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An In Vitro Study on the Synergistic Effect of the Musa Acuminata and Citrofortunella Microcarpa Peel Extract Against Escherichia coli

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Abstract

Musa acuminata, locally known as Saba Bananas, and *Citrofortunella microcarpa*, locally known as Calamansi, are cheap native fruits in the Philippines. Both peels are commonly thrown out after consumption, but some studies suggest that fruit peels may still be useful for their antibacterial properties. With the rise of the demand for an alternative antibacterial agent, this study aims to test the efficacy of banana and calamansi peels and their synergistic effect as an antibacterial agent. The study utilized a true experimental research design to investigate the Synergistic Effect of the *Musa acuminata* and *Citrofortunella microcarpa* peel extract against *Escherichia coli*. 100g of each dried peel were soaked in 95% ethanol for 48 hours. It was then filtered and evaporated through the rotary evaporator. Phytochemical analysis to identify the secondary metabolites of the combination of fruit extracts. Disk diffusion assay was used to identify the efficacy rate of combining the fruit extracts against Escherichia coli by measuring the zone of inhibition. The data were then analyzed using descriptive statistics using mean, one-way ANOVA, and Post Hoc tests. The study identified secondary metabolites of the combination of both fruit extracts that were positive for Saponins, Flavonoids, Alkaloids, and Triterpenes. The disc diffusion assay identified that the calamansi peels, banana peels, and the combination of calamansi and banana peels fall under the very reactive reactivity rating (>19mm). When the three samples were compared using ANOVA and Post Hoc tests, it revealed that the average zone of inhibition of the three samples was significantly different, with the combined banana and calamansi sample as the highest. The researchers have concluded that the synergistic effect of the banana and calamansi peel extracts proved to be capable of acting as an antibacterial agent against *E. coli.* The researchers recommend exploring the efficacy rate of extracts with different concentrations and using different bacteria for future studies.

Keywords: synergistic effect, antibacterial assay, phytochemical analysis

INTRODUCTION

Bananas and Calamansi are fruits commonly found at a patient's bedside table, whether in the ward or a private room which are believed to pose a myriad of good nutritional benefits. Musa acuminata, locally known as the Saba Banana, is a fruit that is commonly known in the Philippines

for its delicious taste and cheap price tag. This fruit is a rich source of Potassium, Fiber, Vitamin C, Vitamin B6, and many more Citrofortunella microcarpa, locally known as calamansi, Philippine lime, or Philippine lemon, is an economically significant citrus hybrid predominantly cultivated in the Philippines. Calamansi has been found to contain phenolic compounds, for example, caffeic acid, coumaric acid, and sinapic acid, which play a role as natural antimicrobial agents (Cheong et al., 2012). This fruit is always found in most gardens which makes it accessible.

It is grown principally for its fruit juice since it is widely known as a good source of Vitamin C. However, the peels are thrown after the extraction of the juice. The medicinal use of the peel is still unknown to many Filipinos. Different studies have been done on the various parts of banana and orange fruits that performed the inhibitory effect on foodborne pathogens; hence, fruit peels should be considered a potential natural source of antibiotics. Bacteria are living things that have only one cell. Under a microscope, they look like balls, rods, or spirals. Most bacteria help to digest food, destroy disease-causing cells, and give the body needed vitamins. Nevertheless, infectious bacteria can make you ill. They reproduce quickly in your body. Many give off chemicals called toxins, which can damage tissue and make you sick.

As Singh et al. (2016) stated, peels like pomegranate, lemon, and orange were extracted and then utilized in paneer to increase their shelf life by preventing peroxide formation, which proves that these peels are natural antioxidants.

According to Salwe et al. (2015), fruit peels have an antidiabetic property, so a study showed that a higher dose of fruit peel extract of P. granatum (PEPG) and glibenclamide significantly lowered blood glucose. The plant showed many pharmacological effects, including antioxidant, anti-inflammatory, analgesic, antipyretic, antidiabetic, CNS, and many other pharmacological effects, and has been tested and proven to have these properties (Salwe et al., 2015). Although evidence is still lacking, some studies suggest that fruit peels can have antimicrobial and antibacterial properties. This may be due to a high concentration of zinc, magnesium, and total phenolic content in the yellow extract (Rakholiya et al., 2014).

On the other hand, because the demand for an alternative antibacterial agent is greatly encouraging, it will be tested for antibacterial properties to find a safe alternative to synthetic medicine. This opportunity will provide an option to solve the problems in antibiotic application areas in an economical and eco-friendly way, reducing the pollution from the disposal of such agro-waste.

One of the Sustainable Development Goals (SDG) is to have good health and well-being. This study also aims to contribute to that goal by providing an alternative and less expensive way for helping patients with bacterial diseases and infections.

Significance of the Study

The study aims to utilize the findings towards improvement and promotion of the health of the people. The researchers believe that the results can be of great help to the following persons involved in this endeavor and provide a significant contribution to the following fields.

Nursing education. This study will be useful for the nurse educators in their health teaching regarding natural remedies. Since the study will prove that if the synergistic effect of *Musa acuminata* and *Citrofortunella microcarpa* Peel extract will be effective as an antimicrobial, this study will provide empirical evidence and strengthen available information on alternative and natural ways to reduce infection. Further, this study will be used as a basis for health promotion and disease prevention in the community.

Nursing practice. The study will provide an evidence-based and cost-effective approach and interventions in primary care settings or community-based health promotion, especially in the prevention of the spread of infection. It will also be a useful tool to teach individuals and families about alternative ways to reduce infection(s) and provide cost-effective intervention. Through the knowledge acquired in giving simple, affordable, and available treatments to the family, it will develop a sense of responsibility in the time of illness and in the maintenance of health.

Nursing research. The conclusion of this study provides empirical evidence as to the health benefits of *Musa acuminata* and *Citrofortunella microcarpa* peel, specifically in reducing infection(s). Also, it stimulates other researchers to explore the effect or usefulness of the *Musa acuminata* and *Citrofortunella microcarpa* peel on infections utilizing a wider scope and considering other variables.

Nursing Community. The in vitro study of the synergistic effect of such peels can be a learning paradigm in the more profound study and deeper study of such peels. The study's goal is to help nurses find an alternative and cheap way to help patients with bacterial diseases and infections. Also, the study is very timely and relevant because today, it is science and technology that are making some nations very industrialized and progressive. Lastly, the study's goal is designed to medical workers also be curious and be thirsty for knowledge, especially since the world is in need of finding other cures.

Scope and Limitation of the Study

This study is primarily focused on the assessment of investigating the Synergistic Effect of the Musa acuminata and Citrofortunella microcarpa Peel Extract Against Escherichia coli. The study aims to produce results depicting the antibacterial property of each fruit peel and the combination of the three. The study will be conducted in the chemistry and microbiology laboratories.

Collection and preparation of materials will be done through maceration of the fruit peels, extraction, phytochemical analysis, and antibacterial screening using the disc diffusion method against Escherichia Coli. This study will also use three (3) different extracts with the controlled variable only. This study will be conducted somewhere between the months of October 2020 to May 2021.

METHODOLOGY

Banana and calamansi peels are commonly thrown out after consumption, but some studies suggest that fruit peels may still be useful for their antibacterial properties. With the rise of the demand for an alternative antibacterial agent, this study aims to test the efficacy of banana and calamansi peels and their synergistic effect as an antibacterial agent.

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To accomplish this objective, the researchers utilized a true experimental research design by first gathering 500 grams for each fruit, collecting the peels, followed by the preparation, and drying of fruit peels, preparation for the fruit peel extract, phytochemical analysis done at the University of the Philippines-Miagao, then the antibacterial activity test by the Department of Science and Technology (DOST). The data were analyzed using descriptive statistics using mean, one-way ANOVA, and Post Hoc tests.

RESULTS AND DISCUSSION

The study identified secondary metabolites of the combination of both fruit extracts that were positive for Saponins, Flavonoids, Alkaloids, and Triterpenes. The disc diffusion assay identified that the calamansi peels, banana peels, and the combination of calamansi and banana peels fall under the very reactive reactivity rating (>19mm). When the three samples were compared using ANOVA and Post Hoc tests, it revealed that the average zone of inhibition of the three samples was significantly different from each other, with the combined banana and calamansi sample as the highest.

The study identified secondary metabolites of the combination of both fruit extracts. Saponins, Flavonoids, Alkaloids, and Triterpenes had positive results. On the other hand, Tannins and Phenols both had negative results. The disc diffusion assay identified that the calamansi peels, banana peels, and the combination of calamansi and banana peels fall under the very reactive reactivity rating (>19mm). When the three samples were compared using ANOVA and Post Hoc tests, it revealed that the average zone of inhibition of the three samples was significantly different from each other. The zone of inhibition of the combined calamansi and banana sample was significantly higher than both the calamansi sample and the banana sample. Therefore, this proves the effectiveness of the calamansi and banana combination better than the single samples.

CONCLUSION

Based on the findings of the study, the researchers were able to conclude that the secondary metabolites of the combination of *Musa acuminata* and *Citrofortunella microcarpa* peel extract using phytochemical analysis showed a positive indication of Saponin, Flavonoids, Alkaloids, Sterol, and Triterpenes. The combination of *Musa acuminata* and *Citrofortunella microcarpa* peel extract disc diffusion method is very active. The combination of banana and calamansi peel extract produced a 20% higher reactivity rating than calamansi peels alone and a 42.86% higher reactivity rating than banana peels. Moreover, there was a significantly higher difference in the zone of inhibition of the calamansi sample than with the banana. Lastly, the zone of inhibition of the combination of calamansi and banana sample had a significantly higher difference than both the calamansi sample and the banana sample.

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