

# Mosquito control, killing off the females.

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## Research Article

**Keywords:** Mosquitoes malaria dengue, control, toxic, sugar bait, ATSB, samples

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# Mosquito control, killing off the females.

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## **Abstract:**

In addition to causing discomfort, female mosquitoes introduce disease-carrying viruses and bacteria into the bloodstream of their victims. There are numerous publications describing the uses of sugary mosquito baits with promising results. Without temperature control measures however, these methods are mainly useful for only nectar-feeding insects, including male mosquitoes, because the warmth of the blood is a condition for the females to locate their meals. The efforts required to keep the baits fresh against the natural spoiling process make them less attractive or impractical to implement. These experiments address these issues by using warm baits of water, sugar, boric acid, and antibiotics. Overnight, the general areas became clear of blood-sucking female mosquitoes while in numbers, the harmless males concentrated into the immediate vicinities. Control vs. experiment protocol established no other logical explanation for this phenomenon other than that the females were attracted and killed by the bait. As expected, there was no mosquito egg-laying activity in these areas.

*Keywords:* Mosquitoes malaria dengue, control, toxic, sugar bait, ATSB, samples.

## **Introduction:**

In the field, the above-mentioned scheme worked, and the neighbors were happy. Yet, observations and feedback are considered subjective opinions, and the academic world demands objective and reproducible results.

Findings, regardless of how valuable they are, are stepping stones to pave the way on which the next generations walk. Although the end result of the experiment is only a simple baiting device, the community deserves to know better. Any change that causes mosquitoes to behave differently deserves an explanation.

Throughout most of human history, mosquitoes were not considered harmful animals, rather as annoying creatures. Only fairly recently when mosquito-borne diseases were identified, efforts to put them in control came to forefront, especially when people's lives are on the line.

There were studies trying to identify environmental variables that blood-seeking female mosquitoes could sense and/or use to differentiate their food among others in order to produce effective baits to trick them to come. Nevertheless, the experiments used baits that were primarily based on common sense; therefore, if there was a 'breakthrough', it was the methods and setup that enabled the experiments to give out objective and reproducible data. It did not use stimulants to lure, but provided favorable shelters.

The composition of the baits was simple: mosquitoes feed on nectars made up of sugary solutions. Boric acid is a known insect toxin. Mosquito feed on warm-blooded animals and antibiotics are germ-killing agents used to prevent things from being spoiled and to keep them active as long as the losses of active ingredients are compensated.

Thus, through trial and error, we decided on a warm-water solution of 5% sugar, 5% boric acid, and traces of antibiotics. As a result, both female and male mosquitoes were drawn to the area. Only the females consumed the solution, and their guts were subsequently crystallized. Figure 1 is the image of 2 female mosquitoes with and without crystals in their guts.



*Figure 1*

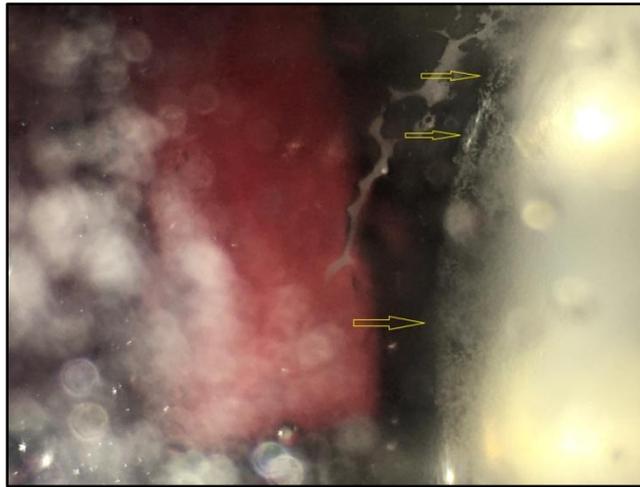
Although the caught mosquitoes were almost exclusively males, the numbers significantly increased. There were two further observations that validated our ideas: (a) when the samples of both genders were placed in the chamber with 'cool' baits, they died within a few hours, with few exceptions, and most of the carcasses were in the immediate vicinity of the bait as if the fatal incidents occurred suddenly in midair (showed in Figure 2).



*Figure 2*

This explains the phenomenon that only a few females were caught. When compared to the number of males caught, it suggests the notion that they were attracted by the composition of the bait.

Furthermore, (b) crystals began to form when the solution reacted with gelatin, a form of animal fat and complex amino acids (showed in Figure 3).



*Figure 3*

Previous experiments depended on laboratory environments, with live samples available in valid numbers. Out of necessity, this endeavor started as an attempt to find a method to attract and collect wild mosquitoes for experimental purposes, as traps available on the market or built following publicly-available instructions failed to produce sufficient quantities and/or healthy samples.

During the course of our search for a method to prove the efficacy of mosquito-repelling light and the need for samples in small quantities for quick tests, we relied on wild samples. Using several black trashcans placed in the corner of a backyard shed within a narrow window of ½ hour after sunrise, we were able to gather approximately 10 mosquitoes on warm days.

Although the optimum timing window was strictly the fruit of experience and observations over time, it deserved further investigation to come up with a logical explanation. The key was not the time of the day, but the sunrise. Before the marks they weren't there, it's logical to state that nocturnal animals start looking for the best suitable shelters when the sunbeams begin to appear on the sky. They then started to vacate those areas receiving the light, preferring the darker areas or they disappeared into the environment. The idea emerged to develop favorable shelters for mosquitoes to land in the first place.

The settings provided opportunity for further studies by comparing the average distribution rates of the species against the others over periods. Known stimulants (moistures, water bodies, and CO<sub>2</sub>) were introduced and they did not play significant role in the way mosquitoes favored one shelter over the others. The presence of overnight wet towels provided significant improvements; however, very warm nights nearly dried them up the next day. Things gradually pointed to temperature as the major player. By keeping one unit dry, calm, vibration-free, noise-free, and cooler than the surrounding area, we were not only able to collect more than double the number but also to clear them from places where they normally hide during the days. This goes along with the common wisdom that animals prefer cooler places for resting purposes. It is worth noting that the 'cool can' did not only keep them sheltered throughout the day (until dusk), but also attracted the daytime late comers.

It became a laboring chore everyday to gather and kill, because the settings were in a residential, urban area. In an attempt to avoid mosquito bites, the bait was recently deployed. In contrary to the expectation, the yields were surprising and dramatically increased. Occasionally, other experiments required the use of the operator's hands and arm soon starved samples, and the loss of mosquitoes' appetites was noticed. Further investigations were performed to remove and/or to simplify the process and the equipment. In addition, the paper describes the final assessment.

The catching method gave us a means to measure the effect of the baits with experimental and control protocols in the field. Although the effective radius was observed to be hundreds of meters, the distance was not within the scope of the presentation, and the experiments focused on the difference between the presence and absence of the baiting apparatus.

The data collection method of the experiments mainly exploited the effects of temperature sensing systems of mosquitoes. The following are supportive experiences and observations. They are provided for informational purposes.

These results came from hard lessons learned over 5 years. With perhaps over hundred thousands of samples and hundreds or even thousands of different settings, the above element was identified to give the resolution for the hurdle of how come the mosquito repelling lights worked on the fields and in the laboratory only on the first 2 hours of the first run of the day. They failed miserably afterwards; the mosquitoes made efforts to come to the illuminated, but cooler, side of the chamber. They even squeezed themselves through sharp, narrow, 1.5 - 2 mm gaps to come the other side and die there. The greenhouse effect from a meters-away LED was too minuscule for us to glimpse, but the mosquitoes indeed possessed special capacities to sense such coolness on the other side.

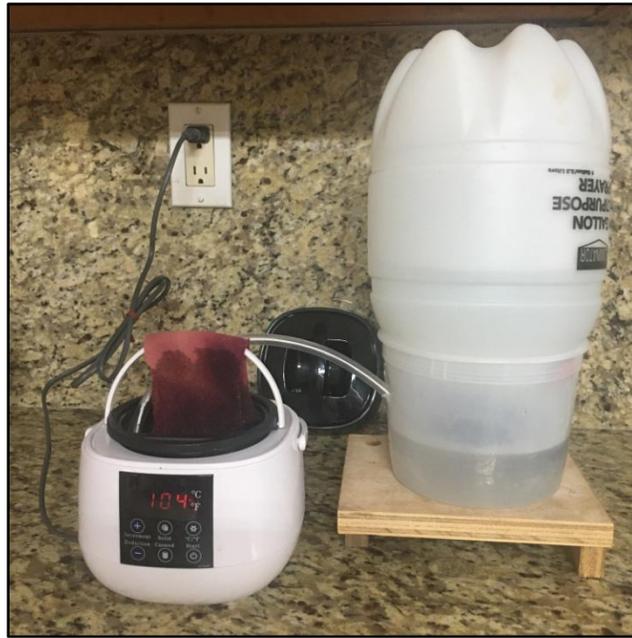
At the time, the experiments were conducted using an opaque chamber with a transparent top that was perceived as a wide, passable opening in the eyes of the samples. By lowering or elevating the outside temperature, the operators were able to increase or reduce the number of incidents of the samples colliding themselves with the 'invisible' top in their attempts to escape as if they were able to 'see' the coolness or the warmth of the outside using infrared lenses.

Furthermore, only the females chose the 37° C (or warmer) among the side-by-side feeding apparatuses. They were identified with the help of food colors.

### **Equipment and method:**

*Equipment:* The experiments required two major components: the baiting apparatus and the catching device.

**The baiting apparatus** (shown in Figure 4): It's a wax warmer with a cloth wick and auto-refill.



*Figure 4*

To simplify the description of the function, it is an adjustable, slow heating device set at 40° C (104°F) with a large wick (shown in Figure 5).



*Figure 5*

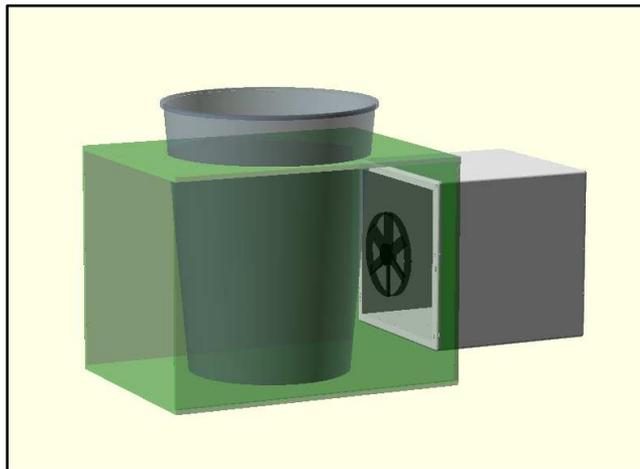
It contains baiting solution (water + 5% sugar + 5% boric acid) and over-the-counter triple antibiotic ointment at a pea-size-per-liter ratio. The same ratio of plain water and antibiotic was also applied for refilling the apparatus after evaporation of water during the sessions.

**The catching device** (shown in Figure 6:



*Figure 6*

Detailed description: it includes: A 24' x 24' x 32' insulated chamber, a 31-gallon metal trashcan with its inside painted black, a fan to circulate the air, and a small refrigerator. Coupled with a dual probe thermostat, they were arranged to regulate the temperature of the inner side of the can at 0.5°C (0.9° F) cooler than its surroundings (shown in Figure 7)



*Figure 7*

The device also needs some dark-colored debris, such as wooden sticks, to provide places for mosquitoes to land and to be collected.

Both devices were placed on the ground approximately 2 meters apart, in the calm corners of the shed-like facility, which was known to have a slight-to-moderate mosquito problem.

***Method:***

There were 5 experimental sessions, with 5 more sessions performed without a baiting control, each lasting a full day, to end with the collection of the samples at ½ hour after sunrise using a low-

power vacuum suction. The mosquitoes were then killed, and males and females were then separated and counted.

In both cases, the sessions occurred during summer days, and if anyone encountered a downpour or it was too cool, the data from that day (and the next four days) were not considered valid for the record.

**Result:**

**5 Control sessions:** From 07/30/2021 → 08/03/2021, 5 pictures with females and males separated (shown in Figure 8).



*Figure 8*

The counts were:

1. 133 mosquitoes:
2. 68 males (51%)
3. 65 females (49%).

**5 Experiment sessions:** From 07/23/2021 → 08/03/2021, the results were captured in the following pictures (showed in Figure 9)



*Figure 9*

The counts were:

1. 298 mosquitoes:
2. 291 males (98%)
3. 7 females (2%).

**Discussion:**

Changes in the catch from control group to experimental group:

1. The tally increased from 133 to 298, or 220%.
2. The male count increased from 68 to 284, or 418%.
3. The female count decreased from 65 to 7, or -89.3% (reduction).

Using side-by-side visualizations of the results :( showed in Figure 10):

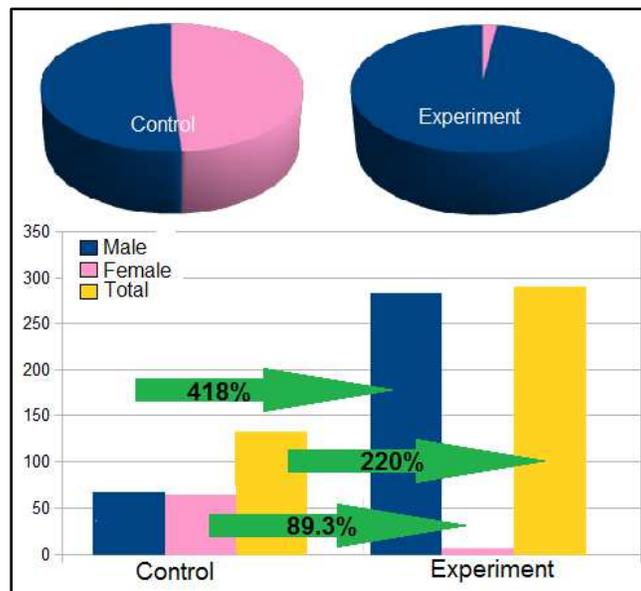


Figure 10

- In the control settings, the 51% male 49% female distributions validate the common wisdom that the sexes occur in somewhat equal ratios in nature. Without counting the attractive characteristics of the bait, the female mosquito population changed from 49% to 2%, or an 89.3% reduction. Thus, it was the baits that caused this unnatural phenomenon
- In addition to the 220% increase in the total populations between the control and experimental sessions, the 418% increment of the male populations furthered the logical explanation that the bait attracted mosquitoes
- In short, the baiting apparatus attracted mosquitoes and killed the females.

#### Observations:

- Although they are not shown in the pictures, all the female mosquitoes in the experiment showed signs of recently being fed (i.e., their bellies were full). They died within 2 hours after being caught.
- 300+ feet away, the neighbors reported not being bitten by mosquitoes.
- Within the 200-foot boundary, there was not only no mosquito-bite activity, but also little or no sign of mosquito egg-laying activities in the shaded and standing bodies of water (previously used for collecting larvae).
- For over a month, the catches were exclusively mosquitoes, except for one month and several spiders.
- During the experiments, there were more activities of predatory insects such as ants, roaches, spiders, etc. in the vicinity.

#### Conclusion:

This study attempted to address the issue of mosquito bites, and was successful. The baiting

method drew in mosquitoes from fairly large vicinity, and the population of female mosquitoes was drastically reduced and was nearly eliminated without harming the males. There was no sign of harm to other insects. At minimum, this approach provides comfort in that by reducing the chances of being bitten, the risk of becoming infected with mosquito-vectored diseases is reduced. We may perhaps never want and never be able to eradicate mosquitoes, but this method gives us a means to control them when they pose imminent harm. The equipment is inexpensive and available at the local level and self-help community applications only need a handful of units each. Thus, good days are yet to come.

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