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Research article

**STUDY OF CHRONIC TREATMENT OF MOSQUITO REPELENT LIQUID INHALATION ON
BIOCHEMICAL CONSTITUENTS OF RAT**

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ABSTRACT: Allethrin is a synthetic analogue of the natural pyrethrum insecticides obtained from the flowers heads of the plant *Chrysanthemum cinerariaefolium*. In most repellents synthetic pyrethroids are used to combat mosquito nuisance and malaria. Present investigation showed that inhalation of mosquito repellent by rat caused selective damage to lung and liver. Kidney was not severely affected by inhalation of mosquito repellent.

Key words: Althrin, pyrethrum insecticides, mosquito repellent

INTRODUCTION

In most urban and rural area of the country mosquito population are menacing throughout the year. Mosquitoes are disease vector transmitting diseases such as malaria, filariasis and many viral diseases such as Japanese encephalitis, dengue, yellow fever etc. currently variety of repellents are marketed in the form of coil, mat, vaporizers, lotions, buzzers electrocuting device etc. These repellent contains Allethrin group of compounds marketing in India well organized. So that many brands can be found throughout the country. Repellents such as vaporizer and herb are widely used in the country to combat mosquito nuisance and malaria. Certain chemicals may affect through modulation of tissue microsomal mixed function oxidase that metabolize endogenous substances like steroid hormones and xenobiotics leading to drug interaction and possible toxicological consequences (Hodgson and Levi, 1994; Gibson and skett, 1994; Hoyumpa and Schenker, 1983). Mostly in repellents synthetic pyrethroids are used. These insecticides are heat stable and used in the treatment of mat coil, and vaporizer includes allethrin, d-transallethrin, S-bioallethrin etc. on heating and burning of mat and liquids these compounds vaporize without decomposition at temperature up to 400°C and produce repellent action on the mosquito. Pyrethroid insecticides have been used for more than 40 years in view of their wide availability, and accounts for 25% of the world insecticide market (Kakko et al., 2003, Shafer et al., 2005). Available literature suggest that indoor pyrethroid exposure is of considerable magnitude in India and other countries including United states (Bateman, 2000; Pankaj and Prahlad, 2004; Narahashi, 2000). No much relevant data or considerable literature are available on the chronic toxic effect of the compound in humans (Pankaj and Prahlad, 2004; Kolaczinski and Curtis, 2004; Mishra and Singh, 2003). Allethrin is a synthetic analogue of the natural pyrethrum insecticides obtained from the flowers heads of the plant *Chrysanthemum cinerariaefolium* known to be act by immobilizing the insect nervous system through poisoning of its nervous system (Craig and Stitzel, 1987). Allethrin biodegraded by the environment after time in an indoor and outdoor situation. The longevity of allethrin in the environment varies from 1-2 hr in the atmosphere to less than 8hr in an aqueous environment. Allethrin will be breakdown in to water, CO₂ and other carbon based material. (www.thermocel.com). Chemical induced organ toxicity may manifest as tissue or organ damage and derangement of cellular metabolism, culminating in cell death and subsequently, organ failure (Gaw et al., 1998). Considering these view present study was conducted to know about effect of mosquito repellent on different organs, biochemical changes and histopathology in rat which is correlated to various human health hazards.

Human Health hazard due to mosquito repellents

There is pucacity of information concern the effects on human health due to prolonged and long-term use of allethrin. (Pankaj and Prahlad, 2004; Kolaczinski and Curtis, 2004; Mishra and Singh, 2003). Allethrin a type-1-pyrethroid is among the top few commonly used insecticides having maximum human exposure for prolonged period as it is used as chief component of mosquito repellent (Anvita et al., 2006; Tsuji, et al., 2002).

Pyrethroids are lipophilic in nature responsible for various pyrethroid induced toxicity (Narahashi, 1996). The main site of action of the pyrethroids is the sodium channel, which is kept open for long period of time, causing prolonged sodium current to flow, leading to hyper excitation, of the nervous system. (Narahashi et al.,1992). Synthetic pyrethroids like allethrin cause subnormal or super-normal excitability affecting the sodium channel opening time (Cheng et al., 1992). Many researchers are now providing data on the harmful health hazards due to repellents used against mosquito. Liu and Sun (1998) reported that mosquito coils containing aromatic and aliphatic hydrocarbons which are combustion product of wood, dist, filler and dyes in the mats. Gupta et al., (1999) reported allethrin used in the mat and vaporizer increases blood brain barrier and biochemical changes causing health risk, especially at early age. Narendra et al., (2008) Studied, allethrin induced biochemical changes in erythrocyte membrane of human. They noticed reduction in phosphatidyl serin (PS) in human blood. They have also reported decrease in membrane cholesterol. Total phospholipid concentration and membrane lipid peroxidation. Sharma (2001) in his study reported repellents are harmful to human health. In his study 11.8 % people using various types of repellent complained of ill health effect. Menon and Hanker (1998) stated that repellents could lead to running nose and wheezing, prolonged use could lead to corneal damage, asthma and liver damage. Diel et al., (1999) reported the immunotoxic properties of s-bioallethrin caused by inhibiting lymphocyte proliferation in a dose-dependent manner. Moya –Quiles et al., (1995) suggested a possible insertion and aggregation of allethrin in the lipid bilayer of model membrane creating special domains with consequent increase in membrane instability and allethrin induced fluidizing effect. They also noticed that allethrin modified bilayer order (Moya-Quile et al.,1995)

MATERIALS AND METHODS

Mosquito repellent containing allethrin 0.88% (Good Knight) was selected for the study. Adult rat (*Rattus rattus*) weighing about 200-250 gm made available from the warehouse nearby Sangola. The collected rats were divided in three groups each having 5 individuals kept in steel cage and feed with pelleted food during winter and summer. 1st group is assigned as control group, 2nd group as test group for 8 hr exposure to 0.88 % allethrin inhalation and 3rd group as test group for 24 hr for inhalation of allethrin 0.88 % for 30 days. Blood sample for biochemical study were collected from all animals prior to commencement of the studies and also at termination. From these pooled sample estimation of glycogen by De Zwaan and Zandee (1972), total protein by Lowry (1951), total lipid by Barnes and Blackstock (1973). Simultaneously, for histopathological study organs like liver, lung, kidney were pooled out from each group and fixed in formaldehyde and dehydrated with alcohol. These tissues were cleared with xylene and impregnated with paraffin wax and sections cut and stained with haematoxylin and eosin, and mounted on slides for light microscopic examination. For study of formulations available in the market, personnel interview with chemists and druggist of Sangola Dist. Solapur Maharashtra state have been carried out.

RESULTS

Effect of Mosquito repellent inhalation on some organs of rat:

There were no significant difference in the mean body weight between control and inhaled animals. The effect of inhalation of repellent on some organs weights at termination are shown in table No. 2. When compared to control wet-weight. The lung, and kidney showed decrease in weight but there was very little change in weight of liver.

Table: 1. Effect of mosquito repellent liquid inhalation on organs weight of rat at termination of experiment after 30 days of exposure to allethrin (0.88%).

Organ	Weight of organs (Wet-weight) in gm.		
	Control group	Test group 8 hrs of exposure	Test group 24 hrs of exposure
Kidney	1.54±0.06	1.48±0.09 (3.89%)	1.41± 0.05 (8.44%)
Lung	1.80±0.04	2.32±0.07 (28.88%)	2.53± 0.1 (40.55%)
Liver	8.12±0.23	8.16±0.25 (0.49%)	8.22±0.15 (1.23%)

Values are expressed as means ± SD. Of n=5, Values in parenthesis represents percent

Effect of mosquito repellent liquid on biochemical composition of rat.**Table No. 2. Effect of mosquito repellent liquid inhalation on serum biochemical constituents of rat at termination of experiment after 30 days of exposure to allethrin (0.88%).**

Parameters	Control group	Test group (8 hr)	Test group (24 hr)
Blood glucose	64.34	61.23±0.11 (4.83%)	59.05±0.17 (8.22%)
Cholesterol	112.67	105.72±0.23 (6.16%)	103.97±0.2 (7.72%)
Total protein	280.27	237.13±0.12 (15.39%)	212.54±0.22 (24.16%)

Values are expressed as means ± SD. Of n=5 Values in parenthesis represents percent

DISCUSSION

Results obtained from experiment of study of effect of mosquito repellent on rat showed that the allethrin vapour inhalation caused change in weight of organs like kidney, lung and liver. Present study also showed effect on biochemical parameters including protein, glucose and cholesterol. Liu and sun (1987), exposed rats to the mosquito coil smoke for 60 days resulted in focal delication to tracheal epithelium, metaplasia of epithelial cells and morphological alterations of alveolar macrophages. Okine et al, (2004) reported decreased in lung and plasma biochemical parameter but not in kidney from albino rat due to mosquito coil. They further stated that smoke affect on tissue microsomal mono-oxygenase activities. Which are likely to affect the metabolism of the other xenobiotics and hence cause drug interaction. In present investigation similar might be the case where decrease in biochemical constituents have been observed.. Maximum decrease in protein level followed by cholesterol and blood glucose have been observed in both treated groups (8 hrs and 24 hrs) after 30 days of exposure to allethrin (0.88%).

CONCLUSION

Inhalation of mosquito repellent by rat caused selective damage to lung and liver. Kidney was not severely affected by inhalation of mosquito repellent. It is possible that prolonged or chronic exposure/inhalation of mosquito repellent liquid in human may also be harmful and this will be investigated and need further study in this regard.

Suggestions or alternative measures to combat mosquito

From the present study it has been observed that mosquito repellent and other device are not suitable and safe for human health. Considering this here I am going to suggest some safe alternative measures to the use of chemical based mosquito repellents. These measures requires personal, community and local bodies attention, which are as follows.

1. Good drainage: Proper gradient should be provided to eliminate standing water in drains low-lying areas, pits burrows, ditches etc. periodical de-slitting of drains before the onset of monsoon to maintain steady flow.
2. Regular (Weekly) emptying and drying of all standing water sources around houses.
3. Underground and over head water tank well etc will be sealed properly to prevent entry of mosquito.
4. Larvi-vorous fishes should be released in ponds, lake, drains etc.
5. Personal protection includes use of mosquito net, wire mesh doors, windows and ventilator can be used
6. Burning Neem oil with kerosene would be cost effective alternative to chemical repellent.

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