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Review

Cypermethrin induced toxicities in fish and adverse health outcomes: Its prevention and control measure adaptation

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ABSTRACT

Pesticides are being widely employed in the modern agriculture, though in different quantities, across the globe. Although it is useful for crops yield enhancement, however, there are the serious environment, health and safety related concerns for aquatic and terrestrial living biomes that include humans, animals, and plants. Various in practice and emerging pesticides adversely affect the survival, development and biological systems stability. Several research efforts have been made to highlight the bio-safety and toxicological features of toxicants through risk assessment studies using different animal models, e.g., different fish species. Among several pesticides, cypermethrin is extensively used in agriculture and households, and the reported concentrations of this pesticide in different water bodies including rivers and streams, soil and even in rainwater are threatening. Consequently, cypermethrin is considered for risk assessment studies to know about its deep and different level of toxicological effects subject to its dose, exposure time and route. The cypermethrin existence/persistence in the environment is posing a severe threat to humans as well as another non-target terrestrial and aquatic organism. Herein, the toxic effects of pesticides, with special reference to cypermethrin, on fish, the mode of toxicity, concerns regarding public health and harmful impacts on human beings are comprehensively reviewed. The information is also given on their appropriate control and prevention strategies.

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1. Introduction

The industrial advancement is accompanied by various synthetic chemicals which can get dissolved and pollute water streams particularly in aquatic bodies (Ullah et al., 2014a). The dissolution of these chemicals is a leading cause of environmental pollution of almost all the key spheres including hydrosphere, lithosphere, and biosphere among others. Environmental pollution is a multifaceted and complex phenomenon with partially known or unknown origin (Ullah et al., 2014b). In recent decades, environmental pollution has emerged as a core issue around the globe, rendering it of fundamental concern to the ecotoxicologists, environmental biologists, eco-chemists, pathologists and researchers from other fields. Owing to the rapid industrial expansion and continued growth of human population, the consequences of environmental pollution are worse than before (Sthanadar et al., 2015).

Human beings and terrestrial animals are continuously being exposed to different types of pesticides via numerous ways such as occupational exposure, residential exposure and through consumption of pesticides-polluted water and food. Aquatic organisms, e.g., fish are exposed to pesticides and their residues via different routes including run-offs or spray drifting from agricultural fields, gardens, and orchids. Among the aquatic organism, fish is considered as an excellent sentry for evaluating the toxic effects of pollutants. Pesticides lead to water bodies, deteriorating its quality followed by affecting the abiding organisms (Sarwar et al., 2007; Sabae et al., 2014). It also adversely affects biodiversity at both regional and local level, alter the functions of the ecosystem as well as impact the interspecies communication (Shuman-Goodier and Propper, 2016). Heavy mortalities of fish have been observed worldwide because of different toxicants, present in over permissible limits (Ullah and Zorriehzahra, 2015). A significant threat is posed to human via consumption when these chemical bioaccumulate in edible tissues of the aquatic organisms even at low concentrations (De Gavelle et al., 2016). Cypermethrin (CYP) is one of the most widely used pesticides around the globe. CYP has been investigated for its toxicity against different aquatic organisms such as fish, mussel, daphnia, etc., lizards, goats, and human cell (Ahmad et al., 2009; Akinrotimi et al., 2012; Chen et al., 2016; Dawar et al., 2016).

The molecular analysis and epidemiological studies showed that pesticides lead to damage at genetic/DNA level as well as cause different types of cancers (Alavanja and Bonner, 2012). Although pesticides play a core role in securing food and vector control, yet it is hazardous as it leads to different chronic and acute illnesses among the exposed communities (Ullah and Zorriehzahra, 2015). This review focuses on the toxicological impacts of pesticides with particular reference to CYP on fish, its toxicological mechanism of action and mode of toxicity. The associated risks via consumption of pesticides in bulk at various agricultural levels are discussed. The major control and suitable preventive measures that need to be adopted are also discussed.

2. Pesticides-based pollution – an alarming threat

Globally, thousands of chemicals are synthesized and used under this broader term of pesticides. Nowadays, pesticides are being extensively employed in almost all sectors including agricultural, livestock and households, etc. Their existence or persistence in water and soil is attributed to run from agricultural setups, seepage through soil and transportation via air (Fevery et al., 2016). A considerable number of insecticides are documented by the pesticides action network (UK PAN, 2009), but class pyrethroid is the widely and most commonly used (Allinson et al., 2015). Due to this widespread presence, pesticides are considered as the key contributor to pollution (Hua and Relyea, 2014). Across the globe, different pesticides are synthesized in various ratios, e.g., herbicides (15%), fungicides (1.46%) and insecticides (80%) (Marigoudar, 2012). Previous studies revealed the presence of pesticides in the water bodies, aquatic organisms and sediments in higher concentration (Zheng et al., 2016).

2.1. Common pesticides and classification

There are different classes of pesticides consisting of thousands of various chemicals. These are used in agriculture, domestic and industrial sectors for an economy boost up, higher yields/production, saving time, reduced labor dependence and public health perspectives (Molina-Ruiz et al., 2015; Rocha et al., 2015; Ullah and Zorriehzahra, 2015; Ullah et al., 2015). Some of the widely employed pesticides are shown in Table 1. Pesticides are divided/

Table 1
Names of the different pesticides used around the globe.

S. No.	Name of the pesticides	S. No.	Name of the pesticides
1	Acephate	2	Fenvalerate
3	Alaclor	4	Sevin
5	Akton	6	Rogor
7	BHC	8	Endosulfan
9	Carbaryl	10	Malathion
11	Carbofuran	12	Termifos
13	DDT	14	Delmithrin
15	Endosulfan	16	Paraquat
17	Diazinon	18	Allethrin
19	Elsan	20	Resmethrin
21	Permethrin	22	Deltamethrin
23	Biosal	24	Permithrin
25	λCyhalothrin	26	Bifenthrin
27	Dimethoate	28	Cinerin
29	Methyl parathion	30	Jasmolin
31	Metasystox	32	Sumithion
33	Fenitrothion	34	Lindane
35	Dichlorvos	36	Dieldrin
37	Aldrin	38	Triazine
39	Heptachlor	40	Chlordane
41	DDE	42	Chlorpyriphos
43	Malathion	44	Pestanal
45	Banvel	46	Zineb
47	Flurochloridone	48	Aficida
49	Imidacloprid	50	Cypermethrin