







Review

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

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Highlights

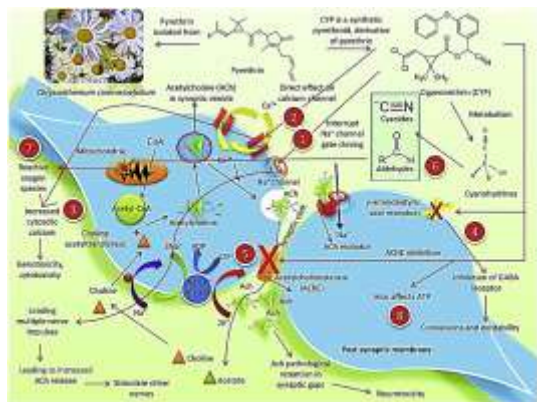
- Herein, the toxic effects of pesticides, the mode of toxicity, and harmful impacts are reviewed.
- Pesticides exposure and associated human vulnerabilities are discussed.
- The information is also given on their appropriate control and prevention strategies.

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.

Graphical abstract



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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 orchards. 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.

Section snippets

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

Cypermethrin (CYP) – a model pesticide

Pyrethroids are divided into two types, i.e., (1) type I (allethrin, tetramethrin, permethrin, resmethrin, and bioresmethrin) and (2) type II (cyfluthrin, deltamethrin, cyphenothrin and CYP), based on their chemical structure. CYP is a widely used, efficient and readily available pyrethroid, derived from pyrethrin, itself extracted/derived from *Chrysanthemum cinerariaefolium* (Soderlund et al., 2002, Ahmad et al., 2009). It is employed in almost every type of agricultural setups, gardens,

Prevention/control measure adaptation

Proper management should be practiced, and strategies should be devised to minimize the use of pesticides, specifically gradual phase-out of synthetic ones completely. Industrial agriculture should be replaced with ecological farming to reduce the potential risks. Crops should be protected at multi-level approaches, instead of solely depending on pesticides, which will not only elevate heterogeneity of the landscapes and suitable habitat for pollinators but also controlling pests

Conclusion and future directions/perspectives

Pesticides are employed globally to avoid damage to the crops and elevate their quantity and quality. Although their use resulted in a higher yield, research finds these to be disadvantageous and threats imposing to the environmental, animal and human health, and safety. Most of the time, the non-target organisms are continuously disturbed and adversely affected, due to the persistence of the widely used toxic pesticides, employed on a regular basis. These pesticides affect the survival and

Conflict of interest

The authors report no conflicting interest in any capacity, competing or financial.

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