



## Comparative Insecticidal Effects of Dry *Ocimum gratissimum* (Scent Leaves) and Rambo™ Paper on Mosquitoes in Jos, Nigeria

Priscilla Agbalaka<sup>1</sup>, Gumta Matthew<sup>2</sup>, Uchejeso Obeta<sup>1\*</sup>, Jonathan Sabulu<sup>3</sup>, Rose Joshua-Ojokpe<sup>1</sup> and Nathan Pada<sup>1</sup>

<sup>1</sup>Federal School of Medical Laboratory Science, Npkwuis 930105, Jos, Nigeria.

<sup>2</sup>Our Lady of Apostle Hospital, Jos-Nigeria, Nigeria.

<sup>3</sup>Federal Teaching Hospital Gombe, 74XQ+H9R, 760253, Gombe State, Nigeria.

\*Corresponding author:

Uchejeso Obeta,

Federal School of Medical Laboratory Science,

Npkwuis 930105,

Jos,

Nigeria.

Email: [uchejesoobeta@gmail.com](mailto:uchejesoobeta@gmail.com)

### HISTORY

Received: 17<sup>th</sup> Sep 2021  
Received in revised form: 23<sup>rd</sup> Nov 2021  
Accepted: 10<sup>th</sup> Dec 2021

### KEYWORDS

*Ocimum gratissimum*  
Mosquitocidal  
Insecticidal  
Rambo™ paper  
Malaria eradication

### ABSTRACT

Insecticides are chemicals or biological substances that are used to kill or disable insects. Blood feeding mosquitoes are responsible for the intolerable biting nuisance and transmission of large number of diseases such as malaria, yellow fever, dengue fever, filariasis amongst others, causing serious health problems to humans and obstacles to socioeconomic development of developing nations like Nigeria. The insecticidal effect of scent leaves (*Ocimum gratissimum*) and Rambo™ paper on mosquitoes was investigated. The study is aimed at comparing the insecticidal effects of *Ocimum gratissimum* and Rambo™ paper on mosquitoes in Jos. 100 mosquitoes were exposed to dried *Ocimum gratissimum* and Rambo™ paper at different time intervals of 5, 10 and 12 min. Results obtained showed a time dependent insecticidal effect on mosquitoes, which was 54.2%, 54.0% and 55.6% total mortality of mosquitoes at respective time intervals on exposures to both Rambo™ paper insecticide and *Ocimum gratissimum*, indicating that there was a significant difference in the lethal effect of Rambo™ paper insecticide and scent leave on mosquitoes at ( $p < 0.05$ ). In comparing the lethal effect of Rambo™ paper insecticide and *Ocimum gratissimum* on mosquitoes at different locations in Jos, at Dogon Karfe, after 10 min of treatment, Rambo™ paper had the highest lethal effect of 21 (84.0%) compared to scent leaves 6 (24.0%) and at Abattoir Jos, after 12 min of treatment, Rambo™ paper had the highest lethal effect of 17 (94.4%) compared to *Ocimum gratissimum* 3 (16.7%). These comparisons were significant at  $p < 0.05$ . This study provides evidence that *Ocimum gratissimum* has a mosquitocidal effect. However, the Rambo™ paper gave a better mosquitocidal effect than *Ocimum gratissimum*. There is a need to discover better additive or extract options that could give *Ocimum gratissimum* a better effect as a natural product available in Africa towards the malaria eradication programme.

### INTRODUCTION

The arrival of an effective and durable human malaria vaccines that could eliminate *Plasmodium* spp. [1] especially in Nigeria is highly sought. Notwithstanding, the population and remove nature of Nigerian regions may pose threat to vaccine coverage on arrival. This gives an impetus to applying every available and effective means of mosquito control not leaving out the integrated vector management [2,3]. Mosquitoes are one of the most disturbing bloodsuckers afflicting man. Mosquitoes are very important primary hosts in the spread of malaria, yellow fever, filariasis and severe arboviral infections because females are anautogenous (requiring blood meal), before oviposition. One of the important aspects of the fight against malaria and other

mosquito-borne diseases is the prevention of mosquito-man contact in reducing or curbing the spread of mosquito-borne diseases. Several efforts have been made to prevent and or reduce mosquito contact with a man [4-6]. Some of these efforts include the use of untreated mosquito nets, treated mosquito nets and treated clothing for outdoor lovers and synthetic chemical irritants (insecticides).

Conventionally, mosquito control relies heavily on synthetic and imported insecticides as applied over the decades (may be because of fast action and are easy to use). However, people may be ignorant of the fact that overuse and injudicious application of such synthetic insecticides may result in resistance and unwarranted toxic or lethal effects on a non-target organism as

well as man and other environmental health challenges [7]. Hence there is a constant need for developing biologically active plant materials which are expected to reduce the hazard to humans, other organisms by minimizing the accumulation of harmful in the environment's insecticides. Several synthetic chemicals like pyrethroids, di-ethyl-amide, have been used with success in repelling mosquitoes. There may be less study on the harmful effect of those products once potent insecticides are repelled. There is an urgent need to address the shortcoming of already existing vector-man control/prevention methods and develop ecofriendly repellants [8].

The search for potent and environmentally friendly chemical substances holds a lot of promise for the development of biologically/environmentally friendly repellents with the knowledge about *Ocimum* spp. According to WHO [9], there are 229 million cases of malaria, and malaria deaths stood at 409,000 worldwide. In Africa, about 219 million cases were estimated, with Nigeria having about 292 to 296 cases per 1000 of the population as estimated from 2015-2018. The Jos, Plateau State incidence from 2013-2017 stood at 38, 467 cases of severe malaria [10].

The essence of this study is based on the major concern on how mosquitoes have been rising with increasing rate of cases or affected people globally, Africa, Nigeria and in Jos. Scent leaf, *Ocimum gratissimum* is an aromatic perennial herb, with an erect stem, much-branched, glabrous and woody at the base often with epidermic peeling in strips. *Ocimum gratissimum* is grown for the essential oil in its leaves and stems while eugenol and to a lesser extent thymol are extracted from the oil which are substitutes for clove oil and thyme oil. The essential oil possesses antibacterial properties [11] and is also an important insect repellent.

The burning of dry leaves of *Ocimum* spp. has shown some good results [12]. *Ocimum* spp. are used as vegetables or spice due to their aromatic nature and many has applied it in traditional medicine, especially in Africa and India. The applications include the treatment of ringworms, gout and fungal infections, malaria, catarrh, aches, colon pain. The juice gotten from squeezing its leaf can be used to cure several stomach related illnesses like cholera, diarrhoea, dysentery, vomiting and convulsion [13]. Several health challenges and most importantly, mosquito eradication has been in the front burner among the uses [6,14].

*Ocimum gratissimum* (scent leaf) is one of the plants of interest in the quest for solving the above-mentioned problems militating against the animal production industry in Nigeria. The plant is called Effirin by the Yoruba speaking tribe, Nchuanwu in Igbo, while in the northern part of Nigeria, the Hausas called it Daidoya [15]. Mosquitoes are the deadliest vectors of parasites that cause diseases such as malaria, filariasis, Japanese encephalitis, dengue fever, dengue hemorrhagic fever, and yellow fever [16]. *Aedes aegypti* alone is a very important disease vector, transmitting the arbovirus that causes dengue fever and dengue hemorrhagic fever, chikungunya, and allergic skin reaction especially in children, which is endemic to Southeast Asia, the Pacific Island area, the Americas, and Africa [17]. The effort to repel mosquitoes is yielding worldwide and in Nigeria particularly using dry leaves or leave extracts of *Ocimum gratissimum* in the repellent production [18-20] without sparing the vectors from the larva stages.

The chemical substance which produces a definite physiological action on the human body is where the medicinal values of these plants lie. The most important of these bioactive constituents of plants are flavonoids, saponins, alkaloids, tannins and phenolic compounds [20]. The choice of an acceptable technique to obtain maximum yield and highest purity varies according to the nature of the target compound. Numerous chemical and mechanical processes like solvent extraction and steam distillation are used for the extraction of compounds from plants [21]. The objective of this study is to determine the insecticidal effects of scent leaves (*Ocimum gratissimum*) and comparatively find the effect in relation to Rambo™ paper on mosquitoes in Jos.

## MATERIALS AND METHODS

### Study area

The study was carried out in Jos, Jos North L.G.A using mosquitoes collected in three (3) locations- Plateau state water board (British), Dokon Karfe and Abattoir.

### Materials

The materials used in this study are Mosquitoes, Scent leave (*Ocimum gratissimum*), Rambo™ paper, Mosquito catch, Mosquito save container, Sugar solution and Lighter.

### Mosquitoes Catching

Mosquitoes were ascertically caught around plateau state water board (British), Dogon Karfe and Abattoir on their water pass gutters and where stagnant water is stand. And immediately transfer to the mosquito save container when caught.

### Mosquitoes processing

Mosquitoes were placed on the two mosquitoes save containers, one for the scent leave and another one for the Rambo paper. The sugar solution was removed which was the food or nutrition for mosquitos' survival before the processing took place. Lighter was used to light both the scent leave and Rambo™ paper, and Rambo™ paper was placed in one and scent leaf was placed into the second container, it was timed for 5 min, 10 min, and 15 min, to detect the effectiveness of both Rambo™ paper and scent leave on mosquitoes.

### Detection of the effectiveness of scent Leave and Rambo™ paper on mosquitoes

After lighting the scent leave and Rambo™ paper in the different mosquitoes catch net, the mortality rate was observed at a different time interval of 5 min, 10 min, and 15 min. Rambo™ paper was more effective on mosquitoes than scent leaves. And it was clear that Rambo™ paper killed mosquitoes faster than scent leave. So therefore, Rambo™ paper is more effective on mosquitoes than scent leave (Fig. 1).



Fig. 1. *Ocimum gratissimum* and Rambo™ Paper used in this study.

### Data Analysis

Data analysis was carried out using Chi-square to establish a significant difference in the comparative insecticidal effect of scent leaf (*Ocimum gratissimum*) and Rambo paper on mosquitoes in Jos North LGA of Plateau state, using SPSS version 22.0

### RESULT

**Table 1** Shows that there was a significant difference in the Lethal effect of Rambo paper insecticide and scent leaves on mosquitoes at  $p < 0.05$ . Rambo™ paper had the highest lethal effect 10 (88.3%) compared to scent leaves 3 (33.3), this is the higher insecticidal proficiency of Rambo™ Paper on mosquitoes compared to the scent leaves. **Table 2** Shows that there was a significant difference in the Lethal effect of Rambo™ paper insecticide and scent leaves on mosquitoes at  $p < 0.05$  after 10 min of treatment, Rambo™ paper had the highest lethal effect of 21 (84.0%) compared to scent leaves 6 (24.0%), this reveals a higher insecticidal effect of Rambo™ Paper on mosquitoes compared to the scent leaves.

**Table 3** Shows that there was a significant difference in the Lethal effect of Rambo™ paper insecticide and scent leaves on mosquitoes at  $p < 0.05$ . After 15 min of treatment, Rambo™ paper had the highest lethal effect of 17 (94.4%) compared to scent leaves 3 (16.7%), this reveals a higher insecticidal effect of Rambo™ Paper on mosquitoes compared to the scent leaves.

**Table 1.** Comparative lethal effect of Rambo™ paper insecticide and scent leaf (*Ocimum grastisimum*) on mosquitoes After 5 min of treatment in Jos.

Insecticide	No. of No. Mosquitoes observed	No. Living (%)	No. Dead (%)	X <sup>2</sup>	Df	p-value
Rambo™ Paper	12	2 (16.7)	10 (83.3)	7.243	1	0.001
Scent leaves	12	9 (75.0)	3 (25)			
Total	24	11 (45.8)	13 (54.2)			

Note: Result is deemed significant when  $p < 0.05$  at the 95% confidence level.

**Table 2.** Comparative Lethal Effect of Rambo™ Paper Insecticide and Scent Leaf (*Ocimum grastisimum*) on Mosquitoes After 10 Min of Treatment in Jos.

Insecticide	No. of Mosquitoes observed	No. Living (%)	No. Dead (%)	X <sup>2</sup>	Df	p-value
Rambo™ Paper	25	4 (16.0)	21 (84.0)	8.724	1	0.002
Scent leaves	25	19 (76.0)	6 (24.0)			
Total	50	23 (46.0)	27 (54.0)			

Note: Result is deemed significant when  $p < 0.05$  at the 95% confidence level.

**Table 3.** Comparative lethal effect of Rambo™ paper insecticide and scent leaf (*Ocimum grastisimum*) on mosquitoes after 15 min of treatment in Jos.

Insecticide	No. of Mosquitoes observed	No. Living (%)	No. Dead (%)	X <sup>2</sup>	Df	p-value
Rambo™ Paper	18	1 (5.6)	17 (94.4)	9.624	1	0.001
Scent leaves	18	15 (83.3)	3 (16.7)			
Total	36	16 (44.4)	20 (55.6)			

Note: Result is deemed significant when  $p < 0.05$  at the 95% confidence level.

### DISCUSSION

Many mosquito-borne diseases, such as malaria, dengue fever, and yellow, are serious public health problems in tropical regions, especially in Nigeria. These diseases are transmitted to human beings through mosquito bite only. Prevention of mosquito bites is one of the main strategies to control or minimize the incidence of these diseases. The use of insect repellents can provide practical and economical means of preventing mosquito-borne diseases and death. It is important not only for local people in disease risk areas as Nigeria but also for travelers who are vulnerable to diseases spread by mosquito vectors when they visit and seek leisure away from their home countries. Many mosquito formulations have been made containing plant materials [21,22]. Efforts are being made to ensure safety and effectiveness of such repellants [23].

In the present study, the comparative lethal effect of Rambo paper insecticide and *Ocimum gratissimum* on mosquitoes after 5 minutes of treatment shows that a total of 24 mosquitoes were observed (12 mosquitoes for Rambo™ paper treatment and 12 mosquitoes for *Ocimum gratissimum*). The mortality rate for exposure on Rambo™ paper was 10(88.3%) and 3(33.3%) for *Ocimum gratissimum*. The total mortality was 13(54.2%), this shows that there was a significant difference in the Lethal effect of Rambo™ paper insecticide and scent leaves on mosquitoes at ( $p < 0.05$ ). However, Rambo™ paper had the highest lethal effect compared to scent leaves (**Table 1**). The study, therefore, shows that *Ocimum gratissimum* is lethal to mosquitoes especially the dry ones thereby supporting the works of Anzaku *et al.* [24] with regards to *Ocimum* spp.

Also, the comparative lethal effects of Rambo paper insecticides and *Ocimum gratissimum* on mosquitoes after 10 minutes treatment indicates a total of 50 mosquitoes were observed, in this case (25 mosquitoes for Rambo™ paper treatment and 25 for *Ocimum gratissimum*). The mortality recorded was as follows; For Rambo paper 21(42%) out of 25 mosquitoes dead while 3(6.0) out of 25 mosquitoes exposed to *Ocimum gratissimum* dead, this gave rise to the total mortality of 27(54.0%), this implies that there was a significant difference in the Lethal effect of Rambo™ paper insecticide and scent leaves on mosquitoes at ( $p < 0.05$ ). after 10 min of treatment. Rambo™ paper also had the highest lethal effect compared to scent leaves (**Table 2**). Again, the ability to repel mosquitoes is confirmed in this case of burning dry scent leaves thereby adding to other studies that formulate creams [25] and candles [26].

Lastly, the comparative lethal effects of Rambo paper insecticides and *Ocimum gratissimum* on mosquitoes after 15 min of treatment shows that a total of 36 mosquitoes were exposed (18 mosquitoes for Rambo™ paper treatment and 18 for *Ocimum gratissimum*). Out of 18 mosquitoes exposed to Rambo paper insecticide 17(94.4%) were dead while the remaining 18 mosquitoes were exposed to *Ocimum gratissimum* 3(16.7%) dead. The total mortality recorded was 20(55.6%), this indicates that there was a significant difference in the Lethal effect of Rambo™ paper insecticide and scent leaves on mosquitoes at ( $p < 0.05$ ) after 15 min of treatment. Rambo™ paper as well had the highest lethal effect compared to scent leaves (**Table 3**). From this study, it is showing that *Ocimum gratissimum* has less effect than Rambo™ paper.

The less effect could be the time of exposure 5 to 10 min used in the study unlike Etta *et al* [27] that gave 100% lethal effect to mosquitoes at 60 min. It is important to note that time is of essence in the fight against mosquito adults or any stage of the vector's life cycle like larva [18,19]. The results obtained from this study showed that insecticidal effects of dry scent leave and Rambo paper on mosquitoes in Jos. It was apparent that the Rambo paper is more effective on mosquitoes than scent leave on mosquitoes.

## CONCLUSION

*Ocimum gratissimum* is an insecticidal/ mosquitocidal plant and should be explored in the eradication of mosquitoes in our environment. *Ocimum gratissimum* is natural and may have less side effects unlike the commercial product Rambo™ that is synthetic in origin. The plant deserves more studies to ascertain the best preparation or additives that could make it better to be used in Nigeria for mosquito eradication. Natural products should not be neglected in the advocated integrated vector management approach in malaria programs in Africa and in Nigeria in particular. The result in this study indicates that Rambo™ paper currently has more lethal effect on mosquitoes than *Ocimum gratissimum*. It is suggested to allow *Ocimum gratissimum* for more time of exposure to produce the expected effect in future studies.

## ACKNOWLEDGMENTS

We acknowledge the International Conference on Microbiology and Immunology-Webinar where this paper was presented on the 16-18<sup>th</sup> November, 2021.

**CONFLICT OF INTEREST:** None

**FINANCIAL SUPPORT:** None

**ETHICS STATEMENT:** We got approval from Academic Board and Ethical Committee of Federal School of Medical Laboratory Science (FSMLS) Jos-Nigeria.

## REFERENCES

1. Draper SJ, Sack BK, King CR, Nielsen CM, Rayner JC, Higgins MK, Long CA, Seder RA. Malaria Vaccines: Recent Advances and New Horizons. *Cell Host Microb Rev*. 2018;43-56.
2. WHO & IAEA. Guidance framework for testing the sterile insect technique as a vector control tool against Aedes-borne diseases. Geneva: World Health Organization and the Int Atomic Energy Agency; 2020.
3. Chanda E, Govere JM, Macdonald MB, Richard L Lako RL, Haque U, et al. Integrated vector management: A critical strategy for combating vector-borne diseases in South Sudan. *Malaria J*. 2013;12:369.
4. Youmsi R, Fokou P, Menkem E, et al. Ethnobotanical survey of medicinal plants used as insects repellents in six malaria endemic localities of Cameroon. *J Ethnobiol Ethnomed*. 2017; 13(1):33.
5. Barnard, D. R., and R. D. Xue. Laboratory evaluation of mosquito repellents against *Aedes albopictus*, *Culex nigripalpus*, and *Ochlerotatus triseriatus* (Diptera: Culicidae). *J. Med. Entomol.*, 2004;41:726–730.
6. Chauhan, C. L. Cantrell, and J. C. Dickens. Multiple activities of insect repellents on odorant receptors in mosquitoes. *Med Vet. Entomol.*, 2011;25:436–444.
7. WHO (2018): Vector control for malaria and other mosquito borne disease, WHO Tech.
8. WHO. Specification and Evaluation for public Health pesticides, (2002): Available from, [http://www.who.int/who\\_pest\\_quality\\_transfluthrin\\_eval\\_only\\_Nov2006pdf](http://www.who.int/who_pest_quality_transfluthrin_eval_only_Nov2006pdf).
9. World Health Organisation. World Malaria report 2013. Geneva. 2013;284
10. Ita OI, Inaku KO, Iwuafor AA, Udoh UA. The Pattern of Severe Malaria in Plateau State of Nigeria: A Five-Year Review of Severe Malaria Case-Based Surveillance Data from 2013 to 2017. *Central Afr J Public Health*. 2019;5(1):52-57.
11. Amengialun O., et al. : Antibacterial activity of extracts of *ocimum gratissimum* on bacteria Associated with Diarrhea. *Bayero J Pure Appl Sci*. 2015;143-145.
12. Aziba P.L, Bass D. and Elegbe Y. Pharmacolical Investigation of *Ocimum gratissimum*. *Int J Health and Pharma Res Phytothen Res*. 1999;13:427-9.
13. Shoukat RF, Shakee M, Rizvi SAH, Zafa J, Zhang Y, Freed S, Xu X, Jin F. Larvicidal, Ovicidal, synergistic, and repellent activities of *Sophora alopecuroides* and Its Dominant constituents against *Aedes albopictus*. *Insects* 2020;;11:246;
14. Molineaux L, Gramiccia G, Organization WH. The Garki project : Res on the epidemiology and control of malaria in the Sudan savanna of West Africa [Internet]. World Health Organization; 1980.
15. Esimone, C. O., A. A. Attama, G. Ngwu, C. A. Iloabanafo, M. A. Momoh, and L. O. Onaku. Mosquito repellent activity of herbal ointments formulated with *Occimum gratissimum* oil. *J Pharm Res*. 201;14:3442–3444.
16. Renugadevi, G., T. Ramanathan, P. R. Shanmuga, and P. Thirunavukkarasu. Studies on combined effect of mangrove plants against three dangerous mosquitoes. *Int J Pharm Biol Arch*. 2012;3:357–362.
17. Supratik, C., S. Someshwar, and C. Goutam. Mosquito larvicidal effect of orthophosphoric acid and lactic acid individually or their combined form on *Aedes aegypti*. *Asian Pac J Trop Med*. 2010;3:954–956.
18. Anitha, R., and D. Geethapriya.( ). Larvicidal activity of plant extracts on *Aedes Aegypti* L. *Asian Pac J Trop Biomed*. 2012;2(Suppl 3):S1578–S1582.
19. Chinnaperumal, K., and A. A. Rahuman. Larvicidal and adulticidal potential of medicinal plant extracts from south India against vectors. *Asian Pac J Trop Med*. 2010;3:948–953.
20. Ekhaife, F. O., Ofoezie, V. G., & Enobakhare, D. A. : Antibacterial properties and preliminary phytochemical analysis of methanolic extract *Ocimum gratissimum*. *J Pure Appl Sci*. 2010;3(2):65-68.
21. Adeniran, O. I., and E. Fabiyi. A cream formulation of an effective mosquito repellent: a topical product from lemongrass oil (*Cymbopogon citratus*) Stapf. *J Nat Prod Plant Resour*. 2012;2:322–327.
22. World Health Organisation . Guidelines for efficacy testing of mosquito repellents for human skin. WHO\_HTM\_NTD\_WHOPEP\_( 2009),4 eng. Geneva, Switzerland: World Health Organization, 2009;30 p.
23. Dickens, J. C., and J. D. Bohbot. Mini review: mode of action of mosquito repellents. *Pestic Biochem Physiol*. 2013;106:149–155.
24. Anzaku FA, Obeta KO, Mairiga JP, Obeta MU, Ejinaka OR, Akram M, Ekpere-Ezeugwu MO, Elbossaty W. Evaluation of the insecticidal effects of *Ocimum sanctum* on mosquito. *Int J Pharma Phytopharmacol Res*. 2021;11(5):11-17.
25. Ezeike AK, Elias NN, Pierre S Danga Y, Younoussa L, Esimone CO. Creams formulated with *Ocimum gratissimum* L. and *Lantana camara* L. crude extracts and fractions as mosquito repellents against *Aedes aegypti* L. (Diptera: Culicidae). *J Insect Sci*. 2015;15(1): 45.
26. Okorie AN, Wirnkor VA, Enyoh CE, Verla EN, Amaobi CE. Potentials of *Ocimum gratissimum* extracts as mosquito repellents and mosquitocidal candles., *Int J Adv Res Chem Sci*, 2020;7(5):30-36.
27. Etta HE, Ukpong IG, Iboh CI, Nsharr ME. Preliminary investigations of the insecticidal effect of *Ocimum gratissimum* (L) on adult anopheles mosquitoes. *Int J Health Pharma Res*. 2016;2(1):66-72.