Lanzones (*Lansium domesticum*) Peels, Sawdust, and Wax Shavings as an Organic Alternative Ingredient in Mosquito Coils in Repelling the Philippine Prominent *Aedes aegypti* and *Aedes albopictus*

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Abstract

This study reported the use of lanzones (*Lansium domesticum*) peels, sawdust, and wax shavings as an organic alternative ingredient in mosquito coils. The mosquito coils were produced by mixing the ground lanzones peels, sawdust, corn starch, wax shavings and water and molded using the aluminum mold. The samples were oven-dried and stored in a sealed bag. The study focused on determining the effectivity of the produced coils in repelling mosquitoes as well as the commercial coils in the factors that make up a good and useful product. Combustion periods were measured, and the effectivity was tested in both close and far proximities. Burn duration test showed that lanzones peel mosquito coils burn faster than the commercial mosquito coil. However, lanzones peel mosquito coil was proven to be effective as a repellant as it was able to debilitate the mosquitoes quicker than the commercial coils did. This was true for both the close proximity contact and far proximity contact with mosquitoes.

Keywords: dengue, mosquitoes, lanzones peels, mosquito coils, triterpenes

Introduction

Dengue fever is a mosquito-borne viral disease that occurs in tropical and subtropical areas like South and North America, Africa, and Asia. It is transmitted to humans through the bite of infected Aedes aegypti or Aedes albopictus mosquitos. This deadly disease has been terrorizing many households in many countries and regions all over the world. According to the World Health Organization, dengue fever is the most critical mosquito-borne disease in the world – it is also the most rapidly spreading. There has been a 30-fold increase in global incidence over the past 50 years. Annual estimates show that 390 million dengue infections occur where 96 million results in illnesses with 500 000 of these illnesses develop into severe dengue or dengue hemorrhagic fever – a more severe form of the said disease. Unfortunately, 25 000 of these infections lead to death.

The Philippines, being in the tropics, records high cases of this disease yearly and Filipinos find ways to deal with the disease-carrying insects to prevent outbreaks. Several measures are done, and products are created to battle the disease. One of the commonly used products is repellants like lotions, incense, and mosquito coils. Mosquito Coils are the most popular in the Philippines due to their affordability and effectivity. However, they unknowingly present another health issue as they have adverse health effects on human beings due to the inorganic materials used for their active ingredient.

Objectives

1. Create an Effective Mosquito Repellant
   - Create a product that can prevent mosquito contact
2. Create a Less Harmful Mosquito Coil
   - Eliminate inorganic compounds in creating mosquito coil
3. Find Cheaper Alternative Materials for Mosquito Coil
   - Utilize waste materials to reduce cost and make production process sustainable
4. Test Product in Real Life Conditions
   - Use resulting coil in realistic environment and compare it to commercial counterpart
5. Satisfy Sustainable Development Goals (SDGs)

Methodology

Collection and Preparation of Materials
- Lanzones peels, corn starch, sawdust, wax shavings, and commercial mosquito coil obtained from the local market in Los Banos, Laguna
- The lanzones peels were sun-dried to remove moisture

Preparation of Lanzones Peel Mosquito Coil
- The best ratio of materials determined by trial and error method
- Chosen ratio: 2 1/2 lanzones peels to 1 1/2 corn starch to 2 sawdust to 3 water
- Dry ingredients were mixed; Water added to complete the mixture
- The individual coil produced by mixing 1/8 cup of resulting mixture and a teaspoon of wax shavings
- oven-dried for 15 minutes to fully dry the coil

Measurement of Combustion Period
- Lanzones peel mosquito coil and commercial mosquito coil altered to match weights
- Coils lit and placed three meters away in open spaces
- Observations were recorded after the timer stopped

Testing the Effectivity of Both Coils in Repelling Mosquitoes in Close Proximity
- Improvised chamber prepared by cutting several holes in container
- Hole cut from side of container at the bottom:entry point of coil
- Holes placed on cover of container for sufficient air and exit for smoke; mosquito was set free inside the chamber
- Piece of the coil lit and inserted in hole
- Thermometer on the top of the chamber to monitor the temperature.
- Reached 25°C, the coil was removed, and the mosquito was observed. This process was repeated three more times.

Testing the Effectivity of Both Coils in Repelling Mosquitoes in Far Proximity
- Three setups were created: a commercial mosquito coil, a lanzones peel mosquito coil, and no mosquito coil
- Includes plastic bottle mosquito trap created with sugar and yeast
- Placed in different spaces in the backyard
- The mosquito coils were lit and placed in three setups.
- Left for 12 hours and were observed for mosquitoes in the trap.

Results & Discussions

- Figure 1 shows lanzones peel mosquito coil and commercial mosquito coil
- In Fig. 1A, lanzones peel mosquito coil has rough surface and noticeable larger particles than the commercial mosquito coil.

Figure 1: (A) Lanzones Peel Mosquito Coil and (B) Commercial Mosquito Coil

- Burn duration of both coils shown in Table 1.
- Commercial mosquito coil takes a longer time to be consumed by 33.33 %
- Difference of two hours was observed in the burn duration
- Result can be attributed to the types of materials used
  - Dry ingredients used for producing the commercial coils are finer and produces a more compact coil than the lanzones peel
  - Another reason: sawdust is more combustible than any other materials
  - Particle size of sawdust is the largest in size in the lanzones peel mosquito coils.

Table 1: Burn duration of the Lanzones Peel Mosquito Coil and Commercial Coil

	Lanzones Peel Mosquito Coil	Commercial Mosquito Coil
Weight of Coil in	12.5 grams	12.5 grams
Time it took to fully consume Coil	6 hours	8 hours
Burn Rate	2.0833 g/hour	1.5625 g/hour

- Figure 2 shows average time to reach the stages of debilitation of mosquitoes by commercial coil and lanzones peel coil.
- Results show that the average time the lanzones peel coil debilitated mosquito in three stages with the same temperature in both setups was faster than the commercial coil.
  - Confirms that the lanzones peel is an effective active ingredient in mosquito coils
  - Even more effective than the commercial mosquito coil in close proximity to the mosquitoes.

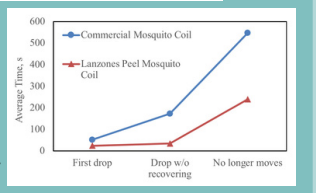

Figure 2: Average Time to Reach the Stages of Debilitation of the Mosquitoes by the Commercial Mosquito Coil and the Lanzones Mosquito Coil

- It was observed that there was more smoke produced by the lanzones peel mosquito coil compared to the commercial coil.
- Smoke is due to the high moisture content of the lanzones peels and sawdust as it was only sun dried.
- Number of mosquitoes trapped in three setups (lanzones peel coil, commercial coil, and no mosquito coil) for 12 hours shown in Table 2.
- Difference in number of mosquitoes caught by the mosquito trap in each setup can be observed. (Setup with no mosquito coil has the most mosquitoes)
- Most notable result: lanzones peel mosquito coil setup was able to catch less mosquitoes than commercial mosquito coil's setup
  - Shows that lanzones peel mosquito coil is more effective than the commercial mosquito coil.
  - Lanzones peel coil shooed the mosquitoes before getting caught by trap

	Lanzones Mosquito Peel Coil	Commercial Mosquito Coil	No Mosquito Coil
Time, h	12	12	12
No. of Mosquitoes trapped	9	15	26

Table 2: Number of Mosquitoes Trapped in Three Setups for 12 hours

Conclusion

The Lanzones Peel Mosquito Coil is:

- effective as a mosquito coil and mosquito repellant
- better than commercial mosquito coil
- organic and safe; eliminated inorganic compounds in mosquito coil
- homemade and can be made by a common household

Recommendations

To Improve Study and Results:

- use better tools and equipment
- use finer pulverized materials
- apply better drying procedure to eliminate most moisture
- study other factors that make commercial coil functional
- explore better production methods