

# Mosquito Control, Killing off the Females

Phi Tran

School of Liberal Art, University of St. Thomas of Houston, Houston, USA

Email: ephitran@gmail.com

**How to cite this paper:** Tran, P. (2024) Mosquito Control, Killing off the Females. *Open Journal of Animal Sciences*, 14, 14-22.

<https://doi.org/10.4236/ojas.2024.141002>

**Received:** September 26, 2023

**Accepted:** December 3, 2023

**Published:** December 6, 2023

Copyright © 2024 by author(s) and Scientific Research Publishing Inc. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

## 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 females were attracted and killed by the bait. As expected, there was no female mosquito's activity in these areas. There weren't many left to do the work.

## Keywords

Mosquitoes Malaria Dengue, Control, Toxic, Sugar Bait, ATSB, Samples

## 1. 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 steppingstones to pave the way on which the next generations walk. Although the 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 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: Female mosquitoes only drink, don't eat, they only bite warm blood animals and spare the cold blood such as lizards or snakes. 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: water, sugar, boric acid, a known insect toxin and off-the shelves antibiotic a germ-killing agent to prevent the solution from spoiled, through trial and error, we decided on a 40°C 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 a female mosquito with her blood crystallized.

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 (shown in **Figure 2**).



**Figure 1.** Crystallized blood.



**Figure 2.** Mosquito carcasses in the middle.

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 (shown in **Figure 3**).

The end goal of the endeavor is come up with a system that kill a big, good percentage of female mosquitoes in the area, not a good mosquito catching device, a better trap. Without it we were unable to collect meaningful data to analyze. We struggled with all types of traps we could have our hands on but to no avail. They are not designed for daily counts. During the development of the bait system, we explored the effects of temperature on the insects and came up with some insights.

Mosquitoes are nocturnal insects, right after sunrise, the coolest time of the day, they started to vacate those areas receiving the light, preferring the darker, mean cooler areas.

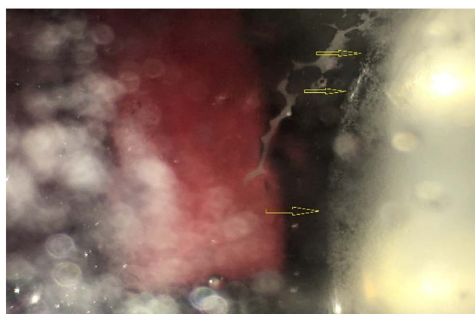
As humans, in summer, we prefer and feel more comfortable in cooler places, and so do mosquitoes. We unsuccessfully played around with air conditioning concept on them. Finally, we end up with their preferred shelter that has its temperature one degree cooler than the surroundings. For them, it's "cooler", better than the rest, once they get in there they don't want to go out, it's hot out there.

Mosquito control is a sensational topic and carries an immediate impact on public health. This paper is not an academic research paper that takes ideas and concepts from previously published material, nor is it a showcase of a book-worm. A google on the topic yields thousands of items. A lot of "me-too", concepts and theories but no concrete, practical and applicable resolutions. Among them we select some random samples [1]-[6]; although we do not incorporate any of their contents in the research. Because Boric acid is a known insect killer therefore it is a good, effective ingredient to kill mosquitoes [1] [2] [3].

## 2. Equipment and Method

### 2.1. Equipment

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



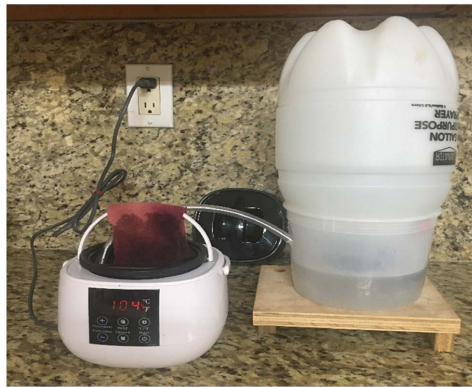
**Figure 3.** Crystal grains.

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

To simplify the description of the function, it is an adjustable, slow heating device set at 40°C (104°F) with a large wick, the landing pad for female mosquitoes (shown in **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 4.** Bait system.



**Figure 5.** Bait system illustration.



**Figure 6.** Mosquito catching device.

Detailed description: it includes (from left to right) a 24' × 24' × 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**).

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.

## 2.2. 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 1/2 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.

## 3. Result

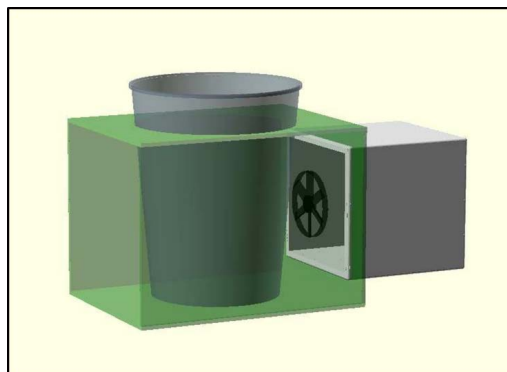
*5 Control sessions:* From 07/30/2021 → 08/03/2021, 5 Experiments, 5 pictures with females and males separated (shown in **Figure 8**, raw data in visual format).

The total counts were:

- 1) 133 mosquitoes:
- 2) 68 males (50.5%) <> 50%
- 3) 65 females (49.5%) <> 50%

*5 Experiment sessions:* From 07/23/2021 → 07/27/2021, 5 Experiments, 5 pictures with females and males separated (shown in **Figure 9**, raw data in visual format).

The total counts were:



**Figure 7.** Mosquito catching device description.

**Control sessions****Figure 8.** DatamIn visual format.**Experiment sessions****Figure 9.** Data in visual format.

- 1) 298
- 2) mosquitoes:
- 3) 292 males (98%)
- 4) 7 females (2%)
- 5) Data availability:

All data generated or analyzed during this study are included in this published article [and its supplementary information files].

#### 4. Discussion

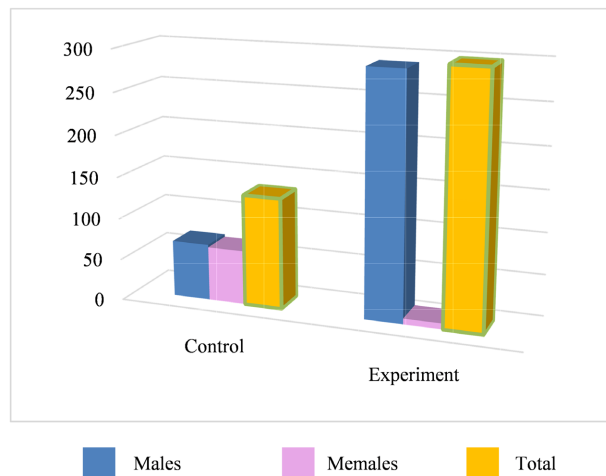
Changes in the catch from control group to experimental group: Using side-by-side visualizations of the results: (shown in **Figure 10** below).

The tally increased from 133 to 298, or 224%. The bait system attracts twice the mosquitoes to the area.

In the control settings, the 50.5% male 49.5% 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 50% to 2%, or a 96% 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 116% increment of the male populations furthered the logical explanation that the bait attracted mosquitoes.

Given time, with 96% female mosquitoes killed, the rest 4% will end up eating



**Figure 10.** Mosquito gender distribution.

the bait and killed, more and more. Until they all got killed.

In short, the baiting apparatus attracted mosquitoes and killed the females.

#### 4.1. 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 roaches, spiders, etc. in the vicinity.

We do not add sugar and antibiotics into the baiting solution anymore.

#### 4.2. Something Are Puzzling Us Please Help

There were no ants “activity within 12” radius even we tried to lure them in.

Our bait is odorless, no scent or chemical escape to the atmosphere except water vapor. There must be other unknown mechanisms that the females use to remotely locate their targets.

The catching device is designed to provide cooler, more comfortable shelters especially during summer hot days. If mosquitoes find it appealing so do other insects, none was caught. Why?

### 5. Conclusion

This study attempted to address the issue of mosquito bites and was successful. The baiting method drew in mosquitoes from 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.

## 6. Product Recommendations

- Although the experiments utilized off-the-shelves low tech, no-auto shut off wax warmers, enabling prolong operation. Their pots were made of metallic material even with aluminum, they do not survive long in contact with acidic boric solution, a plastic layer or a smaller, in the middle cut off bottle will do the job well.
- Unlike aquarium submersible water heaters that keep the water below 35°C we need them to maintain the water at 40°C. With only some resistors and 2 temperature switches, we can build them for about \$1.00 each, a partial cost of an average mosquito net. The measure allows users to utilize the available plastic or ceramic containers at the locals, all people must do is to plug it in, and some water and boric acid to have the treatment for the whole neighborhood. More, wider effective at only spatial of the cost of a mosquito net. This could be the good resolution for government and philanthropies who are in authoritative positions in the areas.
- Keeping the system water filled is an everyday chore due to water evaporation that drains about 2 cm/day. Auto fill feature needs to be addressed.

## Acknowledgements

It has been 3 years since the previous version was rejected by a prestige science journal for the introduction section of the article being “narrative”. Since then, millions of deaths of children under five could have been saved if their parents and governments were equipped with a little know-how. All of us who got involved carried some moral responsibilities. We failed or refused to deliver the life-saving goods. I personally live in agonizing mode of being known that every day passed thousands of children death could have been saved. Is anything I could do to at least to help them to avoid unnecessary suffering and pain from those plagues.

Thanks to my wife, Tu-Hong Tran who is always with me through the toughest times in life.

Thanks to my twins: Minh-Duc and Than-Dan Tran for their unconditional love.

Thanks to Ceclia Ye, your persistence, gave me the biggest encouragement at



least your heart has demonstrated the quality of a good, decent human companion.

### Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

### References

- [1] Beier, J.C., Müller, G.C., Gu, W.D., *et al.* (2012) Attractive Toxic Sugar Bait (ATSB) Methods Decimate Populations of *Anopheles* Malaria Vectors in Arid Environments Regardless of the Local Availability of Favoured Sugar-Source Blossoms. *Malaria Journal*, **11**, Article No. 31. <https://doi.org/10.1186/1475-2875-11-31>
- [2] Müller, G.C., Beier, J.C., Traore, S.F., *et al.* (2010) Successful Field Trial of Attractive Toxic Sugar Bait (ATSB) Plant-Spraying Methods against Malaria Vectors in the *Anopheles gambiae* Complex in Mali, West Africa. *Malaria Journal*, **9**, Article No. 210. <https://doi.org/10.1186/1475-2875-9-210>
- [3] Fiorenzano, J.M., Koehler, P.G. and Xue, R.-D. (2017) Attractive Toxic Sugar Bait (ATSB) for Control of Mosquitoes and Its Impact on Non-Target Organisms: A Review. *International Journal of Environmental Research and Public Health*, **14**, 398. <https://doi.org/10.3390/ijerph14040398>
- [4] Davis, University of California (2016) Mosquito Preference for Human versus Animal Biting Has Genetic Basis. Science Daily. <https://www.sciencedaily.com/releases/2016/09/160919144140.htm>
- [5] Tauxe, G.M., MacWilliam, D., Boyle, S.M., Guda, T. and Ray, A. (2013) Targeting a Dual Detector of Skin and CO<sub>2</sub> to Modify Mosquito Host Seeking. *Cell Press Journal*, **155**, 1365-1379. <https://doi.org/10.1016/j.cell.2013.11.013>
- [6] Davis, J., Bibbs, C.S., Müller, G.C. and Xue, R.-D. (2021) Evaluation of *Bacillus thuringiensis israelensis* as Toxic Sugar Bait against Adult *Aedes aegypti*, *Aedes albopictus*, and *Culex quinquefasciatus* Mosquitoes. *Journal of Vector Ecology*, **46**, 30-33. <https://doi.org/10.52707/1081-1710-46.1.30>