

Cypermethrin Toxicity: A Review



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Abstract

Despite considerable concern regarding the wide use of Cypermethrin for agricultural, insecticidal and veterinary, convincing evidence of Cypermethrin toxicity in human is perceived. Cypermethrin is a synthetic parathyroid, catastrophic in nature and no antidote for its poisoning is available till date. The exposure of Cypermethrin targets sodium channel along with magnesium and Apse in human body. Cypermethrin besides of neurotoxin effects also has hepatotoxic effects that induce microtonal enzymes in liver. Animals tend to have higher tolerance to Cypermethrin than humans but; in direct contact or oral exposure, it is equally toxic in nature. In this study we reviewed the current state of knowledge on Cypermethrin toxicity and its impact on behavior; molecular level and reproductive system in human and animals

Keywords: Cypermethrin; Toxicity; Neurotoxicity; Molecular Channels; Reproductive Toxicity.

Introduction

Cypermethrin is a synthetic pyrethroid which is highly used pesticide in agriculture, household and animal husbandry mainly to crack, crevice and spot treatment for control of insects. It is a mixture of all eight possible chiral isomers [1] (Figure 1).

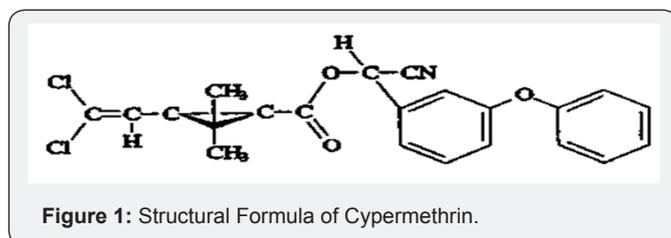


Figure 1: Structural Formula of Cypermethrin.

Other synthetic pyrethroid

- Bifentherin:** is manmade pyrethroid that is a highly used insecticide for agricultural crops and the household work. It comes in many forms, which includes spray, liquid, granule and areoles. Humans can get easily affected by bifentherins, by breathing or touching. Bifenthrin shows slow absorption and is excreted out within 3-7 days [2,3].
- Deltamethrin:** is a synthetic pyrethroid that can be poisonous by dermal contact or may be ingested by the digestive system of the animal. It is one of the highly used pesticides for the commercial use to control the pests. It is the most toxic and hence the most powerful pyrethroid [4].
- Flumethrin:** is a synthetic pyrethroid that is used in veterinary treatments. 10% flumethrin with hot water is used as the treatment for parasitic ticks in the domestic animals. No harmful impact of this pyrethroid has been

reported by skin contact, but when comes in direct contact orally, its toxic effect has been observed [5].

General Effects

Cypermethrin is a reasonably toxic material when intake is through ingestion or directly through dermal absorption. The major symptoms of dermal exposure include symptoms of irritation, itching at skin and eyes, numbness, tingling and itching, burning sensation, loss of bladder control, incoordination, seizures and some time it may lead to death. Nervous and muscular system is the major part which is affected mainly by intoxication with Cypermethrin and other synthetic pyrethroids. The toxic oral dosage in mammals is greater than 100-1000mg/kg and the potentially lethal acute oral doses 10-10g [6]. In extreme cases, sustained inhalation of high doses can cause respiratory paralysis and death. A frequent cause of intoxication in pets is off-label use of products for livestock, crop protection or vector control on dogs and cats. Since such products do include use instructions for pets. Short-term neurotoxicity caused by Cypermethrin is primarily mediated through hyper-excitation of the central nervous system. Additionally, Cypermethrin induces neurotoxicity by modulating the level of gamma-aminobutyric acid (GABA). Furthermore, Cypermethrin-mediated neurotoxicity is contributed by its ability to induce free radical generation.

Methodology

The study was conducted to summarize the effects of Cypermethrin on human and animals. The journal articles were assessed to compile the data. Various authenticated servers like:

pub med, science direct, Elsevier direct were used to collect and compile data.

Discussion

Effects on Human

Cypermethrin is a highly used pesticide for the purpose of killing pests in households, agricultural crops and for several other reasons. Due to the severe increase in usage of Cypermethrin in daily life and its exposure to human beings to such extent, Cypermethrin has caused many health hazards which results into physiological impact, neurotoxicity, reproductive toxicity, molecular toxicity and so on.

Physiological Impact

Varying degree of mild to moderate toxic symptoms and behavioral changes in both male and female rats were observed by Grewal et al. [7,8]. on administration of Cypermethrin at repeated oral doses of 5ml and 20 mg/kg/day for 30 days. Hemorrhages within myocardium, disruption of branching structure, and loss of striation of cardiac tissue which is further followed by the thickening of alveolar septa in lungs, partial to extensive loss of various stages of spermatogenesis in testes, and loss of follicular cells and oocytes in ovaries [7]. The physiological effect of Cypermethrin is also seen on the reproductive health of male. Ahmad et.al. [9]. has concluded in their study that the exposure to Cypermethrin leads to the decrease in testicular and epididymal sperm count. Also, degeneration, arrested spermatogenesis and connective tissue proliferation in testes, while sperm-less seminal plasma and tailless spermatozoa in epididymis. Hence, it was inferred that Cypermethrin induces defects in sperms and pathological alterations in testes and epididymis [9].

Neurological Impacts

It has been observed that Cypermethrin-induced neurotoxicity through free radical formation, reduced antioxidant defense mechanism, and inhibition of acetylcholinesterase (AChE) activity [10]. Cypermethrin displays AChE inhibitory activity by interacting with the anionic substrate binding site. Sharma et.al (2014) observed the resveratrol ameliorates by Cypermethrin-induced brain damage by reducing oxidative stress and by enhancing AChE activity in Westar rats [10]. The effect of Cypermethrin is also observed on the neurobehavioral screening. Mcdanielel.al has concluded that Cypermethrin causes neurobehavioral changes in pawing, burrowing, salivation and it also causes whole body tremor to choreoathetosis, hypothermia, and lower the motor activity. Pronounced neuromuscular weakness and equilibrium changes, retropulsion, lateral head movements, alterations in responses to various stimuli, and increased urination were also observed in cypermethrintoxicity [11].

Impacts at Molecular Level

The effect of pesticides mainly Cypermethrin at molecular level in human body is highly discussed in many studies [12]. It

has been documented that the pyrethroids targets the sodium channel, and shows minor effects on the magnesium channel and Apse. A few studies state Cypermethrin is an axonic poison if it is chemically altered. It may bind to a protein in nerves at voltage-gated sodium channel and prevent it from closing normally which results in continuous nerve stimulation [13]. It leads to tremors and loss of nervous control. Cypermethrin are most of the time used with pepperoni but oxide (PBO) which acts as synergist. PBO enhances the effect of Cypermethrin by inhibiting an enzyme (cytochrome P450) produced by the insect to break down the pesticides. In addition to that the deleterious effect of Cypermethrin has been observed on the nigrostriatal tissues.

Effects on reproductive system

Adverse effect of Cypermethrin in acute or chronic stage has been observed on the seminal gland [14]. Also, the toxic acute activity of the Cypermethrin was observed as an augmentation on the height and proliferation of the cells of the Secretory epithelium of this organ, while both the acute and chronic effects were evidenced by the progressive appearance of mast cells [15]. Rodriguez et.al [14]. Concluded that this phenomenon which could reveal an asymptomatic inflammatory status that, in fact might affect male infertility. The increasing use of Cypermethrin despite in acute or chronic order may lead to cause the adverse effects on the male fertility in coming years. The food is also under the effect of Cypermethrin as it is highly used pesticide in agricultural practices. Despite that it is highly used in household activities to fight against insects, and regular use may cause chronic toxicity among the humans that may influence the fertility [13].

Impacts on Animals

Cypermethrin usually act on the membrane of nerve cells blocking the closure of the ion gates of the sodium channel during re-polarization [15]. This strongly disrupts the transmission of nervous impulses, causing spontaneous depolarization of the membranes or repetitive discharges [16]. At low concentrations, insects and other arthropods suffer from hyperactivity. At high concentrations they are paralyzed and die. Sensory and nervous cells are particularly sensitive [16]. When Cypermethrin applied to animals, very poorly absorbed through the skin due to hair coat. Though the absorption to blood is low, it is quickly metabolized in the liver to non-toxic metabolites that are excreted through urine and the metabolism is accelerated by the specific enzyme glucuronidase [17-19]. A few chordate like, cats lack this enzyme glucuronidase, cannot metabolize Cypermethrin in and other synthetic pyrethroids [13]. Therefore, Cypermethrin in and other synthetic pyrethroids are toxicity are more in these animals. Though, Cypermethrin products are approved for use on dairy animals, its oral ingestion may produce reproductive toxicity same as in humans.

Conclusion

Cypermethrin is a highly used pesticide for agricultural and household purposes. The easy availability of Cypermethrin

in results in the suicidal, homicidal, and accidental acts. As no antidote is available to overcome its toxic effect, the toxicity leads to death. If human comes in contact with it either in acute or chronic stage, through dermal or oral exposure, it does causes toxicity. While in animals, skin is resistant to the exposure of Cypermethrin, but when the exposed orally or directly then it will cause toxic effects as same in human beings. Cypermethrin induced molecular toxicity is a matter of concern, as humans are exposed to it, in their day-to-day life. Despite variability at molecular level responsiveness due to various contributory factors, such as doses, routes of exposure, time, age, environment and as well as the particles potential of Cypermethrin to induce neurodegeneration has been a major concern in neuroscience research. The toxic activity of cyper methr in affects seminal glands in males that reveal an asymptomatic inflammatory status that in fact may cause male infertility. Also, it induces toxicity effects on the behavior and histopathological changes are observed. Hence, it can be concluded that Cypermethrin in do have adverse toxic effect on the humans and animals, though the toxic level varies with the nature and extent.

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