

Study of Safety of Mosquito Repellants

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Abstract: Nowadays mosquitos are growing every where. In this winter season, mosquito born diseases are more common. To prevent mosquito born diseases, every one is widely using mosquito repellants every where. But no one is aware of the safety usage of repellants. Recent studies show repellants are carcinogenic, teratogenic, nephrotoxic, neurotoxic and hepatotoxic on basis of chronic exposure and concentration of chemical present in it. By knowing safety usage of repellants, we can prevent chronic health hazards in future generations and protect health. This is the aim this review article.

Key words: repellants, teratogenic, nephrotoxic, neurotoxic.

I. INTRODUCTION

Mosquito born diseases are more common in this winter season. Because mosquitoes are growing due to lack of sanitation, open drainage system and no proper disposal of waste. So malaria, filaria, dengue, chickenguinya and meningitis are more prevalent in winter season. To protect from mosquito bite and mosquito born disease, people are widely using mosquito repellants.

II. STUDIES ON REPELLANTS

A study done on rats by the industrial toxicology research center showed that the rats suffered from brain, liver, kidney damage after prolonged exposure to liquid mosquito repellants (LMR)¹

Research in Sweden and USA showed that long term and persistent use of products containing allethrin could cause brain cancer, blood cancer and deformity of fetus.¹

Cheng et al exposed male mice to mosquito coil smoke with d-allethrin and reported loss of cilia and increased vascularity in alveolar wall². The health implications of burning one mosquito coil is equivalent to the release of the same amount of particulate matter as burning 75 to 137 cigarettes, and emitting formaldehyde equivalent to 51 cigarettes (Chen et al. 2008, Liu et al. 2003)³.

Liu and sun reported deciliation of tracheal epithelium, metaplasia of epithelial cells and morphological alterations in alveolar macrophages, after exposure of rats to coil smoke for 60 days⁴.

III. MECHANISM OF ACTION OF REPELLANTS

They don't kill mosquitoes. when apply on body, chemical present in it prevent mosquito from biting from limited period of time. The period of time depends on nature of chemical in repellent, humidity and body type⁵.

IV. TYPES OF REPELLANTS⁵

1. Creams, Roll-on sticks, Wipes, Lotions:
Effective indoor, may cause allergic reaction.
Safety precaution: purchase well known brand which clearly mention the composition and percentage of each chemical used.
2. Liquid vapours
Effective indoor, emits fumes when heated.
Safety precaution: make sure you keep away from the room where you have switched on the vapourizer.
3. Sprays and foams
Effective indoor and outdoor in limited area. Noxious fumes in the spray mist may be inhaled.
Safety precaution: may cause allergic and breathing problems.
4. Coils: effective outdoor in limited area. release smoke when burnt.
Safety precaution: allergic and breathing problem.
5. Mats:
Effective indoors. emits fumes when heated.
Safety precaution: allergic and breathing problem.
6. Essential oils such citronella, neem oil etc.
Effective on direct application, allergic reaction.

Safety precaution: as it is strong oils, should not apply baby's skin.

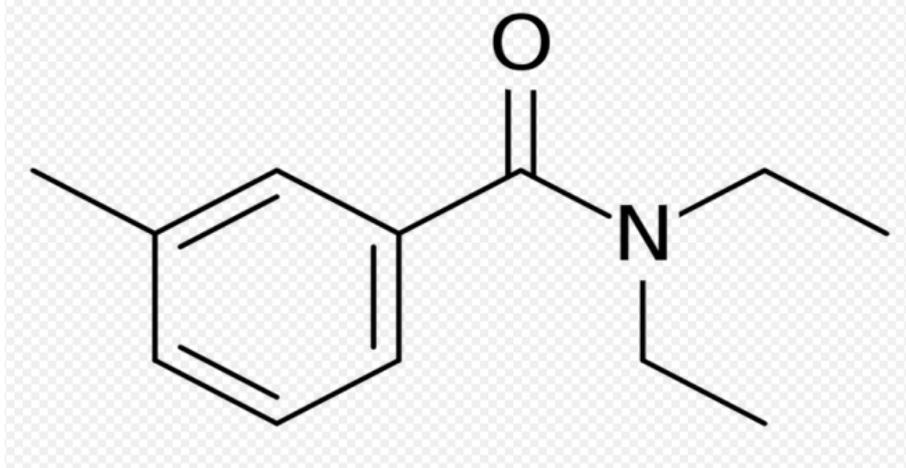
V. KINDS OF REPELLANTS⁵

1. Natural/Plant repellants- marigold, thai lemongrass, and catnip.
2. Plant derivatives- citronella, neem, peppermint, eucalyptus etc.
3. Synthetic chemicals- Diethyl Toludine(DEET) or N- N Diethyl benzamide, allethrin, bioallethrin, d- allethrin, s-bioallethrine, d-transallethrin, resmethrin, sumithrin, permethrin, malathione, synergist (pipernyl butoxide) ,

Creams, roll-on sticks, Wipes, Lotions, Liquid vapours, Sprays and foams, Coils, Mats are made from synthetic chemicals and plant derivatives⁶.

VI. HEALTH HAZARDS OF SYNTHETIC REPELLENTS

N,N-Diethyl-meta-toluamide, also called DEET or diethyltoluamide, is a slightly yellow oil. It is the most common active ingredient in insect repellents. It is intended to be applied to the skin or to clothing, and provides protection against mosquitos, ticks, fleas, chiggers, and many other biting insects. Eg. creams.



Structure of N,N-Diethyl-3-methylbenzamide or N,N-Diethyl-m-toluamide

DEET is often sold and used in spray or lotion in concentrations up to 100%⁷. Consumer Reports found a direct correlation between DEET concentration and hours of protection against insect bites. 100% DEET was found to offer up to 12 hours of protection while several lower concentration DEET formulations (20%-34%) offered 3–6 hours of protection⁸. Other research has corroborated the effectiveness of DEET⁹. The Centers for Disease Control and Prevention recommends 30-50% DEET to prevent the spread of pathogens carried by insects¹⁰. Products containing between 10% to 30% DEET have been found by the American Academy of Pediatrics to be safe to use on children, as well as adults, but recommends that DEET not be used on infants less than two months old¹¹. DEET is commonly used in combination with insecticides and can strengthen the toxicity of carbamate insecticides¹² which are also acetylcholinesterase inhibitors. These findings indicate that DEET has neurological effects on insects in addition to known olfactory effects, and that its toxicity is strengthened in combination with other insecticides.

. Long-term use of DEET could cause testicular cancer¹³. The Centers for Disease Control and Prevention (CDC) classifies DEET as a group D carcinogen -- meaning it's not classifiable as to human carcinogenicity. In simple terms, that means that they can't say it causes cancer, but they can't say it doesn't, either.

List of documented DEET health and environmental effects¹⁴:

- Cancer: Not documented
- Endocrine Disruption: Not documented
- Reproductive Effects: Not documented
- Neurotoxicity: Yes
- Kidney/Liver Damage: Yes
- Sensitizer/Irritant: Yes
- Birth/Developmental Defects: Yes
- Detected in Groundwater: Yes
- Potential Leacher: Yes
- Toxic to Birds: Not documented
- Toxic to Fish/Aquatic Organisms: Not documented

- Toxic to Bees: Not documented

The **allethrin**s are a group of related synthetic compounds used in insecticides. They are synthetic pyrethroids, a synthetic form of a chemical found naturally in the chrysanthemum flower. The compounds have low toxicity for humans and birds, and are used in many household insecticides such as LMR as well as mosquito coils. They are, however, highly toxic to fish and bees. Insects subject to exposure become paralyzed (nervous system effect) before dying. Allethrin is toxic to cats¹⁵ because they either do not produce, or produce less of certain isoforms of glucuronosyltransferase, which serve in hepatic detoxifying metabolism pathways¹⁶. Carcinogenicity studies were conducted on rats and mice which suggests evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential.¹⁷ Allethrin potentially harmful to the eyes, skin, respiratory tract and nervous system.

VII. COMPOSITION AND INGREDIENTS OF MOSQUITO REPELLANTS

All repellants contain Type I synthetic pyrethroids.

Type I pyrethroids are heat stable, used in mats, coils, and vapourizers. They produce reflex hyperexcitability and fine tremors. eg. allethrin, resmethrin, sumithrin.

Type II pyrethroids mostly organophosphate insecticides like malathion. They produce salivation, hyperexcitability, and seizures.

Type I and II both pyrethroids affect liver, thyroid, nervous, immune, endocrine systems and produce potent sympathetic activation.

VIII. PRECAUTIONS WHILE USING

BabyCenter expert and paediatrician Dr Saroja Balan advises that it is safer to use mosquito repellent creams and lotions only on babies over six months old. The chemicals in the repellents could be harmful for younger babies. They may cause an allergic reaction on your baby's delicate skin. For babies younger than six months, it's better to use baby mosquito nets and natural or herbal remedies. Dr Balan suggests lighting citronella candles to ward off mosquitoes in your baby's room. If you would still prefer using some repellent, apply it on your baby's clothes or the bedding. Make sure that you do not apply the cream in areas like the cuffs which your baby can easily put in her mouth⁵. In many Indian homes, neem leaves are burnt as the smoke that is produced helps to drive away mosquitoes. Essential oils of neem, citronella, peppermint, and eucalyptus are all known to be effective mosquito repellents. But don't apply them directly on the skin. They are strong and known to cause allergies on sensitive skin. A few drops of essential oils on your bedding will be sufficient. You could also put a few drops on a piece of cloth which you can put under your sheet⁵

IX. CONCLUSION

Today, people are sleeping in closed rooms, using liquid mosquito repellants whole night. Many people are suffering with different types of cancers, endocrine and immunological disorders. There may be close association between chronic exposure and health hazards. Health hazards depend upon concentration of ingredient and hours of exposure. More studies are needed in this context.

REFERENCES

- [1]. Case Studies and Management Resources <http://www.icmrindia.org/free%20resources/casestudies/alloutmarketing%204.htm>
- [2]. Cheng, V., Lee, H. R. and Chen, C. S., *Toxicol. Lett.*, 1992, 62, 163–177.
- [3]. Toxicological effects of prolonged and intense use of mosquito coil emission in rats and its implications on malaria control <http://revistas.ucr.ac.cr/index.php/rbt/article/viewFile/11972/11274>
- [4]. Liu, W. K. and Sun, S. E., *Toxicol. Lett.*, 1998, 41, 145–157
- [5]. <http://www.babycenter.in/a1011642/how-do-mosquito-repellents-work>
- [6]. <http://www.herbalstrategi.com/2014/11/23/14865/>
- [7]. Record in the Household Products Database of NLM
- [8]. Matsuda, Brent M.; Surgeoner, Gordon A.; Heal, James D.; Tucker, Arthur O.; Maciarelo, Michael J. (1996). "Essential oil analysis and field evaluation of the citrosa plant "Pelargonium citrosum" as a repellent against populations of Aedes mosquitoes". *Journal of the American Mosquito Control Association* **12** (1): 69–74. PMID 8723261.
- [9]. David Williamson (3 July 2002). "Independent study: DEET products superior for fending off mosquito bites" (Press release). University of North Carolina.
- [10]. "Protection against Mosquitoes, Ticks, Fleas and Other Insects and Arthropods". *Travelers' Health - Yellow Book*. Centers for Disease Control and Prevention. 2009-02-05.
- [11]. "Insect Repellent Use and Safety". *West Nile Virus*. Centers for Disease Control and Prevention. 2007-01-12.
- [12]. Moss (1996). "Synergism of Toxicity of N,N-Diethyl-m-toluamide to German Cockroaches (Othoptera: Blattellidae) by Hydrolytic Enzyme Inhibitors". *J. Econ. Entomol.* **89** (5): 1151–1155. PMID 17450648
- [13]. <http://www.atsdr.cdc.gov/consultations/deet/carcinogenicity.html>
- [14]. <http://adventure.howstuffworks.com/outdoor-activities/hiking/deet3.htm>

- [15]. "Pyrethrin and Permethrin Toxicity in Dogs and Cats". peteducation.com.
- [16]. Court, M. H.; Greenblatt, D. J. (2000). "Molecular genetic basis for deficient acetaminophen glucuronidation by cats: UGT1A6 is a pseudogene, and evidence for reduced diversity of expressed hepatic UGT1A isoforms". *Pharmacogenetics* **10** (4): 355–369. doi:10.1097/00008571-200006000-00009. PMID 10862526
- [17]. <http://www.epa.gov/pesticides/reregistration/REDs/allethrins-amended-red.pdf>