JSIANE : Vol. 3, Issue 1, 2023, Page 59-64 ISSN (Online) 2583-2093

Journal of Science Innovations and Nature of Earth

Journal homepage : www.jsiane.com

ALTERATION IN KIDNEY BIOMARKERS AFTER INHALATION EXPOSURE OF TRANSFLUTHRIN BASED LIQUID MOSQUITO REPELLENT IN *RATTUS NORVEGICUS* (BERKENHOUT)

Shekhar Biswas[1], Vishwakant[1], Anand Pratap Singh[1], Prem Sagar[2]

[1]Department of Zoology, Agra College, Agra Affiliated to Dr. Bhimrao Ambedkar University, Agra, Uttar Pradesh, India

[2]Department of Zoology, Government PG College, Jalesar, Affiliated to RMPSU Aligarah, Uttar Pradesh, India

Email.id:- Shekharbiswas442@gmail.com

www.doi.org/10.59436/jsiane.com/archives3/12/90

Abstract

The use of liquid mosquito repellent is one of the most significant and persistent sources of indoor air pollution in houses. Human deals with the world's deadliest vector-borne disease, malaria, as well as the fastest-growing vector disease in the world right now, dengue, which is also spread by mosquitoes. Insect-borne diseases are a major public health concern. Transfluthrin, d-allethrin, bioallethrin, dimefluthrin, pralethrin, dphenothrin, cypenothrin, or esbiothrin are some of the more common insecticides contained in mosquito repellents. All of them are pyrethroid derivatives. After 7, 15, 30, 45 and 60 days of exposure to liquid insect repellent in the treated group as compared to the control group, *Rattus norvegicus* (Berkenhout) showed substantial increases in kidney biomarkers Urea, Creatinine, Uric acid and Blood Urea Nitrogen (BUN). The current study shows that different kidney biomarkers are adversely affected by liquid mosquito repellent. The main component of this repellent is lethal and dangerous for both people and the environment.

***Keywords* :** Repellent, Insecticides, Transfluthrin, Pyrethroid

Received 13.12.2022 **Revised 20.02.2023** **Accepted 26.03.2023**

Introduction

As a result of India's rapid economic growth, environmental pollution has become a problem that has sparked conflict between nations and within regions. It is a serious problem since interior pollution affects people more than outdoor pollution. Without being aware of the types of toxins present, people spend more than 90% of their time at home or work. Insect-borne diseases are a major public health concern in the twenty-first century. Humans are affected by the world's deadliest vector-borne disease, malaria, as well as the fastest-growing vector disease, dengue, which is also conveyed by mosquitoes. The use of insect repellents is one of the primary and continuous causes of indoor air pollution in homes. There are several types of mosquito repellents on the market, including spray repellents, mosquito coils, lotion repellents and liquid repellents. Both liquid and solid insect repellents harm the ecosystem. Because they interfere with mosquitoes capacity to detect when the liquid form is present, the airborne harmful compounds it contains combine with it and disperse throughout the entire area, successfully preventing mosquitoes from landing on people to feed. Active compounds in mosquito repellent include pyrethroid derivatives such transfluthrin, d-allethrin, bioallethrin, dimefluthrin, pralethrin, dphenothrin, cypenothrin and esbiothrin, among others (Aprilia *et al.*, 2023). Our mosquito repellents primarily contain the active chemicals pyrethroid and its related derivatives. The oldest known insecticides, pyrethroids, are made from the dried and crushed flowerheads of the pyrethrum plant, Chrysanthemum cinerariifolium (Siddique *et al.,* 2015). It mostly affects the sodium channel since it is exposed for a long time. This leads in prolonged sodium current flow, which overexcites the neurological system (Narahashi *et al.*, 1992). These extremely lipophilic esters have the ability to paralyze the central and peripheral nervous systems of insects (Abdrabouh, 2021). In comparison to mammals, insects are 2,500 times more poisonous to pyrethroids (Bradberry *et al.*, 2005). Pyrethroids have been divided into Type I and Type II classes based on their chemical composition and negative effects. Type I pyrethroids do not have a cyano group, in contrast to Type II pyrethroids (Akthar *et al.*, 2012). The type I pyrethroid insecticide transfluthrin, which has the chemical formula $C_{15}H_{12}C_{l2}F_{4}O_{2}$, is the fast-acting, low persistence liquid mosquito repellent that we use. It is extremely effective against flies, mosquitoes, moths and cockroaches in indoor environment (Prabhakara *et al.*, 2020). Transfluthrin poisoning symptoms, such as jitteriness, anxiety, tremors, convulsions, skin allergies, sneezing, runny nose and irritation, can be brought on by inconsistent use of the drug. If insect repellents are used often, a single or repeated exposure could result in short- or long-term detrimental health consequences on the lungs, liver and kidney among other organs. Even while improper repellent use frequently causes allergic reactions and skin irritation, most individuals are still unaware of the negative effects that indoor air pollution has on humans. The current work shows that *Rattus norvegicus* (Berkenhout) rats exposed to a liquid mosquito repellent containing transfluthrin exhibit altered kidney biomarkers. For this experiment, an albino rat was used since it is simple to handle in laboratory and has many physiological characteristics in common with humans.

Material and Methods

The usual liquid mosquito repellent of A Brand was employed for the current study, **Transfluthrin** (1.6% w/w) is the primary active component. *Rattus norvegicus* (Berkenhout) albino rats, which are mature and healthy, were used in this investigation. The treated group rats were separated into five subgroups B, C, D, E, and F each of which contained 10 rats. The control group (A) consisted of ten rats. Albino rats were treated to liquid mosquito repellent vapours all over their bodies for six hours each day for 7, 15, 30, 45, and 60 days, respectively. On 7, 15, 30, 45 and 60 days, the treated and control group rats will be dissected out. Blood samples were directly collected from the ventricles of dissected albino rats utilizing a cardiac puncture for the aim of separating the serum for the assessment of kidney biomarkers among all the groups. In order to estimate urea, Fawcett (1960) used the Urease Berthelot method, while Henry (1974) used the Jaffe's method to estimate creatinine, Tietz (1995) used the Uricase Enzymatic method to estimate uric acid, and Talke and Schubert (1979) used the UV-Kinetic GLDH method to estimate blood urea nitrogen (BUN). The mean and standard error of the mean were computed using the gathered data, and the significance level was determined using the "t" test.

Results

The present investigation demonstrates a significant increase in kidney biomarkers in treated groups of rats when compared to control group rats following inhalation exposure to a liquid mosquito repellent based on transfluthrin in *Rattus norvegicus* (Berkenhout). The current research shows an elevated level of Urea (Table I & Fig. 1), Creatinine (Table II & Fig. 2), Uric acid (Table III & Fig. 3), and Blood Urea Nitrogen (BUN) (Table IV & Fig. 4) after 7, 15, 30, 45 and 60 days that is both significant and highly significant.

Table – I Alteration in Urea (mg/dl) after Inhalation Exposure of Transfluthrin Based Liquid Mosquito Repellent in *Rattus norvegicus* (Berkenhout) after 7, 15, 30, 45 and 60 days Exposure

S.No.	No. of days	No. of rats	Range Mean ± S.Em.	
			Control	**Treated**
1	7 Days	10	30.91–40.87 (34.17 ± 1)	35.12–43.28 (38.77 ± 0.77) ↑**
2	15 Days	10	30.91–40.87 (34.17 ± 1)	38.57 – 43.98 (41.46 ± 0.48) ↑***
3	30 Days	10	30.91–40.87 (34.17 ± 1)	44.09 – 49.03 (47.02 ± 0.48) ↑***
4	45 Days	10	30.91–40.87 (34.17 ± 1)	48.91 – 52.34 (50.36 ± 0.37) ↑***
5	60 Days	10	30.91–40.87 (34.17 ± 1)	54.21 – 56.98 (55.54 ± 0.27) ↑***

S.Em. = Standard Error of Mean ↑ Increase ** Significant *** Highly Significant

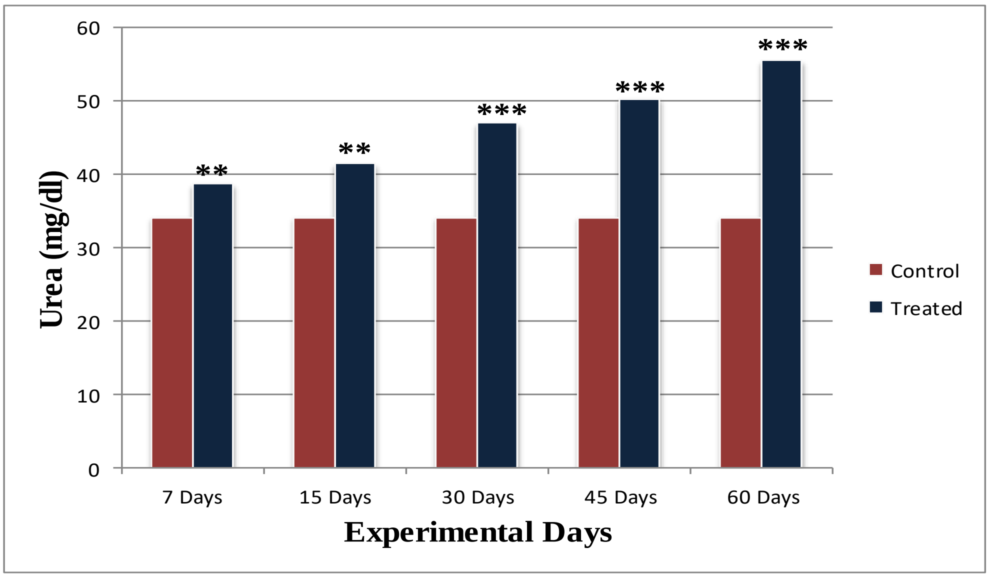

Fig. 1 - Alteration in Urea (mg/dl) after Inhalation Exposure of Transfluthrin Based Liquid Mosquito Repellent in *Rattus norvegicus* (Berkenhout) after 7, 15, 30, 45 and 60 days Exposure

Table – II Alteration in Creatinine (mg/dl) after Inhalation Exposure of Transfluthrin Based Liquid Mosquito Repellent in *Rattus norvegicus* (Berkenhout) after 7, 15, 30, 45 and 60 days Exposure

S.No.	No. of days	No. of rats	Range Mean ± S.Em.	
			Control	Treated
1	7 Days	10	0.81–1.12 (0.96 ± 0.03)	1.27–1.41 (1.33 ± 0.01) ↑**
2	15 Days	10	0.81–1.12 (0.96 ± 0.03)	1.47 – 1.64 (1.54 ± 0.01) ↑***
3	30 Days	10	0.81–1.12 (0.96 ± 0.03)	1.68 – 1.89 (1.77 ± 0.01) ↑***
4	45 Days	10	0.81–1.12 (0.96 ± 0.03)	1.90 – 2.07 (1.99 ± 0.01) ↑***
5	60 Days	10	0.81–1.12 (0.96 ± 0.03)	2.02 – 2.27 (2.12 ± 0.02) ↑***

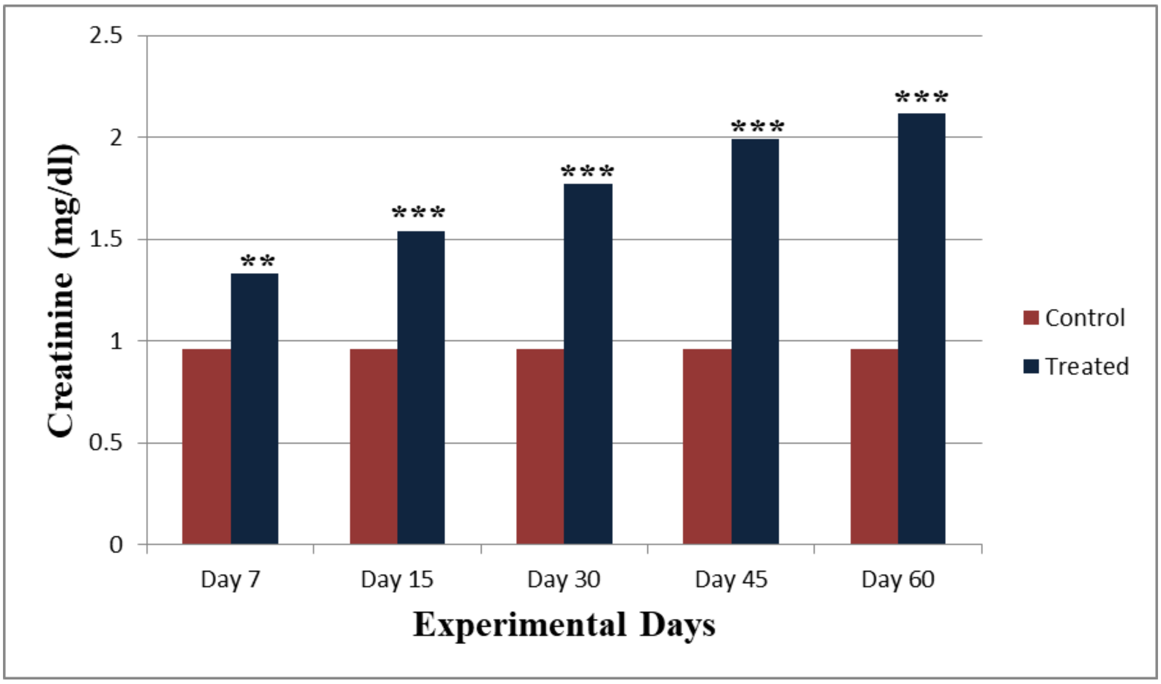

Fig. 2 - Alteration in Creatinine (mg/dl) after Inhalation Exposure of Transfluthrin Based Liquid Mosquito Repellent in *Rattus norvegicus* (Berkenhout) after 7, 15, 30, 45 and 60 days Exposure

Table – III Alteration in Uric acid (mg/dl) after Inhalation Exposure of Transfluthrin Based Liquid Mosquito Repellent in *Rattus norvegicus* (Berkenhout) after 7, 15, 30, 45 and 60 days Exposure

S.No.	No. of days	No. of rats	Range Mean ± S.Em.	
			Control	Treated
1	7 Days	10	4.53–5.41 (5.04 ± 0.09)	6.84–8.49 (7.57 ± 0.17) ↑**
2	15 Days	10	4.53–5.41 (5.04 ± 0.09)	9.53 – 10.83 (10.01 ± 0.13) ↑***
3	30 Days	10	4.53–5.41 (5.04 ± 0.09)	12.49 – 13.40 (13.05 ± 0.08) ↑***
4	45 Days	10	4.53–5.41 (5.04 ± 0.09)	15.72 – 16.45 (16 ± 0.07) ↑***
5	60 Days	10	4.53–5.41 (5.04 ± 0.09)	16.96 – 18.67 (18.06 ± 0.17) ↑***

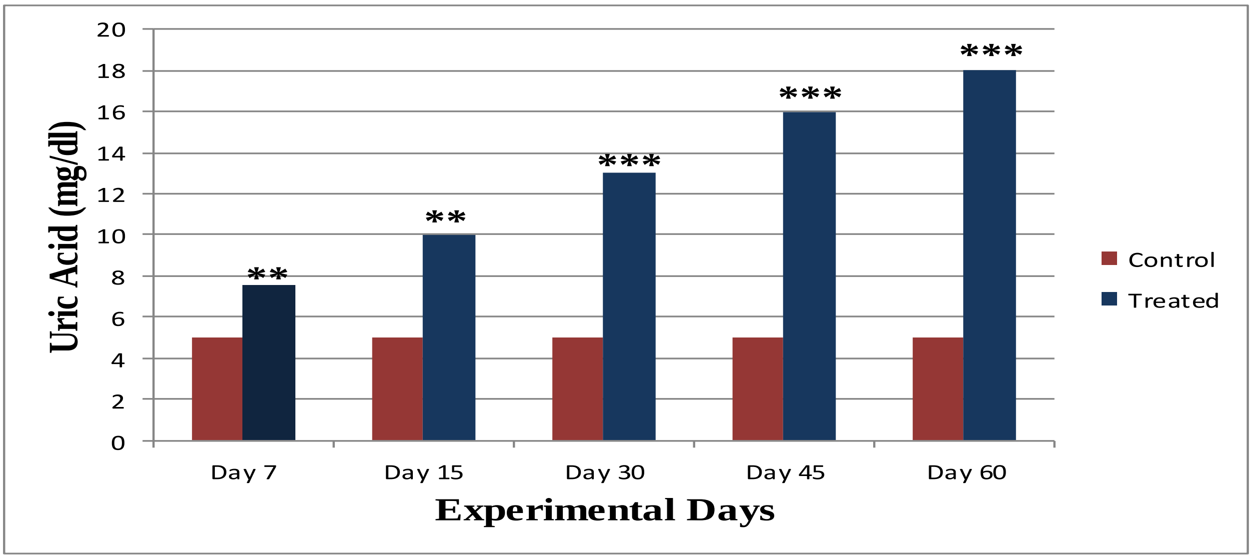

Fig. 3 **-** Alteration in Uric acid (mg/dl) after Inhalation Exposure of Transfluthrin Based Liquid Mosquito Repellent in *Rattus norvegicus* (Berkenhout) after 7, 15, 30, 45 and 60 days Exposure

Table – IV Alteration in Blood Urea Nitrogen (BUN) (mg/dl) after Inhalation Exposure of Transfluthrin Based Liquid Mosquito Repellent in *Rattus norvegicus* (Berkenhout) after 7, 15, 30, 45 and 60 days Exposure

S.No.	No. of days	No. of rats	Range Mean ± S.Em.	
			Control	Treated
1	7 Days	10	16.85–19.67 (17.87 ± 0.29)	20.82–23.46 (22.17 ± 0.26) ↑**
2	15 Days	10	16.85–19.67 (17.87 ± 0.29)	23.19 – 26.01 (24.80 ± 0.30) ↑***
3	30 Days	10	16.85–19.67 (17.87 ± 0.29)	26.89 – 29.53 (28.13 ± 0.28) ↑***
4	45 Days	10	16.85–19.67 (17.87 ± 0.29)	28.93 – 31.46 (30.01 ± 0.24) ↑***
5	60 Days	10	16.85–19.67 (17.87 ± 0.29)	31.26 – 33.88 (32.42 ± 0.23) ↑***

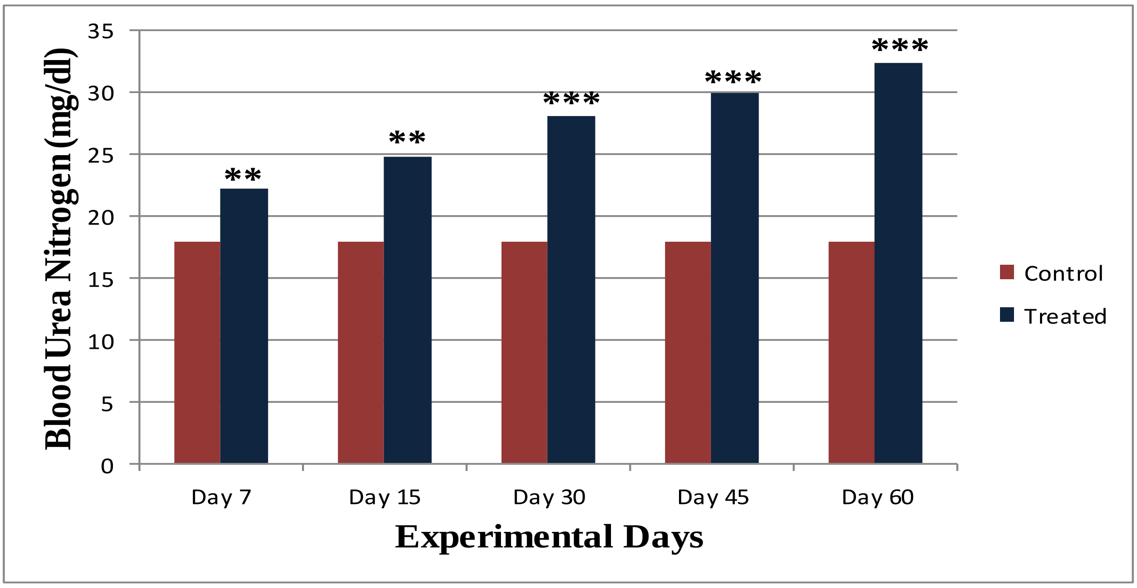

Fig. 4 - Alteration in Blood Urea Nitrogen (BUN) (mg/dl) after Inhalation Exposure of Transfluthrin Based Liquid Mosquito Repellent in *Rattus norvegicus* (Berkenhout) after 7, 15, 30, 45 and 60 days Exposure

Discussion

It is well recognized that xenobiotics and environmental pollutants like pesticides, insecticides, etc. have a wide range of toxicological consequences that pose substantial health risks. Man consumes, inhales and absorbs countless substances in his surroundings, which can put stress on a variety of biological pathways. Insect repellents are a major contributor to indoor air pollution. Chemicals included in insect repellents are deadly and harmful to both humans and mosquitoes. Transfluthrin is a pyrethroid insecticide that doesn't contain cyano group that is frequently used to control mosquitoes and flies. In a lot of houses, using liquid insect repellents is a very popular habit. People of all ages and both sexes are inevitably exposed to them because to their frequent nocturnal use (Srivastava *et al.*, 2005). The human body's biochemical processes are vital to its operation. These metrics measure different chemical elements and bodily functions, and they are crucial for understanding a person's health and physiological condition. The kidneys are essential bodily organs that serve a number of crucial purposes. The kidney is a highly specialized organ that regulates the body's internal environment by selectively excreting or holding back different substances in response to particular needs (Liu *et al.*, 2010). The kidneys function as blood filters, taking out excess and waste materials from the bloodstream. management of electrolytes, detoxification, metabolic waste elimination, and blood pressure regulation. The current study shows that the renal biomarkers Urea, Creatinine, Uric acid and BUN are at an elevated level. The waste products of protein metabolism, urea and creatinine, must be expelled by the kidney; hence, the substantial increase in serum urea and creatinine levels seen in this study supports the presence of functional renal injury (Panda, 1999). While many other factors, including dehydration, antidiuretic medications and nutrition can raise urea level, creatinine is more specific to the kidneys because renal impairment is the only important factor that raises serum creatinine level (Cheesebrough, 1998 ; Garba *et al.*, 2007). The Glomerular Filtration Rate (GFR) may have decreased as a result of these increase in urea and creatinine level (Abu El-Saad, 2011). The breakdown of purines and pyrimidines, excessive synthesis, or difficulty excreting uric acid could all be contributing factors to this rise in levels (Wolf *et al.*, 1972 ; Refaie *et al.*, 2014). Urinary excretion of uric acid is typically filtered out by the kidneys. The amount of uric acid produced by the body increases when the kidneys are unable to adequately remove it, which can cause the body to break down body tissues and release purines into the blood. Blood urea nitrogen (BUN) is a marker for renal disease when it is increased. A blood test called BUN detects the level of urea nitrogen, a waste product of protein breakdown that is predominantly excreted by the kidneys, in your bloodstream. The kidneys may struggle to filter and remove urea from the blood when they are not functioning properly (Chauhan, 2009). Comparable to current findings, Fetoui *et al.*, (2010) noted an increase in Blood Urea Nitrogen (BUN), serum urea, serum creatinine, uric acid and uric acid following the harmful effects of the synthetic pesticide lambda-cyhalothrin on the rat kidney. In rats exposed to deltamethrin, Abu El-Saad (2011) observed an increase in the major alterations in urea, creatinine and uric acid that lead to renal impairment. Refaie *et al.*, (2014) also showed an increase in the renal biomarkers urea, creatinine and uric acid following the nephrotoxicity induced by prallethrin in rats, supporting our current findings. After exposure to DD-Force and Baygon insecticides, Nwankwo *et al.*, (2017) noticed similar changes to our current findings in the rise of urea, creatinine and uric acid. Magesh *et al.*, (2019) also noted that wistar rats exposed to deltamethrin had elevated levels of uric acid and creatinine. Syed *et al.*, (2019) and Karim *et al.*, (2020) also noted a considerable increase in urea and creatinine that produces nephrotoxicity in albino rats after the effect of mosquito coil smoke, which is similar to the current findings. Abdrabouh (2021) observed a considerable increase in urea, creatinine and uric acid in young and adult rats following the influence of mosquito coil emissions.

Conclusion

Our everyday exposure to liquid insect repellents may have considerable negative health implications, which call for cautious attention. In contrast to liquid mosquito repellents, which are essential for preserving human health from mosquito-borne illnesses, these products are helpful instruments in preventing mosquito-borne illnesses but also come with possible hazards. We can therefore conclude that insect repellent is both a good friend and a dreadful evil. The proposed research will raise public awareness of the indoor air pollution that liquid insect repellent cause and its findings can be generalized to higher mammals including humans. For subsequent academics and scientists engaged in this type of study, the suggested research endeavor would offer a baseline of data.

References

Aprilia, D., B. P. S. Rahardjo, I. S. Yudaniayanti, W. Widjiati, S. A. Sudjarwo, B. Budiarto and E. M. Luqman (2023) Teratogenic Effect of Electric Mosquito Repellents on Mouse (*Mus Musculus*) Fetuses. *World J. Adv. Res. Rev.*, **18**(2) :1024–1029.

Prabhakara, A., D. P. Nanjappa, N. Babu, K. Kalladka, A. Chakraborty and G. Chakraborty (2020) Exposure to Mosquito Repellents Causes Profound Development Defects and Induces Oxidative Stress in Zebrafish. *J. Health Allied Sci.*, **10**(3) :122–127.

Bradberry, S. M., S. A. Cage, A. T. Proudfoot and J. A. Vale (2005). Poisoning due to Pyrethroids. *Toxicol. Rev.*, **24**(2) :93–106.

Akhtar, A., A. A. Deshmukh, C. G. Raut, A. P. Somkuwar and S. S. Bhagat (2012) Prallethrin Induced Serum Biochemical Changes in Wistar Rats. *Pest. Biochem. Physiol*., **102** :160-168.

Garba, S.H., A. B. Adelaiye and L. Y. Mshelia (2007) Histopathological and Biochemical Changes in the Rats Kidney Following Exposure to a Pyrethroid Based Mosquito Coil. *J. Appl. Sci. Res.*, **3**(12) :1788-1793.

Magesh, A., S. Sivanesan, V. Rajagopalan, R. V. Geetha and A. Roy (2019) Safety Evaluation of Various Vector Repellents in Combination with Deltamethrin in Wistar Rats. *J. Pharm. Bio. Sci.*, **10**(1) :21-28.

Srivastava, A., M. K. Srivastava and R. B. Raizada (2006) Ninety-Day Toxicity and One-Generation Reproduction Study in Rats Exposed to Allethrin-Based Liquid Mosquito Repellent. *J. Toxicol. Sci.*, **31**(1) :1-7.

Syed, M., S. Tousia, K. S. Balowria, N. Jabeen, N. A. Faruqi and A. Beg (2019) Haematological and Histopathological Effects of Mosquito Coil Smoke on Kidney-An Experimental Study on Albino Rat. *Acad. Anat. Int*., **5**(1) :49-53.

Nwankwo, V. O., A. J. Uraku, A. C. Famurewa and O. H. Uraku (2017). Assessment of Nephrotoxicity and Histopathological Lesions of Albino Rats Exposure to DD-Force and Baygon Insecticides. *Int. J. Med. Surg. Sci.,* **4**(4) :1156-1163.

Chauhan, R. S. (2009) Textbook of Veterinary Pathology, 3rd Ed. Published by CBS Publishers and Distributors Pvt. Ltd., India, 660 pp.

Cheesbrough, M. (1998) Clinical Chemistry Tests in:District Laboratory Practice in Tropical Countries. Cambridge New Edition Part I, pp. 331-363.

Refaie, A. A. E., A. Ramadan, A. H. Mossa (2014) Oxidative Damage and Nephrotoxicity Induced by Prallethrin in Rat and the Protective Effect of *Origanum majorana* Essential Oil. *Asian Pac. J. Trop. Med.,* **7**(Suppl 1): S506-S513.

Fetoui, H., M. Makni, E. M. Garoui and N. Zeghal (2010) Toxic Effects of Lambda-Cyhalothrin, A Synthetic Pyrethroid Pesticide on the Rat Kidney : Involvement of Oxidative Stress and Protective Role of Ascorbic Acid. *Exp. Toxicol. Pathol.,* **62** :593-599.

Narahashi, T., J. M. Frey, K. S. Ginsburg and M. L. Roy (1992) Sodium and GABA-Activated Channels as the Targets of Pyrethroids and Cyclodienes. *Toxicol. Lett.,* **64** :429-436.

Panda, N. C. (1999) Kidney in : Textbook of Biochemistry and Human Biology 2nd Ed. Prentise Hall India, 296 pp.

Siddiqui, N., S. Nazir and R. Jabeen (2015) Mosquito Coil Smoke Inhalation Effects on Interstitium of Kidney of Albino Rats. *PJMHS,* **9**(2) :672-675.

El-Saad, A. M. A. (2011) Lycopene Protects Against Deltamethrin Induced Oxidative Renal Dysfunction in Rats. *Egypt. J. Exp. Biol.,* **7**(2) :111-121.

Liu, C. M., Y. L. Zheng, J. Lu, Z. F. Zhang, S. H. Fan, D. M. Wu and J. Q. Ma 2010. Quercetin Protects Rat Kidney Against Lead-Induced Oxidative Stress and Apoptosis. *Environ. Toxicol. Pharmacol.,* **29** :158-166.

Abdrabouh, A. E. (2021) Susceptibility of Young and Adult Rat Kidneys to Impacts of Mosquito Coil Fumes. *Egypt. J. Bas. Appl. Sci.,* **8**(1) :1-11.

Karim, M. R., D. K. Ghose, M. F. Rahman, M. T. Hossain, M. R. Rahman, M. A. Rahman and R. Islam (2020) Evidence of Health Complications Caused by Mosquito Coil Smoke Inhalation in Mouse Model . *J. Adv. Biotechnol. Exp. Ther.,* **3**(2) :122-127.

Wolf, P. L.,D. Williams, T. Tsudaka and L. Acosta (1972). Methods and Techniques in Clinical Chemistry. New York: Wiley-Interscience, A Division of John Wiley and Sons, Inc.

Cite this article-

Shekhar Biswas, Vishwakant, Anand Pratap Singh, Prem Sagar, 2023 “Alteration In Kidney Biomarkers After Inhalation Exposure of Transfluthrin Based Liquid Mosquito Repellent In *Rattus norvegicus* (Berkenhout)” **Journal of Science Innovations and Nature of Earth**, Vol. 3(1), page- 59-64

www.doi.org/10.59436/jsiane.com/archives3/12/90