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EVALUATION OF ANTIBACTERIAL EFFICACY OF ALOE VERA (*Aloe barbadensis miller*) AS AN ORGANIC LIQUID HAND SOAP WITH CANTALOUPE (*Cucumis melo var. cantalupensis*) SCENT

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ABSTRACT

This study evaluated the antibacterial efficacy of Aloe Vera *(Aloe barbadensis miller)* as an organic liquid hand soap with Cantaloupe *(Cucumis melo var. cantalupensis)* scent. It used the quantitative method, particularly the true experimental design to attain its objectives. Furthermore, the formulated organic liquid hand soap was successfully accomplished by following the adopted but modified protocol from Boquecosa, et al. (2022). Then, the researchers evaluated its efficacy by determining its pH level, wetting ability, foaming ability, and antibacterial activities. Concerning its pH level, the *25%* Aloe Vera concentration was safe for human skin. Also, the wetting ability of the formulated organic liquid hand soap was highest at *75%* Aloe Vera concentration, while its foaming ability was highest at *25%* Aloe Vera concentration. When it comes to its antibacterial activities, the results demonstrated that the formulated organic liquid hand soap was inactive compared to the Gentamicin as positive control where it showed a very active in performing antibacterial activities. Furthermore, statistically, the results exemplified that there is a significant difference in the antibacterial activities between the control (Gentamicin) and treatment (Formulated Organic Liquid Hand Soap) in favor of the control. Thus, the researchers recommend that other microbes like bacteria and fungi may be utilized to test the antibacterial property of Aloe Vera apart from *Staphylococcus aureus*. Future researchers may deepen the investigation of the antibacterial property of Aloe Vera since the results of the present study proved otherwise. Also, they may explore other uses of Aloe Vera.

Keywords: *Evaluation, Efficacy, Aloe Vera, Organic, Liquid Hand Soap, Cantaloupe Scent, pH testing, Wetting Ability, Foaming Ability, Antibacterial Activities*

INTRODUCTION

Triclosan, triclocarban, phenols, halogens, trichlorocarbonalide, hydrogen peroxide, and alcohols are often used as antibacterial agents in cosmetics like liquid hand soaps, solid soaps, disinfectants, deodorants, toothpaste, and liquid hand sanitizers. For example, many commercial hand-washing liquid soaps contain triclosan as an antibacterial agent. Unfortunately, studies have linked triclosan, like many other synthetic organic antibacterials, to major health problems, from skin irritation to hormone disruption. Thus, this makes it important to find new antimicrobial agents for cosmetics that are useful, less harmful, and better for the environment (Montagner, et al., 2014).

Moreover, phytochemicals are chemicals that come from plants. They have strong antibacterial properties against a wide range of microorganisms, including fungi, and could be used to make cosmetics with antibacterial properties. Because they come from plants, phytochemicals are less dangerous and do not stick around in the environment. Even though phytochemicals' antibacterial properties, their toxicity, and what happens to them in the environment have been well studied, they do not have many uses. It is thought that they can replace harmful synthetic organic antibacterial agents in cosmetics.

Aloe Vera *(Aloe barbadensis miller)*, for example, has phytochemicals like phenolic acids/polyphenols, phytosterols, fatty acids, indoles, alkanes, pyrimidines, alkaloids, organic acids, aldehydes, dicarboxylic acids, ketones, saponins, and alcohols. Pathogenic microorganisms on the skin, like Gram-positive *Staphylococcus aureus* and Gram-negative *Staphylococcus aureus*, are said to be stopped from growing by Aloe Vera juice (Hedayati et al., 2007). Based on this, it is thought that cosmetics like liquid hand soap with Aloe Vera extracts and gel can stop these microorganisms from growing and stop medical diseases that are linked to them. So, the goal of this study was to evaluate the antibacterial efficacy of the formulated organic liquid hand soap using Aloe Vera gel with Cantaloupe (*Cucumis melo var. cantalupensis*) scent against *S. aureus*. Further, this study supports the previous claims of the researchers regarding Aloe Vera extracts and gel in a liquid hand soap that works as a natural antimicrobial agent, which means they can replace the dangerous synthetic antibacterial agents that are often used in antibacterial soaps and other cosmetics.

Objectives of the Study

This study evaluated the antibacterial efficacy of the formulated organic liquid hand soap using Aloe Vera *(Aloe barbadensis miller)* gel with Cantaloupe (*Cucumis melo var. cantalupensis*) scent. In achieving this primary goal, these tasks were accomplished:

1.) Modify the protocol from Boquecosa, et al. (2022) for the formulation of organic liquid hand soap using Aloe Vera *(Aloe barbadensis miller)* gel with Cantaloupe (*Cucumis melo var. cantalupensis*) scent.
2.) Evaluate the efficacy of the formulated organic liquid hand soap using Aloe Vera *(Aloe barbadensis miller)* gel with Cantaloupe (*Cucumis melo var. cantalupensis*) scent in terms of:
    2.1 pH Level;
    2.2 Wetting and Foaming Abilities; and
    2.3 Antibacterial Activities.
3.) Compare the control (Gentamicin) and treatment (Formulated Organic Liquid Hand Soap) in terms of antibacterial activities.

Research Questions

This study evaluated the antibacterial efficacy of the formulated organic liquid hand soap using Aloe Vera *(Aloe barbadensis miller)* gel with Cantaloupe (*Cucumis melo var. cantalupensis*) scent.

Specifically, the researchers answered these scientific questions:

1.) What is the modified protocol for formulating an organic liquid hand soap using Aloe Vera gel with a Cantaloupe scent?
2.) What are the results of the evaluation tests of the efficacy of the formulated organic liquid hand soap using Aloe Vera gel with a Cantaloupe scent in terms of:
    2.1 pH Level;
    2.2 Wetting and Foaming Abilities; and
    2.3 Antibacterial Activities?
3.) Is there a significant difference in the antibacterial activities between the control (Gentamicin) and treatment (Formulated Organic Liquid Hand Soap)?

Hypothesis of the Study

Ho1 There is no significant difference in the antibacterial activities between the control (Gentamicin) and treatment (Formulated Organic Liquid Hand Soap).

Scope and Delimitation of the Study

This study mainly evaluated the antibacterial efficacy of the formulated organic liquid hand soap using Aloe Vera gel with a Cantaloupe scent. The formulation protocol of the previous researchers, i.e., Boquecosa, et al. (2022) was modified by adding wetting and foaming abilities, and a scent using Cantaloupe essential oil. Also, it included the pH level and antibacterial activities testing of the formulated

organic liquid hand soap. Furthermore, by utilizing the Analysis of Variance (ANOVA) -Two Factors with Replication, the significant difference in the antibacterial activities between the control (Gentamicin) and treatment (Formulated Organic Liquid Hand Soap) was determined. The product formulation and the antibacterial testing were done at the Nutraceutical Laboratory of Mindanao State University, General Santos City, while the pH level, wetting, and foaming abilities testing were performed at the Chemistry Laboratory of Colon National High School in the academic year *2022-2023*.

Limitations of the Study

In the conduct of this study, the researchers encountered happenings beyond their control that formed part of the study's limitations. First, other microbes like *Pseudomonas. aeruginosa* and a fungus species (*Aspergillus flavus*) were unable to be part of the antibacterial testing since they were unreadily available at the Nutraceutical Laboratory. Second, other tests like cleansing ability and oil density determination were not performed due to financial constraints. Lastly, the term of the study. This study was only conducted for a short period of time; thus, other tasks were not carried out.

Significance of the Study

To Environmental Science, by using natural and organic ingredients in liquid hand soap formulations, the environmental impact of the product may be minimized. This includes using sustainable and renewable resources, such as Aloe Vera and Cantaloupe, that are grown and harvested in an eco-friendly manner.

To Policy Implication, Policy requirements may also encourage research and development into new and innovative liquid hand soap formulations that meet regulatory and consumer demands such as pH level of the products and its antibacterial efficacy.

To STEM Students, formulating liquid hand soap requires an understanding of chemical reactions, the properties of different ingredients, and the role of emulsifiers, preservatives, and other additives. This provides a hands-on experience for STEM students to apply their knowledge of chemistry and other STEM fields.

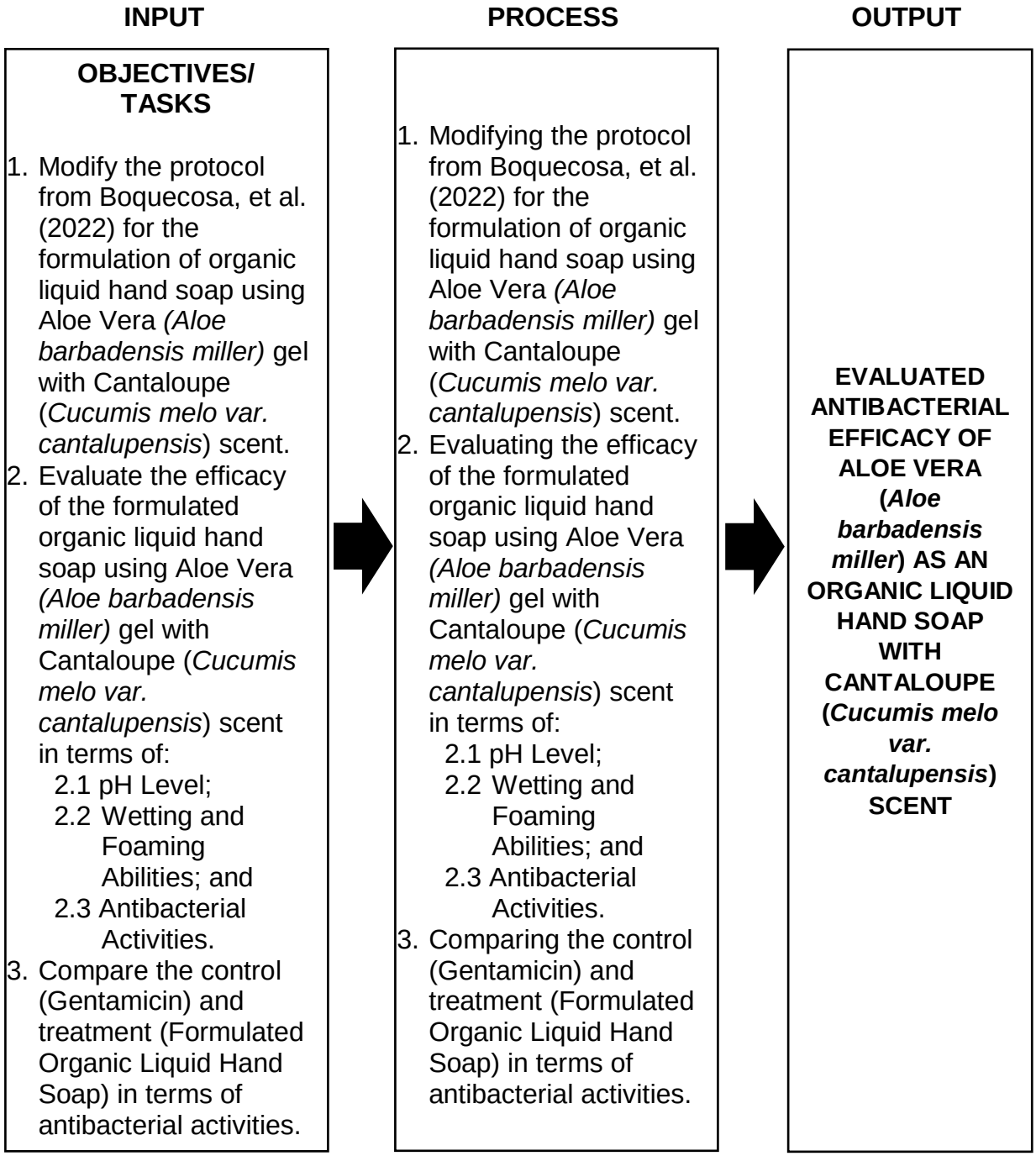
To the Community, formulating liquid hand soap with antibacterial or antiviral agents may enhance its effectiveness in promoting hygiene and preventing illness in the community.

To Future Researchers, formulating liquid hand soap requires creativity and innovation in developing new formulations, testing and optimizing their properties, and addressing challenges in the formulation process. This may foster innovation and creativity in future researchers and encourage them to develop new solutions to real-world problems.

Research Gap

There is limited research on the inclusion of different formulation variables, such as the wetting ability, foaming ability, and fragrance using Cantaloupe scent. Thus, the researchers included these variables in the present study to further investigate the efficacy of the formulated organic liquid hand soap using Aloe Vera with fragrance.

Conceptual Framework of the Study



METHODOLOGY

The study conducted by the researchers employed the quantitative approach, more specifically, a true experimental design. The research investigation centered on scientific experimentation and utilized statistical analysis in its implementation (Pubrica-Academy, 2020).

Materials Used: Aloe Vera, Cantaloupe Essential Oil, Lye, Coconut Oil, Olive Oil, Castor Oil, Ethyl Alcohol, Distilled Water

Tools Used: Beaker, Graduated Cylinder, Erlenmeyer Flask, Container Jar, Pipette, Dropper, Pipette Rubber Bulb Dropper, Weighting Boat, Magnetic Stirrer, Stirring Rod, Long Spoon, Spatula, Petri Dish, Alcohol Lamp, Paper Discs, Forceps, Cotton Swabs, Caliper, Universal Indicator Paper, Litmus Paper, Wash Bottle, Basin

Equipment Used: Analytical Balance, Top Loading Balance, pH Meter, Hot Plate, Laminar Flow, Incubator, Food Blender, Commercial Blender

Paraphernalia Used: Laboratory Gown, Laboratory Footwear, Gloves, Facemask, Hairnet

Procedures

A. Collection and Sanitation of Materials

The researchers collected the materials (Aloe Vera), then cleaned them using tap water two times, cleaning the skin of the aloe vera to remove dirt and residues from the collection. Next, in the final washing of the Aloe Vera, distilled water was used. Then, the researchers peeled the thorny part of the plant then added little incisions in the plant. After sanitation, the Aloe Vera was stored in a cooler with ice to avoid spoilage.

B. Peeling and Separation

After the researchers collected the materials, they peeled and separated the aloe vera gel from the peel.

C. Extraction of Aloe Vera Gel

The researchers extracted the aloe vera gel from its leaves using a long spoon/spatula.

D. UV Sanitation

After extracting, the researchers placed the extracted Aloe Vera gel into the laminar flow for disinfection to avoid any contaminations/bacteria infestation.

E. Formulation Protocol of Liquid Soap Base

First, an oil mixture consisting of Coconut Oil (*7*g), Olive Oil (*49*g), and Castor Oil (*14*g) was saponified using an aqueous solution of KOH (*15*g) and Distilled Water to create a soap paste (*60*g). Second, the researchers combined all the components (ingredients) in a beaker and heated it on a hot plate for roughly *200* degrees Celsius, constantly stirring it with a magnetic stirrer to maintain the temperature. Third, the six stages of a soap paste consistency, including watery mashed potatoes, chunky taffy, chunky/creamy petroleum jelly, transparent petroleum jelly, thick applesauce, custard with small bubbles, and were attained. Fourth, the researchers replaced the magnetic stirrer with a stirring rod and continued stirring until the soap paste resembled translucent petroleum jelly since it was difficult for the magnetic stirrer to continue churning in the solid taffy stage. Fifth, the paste was allowed to cool to room temperature. After the paste had cooled off, the researchers then diluted the soap paste into liquid soap paste, then the Aloe Vera gel was added to it to produce samples.

F. Converting the Soap Paste to Liquid Hand Soap

To obtain the liquid hand soap, *20*g soap paste was diluted in distilled water (*80*g), heated on a hot plate at *100* degrees Celsius, and continuously stirred using a stirring rod. Thereafter, the Aloe Vera gel and Cantaloupe Scent (*10* ml) were mixed with the liquid hand soap (*80 ml*).

G. Testing of pH Level of Soap Base

The researchers tested the soap paste's pH by using a universal indicator paper and litmus paper to measure its pH level and acidity. Five *(5)* trials were conducted during the testing.

H. Wetting Ability Testing

In finding which concentrates possess a much more effective cleansing power, the researchers subjected the various concentrations to wetting ability. By weighing 3-gram cotton wool, the researchers drooped the wool into a solution of *20* grams of distilled water along with *3* grams of the various concentrations in a beaker. Each concentration was measured to identify which concentrations do possess a much faster soaking.

I. Foaming Ability Testing

Most commercial soaps do consider foam stability as an essential factor in formulating an effective liquid hand soap. In this study, the researchers mixed *20* grams of water into *3* grams of varying concentrations in a beaker. Then, each concentration was agitated to produce foam for about *2* minutes. Thereafter, the researchers measured the height of the foam produced after agitation to identify which concentrations provided a much larger foaming stabilization.

J. Testing the Antibacterial Activities of the Formulated Organic Liquid Hand Soap Through Antibacterial Assay

Aloe Vera (*Aloe barbadensis miller*) liquid hand soap was tested in this study using an antibacterial assay to determine its antibacterial efficacy against *S. aureus*. Using Pure Soap Base (T*1*), *25%* Aloe Vera Gel Concentrate (T*2*), *50%* Aloe Vera Gel Concentrate (T*3*), *75%* Aloe Vera Gel Concentrate (T*4*), *100%* Aloe Vera Gel (T*5*), Gentamicin (PC) and Distilled Water (NC). Based on the existence or absence of a millimeter-sized zone of inhibition (ZOI), susceptibility and resistance were detected. ZOI ranges from *0* to *9* mm are regarded inactive, while ZOI ranges from *10* to *13* mm are considered partially active, *14* to *19* mm are considered active, and >*19* mm is considered very active.

Variables of the Study

The independent variable of the study was the formulated organic liquid hand soap using Aloe Vera (*Aloe barbadensis miller*) Gel and Cantaloupe (*Cucumis melo var. cantalupensis*) scent, while the dependent variables of the study were the pH level, wetting, and foaming tests and the Antibacterial activities. On the other hand, the control variable of the study was Gentamicin.

Statistical Tools

This study determined the significant difference in the antibacterial activities between the control (Gentamicin) and treatment (Formulated Organic Liquid Hand Soap) using Analysis of Variance (ANOVA) -Two Factors with Replication at *0.05* level of significance.

RESULTS AND DISCUSSIONS

Formulation Protocol of Organic Liquid Hand Soap

The formulation protocol was adopted but modified from Boquecosa, et al. (2022). First, an oil mixture consisting of Coconut Oil (*7*g), Olive Oil (*49*g), and Castor Oil (*14*g) was saponified using an aqueous solution of KOH (*15*g) and Distilled Water to create a soap paste (*60*g). Second, the researchers combined all the components (ingredients) in a beaker and heated it on a hot plate for roughly *200* degrees Celsius, constantly stirring it with a magnetic stirrer to maintain the temperature. Third, the six stages of a soap paste consistency, including watery mashed potatoes, chunky taffy, chunky/creamy petroleum jelly, transparent petroleum jelly, thick applesauce, custard with small bubbles, and were attained. Fourth, the researchers replaced the magnetic stirrer with a stirring rod and continued stirring until the soap paste resembled translucent petroleum jelly since it was difficult for the magnetic stirrer to continue churning in the solid taffy stage. Fifth, the paste was allowed to cool to room temperature. After the paste had cooled

off, the researchers then diluted the soap paste into liquid soap paste, then the Aloe Vera gel was added to it to produce samples.

Evaluation of the Efficacy of the Formulated Organic Liquid Hand Soap

This study evaluated the efficacy of the formulated organic liquid hand soap to determine its effectiveness considering its pH level, wetting ability, foaming ability, and antibacterial activities. Tables 1-4 show the complete results of the testing performed.

pH Level of the Formulated Organic Liquid Hand Soap

The pH level testing was done to determine whether the formulated organic liquid hand soap is suitable for skin usage, in accordance with the pH requirement of a cosmetic product. Table *1* shows the results of the pH level test among the samples used.

Table 1. pH Level Test Results of Samples Used

SAMPLE	REPLICATE	pH	AVERAGE	REMARKS
Pure Liquid Soap Base	R1 R2 R3	7 7 7	7	NEUTRAL
25% *Aloe barbadensis* Gel	R1 R2 R3	9 9 9	9	BASE
50% *Aloe barbadensis* Gel	R1 R2 R3	7 7 7	7	NEUTRAL
75% *Aloe barbadensis* Gel	R1 R2 R3	7 7 7	7	NEUTRAL
100% *Aloe barbadensis* Gel	R1 R2 R3	4 4 4	4	ACIDIC

The soap with *25%* Aloe Vera gel concentrate had a pH level of *9* which indicates that it is safe for human skin along with other concentrations that exhibited a pH level between *4-7*. Checking the pH of soap is important not only to improve the quality of the soap but also to make sure that the pH level does not make hands and skin too rough. In order to protect public health, high pH levels in the *9–11* range or low pH levels in the *3–5* range are thought to be bad for the face. This is in line with the rules about makeup, soaps, and detergents set by NAFDAC (Umar, 2002).

Wetting Ability of the Formulated Organic Liquid Hand Soap

This testing was performed to test the cleansing power of the formulated organic liquid hand soap. Table *2* shows the generated results from the said testing among the concentrations used.

Table 2. Wetting Ability of the Formulated Organic Liquid Hand Soap

CONCENTRATIONS	TIME (in seconds)
25% *Aloe barbadensis* Gel	41.79
50% *Aloe barbadensis* Gel	9.01
75% *Aloe barbadensis* Gel	7.65

The liquid hand soap with *75%* Aloe Vera concentration showed the quickest time with respect to the wetting ability as evidenced by *7.65* seconds time, proving that it has a much stronger cleansing ability than the other concentrations that demonstrated *41.79* seconds and *9.01* seconds time for *25%* and *50% Aloe barbadensis* Gel, respectively. This result contradicts the study of Tyowua, Vitalis, Terhemen, and Mbaawuaga (2020) who indicates that the *25%* Aloe *barbadensis* Gel Concentrates have a much faster wetting ability.

Foaming Ability of the Formulated Organic Liquid Hand Soap

Just like wetting ability testing, the foaming ability testing was also done to determine the cleansing power of the liquid hand soap. Table *3* shows the generated results from the said testing among the concentrations used.

Table 3. Foaming Ability of the Formulated Organic Liquid Hand Soap

CONCENTRATION	FOAMING ABILITY (in mm.)
25% *Aloe barbadensis* Gel	17
50% *Aloe barbadensis* Gel	8
75% *Aloe barbadensis* Gel	6

The 25% Aloe Vera gel concentrate shows to have a substantially bigger volume of foam with *17*mm than the other concentrations with *8* and *6* for *50%* and *75%*, *Aloe barbadensis* Gel, respectively. This means that the *25%* Aloe Vera gel concentrate promotes a much larger volume of foam if utilized. This supports the study of Tyowua, Vitalis, Terhemen, and Mbaawuaga (2020), who averred that decreasing the value of the *Aloe barbadensis* Gel Concentration results in a significantly higher value of foam.

Antibacterial Activities of the Formulated Organic Liquid Hand Soap

The antibacterial assay was done to determine which concentration demonstrated a much larger Zone of Inhibition (ZOI) against *Staphylococcus Aureus* as the bacteria used in the study. Table *4* shows the complete results of the testing.

Table 4. Comparative Measures of Zone of Inhibition of the Control and the Treatment Against *S. aureus*

CONTROL	REPLICATE	RESULTS (IN MM). *S. aureus*	REMARKS
Gentamicin (PC)	R1 R2 R3	27 27 29	Very Active Very Active Very Active
Distilled Water (NC)	R1 R2 R3	0 0 0	Inactive Inactive Inactive
TREATMENT	**REPLICATE**	**RESULTS (IN MM). *S. aureus***	**REMARKS**
Pure Soap Base (0%)	R1 R2 R3	6 6 6	Inactive Inactive Inactive
25% *Aloe barbadensis* Gel Concentrate	R1 R2 R3	7 8 8	Inactive Inactive Inactive
50% *Aloe barbadensis* Gel Concentrate	R1 R2 R3	10 8 6	Partially Active Inactive Inactive
75% *Aloe barbadensis* Gel Concentrate	R1 R2 R3	8 8 8	Inactive Inactive Inactive
100% *Aloe barbadensis* Gel Concentrate	R1 R2 R3	9 7 7	Inactive Inactive Inactive

The *25%, 50%, 75%,* and *100%* Aloe Vera gel concentrations inhibited an average of *7, 8, 8,* and *8*, respectively in their zone of inhibition, indicating Inactive. The positive control (Gentamicin) and Negative Control (Distilled Water) however, manifested an average of *27* (Very Active) and *0* (Inactive), respectively in their ZOI. Simply put, the formulated organic liquid hand soap demonstrated no antibacterial activities compared to Gentamicin which is very active in its antibacterial activities against *Staphylococcus Aureus.* These results are opposed to the investigation of Tyowua, Vitalis, Terhemen, and Mbaawuaga (2020) who conducted a study on the ability of the liquid soap samples, particularly the Aloe vera (*Aloe barbadensis Miller*) extract as a natural antimicrobial agent in handwashing liquid soap and found to have inhibited the

growth of microorganisms which was studied using two modeled-bacteria (*S. aureus* and *P. aeruginosa*) and a fungus species (*A. flavus*) and compared with that of the commercial liquid soap.

Significant Difference in the Antibacterial Activities

This study determined the significant difference in the antibacterial activities between the control (Gentamicin) and treatment (Formulated Organic Liquid Hand Soap). Using Analysis of Variance (ANOVA) -Two Factors with Replication, the results presented in Table *5* were identified.

Table 5. Difference in the Antibacterial Activities

	Sum of Squares	df	Mean Square	F	Sig.	F-crit
Between Groups	1330.29	6	221.71	221.71	0.00	2.85
Within Groups	14	14	1			
Total	1344.29	20				

The above table shows the results from the Analysis of Variance (ANOVA) -Two Factors with Replication conducted to evaluate the null hypothesis that there is no significant difference in the antibacterial activities between the control (Gentamicin) and treatment (Formulated Organic Liquid Hand Soap). Conversely, it was determined that there was a statistically significant difference between groups (F=*221.71*, p=*0.00*). Since the p-value > *0.05*, there is significant evidence to reject the null hypothesis and conclude that there is a significant difference in the antibacterial activities between the control (Gentamicin) and treatment (Formulated Organic Liquid Hand Soap).

These results negate the study conducted by Tyowua, Vitalis, Terhemen, and Mbaawuaga (2020) who revealed that the soap solution without aloe vera extract inhibited the growth of both bacteria up to an average of *6.0±0.1*mm. This is probably due to the presence of unsaponified components in the oil blend. As expected, the incorporation of the extract increased the zone of inhibition significantly (p = *0.05*) to an average of between *9.0±0.3*mm and *11.0±0.2*mm for *S. aureus* and between *7.0±0.1*mm and *10.0±0.2*mm for *P. aeruginosa*. This was compared with the Aloe vera extract alone which gave an average inhibition zone of *9.0±0.2*mm for both bacteria, *11* mm for *P. aeruginosa*, and *15* mm for *S. aureus* as reported by Philip et al., (2012). Statistical analysis shows that there is no significant difference (p = *0.05*) in the activity of the extract when incorporated into liquid hand soap. These results compare favorably (p = *0.05*) with the commercial soap solution, which gave an average inhibition zone of *9.0±0.1*mm for both bacteria.

SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATIONS

Summary of Findings

The formulated organic liquid hand soap was successfully accomplished by following the adopted but modified protocol from Boquecosa, et al. (2022). Then, the researchers evaluated its efficacy by determining its pH level, wetting ability, foaming ability, and antibacterial activities. Concerning its pH level, the *25%* Aloe Vera concentration was safe for human skin. Also, the wetting ability of the formulated organic liquid hand soap was highest at *75%* Aloe Vera concentration, while its foaming ability was highest at *25%* Aloe Vera concentration. When it comes to its antibacterial activities, the results demonstrated that the formulated organic liquid hand soap was inactive compared to the Gentamicin as positive control where it showed a very active in performing antibacterial activities. Furthermore, statistically, the results exemplified that there is a significant difference in the antibacterial activities between the control (Gentamicin) and treatment (Formulated Organic Liquid Hand Soap) in favor of the control.

Conclusions

Based on the findings of the study, it can be concluded that the formulated organic liquid hand soap was successfully accomplished by following the adopted but modified protocol. Moreover, after evaluating its efficacy, it was found that the formulated product is safe for use on human skin as it passed the required pH level. Also, it has cleansing properties since it demonstrated wetting and foaming abilities. However, with respect to its antibacterial activities, it exhibited no active property to inhibit bacteria compared to Gentamicin. Hence, there is a significant difference in the antibacterial activities between the formulated organic liquid hand soap (treatment) and positive control (Gentamicin).

Recommendations

Taking the summary of findings and conclusions into account, the researchers recommend the following:

1. Other microbes like bacteria and fungi may be utilized to test the antibacterial property of Aloe Vera apart from *Staphylococcus aureus*.
2. Future researchers may deepen the investigation of the antibacterial property of Aloe Vera since the results of the present study proved otherwise.
3. Also, future researchers may dwell on studies relative to other uses of Aloe Vera apart from making it an organic liquid hand soap.

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