

Aculeunas: Exploring the Antimicrobial Properties of Mayana (*Coleus Blumei*) and Cavendish Banana (*Musa Acuminata*) Pseudostem Pure Extract Against *Pseudomonas Aeruginosa*

Adlawan, Ava Kathareen S., Agunod, Xianan Mhe A., Araña, Lotis Kate A., Bernaldo, Amiel Hella E., Cariquitan, Babe Xyzette R., Dinsay, Zac Robert Anthony C., Reyes, Raxenne Gwyneth B., Templa, John Benedict R., Ellaga, Mark Jobert C., Bacan, Cleford Jay D.

Cor Jesu College, Inc. - Basic Education Department

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ABSTRACT

Bacterial infections from *Pseudomonas aeruginosa* have been causing problems due to its resistance to antibiotics and ability to adapt in diverse environments and healthcare settings. To address this growing concern, this research was conducted to investigate the antimicrobial properties of mayana leaf extract with cavendish banana pseudostem pure extract as a potential alternative treatment in inhibiting the growth of *P. aeruginosa*. The extracts were obtained using ethanol maceration for Mayana leaves and simple distillation, while hand pressing as an alternative for extracting the pure extract of the banana pseudostem. Three different concentrations of the combined extracts were tested using the Kirby-Bauer test, with povidone-iodine as a positive control. The results showed that the combined extracts exhibited significant antimicrobial activity with inhibition zones comparable to the commercial treatment. However, the test result showed that there is no significant difference ($p \geq 0.05$, $p = 0.55$) compared to the treatment. These findings suggest that Mayana leaf and Cavendish banana pseudostem extracts have potential as natural antibacterial agents against *P. aeruginosa*, and further studies should be conducted to explore its efficacy against bacteria.

Keywords: mayana leaf extract, cavendish banana pseudostem pure extract, bacterial infections, *P. aeruginosa*

INTRODUCTION

Bacterial infections pose a significant health problem globally to many individuals due to their ability to adapt to diverse environments and persist in healthcare settings. Consequently, bacterial infections grow more prevalent as bacteria adapt to their environment and reproduce quickly in a person's body. It became a serious issue, particularly if those individuals have a weak immune system, making it hard for their bodies to fight the pathogens. One of those disease-causing bacteria is called *Pseudomonas aeruginosa*. The presence of this bacteria could contribute to increased infection rates and higher medical costs, urging researchers to explore more affordable and accessible herbal remedies that have the potential to treat this kind of disease.

Globally, the disease-causing pathogen *P. aeruginosa* poses a threat to the health of individuals especially those with a weakened immune system. This is supported by a study of Qin et al. (2024), stating that *P. aeruginosa* is widely recognized for its ability to cause diseases, specifically persons with immunodeficiency, posing a significant threat, especially to immunocompromised individuals. Furthermore, a study conducted in Spain revealed that *P. aeruginosa* can cause infections of the lower respiratory tract in people with chronic inflammatory airway diseases such as asthma, chronic obstructive pulmonary disease (COPD), cystic fibrosis (CF), and bronchiectasis. Thus, while it does not cause the aforementioned diseases, it can increase the risk of infection, making patients' conditions exacerbate and are more difficult to treat (Garcia-Clemente et al., 2020). Additionally, Reynolds and Kollef (2021) conducted a global observational study, it was found that 16.2% of infections in intensive care units were caused by *P. aeruginosa*. Overall based on the cited literature, the presence of this pathogen is concerning, as it has been associated with pneumonia and other severe infections, particularly in individuals with compromised health.

Pseudomonas aeruginosa is a major pathogen in Asia, particularly affecting immunocompromised patients, and is frequently reported in countries such as India and Malaysia (Phan et al., 2023). In India, it contributes to both hospital- and community-acquired infections (Bindu & Saikumar, 2022), with a notable presence in intensive care units where it drives many healthcare-associated infections (Gill et al., 2020). Similarly, in China, it was the third most commonly isolated Gram-negative bacillus in 2021, accounting for 7.96% of healthcare-related infections (Huang et al., 2023). The challenge is further intensified by rising multidrug resistance (MDR) across the region. According to Salleh et al. (2025), the overall MDR rate of *P. aeruginosa* in Asia reached 44.3% between 2018 and 2023. Country-specific data reveal particularly high MDR rates in Iraq (74.2%), Yemen (66.3%), and Egypt (64.3%), while Iran recorded the highest number of MDR cases (199), with a prevalence of 44.8%. These alarming figures highlight the growing threat of MDR *P. aeruginosa* and emphasize the urgent need for regional and global action to mitigate its impact.

In discovering the use of alternative medicine for *P. aeruginosa*, numerous research on the antimicrobial effects of mayana (*Coleus blumei*) and cavendish banana (*Musa acuminata*) pseudostem highlight their varying effectiveness against different microbial pathogens. Results from the research conducted in Malaysia by Bismelah et al. (2019), showed *C. blumei* leaves extract its antibacterial activity against both bacteria *Staphylococcus aureus* (14.56 mm) and *Streptococcus mitis* (13 mm) using disc diffusion method. Moreover, in Hanoi, Vietnam, a study testing the antimicrobial activity of Cavendish Banana (*M. acuminata*) against 3 different gram-positives strains, 3 gram-negative strains, and 1 strain of yeast showed modest effect on inhibiting the growth of *Bacillus cereus* strain. In contrast, the MIC values of banana leaf extract against the pathogenic yeast strain *Candida albicans* strain varied between 256 µg/mL to 1024 µg/mL demonstrating strong antifungal activity (Thi et al., 2024). Overall, both Cavendish banana and mayana can be utilized to combat certain bacterial strains.

The antibacterial properties of mayana (*C. blumei*) and Cavendish banana (*M. acuminata*) pseudostem have been the focus of several studies in the Philippines, revealing both their potential and limitations in combating different bacterial strains. Buniel's (2024) study at Surigao del Sur, found that Mayana (*C. blumei*), which contains phytoconstituents like alkaloids, saponins, and quercetin, had partial efficacy against *Escherichia coli* with Zone of Inhibition of 17mm and potent efficacy against *Staphylococcus aureus* with 26mm Zone of Inhibition. On the other hand, a study at Cebu Doctor's University found that *S. epidermidis* is resistant to mayana, with a mean ZOI (mm) below the target range of 28 mm. This means mayana has no bacterial effect against *Staphylococcus epidermidis* (Arguilles et al., 2019). Additionally, The ethanol extract from cavendish banana (*M. acuminata*) showed a higher inhibition zone of 9mm against *S. aureus*, whereas it showed that it has a lower inhibition zone of about 5 mm against the standard antibiotic ciproflaxin. It was then discovered that the ethanol extract of the banana was effective against the *S. aureus* bacterium (Balmes et al., 2018). However there are no studies that highlight their antimicrobial effects on the bacteria *P. aeruginosa*.

Several medicinal plants from the Philippines have shown inhibitory effects against *P. aeruginosa* indicating their potential as alternative antimicrobial treatments. According to Barcena et al. (2022) study, the extract of Indian goosegrass (*Eleusine indica*) which contains alkaloids, flavonoids, steroids, glycosides, and saponins, at 50 mg/mL has statistically significant activity ($p < 0.05$) against the swarming motility of *P. aeruginosa* and is 71.6% as effective as cinnamaldehyde in reducing the bacteria's swarming area. On the other hand, a study conducted using *Crescentia cujete*, commonly known as Calabash tree at various concentrations showed no zone of inhibition against bacteria, with an exception of an insignificant inhibition against *P. aeruginosa* by pure extract. The study concluded that *C. cujete* ethanolic fruit extract is not effective against *B. subtilis* and *P. aeruginosa* due to insufficient inhibitory activity (Bautista et al. 2023). The findings highlight the promising potential of Indian goosegrass (*E. indica*) extract as an alternative antimicrobial agent against *P. aeruginosa*, demonstrating significant inhibitory effects on bacterial swarming motility. In contrast, the lack of efficacy observed in Calabash tree (*C. cujete*) extract emphasizes the variability in antibacterial properties among different medicinal plants.

Furthermore, locally within the region of Davao, *P. aeruginosa* also poses risk to public health. In a study conducted in Davao city identified microbial organisms in water fountains and hand faucets in a school canteen and through biochemical methods, it was identified to be present with *P. aeruginosa*, which is a

frequent cause of pneumonia, urinary tract infections and bacteremia (Degayo et al., 2018). With the bacteria present, it became the leading cause of morbidity by causing pneumonia. According to the Philippine Statistics Authority (2023), pneumonia is the fifth leading cause of death in the Davao region for both sexes. Various health centers and pharmacies in Davao City offer pneumonia treatment and vaccines. However, because pneumonia is caused by *P. aeruginosa*, a bacteria resistant to multiple drugs, not all treatments and vaccines may completely eradicate it. This may force medical professionals to rely on more powerful and frequently costly treatments such as colistin or polymyxins (Karruli et al., 2023), which may not be available locally.

Multidrug-resistant bacteria such as *P. aeruginosa*, remain a significant global health threat, underscoring the urgent need for affordable and effective therapeutic alternatives. Although some studies have explored the antimicrobial potential of traditional herbal medicines, few have investigated the combined effects of different plant extracts. One promising combination that has yet to be explored is the cavendish banana pseudostem alongside mayana leaf, both of which have demonstrated individual antimicrobial properties from previous studies. Its potential involvement in suppressing the bacterium in combination remains unknown. This study was anchored on Germ's Theory of Disease by Louis Pasteur and Robert Koch, stating that specific diseases cause certain microorganisms. The theory is essential for understanding the bacterium *P. aeruginosa*, which is a frequent cause of infections such as pneumonia, urinary tract infections (UTIs), and bacteremia. This research is also based on Daniel Moerman's theory of non-random plant selection, which suggests that larger families are most likely to contain more medicinal plants than smaller ones. Understanding this selection can improve the discovery of new medicinal plants and plant organs with bioactive compounds beneficial to human health. Overall, this research aims to address the gap in knowledge regarding their potential synergistic effect against *P. aeruginosa*, offering a potential alternative treatment for combating multidrug-resistant bacteria.

Statement of the Problem

The bacterium *P. aeruginosa* has been a problem because of the diseases it causes. As the problems it causes increase, a need to find a natural and cost-effective alternative is crucial. Thus, specifically, this study seeks to answer the following research questions:

1. What are the zone of inhibition of mayana leaf (*C. blumei*) extract combined with the cavendish banana (*M. acuminata*) pseudostem pure extract required to inhibit the growth of *P. aeruginosa* in terms of;
 1. 100 µg/mL extraction of mayana leaf with 1 mg/mL of Cavendish banana pseudostem pure extract;
 2. 200 µg/mL extraction of mayana leaf with 1.5 mg/mL of Cavendish banana pseudostem pure extract;
 3. 300 µg/mL extraction of mayana leaf with 2 mg/mL of Cavendish banana pseudostem pure extract; and
 4. 1% w/v povidone-iodine solution?
2. What is the zone of inhibition (ZOI) of povidone-iodine used against *P. aeruginosa*?
3. Is there a significant difference in the zone of inhibition of the Mayana leaf (*C. blumei*) extract combined with the Cavendish banana (*M. acuminata*) pseudostem pure extract compared to povidone-iodine in inhibiting the growth of *P. aeruginosa*?

Hypothesis

The hypothesis of the study was tested at a 0.05 alpha level of significance.

Ho: There is no significant difference between the zone of inhibition of the mayana leaf (*C. blumei*) extract combined with the cavendish banana (*M. acuminata*) pure extract and the povidone-iodine control group in inhibiting the growth of *P. aeruginosa*.

Significance of the Study

Exploring the potential antimicrobial properties of the mayana leaf (*C. blumei*) and cavendish banana (*M. acuminata*) pseudostem is critical to understanding its benefits in combating *P. aeruginosa*. This study could be beneficial to the following groups:

Department of Health Officials. The findings of this research can give valuable insights into the antibacterial potential of cavendish banana pseudostem and mayana leaf extract against *P. aeruginosa*. This study could find natural antibacterial agents, sustainable and cheaper alternatives to traditional treatments, and beneficial in preventing pneumonia and other diseases.

Medical Practitioners. Healthcare providers can benefit from this research study as it leads to an innovative perspective and new treatment strategies in treating *P. aeruginosa*. Healthcare professionals may also consider using this herbal remedy extract in combating antibiotic-resistant bacteria.

Food and Drug Administration Personnel. Drug development professionals can use the results of this study to find ways to enhance existing formulations or produce new antimicrobial products. Experts can also use the findings to innovate therapies from natural products that meet the demand for alternatives to standard antibiotics.

Patients. Individuals who are infected with *P. aeruginosa* can benefit from this study as it provides a natural alternative in treating the bacteria. Additionally, this may potentially lower the cost of treating such infections and could enhance the overall health of the affected individuals.

Pharmaceutical Researchers. Drug researchers who retail and develop healthcare products can use the result of the research study in exploring and developing cost-effective herbal remedies as an alternative to traditional antibiotics. Hence, it could improve public health outcomes and could widen healthcare options in combating antibiotic-resistant diseases.

Future Researchers. This study can benefit future researchers by providing thorough insights that they could use to stimulate further studies. The researchers may use the findings to advance knowledge in developing natural and environment-friendly therapies.

Scope and Limitations

This study focused primarily on the potential germicide properties of cavendish banana (*M. acuminata*) pseudostem and mayana leaf (*C. blumei*) extracts against the bacteria *P. aeruginosa*. The researchers conducted the study in a local hospital laboratory in Digos City, Davao del Sur, and it was completed in the first and second semesters of the academic school year of 2024 to 2025. The process involved preparing the independent variable, the cavendish banana pseudostem and mayana leaf extracts, and the cultivation of the dependent variable, *P. aeruginosa*.

The study is limited to an in vitro experiment, in which the bacteria were cultured on petri dishes and the administration of the antimicrobial agent was through the different concentrations of the extract, utilizing the agar diffusion technique. Thus, the efficacy of the extract in vivo experiment was not assessed in the study. Furthermore, the study followed a controlled setting and standardized an appropriate procedure to assess the data accurately.

Definition of Terms

The following terms were defined to have a better understanding of this study.

Antimicrobial Properties. A chemical and physical agent used to eliminate and prevent the growth of a microorganism (Britannica, 2024). Specifically, in this study, this refers to the bioactive properties in the cavendish banana pseudostem and mayana leaf extracts which could hinder the growth or development of

multidrug-resistant bacteria, *P. aeruginosa*, thereby preventing diseases that it may bring about. This is assessed through measuring the Zone of Inhibition.

Cavendish Banana Pseudostem extract. It refers to the pure extract from the pseudostem or the trunk of a cavendish banana (*M. acuminata*) tree, a common variety in the Philippines with known antibacterial properties (Nielsen et al., 2022). In this study, it was processed into an extract to be utilized for inhibiting the growth of *P. aeruginosa* bacteria.

Mayana. A widely known ornamental plant in the Philippines for its colorful foliage, traditionally used to treat bruises and boils (Medina & Cardenas, 2017). In this study, the mayana (*C. blumei*) leaves were utilized by soaking in ethanol for extraction and combined with the cavendish banana pseudostem extract which will be the medium to inhibit *P. aeruginosa* bacteria.

***Pseudomonas aeruginosa*.** An opportunistic gram-negative bacterium that is typically present in areas with high moisture content (Sapkota, 2023). In this study, it was utilized to evaluate the antimicrobial properties of cavendish banana pseudostem combined with mayana leaf extract by looking at the zone of inhibition.

METHODS

This chapter outlines the methodologies utilized in conducting the study. It includes a comprehensive discussion of the research design, respondents, sampling techniques, measures, data gathering procedure, data analysis, and interpretation, as well as the ethical considerations observed throughout the study.

Research Design

This study utilized a true experimental, posttest-only control group design, a type of quantitative research. Subjects were randomly assigned to either an experimental group receiving varying concentrations of the plant extract or a control group, which was treated with povidone iodine, a synthetic antiseptic used externally for disinfection and prevention of infections (Sircilla, 2023; Chandrababu, 2022). The intervention was administered once, and the outcome, bacterial growth, was measured only after the treatment to evaluate its effectiveness (Bhattacharjee, 2019). The independent variable (treatment type and concentration) was deliberately manipulated by the researchers, while key control variables such as bacterial strain, incubation period, and environmental conditions were kept constant to ensure valid and reliable results.

Subjects of the Study

This study focused on bacteria, specifically *Pseudomonas aeruginosa*, a gram-negative bacterium. It is a versatile and opportunistic pathogen that can develop resistance to various medications. According to Sanya et al., (2023), *P. aeruginosa* is an ideal subject for a research study due to its ability to resist multiple antibiotics and biofilm formation capabilities. The global spread of antibiotic-resistant *P. aeruginosa* poses a significant health threat, necessitating urgent action for better antibiotic stewardship, infection control, and new therapeutic options [World Health Organization (WHO), 2021].

This study chose the bacteria *P. aeruginosa* in accordance with the goal of producing a cost-effective alternative treatment to reduce or eradicate the harmful effects of the bacteria. The researchers obtained the subjects of the study by isolating *P. aeruginosa* from the microbial stock of a private hospital's laboratory through subculturing, and it was confirmed using Gram staining and colony morphology. With the help of a licensed medical laboratory scientist, the 12 bacteria cultures were prepared on Petri dishes. The study focused on employing microorganisms and did not consider other aspects. The experiment was conducted on the sole premises of a private hospital in Digos City, which is responsible for carrying out the studies and providing all required materials.

Sampling Technique

The study utilized a Completely Random Design (CRD) for subject selection in the experiment. The researchers randomly selected a bacterium devoid of any systematic bias. This way, researchers could ensure

that the subset of bacteria used in the experiment was neutral and representative. CRD is a research methodology in which experimental units are randomly assigned to treatments without any systematic bias (Costello, 2023). The random nature of CRD helps minimize the influence of external factors. By giving each subject an equal chance of receiving treatment, CRD eliminates bias and enhances the reliability of the findings. Furthermore, the research intends to mitigate risks in research biases and show strong validity by utilizing a completely random design. Thus, applying this specific sampling approach ensures the enhancement of the validity and soundness of the findings in this study, ensuring the study's credibility.

Measures

To determine the potential antiseptic activity of the maypana (*Coleus blumei*) and banana cavendish (*Musa. acuminata*) pseudostem extracts to the bacteria *P. aeruginosa*, this quantitative study will adopt the Zone of Inhibition Test or also known as the Kirby Bauer Test. First developed in the 1950's and then standardized by the (WHO) in 1961, the Zone of Inhibition Test is commonly used as a fast and accessible method to measure the antimicrobial activity of a material or solution against a specific microorganism (Nelson, 2019). The process will include the cultivation of *P. aeruginosa*, preparation of mayana leaf extract and cavendish banana pseudostem extract, as well as the preparation of the Agar plates. The preparation of the Agar plates will be done by establishing a proper sterilization and a 24 hour incubation at 37° C prior to the experiment. In measuring the Zone of Inhibition growth, every diameter of the zone of inhibition will be measured with an indication (Bayston, 2017) . To assess the efficacy of the extracts, the reading of the zone of inhibition will follow three identifications . In the identification, the diameter of zone inhibition will be considered resistant if it is $\leq 14\text{mm}$, moderately sensitive if it is 15mm-16mm , and sensitive if $\geq 17\text{mm}$ (Hudzicki, 2016).

Table 1. Interpretation of Zone of Inhibition

Mean Score Interval	Descriptive Equivalent	Interpretation
>17mm	Susceptible	The antibacterial activity showed an excellent image of the zone of inhibition.
15.00 mm – 17.00mm	Moderate	The antibacterial activity showed a fair image of the zone of inhibition.
<15 mm	Resistant	The antibacterial activity showed a poor image of the zone of inhibition.

The research aimed to demonstrate the therapeutic effect of the combination of mayana leaf extract and cavendish banana pseudostem against the immune bacteria *P. aeruginosa*. In the post-evaluation, the data collected has undergone a systematic analysis and further discussion of the results.

Data Gathering Procedure

Gathering the data requires the researchers to follow the procedures below to obtain the necessary information:

Preparation of mayana leaf and cavendish banana pseudostem

1. The researchers collected sufficient mayana leaves in the afternoon from a local area and obtained the cavendish banana pseudostem by cutting the pseudostem at a nearby banana plantation.
2. The mayana leaves and cavendish banana pseudostem will be thoroughly washed using clean water to remove dirt and impurities.
3. The mayana leaves were air-dried in the shade at room temperature for at least 2-3 days to preserve their bioactive compounds while keeping the cavendish banana pseudostem in a container.

Extraction of Compounds

The process of extraction of the mayana leaves crude extract was based on the study of Yesmin et al. (2020) and Prayoga (2019). Also, the process of extraction of the cavendish banana pseudostem is based on the study Miglani et al. (2023) where the sugarcane's bark extract was obtained through mechanical pressing.

1. To extract the ethanolic extract of the mayana leaf, the leaves were air-dried for 3 days. Then, it was measured using a weighing scale to ensure that at least enough mayana leaves were prepared.
2. After obtaining 135 grams of mayana leaves, the researchers sterilized the laboratory materials such as beakers, stirring rods, and containers to contain the mayana.
3. Afterward, the researchers formulated the solution by preparing 661.5 ml of ethanol and 283.5 ml of distilled water to have a 945 ml solvent.
4. The mayana was then put into the clear container before the solvent was added. It was then stirred and the leaves were pressed underneath to ensure no molds may surface the solution after being left at room temperature for 1 week.
5. After a week, the extract was brought to a research laboratory to have the ethanol removed until only the crude extract of mayana was left. Since there is no rotary evaporation available, the researchers used simple distillation as an alternative.
6. Before distillation, the solution was filtered using a fine-mesh filter or Whatman filter paper to remove any solid plant residues, ensuring a clear extract for distillation.
7. The laboratory setup included a distillation flask, a condenser, a receiving flask, rubber tubing for water circulation, a water bath to provide controlled heating, and a thermometer to monitor the temperature. The apparatus was carefully assembled to prevent leaks and errors.
8. The simple distillation process involved heating the filtrate in the distillation flask using a water bath to gradually evaporate ethanol, which has a lower boiling point ($\sim 78.5^{\circ}\text{C}$) compared to water and the crude extract. The vaporized ethanol traveled through the condenser, where it was cooled and collected in the receiving flask. The temperature was closely monitored to ensure effective separation.
9. Once the ethanol was fully evaporated, the remaining crude extract was transferred into a sterilized reagent bottle for storage. The bottle was sealed tightly to prevent contamination and degradation of the extract before further testing.
10. To obtain the cavendish banana pseudostem pure extract, the pseudostem was thoroughly washed to remove dirt and impurities.
11. Since there is no available machine for mechanical pressing, the researchers used hand pressing as an alternative as suggested by the statistician from the research laboratory.
12. The researchers ensured that the materials needed for the process are sterile before finely chopping the pseudostem.
13. After the pseudostem was finely chopped, it was placed in the food processor for extraction. Then, the processed pseudostem was manually pressed for further extraction.
14. The extract was then filtered using a Whatman filter paper to ensure that no residues were mixed with the solution.
15. The extract was then placed in a sterile container and put in a cold temperature to ensure that the bioactive compounds will remain.

Preparation of Mixed Extracts

The concentrations used are based on the study of Mpila et. al (2012) where it highlighted the capability of mayana to inhibit the *P. aeruginosa*, while the used concentration for the pseudostem pure extract is based on the study of Ismail et al. (2018) where it shows the ability of the acetate extract of the cavendish banana pseudostem in inhibiting the *P. aeruginosa*.

1. For the Mayana leaf extract, the researchers will prepare the solutions in different concentrations of 100 µg/mL, 200 µg/mL, and 300 µg/mL.
2. For the cavendish banana pure extract, the researchers will prepare 1mg/mL, 1.5 mg/mL, and 2mg/mL.
3. After preparing the two extracts, the prepared solutions was mixed in the combinations of 100 µg/mL of mayana with 1 mg/mL of cavendish banana pseudostem, 200 µg/mL of mayana with 1.5 mg/mL of cavendish banana pseudostem, and 300 µg/mL of mayana with 2 mg/mL of cavendish banana pseudostem.
4. The extracts were then combined by volume equal parts (1:1 ratio) and were shaken manually for 20 seconds.
5. The extract was then placed in a sterile container and stored at 4 °C to ensure that the active compounds would remain.

Antimicrobial testing

The interpretation of the zone of inhibitions used for assessing the ability of the mayana leaf extract with cavendish banana pseudostem pure extract is based on the table of Hudziki (2016).

1. The researchers prepared the necessary documents needed for laboratory requests, to ensure a smooth process. They then coordinated with the hospital's laboratory head to discuss the testing procedures and safety measures.
2. The Kirby-Bauer test was used to test the antimicrobial activity of the extracts. This method measures the zone of inhibition, which is the clear area around the wells where bacterial growth is prevented.
3. The microbial stock present in the laboratory was used for subculturing and subsequent isolation of a pure strain of *P. aeruginosa* and was confirmed using colony morphology and gram staining.
4. A total of 12 petri dishes were prepared with three petri dishes allocated for the treatment group, including the positive and negative controls.
5. The researchers worked with the laboratory head to follow proper testing protocols and were trained in handling bacteria safely.
6. The extracts were prepared in small tubes in different concentrations using a micropipette: mayana leaf extract 100 µg/mL and 1 mg/mL of cavendish banana pseudostem extract, 200 µg/mL of Mayana and 1.5 mg/mL of cavendish banana pseudostem extract, 300 µg/mL of mayana leaf extract with 2 mg/mL of cavendish banana extract, and 1% w/v of the povidone-iodine solution as the control group.
7. To ensure consistent bacterial concentration across all agar plates, the bacterial suspension was first standardized by comparing its turbidity to a 0.5 McFarland standard ($\sim 1.5 \times 10^8$ CFU/mL).
8. Afterwards, it was then carefully spread evenly across the agar surface using a sterile cotton swab.
9. The researchers added 30 µL of each extract into the wells and then the plates were incubated at 37°C for 24 hours.

10. After incubation, the zones of inhibition (in mm) were measured using a digital caliper to determine the effectiveness of the extracts.
11. The results were recorded, and comparisons were made between the plant extracts and the controls to assess their antimicrobial activity.

Analysis and Interpretation

This study will utilize various statistical techniques to analyze the antimicrobial properties of Mayana and cavendish banana pseudostem extracts against *P. aeruginosa*, specifically:

Mean. The average of all the numbers within a data set can be found by dividing the sum of all the numbers within the data set by the number of data points (Hurley & Tenny, 2023). It served as a measure of the average size of the inhibition zones, expressed in millimeters. It was observed around agar plates for each test concentration ratio of mayana leaf extract combined with cavendish banana pseudostem extract.

Kolmogorov–Smirnov Test. This test is a non-parametric tool commonly used to assess whether a dataset significantly deviates from a specified distribution, most often the normal distribution (Yang, 2021). In this study, the one-sample K–S test was used to evaluate whether the distribution of inhibition zone measurements within each treatment group comply with the normal distribution. This analysis helped determine whether the data met the assumptions required for parametric testing.

Kruskal–Wallis H Test. The Kruskal–Wallis test is a non-parametric statistical method employed to compare two or more independent groups when the underlying data violate the assumptions of normality, as is often the case with skewed or ordinal data (McClenaghan, 2024). In the present study, the Independent-Samples Kruskal–Wallis test was applied to assess differences in inhibition zones across treatment groups, given its suitability in handling non-normally distributed data.

As the Kruskal–Wallis test indicates only the presence of overall group differences without identifying where those differences occur, a post hoc analysis was conducted. Specifically, Dunn’s test with Bonferroni correction was used for pairwise comparisons to determine which treatment groups differed significantly. This approach controls for Type I error across multiple comparisons, ensuring the reliability of the observed differences between groups.

Ethical Considerations

The researchers ensured that procedures were taken in accordance with ethical considerations for research.

Laboratory Safety. The researchers obtained all the necessary documents, such as approval letters and laboratory requests, to ensure the study followed proper protocols. The study adhered to ethical guidelines by ensuring that no humans or animals were involved as subjects. Additionally, the researchers made sure that no harm was caused to the environment or living organisms during the collection of the extracts. The researchers also maintained a sterile environment throughout the experiment by gathering the required materials, utilizing sterile equipment, and using proper protective gear. Finally, the bacteria were disposed of safely after use, following the correct procedures.

Data Integrity. The data collection process was assisted by a medical technologist, who helped interpret results, ensure accuracy in measurements, and identify any anomalies in the data. Additionally, to ensure reliable data analysis, a statistician contributed by performing accurate analyses and interpreting the results to draw valid conclusions. They ensured that the data was reliable, the analysis was sound, and the findings were statistically significant. Furthermore, proper control groups were used during the testing of the extracts against *P. aeruginosa* to ensure that the observed effects were due to the treatment and not confounding factors. Finally, all previous studies, data, or methods used in the research were properly cited to avoid plagiarism.

RESULTS AND DISCUSSION

This chapter deals with the presentation, analysis, and interpretation of data. The first section discusses the levels of antibacterial activity on each concentration of mayana and cavendish banana pseudostem combined pure extract, including the commercial treatment, povidone-iodine. The second section highlights the significance of the difference among different concentrations in inhibiting the growth of *Pseudomonas aeruginosa*. The data was further analyzed using the Independent-Samples Kruskal-Wallis Test.

Antimicrobial Properties of the Different Concentrations of Mayana Leaf and Cavendish Banana Pseudostem Extract in Inhibiting *P. aeruginosa*

The study determined the effectiveness of the minimum inhibitory concentration of mayana leaf extract combined with the cavendish banana pseudostem pure extract required to inhibit the growth of *P. aeruginosa* with three different treatments: Treatment 1 - 100 μ L/mL extraction of mayana leaf with 1 mg/mL of cavendish banana pseudostem pure extract; Treatment 2 - 200 μ L/mL extraction of mayana leaf with 1.5 mg/mL of cavendish banana pseudostem pure extract; and Treatment 3 - 300 μ L/mL extraction of mayana leaf with 2 mg/mL of cavendish banana pseudostem pure extract. The researchers determined the antimicrobial properties of mayana and cavendish banana pseudostem pure extract on each concentration by seeing the size of the zone of inhibition per treatment in each technical replicates (R1, R2, R3). Table 2 presents the antibacterial properties of mayana and cavendish banana pseudostem pure extract at varying concentrations, with a focus on the inhibition of *P. aeruginosa*. The results indicated that the treatments exhibited antibacterial activity against *P. aeruginosa*. The samples treated with T1, which contained 100 μ L/mL extraction of mayana leaf with 1 mg/mL of cavendish banana pseudostem pure extract, and T3, which contained 300 μ L/mL extraction of mayana leaf with 2 mg/mL of cavendish banana pseudostem pure extract, displayed a close mean with 19 mm and standard deviation of 1.53, 20.67 mm and standard deviation of 2.08 respectively, both categorized as susceptible inhibition, with T3 being the highest. On the other hand, as shown on the table, the T2 treatment which contains 200 μ L/mL extraction of mayana leaf with 1.5 mg/mL of cavendish banana pseudostem pure extract, displayed a minute gap or difference compared to the other treatments. Its zone of inhibition was lower, but it was not significantly different, with a mean of 18 mm and a standard deviation of 2.52, indicating susceptible inhibition. Hence, the researchers attained the following results.

Table 2. Antimicrobial Properties of the Different Concentrations of Mayana Leaf and Cavendish Banana Pseudostem Extract in Inhibiting *Pseudomonas aeruginosa*

Treatments	Zone of Inhibition (in mm)			Mean	SD	Description
	R1	R2	R3			
T1	17	19	20	19	1.53	Susceptible
T2	15	18	20	18	2.52	Susceptible
T3	19	20	23	21	2.08	Susceptible

The obtained findings were tested in triplicate using three independent bacterial cultures on separate petri dishes, serving as biological replicas. This is supported by the study of Buniel (2024), which states that mayana (*Coleus blumei*), which contains phytoconstituents like alkaloids, saponins, and quercetin, had antibacterial efficacy against bacteria, including partial efficacy against *Escherichia coli* with a 17 mm zone of inhibition and potent efficacy against *Staphylococcus aureus* with a 26 mm zone of inhibition. Moreover, according to Bhattacharjee and Singh (2024), banana pseudostem traditionally used for nutrition and medicine, contains bioactive compounds such as flavonoids, tannins, and terpenoids that exhibit potent antioxidant, antibacterial, and anti-inflammatory properties, contributing to treatments and wound healing. Thus, this is supported by a study on the extract of cavendish banana pseudostem (*Musa acuminata*) showing a higher inhibition zone of 17 mm to *P. aeruginosa* (Verma & Singh, 2016). This could imply that there is a synergistic effect of the cavendish banana pseudostem and mayana as an antimicrobial extract against *P. aeruginosa*.

Antimicrobial Property of Commercial Treatment on *Pseudomonas aeruginosa*

The study included the antimicrobial property of the positive control using commercial treatment for *P. aeruginosa* using 1% w/v of povidone-iodine solution. The amount of povidone-iodine used was 30 µL/mL for each petri dish. The researchers determine the antimicrobial efficacy of the commercial product, povidone iodine, by seeing the size of the zone of inhibition in the three replications (R1, R2, R3). Table 3 shows that there is significant antimicrobial activity of povidone iodine, with a mean of 26.00mm and standard deviation of 1.00 indicating a susceptible inhibition against the bacteria. Hence, the researchers obtained the following results.

Table 3. Antibacterial Property of Commercial Treatment on *Pseudomonas aeruginosa*

Treatments	Zone of Inhibition (in mm)			Mean	SD	Description
	R1	R2	R3			
Povidone-iodine	26	25	27	26.00	1.00	Susceptible

This finding is supported by Nielson and Motaparthi (2021), which states that povidone-iodine is a powerful antimicrobial agent against a wide range of bacteria, both gram-positive and gram-negative. Furthermore a similar study conducted by Seema et al. (2024), povidone iodine commonly known as betadine in 100%, showed the strongest antibacterial activity against *L. acidophilus* and *E. coli* strains with 23mm and 18mm inhibition zones, respectively. Povidone iodine in low concentrations exhibits a high level of safety and tolerability, as well as quick broad-spectrum effectiveness against bacteria, including *P. aeruginosa*, fungi, viruses, protozoa, and biofilms (Castelnuovo, 2022). Thus, povidone-iodine has long been recognized as a potent and effective antimicrobial agent.

Significant Difference in the Antimicrobial Properties of the Different Concentrations of Mayana Leaf and Cavendish Banana Pseudostem Extract Compared to the Commercial Treatment in Inhibiting *Pseudomonas aeruginosa*

Table 3 presents the results of the comparative analysis of the antibacterial properties between the experimental groups and the control group, based on the zone of inhibition. To evaluate the statistical validity of the study, a normality test using the Kolmogorov-Smirnov test was conducted to determine if the data followed a normal distribution. The test indicated a significant deviation from normality ($W = 0.247$, $p = 0.042$), suggesting that the data on the inhibitory properties of the treatment did not meet the assumptions necessary for parametric analysis. As a result, alternative statistical methods were considered. Therefore, the Kruskal-Wallis H Test was employed for the analysis. This non-parametric method is appropriate for comparing treatments without requiring normality, given that the data is skewed. As stated by Fein et al. (2022), when examining the differences between three or more variables, the Kruskal-Wallis H Test is more suitable especially when the data does not meet the assumptions for a standard one-way ANOVA, where the data might be skewed.

It can be noted that the test statistic value for the overall zone of inhibition is 7.607, with 3 degrees of freedom and a p-value of 0.055 which is greater than 0.05. This means that the study failed to reject the null hypothesis. This indicates that there is no significant difference on the inhibitory property of the experimental and control treatments when observed using the zone of inhibition. Further, this means that the different treatments have comparable levels of effectiveness in inhibiting *P. aeruginosa*.

Table 4. Significant Difference in the Antimicrobial Property of the Different Concentrations of Mayana Leaf and Cavendish Banana Pseudostem Extract Compared to the Commercial Treatment in Inhibiting *Pseudomonas aeruginosa*

Variables Reviewed	Test Statistic	df	p-value	Decision	Interpretation
Zone of Inhibition	7.607	3	0.055	Failed Reject H_0	No Significant Difference

The zone of inhibition of the treatments was analyzed using statistical testing that yields 7.607 with a $df=3$ and a $p\text{-value}=0.055$ which is slightly higher than the standard alpha level of 0.05. This indicates that we failed to reject the null hypothesis, as the results demonstrate no significant difference between the antimicrobial effects of the mayana and cavendish banana pseudostem pure extract and the control group (povidone-iodine). Moreover, the results suggest that the mayana and cavendish banana exhibits antimicrobial activity comparable to povidone-iodine against *P. aeruginosa*.

Related studies highlight the ability of plant extract's bioactive compounds such as flavonoids, tannins, and other phenolic compounds in inhibiting bacterial growth through cell membrane disruption and enzyme inhibition. A study by Akinpelu et al. (2009) assessed the biocidal and cell membrane disruption the aqueous and butanol extract of the stem bark of *Afzelia africana* where it shows antimicrobial activity with minimum inhibitory concentration of 0.313 and 2.5 mg/ml. In contrast, povidone-iodine inhibits the bacteria through oxidative damage and protein disruption (Eggers, 2019). Therefore, the difference in results may be due to its mechanisms in inhibiting bacteria.

Additionally, although there is significant antimicrobial activity from the mayana and cavendish banana pseudostem pure extract, it is not relatively significant in comparison with the commercial product. However, when the concentration of extracts increased, so did their potency. This suggests that refining the concentration plant-based extracts can be explored and used as a natural antimicrobial alternative as a cost-effective and sustainable option. This can be seen in the study of Almawlah et al. (2017), stating that the highest concentration of pomegranate (*Punica gratum*) extract showed the highest inhibition against *P. aeruginosa* for all types of extraction methods with 38 mm for ethanolic extract, 36 mm for methanolic extract and 22 mm for the water extract.

These findings are supported by Daniel Moerman's theory of non-random plant selection (1979), which emphasizes the purposeful selection of plants based on their perceived medicinal value. In this context, the combined extract of mayana and cavendish banana pseudostem exemplifies the potential of such selections, as enhanced knowledge of medicinal plants can lead to the discovery of new plants and specific plant organs rich in bioactive compounds that benefit human health and well-being (Gaoe et al., 2021). Moreover, this research is supported by the Germ Theory of Disease by Pasteur and Koch (1861) which states that specific diseases are caused by certain microorganisms, thus this can be inhibited through the use of antimicrobial agents.

Overall, the mayana leaf extract combined with cavendish banana pseudostem against the bacterium *P. aeruginosa* has produced significant results, with findings supported by other studies. These results suggest that, with further research and optimization of its phytochemicals this combination could have potential applications in the medical field. However, when compared to the commercial antimicrobial agent, povidone-iodine, which remains highly effective against the bacterium, the combination of mayana leaf extract and banana pseudostem may still require further development to match its potency.

Summary

In summary, the study was able to bridge the research's gap in the discovery that the combination of the antimicrobial properties present in mayana leaf (*C. blumei*) and cavendish banana (*M. acuminata*) pseudostem which showed synergistic efficacy in inhibiting *P. aeruginosa*, and the bacteria are susceptible to the agent. However, the effectiveness of the antimicrobial agent was not able to surpass the performance exhibited by the Povidone-iodine. Statistical analysis revealed no significant difference in antimicrobial activity between the natural extracts and the control treatment. Therefore, the null hypothesis was not rejected. Although the extracts demonstrated potential antibacterial activity, further research is needed to enhance their potency and explore possible synergistic effects or alternative formulations. This highlights a gap in the development of plant-based antimicrobials that are equally or more effective than standard commercial agents.

CONCLUSIONS

1. The results of the first, second, and third treatment revealed that the mayana leaf extract combined with the cavendish banana pseudostem pure extract exhibits antimicrobial properties and is effective in inhibiting the growth of *P. aeruginosa*.

2. The commercial product which is the povidone-iodine solution has shown excellent efficacy in resisting *P. aeruginosa*.
3. The plant extract shows potential and efficacy in treating *P. aeruginosa* but is not superior compared to povidone-iodine.
4. All in all, the effectiveness of the antimicrobial activity against *P. aeruginosa* was not significantly different from the povidone-iodine.

RECOMMENDATIONS

These findings lead the researchers to suggest the following:

1. For the Department of Health officials, the researchers suggest conducting thorough research and clinical trials on utilizing mayana and cavendish pseudostem pure extract against *P. aeruginosa*. This could be beneficial in finding natural, sustainable and cheaper alternatives to antibiotics.
2. For medical practitioners, it is recommended to carry out comprehensive studies in the implementation of mayana and cavendish banana pseudostem in combating bacterias such as *P. aeruginosa*.
3. The Food and Drug Administration personnel can also utilize the findings of the study to further explore and conduct interventional studies. This could help in finding new drugs and meet the demands for alternatives to standard antibiotics.
4. For patients, although the initial results are encouraging. The researchers suggest that patients avoid self-medication. Further clinical studies are required to ensure safety, efficacy, and appropriate dosage before any medical application is advised.
5. Researchers suggest that pharmaceutical researchers use the findings in this experiment to further explore the effectiveness of utilizing mayana extract and cavendish banana pseudostem against *P. aeruginosa*. This could help in developing cost-effective alternatives to traditional antibiotics and widen healthcare options in combating antibiotic-resistant diseases.
6. Future research could focus on refining extraction techniques, enhancing formulation stability, and exploring possible synergistic effects with other antimicrobial agents.

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Ametur Cor Jesu! Ametur Cor Mariae!

APPROVAL SHEET

This study entitled “**ACULEUNAS: EXPLORING THE ANTIMICROBIAL PROPERTIES OF MAYANA (*Coleus blumei*) AND CAVENDISH BANANA (*Musa acuminata*) PSEUDOSTEM PURE EXTRACT AGAINST *Pseudomonas aeruginosa***” prepared and submitted by, **AVA KATHAREEN S. ADLAWAN, XIANAN MHE A. AGUNOD, LOTIS KATE A. ARAÑA, AMIEL HELLA E. BERNALDO, BABE XYZETTE R. CARIQUITAN, ZAC ROBERT ANTHONY C. DINSAY, RAXENNE GWYNETH B. REYES, and JOHN BENEDICT R. TEMPLA**, in partial fulfillment of the requirements in the Practical Research, is hereby accepted.

CLEFORD JAY D. BACAN, MAEd

Adviser

Date Signed

NIEKY MAE B. GUMERA, LPT

ALMIRA A. BATULANON, MEDLT

Member

Member

Date Signed

Date Signed

MARK JOBERT C. ELLAGA, LPT

Chairperson

Date Signed

Accepted and approved in partial fulfillment of the requirements for the Practical Research in the Senior High School Program.

JUN REY DEQUINÁ, MATCC

School Principal

Basic Education Department

Cor Jesu College, Inc.

Date

Signe

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APPENDIX

Appendix A

Certificate of Editing and Statistical Review



CERTIFICATE OF EDITING AND STATISTICAL REVIEW

Name of Students: AVA KATHAREEN S. ADLAWAN, XIANAN MHE AGUNOD, LOTIS KATE A. ARANA, AMIEL HELLA BERNALDO, XYZETTE BABE CARIQUITAN, ZAC ROBERT ANTHONY DINSAY, RAXENNE REYES, AND JOHN BENEDICT TEMPLA

Grade and Specialization: GRADE 12 – HEALTH STUDIES

Research Title: ACULEUNAS: EXPLORING THE ANTIMICROBIAL PROPERTIES OF MAYANA (*Coleus blumei*) AND CAVENDISH BANANA (*Musa acuminata*) PSEUDOSTEM PURE EXTRACT AGAINST *Pseudomonas aeruginosa*

PART I. For Editor

This is to certify that the above study, prepared as a requirement for the basic education, was submitted to the undersigned for grammar checking and proofreading. I endorse the manuscript submitted as it has generally met the standards and requirements, including the form and style as prescribed by Cor Jesu College.

Signed: APPLE JOY P. FLORES, Med-IT

Date: 04/14/25

PART II. For Statistician

I endorse the manuscript submitted by the student with the statistical requirements checked and found appropriate for the purpose(s).

Signed: CLEFORD JAY D. BACAN, MAEd-MT

Date: 4/14/25

PART III. For Research Adviser/Mentor

I am satisfied with the student's manuscript and accept this in partial fulfillment of the requirements for the degree identified.

Signed: CLEFORD JAY D. BACAN, MAEd-MT

Date: 4/14/25

Appendix B

Letters of Approval



January 24, 2025

JUN REY D. DEQUINA, MATCC
School Principal
Cor Jesu College, Inc.
Sacred Heart Ave., Digos City

Dear Sir,

We, the Senior High School students at Cor Jesu College, Inc., are currently conducting a research project entitled "Aculeunas: Exploring the Antimicrobial Properties of Mayana (*coleus blumei*) and Cavendish Banana (*musa acuminata*) Pseudostem Against *Pseudomonas aeruginosa*" which is a partial fulfillment for requirements in Research 3. In this connection, we would like to ask permission to conduct the study and use the laboratory materials and facilities at Davao del Sur State College.

The study aims to assess the antimicrobial property of mayana leaves and banana pseudostem extract against *Pseudomonas aeruginosa*. The research will be conducted under the supervision of our research teacher, ensuring all necessary safety and ethical protocols are followed. We will ensure minimal disruption to the school environment and will adhere to all guidelines set by the administration. We humbly request your approval to proceed with the study and access to the necessary facilities for the proper conduct of the experiment. Should you require any further details or clarification, we are more than willing to meet with you at your convenience to discuss the study further.

Thank you very much for your time and consideration. We look forward to your positive response and support.

Yours sincerely,

ADLAWAN, AVA KATHAREEN S.
AGUNOD, XIANAN MHE A.
ARANA, LOTIS KATE A.
BERNALDO, AMIEL HELLA E.
CARIQUITAN, BABE XYZETTE R.
DINSAY, ZAC ROBERT ANTHONY C.
REYES, RAXENNE GWYNETH
TEMPLA, JOHN BENEDICT R.

Noted by:

CLEFORD JAY D. BACAN, MAEd-MT
Research Teacher



COR JESU COLLEGE, INC.

Sacred Heart Avenue, Digos City, Province of Davao del Sur, Philippines
Tel. No. (082) 553-2433 local 101 • Fax No. (082) 553-2333 • www.cjc.edu.ph

January 23, 2025

DR. AUGIE E. FUENTES, PhD
College President
Davao del Sur State College
Matti, Digos City, Davao del Sur

Dear Sir/Madam,

We, the Senior High School students at Cor Jesu College, Inc., are currently conducting a research project entitled "**Aculeunas: Exploring the Antimicrobial Properties of Mayana (*Coleus blumei*) and Cavendish Banana (*Musa acuminata*) Pseudostem Against *Pseudomonas aeruginosa***" which is a partial fulfillment for requirements in Research 3.

Our study aims to evaluate the antimicrobial properties of mayana leaf and cavendish banana pseudostem extracts against *Pseudomonas aeruginosa*. In this connection, we would like to request your permission to use the laboratory and the materials to perform the steam distillation of our extracts. To ensure the proper conduct of the experiment, we would need access to equipment such as a heating flask, extraction column, condenser, collection flask, tape, and insulation funnel.

We would like to assure you that all safety guidelines and protocols will be strictly followed as the extraction will be conducted under the supervision of Prof. Kris Kristofferson Tan.

Thank you very much for your time and consideration. We look forward to your positive response and support.

Yours sincerely,

ADLAWAN, AVA KATHAREEN S.
AGUNOD, XIANAN MHE A.
ARAÑA, LOTIS KATE A.
BERNALDO, AMIEL HELLA E.
CARIQUITAN, BABE XYZETTE R.
DINSAY, ZAC ROBERT ANTHONY C.
REYES, RAXENNE GWYNETH
TEMPLA, JOHN BENEDICT R.

Noted by:

CLEFORD JAY D. BACAN, MAEd-MT
Research Teacher

Approved by:

JUN REY D. DEQUIÑA, MATCC
School Principal



COR JESU COLLEGE, INC.

Sacred Heart Avenue, Digos City, Province of Davao del Sur, Philippines
Tel. No. (082) 553-2433 local 101 • Fax No. (082) 553-2333 • www.cjc.edu.ph

January 24, 2025

ARA REMEA D. AMAHAN, RMT
Chief Medical Technologist
Laboratory Department
Digos Doctors Hospital, Inc.

Greetings, Ma'am:

We are Senior High School students from Cor Jesu College, Inc. and are presently conducting a research paper entitled "**Aculeunas: Exploring the Antimicrobial Properties of Mayana (*Coleus blumei*) and Cavendish Banana (*Musa acuminata*) Pseudostem Against *Pseudomonas aeruginosa***" which is a partial fulfillment for requirements in Practical Research 2. As part of our study's data gathering method, we are writing this letter to purchase the bacterium *Pseudomonas aeruginosa* and to also have the antimicrobial testing in the hospitals laboratory for the said research purpose.

If you require any additional information from our end to process this inquiry, please let us know. You can reach us at avaadlawan@gmail.com or 0939-8318-747

Thank you very much and God bless.

Yours sincerely,

ADLAWAN, AVA KATHAREEN S.
AGUNOD, XIANAN MHE A.
ARAÑA, LOTIS KATE A.
BERNALDO, AMIEL HELLA E.
CARIQUITAN, BABE XYZETTE R.
DINSAY, ZAC ROBERT ANTHONY C.
REYES, RAXENNE GWYNETH
TEMPLA, JOHN BENEDICT R.

Noted by:

CLEFORD JAY D. BACAN, MAEd-MT
Research Teacher

Appendix C

Financial Statement



COR JESU COLLEGE, INC.

Sacred Heart Avenue, Digos City, Province of Davao del Sur, Philippines
Tel. No. (082) 553-2433 local 101 • Fax No. (082) 553-2333 • www.cjc.edu.ph

**PRACTICAL RESEARCH 2
FINANCIAL STATEMENT**

Research Title:	PSEUDOLEUNAS: EXPLORING THE ANTIMICROBIAL PROPERTIES OF MAYANA (<i>Coleus blumei</i>) AND CAVENDISH BANANA (<i>Musa acuminata</i>) PSEUDOSTEM AGAINST <i>Pseudomonas aeruginosa</i>		
Grade and Section	I2- STEM B		
Submission Date:	April 14, 2025		

Particulars	Price	Quantity	Amount
<i>Pseudomonas aeruginosa</i> strains	P300.00	12	P1,740.00
Whatman filter paper No. 1	P10.00	20	P200.00
100% Ethanol alcohol	P2,500.00	1	P2,500
Simple distillation	P1,425.00	1	P1,425.00
TOTAL			P5,865.00

Prepared by

RAXENNE GWYNETH B. REYES
 Group Leader

Noted by

CLEFORD J. V. BACAN, MAEd-MT
 Research Teacher

Approved by

JUN REY D. IYOGUINA, MATCC
 School Principal

Appendix D

Captured Process and Results

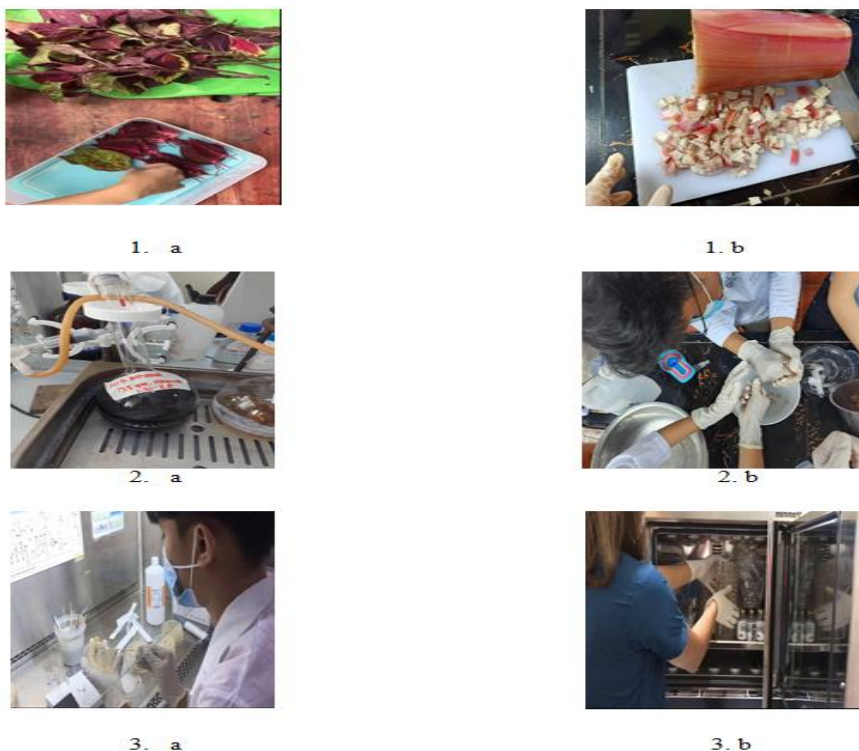


Figure 1, 2, 3. Preparation, Extraction, and Antimicrobial testing.



4



5.



6



Figures 4,5,6 and 7. Zone of Inhibition of treatments 1-3 and the positive control.

	Antimicrobial Property (Zone of Inhibition)			
	<i>Zone of Inhibition in mm (millimeters)</i>			
	Treatment 1	Treatment 2	Treatment 3	Treatment 4
	Mayana & Cavendish banana (1,100 μ L/mL)	Mayana & Cavendish banana (1,700 μ g/mL)	Mayana and Cavendish banana (2,300 μ g/mL)	Povidone-iodine (Control group)
Replicate 1	17	15	19	26
Replicate 2	19	18	20	25
Replicate 3	20	20	23	27

Appendix E

Spss Results

Tests of Normality								
	Kolmogorov-Smirnov ^a				Shapiro-Wilk			
	Statistic	df	Sig.	Statistic	df	Sig.		
ZOI	.247	12	.042	.935	12	.438		
a. Lilliefors Significance Correction								
Descriptives								
ZOI								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
T1	3	18.6667	1.52753	.88192	14.8721	22.4612	17.00	20.00
T2	3	17.6667	2.51661	1.45297	11.4151	23.9183	15.00	20.00
T3	3	20.6667	2.08167	1.20185	15.4955	25.8378	19.00	23.00
Control	3	26.0000	1.00000	.57735	23.5159	28.4841	25.00	27.00
Total	12	20.7500	3.72034	1.07397	18.3862	23.1138	15.00	27.00

Hypothesis Test Summary				
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of ZOI is the same across categories of Treatment.	Independent-Samples Kruskal-Wallis Test	.055	Retain the null hypothesis.
Asymptotic significances are displayed. The significance level is .050.				

Independent-Samples Kruskal-Wallis Test Summary	
Total N	12
Test Statistic	7.607 ^{a,b}
Degree Of Freedom	3
Asymptotic Sig.(2-sided test)	.055
a. The test statistic is adjusted for ties.	
b. Multiple comparisons are not performed because the overall test does not show significant differences across samples.	



Name : Ava Kathareen S. Adlawan
Birth Date : July 3, 2007
Birth Place : Cebu City
Address : Padada, Davao del Sur
Civil Status : Single
Religion : Roman Catholic
Parents : Mr. Edward A. Adlawan
: Mrs. Rosaree S. Adlawan

Elementary	: ATO Padada Christian School Padada Davao del Sur (With Honors)
Junior High School	: Saint Michael’s School of Padada, Inc., Quezon St. NCO District, Padada Davao del Sur (With Honors)
Senior High School	: Cor Jesu College, Inc.- Basic Education Department Sacred Heart Ave. Digos City, Davao del Sur



Personal Background

Name : Xianan Mhe A. Agunod

Birth Date : November 27, 2006

Birth Place : Bansalan Davao del Sur

Address : Tres de Mayo, Digos City

Civil Status : Single

Religion : Roman Catholic

Parents : Christdy Agunod
: Michael Agunod

Educational Background

Elementary : St. Mary's College of Bansalan, Inc. Dhalia St., Poblacion
Uno, Bansalan, Philippines
(With Honors)

Junior High School : Saint Mary's College of Bansalan, Inc.,
Dahlia St., Poblacion Uno, Bansalan, Philippines
(With Honors)

Senior High School : Cor Jesu College, Inc.- Basic Education Department
Sacred Heart Ave. Digos City, Davao del Sur



Personal Background

Name : Lotis Kate A. Araña

Birth Date : January 13, 2007

Birth Place : Poblacion Matanao, Davao del Sur

Address : Matanao, Davao del Sur

Civil Status : Single

Religion : Roman Catholic

Parents : Mr. Jason U. Araña
: Mrs. Marilou S. Albarracin

Educational Background

Elementary : New Visayas Elementary School
New Visayas, Matanao, Davao del Sur
(With Honors)

Junior High School : Matanao National High School
Poblacion Matanao, Davao del Sur
(With High Honors)

Senior High School : Cor Jesu College, Inc.- Basic Education Department
Sacred Heart Ave. Digos City, Davao del Sur



Personal Background

Name : Amiel Hella E. Bernaldo

Birth Date : January 31, 2007

Birth Place : Monarca Lying-In Hospital, Digos City

Address : Northern Paligue, Padada, Davao del Sur

Civil Status : Single

Religion : Roman Catholic

Parents : Mr. Arnel L. Bernaldo
: Mrs. Normelita E. Bernaldo

Educational Background

Elementary : Mariano Sarona Elementary School
Northern Paligue, Padada Davao del Sur
(With Honors)

Junior High School : Saint Michael's School of Padada, Inc.,
Quezon St. NCO District, Padada Davao del Sur
(With Honors)

Senior High School : Cor Jesu College, Inc.- Basic Education Department
Sacred Heart Ave. Digos City, Davao del Sur



Personal Background

Name : Zac Robert Anthony C. Dinsay

Birth Date : July 13, 2006

Birth Place : Digos City

Address : Manga, Matanao, Davao del Sur

Civil Status : Single

Religion : Roman Catholic

Parents : Mr. Roberto A. Dinsay
: Mrs. Josephine C. Dinsay

Educational Background

Elementary : Brighter Beginnings Learning Center of Bansalan
Lily Street, Bansalan, Davao del Sur, Philippines
(With Honors)

Junior High School : Cor Jesu College
Sacred Heart Ave., Digos City, Philippines
(With Honors)

Senior High School : Cor Jesu College, Inc.- Basic Education Department
Sacred Heart Ave. Digos City, Davao del Sur



Personal Background

Name :Babe Xyzette R. Cariquitan

Birth Date :September 09, 2006

Birth Place :Sallab, Magpet, North Cotabato

Address :Prk. Padema, Tres de Mayo, Digos City

Civil Status :Single

Religion :Roman Catholic

Parents :Mr. Jessie F. Cariquitan
:Mrs. Monica R. Cariquitan

Educational Background

Elementary Pedro V. Basalan Elementary School
Tres de Mayo, Digos City, Davao del Sur, Philippines
(With High Honors)

Junior High School :Digos City National High School
Rizal Ave., Digos City, Philippines
(With High Honors)

Senior High School : Cor Jesu College, Inc.- Basic Education Department
Sacred Heart Ave. Digos City, Davao del Sur



Personal Background

Name :Raxenne Gwyneth B. Reyes

Birth Date :April 19, 2007

Birth Place :Digos City

Address :Tuban, Sta. Cruz, Davao del Sur, Philippines

Civil Status :Single

Religion :Bible Baptist

Parents :Mr. Raul V. Reyes
:Mrs. Sisinia B. Reyes

Educational Background

Elementary :Tuban Elementary School,
Tuban, Sta. Cruz, Davao del Sur, Philippines
(With High Honors)

Junior High School :St. Mary's Academy of Sta. Cruz
Sta. Cruz Poblacion, Sta. Cruz, Davao del Sur, Philippines
(With Honors)

Senior High School :Cor Jesu College
Sacred Heart Ave., Digos City, Philippines



Personal Background

Name : John Benedict R. Templa

Birth Date : May 22, 2007

Birth Place : Roxas Corner, Tandang Sora St., Digos City, Davao del Sur

Address : Purok 2, Poblacion, Sulop, Davao del Sur

Civil Status : Single

Religion : Roman Catholic

Parents : Mr. Edward F. Templa
: Mrs. Arlene R. Templa

Educational Background

Elementary : Saint John Marie Vianney Academy of Sulop, Inc.
Purok 11, Brgy., Poblacion, Sulop, Davao del Sur
(With Honors)

Junior High School : Saint Michael's School of Padada, Inc.,
Quezon St. NCO District, Padada Davao del Sur
(With Honors)

Senior High School : Cor Jesu College, Inc.- Basic Education Department
Sacred Heart Ave. Digos City, Davao del Sur