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Environmental Control of Mosquitoes: A Case Study of the Effect of *Mangifera Indica* Root-Bark Extracts (Family Anacardiaceae) on the Larvae of *Anopheles Gambiae*

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ABSTRACT

Due to the environmental and health concerns associated with chemical-based insecticides, researchers have focused on suitable alternative and plants have emerged as a credible candidate. This study evaluated the effect of Mangifera indica *root-bark extracts on larvae of Anopheles gambiae. The Anopheles gambiae larvae used for this study was obtained from the field. Some of the larvae were allowed to develop into an adult, and they were identified following standard protocols. The larvae were exposed to methanolic and ethanolic extracts of* Mangifera indica *root-bark for 24 hours. Results revealed a significant deviation ($p<0.05$) across the concentrations. The mortality rate increased as the concentration of the plant extracts increased. The LC50 values were 395.09 ppm and 455.83 ppm for ethanolic and methanolic extracts, respectively of Mangifera indica root-bark. The ethanolic extract of the plant part possess superior activity against the larvae compared to the methanolic extracts. Therefore, there is a need for research to be carried out to ascertain the compounds responsible for the larvicidal potentials of the plant part under study.*

***Keywords:** Control of Tropical vectors, Malaria vector, Mangifera indica, Public health*

INTRODUCTION

Medicinal plant is often described as a plant whose one or more parts have therapeutic properties. A significant number of the global population (especially in rural areas in many developing nations) still depend on herbs for the treatment of diseases. Ejeta (2019) also reported that medicinal plants play an essential role in health care services in developing countries.Due to the evolution of insecticide resistance strain of malaria vector, *Anopheles* species, and environmental and health concerns associated with chemical-based insecticides, research has focused on the development of insecticides with a less toxic effect on humans and the ecosystem. To these effects, research has focused on plants. Plants have been studied based on different health problems including antimicrobial due to antibiotics resistance, bio-pesticides potentials, and other health care delivery services. *Mangifera indica* which is commonly referred to as mango belongs to the family Anacardiaceae (Ediriweera et al., 2017; Ross, 2003). The *Mangifera* genus is made up of about 30 species (Shah et al., 2010). *Mangifera indica* is a common horticulture and medicinal plant, and it is used to treat several ailments in a traditional setting in some region of the world (Bbosa et al., 2007). *Mangifera indica* can grow in tropical and sub-tropical countries. The trees of *Mangifera indica* can grow up to 30 meters in height. *Mangifera indica* is found in many regions of the world including Nigeria, India, China, Mexico, Thailand, Brazil, Pakistan and Philippine (Ediriweera et al., 2017), Tanzania, Sudan etc.

Like many other plants, Mangifera indica has been several studied for its therapeutic properties. Several parts (leaves, bark, fruit peel and flesh, roots, and flowers) of Mangifera indica is useful for the treatment of several ailments. The commonly reported medicinal potentials of Mangifera indica include analgesic, and hypoglycemic (Ojewole, 2005), anti-

modulatory, anti-diabetic, anti-oxidant, anti-inflammatory, anti-helmintic, anti-cancer, anti-microbial, hepatoprotective, gastroprotective, anti-plasmodial (Ediriweera et al., 2017; Shah et al., 2010), anti-hyperlipemic (Ediriweera et al., 2017), hypolipidemic, cardiotonic, hypotensive, anti-parasitic, anti-tumor, antibone resorption, anti-pyretic, anti-diarrhoeal and anti-allergic (Shah et al., 2010).

Previous studies have indicated that leave and bark of *Mangifera indica* are potent against dengue fever vector, *Aedes aegypti* and *Aedes albopictus* (Yousaf and Zuharah, 2015; Zuharah et al., 2014). Despite these, the activities of the various parts of *Mangifera indica* on the vector of malaria is scanty in literature. Hence this study aimed at assessing the effect of methanolic and ethanolic extracts of *Mangifera indica* root-bark on larvae of Anopheles gambiae.

Materials and Methods

Plant Collection and Preparation

The root-bark of *Mangifera indica* was obtained from a mango tree in Yenagoa metropolis, Bayelsa state, Nigeria. The root was washed with distilled water and then cut into pieces and shade dried. The dried root-bark of *Mangifera indica* was blended into a powder.

Plant Extracts

The *Mangifera indica* root-bark powder was extracted by weighing 500g into 1000ml of the solvent (ethanol and methanol). The samples were soaked for 72 hours and it was subsequently filtered using a double-layered muslin cloth, and the filtrate was then concentrated using a rotatory evaporator. Then after, different concentrations of the extracts were made viz: 0.00ppm, 150.00ppm, 300.00ppm, 450.00ppm and 600.00ppm and 750.00ppm).

Larvicidal Bioassay

Anopheles gambiae larvae used for this study was obtained from the wild following the methods previously described by Izah (2019), Youkparigha and Izah (2019), Izah and Youkparigha (2019). Some of the larvae were allowed to develop into adults *Anopheles gambiae*, and the resultant features were compared with the ones previously presented by Gimba and Idris (2014), Ahmed and Ahmed (2011). The larvicidal activities of both methanolic and ethanolic extracts of *Mangifera indica* root-bark were done following the World Health Organization protocol (WHO, 1981; Rathy et al., 2018) with some changes. Exactly 10 *Anopheles gambiae* larvae was introduced to the various concentrations viz: 0.00ppm, 150.00ppm, 300.00ppm, 450.00ppm and 600.00ppm and 750.00ppm. The larvae were confirmed dead when they did not respond to repeated prodding with a soft brush after 24 hours of exposure (Izah, 2019).

Statistical Analysis

The statistical analysis was carried out using SPSS, Graph pad prism and Microsoft excel. The number of counts was expressed as a percentage. One-way analysis of variance was carried out at $p=0.05$ across the various concentrations, and Tukey Honestly Significance Difference (HSD) statistics were used to discern the source of the observed variation.

The percentage mortality data were plotted using Graph pad prism 5 and values expressed as mean ± standard error. The Finney Table – Microsoft excel regression method previously applied by Izah (2019) was adopted for the calculation of the LC50 values.

Results And Discussion

Figure 1 shows the mortality rate of ethanolic extract of *Mangifera indica* root-bark against *Anopheles gambiae*. At different concentrations viz: 0.00 ppm, 150 ppm, 300 ppm, 450 ppm, 600 ppm and 750 ppm the mortality rate were 0.00±0.00%, 13.33±3.33%, 23.33±3.33%, 46.67±8.82%, 76.67±3.33% and 86.67±3.33%, respectively. Statistically, there was significant deviation at $p<0.05$ across the concentrations. Tukey HSD statistics showed no significant variation at $p>0.05$ in the concentration between the 0.00 ppm and 150 ppm, between 0.00 ppm and 300 ppm, and 600 ppm and 750 ppm. Furthermore, the mortality rate of methanolic extract of *Mangifera indica* root-bark against *Anopheles gambiae* is presented in Figure 2.

At 0.00 ppm, 150 ppm, 300 ppm, 450 ppm, 600 ppm and 700 ppm concentrations, the 0.00±0.00%, 10.00±0.00%, 20.00±5.77%, 46.67±3.33%, 66.67±3.33% and 76.67±3.33%, being significantly different at $p<0.05$ across the concentrations. Tukey HSD statistics revealed that there is no significant deviation at $p>0.05$ between 0.00 ppm and 150 ppm, between 0.00 ppm and 300 ppm, and 600 ppm and 750 ppm. In both solvents extracts, the mortality rate increased as the concentration of the plant

extract increased. This trend is in accordance with the findings of previous studies by researchers in the same field (Youkparigha and Izah, 2019; Izah and Youkparigha, 2019; Izah, 2019).

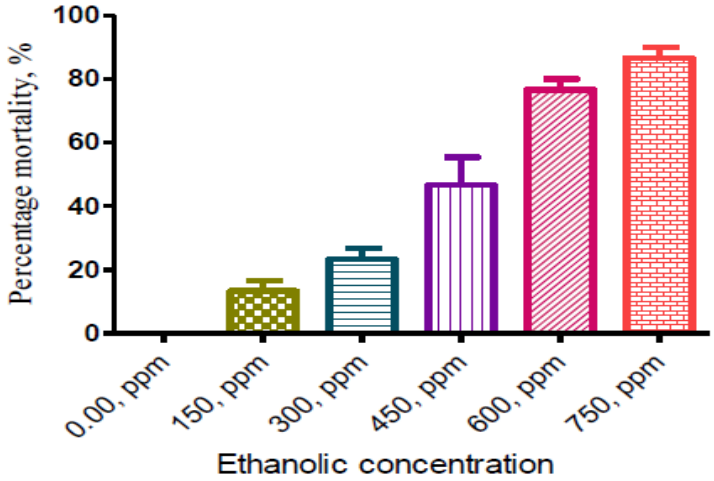

Figure1. *The mortality rate of ethanolic extract of Mangifera indica root-bark against Anopheles gambiae*

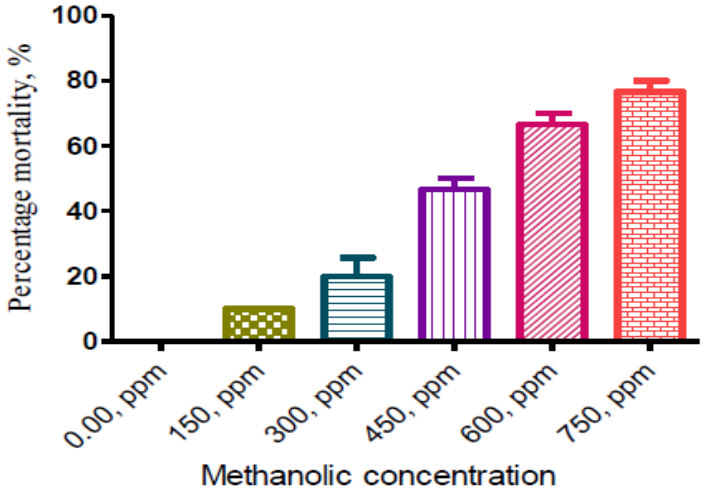

Figure2. *The mortality rate of methanolic extract of Mangifera indica root-bark against Anopheles gambiae*

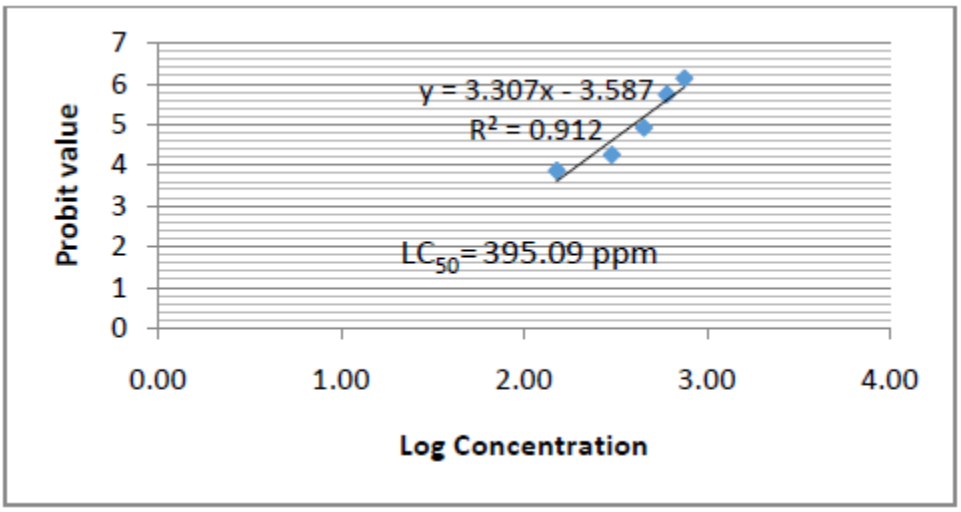

Figure3. *LC50 values of the mortality rate of Anopheles gambiae induced by ethanolic extracts of Mangifera indica root-bark*

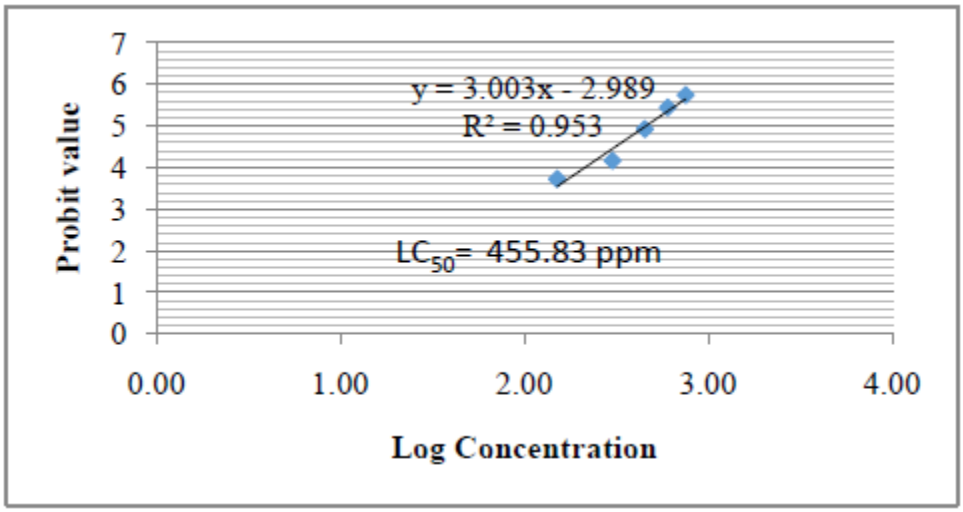

Figure4. *LC50 values of the mortality rate of Anopheles gambiae induced by methanolic extracts of Mangifera indica root-bark*

Figures 3 and 4 show the larvicidal activities of ethanolic and methanolic extracts of *Mangifera indica* root-bark against *Anopheles gambiae*. The LC50 values were 395.09 ppm and 455.83 ppm for ethanolic and methanolic extracts respectively for *Mangifera indica* root-bark. The ethanolic extract is more potent when compared to the methanolic extracts. This observation is similar to previous works that reported that different solvent extracts of a plant have a varying effect on the larvae of *Anopheles gambiae* (Yousaf and Zuharah, 2015; Izah, 2019). This may be attributed to differences in their polarity level as well as chemical and physical characteristics.

The values observed in higher than the values previously reported larvae of *Anopheles gambiae* exposed to extracts of *Cymbopogon citratus* (Youkparigha and Izah, 2019), Capsicum *frutescens var. minima* fruit (Izah, 2019) and *Zingiber officinale* (Youkparigha and Izah, 2019). Also, the values recorded were lower than the values of the previous study that reported LC50 value of *Aedes aegypti* and *Aedes albopictus* exposed to methanolic extracts of *Mangifera indica* as 570.36 ppm and 528.12 ppm, respectively (in a leave using laboratory strain of mosquito), 523.91 ppm and 431.19 ppm, respectively (in a bark using laboratory strain of mosquito), 697.36 ppm and 722.28 ppm, respectively (in a leave using field strain of mosquito), and 582.06 ppm and 550.59 ppm, respectively (in a bark using field strain of mosquito) (Yousaf and Zuharah, 2015). Zuharah et al. (2014) also reported LC50 value of 630.39 ppm when *Aedes aegypti* larvae (dengue hemorrhagic vector) was exposed to an acetone extract of *Mangifera indica* leaves. The differences may be due to the biochemical characteristics of the plant species and solvent used for their extraction, and genetic make-up of the mosquito species.

The activities of ethanolic and methanolic extracts of *Mangifera indica* root-bark against *Anopheles gambiae* larvae could be attributed to the bioactive and phytochemical constituents it contains. Karumanchi et al. (2016) reported that ethanolic extracts of *Mangifera indica* flower contain icosanedioic acid monomethyl ester, nonadec-16-enyl-benzene, 1, 9 diphenyl nonane, icosane, octadecane, dodecanoic acid butyl ester and tetracosyl- benzene. Helen et al. (2013) reported that hexane-ethyl acetate extract of *Mangifera indica* leave contains terpinyl acetate, phytol isomer, oxirane, sabinene, beta-pinen, beta-myrcene, cymene, alpha-limonene, eucalyptol (1,8-cineo, 1,3-benzodioxole, 5-(2-). The authors further reported benzoic acid, pyrogallol, p-hydroxybenzoic acid, vanillic acid, syringic acid ferulic acid, ethyl gallate and gallic acid as the phenolic compounds from ethyl acetate fraction of *Mangifera indica* leaves. Ediriweera et al. (2017) have reported that *Mangifera indica* contains bioactive phytochemicals such as polyphenols, terpenes, sterols, carotenoids, vitamins, and amino acids. Ojewole (2005) also reported polyphenolics, flavonoids, triterpenoids and mangiferin as some of the major bioactive component of Mangifera indica. Ukpo et al. (2013) reported the presence of carbohydrates, reducing sugars, alkaloids, flavonoids, tannins and phlobatannins in ethanolic extracts of *Mangifera indica* stem-bark. Bbosa et al. (2007) reported alkaloids,

anthracenosides, reducing sugars, steroids and triterpenoids, saponins, coumarins, catechol and gallic tannins and flavonoids in ethanolic extract of *Mangifera indica* leaves. Mushore and Matuvhunye (2013) reported that water, ethanol, hexane and ethylacetate extracts of *Mangifera indica* stem-bark contain cardiac glycosides, saponins, resins, tannins, phenols, terpenoid, glycosides, flavonoids and phlobatannins. According to David et al. (2000a,b), Izah (2019), polyphenol makes plants confers insecticidal activity.

CONCLUSION

The activities of methanolic and ethanolic extracts of *Mangifera indica* root-bark against larvae of *Anopheles gambiae* was assessed, and the results showed that the extracts confer insecticidal potentials. The LC50 values show that the ethanolic extract confers apparent superior larvicidal activities compared to the methanolic extract. Therefore, there is a need to study to isolates the exact compound that enables the plant to confers the larvicidal activity.

REFERENCES

[1] Ahmed, U.A., & Ahmed, M.M. (2011). Morphological identification of Malaria vectors within Anopheles Species in Parts of Kano State, Nigeria. Bayero Journal of Pure and Applied Sciences, 4(2), 160-163.

[2] Bbosa, G. S., Lubega, A., Musisi, N., Kyegombe, D. B., Waako, P., Ogwal-Okeng, J., & Odyek, O. (2007). The activity of Mangifera indica L. leaf extracts against the tetanus causing bacterium, Clostridium tetani. African Journal of Ecology, 45(s3), 54–58.

[3] David, J.P., Rey, D., Marigo, G., & Meryran, J.C. (2000). Larvicidal effect of a cell-wall fraction isolated from alder decaying leaves. J Chem Ecol., 26, 901-13.

[4] David, J.P., Rey, D., Pautou, M.P., & Meryran, J.C. (2000). Differential toxicity of environmental vegetation on some aquatic dipteran larvae of mosquito breeding sites. J. Invert. Pathol., 75, 9-18.

[5] Ediriweera, M.K., Tennekoon, K.H., & Samarakoon, S.R. (2017). A Review on Ethnopharmacological Applications, Pharmacological Activities, and Bioactive Compounds of Mangifera indica (Mango). Evidence-Based Complementary and Alternative Medicine, 24 pages | https: //doi. org/10. 1155 /2017 /6949835

[6] Ejeta, D. (2019). Ethno-botanical Survey Of Plants Used For Prevention Against Mosquito Bites And Control Of Malaria In Assosa District, Western Ethiopia. International Journal of Ethnobiology & Ethnomedicine, No volume, 1 -9.

[7] Gimba, U.N., & Idris, H.S. (2014). Morphological Identification and Distribution of Anopheles Species in Gwagwalada Town, F.C.T, Nigeria, Inter J Environ Sci Toxicol Res. 2(10), 210-6.

[8] Helen, P.A.M., Aswathy, M.R., Deepthi, K.G., Mol, R.R., Joseph, J.J., & Sree, S.J. (2013). Phytochemical analysis and anticancer activity of leaf extract of Mangifera indica (Kottukonam varika). International Journal of Pharmaceutical Sciences and Research, 4(2), 823-828

[9] Izah, S.C. (2019). Activities of Crude, Acetone and Ethanolic Extracts of Capsicum frutescens var. minima Fruit Against Larvae of Anopheles gambiae. Journal of Environmental Treatment Techniques, 7(2), 196-200.

[10] Izah, S.C., & Youkparigha, F.O. (2019). Larvicidal Activity of Fresh Aqueous and Ethanolic Extracts of Cymbopogon citratus (DC) Stapf on Malaria Vector, Anopheles gambiae. BAOJ Biotech. 5, 040.

[11] Karumanchi, N.K., Gupta, B.S., Mehta, D., & Mehta, B.K. (2016). Phytochemical Analysis And Antitubercular Activity Of Flowers Extract Of Mangifera Indica. International Journal of Pharmaceutical Sciences and Research, 7(8), 3472-3476.

[12] Mushore, J., & Matuvhunye, M. (2013). Antibacterial properties of Mangifera indica on Staphylococcus aureus. African Journal of Clinical and Experimental Microbiology, 14(2), 62 – 74.

[13] Ojewole, J. (2005). Anti-inflammatory, analgesic and hypoglycaemic effects of Mangifera indica Linn. (Anacardiaceae) stem-bark aqueous extract. Methods Find Exp Clin Pharmacol., 27(8), 547

[14] Rathy, M.C., Sajith, U., & Harila, C.C. (2015). Larvicidal efficacy of medicinal plant extracts against the vector mosquito Aedes albopictus. International Journal of Mosquito Research, 2 (2), 80-82.

[15] Ross, I.A. (2003). Mangifera indica. Medicinal Plants of the World. page 315–328.

[16] Shah, K.A., Patel, M.B., Patel, R.J., & Parmar, P.K (2010). Mangifera indica (Mango). Pharmacognosy Reviews, 4(7), 42 – 48.

[17] Ukpo, G., Ogbonnia, S., Ehianeta, T., & Bashir, S. (2013). Immunostimulatory and biochemical effects of ethanolic extract of Mangifera indica stem bark on dexamethasone-induced immuno suppressed male rats. Int J Pharm Pharm Sci, 5(2), 569-572.

[18] World Health Organization (1996). Report of the WHO Information Consultation on the evaluation on the testing of insecticides. 1996. CTD/WHO PES/IC96. pp 1:96.

[19] Youkparigha, F.O., & Izah, S.C. (2019) Larvicidal efficacy of aqueous extracts of Zingiber officinale Roscoe (ginger) against malaria vector, Anopheles gambiae (Diptera: Culicidae) International Journal of Environmental and Agricultural Sciences, 3:020.

[20] Yousaf, A., & Zuharah, W. F. (2015). Lethal response of the dengue vectors to the plant extracts from family Anacardiaceae. Asian Pacific Journal of Tropical Biomedicine, 5(10), 812–818.

[21] Zuharah, W.F., Fadzly, N., Ali, Y., Zakaria, R., Juperi, S., Asyraf, M., & Dieng, H. (2014). Larvicidal efficacy screening of Anacardaciae crude extracts on the dengue hemorrhagic vector, Aedes aegypti. Tropical Biomedicine 31(2), 297–304.

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