PHILIPPINE SCIENCE HIGH SCHOOL WESTERN VISAYAS
Doña Lawaan H. Lopez Campus
Iloilo City

MOSQUITO-REPELLENT LOTION FROM LOCAL PLANT EXTRACTS

A Research Paper Presented to the
faculty of the Philippine Science High School Western Visayas
Iloilo City

In Partial Fulfillment
of the Requirements in
Science Research II

By:

Claudette Mae S. Cordero
Marjorie S. Halique
Lorie Therese F. Locara
Kitchie Mae S. Sumaylo

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APPROVAL SHEET

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Approved by the Research Committee:

MR. MARVIN L. CADORNIGARA, Chairperson/Adviser

MR. LEO E. PEDROSOSA, Member

MS. LEA P. SALINEL, Member

MS. ROWENA M. MAGNO, Member

PROF. REBECCA V. YANDOG
Director III

March 2001

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Doña Lawaan H. Lopez Campus
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Claudette Mae S. Cordero
Marjorie S. Halique
Lorie Therese F. Locara
Kitchie Mae S. Sumaylo

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Chapter 1

Introduction to the Study

Background of the Study

In a tropical country such as the Philippines, mosquitoes abound every nook and cranny. These pests not only annoy their prey, specifically, the humans they feed on, but they also carry harmful bacteria and viruses that they pass on their victims.

To repel these annoying and potentially dangerous insects, insect repellents are available to the consumers. These repellents are quite effective, but they usually contain synthetic compounds, and in most cases, petroleum-based substances.

Petroleum-based substances are usually irritating to the nose, and even to the skin, especially to people who are extra-sensitive.

Plant extracts are usually used as solutions to everyday problems. Not only are they more economical to use, they also pose lesser health risks than synthetic products.

Neem extract has been proven to be very effective as an insecticide, and even as a nematicide, and, doesn't have any effect on animals or humans.

This project aimed to study the feasibility of a neem-based repellent lotion. The lotion contained not only neem seed oil, but also marigold flower extract, known for its mildly repulsive odor, and aloe vera gel and vitamin E (from capsules), for its skin-saving properties.

If proven effective, the lotion will be a healthier and more economical alternative to the commercial insect repellent lotions.

In this study the mosquito repellent lotion was the independent variable. Its potency in repelling insects compared with two (2) commercial lotions, as well as its allergenic potentials to humans was the dependent variables.

The relationship between the independent and dependent variables is present in Figure 1.

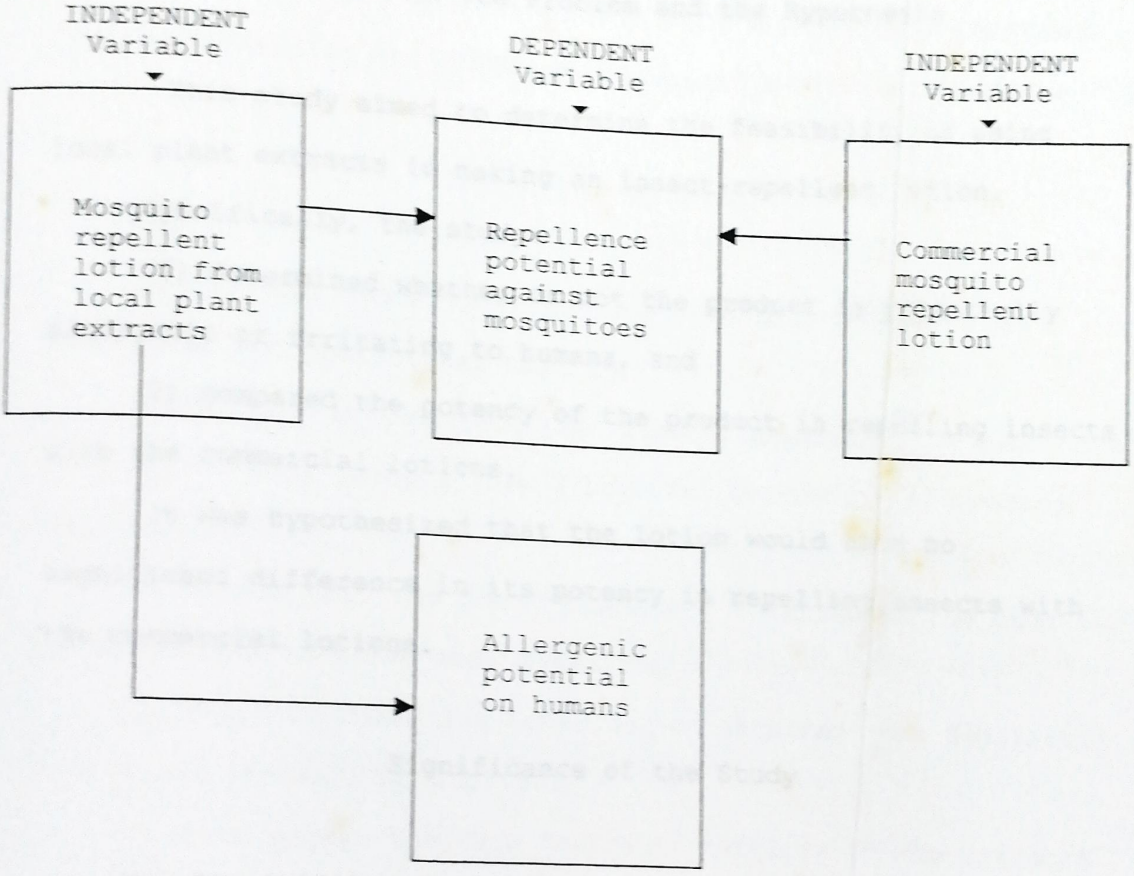

Figure 1. Potency of mosquito repellent lotion from local plant extracts in terms of repellence and allergenic potentials.

Statement of the Problem and the Hypothesis

This study aimed to determine the feasibility of using local plant extracts in making an insect-repellent lotion.

Specifically, the study:

(1) determined whether or not the product is potentially allergenic or irritating to humans, and

(2) compared the potency of the product in repelling insects with the commercial lotions.

It was hypothesized that the lotion would have no significant difference in its potency in repelling insects with the commercial lotions.

Significance of the Study

The feasibility of a plant extract based insect-repellent lotion may prove to be a more economical alternative to commercial brands. The affordability of the product may prove to have significant effects, as affordability means accessibility to the product. Meaning, those who can ill-afford 'luxuries' such as these lotions, which have steep prices, will now have a

healthier protection against such harmful insects as mosquitoes, thereby minimizing the incidence of mosquito-carried epidemics.

Definition of Terms

Significant terms in this study have been given their conceptual and operational meanings:

Repellent- is something that repels; especially, a substance that drives away insects (New Schclastic Dictionary of American English, 1981).

In this study, the term "repellent" referred to the capacity of the lotion to drive away mosquitoes.

Extract- is something taken out or obtained (New Scholastic Dictionary of American English).

In this study, the term "extract" referred to the extracts of neem, marigold, and aloe vera.

Lotion- is a liquid preparation used to soothe, treat, or beautify the skin (New Scholastic Dictionary of American English).

In this study, the term "lotion" referred to the mosquito repellent lotion, specified as the product lotion or the commercial ones.

Marigold- is garden plant having yellow, orange, or dark-eyed flowers (New Scholastic Dictionary of American English, 1981).

In this study, the term "marigold" referred to one of the plants from which insect-repellent juices was extracted.

Neem tree- is a drought-relative relative of the mahogany tree, which is native to India and Burma, and is good for reforestation purposes (Miller, 1994).

In this study, the term "neem tree" referred to one of the plants from which insect-repellent juices was extracted.

Aloe vera- is a garden plant whose thick, fleshy leaves have spiny edges and grow in a cluster from the base of the plant (New Scholastic Dictionary of American English).

In this study, the term "aloe vera" referred to the plant from which an extract of its gel was used as a binder.

Mosquito- is a two-winged, dipterous insect, having (in the female) a long proboscis capable of puncturing the skin for extracting the blood (Webster Comprehensive Dictionary, Encyclopedic Edition, 1995).

In this study, the term "mosquito" meant the specific insect on which the lotion was tested for repelling capacity.

Potency- is the ability of effecting particular results (Webster Comprehensive Dictionary, Encyclopedic Edition).

In this study, the term "potency" referred to the ability of the product to drive away mosquitoes.

Scope and Delimitation

The neem leaves were taken from a neem tree in front of the Locara Residence and in the Philippine Science High School Campus. To ensure that the leaves contained enough juice to make the lotion, the young, new growths were selected and preferred over the tough, dry leaves.

The lotion was initially manufactured in the Locara residence. The subsequent creation of the lotion was done in the research lab of Philippine Science High School.

The conduct of the experiment was done in the same research lab. Ten persons were made to use the lotion to test for allergic reactions. Eighteen mosquitoes were used as "test organisms" in comparing the differences in the repellence of the neem lotion and the commercial lotions. After the conduct of the experiment, the results were subjected to the One-way ANOVA.

This study was conducted to test the product's effect on mosquitoes only. Furthermore, the study is not concerned about the commercial possibilities of the product.

Chapter 2

Review of Related Literature

Chapter 2 is divided into 5 parts, namely, (1) Mosquitoes, (2) Aloe Vera, (3) Marigold and (4) Neem Tree

Mosquitoes

Mosquito is an insect pest, a kind of fly of the family Culicidae in the order Diptera. Most mosquitoes suck blood and are serious pests of man and other warm-blooded animals. Some feed chiefly on the juices of plants, and some kinds do not feed at all in the adult stage. The larvae, known as wrigglers, are aquatic, feeding upon dead plant tissues, algae, and microscopic animal life; a few kinds are, however, predaceous upon other mosquitoes. The pupae, known as bullheads, are active and swim about freely. The eggs are whitish or yellowish when laid, but soon become brown; they may be laid singly or in "floats" of twenty-five to several hundred. The eggs of the anopheline (malaria) mosquitoes are laid singly and have a pair of floats that differ in shape and size in each species. About 3000 species of mosquitoes are known (Collier's Encyclopedia, 1994).

The slender elongated body of the adult mosquito is covered with scales; in addition the mosquito is characterized by its long, fragile looking legs and its mouthparts, which are contained in an elongated proboscis. The threadlike antennae of the male are generally bushier than those of the female. The males, and sometimes the females, feed on nectar and other plant juices. In most species, however, the females require a blood meal in order to mature their eggs, which are laid on the surface of the water (Encyclopedia Britannica, 1993).

Mosquitoes are apparently attracted to host animals by moisture, lactic acid, carbon dioxide, body heat, and movement. The mosquitoes' hum results from the high frequency of its wingbeats; the females' slightly lower frequency may serve as a means of sex recognition (Encyclopedia Britannica).

A great nuisance, mosquitoes are of deeper concern to man as carriers of disease, usually as intermediate hosts of the infective organisms. Malaria cannot exist without the presence of species of Anopheles mosquitoes, and about 50 species, or one fourth of the total, transmit it. Yellow fever also cannot exist without mosquitoes, since the one developmental stage of the causative organism develops in the yellow fever mosquito, Aedes aegypti, a species found throughout tropic and warm temperature regions (Collier's Encyclopedia, 1994).

Protection from adult mosquitoes, tabanids and other biting flies for limited periods can be obtained through the use of insect repellents applied to the skin of the head, neck and arms. While these chemicals may prevent some flies from biting, they usually do not prevent the offending flies from hovering close by and being a nuisance (Robinson, 1996).

Measures used to control mosquitoes include the elimination of breeding sites, the application of surface films of oil to clog the breathing tubes of wrigglers, and the use of larvicides. Synthetic organic insecticides may be used to destroy adult mosquitoes indoors (Encyclopedia Britannica, 1993).

Aloe Vera

Aloe is any of about 200 species and hybrids of perennial succulent plants that belong to the lily family, Liliaceae. They are used as landscape plants in dry, frost - free areas and are sometimes grown as houseplants. Their leaves are fleshy, stiff, and spiny along the edges and are often crowded together into a rosette (Grolier International Encyclopedia, 1991).

The succulent leaves of Aloe Vera are one of the nature's perfect packaging miracles. The transparent pulp from a fresh-cut leaf helps the work of healing cuts and burns. It is used in

shampoo, sunburn lotions, and burn ointment that has been given government contracts after testing at Los Alamos proving ground under the auspices of the US Atomic Energy Commission (Onaylos, 1994).

Several species of aloe are cultivated as ornamentals for their sharp-pointed, spiny leaves and colorful clusters of yellow or red flowers. The juice of some species, especially the popular pot plant known as true aloe (*A. vera*), is used as an ingredient in cosmetics and in medicine as a purgative and as treatment for burns (Encyclopedia Britannica, 1993).

Species of Aloe vary in height from several centimeters to more than 9 m (30ft) and they are widely cultivated as garden and tub plants (Funk & Wagnalls New Encyclopedia, 1986).

Aloe vera is used to treat skin that has been damaged from the sun or other forms of radiation (Starr and Staggart, 1993).

It is commonly believed that the moisturizing emollient and healing properties of Aloe gel are due to the polysaccharides present. The major polysaccharide present has been determined to be a glucomannan. Other polysaccharides containing galactose and uronic acids as well as pentose are also present (Onaylos, 1994).

Neem Tree (*Azadirachta indica*)

Neem (also known as azadirachtin) is an insecticide extracted from the seeds of the Neem tree (*Azadirachta indica*) common in most of Africa and India. It is closely related to the chinaberry tree (*Melia azadarach*), common in the southern and southeastern United States. Extracts of both trees have insecticidal properties. Neem is unique among pesticides since it has so many uses: it acts as a broadspectrum repellent, growth regulator and insect poison. It discourages feeding by making plants unpalatable to insects; if they still attack, it inhibits their ability to molt and lay eggs.

Neem is also nontoxic to mammals and beneficial insects and is biodegradable. It is used in India as an ingredient in toothpaste, soap, cosmetics, pharmaceuticals, and cattle feed. The seeds and extracts of both neem and chinaberry trees, however, are poisonous if consumed. Because neem's chemical structure is so complex, scientists hypothesize that it will take long time for pests to develop resistance to it (Bradley and Ellis, 1992).

Extracts from neem seeds and leaves can be used to fight bacterial, viral, and fungal infections. The tree's chemicals have allegedly relieved so many different afflictions that the

tree has been called a "village pharmacy". The neem produces chemicals useful in fighting inflammation, reducing high blood pressure, preventing ulcers, and fighting tooth decay and gum disease (Miller, 1999).

Neem extracts is useful against leaf-miner, a serious pest in parts of North America. Neem seed extracts works as well as available commercial synthetic pesticides. It has been approved by the US environmental protection agency for use on leaf-miners.

Neem is extremely useful as an anti-feedant and avi-positional repellent for protection of crops like tobacco, groundnut, cotton and sweet potato from the damages caused by tobacco caterpillar or tobacco cutworm, a serious polyphagous pest of several crops in India (in Aguilos, Pacificar and Zuloaga, 1999).

Various neem products play an important role in the population control of many insect species. Reports given by a number of researchers revealed that the neem in one way causes the death of adults and larvae and in other we can deter the growth and feeding behavior of the pest (Tabassum, Narulaim, Naqui, and Azmi, 1996).

One promising new synthetic botanical is a modified seed extract from the neem tree. The neem-related botanical stops

more than 100 insect species from feeding repels them from treated plants, and is harmless to pest and humans (Miller).

Rembold and Schmutterer (1981) reported that azadirachtin (isolated from the mathanolic extract of the neem seed) is a potent growth inhibitor with only weak antifeedant activity and no acute toxicity against *Epilachua varivestis* larvae even the low dose prevents larval-pupal moulting and blocks further metamorphosis.

Marigold (*Tagetes erecta L.*)

Marigold, common name for several related plants that typically have orange to yellow flowers. Marigolds of one genus are native to tropical and subtropical regions of the western hemisphere. Aztec, or African, marigold, native to Mexico, is one member of the genus. It is an annual herb growing up to about 1 m (about 3 ft) tall and producing large, globular, golden-yellow or orange flower heads. Aztec marigolds have been bred in both single- and double-flowered varieties. French marigold is a smaller Mexican annual growing about 46 cm (about 18 in) high and producing small yellow and red flower heads. Sweet-scented marigold is a perennial that is usually cultivated as an annual. It grows to about 46 cm (about 18 in) high and

produces small yellow-orange flower heads. The marsh marigold belongs to the buttercup family.

Scientific classification

Marigolds belong to the family Compositae. Aztec, or African, marigold is classified as *Tagetes erecta;* French marigold as *Tagetes patula;* and sweet-scented marigold as Tagetes lucida. The marsh marigold belongs to the family Ranunculaceae and is classified as *Caltha palustris* (Microsoft Encarta, 1994).

The marigold plant is also known as the *amarillo* in the Tagalog dialect and *ahito* in Ilokano.

The plant has a rather coarse, erect, glabarous, branched, rank-smelling annual herb of 0.4 to 1 meter high. Its leaves are 4 to 11 cm long, very deeply pinnatified, the lobes lanceolate, coarsely and sharply toothed, 1 to 2.5 cm long. The plant's heads are solitary, long-peduncled, the peduncle thickening upward, 2.5 to 3.5 cm long, 2 to 4 cm in diameter, the involcre is green in color. The flowers of the plant range from yellow to deep yellow, achenes 6 to 7 mm long (Quisumbing, 1978).

McHoy and Westland (1994), cited that the marigold plant has many uses, its petals as spice and dye, flowers for garland and used for culinary purposes for rice, cheese, meat dishes, and salads, the plant is also used for skin and hair care, and the

plant is used as medicine. The plant is cultivated in Filipino homes for its attractive flowers and used. The plant as a medicine for rheumatic pains, colds and bronchitis. Its leaves are used for boils, cabuncles, and earache. Decoction of flowers and leaves is carminative, diuretic and vermifuge. The flowers are used for eye diseases and skin ulcers. The roots serve as laxatives.

Summary

The literature suggests that there is a need for protection against mosquitoes. The literature on the plants confirms that these have properties that have significant effects in repelling mosquitoes and other insects. This study hopes to produce a lotion that is potent in repelling mosquitoes, as are the qualities of the plants the study plans to use.

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Chapter 3

Research Design and Methodology

This study aimed to determine the feasibility of using local plant extracts in making an insect-repellent lotion.

Specifically, the study determined whether or not the product is potentially allergenic or irritating to humans, and compared the potency of the product in repelling insects with the commercial lotions.

The Research Design

The study used the One-Spot Case Study design. The independent factor was the neem lotion and the two commercial lotions, while the dependent factors were the allergenic potential of the lotion (product), its potency as a repellent, and its potency as compared to the commercial lotions.

The One-Spot Case Study which was employed in this research would require no pre-test, only a treatment on the test organisms and the post-test in terms of the height (in cm) the mosquitoes would ascend for every sixty (60) seconds interval.

Methodology

Materials and Equipment

The materials used in this study were: neem-seed oil or neem-leaf extract, aloe vera powder, marigold flower extract, emulsifying wax, stearic acid, citric acid, glycerin, and Germaben II, an antibacterial preservative used in lotion making. The study also used the two (2) leading insect repellent brands, for comparison testing.

The equipment used in this study were: a microwave oven, a blender, and a computer with a spreadsheet program (for calculating the amounts and values of the ingredients).

Site of Experimentation

The lotion was mixed and made at the Locara residence in Tagbac, Jaro, Iloilo City. The testing of the lotion was conducted at the PSHS-WVC research laboratory.

Gathering of the Materials

Neem leaf extract was used in making the lotion. The leaves were gathered from a neem tree in the Locara residence, and from the neem trees in the PSHS-WV Campus. The marigold flowers and leaves were obtained, with permission, from the PSHS-WV campus

grounds. An *Aloe Vera* gel was used in lieu of *Aloe Vera* powder, normally used in lotion preparations, as purchasing from the Internet was not a feasible idea for the reseachers. The citric acid and the glycerin were obtained from a laboratory in which a parent of a researcher (Marjorie Halique) worked. The stearic acid was obtained from the PSHS-WVC Chemistry department, and the emulsifying wax was obtained from a DOST employee. The rest of the ingredients were bought at department stores.

Germaben II, however, was omitted, because the researchers still have to purchase it over the Internet, which is expensive and time-consuming. However, the researchers still recommend the use of the said product, as it will prolong the shelf life of the insect-repellent lotion.

Making of the Lotion

The lotion was formulated at the calculated values. The preparation process of the lotion was based on the recipes on the Mountain-Sage website, a site for lotion-making.

The following is the procedure on how to manufacture the lotion:

Step 1. The neem leaves were gathered, then rinsed to rid them of dirt and resident insects.

Step 2. The leaves were put in a blender and processed until fine.

Step 3. The other ingredients were measured based on the recipe provided for by the Mountain-Sage website. The following are the measurements:

1 gram Citric Acid

3.5 grams Glycerin

4.5 grams Stearic Acid

5 grams Emulsifying Wax

20 grams oil (liquid at room temperature)

65 grams purified water

.5 grams Germaben II

Step 4. All the ingredients were combined, including the neem extract, in a microwave safe container. Then the mixture was heated until the waxes were melted and became easy to mix.

Step 5. The mixture was processed in an immersion blender until all the waxes were emulsified.

Step 6. The lotion was left to cool for a while. When it cooled down to a temperature tolerable to the skin, it was tested on the test organisms.

Testing For Allergenic Reaction and Repelling Capacity

To test for allergenic reactions, the product was given to ten (10) people. They were requested to apply the lotion on specific areas of their skin. The subjects then monitored for allergenic reactions five (5) minutes upon application of lotion.

To test for the repelling capacity, a quantity of lotion was applied on the hands of one of the researchers which was placed inside the cage, where the mosquitoes were housed. The number of mosquitoes repelled was noted for every thirty (30) second interval for five minutes (i.e., 30 sec. = 18 mosquitoes; 60 sec. = 16 mosquitoes, etc.).

Comparison of the Lotion to Commercial Products

If the mosquitoes fly away from the paper with the product higher than in the papers with commercial repellents, then it is more potent than the commercial products.

Statistical Data Analysis

In treating the data gathered from the study, the following statistical tools were used:

The mean was used as descriptive statistical tool. The One Way Analysis of Variance (ANOVA), set at 0.05 alpha level of significance, was used as inferential statistical tool.

The mean was used to determine the average number of mosquitoes repelled by the lotion treatment for all the trials.

The One-Way ANOVA was used to determine the differences in the repellent potential of the product lotion compared with two commercial lotions.

Chapter 4

Results

This study aimed to determine the feasibility of using local plant extracts in making an insect repellent lotion.

Specifically, the study determined whether or not the product is potentially allergenic or irritating to humans, and compared the potency of the product in repelling insects with the commercial lotions.

It was hypothesized that the lotion would have no significant difference in its potency in repelling insects with the commercial lotions.

Allergenic Potential of Mosquito Repellent Lotion from Local Plant Extract

The mosquito repellent lotion was given to ten (10) people. These persons were initially interviewed about their skin type. It was found out that they vary in their skin type. They were instructed to apply the lotion on their arm and observe for allergenic reaction. No allergenic reaction was detected five (5) minutes after application and thereafter. The respondents noted that the texture of the product was the same with the usual mosquito repellent lotion.

Potency of the Mosquito Repellent Lotion from Local Plant Extracts Compared with Two (2) Commercial Insect Repellents

The mosquito repellent lotion from local plant extracts was as potent as the two(2) commercial insect repellents. In the duration of the five-minute test, all of the eighteen(18) mosquitoes were repelled by the both the product and the commercial brands.

Table 1

Number of Mosquitoes Repelled by the Mosquito Repellent Lotion from Local Plant Extracts and the Two(2) Commercial Lotions

Name of Lotion	Time	No. of mosquitoes repelled	No. of mosquitoes not repelled	Name of Lotion	Time	No. of mosquitoes repelled	No. of mosquitoes not repelled
Neem				Off!, Johnson &Johnson			
	0-30s	18	0		0-30s	18	0
	30-60s	18	0		30-60s	18	0
	60-90s	18	0		60-90s	18	0
	90-120s	18	0		90-120s	18	0
	120-150s	18	0		120-150s	18	0
	150-180s	18	0		150-180s	18	0
	180-240s	18	0		180-240s	18	0
	240-270s	18	0		240-270s	18	0
	270-300s	18	0		270-300s	18	0
	300-330s	18	0		300-330s	18	0
MEAN		18	0	MEAN		18	0

Table 1 shows that in the duration of five minutes, the mosquito repellent lotion repelled all mosquitoes. For every interval of 30 seconds, 18 mosquitoes were repelled. Thus, having a mean of 18.

The same results also appeared for both Off! and Johnson&Johnson lotion brands.

Differences in the Number of Mosquitoes Repelled by the Mosquito-Repellent Lotion from Local Plant Extracts, Off! And Johnson&Johnson and at Different Exposure Times

The One-Way ANOVA showed that there is no significant difference in the number of mosquitoes repelled and not repelled by the product lotion, Off! and Johnson&Johnson and at different exposure times as reflected by $F(2)=0$ and $F(10)=0$, respectively.

Table 2 shows the data.

Table 2
One-way ANOVA for the Number of Mosquitoes Repelled and Not Repelled and at Different Exposure Times

Category	Sum of Squares	df	Mean Square	F	Sig.
Lotion from Local Plant Extracts ***Repelled***					
Between Groups	.000	2	.000		
Within Groups	.000	96	.000		
Total	.000	98	.000		
Lotion from Local Plant Extracts ***Not Repelled***					
Between Groups	.000	2	.000		
Within Groups	.000	96	.000		
Total	.000	98	.000		
Off! and Johnson&Johnson ***Repelled***					
Between Groups	.000	2	.000		
Within Groups	.000	96	.000		
Total	.000	98	.000		

Off! And Johnson&Johnson ***Not Repelled***					
Between Groups	.000	2	.000		
Within Groups	.000	96	.000		
Total	.000	98	.000		
TIME					
Lotion from Local Plant Extracts ***Repelled***					
Between Groups	.000	10	.000		
Within Groups	.000	88	.000		
Total	.000	98	.000		
TIME					
Lotion from Local Plant Extracts ***Not Repelled***					
Between Groups	.000	10	.000		
Within Groups	.000	88	.000		
Total	.000	98	.000		
TIME					
Off! and Johnson&Johnson ***Repelled***					
Between Groups	.000	10	.000		
Within Groups	.000	88	.000		
Total	.000	98	.000		
TIME					
Off! And Johnson&Johnson ***Not Repelled***					
Between Groups	.000	10	.000		
Within Groups	.000	88	.000		
Total	.000	98	.000		

Chapter 5

Findings, Conclusions, and Recommendations

This study aimed to determine the feasibility of using local plant extracts in making an insect-repellent lotion.

Specifically, the study:

(1) determined whether or not the product is potentially allergenic or irritating to humans, and

(2) compared the potency of the product in repelling insects with the commercial lotions.

It was hypothesized that the lotion would have no significant difference in its potency in repelling insects with the commercial lotions.

Findings

1. The mosquito repellent lotion was given to ten (10) respondents in order to test its allergenic potential to humans. After five (5) minutes, it was found out that the product does not cause any harmful allergenic reactions to humans. Even after five (5) minutes, the respondents still did not have allergies towards the product.

2. The mosquito repellent lotion was tested on eighteen (18) mosquitoes placed in a cage enclosed with a mosquito net. The same was done on the two (2) commercial mosquito repellent lotions. It was found out that the mosquito repellent lotion from local plant extracts showed the same repelling potential as the one exhibited by the commercial lotions. All the lotions repelled eighteen (18) of the test organisms.

Conclusions

The data based on this study were evidences of the following conclusions:

The mosquito repellent lotion from local plant extracts is an effective repellent. Furthermore, it causes no allergenic reactions to humans.

Recommendations

Further studies on the effectiveness of neem extracts as insect repellent is recommended.

It is recommended that a study be conducted to test the lotion's effectiveness even after it was washed off. It was

observed that after testing the repelling potential of the lotion and washing it away, hours later the mosquitoes are still repelled.

It is also recommended that the amount of plant extracts be varied to obtain the highest potency in repelling insects.

It is also recommended that the appropriate consistency of the lotion be determined, also through further studies.

PHILIPPINE SCIENCE HIGH SCHOOL WESTERN VISAYAS
Doña Lawaan H. Lopez Campus
Iloilo City

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