Volume 7 Issue 2 2021

ISSN 2454-3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 7, No. 2, 880-886 (2021)

International Journal of Zoological Investigations
ISSN: 2454-3055
Contents available at Journals Home Page: www.ijzi.net

Activity of Polyherbal Formulated Mosquito Liquid Vaporizer Against *Culex quinquefasciatus*

Babu M.[1*], Ashok K.[1], Nivedhini V.[2], Thatiparthi Stephen[2] and Gautham B.[2]

[1]Department of Microbiology and Biotechnology, School of Basic Sciences, Bharath Institute of Higher Education and Research (BIHER), Chennai, Tamil Nadu, India
[2]Department of Biochemistry, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research (BIHER), Chennai, Tamil Nadu, India

**Corresponding Author*

Received: 9th November, 2021; **Accepted:** 6th December, 2021; **Published online:** 11th December, 2021

https://doi.org/10.33745/ijzi.2021.v07i02.077

Abstract: This is the first report on larvicidal and repellent practises in polyherbal repellent (PHR) formulation BIHER01 (Bharath Institute for Higher Education and Research 01) and its components. Our findings showed that polyherbal (POLH) extracts are promising and noteworthy larvicides for *Culex quinquefasciatus* which can be linked to polyphenols such as flavonoids, phenols, tannins, alkaloids, saponins, terpenoids, tri-terpenoids, glycosides, cardiac glycosides, protein, carbohydrates, acids and steroids. Based on the time periods used, either a synergist or an antagonistic effect of the phytoconstituents was observed against larvae. On the other hand, owing to its high potential for repellence, PHR was known as an active repellent for *Culex quinquefasciatus*. Nevertheless, further studies are necessary to establish the contribution to mode of action and repellence of the major and minor elements of POLH extract.

Keywords: Polyherbal repellent, BIHER01, *Culex quinquefasciatus*, Phytochemical analysis, *Azadirachta indica*, Eucalyptus, *Curcuma longa* Eucalyptus, *Curcuma longa*

Citation: Babu M., Ashok K., Nivedhini V., Thatiparthi Stephen and Gautham B.: Activity of polyherbal formulated mosquito liquid vaporizer against *Culex quinquefasciatus*. Intern. J. Zool. Invest. 7 (2): 880-886, 2021.
https://doi.org/10.33745/ijzi.2021.v07i02.077

Introduction

In the tropics, mosquito (MQ)-borne disease, including malaria, yellow fever,Chikungunya, Filaria, Japanese Encephalitis, Kala azar and dengue fever (DEN-1, DEN-2, DEN-3 and DEN-4), pose a significant danger to over 2 billion people. MQ bites can also induce allergic reactions to local skin, including local and systemic reactions including urticaria and angioedema (Benelli, 2016; Lee *et al.*, 2018; Tjaden *et al.*, 2018; Franklinos *et al.*, 2019; Cameron and Ramesh, 2021). MQ's can vector multiple viruses and parasites that cause disease (Dahmana and Mediannikov, 2020). These species are carried by the infected mosquitoes from person to person without any symptoms (Massaro *et al.*, 2019). Dengue fever is DENV-14's fastest growing spore of antiviral infection (Jain and Kumar, 2018; Ludwig *et al.*, 2019; Lowe *et al.*, 2020). Home remedies such as Neem (*Azadirachta*

indica) leaves and Papaya (*Carica papaya*) juice are used for treating dengue fever (Uppala *et al.*, 2017; Hina and Rizwani, 2019; Ghani *et al.*, 2019; Dave *et al.*, 2020; Mohammadi *et al.*, 2021). Dengue has been the most significant infection of arboviruses (Nunkoo and Mahomoodally, 2012). Natural repellent produced no side effects (Pattanayak *et al.*, 2010; Benelli *et al.*,2018). The above-mentioned reports inspired us to work with herbal repellent. Moreover, in public health, the use of various components of plants is popular. A cost efficient, beneficial way of dealing with illnesses is the use of natural cures and herbal medicines (Karunamoorthi and Tsehaye, 2012; Yuan *et al.*, 2016; Chaudhari *et al.*, 2020).

In the treatment of multiple chronic disorders, POLH medicines play a key role. In ethanomedics as well as in the conventional medicines scheme worldwide, several POLH formulations are used (Sergon *et al.*, 2008; Coll *et al.*, 2015; Narang *et al.*, 2017; El-Naggar *et al.*, 2018). POLH formulation acts as the useful rational approach of researchers (Geethangili and Tzeng, 2011). POLH formulas also made a major effort to combat MQ-borne infections in their prehistoric formulation (Zhang *et al.*, 2011; Ashok *et al.*, 2018). While they are separately assessed for their repellent activity, four herbs are combined with little experimental research. The aim of this study is to test *Acorus calamus* powder, the eucalyptus oil (*Eucalyptus obliqua*), the turmeric powder (*Curcuma longa*) and the Neem oil (*Azadirachta indica*) as MQ liquid vaporizer for the use of the POLH formulation.

Materials and Methods

BIHER01 (Bharath Institute of Higher Education and Research 01) formulation of polyherbal repellent (PHR):

Specimens of the *C. quinquefasciatus* mosquitoes larvae were collected from and around Paruthipattu, Chennai and Tamil Nadu, India. The larvae were transferred into a 500 ml vessel and are fed glucose and yeast powder as a food at ratio of 3:2. The test box was used for emergencies with 100 adult pupae MQ's with the MQ net closed to the open end of the test box. The MQ's are gathered from the attraction of used socks and cloths held under the net. Field assessment repellent POLH extract activity was performed in empty space. The different herbal formulations were procured from Thirumullaivoyal herbal shop such as *A. calamus* powder (Fig. 1A), *Eucalyptus* oil *(E. obliqua)* (Fig. 1B) and turmeric powder *(C. longa)* (Fig. 1D). From each different herbal powder, 10 g of *A. calamus* powder and *C. longa* powder were mixed with 50 ml of Eucalyptus oil and 50 ml of neem oil *(A. indica)* (Fig. 1C) and the mixtures were allowed to blend for 24 h and then the blended POLH extract was filtered using Whatman No.1 filter paper. It is easy for local people to follow this approach and is cheap. The preparation of the polyherb extract was then transformed into appropriate liquid vaporizers for commercial use, as shown in Figure 1E. The regulation consisted of three replicates of the same concentration. For control group, instead of POLH extracts, potable tap water blended with glucose was used. The MQ replacement device is attached to the electric vaporizer and is then held in the laboratory, and the electric vaporizer is kept next to the test box. At 6 h and 12 h the mortality rate was recorded.

Qualitative phytochemical analysis of PHR:

Qualitative phytochemical profiling of PHR was done according the method of Ashok *et al.* (2018).

Results and Discussion

The mortality rate for 6 h and 12 h was 30% (laboratory) and 70% (open field), respectively. No deaths were recorded in the control group. These investigations show that pesticides dependent on PHR do not quickly result in death, but can lead to certain activity changes. The poly-extractor biological activity could be caused by active polyphenolic compounds in *A. calamus, Eucalyptus, C. longa* and *A. indicica*. The PHR vaporizer begins to release PHR vapours that prevent MQ's from flying and falls down in 20 min, but did not kill mosquitoes. At the end of 25 min of PHR treatment some MQ's found to be active. In

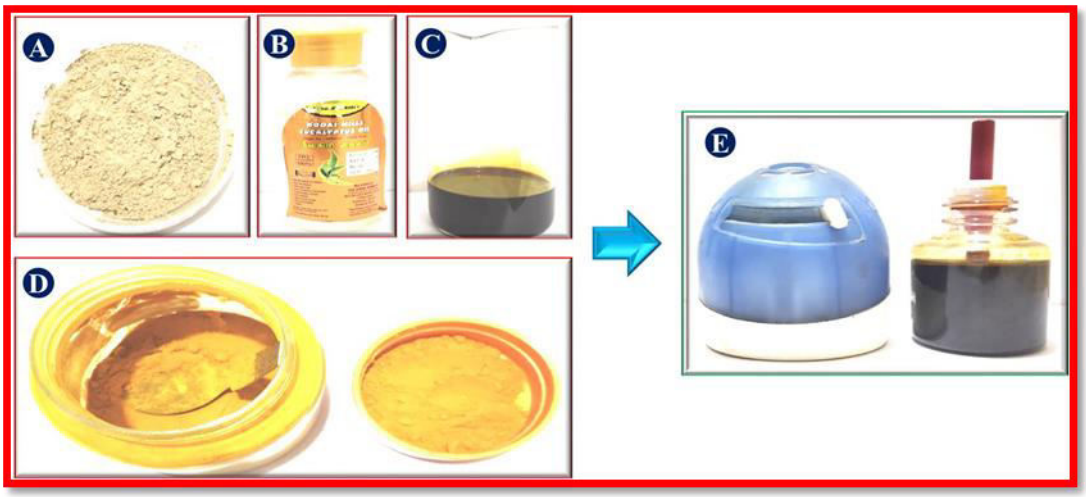

Fig. 1: PHR formulation.

open area tests, the result shows that the MQ's are repelled within 1 h and certain improvements in the MQ's, and that some mosquitoes exhibit swirling activity over a short time. The results show that direct interaction with mosquitoes with PHR vapours increases deaths as treatment time increases (Fig. 2).

The pesticides dependent on PHR do not quickly knock insects can be a benefit if it is used as an alternative pesticide without side effects for the prevention of vector-borne diseases and it is environmentally friendly. Future repellent marks a departure since it can be used in the time release scheme that puts active ingredients. The principal action of poly-herbal extract has been observed to deter the host from landing or biting vectors. POLH extract has shown promising insecticide efficacy against *C. quinquefasciatus* MQ's in this study. Different extraction techniques have limits and benefits of their own. Essential oils, on the other hand, are intensely concentrated compounds derived from plant parts. Oils such as *Eucalyptus* oil and neem oil are also used for their flavour and therapy or odour. Essential oils of volatile ingredients with small components contain strong scent which causes mosquito repellence and inhibit bleeding insects' orientation (Benelli *et al.,* 2017; Orchard and van Vuuren, 2017; Maggi and Benelli, 2018; Pavela *et al.,* 2018).Various considerations such as MQ-species, consistency of POLH extract and essential oils blending may be due to the difference in research results, i.e. the attractiveness to mosquitoes (Ganjewala, 2009).

PHR are determined by several influences, such as plant types, growing conditions, plant maturity, plant storage, essential oil storage plant preparation and extraction methods (Michaelakis *et al.,* 2009; Dua *et al.,* 2010; Maciel *et al.,* 2010). Further research is required to elucidate the effectiveness of the PHR formulation for a broad spectrum of mosquito born diseases, as well as classify active compounds for MQ repellents for use in the preparation of commercial products to be used as MQ repellents if necessary. Major phytochemical compounds present in PHR namely flavonoids, phenols, tannins, alkaloids, saponins, terpenoids, triterpenoids, glycosides, cardiac glycosides, protein, carbohydrates, acids and steroids has potential MQ larvicides and repellents for *C. quinquefasciatus* (Abdul *et al.,*2018; Alharbi *et al.,* 2018; Biswas *et al.,* 2020).

Figure 3 shows the MQ repellent refilling (PHR). The liquid is used in a plastic container, a POLH mixture, and these compounds are

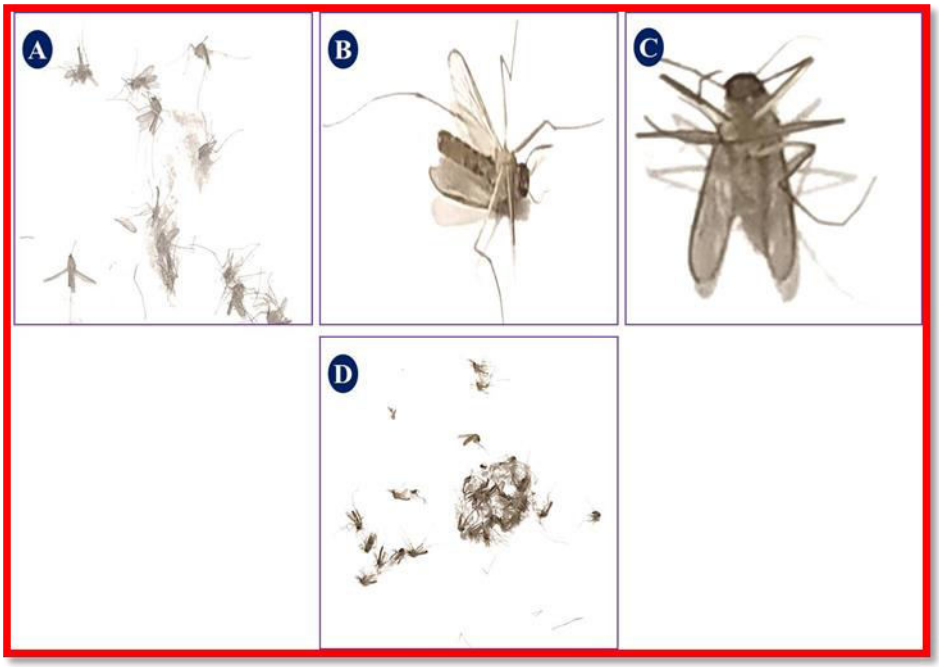

Fig. 2: A- MQ's death in laboratory; B and C- MQ's death in empty room; and D-MQ's death when exposed to PHR vapours.

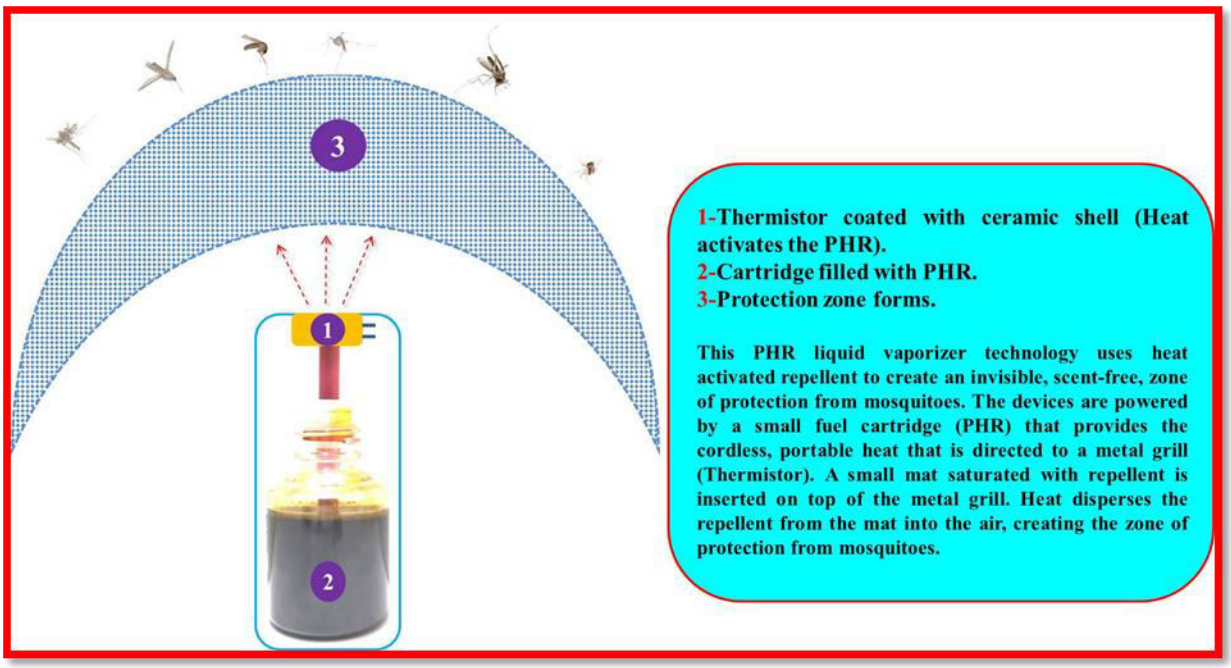

Fig. 3: Possible mechanism caused by liquid vaporizer when it is fuelled by PHR.

dissolved in essential oils to be readily vaporised under temperature. The combination is nontoxic and does not induce a range of reactions like dizziness, headache, allergies to the eyes, inflammation and other fitness. The most significant component of the combination is the poly-herbal combination. It enters the skin of the MQ's and causes paralysis, which slows MQ flight, thus destroying the nervous system. The wick is the only way the liquid gets through the repulsive

vaporising system. The wick collects the PHR and the top section heats up when put into the pump. It splashes the fluid and spreads it into the room.

The findings of physicochemical and phytochemical analysis can be slightly different for various reasons. It may be attributed to various geographic factors, environmental conditions, cultivation and harvest time, plant age, collection methods, etc. The pulverisation and extraction process can also lead to variance. This research was therefore carried out in conjunction with the pharmacopoeia criteria for determining the quality of raw drugs, as they are used in preparation of herbal remedies. The standardization criteria conducted in the phytochemical analysis offer valuable knowledge on raw material recognition and authentication. The study of the raw materials used in the preparation of PHR will use the findings as appropriate control measures of consistency. The presence of saponins and tannins in POLH extract contribute to the susceptibility of MQ larvae and act as a killing agent (Abou-Elnaga, 2015; Goc and rath, 2016; Sharifi-Rad *et al.*, 2017; Villaba *et al.*, 2017; Akhtar *et al.*, 2019; Nayak *et al.*, 2020). POLH extract's mortality effect on MQ larvae is because of the presence of saponins and tannin molecules in our study.

Conclusion

It has been concluded that the PHR MQ repellent is safe, cheaper and not toxic than the currently available chemical MQ repellents on the market and ensures a stable, MQ free atmosphere for society.

References

Abdul WM, Hajrah NH, Sabir JS, Al-Garni SM, Sabir MJ, Kabli SA, Saini KS and Bora RS. (2018) Therapeutic role of *Ricinus communis* L. and its bioactive compounds in disease prevention and treatment. Asian Pacific J Tropical Med. 11(3): 177-185.

Abou-Elnaga ZS. (2015) Strong larvicidal properties of *Argemone mexicana* L. against medically important vectors *Culex pipens* and *Aedes aegypti*. Int J Mosq Res. 2: 9-12.

Akhtar A, Hussain W and Rasool N. (2019) Probing the pharmacological binding properties, and reactivity of selective phytochemicals as potential HIV-1 protease inhibitors. Universitas Scientiarum 24(3): 441-464.

Alharbi NS, Govindarajan M, Kadaikunnan S, Khaled JM, Almanaa TN, Alyahya SA, Al-anbr MN, Gopinath K and Sudha A. (2018) Nanosilver crystals capped with *Bauhinia acuminata* phytochemicals as new antimicrobials and mosquito larvicides. J Trace Elements Med Biol. 50: 146-153.

Ashok K, Sivakumari K and Rajesh S. (2018) *Achyranthes aspera* mediated green synthesis of silver nanoparticles. Indo Am J Pharmaceut Sci. 5(1): 64-73.

Benelli G. (2016) Green synthesized nanoparticles in the fight against mosquito-borne diseases and cancer--a brief review. Enzyme Microb Technol. 95: 58-68.

Benelli G, Govindarajan M, Senthilmurugan S, Vijayan P, Kadaikunnan S, Alharbi NS and Khaled JM. (2018) Fabrication of highly effective mosquito nanolarvicides using an Asian plant of ethno-pharmacological interest, Priyangu (*Aglaia elaeagnoidea*): toxicity on non-target mosquito natural enemies. Environ Sci Poll Res. 25(11): 10283-10293.

Benelli G, Pavela R, Iannarelli R, Petrelli R, Cappellacci L, Cianfaglione K, Afshar FH, Nicoletti M, Canale A and Maggi F. (2017) Synergized mixtures of Apiaceae essential oils and related plant-borne compounds: Larvicidal effectiveness on the filariasis vector *Culex quinquefasciatus* Say. Indust Crops Products 96: 186-195.

Biswas D, Nandy S, Mukherjee A, Pandey DK and Dey A. (2020) *Moringa oleifera* Lam. and derived phytochemicals as promising antiviral agents: A review. South African J Botany 129: 272-282.

Cameron MM and Ramesh A. (2021) The use of molecular xenomonitoring for surveillance of mosquito-borne diseases. Philosophical Transactions Royal Soc. B 376(1818): 20190816.

Chaudhari AK, Das S, Singh BK, Prasad J, Dubey NK and Dwivedy AK. (2020) Herbal medicines as a rational alternative for treatment of human diseases. In: Botanical Leads for Drug Discovery, Springer, Singapore, pp. 29-49.

Coll RC, Robertson AA, Chae JJ, Higgins SC, Muñoz-Planillo R, Inserra MC, Vetter I, Dungan LS, Monks BG, Stutz A, Croker DE, Butler MS, Haneklaus M, Sutton CE, Núñez G, Latz E, Kastner DL, Mills KH, Masters SL, Schroder K, Cooper MA and O'neill LA. (2015) A small-molecule inhibitor of the NLRP3 inflammasome for the treatment of inflammatory

diseases. Nature Med. 21(3): 248-255.

Dahmana H and Mediannikov O. (2020) Mosquito-borne diseases emergence/resurgence and how to effectively control it biologically. Pathogens 9(4): 310.

Dave PP, Singh S, Chodvadiya MB and Choudhary H. (2020) Bioefficacy of crude polyherbal formulations against hoppers (Insecta: Hemiptera) of rice. J Entomol Zool Stud. 8(6): 1392-1398.

Dua VK, Pandey AC and Dash AP. (2010) Adulticidal activity of essential oil of *Lantana camara* leaves against mosquitoes. Ind J Med Res. 131(3): 434.

El-Naggar HA and Hasaballah AI. (2018) Acute larvicidal toxicity and repellency effect of *Octopus cyanea* crude extracts against the filariasis vector, *Culex pipiens*. J Egyptian Soc Parasitol. 48(3): 721-728.

Franklinos LH, Jones KE, Redding DW and Abubakar I. (2019) The effect of global change on mosquito-borne disease. Lancet Infect Dis. 19(9): e302-e312.

Ganjewala D. (2009) Cymbopogon essential oils: Chemical compositions and bioactivities. Int J Essential Oil Therapeut. 3(2-3): 56-65.

Geethangili M and Tzeng YM. (2011) Review of pharmacological effects of *Antrodia camphorata* and its bioactive compounds. Evidence-based Complemen Alternat Med. 2011: 212641.

Ghani U, Batool A, Rafeeq H, Naeem M, Bukhari SSH, Ahsan H, Naeem A, Saddique S and Chand SA. (2019) Advancement and future directions towards herbal treatment for various diseases. Saudi J Med Pharmaceut Sci. 5(11): 931-941.

Goc A and Rath M. (2016) The anti-borreliae efficacy of phytochemicals and micronutrients: an update. Ther Adv Infect Dis. 3(3-4): 75-82.

Hina B and Rizwani GH. (2019) Need of innovative research in herbal pharmacotherapy for better therapeutic efficacy and safety--A review. Ann Jinnah Sindh Med Univ. 5(2): 93-98.

Jain VK and Kumar S. (2018) Effective surveillance and predictive mapping of mosquito-borne diseases using social media. J Comput Sci. 25: 406-415.

Karunamoorthi K and Tsehaye E. (2012) Ethnomedicinal knowledge, belief and self-reported practice of local inhabitants on traditional antimalarial plants and phytotherapy. J Ethnopharmacol. 141(1): 143-150.

Lee H, Halverson S and Ezinwa N. (2018) Mosquito-borne diseases. Primary Care: Clinics Office Practice 45(3): 393-407.

Lowe R, Ryan SJ, Mahon R, Van Meerbeeck CJ, Trotman AR, Boodram LLG, Borbor-Cordova MJ and Stewart-Ibarra AM. (2020) Building resilience to mosquito-borne diseases in the Caribbean. PLoS Biol. 18(11): e3000791.

Ludwig A, Zheng H, Vrbova L, Drebot MA, Iranpour M and Lindsay LR. (2019) Climate change and infectious diseases: The challenges: Increased risk of endemic mosquito-borne diseases in Canada due to climate change. Canada Commun Dis Rep. 45(4): 91.

Maciel MV, Morais SM, Bevilaqua CML, Silva RA, Barros RS, Sousa RN, Sousa LC, Brito ES and Souza-Neto MA. (2010) Chemical composition of *Eucalyptus* spp. essential oils and their insecticidal effects on Lutzomyia longipalpis. Vet Parasitol. 167(1): 1-7.

Maggi F and Benelli G. (2018) Essential oils from aromatic and medicinal plants as effective weapons against mosquito vectors of public health importance. In: Mosquito-borne Diseases. Parasitology Research Monographs, (eds.) Benelli G and Mehlhorn H, Springer Cham. https://doi.org/10.1007/978-3-319-94075-5_6.

Massaro E, Kondor D and Ratti C. (2019) Assessing the interplay between human mobility and mosquito borne diseases in urban environments. Sci Rep. 9(1): 1-13.

Michaelakis A, Papachristos D, Kimbaris A, Koliopoulos G, Giatropoulos A and Polissiou MG. (2009) Citrus essential oils and four enantiomeric pinenes against *Culex pipiens* (Diptera:Culicidae). Parasitol Res. 105(3): 769-773.

Mohammadi L, Pal K, Bilal M, Rahdar A, Fytianos G and Kyzas GZ. (2021) Green nanoparticles to treat patients with Malaria disease: An overview. J Molec Struct. 1229: 129857.

Narang KJ, Narang SR, Ali J, Baboota S, Nagpal N, Kaur S and Kaur H. (2017) Nanoemulsions for improved efficacy of phytotherapeutics- A patent perspective. Recent Patents Nanotechnol. 11(3): 194-213.

Nayak B, Mishra L, Mishra BP, Pradhan S, Behera B and Pandey M. (2020) Potency of phytochemicals from guava (*Psidium guajava*) seeds against *Escherichia coli* to cure diarrhoea: An in silico analysis. J Pharmaceut Res Int. 32(9): 110-113.

Nunkoo DH and Mahomoodally MF. (2012) Ethnopharmacological survey of native remedies commonly used against infectious diseases in the tropical island of Mauritius. J Ethnopharmacol. 143(2): 548-564.

Orchard A van Vuuren S. (2017) Commercial essential oils as potential antimicrobials to treat skin diseases. Evidence-based Complem Altern Med. 2017: 4517971.

Pattanayak P, Behera P, Das D and Panda SK. (2010) *Ocimum sanctum* Linn. A reservoir plant for therapeutic applications: An overview. Pharmacognosy Rev. 4(7): 95.

Pavela R, Maggi F, Lupidi G, Mbuntcha H, Woguem V, Womeni HM, Barboni L, Tapondjou LA and Benelli G. (2018) *Clausena anisata* and *Dysphania ambrosioides* essential oils: from ethno-medicine to modern uses as effective insecticides. Environ Sci Poll Res Int. 25(11): 10493-10503.

Sergon K, Njuguna C, Kalani R, Ofula V, Onyango C, Konongoi LS, Bedno S, Burke H, Dumilla AM, Konde J, Njenga MK, Sang R and Breiman RF. (2008) Seroprevalence of Chikungunya virus (CHIKV) infection on Lamu Island, Kenya, October 2004. Am J Trop Med Hyg. 78(2): 333-337.

Sharifi-Rad M, Varoni EM, Salehi B, Sharifi-Rad J, Matthews KR, Ayatollahi SA, Kobarfard F, Ibrahim SA, Mnayer D, Zakaria ZA, Sharifi-Rad M, Yousaf Z, Iriti M, Basile A and Rigano D. (2017) Plants of the genus *Zingiber* as a source of bioactive phytochemicals: From tradition to pharmacy. Molecules 22(12): 2145.

Tjaden NB, Caminade C, Beierkuhnlein C and Thomas SM. (2018) Mosquito-borne diseases: advances in modelling climate-change impacts. Trends Parasitol. 34(3): 227-245.

Uppala PK, Radhadevi JB and Kumar KA. (2017) Formulation and evaluation of mosquito repellent activity of polyherbal formulations of extraction of *Annona squamosa*, *Azadirachta indica*, *Eucalyptus alba*, *Citrus aurantium* and *Rosa indica* and their phytochemical analysis. Asian J Pharm Technol. 7: 91-102.

Villalba JJ, Costes-Thiré M and Ginane C. (2017) Phytochemicals in animal health: diet selection and trade-offs between costs and benefits. Proc Nutrit Soc. 76(2): 113-121.

Yuan H, Ma Q, Ye L and Piao G. (2016) The traditional medicine and modern medicine from natural products. Molecules 21(5): 559.

Zhang Y, Liu S, Mickanin C, Feng Y, Charlat O, Michaud GA, Schirle M, Shi X, Hild M, Bauer A, Myer VE, Finan PM, Porter JA, Huang SMA and Cong F. (2011) RNF146 is a poly (ADP-ribose)-directed E3 ligase that regulates axin degradation and Wnt signalling. Nature Cell Biol. 13(5): 623-629.