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Female Mosquitoes Track to the Hosts by the Blue

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ABSTRACT

Mosquitoes are the most harmful animals. Annually, they cause illnesses and deaths equivalent to the entire global COVID-19 pandemic over three years[1][2][3]. They are not naturally born with disease-causing pathogens but acquire them from infected individuals and then transmit them to the healthy population through their bites. Their ultimate hosts are those who carry blood, a water solution beneath their skin, a natural membrane that allows water vapor to leak out and their needle to access the liquid. Water vapors are theoretically visible because water molecules are known to naturally reflect blue[4] and absorb others, making it appear blue. This study investigates the reactions of female mosquitoes when blueness variable is added to the mosquito luring equation by amplifying the reflective the blueness variable of water vapor. This is done by adding more blue photons for them to reflect, increasing their visibility. The search for visible signs of water vapor is the top priority for these insects when they identify and target their hosts from afar, as they selectively respond to this over other mosquito attractants.

Keywords: *Mosquito, Malaria, Dengue, West Nile Virus, Zika, Yellow Fever, Chikungunya.*

Introduction

Being not academically credential or trained in the discipline, we are not familiar with proving a theory but just to resolve issues encountered. The outcomes may imply new scientific findings, they are not the objectives of our studying journey but the unintended consequences.

The hints were implanted in us began decades ago when we raised mosquitoes for our lab uses, lake others we used our arms as the mean to supply their protein needs, they did not feed arms wearing latex gloves, they will immediately resume their attack as soon as the gloves were wetted, thus, it was the 'water' that they came after while our naked arms were not wet but only discharging water vapor as indicator of the presence of liquid water underneath their skins. 1 of our quest since then was to find artificial methods to communicate water vaporing states to the insects.

Only very recently have we come to know that mosquitoes identify and target their hosts by means of vision or by capturing their electromagnetic radiation from the hosts'[5][6][7]. Among them thermal images are the means to communicate to them the presence of warm-blooded animals whose blood are that they need. The TLTB (Thermal Lure Toxic Bait) mosquito traps were developed with a warmed object and a nearby toxic water body. The trap succeeds killing 97 female mosquitoes overnight[8][9]. The trap has several issues. First, because the insects choose the warmer when facing multiple choices of potential hosts[9][10][11], they do not come to the traps when the ambient temperature in the areas warmer than ours they go to find the warmer drink here before us[12][13][14][15]. Second, when facing multiple choices of nearby water bodies such as in indoor environment, the trap fails to draw the insects to the toxic bait we want them to consume and die rather than the other harmless ones.

The quest became an attempt to find alternative means to draw the insects to the intended bait water body rather than just the temperature. We turned to water vapor because it is the indicator of an open water body or underneath a membrane where they can stick their needles to get a drink, and because insects use vison we start to intensify to increase the visibility of it.

Our home, planet Earth, appears blue from outer space because of its abundant surface liquid water and atmospheric water in vapor form. Water is known to reflect blue photons while absorbing others, as shown in the following NASA image of Earth. The atmospheric water vapors are visible as a light blue ring at the edge.

Earth – NASA Science

In theory, because water reflects blue, making it appear bluer will make it reflect more blue light and therefore make it brighter and more visible. As shown in Figure 4, there is a narrow, faint blue band right above the surface, which must come from the reflection of water vapor and not the liquid itself. As shown in Figure 1, water vapor is seen as a light blue band above the surface.

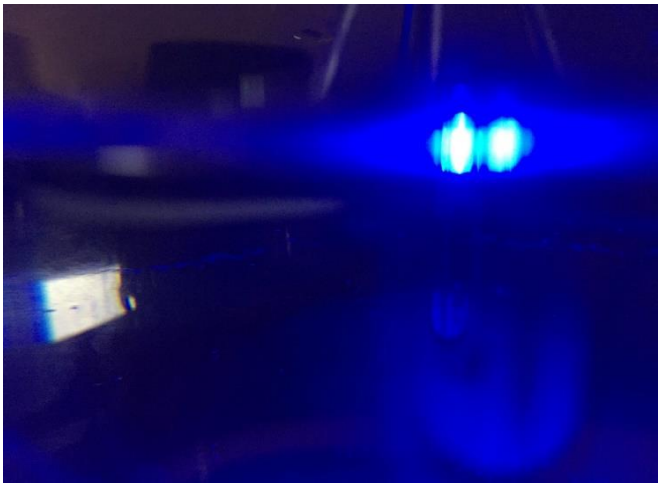

Figure 1: Water vapor in enhanced vision

To determine whether female mosquitoes also observe this effect, we designed a test with two mosquito traps placed 10 meters apart (please refer to the instructions described in[12] in the reference section), as shown in Figure 2.

Figure 2: USB-powered female mosquito trap

One trap had a transparent bait container with a single blue LED lamp attached to its wall, as shown in Figure 3.

Figure 3: Clear mosquito bait with one blue LED

We experimented with one 2-liter bait in a transparent container with two LEDs attached to its wall and three others placed one meter apart around a USB mosquito trap (please see appendix for the description). The results showed that the transparent wall bait got all the kills, while the others did not.

The test showed the female mosquitoes' bait preference, where the blue is amplified in conjunction with the warmth stimulants, supporting our hypothesis. However, further experiments with such traps are needed to strengthen its conclusiveness.

Encouraged by the above tests, we developed the "Blue Trap," as shown in Figure 4.

Equipment & Method

EQUIPMENT

1. TLTB mosquito trap, as shown in Figure 2 above[16], served as the control trap.

2. The experimental Blue Trap included a 2-liter bait of water + 5% boric acid in a clear container, like the one described in Figure 3 but sitting on top of six blue LED lamps to ensure no other stimulant but the injection of the blue light.

METHOD

While the TLTB traps tell the insects of the present of the hosts, the blue trap otherwise tells them the presence of the feed they can drink. We expected the second one to be better. The 2 were set in unobstructed view and 15 meters apart. The results are captured visually after 5 days to represent the results of five 1-day sessions.

Result

Using boric acid as the toxic agent bait allows us to visualize feeding activity of female mosquitoes per visit when their left-behind saliva crystalizes into white dots on the walls of the containers[9].

Figure 4: Result from female mosquito trap

Figure 5: Result from Blue Trap

As expected, and as shown in the above figures, we can safely say that among thousands of female mosquitoes looking for food, only a few dozen tracked the hosts by following their thermal image clues, whereas the others tracked the blue light. The ratio allowed us to conclude that when female mosquitoes set out for food, they look at the blue clue first.

Discussion

Scientific findings, regardless of how valuable they are, remain theoretical until applications are developed. Because measures to prevent mosquito bites are urgently needed, under the presumption that the hypothesis works, we afterward developed low-tech outdoor Blue Traps from materials that are widely available in people's houses to utilize reflective blue from natural sunlight instead of the lamps though it comes with time limitations. These traps take almost no time to set up and can turn areas into daytime mosquito-free zones for immediate needs. Figure 6 shows a Blue Trap 24 hours after setup.

Figure 6: Low-tech mosquito Blue Trap

As shown in the above figure, the trap consists of an 8-inch glass bowl containing bait with a blue disposable party cup in the middle. The trap is placed on top of a blue tarp to add blue photons to the area right above the water's surface.

> In our practice, we see a 1-mm ring as a gauge representing 100–150 kills[9] to give a rough 400-500 estimated casualties caused by the trap.
>
> We do not know how to conduct experiments to determine the effective area of the trap; we can only share our self-reported observation of having no mosquito bites within a 20-meter radius.
>
> The trap is ***only*** effective during the daytime, with experience working at early dusk but not dawn. However, there is not much left for them to work after dark. It's not 24/7 best but adequate.

The evidence does not support the notion that mosquitoes are attracted by blue. We do know for sure if they are attracted by blue water or blue 'water vapor'. It opens for later studies to narrow the manner down.

Most common users don't have to wait until the lamps to be on the market, blue LEDs for USB 5V are inexpensive and widely available to allow them to be easily built in minutes using parallel connections, on the LEDs then to a USB cord. They go directly to equip themselves with the 24/7 better blue trap instead of using the above low-tech one.

Blue traps are inexpensive to build; it costs us less than $0.12 a piece to manufacture six LED lamp modules. A house needs two to four traps to create a mosquito-free buffer, costing less than $100.00 as an initial investment to equip the whole 100-family village. This not only helps stopping the spread of the disease but also adds comfort to their lives.

Blue Traps use very little energy; a 3A hand-sized solar panel and a thumb-sized battery allowed us to operate six LEDs 24/7 for about a year.

Blue clothes add more blue photons to the environment, making water more visible to insects and attracting more mosquitoes.

In theory, we can count the mosquitos killed by the trap by measuring the amount of the left-behind crystals on its wall. The Blue Trap provides a useful tool to monitor the mosquito population in the area as part of a collective mosquito-control effort.

We do not know the reason why smaller; 12 cm diameter bait container traps do not function as expected, we share here as an experience.

PRODUCT RECOMMENDATIONS

- Solar-powered 24/7 blue lamps
- USB-powered blue lamps
- A blue laser to shine on the outdoor Blue Traps

Conclusion

Experiments with the Blue Traps were not conducted in indoor environments, although indoor environments were the focus of this study. The end goal of any mosquito-control measure is to avoid or at least lessen bites by infected mosquitoes. Given the success of the Blue Trap in this study, Blue Traps are ready for use on the front line of collective mosquito -borne-disease control, allowing people to kill the mosquitoes before they have the chance to infect others. The theories behind the trap may be complex, but the application is simple and ready for mass deployment. People just need blue lamps and a little boric acid to not only add comfort to their lives but also prevent deadly diseases.

Intellectual Property:

Besides the benefits of our works impacting large numbers of human sufferings and deaths they also bestow means for everyone to entertain more comforts and joys. To set the record straight, to "Give to Caesar what belongs to Caesar, and to God what belongs to God". As His instrument and servant, we claim no merit or ownership.

Conflict of Interest Statement:

None

Acknowledgements:

None

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