Hepatic effect of the sub-chronic exposure to mosquito coil smoke in albino mice

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Abstract

The hepatic effect of chronic inhalation of mosquito coil smoke in mice was investigated. Mosquito coil smoke is mosquito repellent incense made from dried pyrethrum powder. It is widely used in Africa, Asia and South America. Exposure to mosquito coil smoke may lead to coughing, sneezing, and inflammation of trachea, renal damage, weight loss, headache, itching and skin reaction. It decreases the protein biosynthetic activity of the liver. This could affect capacity of serum protein-mediated transport of various substances. Goldeer mosquito coil containing 0.03% Transfluthrin, manufactured in Kano, Nigeria and purchased in Zaria was used for this experiment. Twenty-four (24) male mice (20-40 g), were divided into four groups of six mice each and exposed for six weeks to mosquito coil smoke for 1, 2 and 3 hours in an inhalation chamber. The animals were humanely sacrificed and the their blood samples collected and analysed for the enzymes, Aspartate amino transferase (AST), Alanine aminotransferase (ALT) and Alkaline Phosphatase (ALP) as markers of Hepatic function. Also, their brain tissues were collected, homogenized and centrifuged and the supernatants assayed for oxidative stress biomarker, malondialdehyde (MDA) and antioxidant enzymes, superoxide dismutase (SOD) and Catalase (CAT). Data were analysed using one way ANOVA and expressed as Mean±SEM with value of $P<0.05$ considered statistically significant. The result showed that the mosquito coil smoke exposure in mice does not cause any significant change in liver enzymes, MDA and SOD. However, there were significant increases in CAT activity (43.83±1.85) and (41.67±1.36) as compared to control (38.50±1.00)

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Introduction

Mosquito coil smoke is a mosquito repellent incense made from dried pyrethrum powder. It is widely used in Asia, Africa and South America.[1] Each coil burns for several hours and are used in close proximity to persons requiring protection against mosquitoes bites.[2] It poses a serious public health hazards and ecological challenges because of the effects associated with their use, especially innocuous and chronic inhalation of the fumes.[3] It has also been reported that burning one mosquito coil would release the same amount of particulate matters as burning 75-137 cigarettes and emission of formaldehyde as high as that released from burning 51 cigarettes.[4] It could also lead to coughing, sneezing, inflammation of trachea, renal damage, body weight reduction, headache, itching and skin reaction.[1] With malaria and other mosquito-borne diseases a health challenge in tropical areas, mosquito coil usage has increased in recent decades and the annual world consumption was estimated at 32 billion coils as at the year 2000.[5] The endemic nature of malaria infestation in Nigeria and the economic implication of being infected have left many families with no choice other than to look for any way possible to avoid it. The mosquito coil is the commonest and cheapest methods used by many families to drive away mosquitoes from sleeping rooms.

Enzymes catalyse specific biochemical reactions.[6] And they always function intracellularly and have no physiologic use in the plasma. In healthy individuals, the levels of these enzymes are fairly constant, and represent a steady state in which the rate of release from damaged cells into the plasma is balanced by an equal rate of its removal from the plasma. The presence of elevated activity in plasma indicates tissue damage that is accompanied by increased release of intracellular enzymes.[7-8] Elevated hepatic enzymes and markers of oxidative stress are important biochemical markers of liver damage and disease state. This study is therefore aimed at investigating the effect of mosquito coil smoke on Hepatic enzymes and oxidative stress.

Materials and Methods

Twenty-four adult mice weighing 20-40 g were obtained from the National Institute of Trypanosomiasis and Oncocerciasis Research (NITOR), Kaduna, Nigeria and transported to Zaria, Nigeria where they were allowed to get accustomed to the environ-

ment for two weeks at the Department of Human Physiology, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. They were fed mainly with grower mash and water ad Libitum. Goldeer® mosquito coil containing 0.03 transfluthrin and manufactured in Kano, Nigeria was obtained from a retail shop in Zaria, Nigeria. The experimental animals were divided into four groups of six mice each. Group 1 was exposed to environmental air only while mice in groups 2, 3 and 4 were exposed to mosquito coil smoke for 1, 2 and 3 hours daily for 6 weeks respectively, in a partially ventilated inhalation chamber (2.00 × 0.98 × 1.55 m). After which the animals were humanely sacrificed and the blood samples collected were assayed for liver enzymes, aspartate transaminase (AST), alkaline phosphotase (ALP) and alanine transaminase (ALT). Whole brain tissues collected were homogenized and centrifuged and the supernatants assayed for oxidative stress biomarker, malondialdehyde (MDA) and antioxidant enzymes, superoxide dismutase (SOD) and catalase (CAT). Data were analyzed using one-way ANOVA and expressed as Mean±SEM with value of P<0.05 considered statistically significant.

Results

All experimental protocols were conducted in accordance with the Ahmadu Bello University research policy, ethics and regulations governing the care and use of experimental animals. The summary results are presented in Tables 1 and 2.

Discussion and Conclusion

The result as presented in Table 1 showed no significant increase in the liver enzymes, indicating no liver damage as a result of mosquito coil smoke exposure in this experiment. This is not in agreement with several studies,[9,10] that have shown the activity of all liver enzymes increased. They investigated the toxicological effects of smoke from locally manufactured mosquito coil insecticides of different brands on male albino rats. The animals were exposed to the smoke for different duration of exposure ranging from 2 to 16 weeks for up to 8 hours daily. Mosquito coil smoke produced significant increase (P<0.05) in the level of AST, ALP and ALT in all the exposed groups. And the investigation of Al-Mamun *et al*.[11] who studied the biochemical and histological alterations induced by the smoke of mosquito coil on mice model, in which a total of twenty four Swiss albino mice were allowed to inhale the smoke of mosquito coil at different duration per day for 120 days. By the end of treatment period, blood sample was drawn from each mouse and blood biochemical parameters including alanine transaminase (ALT), aspartate transaminase (AST) were analysed. Their result indicates that the activity of two key hepatic enzymes, ALT and AST were increased significantly (P<0.05) by 89% and 85%, respectively in mice exposed to the smoke for 3 hour/day.

The significant increase in CAT in groups 2, 3 and 4 of this study, which were exposed to mosquito coil smoke daily for 1, 2 and 3 hours respectively over a duration of 6 weeks (Table 2) could be due to slight antioxidant activity which might have taken place to bring about balance. This didn't agree with our previous study,[12] in which after investigating the effect of sub-chronic exposure to mosquito coil smoke on motor coordination in mice, using twenty-eight adult mice and grouped into four with seven mice each and were exposed for 1, 2 and 3 hours daily for 6 weeks, show no significant increase in CAT activity.

And this was also collaborated by Scalios,[13] who showed that mosquito repellent exposure could lead to decrease in CAT which exhibits a higher affinity for H_2O_2 by degrading it to H_2O and O_2, limiting the damage of H_2O_2 before it could diffuse to other parts of the cell. However, this study agrees with Chizefin *et al*.[14] who reported no significant increase in ALT in insecticidal workers exposed to pyrethroids.

The lack of significant increase in the liver enzymes to the mosquito coil smoke exposure in this study could be as a result of the duration and time of exposure to the mosquito coil smoke. Significant result might be recorded with longer duration and time of exposure.

In conclusion, short duration of exposure to mosquito coil smoke may not affect liver function.

Table 1. Table showing the effect of mosquito coil smoke on liver enzymes.

Groups	N.	AST (IU/L)	ALT (IU/L)	ALP (IU/L)
Group 1*	6	11.50±0.43	51.83±1.96	116.17±15.85
Group 2**	6	10.67±0.42	55.00±1.06	103.17±2.58
Group 3***	6	11.00±0.26	52.17±1.38	128.83±15.51
Group 4****	6	10.17±0.20	53.50±0.78	112.79±5.76

ALT = Alanine amino transferase, AST = Aspartate amino transferase, ALP= Alkaline phosphatise. *Exposed to environmental air; **Exposed to mosquito coil smoke, 1 hour daily for 6 weeks; ***Exposed to mosquito coil smoke, 2 hours daily for 6 weeks; ****Exposed to mosquito coil smoke, 3 hours daily for 6 weeks.

Table 2. Table showing mosquito coil smoke effect on oxidative stress biomarker.

Groups	N.	MDA (µmol/L)	SOD (IU/L)	CAT (IU/L)
Group 1*	6	1.50±0.13	1.82±0.06	38.50±0.92
Group 2**	6	1.72±0.15	2.10±0.17	43.83±1.85[a]
Group 3***	6	1.57±0.16	2.00±0.12	34.00±2.31[a]
Group 4****	6	1.57±0.09	2.15±0.13	41.67±1.36[a]

Values with [a]superscripts are statistically significant (P<0.05) as compared to control; MDA = malondialdehyde, SOD = superoxide dismutase, CAT = Catalase. *Exposed to environmental air; **Exposed to mosquito coil smoke, 1 hour daily for 6 weeks; ***Exposed to mosquito coil smoke, 2 hours daily for 6 weeks; ****Exposed to mosquito coil smoke, 3 hours daily for 6 weeks.

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