Original Research Article

THE EFFECT OF INHALATION OF FUMES FROM ESBIOTHRIN BASED MOSQUITO COIL ON SOME RENAL FUNCTION MARKERS AND HEMATOLOGICAL PARAMETERS IN MALE WISTAR RATS.

ABSTRACT

Esbiothrin is a synthetic pyrethroid with quick activity used in public health against mosquitoes, houseflies, ectoparasites and cockroaches as well as agricultural applications. These coils and the inhalation of their fumes have been reported and proved to cause grave consequences to the respiratory tract majorly. Hence, this current study was aimed at assessing the renal and hematological effect of inhalation of fumes from esbiothrin based mosquito coil using experimental animal models. Ten (10) male wistar albino rats were divided into two (2) groups (A and F) of five rats each. Rats in group F were exposed to esbiothrin based mosquito coil fumes for about 6 hours per day, five (5) days per week for four (4) weeks and were weighed weekly, while the group A served as the control group and therefore was not exposed. The weight of the rats in group A was increased and the weight of the rats in group F was fluctuating. At the end of the experimental period, blood was collected from each rat for the hematological analysis of Red Blood Cell (RBC), White Blood Cell (WBC), Packed Cell Volume and platelets Count using automated hematology analyzer and also for the analysis of some renal function markers (urea and creatinine). Result on hematological analysis revealed that group F had a significant decrease ($p>0.05$) in both urea and creatinine levels as well as WBC count, RBC count, PCV and PLT count. Results from this study indicates that esbiothrin based mosquito coil fumes, though considered the least toxic insecticide, are very capable of causing harm.

Keywords: Esbiothrin, Mosquito coil,Hematology, Renal function.

INTRODUCTION

Mosquitoes are group of very familiar insects that grow and pass their early stages of lives in a variety of aquatic habitats: permanent and transient. Permanent habitats are river, ponds, lakes and so on. and transient habitats include hollow trees, bromeliad tanks, and so on [1]. Several lines of evidence established that mosquitoes are main vectors of some catastrophic mammalian

and animal diseases such as malaria, dengue, filariasis, chikungunya and West Nile virus [2]. As stated by the United States Environmental Protection Agency, mosquito bites can cause skin irritation through an allergic reaction to the mosquito's saliva - this is what causes the red bump and itching [3].

As reported by the National Pesticide Information Center, insecticides are pesticides that are formulated to kill, harm, repel or mitigate one or more species of insect [4]. However, the use of mosquito coil as a controlling measure against mosquitoes at household level is widespread in malaria endemic countries across Africa, Asia and South America [5]. Mosquito coils are smoldering insecticides used in close proximity to persons requiring protection against mosquitoes in order to prevent malaria, a disease of wide distribution [6]. Mosquito coil is a mosquito repelling incense-like product formulated from a paste of granulated insecticide and a filler, such as sawdust and other solid materials, and then extruded into a coiled shape[5]. Because of their cheapness and readily availability, mosquito coils are the preferred anti-mosquito materials in many developing countries especially Nigeria [7].

According to the World Health Organization [8] and Midouhas*et al*[9], air inside our homes can be 5 times more toxic than air outside our homes depending on pollutant sources and nature of ventilation of the indoor environment. Mosquito repellents are used in most homes to drive away mosquitoes which are the principal vectors for malaria parasite. The use of these coils is a significant cause of indoor air pollution. Recent WHO figures estimated nearly 7 million annual premature deaths; 1 in 8 of the total deaths was due to exposure to air pollution [10]. This incredible figure makes air pollution one of the biggest health threats in the world. Most of the deaths from this conservative estimate come from combustion of biomass fuels and smoldering mosquito coils where half of the world’s population in the developing countries relies on these crude fuels for multiple needs [11, 12]. The disease burden in developing countries is relatively high, and malaria-a vector borne disease is no exception. Approximately 2 billion people worldwide are using mosquito coils [13]. These coils are usually made up active ingredients that could be any or a combination of pyrethroids such as metofluthrin, d-allethrin d-trans allethrin, and prallethrin and the percentage of the active ingredients usually ranged between 0.10% and 2.0% [10, 13]. These substances are low-toxicity insecticides.

In Nigeria, mosquito coils have been the major mosquito repellents because they are not expensive and can easily be purchased in the neighborhood [10]. Mosquito coils contain insecticides that slowly vaporize into the air to provide mosquito protection to prevent malaria. Some of the toxic contaminants that may result from the burning of mosquito coils and related incense-like items are carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and particulate matters (PM) [14].

This research focused on the investigation of the effect of inhaling mosquito coil fume (esbiothrin) on some renal function markers and on some hematological parameters. It may provide scientific rationale to either promote or discourage the combustion of this mosquito coil in a population.

MATERIALS AND METHODS

Mosquito coil

The mosquito coil was purchased from a retail outlet in Awka, Anambra State, Nigeria.

Experimental Animals

Ten (10) male wistar albino rats were purchased from an animal farm in Mgbakwu, Anambra State. Prior to commencement of the study, the rats were acclimatized for two (2) weeks. The rats were housed in standard cages dressed with sawdust litter, at housing conditions of 12 light: 12 dark cycles in the animal house and fed growers mash and water for the entire duration of the study. All procedures were followed according to the guidelines of proper conduct of animal experimentation.

Design of Exposure

Inhalation of ablaze coil fumes was achieved by the construction of a microenvironment mimicking a room with a dimension of 50cm x 45cm x 20cm and two openings with a dimension of 10cm x 10cm (mimicking the windows) on opposite sides for cross ventilation. The rats were observed for any clinical signs associated with the exposure to the active ingredient from the fumes.

Research Plan

After acclimatization, the animals were weighed before the commencement of the experiment. They were then randomly grouped into two groups (the test and control group) with five rats per group.

Group A: Control group which were not exposed to the esbiothrin based mosquito coil.

Group B: Rats were exposed to esbiothrin based mosquito coil for six (6) hours of five days per week for four weeks.

Ethical Consideration

This research was cleared and approved by the Animal Research Ethics Committee (AREC) of Nnamdi Azikiwe University, Awka.

Place of Study

This research was carried out at the laboratory of Applied Biochemistry, Nnamdi Azikiwe University, Awka.

Collection of Samples

After the last day of exposure, the rats were fasted overnight before being sacrificed. Blood collection was done by heart puncture with use of a syringe and into clean plain and EDTA bottles.

Biochemical Analysis

Blood Urea and creatinine contentswere determined using commercial kits from Randox Laboratories and manufacturer's instructions were duly followed.

Hematological Analysis

The samples were then sent to the laboratory for the determination of the full blood count (packed cell volume, red blood cell, and white blood cell) using automated hematology analyzer (Minary Model BC 3200).

Data Analysis

Data was analyzed statistically using Statistical Package for the Social Sciences (SPSS). Statistical significance was evaluated by one-way analysis of variance (ANOVA) for renal function test and hematological analysis.

RESULTS

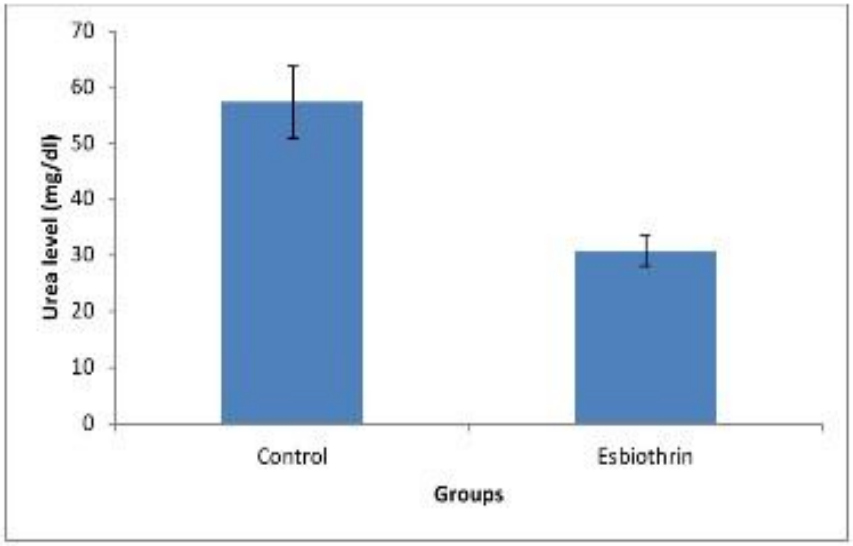

Figure 1:Effect of esbiothrin based mosquito coil on the urea levels of experimental animals after exposure

The test group shows a significant decrease (p>0.05) in the urea levels.

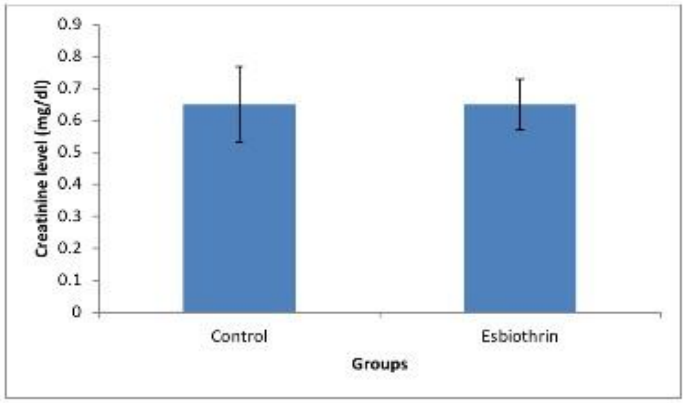

Figure 2: Effect of esbiothrin based mosquito coil on the creatinine levels of experimental animals after exposure

The test group shows a significant decrease (p>0.05) in the creatinine levels.

Table 1: Effect of esbiothrin based mosquito coil on hematological parametersof experimental animals after exposure

	WBC	RBC	HGB	PCV	PLT
Control	13.01±1.72	6.97±0.20	15.52±0.20	46.92±0.73	717.40±50.45
Esbiothrin	12.89±0.23	5.02±0.88	10.00±1.77	28.94±6.91	642.60±41.72

Result showed a significant decrease (p>0.05) in the levels of white blood cell count, red blood cell count, packed cell volume and platelets count.

DISCUSSION

Mosquito coils are insecticides primarily manufactured from the pyrethrum plant. However, with increasing demand for this type of pest control, due to its cheapness and availability, synthetic pyrethroid mainly esters are produced [15]. One of the pyrethroid esters is esbiothrin (the active ingredient of the mosquito coil used in this study).

Assessment of renal function is important in the management of patients with kidney disease or pathologies affecting renal function. Tests of renal function have utility in identifying the presence of renal disease monitoring the response of kidneys to treatment, and determining the progression of renal disease [16]. The result showing the effect of the fumes of esbiothrin based mosquito coil in urea level is presented in Fig 1. From this result, there was a significant decrease in the urea level of the rats exposed to the mosquito coil when compared to the control group. The control had a higher urea level (57.40±6.33mg/dl) while the test group had a lower urea level (30.85±2.63mg/dl). The findings of this research are in discordant with the findings of Abdrabouh, [17] who stated that there was a significant increase in serum levels of urea of young and adult rat.

Urea is major nitrogen containing substance that is cleared from the blood by the kidney in to the urine [18]. It is useful in differential diagnosis of acute renal failure and pre-renal condition where blood urea nitrogen–creatinine ratio is increased [19]. According to Ambardekar, [20], the normal range of urea nitrogen in blood or serum ranges from 7 to 20 mg/dl. Since increased levels of serum urea are pointer to severe kidney damage, it could be inferred, from the result of

this study that continuous inhalation of fumes from this coil might pose a great threat to the kidney.

The result showing the effect of the fumes of esbiothrin based mosquito coil in creatinine level is presented in Fig 2. The control group had a higher creatinine level (0.65±0.12mg/dl) while the test group had the lower (0.65±0.08 mg/dl).When the control group was compared with the test group, there was a significant decrease in creatinine level ($p>0.05$). This was contrary with the findings of Hui *et al*., [21] that reported an increase in creatinine level of wistar rats exposed to pyrethroid based compound. This result showed a significant decrease in the level of creatinine of the test group when compared to the control group.

Creatinine is an end product of muscle catabolism of creatine. For a given individual, creatinine production is relatively stable and mainly depends on muscle mass [22]. The creatinine clearance test is used to monitor the progression of renal disease. In chronic renal failure and uremia, an eventual reduction occurs in the excretion of creatinine by both the glomeruli and the tubules [23]. The normal reference range for creatinine levels is 0.6 to 1.2 mg/dl in males and 0.5 to 1.1 mg/dl in females. Therefore, with the values gotten, it falls within the range of the standard reference range which might indicates no loss of kidney function.

The white blood cell count (WBC) estimates the total number of white blood cells per liter in the blood[24]. The control group had the higher WBC (13.01±1.72 10^9/L) while the test group had the lower WBC (12.89±0.2310^9/L) as presented in table 1. When the control group was compared to the test group, there was a significant decrease ($p>0.05$). This was at variance with the findings of Saka *et al*., [25] whose findings showed an increase in WBC after exposure to pyrethroid insecticides. This may be due to the fact that the authors carried out a minimal exposure of three (3) minutes daily for 3 weeks, a shorter duration of exposure. The normal reference range WBC is 4.5 to 11.0 x 10^9/L. The values gotten from the research surpasses the normal standard range. High white blood cell count could indicate infections, inflammation or immune system disorder [26].

A red blood cell count is a test that measures the number of red blood cells (RBCs) in the blood [27, 28]. The control group had higher RBC (6.97±0.20 10^9/L) while the test group had lower RBC (5.02±0.8810^9/L). When the control group was compared to the test group, there was a significant decrease ($p>0.05$). The normal standard range for RBC is 4.5 to 6.5 x 10^{12}/L in males while 3.8 to 5.8 x 10^{12}/L [29]. The values gotten from this study is a little lower than the normal

standard reference range. A low RBC count could also indicate a vitamin B6, B12 or folate deficiency [26]. It may also signify kidney disease [30].

Packed Cell Volume (PCV) is the percentage of red blood cells in the total blood volume [28, 31]. It is carried out to measure the volume of packed red blood cells relative to whole blood i.e. the proportion of red blood cells in the blood. The control group had the higher PCV (46.92±0.73 %) while the test group had the least (28.94±6.91 %). When the control group was compared to the test group, there was a significant decrease ($p>0.05$). This result is in consonance with Kamal *et al*. [32] that also recorded a decrease in PCV levels but was in contrast with the findings of Saka *et al*. [25], whose report showed an increase in PCV levels. This however, could be due to minimal duration of exposure. A normal adult male shows a PCV of 40% to 54% and a female show 36% to 48% [33]. Increased PCV levels may be grounds to indicate dehydration.

The platelet count is a standard component in screening for coagulation abnormalities [34]. The control group has a higher PLT count ($717.40\pm50.45 10^9$/L) while the test group has a lower PLT count ($642.60\pm41.72 10^9$/L). Results from this study which presents platelets count decrease is in contrast with the previous by study Saka *et al*., [25], this might suggest that at minimal exposure, esbiothrin do not have a suppressive effect on the thrombopoietin, the regulator of platelets production. It also shows that pyrethroid cause structural or functional damage at high exposure. The normal platelet count in humans ranges from 150×10^9/L to 400×10^9/L [35]. High level of platelets count could be an indicator of hemostasis or lung disease.

CONCLUSION

The results of the present study suggest that despite being the least toxic insecticide safer for human beings than other insecticides such as dichlorodiphenyltrichloroethane (DDT), esbiothrin based mosquito coil still have harmful effects, as exposure to it can challenge the immune system and induce adverse changes on the kidney. However, based on the results from this work, studies aimed at producing alternative mosquito coils with minimal toxicity should be an area of practical interest.

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