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Studies on effect of fipronil on behavioural aspects and protein metabolism of freshwater fish *Oreochromis mossambicus*

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Abstract

Pesticide application plays a crucial role in modern day agriculture. Leaching and mixing of chemicals from agricultural practices have a direct impact on the aquatic systems posing great threat to the aquatic life forms. Indiscriminate usage of new class insecticide fipronil (FPN) has been found to affect freshwater fish. The present work was aimed to elucidate the toxicity of FPN on freshwater fish, *Oreochromis mossambicus*. The acute toxicity was evaluated and 96 hr LC₅₀ was found to be 3.0 mg/L. Further, two sub-lethal concentrations (0.5 mg/L and 1.0 mg/L) were selected for the assessment of behavioural toxicity and protein metabolism investigations. The duration of exposure selected for each sublethal concentration was 7 and 14 days. Changes in behavioural responses were noticed in fish exposed to FPN and found to affect the fish in dose and duration dependent pattern. Protein levels were estimated in terms of soluble, structural and total proteins and were found to significantly ($p < 0.05$) decline with the increase in the days of exposure. Based on the outcome of the present study, it is inferred that FPN is highly toxic as it affects the behavioural aspect and protein biochemistry within the exposed fish. It is therefore suggested that care must be taken when FPN is used and disposed in the proximity of aquatic habitats.

Keywords: Ecotoxicology, fipronil, fish, tilapia

1. Introduction

By virtue, pesticides have turned out to be an integral utility in agricultural practice [1]. The environmental impact of pesticides is often greater than what it is intended by the users. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water, sediments and even food [2]. Assessing the toxicological impact on aquatic organisms is therefore one of the preliminary requirement for maintaining a balanced ecosystem [3]. Environmental monitoring plays a major role which provides a frame-work for the controlled usage of chemical pesticides for agriculture, household and veterinary uses. Fishes are one of the economically important natural resources which are known to play a crucial role in ecological sustenance [4].

The scarcity in the fish population is a matter of concern that has attracted many studies in the view of their conservation, proper health and growth which is important under aquaculture practice. Additionally, fishes serve as a form of cheap protein and also constitute to the major minerals and nutrients which otherwise act as an important component in the diet [5]. Fishes are directly exposed to the environmental stressors, the impact of which can be assessed at various levels viz., behavioural [6], histopathological [7], and biochemical outcome [8]. This makes them ideal organisms to analyze the impact of toxicants that are released into the aquatic systems by the water flow from the fields and disposed off from the industries and storage tanks. Few of these toxicants are potentially biodegraded if they have a short half-life, whereas some persist for a longer duration without undergoing degradation. The level of persistence is also attributed to the by-products of pesticides that cause more harm than the parent compound.

Fipronil (5-amino-1-[2, 6- dichloro-4-(trifluoromethyl) phenyl]-4-[(trifluoromethyl) sulfinyl]-1H-pyrazole-3-carbonitrile] (FPN) is the first and a highly active, broad spectrum pesticide from the phenylpyrazole chemical family effective against a wide range of economically important pests [9]. FPN was first registered for use in the United States in 1996. This pesticide is designed to specifically inhibit insect gamma amino-butyric acid (GABA) receptors in the