control Group (3.08), indicating that Ratio B is perceived as the most effective formulation for sustaining performance over time.

Respondents generally agreed that the dehumidifier effectively eliminates odors, improves air quality rapidly, and continues to function well even after many hours. Some items received slightly lower ratings that indicate that users still notice minor changes in performance depending on how long the unit is used.The study demonstrates that the type of dehumidifier and its operating conditions, which can vary over time, affect its dehumidification efficiency, suggesting that performance may change depending on usage context and duration (Santos et al., 2023). These perceptions are consistent with studies showing that dehumidifier efficiency can vary based on airflow stability, filter quality, and operating duration (Richards, N., 2025).

Overall, the findings suggest that the Calho Mist dehumidifier performs reliably during extended use, with Ratio B providing the most consistent results based on the respondents feedback. A limitation of this table is that the evaluation is based only on the user perception. Furthermore, future studies may include technical measurements to verify the device’s long-duration performance.

Table 3.5
Perceived effectiveness of Calho Mist dehumidifier in terms of appearance

Appearance	WM (Control n=33)	VI	WM (Ratio A n = 11)	VI	WM (Ratio B n = 11)	VI	WM (Ratio C n = 11)	VI
30. It appears durable and made with quality materials.	3.09	Strongly Agree	3.55	Strongly Agree	3.73	Strongly Agree	3.27	Strongly Agree
31. Its color and finish are visually appealing.	2.94	Agree	3.27	Strongly Agree	3.64	Strongly Agree	3.00	Strongly Agree

32. Its size and shape suit indoor household use.	3.15	Strongly Agree	3.55	Strongly Agree	3.82	Strongly Agree	3.27	Strongly Agree
33. It looks modern compared to existing products.	2.85	Agree	3.09	Strongly Agree	3.64	Strongly Agree	3.09	Strongly Agree
34. Overall, its design appears neat and well-made.	3.15	Strongly Agree	3.45	Strongly Agree	3.64	Strongly Agree	3.18	Strongly Agree
Composite Mean	3.04	Strongly Agree	3.38	Strongly Agree	3.69	Strongly Agree	3.16	Strongly Agree

LEGEND: WM - Weighted Mean VI - Verbal Interpretation

Table 3.5 presents the perceived effectiveness of the Calho Mist dehumidifier in terms of appearance. All ratios received strong agreement from respondents, with the experimental formulations rated higher than the control group, suggesting that the new designs were perceived as more visually appealing. Composite means were 3.04 (Control), 3.38 (Ratio A), 3.69 (Ratio B), and 3.16 (Ratio C). Among the Calho Mist formulations, Ratio B had the highest ratings, suggesting the most polished and modern appearance.

Comparing the ratios, the dehumidifiers were rated higher in aspects related to durability, neatness, and overall design quality. This supports findings that consumer aesthetics influence design choices, with preferences for simple forms, premium controls, and portable features. Visual elements also enhance the users' emotional perception of quality and distinction (Liu, 2024). Additionally, aesthetically pleasing designs such as smooth finish or pleasant colors enhance user affinity and boost marketability. Poor displays or finishes can signal low build quality and discourage users (Lewsley & Gora, 2023). Overall, the dehumidifiers enhanced the product's appearance, with Ratio A and Ratio B being most preferred by the respondents. The results show that good design affects how people perceive a product. However, these findings are based only on the perception of a small group of respondents.

C. Difference between the perceived effectiveness of ratios of Calho Mist dehumidifier and the control group

Table 4
Significant Differences in Overall Perceived Effectiveness for Control and Calho Mist Ratios

Analysis	F-value	p-value	Decision on H_0	Verbal Interpretation
ANOVA (Overall Perceived Effectiveness)	6.26	0.003	Reject H_0	Significant
POST-HOC (Games-Howell)				
Control vs. Ratio A	-0.401	0.029	Reject H_0	Significant
Control vs. Ratio B	-0.523	0.006	Reject H_0	Significant
Control vs. Ratio C	-0.182	0.082	Do not Reject H_0	Not Significant
Ratio A vs. Ratio B	-0.121	0.876	Do not Reject H_0	Not Significant
Ratio A vs. Ratio C	0.220	0.281	Do not Reject H_0	Not Significant
Ratio B vs. Ratio C	0.341	0.070	Do not Reject H_0	Not Significant

INTERPRETATION: p-value $\leq$ 0.05 - Significant; p-value > 0.05 - Not Significant

Table 4 presents the significant differences in overall perceived effectiveness among the Control and Calho Mist ratios. A one-way ANOVA revealed a significant difference, F = 6.26, p = 0.003, rejecting the null hypothesis and indicating differences in perceived effectiveness among the four groups. These results suggest that the type of dehumidifier affects how users perceive its effectiveness.

Post-hoc Games-Howell tests further clarified these differences, with Ratio A (p = 0.029) and Ratio B (p = 0.006) being perceived as significantly more effective than the Control group, whereas Ratio C did not differ significantly from Control (p = 0.082). Comparisons among the ratios themselves revealed no significant differences (Ratio A vs. Ratio B, p = 0.876; Ratio A vs. Ratio C, p = 0.281; Ratio B vs. Ratio C, p = 0.070), indicating that respondents' perceptions did not differ statistically between the experimental formulations.

The significant perceived effectiveness of Ratios A and B can be attributed to their higher charcoal content, which enhances moisture and odor management, consistent with research on moisture-controlled charcoal systems, demonstrating that charcoal regulates humidity through adsorption and improves indoor air freshness (Matsumoto et al., 2017). Similarly, literature on solid desiccant dehumidifiers emphasizes that desiccant composition and structural characteristics play critical roles in performance and user satisfaction (Shamim et al., 2021). Consistent with these findings, Ratios A and B outperformed the Control, and the comparable perceptions across all experimental ratios suggest that the Calho Mist blends share key desiccant-like properties that contribute to better performance in an environmentally friendly manner.

Collectively, these results underscore the importance of material formulation in dehumidifier performance. Practically, Ratios A and B may provide improved odor reduction, moisture control, air freshness, and overall user satisfaction compared to conventional chemical-absorbent dehumidifiers, supporting their potential as alternatives especially in household settings.

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A. Summary

The researchers aimed to assess the effectiveness of “Calho Mist”, an organic dehumidifier made from calamansi infused oil, honey and charcoal in alleviating intense heat among selected households in Golden Country Homes, Alangilan, Batangas. With many people experiencing discomfort, mold growth, and poor air quality due to high humidity, the researchers explored whether a natural, affordable alternative could offer a sustainable solution. The dehumidifiers consist of three formulations- Ratio A, Ratio B, and Ratio C varying proportions of calamansi infused oil, honey, and charcoal. These formulations were compared to a chemical-based dehumidifier using pre-test and post-test evaluations from 33 participants.

The study evaluated how effective each formulation is in terms of odor reduction, moisture control, air freshness, duration of effectiveness, and overall appearance. By gathering the participants’ perceptions, Ratio B emerged as the most effective in moisture reduction, odor control, and overall appearance. Ratio A in enhancing air freshness, and Ratio C, though still effective, showed weaker performance and may need enhancement. These results highlight Calho Mist’s potential as an eco-friendly and low-cost option for improving indoor air quality, especially in households experiencing high heat.

B. Conclusions

The following were the conclusions of the researchers drawn from the findings of the study:

1) The Calho Mist formulations demonstrated that the proportion of charcoal and organic humectants (calamansi and honey) directly affects moisture absorption and aroma. Ratio A (12.5% calamansi, 12.5% honey, 75% charcoal) remained dry with a mild scent, showing sustained adsorption. Ratio B (25% calamansi, 25% honey, 50% charcoal) had a balanced texture and moderate fragrance, reflecting combined moisture control and aromatic benefit. Ratio C (37.5% calamansi, 37.5% honey, 25% charcoal) exhibited the highest moisture uptake and strongest aroma, indicating rapid but shorter-duration adsorption. The chemical dehumidifier served as a control, providing a benchmark for comparison. These results support the use of varying formulations to tailor moisture absorption and fragrance intensity.
2) The overall findings of the study confirm that the Calho Mist dehumidifier is effective in enhancing indoor environmental quality across odor control, moisture reduction, air freshness, duration, and appearance, with all experimental formulations outperforming the control group. Respondents strongly agreed that the device reduced unpleasant smells, improved air freshness, and controlled excess moisture more efficiently than natural ventilation, while also sustaining reliable performance during extended use. In addition, the product’s design and appearance were perceived positively, with durability and neatness contributing to user satisfaction. Among the three formulations, Ratio B consistently demonstrated the strongest and most balanced performance, while Ratio A excelled in air freshness and Ratio C showed moderate improvements that highlight the need for refinement. Taken together, these results validate the dehumidifier’s role as a practical and innovative solution for improving household air quality, with Ratio B emerging as the most effective and reliable formulation overall.
3) A one-way ANOVA revealed significant differences in perceived effectiveness among the Control and Calho Mist formulations. Post-hoc tests showed that Ratios A and B were rated significantly higher than the chemically-absorbent control, while Ratio C did not differ. Descriptive results align with these findings, with Ratios A and B receiving the highest agreement, likely due to their higher charcoal content enhancing moisture and odor control. No significant differences were observed among the experimental ratios, suggesting that all ratios share desiccant-like properties. Collectively, the findings showed Ratios A and B as the most promising environmentally-friendly alternative to chemically-absorbent dehumidifiers for household settings.

C. Recommendations

The following are the recommendations based from the findings and conclusion of the study:

1) Conduct laboratory experiments to quantify the measurement of odor, moisture reduction, and air freshness and validate the user perceptions with objective data, for a more comprehensive analysis about Calho Mist's performance.
2) Future research should increase sample size and ensure that the number of respondents for each experimental ratio is equal to that of the control group to improve the reliability of findings and allow for a more generalizable conclusion.
3) Future research could collaborate with organizations or local government units to broaden the study's reach and explore similar investigations, helping to address the limited literature on organic dehumidifiers.
4) Further studies are recommended to test different types of essential oils in the Calho Mist formulation, as aroma and other effects may vary depending on the oil used.
5) Further studies are recommended to develop an electronic version of Calho Mist that retains its original components, improving both functionality and modernity.

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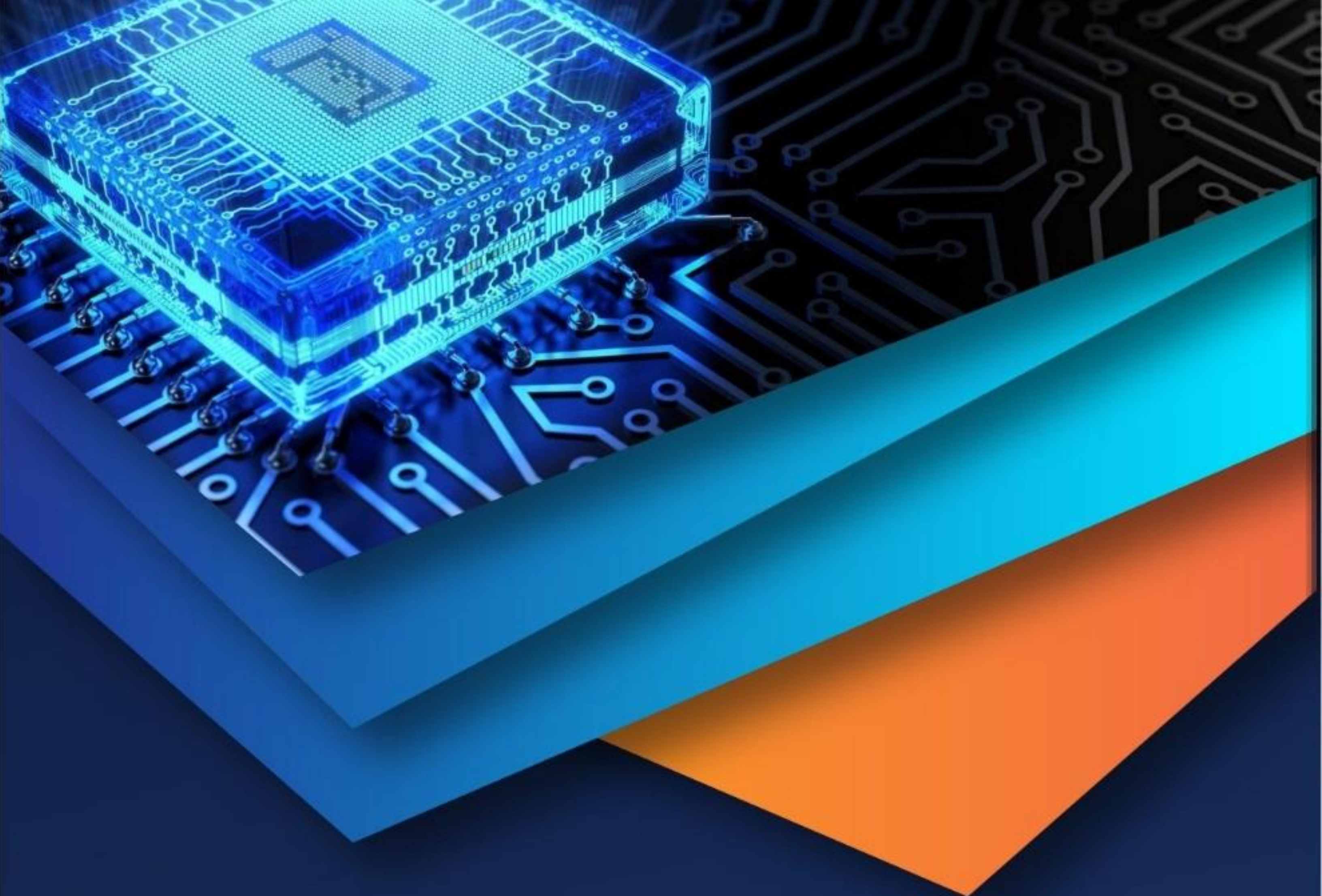

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