UNIVERSITI TEKNOLOGI MARA

EXPOSURE OF RADIOFREQUENCY IN RELATION TO THE METABOLIC RATE OF *Aedes aegypti* (LINNAEUS) AND *Aedes albopictus* (SKUSE) (DIPTERA: CULICIDAE)

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Thesis submitted in fulfilment
of the requirements for the degree of
Doctor of Philosophy
(Environmental Health and Safety)

Faculty of Health Sciences

March 2024

ABSTRACT

Wireless communication between billions of people throughout the world is made possible by the radiofrequency electromagnetic field (RF-EMF). The radiofrequency (RF) employed as carriers in wireless telecommunications will partially migrate to higher frequencies with the arrival of fifth-generation (5G) networks. Radio, cell phones, and television are examples of telecommunication technologies that were created to satisfy human needs and have been used extensively for decades. Nevertheless, because the invention depends on RF transmission to carry and receive signals, there is now more worry about how exposure to these fields may affect human health, especially the risk of contracting diseases spread by mosquitoes. Hence, this present study was conducted to determine the effect of RF exposures on the metabolic rate of *Aedes* mosquitoes as the primary vector for dengue fever, especially *Aedes aegypti* and *Aedes albopictus*. This is an experimental study involving triplication with laboratory and field strain eggs subjected to RF exposure at three different exposure levels: control (unexposed), 900 MHz, and 18 GHz. The entire life cycle and development were carefully observed within a controlled insectarium setting, from the egg's aquatic phase until fully adult emergence. Given the importance of temperature in influencing mosquito biology, the relationship between RF exposure and temperature was a key aspect investigated in this study. The results of the study revealed that the exposure of RF at 900 MHz to *Ae. aegypti* eggs clearly affected them, and obvious abnormalities were seen on the surface and structure of the eggs. Moreover, the adult emergence rate of *Ae. aegypti* was the lowest at 33±2.77% under 900 MHz exposure compared to the other exposures (p=0.03). For *Ae. albopictus*, the RF exposure at 18 GHz noticeably had a shorter hatching period of 1.5±2.61 days compared to other exposures (p=0.03). In addition, a shorter pupation cessation period (CP_2) of 8±1 day (p=0.04) and a lower adult emergence rate of 11.1 ±8.68% (p=0.03) were demonstrated compared to other exposures for *Ae. albopictus*. Notably, *Ae. aegypti* had a higher hatching rate of more than 50% and a longer pupation cessation period (CP_2) at any RF exposures (p<0.05) compared to *Ae. albopictus*. Interestingly, a significant relationship between the combined effect of RF exposure and temperature also demonstrated, especially on *Ae. Aegypti*, regarding hatching period (p=0.02, R^2=0.86), larval period (p=0.02, R^2=0.85), and pupation period (p=0.04, R^2=0.89). In conclusion, this study demonstrated that the egg structure, morphology, and development of *Aedes aegypti* and *Aedes albopictus* during the aquatic phase until adult emergence can be sensitive to RF exposure and temprature, consequently opening the possibility of altering the population dynamics of these insects.

Keywords: *Aedes*, development, hatching, metabolic rate, radiofrequency.

ACKNOWLEDGEMENT

In the name of Allah, The Most Gracious, The Most Merciful.

Assalamualaikum and Alhamdulillah, all praise to Allah S.W.T., The Supreme Lord of the Universe. Peace and blessings to Nabi Muhammad S.A.W., all prophets, and their families. Firstly, I praise Allah S.W.T. and His blessings for giving me the opportunity to embark on my PhD and for completing this long and challenging journey successfully on the project titled "Exposure of Radiofrequency in Relation to the Metabolic Rate of *Aedes aegypti* (Linnaeus) and *Aedes albopictus* (Skuse) (Diptera: Culicidae)." My deepest gratitude and appreciation go to my dearest supervisor, Associate Professor Dr. Nazri bin Che Dom, who spent his time and efforts guiding and advising me from the beginning until the end of my research journey.

Thousands of thanks to my wife Rafidah binti Abd Razak, my son Nik Muhammad Zayyad Rizqi bin Nik Muhammad Hanif, and all my family members for their support and encouragement through thick and thin of my study. I would also like to convey my heartfelt and appreciation to all my colleagues and beloved friends who have directly or indirectly contributed to my study and become part of my experience in finishing my study. My sincere thanks and appreciation go to all organisations involved in this project, especially Associate Professor Nurul Huda binti Abd Rahman and her team from the Head of Antenna Research Centre (ARC), School of Electrical Engineering, College of Engineering, Shah Alam Campus, Universiti Teknologi MARA, and also School of Biological Sciences, Universiti Sains Malaysia, for their involvement. May God bless all of us. Thank You.

Finally, this thesis is dedicated to the loving memory of my very dear late father, Nik Abdull Halim bin Nik Abdullah, and mother, , for their vision and determination to educate me. This piece of victory is dedicated to both of you. Alhamdulilah. May Allah forgive both of you always.

Sincerely

March 2024

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CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

The population of the world is growing quickly, and by 2050, large cities' fast urbanisation will have significantly increased population densities. In this sense, there is a growing need for technologically-based inventions that promote a sustainable way of life. This need has led to the introduction of many technologies to meet human requirements, one of which is the development of wireless telecommunication, which can make it simple for anyone to communicate. Wireless communication between billions of people throughout the world is made possible by the radiofrequency electromagnetic field (RF-EMF). This has affected and contributed to the evolution of wireless telecommunications' fourth generation networks (4G) to fifth generation networks (5G) and will partially move to higher frequencies (Agiwal et al., 2016). As the employment of these technologies develops, there are increasing concerns about their possible effects on the environment, as well as living organisms. The carrier frequencies for 5G networks can reach 300 GHz, crossing into the millimetre-wave frequency range, in contrast to current telecommunications networks' utilisation of frequencies between 0.1-6 GHz (Bhatt et al., 2016). At these higher frequencies, the wavelength becomes similar to the size of an insect's body. The effectiveness of RF-EMF absorption in the body should rise when the wavelength and body size are of the same order of magnitude (Bakker et al., 2010). An organism's dielectric heating might happen as a result of RF-EMF absorption in biological tissues (Hirata et al., 2007). As a result, the widespread use of these technologies has sparked worries about the potential impacts of RF-EMF emissions on the environment, particularly the growth of diseases carried by mosquitoes. In addition, it is uncertain if future changes in RF-EMF may have a greater effect on *Aedes* populations and affect dengue transmission in urban areas.

Exposure to radiofrequency (RF) can have serious consequences on wildlife. Research into the possible effects of RF exposure is now underway on humans and a variety of biological life. Currently, little is known about RF exposure in environments