Comparative Study: Anti-Bacterial Efficacy of Commercial Hand Sanitizer and Aloe Vera as an Alternative Hand Sanitizer

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Abstract

Nowadays, hand sanitizers are crucial to the community, since it allows them to be sanitized and protected against the spread of today's Coronavirus. However, the supply of hand sanitizers had major difficulties compensating with the demands. Creating a supply and demand crisis that citizens are concerned about since the virus is still actively spreading and fast. This led to innovation of resources creating a homemade hand sanitizer with Aloe Vera gel. Although many have tried and used the Aloe Vera alternative hand sanitizer, its effectiveness is yet to be proven, according to FMOHLS 2020. Since the study is quantitative in nature needing an experimental approach, the researchers provided observation sheets to assess the zone of inhibition (ZOI) from the Kirby Bauer Disk Diffusion Susceptibility Test. The researchers found that, (a) Aloe Vera alternative hand sanitizer is effective in killing bacteria. However, the commercial hand sanitizer was proven to have a significantly higher mean of 12.167±1.756 compared to the Aloe Vera alternative hand sanitizer with 8.667±0.577. Meaning, (b) the commercial hand sanitizer is more effective than the Aloe Vera alternative hand sanitizer. Thus, (c) there is a significant difference ($p=0.027$) between the two hand sanitizers involved when t-test statistical analysis was applied. The researchers conclude that though the commercially made hand sanitizer is more effective, Aloe Vera is a great and effective alternative hand sanitizer for citizens to use in sanitizing themselves against the virus despite the unstable supply of hand sanitizers. Providing a much cheaper and convenient alternative for them as well.

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TABLE OF CONTENTS

Page

TITLE PAGE..... i

APPROVAL SHEET..... ii

ABSTRACT..... iii

ACKNOWLEDGEMENTS…….. iv

TABLE OF CONTENTS…… v

LIST OF TABLES..... vi

Chapter 1: THE PROBLEM AND ITS SCOPE

Introduction.....1-3

Statement of the Problem……3

Hypotheses.....3

Significance of the Study.....3-4

Scope Limitation and Delimitation..... 4

Objectives……. 4

Definitions of terms……. 4-5

Chapter 2: REVIEW OF RELATED LITERATURE AND STUDIES

Review of Related Literature.....6-9

Chapter 3: METHODLOGY

Research Design.....10

Materials and Apparatus.....11-12

Research Locale.....12

Research Procedure.....12-14

Data Gathering Method.....14

Statistical Analysis.....15

Method of Analysis.....16

Chapter 4: PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

Results and Discusson.....17-21

Chapter 5: SUMMARY, CONCLUSION AND RECOMMENDATION

Summary.....22-24

Conclusion.....24-25

Recommendation.....25

Limitations.....25-26

Direction for Further Studies.....26-27

BIBLIOGRAPHY……28-29

APPENDICES……30-35

CURRICULUM VITAE……..36-43

LIST OF TABLES

TABLE	TITLE	PAGE
1	Presence of ZOI Surrounding both the Commercial and Aloe Vera Hand Sanitizer Impregnated Filter Paper Disc	18
2	Zone of Inhibitions in each of the Trials	19
3	Sample T-test table	20
4	Descriptive Table	21

Chapter I

INTRODUCTION

Our world is facing a wide spread pandemic that greatly altered the meaning of sanitation as now, a means of survival. The Corona Virus is known to be transmitted through close contact. Thus, citizens are advice by the Department of Health to sanitized themselves, specifically their hands for its the most exposed part of the human body. With that, it could transmit the virus much actively and spread within the community in no time. In the beginning of the Coronavirus pandemic, the demand for hand sanitizers, as one of the convenient and effective sanitary essentials, has dramatically increased. As Huddleston Jr. (2020) stated, the COVID-19 pandemic has spurred people around the world to panic-buy sanitary essentials and protective equipment to arm themselves from the virus; toilet paper, mask, alcohol, soap, vitamins and especially hand sanitizers. According to statistics, by the end of February 2020, drug stores and multi-outlet stores have seen increases by 80% and 58%, approximately, compared to the same period from 2019.

Although, the most advice sanitary measure to take, as stated by Center for Disease Control and Prevention (2020), is by washing your hands with soap and water in at least 20 seconds. However, if this way is proven unavailable, hand sanitizers that contains at least 60% alcohol is considered the most acceptable alternative in killing germs and bacteria alike. According to Lasco (2020), most hand sanitizers contain anywhere from 60% to 95% isopropyl or ethyl alcohol mixed with water and gels like glycol and glycerin in order to prevent drying out consumers' skin which alcohol alone tends to do. The resulting product is typically sold in a hand gel

or liquid spray under brand names such as Purell or GermX. But with the spur of the pandemic, supermarkets and pharmacies shelves are emptied by concerned consumers with still an increasing demand and supplies being low. This left people to take certain measures to provide themselves protection against the spread of the virus. In accordance with FMOLHS (2020), that stores across the globe are indeed continuing to report shortages in supplies of the product leading many concerned people to look for ways to make their own homemade versions of hand sanitizers. The most common candidate is Aloe Vera.

According to Surjushe, Vasani & Saple (2020) Aloe vera plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. These very properties made it a promising alternative for hand sanitizers. The Aloe vera gel has a moisturizing property making it a better substitute for glycerol. The polysaccharides help in binding moisture into the skin. Aloe stimulates fibroblast which produces the collagen and elastin fibers making the skin more elastic and less wrinkled. It also has cohesive effects on the superficial flaking epidermal cells by sticking them together, which softens the skin. The amino acids also soften hardened skin cells and zinc acts as an astringent to tighten pores. Its moisturizing effects has also been studied in treatment of dry skin associated with occupational exposure where aloe vera gel gloves improved the skin integrity, decreases appearance of fine wrinkle and decreases erythema. In addition, it also has an antiseptic effect since aloe vera contains 6 antiseptic agents: Lupeol, salicylic acid, urea nitrogen, cinnamonic acid, phenols and sulfur. They all have inhibitory action on fungi, bacteria and viruses. Since Aloe vera does not have enough alcohol that FDA advice for, Isopropyl Alcohol with at least 60% to 80% alcohol is added to

the homemade hand sanitizer solution. Though its effectiveness has not always been proven. (Surjushe, Vasani & Saple, 2020).

Statement of the problem

The research study aims to answer the following questions:

1. How effective is Aloe Vera as an alternative antibacterial hand sanitizer?

2. Which is more effective between the commercial hand sanitizer and Aloe Vera as an alternative antibacterial hand sanitizer?

3. Is there a significant difference in the antibacterial effectiveness between the commercial hand sanitizer and aloe vera as an alternative hand sanitizer.

Hypothesis

1. The Aloe vera as an alternative antibacterial sanitizer is effective.

2. Aloe Vera as an alternative antibacterial hand sanitizer is more effective than Commercial Hand Sanitizer.

3. There is no significance difference between the antibacterial efficacy of the commercial hand sanitizer and aloe vera as an alternative hand sanitizer.

Significance of the Study

This study aims to benefit the consumers and citizens alike whom are concern with how they could continually protect themselves from the widespread pandemic caused by the virus, COVID-19 despite the limited and supply shortage of hand sanitizers. It would ensure them about the effectiveness of the Aloe Vera as an alternative hand sanitizer. Also, this research provides significant knowledge for

consumers about the difference between the commercial hand sanitizers and aloe vera as an alternative hand sanitizer for them to make wise choices in the future. This would also benefit other researchers in their future study.

Scope of the Study

This study focuses on the effectiveness of Aloe vera as an alternative hand sanitizer and its significant difference with the Commercial Hand sanitizer. This will measure the ability of the aloe vera in killing germs found in objects that the human hands could possibly be in contact. With that the researchers will assess if there is a significant difference between the ability of the aloe vera as an alternative hand sanitizer and commercial hand sanitizer in eradicating germs. The brand for the commercial hand sanitizer will be judged depending on the available product brand in the market here in Hindang Leyte.

Objectives

1. To aid the consumers and citizens whom are concerned in keeping themselves sanitized despite the absence of available hand sanitizer in the market.
2. To ensure the effectiveness of Aloe Vera as an alternative hand sanitizer.
3. To provide a cheaper and accessible alternative hand sanitizer.

Definition of terms:

Aloe Vera-(https://en.m.wikipedia.org/wiki/Aloe_vera)Aloe vera is a succulent plant species of the genus Aloe. An evergreen perennial, it originates from the Arabian Peninsula, but grows wild in tropical, semi-tropical, and arid climates around the world. It is cultivated for agricultural and medicinal uses.

Aloe Vera Gel-(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6245421/) have been identified, therapeutic effects have not been correlated well with each individual component. Many of the medicinal effects of aloe leaf extracts have been attributed to the polysaccharides found in the inner leaf parenchymatous tissue.

Hand Sanitizer- (https://dictionary.cambridge.org/us/dictionary/english/sanitizer) a liquid for washing your hands in order to get rid of harmful bacteria from them.

Chapter II

REVIEW OF RELATED LITERATURE

Currently, our world is facing a widespread pandemic. Our only way of protection is to distance ourselves from the crowd and keep ourselves sanitize. When the situation calls it or if it is unavoidable to stay at home due to certain circumstances like work, citizens are adviced by the Centers for Disease Control and Prevention (CDC) to wash their hand with soap and water for at least 20 seconds. If this method is not readily available, hand sanitizers are the most effective substitute. Hand sanitizer protects by killing certain germs on the skin. Alcohol-based hand sanitizers can quickly reduce the number of germs in many circumstances and should be used in the right situations (CDC, 2020)

Nowadays, hand sanitizers are deemed crucial for sanitation, as preventive measure for the virus. As established by the FDA (2020), they have taken significant action to help assure widespread access to hand sanitizers during the COVID-19 public health emergency. They prioritize the front liners and consumer's safety since their mission is to protect the citizens from any danger from the virus. In retrospect, according to Huddleston Jr. (2020) COVID 19 pandemic indeed tests abundant aspect of our lives especially our ability to compensate demands. Panic buying is occurring which leads in the decreasing supply to a variety of household products and essentials at local grocery store, including hand sanitizers.

FDA's attempt to counter the supply and demand problem for hand sanitizers around the globe, and despite the willingness of multiple industries to help meet the increase in demand for alcohol-based hand sanitizer during COVID-19 pandemic, the FDA continue to hear that some smaller hospital systems and markets are still experiencing difficulties accessing alcohol-based hand sanitizers. They also recognize that some consumers may not be able to find alcohol-based hand sanitizer in their local area, and, when they do, it is in limited quantities.

This delivery of fact, make consumers concern on how to keep themselves sanitize despite this undergoing supply and demand problem. Studies suggests alternatives that can suffice the antimicrobial ability of hand sanitizers. One of these alternatives is Aloe Vera, scientifically named *Aloe barbadensis mill*. According to Surjushe, Vasani, & Saple (2008), Aloe Vera is a natural product that is now a day frequently used in the field of cosmetology. It has a moisturizing property, making it a good substitute for glycerol in hand sanitizers. The Aloe Vera plant is known and used for centuries for its health, beauty, medicinal and skin care properties. In terms for its accessibility, it grows mainly in the dry regions of Africa, Asia, Europe and America. In the Philippines, there are Aloe Vera plantations for companies like Forever Living, Nature Republic, and Aloe Vera Philippines who produces Aloe Vera products for skin care. In addition, home cultured Aloe Vera are observed as well, especially in provinces. (WHO, 2020)

Regarding the alcohol in an alcohol-based hand sanitizer, CDC (2008) established that 70% concentration of ethanol or isopropyl alcohol has been demonstrated to be the most effective and permitted in an alcohol-based hand

sanitizer. However, concentrations higher than 80-85% the effectiveness as a disinfectant, decreases. Therefore, the alcohol's bactericidal activity drops sharply when diluted below 50% concentration, and the optimum bactericidal concentration is 60%–90% solutions in water (volume/volume). The concentration of alcohol determines the amount of contact time needed. This actively describes the contact of the sanitizer on your hands. The higher the concentration (<70%) the longer the contact time required for disinfection. Thus, with 70% concentration at least 2-10 minutes of contact time and 5-15 minutes if using greater concentrations of alcohol are used (not to exceed 80%). Both alcohols are used as disinfectants. There are varying grades of both in terms of purity, ethanol is more widely used in wet laboratories whereas isopropyl alcohol is preferentially used to disinfect electronic devices.

The "alcohol" in hand sanitizers, according to CDC (2020), is referred to be ethyl or ethanol. Only two alcohols are permitted as active ingredients in alcohol-based hand sanitizers – ethanol (ethyl alcohol) or isopropyl alcohol (isopropanol or 2-propanol). However, the term “alcohol,” used by itself, on hand sanitizer labels specifically refers to ethanol only.

The Franciscan Missionaries of Our Lady Health System made a ratio in making the Aloe Vera as an alternative hand sanitizer. Their studies suggest that Aloe era is indeed qualified since it has *mucopolysaccharides* that binds moisture into the skin. FMOLH considered the CDC recommendation for an alcohol-based (99%) isopropyl hand sanitizer with at least 60% alcohol. With that, they formulate the recipe for a homemade hand sanitizer. First, 2/3 cup of rubbing alcohol. Second,

is 1/3 cup of Aloe Vera gel. Third, is 5-10 drops of essential oil of your choice. It’s optional since it only adds scent to your hand sanitizer. Though its effectiveness varies on the Aloe Vera and the alcohol used (FMOLHS, 2020).

Chapter III

METHODOLOGY

3.1 Research Design

This study is quantitative in nature as it is a systematic investigation of a phenomenon that is done by gathering quantifiable data and performing statistical, mathematical, or computational techniques. The researchers will implement a comparative and experimental research design during which the data must be able to be quantified or measured. Experimental research design is any research conducted with a specific approach, where an analysis is done around proving or disproving a theory or statement. It is perfect in this case wherein the researchers are trying to know if homemade aloe vera hand sanitizers have comparable effectiveness to commercial hand sanitizers. It includes a hypothesis, a variable that can be manipulated by the researcher, and variables that can be measured, calculated and compared. Most importantly, experimental research is completed in a controlled environment. An experimental study assumes that there is a causal relationship between the variables which in this case are the homemade aloe vera hand sanitizer and commercial hand sanitizer. The researcher will collect data and results which will either support or reject the hypothesis. The study will approach the goals by using a comparative research method by which two independent variables are being compared in terms of its antibacterial effectiveness.

3.2 Materials and Apparatus

Philippine Lemon	Nutrient Agar
Aloe Vera Gel	Petri Dishes
Ethyl Alcohol	Cotton Swab
Measuring Cup	Sterilized Tweezers
Grater	Filter Paper
Knives	Steamer
Hand Gloves	Containers
Strainer	Beakers
Funnel	

3.3 Media Preparation

Sterile technique is always a relative matter. The precautions required depend on the experimental situation, including the growth media used, the competitive abilities of the experimental organism, the duration of the experiment, and the intended use of the culture. Before proceeding to the research process, the materials and apparatus will be prepared by sterilizing and thoroughly sterilizing with moist heat provided by an autoclave or pressure cooker is an efficient way to sterilize most materials but since an autoclave isn't available, we will decide to use a different method. According to a website, methods retrieved from https://www.phys.ksu.edu/gene/a1.html. in many experimental procedures, the most

effective way to sterilize objects is with ethanol. Either 95% or 70% will work. The latter is actually more effective, but the former is often more convenient. In this experiment, we used a 70% ethanol alcohol. The alcohol will be allowed to evaporate first before the object will be in contact with the apparatus. The workplace will be wiped with disinfectant before starting to remove mold-laden dust, the most common source of contamination. The researchers' hands will be applied with a small amount of alcohol, too.

3.4 Research Locale

The study will be conducted at Hindang, Leyte. It was decided that the study will be conducted at Theresa’s, one of the researchers, humble abode since she was kind enough to provide a conducive environment to work in. Hindang is the best place to conduct the study because it, specifically Theresa's home, is the central point, providing members with fairness in terms of time, effort and transportation fares when travelling to the place.

3.5 Research Procedure

3.5.1 Preparation of Aloe Vera as an Alternative Hand Sanitizer

How to make Aloe Vera hand sanitizer:

1. ⅔ cup of rubbing alcohol

2. ⅓ cup of Aloe Vera

3. 5 -10 drops of essential oil (optional)

Directions:

1. Pour the rubbing alcohol (ethyl alcohol) and Aloe Vera in a bowl and stir until completely blended. One can also use a blender. The Aloe Vera will add thickness and moisturize your skin.

1.1 In using a blender, blend starting from lowest to highest intensity until it is mixed completely.

2. Filter the blended solution to remove any coarse particles that might cause discomfort

3. Add in several drops of essential oil and blend. Essential oils will help mask the smell of alcohol. Examples are lavender or citrus-scented oils such as lemon or orange.

4.Whisk all ingredients together.

5. Pour into a container. Make sure to label the hand sanitizer with an adhesive strip.

3.5.2 Preparation of Agar Solution

1. Based on the manufacturer's direction 8.4 grams of nutrients of agar will be suspended in 300 ml distilled water.

2. Bring the mixture to a boil for 1 minute to completely dissolve the agar. The final mixture should be clear without particles floating around in the solution.

3. Let the mixture cool for 3 to 5 minutes.

3.5.3 Preparation of Anti-Bacterial Activity Assessment of the Aloe Vera as an Alternative Hand Sanitizer and Commercial Hand Sanitizer (Kirby Bauer Disk Diffusion Method)

1. Separate the petri dish into two pieces, a top and a bottom. Carefully fill the half bottom with agar nutrient solution. Use the top half to loosely cover the bottom portion. Place the lid agar so moisture can escape.

2. Let the solution cool and harden for at least 1 hour.

3. Once the culture dish was prepared, a sterile cotton swab was used to swab a dirty hand. In Trial 1, one hand of the member will be swabbed. Trial 2 will be another member's hand and Trial 3 will have another hand swabbed.

4. Lift the top of the petri dish and lightly draw a squiggly or zig zag stroke in the agar with the end of cotton swab. Cover the petri dish with its top half and use a permanent marker to label the dish with a sample number and description of the item being tested.

5. A piece of round filter paper will be dipped in the aloe vera as an alternative hand sanitizer and another in the commercial hand sanitizer. The filter papers will be put in the center of its own portion in the culture dish using a sterilized tweezer.

6. The petri dish was placed in a closed box as an alternative incubator that provides a warm, dark place to grow for a week. The box was not open until then.

3.6 Data Gathering Method

This study will use Kirby Bauer Disk Diffusion Method to gather the data to accomplish the objectives of the study. Antimicrobial activity of different fruit extracts was evaluated by performing the mentioned method that will provide answers to RQ1, RQ 2 and RQ3.

The purpose of the Kirby-Bauer disk diffusion susceptibility test is to determine the sensitivity or resistance of pathogenic aerobic and facultative anaerobic bacteria to various antimicrobial compounds. The pathogenic organism is grown on Mueller-Hinton agar in the presence of various antimicrobial impregnated filter paper disks. The presence or absence of growth around the disks is an indirect measure of the ability of that compound to inhibit that organism. The diameter of the zone of inhibition will be measured around the disk that will determine the intensity of its antibacterial efficacy.

The controlled observation method (usually a structured observation) is particularly used because it is likely to be carried out in an experimental environment (McLeod, S. A., 2015). Rather than writing a detailed description of all behavior observed, it is often easier to look for specific characteristics. The researcher systematically classifies whether the Zone of Inhibition (ZOI) is present or not. It will be measured by millimeter (mm)

3.7 Statistical Analysis

The study will use the t-test analysis to compare one sample mean (commercial hand sanitizer) on a measure with another sample mean (Aloe Vera as an alternative hand sanitizer) on the same measure since it is probably one of the most frequently relied upon statistics in inferential research. It will also provide information on whether means are different from one another, provided that certain conditions are met, such as random sampling and a reasonable sample size. Which is accurate in answering research question 2 and 3 of the study. The outcome of t-test is used to determine inferences about how different the samples are from each other.

Chapter IV

PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

4.1 Introduction

This section of the chapter serves to briefly describe the major finding and analysis of the data collected from the tests done using the methodology presented in the previous chapter. The information obtained from the research procedures was summarized using observation sheets designed specifically for each research question.

Results and Discussion

Shown below are the data gathered through the observation method focusing on the presence and absence of the Zone of Inhibition (ZOI) of both Commercial and Alternative hand sanitizers.

4.2 Potency of the Hand Sanitizer to Inhibit Bacterial Growth

To determine if the alternative hand sanitizers are feasible as an anti-bacterial hand sanitizer, the researchers tried to see the presence of the ZOI surrounding each filter paper discs. If bacterial colonies are seen to be absent

around the disc, then the hand sanitizers are able to inhibit the growth of bacteria. Thus, proves its efficacy which provides insight for the research's RQ 1.

Table 1. Presence of ZOI Surrounding both the Commercial and Aloe Vera Hand Sanitizer Impregnated Filter Paper Disc

Is ZOI present around both commercial and alternative hand sanitizer impregnated citrus filter disc?						
	Trial 1		Trial 2		Trial 3	
Hand Sanitizer	Yes	No	Yes	No	Yes	No
Aloe Vera	✓		✓		✓	
Commercial	✓		✓		✓	

Table 1 shows that a ZOI is present among all filter paper discs containing both the commercial and alternative hand sanitizer in all trials made. From these results, we can conclude that the Aloe Vera alternative hand sanitizers made by the researchers for this study is effective since it is able to inhibit bacterial growth on the petri dish. Aside from that mentioned above, the bacteria from the palms of the subjects are all susceptible in the presence of the antimicrobial agent existing on the filter paper discs.

4.3 Anti-bacterial Analysis of the Aloe Vera Alternative Hand Sanitizers

The main purpose of the study was to find out the which of the commercial and aloe vera alternative hand sanitizer is the most effective in inhibiting bacterial growth and thus, in order to determine that the zone of inhibition is measured and compared, providing an insight towards RQ 2 of the study.

Table 2: Zone of Inhibitions in each of the Trials

Diameter of the ZOI (in millimeters)			
Hand Sanitizer	Trial 1	Trial 2	Trial 3
Aloe Vera	9 mm.	8 mm.	9 mm.
Commercial	14 mm.	12 mm.	10.5 mm.

Table 2 shows the raw data collected using an observation sheet. The data above hasn't been processed and computed using a statistical analysis which indicates that the means haven't been compared yet but we could already observe that the commercial hand sanitizer has the largest ZOI in all trials and is therefore the most effective. Out of the two hand sanitizers only the commercial has 14 mm in diameter and has the largest ZOI on Trial 1 followed by its second and third trials which has 12 mm. and 10.5 mm. respectively. The aloe vera alternative hand sanitizer's first and last trial both their ZOI measured 9 mm. in diameter while in Trial 2 the ZOI measured 8 mm. but despite the difference in measurements both are effective only that the commercial hand sanitizer is more effective than the Aloe Vera alternative hand sanitizer.

Table 3. Sample T-test table

Hand Sanitizers	N	Mean	Std. Deviation	Std. Error Mean	t-value	Sig.
Aloe Vera	3	8.667	0.577	0.333	1.36	0.027
Commercial	3	12.167	1.756	1.014		

Table 3 shows the output of the t-test analysis and whether there is a significant difference between the groups mean. From the table above, it can be seen that the significance value is 0.027 (i.e., p = 0.027) which is below 0.05, as our confidence level, suggesting that we reject the research's null hypothesis. Rejecting it, means that the likelihood a relationship between the variables is caused by something other than chance therefore, there is a causal relationship between hand sanitizers. This implement that there is a statistically significant difference in the mean of the ZOI between commercial and aloe vera alternative hand sanitizer.

Shown below is a table of the descriptive on the data when analyzed and run on the SPSS software. Only the mean and standard deviation and taken note of the interpreted in this table for it is of great importance.

Table 4. Descriptive Table

Hand Sanitizers	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Aloe Vera	3	8.667	0.577	0.333	1.434218	10.10088
Commercial	3	12.167	1.756	1.014	3.286205	14.78621

Table 4 shows the mean and standard deviation of the commercial and Aloe Vera hand sanitizers out of the three trials. The mean is the average value of the ZOI while standard deviation refers to how close or far the values are from each other. The Aloe Vera as seen above, has a mean and standard deviation 8.667±0.577 while the commercial hand sanitizer has 12.167±1.756. This implement that the commercial hand sanitizer is proven and tested to be the most effective out of the two hand sanitizers for it has the greater mean and standard deviation compared to the aloe vera alternative hand sanitizer. But the Aloe Vera hand sanitizer has been proven effective as well since the presence the zone of inhibition (ZOI) was observed and shown in Table 1, only that it is not as effective as the commercial regarding anti-bacterial efficacy.

Chapter V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter synthesizes the summary of the major findings of the research along with conclusion, recommendations, suggestions for the future research, and limitations encountered during the research process.

5.1 Summary

In the beginning of the Coronavirus pandemic, the demand for hand sanitizers, as one of the convenient and effective sanitary essentials, has dramatically increased. As Huddleston Jr. (2020) stated, the COVID-19 pandemic has spurred people around the world to panic-buy sanitary essentials and protective equipment to arm themselves from the virus; toilet paper, mask, alcohol, soap, vitamins and especially hand sanitizers.

Since it is important to keep our hands clean from bacteria and contaminants to keep distance from infections and diseases, this left people to take certain measures to provide themselves protection against the spread of the virus. People look for ways to make their own homemade versions of hand sanitizers. The most common candidate is Aloe Vera. Thus, the goal of this study is to compare the Aloe Vera as an alternative hand sanitizer to the commercially produced one to assess its anti-bacterial efficacy, for it is yet to be proven and find out which is the most effective by measuring the size of the bacterial colonies it can remove.

The study implemented a quantitative research design with an experimental approach during which the data must be quantified and measured. Before proceeding to conduct the research, the media was prepared thoroughly by sterilizing with the use of 70% ethanol alcohol and soaking them in hot water for 10-

15 minutes. A total of three trials were repeatedly done for each hand sanitizer being compared. When the organic hand sanitizers were finally ready, the Kirby Bauer Disk Diffusion Susceptibility Test was commenced to determine the sensitivity or resistance of different bacteria to various antimicrobial compounds. The zone of inhibition was measured for each of the hand sanitizers that served as the value of strength of its antibacterial property. The means of the ZOI across the three trials were then compared using t-test to determine which was more effective. All the necessary procedures were done to provide insight to the three research questions.

The first research question inquired about the efficacy of the Aloe vera as an alternative anti-bacterial hand sanitizer and from the results on chapter 4, yes it was effective. The alternative hand sanitizer was able to show the presence of a zone of inhibition around the impregnated filter paper. Indicating it was able to inhibit bacterial growth proving its antibacterial effectiveness.

The second research question, the main purpose of the study, seeks to know which between the commercial hand sanitizer and Aloe Vera is more effective in terms of antibacterial efficacy. This was determined by measuring the ZOI and performing the t-test analysis. The most effective hand sanitizer was commercially made, having a mean of (12.167±1.756). It was significantly larger compared to Aloe Vera.

The third research question looks for the significant difference between the two hand sanitizers involved, the commercial and Aloe Vera. This was assessed yet again through t-test analysis. There was a significance value of p= 0.027 between the mean of ZOI of the commercial and Aloe vera alternative hand sanitizer. Suggesting the rejection of the null hypothesis of the study. Thus, there is a

significant difference between the commercial hand sanitizer and Aloe Vera alternative hand sanitizer.

5. 2. Conclusions

The general objective of this study was to compare the antibacterial efficacy between the Commercial hand sanitizer and Aloe Vera as an alternative hand sanitizer. Accessing which of the two hand sanitizers involved was more effective. The ingredients involved in formulating the Aloe Vera alternative hand sanitizers were all natural for one of the aim of the study is to provide convenience to the consumers since Aloe Vera is prominent in the locale. After testing it out using the Kirby Bauer Disk Diffusion test and analyzing it using the t-test analysis, results show that it was indeed effective.

By comparing the means, it was found out that the commercial hand sanitizer had the highest antibacterial property. Although the commercial had the highest antibacterial property between the two hand sanitizers, this does not cancel the tested and proven fact that the Aloe Vera alternative hand sanitizer is effective. Those products underwent lots of research and processes containing different chemicals which may be the cause of its strong anti-bacterial properties. However, this hand sanitizer is a much more organic, safer and cheaper alternative that still works.

The results of this study contribute and coincide to past studies in this field. It supports the fact that Aloe vera have antibacterial properties accompanied by citrus fruit.

5.3 Recommendations

By the utilization of the findings of this study, the researchers recommend the following practical applications to attain benefits in our usual daily lives:

1. The researchers recommend the mass to create their own hand sanitizers out of Aloe Vera using the ingredients and procedure provided by FMOHLS. It is an eco-friendly, organic, and cheaper alternative towards those of commercially distributed hand sanitizers that is also able to do its job.

2. Citizens that are to try the alternative hand sanitizer, should provide a small container for easy use and accessibility during outdoor errands.

3. It is advisable to put ¼ cup more Aloe Vera gel into the solution for more moisture.

5.4 Limitations

There were numerous limitations encountered during the study. First and foremost, there was a lack of a few proper materials needed for the study and an actual laboratory to conduct to where it is free from contaminants in the air. Sterilizing, especially in these fields of studies, is an important matter that must be paid with utmost attention for it can alter the results in many ways. The proper way to sterilize microbiology apparatus is to use an autoclave but since it wasn't available at the moment, the researchers only used an alternative method that might've caused an effect on the results.

According to the Kirby-Bauer Disk Diffusion Susceptibility Test Protocol, antibiotic discs or cellular discs are the materials that are supposed to be impregnated with antimicrobial agents which in this case were the commercial and Aloe vera hand sanitizers in order to get a valid result. However, the fact that we didn't have that material led us to use an alternative which was a stacked tissue disk. The size is similar but the thickness and the volume it absorbs are different so that may also have an effect on the results. Another thing recommended on that protocol was to use a specific agar which was Mueller Hinton Agar. Since the only agar available at the locale was just plain nutrient agar, the researchers used that instead.

These factors may have a possibility that they may have strayed the results from the intended accurate one. They may have posed as an extraneous variable in the study causing a slight change in the outcome. The researchers had a limited time to conduct the study and so they didn't have the sufficient time to conduct again or correct the mistakes and errors during the process.

5.5 Directions for Further Study

The fact that this research study has many limitations creates a wealth of opportunities for further study in this area. Further research should address the limitations of this study and build on its results. The following are several recommendations for future research.

1. A replication of this study is strongly encouraged to generate credible evidence to support the antibacterial property of Aloe vera hand sanitizer.

2. Future researchers should consider conducting similar research but a study should be conducted determining the level of antibacterial efficacy of the Aloe vera alternative hand sanitizer.

3. Different places should be tested or swabbed other than a hand of a person for more diversity of bacteria to find out in which environment the hand sanitizer is most effective and which type of bacteria is most susceptible and resistant.

4. The researchers recommend another research focusing on a thorough analysis of the characteristics of Aloe Vera whether it could be used in other fields like in medicine and many more.

5. It was advisable to use proper apparatus appropriate for the study such as Miller Hinton Agar and antibiotic disc for more accurate findings.

5.1. Antibiotic discs should be pre-ordered online for it is not available within the locale.

6. It was observed that days after the sanitizer was made, precipitated substances showed up after settling. Future researchers should create a method that would solve this issue.

Bibliography

References

CDC. 2008. Guideline for Disinfection and Sterilization in Healthcare Facilities (2008). Retrieved from.

https://www.cdc.gov/infectioncontrol/guidelines/disinfection/disinfection-methods/chemical.html

CDC. 2019. SARS-CoV-2 and Surface (Fomite) Transmission for Indoor Community Environments. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/more/science-and-research/surface-transmission.html

CDC. 2020. Hand sanitizers use out and about. Retrieved from. https://www.cdc.gov/handwashing/hand-sanitizer-use.html

Dicken, R. D., Gallagher, T., & Perks, S. (2020). Overcoming the Regulatory Hurdles for the Production of Hand Sanitizer for Public Health Protection: The UK and US Academic Perspective. *Journal of Chemical Health & Safety*, *27*(4), 209–213. https://doi.org/10.1021/acs.chas.0c00065

FDA. 2020. Q&A for Consumers | Hand Sanitizers and COVID-19. Retrieved from. https://www.fda.gov/drugs/information-drug-class/qa-consumers-hand-sanitizers-and-covid-19

FMOLHS. 2021. How to make homemade handsanitizer. Retrieved from. https://fmolhs.org/coronavirus/coronavirus-blogs/how-to-make-homemade-hand-sanitizer

Gold NA, Avva U. Alcohol Sanitizer. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2020.https://www.ncbi.nlm.nih.gov/books/NBK513254/

Huddleston Jr., T. 2020. The history of hand sanitizer—how the coronavirus staple went from mechanic shops to consumer shelves. Retrieved from. https://www.cnbc.com/2020/03/27/coronavirus-the-history-of-hand-sanitizer-and-why-its-important.html

Jain, V. M., Karibasappa, G. N., Dodamani, A. S., Prashanth, V. K., & Mali, G. V. (2016). Comparative assessment of antimicrobial efficacy of different hand sanitizers: An *in vitro* study. *Dental research journal*, *13*(5), 424–431. https://doi.org/10.4103/1735-3327.192283

Lasco, G. 2020. Hand Hygiene – Could COVID-19 Permanently Change Hand Hygiene? Retrieved from. https://globalhandwashing.org/hand-hygiene-could-covid-19-permanently-change-hand-hygiene/

Surjushe, A., Vasani, R., & Saple, D. G. (2008). Aloe vera: a short review. *Indian journal of dermatology*, *53*(4), 163–166. https://doi.org/10.4103/0019-5154.44785

APPENDIX A
(Documentation)

Materials and Apparatus







Media Preparation (Sterilization)









Research Procedure

I. Preparation of Aloe Vera as an Alternative Hand Sanitizer





II. Preparation of Agar Solution







III. Preparation of Anti-

Bacterial Activity Assessment of the Commercial and Aloe Vera Altern

Hand Sanitizers

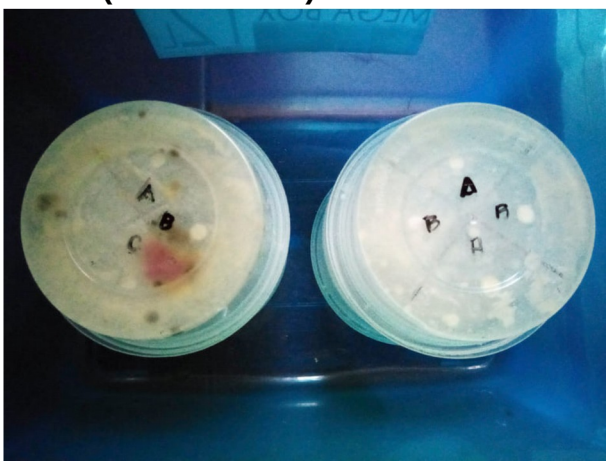








Results (After 1 Week)




APPENDIX B
(Data Gathering Tool: Observation Sheets)

Is ZOI present around both commercial and alternative hand sanitizer impregnated citrus filter disc?						
Hand Sanitizer	Trial 1		Trial 2		Trial 3	
	Yes	No	Yes	No	Yes	No
Aloe Vera						
Commercial						

Table 1. Presence of ZOI Surrounding both the Commercial and Aloe Vera Hand Sanitizer Impregnated Filter Paper Disc

Table 2: Zone of Inhibitions in each of the Trials

Diameter of the ZOI (in millimeters)			
Hand Sanitizer	Trial 1	Trial 2	Trial 3
Aloe Vera			
Commercial			

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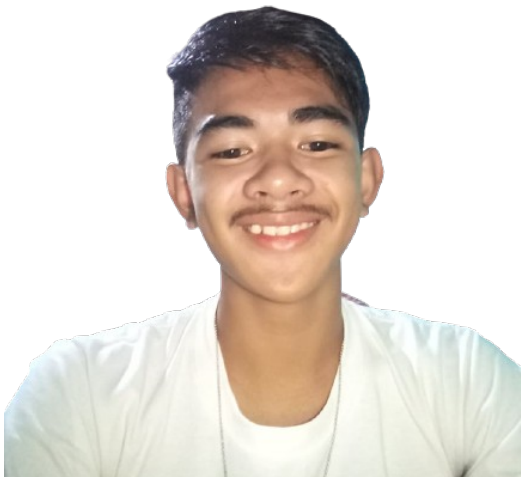
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