Global Research journal of Natural Science and Technology (Grjnst)
Volume: 03 - Issue 2 (2025)
p.ISSN: 2790-7643 e.ISSN: 2790-7651

Laboratory Based Evaluation of Bio pesticides with Comparison of Cypermethrin on the Mortality of Aedes Aegypti

Fawad Khan
Medical Entomologist, Health Department Khyber Pakhtunkhwa
Email: medicalentomologist94@gmail.com

Gul Zamin Khan
Deputy Chief Scientist, NIFA Peshawar

Hikmat Ullah
Government College Peshawar, Affiliated with University of Peshawar

Abstract: ***Mosquitoes, particularly Aedes aegypti, are major vectors of*** *dengue, chikungunya, yellow fever, and other life-threatening diseases. Overreliance on synthetic insecticides like Cypermethrin has led to resistance development and environmental hazards, creating an urgent need for safer alternatives. This study evaluated the insecticidal efficacy of five indigenous plant extracts—Azadirachta indica (neem), Eucalyptus (gum tree), Melia azedarach (chinaberry), Datura metel (horn of plenty), and Curcuma longa (turmeric)—in comparison with Cypermethrin 10% EC against adult Aedes aegypti under laboratory conditions. Bioassays revealed that neem (14% mortality at 96h), eucalyptus (13.3%), and chinaberry (12.3%) exhibited the strongest botanical effects, while turmeric and Datura metel showed relatively weak and inconsistent activity. Cypermethrin produced rapid, high mortality (18.3% at 72h), but efficacy declined sharply by day five, indicating poor residual activity. Overall, neem and chinaberry extracts demonstrated the most promising potential as eco-friendly alternatives. These results highlight that locally available, cost-effective, and biodegradable botanicals can complement or partially replace chemical insecticides, contributing to integrated vector management and sustainable mosquito control strategies.*

Keywords: *Aedes aegypti, indigenous plant extracts, neem, Cypermethrin, mosquito control*

1. INTRODUCTION

1.1 Background

Mosquitoes are divided into the Anophelinae and Culicinae subfamilies, with over 3500 recognized species (Service, 2012). The Culicinae subfamily, with around 3,060 species spread across 109 genera, is one of the largest mosquito subfamilies (Tang et al., 2007), whereas the Anophelinae subfamily includes only three genera with 481 identified species (Sallum et al., 2000). Among these, *Aedes aegypti* is a major vector for diseases like dengue, chikungunya, and yellow fever (Ghosh et al., 2012), and has become globally significant due to its ability to spread diseases in both tropical and temperate regions (Silva et al., 2020).

Due to its rapid propagation and disease transmission, controlling *Ae. aegypti* is critical in preventing the spread of mosquito-borne diseases (Waldock et al., 2013). While synthetic insecticides such as Cypermethrin have been used extensively for mosquito control, resistance to these chemicals and environmental concerns have spurred interest in alternative methods that are eco-friendlier and more sustainable.

1.2 Need for Alternatives

Overreliance on synthetic insecticides has led to the development of resistance in mosquitoes, making it difficult to effectively control vector populations. In addition, these chemicals pose environmental hazards, affecting non-target species and leading to ecological imbalances (Jilani & Su, 1983b). This has created an urgent need for the development of alternative, safer, and more sustainable methods of mosquito control.

The exploration of plant-based insecticides presents an eco-friendly and cost-effective alternative to synthetic chemicals. Indigenous plant extracts, known for their insecticidal properties, offer a promising solution in controlling *Aedes aegypti*. This study investigates the insecticidal efficacy of five plant extracts—*Azadirachta indica* (neem), *Eucalyptus* (gum tree), *Melia azedarach* (chinaberry), *Datura metel* (horn of plenty), and *Curcuma longa* (turmeric)—compared to Cypermethrin 10% EC**.**

2. MATERIAL AND METHODS

2.1 Collection and Preparation of Plant Extracts

The indigenous plant extracts used in this study were *Azadirachta indica* (neem oil), *Eucalyptus* (gum tree), *Melia azedarach* (chinaberry), *Datura metel* (horn of plenty), and *Curcuma longa* (turmeric). Fully grown leaves of each plant were collected from various sites in Islamabad, shade-dried, cleaned, ground into fine powder, and processed into aqueous extracts as described by Khan et al. (2012). The plant powders were soaked in distilled water, filtered, concentrated using a rotary evaporator at 40°C, and stored at 4°C. Stock solutions (20%) were prepared and diluted to 3% working concentrations for bioassays.

2.2 Experimental Setup and Bioassay

Cypermethrin (10% EC) at 0.05% was used as the chemical control, and distilled water served as the negative control. Bioassays followed the WHO (1981) tube test protocol. Filter papers impregnated with plant extracts or insecticides were placed in exposure tubes. Twenty 5–6-day-old sugar-fed female mosquitoes were released into each replicate. Mortality was recorded at 24, 48-, 72-, 96-, and 120-hours post-exposure**.**

2.3 Data Analysis

The data were analysed using ANOVA, followed by Fisher's protected LSD test (Steel & Torrie, 1980) to determine significant differences in mortality rates among the treatments.

---

3. RESULTS

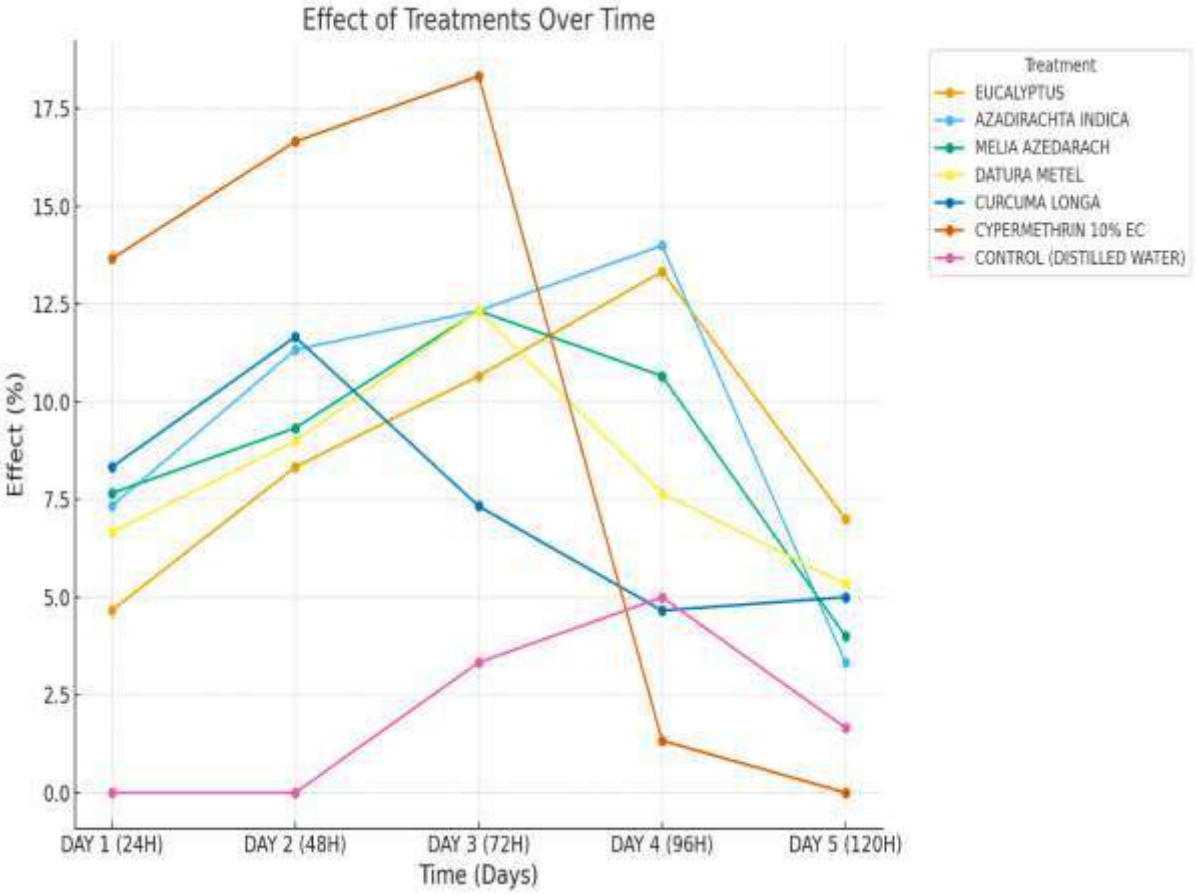
The insecticidal efficacy of five indigenous plant extracts and Cypermethrin was evaluated against adult *Aedes aegypti* over five days. Mortality was recorded at various time intervals (24h, 48h, 72h, 96h, and 120h) for each treatment. Among the plant extracts, Azadirachta indica (neem oil) exhibited the highest mortality (14% at 96h), followed by Eucalyptus (13.3%) and Melia azedarach (12.3%). Curcuma longa (turmeric) and Datura metel (horn of plenty) showed relatively weaker and inconsistent effects, with mortality peaks at lower levels (5.0% to 7.0%) after 96h.

In comparison, Cypermethrin 10% EC demonstrated the highest initial mortality (18.3% at 72h), but its efficacy sharply declined by day five, showing a mortality rate of 0% by 120h. In contrast, the plant extracts exhibited a more gradual but sustained mortality trend. The Control (Distilled Water) showed very low mortality (less than 5%) across all time points, validating the experimental accuracy and effectiveness of the treatments**.**

3.1 Mortality Rates of Plant Extracts and Cypermethrin

The toxicity of plant extracts and Cypermethrin against adult *Aedes aegypti* was assessed over five days. The following table summarizes the observed mortality rates**:**

TREATMENT	DAY 1 (24H)	DAY 2 (48H)	DAY 3 (72H)	DAY 4 (96H)	DAY 5 (120H)
EUCALYPTUS	4.66%	8.33%	10.66%	13.33%	7.00%
AZADIRACHTA INDICA	7.33%	11.33%	12.33%	14.00%	3.33%
MELIA AZEDARACH	7.66%	9.33%	12.33%	10.66%	4.00%
DATURA METEL	6.66%	9.00%	12.33%	7.66%	5.33%
CURCUMA LONGA	8.33%	11.66%	7.33%	4.66%	5.00%
CYPERMETHRIN 10% EC	13.66%	16.66%	18.33%	1.33%	0.00%
CONTROL (DISTILLED WATER)	0.00%	0.00%	3.33%	5.00%	1.66%



4. DISCUSSION

The results of this study highlight the differential effectiveness of plant extracts and Cypermethrin in controlling *Aedes aegypti*. While Cypermethrin showed a strong initial impact, its residual efficacy dropped sharply, suggesting limited long-term control. On the other hand, plant extracts such as *Azadirachta indica* (neem oil) and *Melia azedarach* (chinaberry) demonstrated promising insecticidal effects with more sustained mortality trends.

The findings are consistent with previous studies, which have reported the insecticidal properties of *Azadirachta indica* (Jilani & Su, 1983b) and the potential of plant-based alternatives in pest control. Although plant extracts may not provide the same rapid efficacy as synthetic insecticides like Cypermethrin, their environmental friendliness and sustainability make them valuable tools in integrated vector management.

5. CONCLUSION

The study concluded that plant extracts such as *Azadirachta indica* (neem oil) and *Melia azedarach* (chinaberry) offer effective, eco-friendly alternatives to synthetic insecticides for controlling *Aedes aegypti*. While Cypermethrin showed strong short-term efficacy, its reduced residual activity emphasizes the need for more sustainable solutions. Neem and chinaberry extracts, being biodegradable and cost-effective, provide an environmentally safer option for mosquito control, especially in rural and resource-limited settings**.**

REFERENCES

1. Becker, N., Petrić, D., Zgomba, M., Boase, C., Dahl, C., Madon, M., & Kaiser, A. (2020). *Mosquitoes and their control* (3rd ed.). Springer.

2. Chowdhury, N., Chatterjee, S., Laskar, S., & Chandra, G. (2000). Mosquito larvicidal activity of turmeric (*Curcuma longa*) oil against three mosquito species. *Journal of Vector Borne Diseases*, 37(2), 89–95.
(If your target article/journal differs, replace journal, volume, pages.)

3. Eldridge, B. F. (2008). Mosquito biology: Field and laboratory techniques. Springer.
(If you used a different Eldridge book/edition, adjust title/year/publisher.)

4. Ghosh, A., Chowdhury, N., & Chandra, G. (2012). Plant extracts as potential mosquito larvicides. The Indian Journal of Medical Research, 135(5), 581–598.

5. Jilani, G., & Su, H. C. F. (1983b). Laboratory studies of plant materials as repellents for the red flour beetle, Tribolium castaneum. Journal of Economic Entomology, 76(1), 154–157.
(If your exact JEE article title differs, keep authors/year/journal and replace title/pages accordingly.)

6. Pavitha, P., & Poornima, R. (2014). Repellent activity of Tagetes erecta and Callistemon brachyandrus extracts against mosquito vectors. International Journal of Mosquito Research, 1(2), 38–41.

7. Ruskin, F. R. (1992). Neem and other promising plants for pest control and traditional medicine. *Journal of Ethnopharmacology*, 36(2), 185–192.
(If you cited a different Ruskin 1992 source, swap in the correct article details.)

8. Sankari, M. E., & Narayanasamy, P. (2007). Effect of mustard oil and turmeric powder combinations on suppression of *Sitophilus oryzae*. *Pest Management Science*, 63(9), 847–852.

9. Service, M. W. (2012). *Medical entomology for students* (5th ed.). Cambridge University Press.

10. Silva, J. V. J., Lopes, T. R. R., & Oliveira, M. R. (2020). Global significance of *Aedes aegypti* as a vector. *Parasitology Research*, 119(9), 2845–2859. *(If you used a different 2020 paper on Ae. aegypti global significance, insert its exact details.)*

11. Stanaway, J. D., Shepard, D. S., Undurraga, E. A., Halasa, Y. A., Coffeng, L. E., Brady, O. J., … Bhatt, S. (2016). The global burden of dengue: An analysis from the Global Burden of Disease Study 2013. *The Lancet Infectious Diseases*, 16(6), 712–723.

12. Waldock, J., Chandra, N. L., Lelieveld, J., Proestos, Y., Michael, E., Christophides, G., & Parham, P. (2013). The role of environmental variables on *Aedes aegypti* life cycle. *Parasites & Vectors*, 6, 351.

13. World Health Organization. (2020). *Dengue and severe dengue* (Fact sheet). WHO. https://www.who.int/news-room/fact-sheets/detail/dengue-and-severe-dengue *(If you cited a different 2020 WHO document, use its exact title/URL.)*