

Article

SHORT-TERM MACROSCOPIC EFFECTS OF BROFLANILIDE AND PRALLETHRIN EXPOSURE IN *Aedes aegypti*

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Abstract

Arboviruses such as dengue, Zika, and chikungunya are transmitted primarily by *Aedes aegypti* (L.), making this mosquito a major public health concern in the Americas. Vector control has relied mainly on chemical insecticides, despite the widespread emergence of resistance. Alternative strategies have been proposed, including the use of Wolbachia-infected or sterile mosquitoes, but insecticides remain the first line of response during outbreaks. This study aimed to evaluate and compare the short-term (24-48 h) macroscopic responses of *Ae. aegypti* to broflanilide, a meta-diamide insecticide with limited prior use in mosquito control, and prallethrin, a commonly applied pyrethroid. Female mosquitoes (New Orleans susceptible strain) were exposed to sublethal concentrations of both insecticides using the CDC bottle bioassay. Survivors were subsequently monitored for visible changes in behavior and morphology. Prallethrin exposure caused rapid knockdown and mortality within 24 h, with no survivors showing interest in feeding. In contrast, broflanilide did not induce knockdown but led to a resting, immobile posture at 60 min. After 24 h, most exposed mosquitoes died; however, a subset that fed on sucrose or blood exhibited abdominal distension with apparent gas accumulation. Broflanilide and prallethrin produced distinct short-term phenotypic outcomes, highlighting the need for further investigation of broflanilide's physiological effects and its potential role in integrated vector control.

KEYWORDS: *Aedes aegypti*; broflanilide; prallethrin; CDC bottle bioassay; macroscopic observations; delayed mortality.

Introduction

Aedes aegypti is the primary vector of arboviral diseases of major public health concern, including dengue, Zika, yellow fever, chikungunya, and Mayaro. Its high dispersal capacity and the ability of its eggs to withstand adverse conditions contribute to its persistence across diverse environments. Moreover, environmental factors, including climate change, have facilitated its global expansion (Rodríguez-Sánchez *et al.*, 2021). Insecticide-based interventions remain central to vector control; however, the widespread emergence of resistance poses an increasing challenge (Asgarian *et al.*, 2023).

Mosquito control has historically relied on neurotoxic chemical insecticides that disrupt the nervous system, causing paralysis and death (Zaim & Jambulingam, 2007). In Mexico, vector control programs have used different classes of insecticides since the 1950s (NOM-032-SSA2-2014). Temephos, a larvicide applied for over five decades, is still used for larval control (Davila-Barboza *et al.*, 2024), although its effectiveness has declined as resistance has intensified under sustained selection pressure (Dusfour *et al.*, 2019).

Currently, pyrethroids and organophosphates are the primary insecticides deployed during dengue outbreaks. Public health authorities often recommend their simultaneous use or rotation (Ong, 2016). Constant exposure of wild *Ae. aegypti* populations to these insecticides has generated strong selection pressure, leading to the evolution of resistance mechanisms (Trujillo *et al.*, 2026). Commercial formulations frequently include pyrethroid active ingredients such as metofluthrin, tetramethrin, d-allethrin, transfluthrin, d-phenothrin, s-bioallethrin, cyphenothrin, deltamethrin, d-trans allethrin, prallethrin, and permethrin (Chin *et al.*, 2017). Prolonged household use of these products may further intensify selective pressure and promote cross-resistance among pyrethroids.

Broflanilide is a meta-diamide insecticide that targets the γ -aminobutyric acid receptor (GABAR) through a novel mode of action involving allosteric modulation (Nakao & Banba, 2016). Accordingly, the Insecticide Resistance Action Committee has classified it as a new group (group 30) (Sparks, 2020). Broflanilide has demonstrated high efficacy against a range of lepidopteran pests, including *Plutella xylostella* (Linnaeus, 1758), *Helicoverpa armigera* (Hübner, 1808), *Spodoptera frugiperda* (Smith, 1797), *Spodoptera litura* (Fabricius, 1775), and *Spodoptera exigua* (Hübner, 1808) (Tang *et al.*, 2021), as well as pesticidal activity against thrips, cotton aphids, and two-spotted spider mites (Shen *et al.*, 2021). Commercially registered in China in 2020, it is considered a promising candidate for agricultural pest management (Sun *et al.*, 2022). Beyond agriculture, its potential application in urban environments for vector control remains largely unexplored. The present study evaluates the short-term (24–48 h) macroscopic responses of *Ae. aegypti* to broflanilide and compares them with those induced by prallethrin, a commonly used pyrethroid.

Material and Methods

Mosquito rearing

Aedes aegypti mosquitoes from the susceptible New Orleans (NO) strain were reared in the insectary of the Laboratorio de Fisiología Molecular y Estructural, Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo León, under controlled conditions: $28\pm 2^\circ\text{C}$, 12:12 h light:dark cycle, and $70\pm 2\%$ relative humidity.

Insecticide exposure

Adult female *Ae. aegypti* mosquitoes of the susceptible NO strain, 3–5 days old, were used in the experiments. Mosquitoes were reared under controlled conditions of temperature ($27\pm 2^\circ\text{C}$) and relative humidity ($70\pm 10\%$) and were provided with a 10 % sucrose solution before the experiments.

Bioassays were conducted following the CDC's standardized bottle protocol (CDC, 2024), using reference insecticides: broflanilide (99% purity; catalog no. E8093, Selleckchem, USA) and prallethrin (Sigma-Aldrich Production GmbH, Switzerland). The solutions were prepared in molecular-grade acetone at sublethal concentrations of 0.75 µg/mL and 1 µg/mL, respectively. Aliquots of 1 mL were applied to 250-mL Wheaton bottles, ensuring uniform distribution on the inner surface. The bottles were allowed to evaporate for 1 h under a fume hood before the insects were introduced.

Each treatment was replicated three times with batches of 25 females per bottle. Negative control treated only with acetone was included. Initial observations were recorded at 30 min to assess the knockdown effect of prallethrin. Subsequently, 1 h after exposure, the surviving mosquitoes were transferred to entomological cages measuring 30 × 30 × 30 cm and provided with a 10% sucrose solution as a carbohydrate source.

To assess blood-feeding capacity, blood was offered via an artificial feeder consisting of a metal plate coated with Parafilm, which had been rubbed against human skin for 2 min to saturate it with CO₂. Sucrose and blood were administered simultaneously over a two-hour period. Additional observations were conducted at 24 and 48 h after exposure, only for broflanilide, with cumulative mortality and visible macroscopic changes recorded. All procedures were performed under Biosafety Level II conditions, using nitrile gloves and a fume hood for the preparation of insecticides, and following institutional protocols for the disposal of chemical waste.

Statistical analysis

Mortality data were analyzed at the bottle level. For each bottle, mortality was expressed as the proportion of dead mosquitoes relative to the total number of exposed females. The experiment included three independent repetitions, each consisting of three broflanilide-treated bottles and one acetone-only control bottle, with 25 females per bottle. Therefore, mortality estimates were based on nine broflanilide-treated bottles and three control bottles.

Bottle-level mortality percentages were summarized as the mean ± standard deviation. For the 24-h endpoint, cumulative mortality in broflanilide-exposed mosquitoes was compared with the acetone-only control using Fisher's exact test. This test was selected because mortality in the control group was zero, making it more appropriate than asymptotic tests such as the chi-square test. Exact 95% binomial confidence intervals were calculated for cumulative mortality proportions. Statistical significance was set at $p < 0.05$. Analyses were conducted in R (R Core Team, 2023).

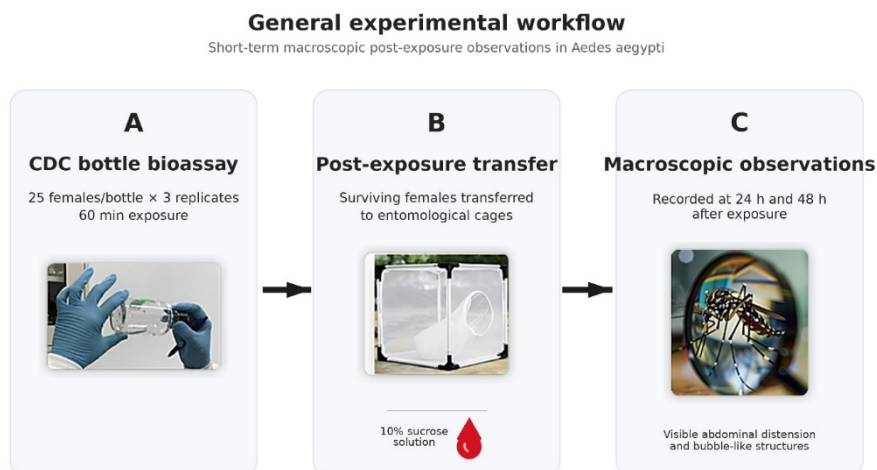


Figure 1. General experimental workflow used to record short-term macroscopic post-exposure responses in *Ae. aegypti* females exposed to broflanilide or prallethrin. (A) Twenty-five adult females were introduced into each treated bottle, with three replicate bottles per treatment, and exposed for 60 min. (B) After exposure, surviving females were transferred to entomological cages and offered a 10% sucrose solution and blood feeding. (C) Macroscopic observations were recorded at 24 h and 48 h after exposure

Results

The controls treated with acetone alone showed no mortality or phenotypic changes, confirming that the bioassay conditions were appropriate and that the solvent did not affect mosquito survival.

Exposure to broflanilide

At 60 min post-exposure, no mortality was observed in broflanilide-treated mosquitoes. Exposed females did not show knockdown or ataxia; instead remaining mostly immobile in a resting position at the bottom of the bottles, with their wings folded and bodies steadily positioned.

A marked delayed mortality effect was recorded at 24 h post-exposure. Across the nine broflanilide-treated bottles, 203 of 225 exposed females were dead, corresponding to a cumulative mortality of 90.2% (95% CI: 85.6-93.8%). At the bottle level, mortality was $90.22 \pm 2.11\%$ (mean $\pm$ SD). The mortality rate after 48 h was 100%. In contrast, no mortality was observed in the acetone-only control group, with 0 of 75 control females dead at 24 h (0.0%; 95% CI: 0.0-4.8%). The difference in 24 h mortality between broflanilide-treated mosquitoes and the acetone-only control was statistically significant according to Fisher's exact test ($p < 0.0001$) (Table I). Surviving broflanilide-exposed mosquitoes represented approximately 10% of the treated individuals and showed reduced mobility. Some of these individuals attempted to feed on sucrose or blood after transfer to entomological cages. Fed survivors displayed visible abdominal distension and apparent gas accumulation in the digestive tract. This alteration was observed in both sucrose-fed and blood-fed mosquitoes and persisted up to 48 h, with individuals remaining immobilized and showing little or no response to mechanical stimuli (Figs. 2 and 3).

Exposure to prallethrin

The response was immediate and consistent with the mode of action of pyrethroids. Within the first 5 min, widespread knockdown was observed, accompanied by uncoordinated movements and ataxia. At 60 min, less

than 5 % of the individuals showed transient recovery, characterized by unsuccessful flight attempts; however, none attempted to feed on carbohydrates or blood.

At 24 h, mortality was 100 %, confirming the high efficacy of prallethrin under the experimental conditions. No additional morphological alterations were observed, as all individuals died before 24 h.

Comparison of insecticides

The results show contrasting macroscopic responses:

Prallethrin produced a rapid knockdown effect and total mortality in less than 24 h, with no survivors capable of feeding. Broflanilide produced a pattern of progressive immobility, with partial survival associated with morphological changes in the abdomen (Figs. 2 and 3), particularly in individuals that fed after exposure.

These differences suggest distinct physiological mechanisms and highlight the need for further studies to understand the implications of broflanilide on the biology of *Ae. aegypti*, including its interaction with the gut microbiota and digestive processes.

Table I. Delayed mortality of *Ae. aegypti* females exposed to broflanilide and prallethrin in CDC bottle bioassays

Treatment	Time	Dead/total	Mortality %	95% CI
Broflanilide	60 min	0/225	0.0%	—
Broflanilide	24 h	203/225	90.2%	85.6-93.8%
Prallethrin	24 h	225/225	100%	100%
Acetone control	24 h	0/75	0.0%	0.0-4.8%

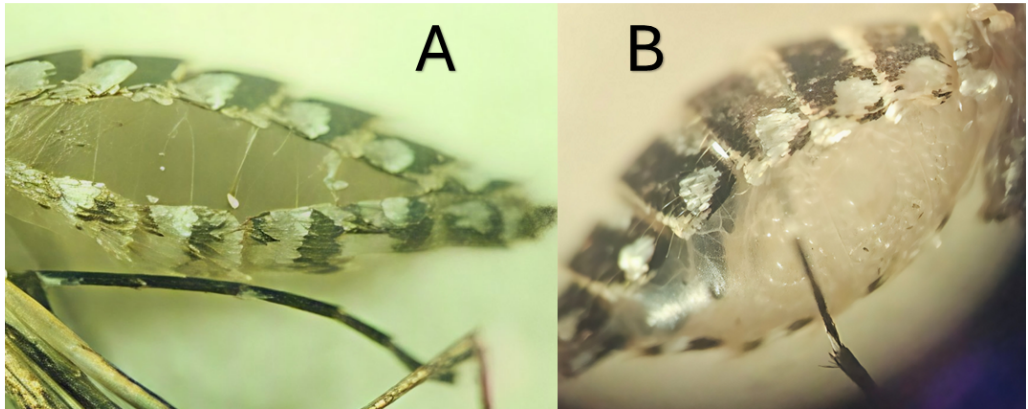


Figure 2. Comparison of the abdomen in female *Ae. aegypti* at 24 h. Panel A (control): female fed only a 10 % sucrose solution, observed at 24 h. The abdomen retains its characteristic banded pattern and shows no signs of distension or gas accumulation, reflecting a normal physiological state. Panel B (treated): female exposed to broflanilide and subsequently fed a 10% sucrose solution. At 24 h, marked abdominal distension is evident, with visible bubbles in the digestive tract associated with gas accumulation. This finding suggests an abnormal physiological process, possibly linked to internal fermentation or alterations in the gut microbiota induced by the insecticide, which could compromise the insect's digestive homeostasis and ability to rest.

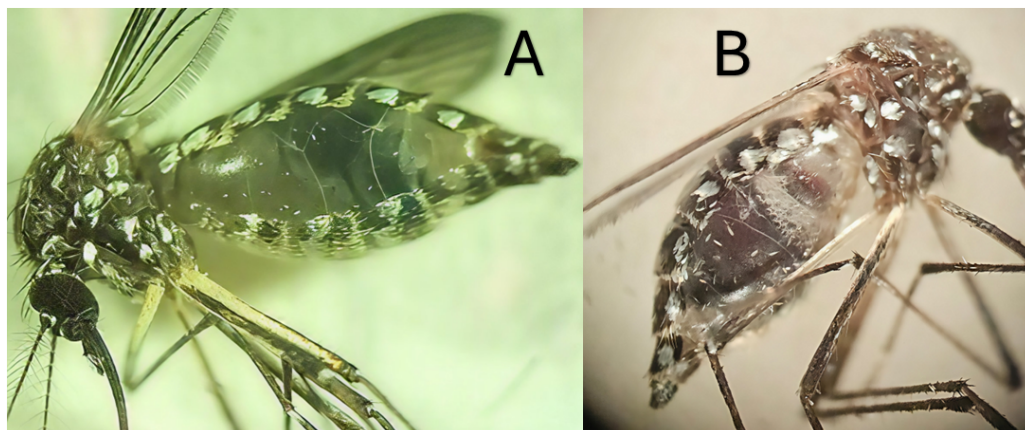


Figure 3. Comparison of the abdomen in blood-fed *Ae. aegypti* females at 24 h. Panel A (control): female fed blood without exposure to insecticide, observed at 24 h. The abdomen retains its translucent appearance and characteristic banding pattern, with no evidence of distension or gas accumulation, reflecting a normal physiological state following blood ingestion. Panel B (treated): female exposed to broflanilide and subsequently fed blood. At 24 h, she was found immobilized, lying on her side, and with marked abdominal distension. Translucent bubbles were observed in the posterior region of the abdomen, indicative of gas accumulation in the digestive tract. Although the mosquito remained alive, it showed no ability to fly and did not respond to stimuli. This phenomenon constitutes an unusual morphological effect, distinct from the typical pyrethroid-induced knockdown, and suggests that broflanilide significantly alters digestive and metabolic processes.

Discussion

The mode of action of pyrethroids involves binding to the α subunit of voltage-dependent sodium channels, thereby reducing their activation (Lafargue *et al.*, 2018). When the channel is open, pyrethroids prolong activation and consequently the depolarization of the neuronal membrane, which manifests as knockdown in mosquitoes. The symptoms observed in our experiments with prallethrin were consistent with these mechanisms and with previous reports (Matsuda *et al.*, 1991; Azratul-Hizayu *et al.*, 2021).

Andreazza *et al.* (2021) reported that exposure to sublethal concentrations of pyrethroids negatively affects insect performance by altering physiology and behavior, placing individuals at a disadvantage compared with unexposed organisms. Our results support this observation; none of the mosquitoes exposed to prallethrin were able to feed on carbohydrates or blood. In contrast, broflanilide exposure allowed a subset of mosquitoes to retain the ability to feed, suggesting a distinct physiological outcome.

Mosquitoes exposed to broflanilide also showed responses consistent with the reported mode of action of this molecule. As an allosteric modulator of the GABA receptor in chloride channels, broflanilide induces neurotoxic activity that causes hyperexcitation and ultimately prevents movement (Snetselaar *et al.*, 2023). In our assays, the compound produced approximately 90% mortality at 0.75 $\mu\text{g/mL}$. This efficacy is notable, though somewhat lower than expected, since previous work has shown higher mortality at lower concentrations (Lees *et al.*, 2020). Differences may be attributable to factors such as the proprietary formulation of the molecule or the specific strain tested.

Other studies have described tissue-level inflammation after ingestion of toxic compounds, such as boric acid, in insects (Sippy *et al.*, 2020). In these studies, electron microscopy revealed disruptions of the gut tissue following exposure to sugar solutions containing boric acid. In our experiments, abdominal swelling was visible

to the naked eye in broflanilide-exposed mosquitoes that had fed on carbohydrates or blood and was associated with apparent gas accumulation. This swelling may have resulted from fermentation of polysaccharides: fructose in sucrose-fed mosquitoes and glucose in blood-fed mosquitoes, although at lower concentrations. This could explain the differences in abdominal size between treatments, with smaller abdomens in blood-fed individuals. Such fermentation processes may generate methane and volatile fatty acids, as documented in other insect taxa (Brune, 2019).

In *Ae. aegypti*, changes in microbiota composition have been detected as early as 24 to 48 h after feeding. Moreover, the composition and diversity of the microbiome vary according to the type of food consumed. Adults fed a sugar-based diet exhibited greater microbial diversity than those fed blood. Similarly, bacterial interaction networks differed according to diet. In blood-fed mosquitoes, significant associations were identified among the phylotypes *Salmonella enterica*, *Enterobacter cloacae*, and other members of the order Enterobacterales. In contrast, in sugar-fed individuals, *Pseudomonas fluorescens*, *Aspergillus flavus*, and *Metarhizium majus* showed the strongest associations within the microbial community (Salgado *et al.*, 2024).

Fermentation could also reflect shifts in the gut microbiota induced by insecticide exposure. Previous studies have shown that chronic exposure to insecticides can alter microbiota composition in several insect orders (Rouzé *et al.*, 2019; Zhang *et al.*, 2022). Moreover, in resistant strains of *Spodoptera frugiperda*, the gut microbiota has been reported to degrade insecticidal compounds (Almeida *et al.*, 2017). This phenomenon may be relevant to our observation that a small proportion of broflanilide-exposed mosquitoes continued to feed during the first 24 h post-exposure.

Conclusions

Exposure to broflanilide produced previously unreported morphological changes in *Ae. aegypti*, including feeding-associated abdominal swelling. Although these findings highlight the novel effects of broflanilide, its indiscriminate use in vector control could contribute to the emergence of resistance. Its application should therefore be approached cautiously and integrated with other vector control strategies.

Insecticide exposure can produce a wide range of morphophysiological effects. As new molecules are introduced for vector management, documenting and characterizing these effects is essential for informing their safe and effective integration into existing control programs.

References

- Almeida, L. G. D., Moraes, L. A. B. D., Trigo, J. R., Omoto, C., & Consoli, F. L. (2017). The gut microbiota of insecticide-resistant insects houses insecticide-degrading bacteria: A potential source for biotechnological exploitation. *PLoS ONE*, 12(3), e0174754. <https://doi.org/10.1371/journal.pone.0174754>
- Andreazza, F., Oliveira, E. E., & Martins, G. F. (2021). Implications of sublethal insecticide exposure and the development of resistance on mosquito physiology, behavior, and pathogen transmission. *Insects*, 12(10), 917. <https://doi.org/10.3390/insects12100917>
- Asgarian, T. S., Vatandoost, H., Hanafi-Bojd, A. A., & Nikpoor, F. (2023). Worldwide status of insecticide resistance of *Aedes aegypti* and *Ae. albopictus*, vectors of arboviruses of Chikungunya, Dengue, Zika and Yellow Fever. *Journal of Arthropod-Borne Diseases*, 17(1), 1–27. <https://doi.org/10.18502/jad.v17i1.13198>
- Azratul-Hizayu, T., Chen, C., Lau, K., Azrizal-Wahid, N., Tan, T., Lim, Y., Sofian-Azirun, M., & Low, V. (2021). Phenotypic profile of *Aedes albopictus* (Skuse) exposed to pyrethroid-based mat vaporizers and underlying detoxification

- mechanisms: A statewide report in Selangor, Malaysia. *Parasitology international*, 10248 <https://doi.org/10.1016/j.parint.2021.102483>.
- Brune, A. (2019). *Methanogenesis in the digestive tracts of insects and other arthropods*. In Biogenesis of hydrocarbons Springer, Cham, 229-260.
- Chin, A. C., Chen, C. D., Low, V. L., Lee, H. L., Azidah, A. A., Lau, K. W., & Sofian-Azirun, M. (2017). Comparative efficacy of commercial mosquito coils against *Aedes aegypti* (Diptera: Culicidae) in Malaysia: A nationwide report. *Journal of Economic Entomology*, 110(5), 2247–2251. <https://doi.org/10.1093/jee/tox210>
- Davila-Barboza, J. A., Gutierrez-Rodriguez, S. M., Juache-Villagrana, A. E., Lopez-Monroy, B., & Flores, A. E. (2024). Widespread resistance to temephos in *Aedes aegypti* (Diptera: Culicidae) from Mexico. *Insects*, 15(2), 120. <https://doi.org/10.3390/insects15020120>
- Dusfour, I., Vontas, J., David, J. P., Weetman, D., Fonseca, D. M., Corbel, V., & Chandre, F. (2019). Management of insecticide resistance in the major *Aedes* vectors of arboviruses: Advances and challenges. *PLoS Neglected Tropical Diseases*, 13(10), e0007615. <https://doi.org/10.1371/journal.pntd.0007615>
- Lafargue, G. L., Medina, J. M. A., Acosta, A. L., & Llanes, Y. M. (2018). Piretrinas y piretroides. *Revista Ciencia Universitaria*, 16(1).
- Lees, R. S., Ambrose, P., Williams, J., Morgan, J., Praulins, G., Ingham, V. A., & Malone, D. (2020). Tenebenal: A meta-diamide with potential for use as a novel mode of action insecticide for public health. *Malaria Journal*, 19(1), 398. <https://doi.org/10.1186/s12936-020-03493-0>
- Matsuda, K., Nakamura, H., Hamada, M., Nishimura, K., & Fujita, T. (1991). Quantitative structure-activity studies of pyrethroids: 26. Rates of development of knockdown and depolarizing effects induced by "kadethric" acid esters and related compounds. *Pesticide Biochemistry and Physiology*, 41, 178-189. [https://doi.org/10.1016/0048-3575\(91\)90072-T](https://doi.org/10.1016/0048-3575(91)90072-T)
- Nakao, T., & Banba, S. (2016). Broflanilide: A meta-diamide insecticide with a novel mode of action. *Bioorganic & Medicinal Chemistry*, 24(3), 372–377. <https://doi.org/10.1016/j.bmc.2015.09.042>
- National Center for Emerging and Zoonotic Infectious Diseases (U.S.), Division of Parasitic Diseases and Malaria, Epidemiology Branch. (2024). *Global manual for evaluating insecticide resistance using the CDC bottle bioassay*. Centers for Disease Control and Prevention.
- Ong, S. Q. (2016). Dengue vector control in Malaysia: A review for current and alternative strategies. *Sains Malaysiana*, 45(5), 777–785.
- R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. <https://www.R-project.org/>
- Rodríguez-Sánchez, I. P., Saldaña-Torres, D. R., Villanueva-Segura, O. K., Garza-Rodríguez, M. L., Gómez-Govea, M. A., Liang, G., & Ponce-García, G. (2021). miRNAs of *Aedes aegypti* (Linnaeus 1762) conserved in six orders of the class Insecta. *Scientific Reports*, 11(1), 10706. <https://doi.org/10.1038/s41598-021-89764-6>
- Rouzé, R., Moné, A., Delbac, F., Belzunces, L., & Blot, N. (2019). The honeybee gut microbiota is altered after chronic exposure to different families of insecticides and infection by *Nosema ceranae*. *Microbes and Environments*, 34(3), 226–233. <https://doi.org/10.1264/jsme2.ME18138>
- Salgado, J. F. M., Premkrishnan, B. N., Oliveira, E. L., Vettath, V. K., Goh, F. G., Hou, X., & Junqueira, A. C. M. (2024). The dynamics of the midgut microbiome in *Aedes aegypti* during digestion reveal putative symbionts. *PNAS nexus*, 3(8), 317.
- Secretaría de Salud. (2014). *NORMA Oficial Mexicana NOM-032-SSA2-2014, Para la vigilancia epidemiológica, promoción, prevención y control de las enfermedades transmitidas por vectores*. Diario Oficial de la Federación.
- Shen, N., Li, Y., Leviticus, K., Chang, X. L., Tang, T., Cui, L., & Zhao, C. Q. (2021). Effect of broflanilide on the phytophagous mite *Tetranychus urticae* and the predatory mite *Typhlodromips swirskii*. *Pest Management Science*, 77(6), 2964–2970. <https://doi.org/10.1002/ps.6282>

- Sippy, R., Rivera, G. E., Sanchez, V., Heras, F., Morejón, B., Beltrán, E., & Neira, M. (2020). Ingested insecticide to control *Aedes aegypti*: Developing a novel dried attractive toxic sugar bait device for intra-domiciliary control. *Parasites & Vectors*, 13(1), 78. <https://doi.org/10.1186/s13071-020-3954-y>
- Snetselaar, J., Rowland, M. W., Azizi, S., Mawa, B., Malone, D. J., & Kirby, M. J. (2023). Laboratory evaluation of broflanilide (TENEBENAL™) against *Anopheles gambiae* in Moshi, Tanzania—delayed mortality, cross-resistance, and residual efficacy. *Frontiers in Tropical Diseases*, 4, 1097189.
- Snetselaar, J., Rowland, M. W., Azizi, S., Mawa, B., Malone, D. J., & Kirby, M. J. (2023). Laboratory evaluation of broflanilide (TENEBENAL™) against *Anopheles gambiae* in Moshi, Tanzania: Delayed mortality, cross-resistance, and residual efficacy. *Frontiers in Tropical Diseases*, 4, 1097189. <https://doi.org/10.3389/ftd.2023.1097189>
- Sparks, T. C., Crossthwaite, A. J., Nauen, R., Banba, S., Cordova, D., Earley, F., & Wessels, F. J. (2020). Insecticides, biologics and nematocides: Updates to IRAC's mode of action classification—A tool for resistance management. *Pesticide Biochemistry and Physiology*, 167, 104587. <https://doi.org/10.1016/j.pestbp.2020.104587>
- Sun, X. I., Wei, R., Li, L., Zhu, B., Liang, P., & Gao, X. (2022). Resistance and fitness costs in diamondback moths after selection using broflanilide, a novel meta-diamide insecticide. *Insect Science*, 29(1), 188–198. <https://doi.org/10.1111/1744-7917.12921>
- Tang, T., Hu, F., Wang, P., Fu, W., & Liu, X. (2021). Broflanilide effectively controls *Helicoverpa armigera* and *Spodoptera exigua* exhibiting diverse susceptibilities to chlorantraniliprole and emamectin benzoate. *Pest Management Science*, 77(3), 1262–1272. <https://doi.org/10.1002/ps.6166>
- Trujillo-Rodríguez, G., Jiménez-Martínez, M. L., Flores Leal, J. A., Huerta García, R. E., de Lourdes Ramírez Ahuja, M., Rodríguez Sanchez, I. P., & Martínez Fierro, M. L. (2026). First Insights into the Comparative Transcriptomic Response of Field and Laboratory *Aedes aegypti* Strains to Partial-Mortality Concentration (< 50%) Imidacloprid and Broflanilide Exposure. *Insects*, 17(2), 217.
- Young, S. J., Gunning, R. V., & Moores, G. D. (2006). Effect of pretreatment with piperonyl butoxide on pyrethroid efficacy against insecticide-resistant *Helicoverpa armigera* (Lepidoptera: Noctuidae) and *Bemisia tabaci* (Sternorrhyncha: Aleyrodidae). *Pest Management Science*, 62(2), 114–119. <https://doi.org/10.1002/ps.1134>
- Zaim, M., & Jambulingam, P. (2007). *Global insecticide use for vector-borne disease control*. World Health Organization.
- Zhang, Q., Wang, Q., Zhai, Y., Zheng, H., & Wang, X. (2022). Impacts of imidacloprid and flupyradifurone insecticides on the gut microbiota of *Bombus terrestris*. *Agriculture*, 12(3), 389. <https://doi.org/10.3390/agriculture12030389>

КРАТКОРОЧНИ МАКРОСКОПСКИ ЕФЕКТИ ИЗЛОЖЕНОСТИ ИНСЕКТИЦИДИМА БРОФЛАНИЛИДУ И ПРАЛЕТРИНУ КОД ВРСТЕ *Aedes aegypti*

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Извод

Арбовирусе, попут денга вируса, зика и чикунгуње, првенствено преноси комарац *Aedes aegypti* (L.), због чега ова врста представља значајан здравствени проблем у Америци. Сузбијање вектора се углавном заснива на примени хемијских инсектицида, упркос широко распрострањеној појави резистенције. Предложене су и алтернативне стратегије, укључујући употребу комараца инфицираних бактеријом *Wolbachia* или стерилних комараца, али инсектициди и даље представљају прву линију одбране током епидемија. Циљ ове студије био је да се процене и упореде краткорочне (24–48 h) макроскопске реакције врсте *Ae. aegypti* на брофланилид, инсектицид из групе мета-диамида који је до сада ограничено коришћен у сузбијању комараца, и пралетрин, често примењивани инсектицид из групе пиретроида. Женке комараца осетљивог соја New Orleans биле су изложене сублеталним концентрацијама оба инсектицида применом CDC теста у бочицама. Преживеле јединке су затим праћене ради уочавања видљивих промена у понашању и морфологији. Изложеност пралетрину довела је до брзог губитка способности кретања и смртности у року од 24 часа, при чему ниједна преживела јединка није показала интересовање за храњење. Насупрот томе, брофланилид није изазвао губитак способности кретања, али је након 60 минута довео до заузимања мирујућег положаја. После 24 часа угинула је већина изложених комараца; међутим, код дела јединки које су се храниле сахарозом или крвљу уочено је проширење абдомена, праћено привидним нагомилавањем гаса. Брофланилид и пралетрин изазвали су различите краткорочне фенотипске ефекте, што указује на потребу за даљим истраживањима физиолошких ефеката брофланилида и његовог потенцијала у интегрисаном сузбијању вектора.

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