

# Effect of 2,4-D Pesticide on Fish Physiology and its Antioxidant Stress

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## Abstract

This study was designed in such a way to assess the toxicity effect of 2, 4- D pesticide in fish physiology and its antioxidant stress. *Channa striatus* fishes were administered with two different dose compensation of 2,4-D pesticide of 100 and 200 mg/kg. After a matter of time interval the effect of 2,4-D on fish behavior and its toxic level was determined by assessing its blood parameter and antioxidant enzyme level. Hemocyte count has considerably reduced in 2,4-D treatment and its responsive antioxidant enzyme level of SOD and Catalase level was also drastically altered. The present study concludes the toxic effect of 2,4-D usage.

**Key words** *Channa striatus*, 2,4-D, Fishes, Pesticide.

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## Introduction

Chemical pollution in the environment by pesticides has been increasing due to their extensive usage in agriculture. Alterations in the chemical composition of natural aquatic environments can affect the freshwater fauna, particularly fish. Many of these compounds or their metabolites have shown toxic effects related to oxidative stress (Winston and Di Giulio, 1991).

Environmental contamination by pesticides may cause physiologic and behavioral changes in fish and also affect functions such as reproduction and metabolism (Oruc- and Uner, 1999; Bretau et al., 2000). The 2,4-D is a widely used herbicide in Southern Brazil due to its low cost and good selectivity. This herbicide has poor biodegradability and has been frequently detected in water courses (Chingombe et al., 2006).

The 2,4-D can be considered as having low contamination potential for surface waters and as a transitional contaminant of subterranean waters in Southern Brazil (Primel et al., 2005). According to Oruc- et al. (2004), 2,4-D showed properties similar to natural plant hormones, being used therefore as a weed killer. This herbicide is generally considered to be non-toxic for fish at low doses (Gallagher and Di Giulio, 1991).

Generally, biochemical parameters are very sensitive to sublethal concentration of many stress agents (Sancho et al., 1997).

Organisms exhibit a characteristic response to a stressor that may be measured through a variety of enzyme activities and metabolic parameters in blood, liver, and muscle. In the present study the effect of 2,4-D stress on antioxidant enzyme status of *C.striatus* fish was evaluated.

## Materials and Methods

**Chemicals.** 2,4-Dichlorophenoxyacetic acid, Enzyme assay kit (Cayman chemicals).

**Experimentation.** *C.striatus* fishes of 150 gram were grouped in culture tanks. Three group of fish set up which constitutes Group I: Control, Group II: 100 mg/L 2,4-D treated fishes Group III: 200mg/L 2,4-D treated fishes.

**Chemical treatments and assay:** 2,4-D pesticide was applied on water in fish tanks and acclimatized for a week time. After a week period fishes were sacrificed and there muscle tissue were dissected out and freezed for antioxidant enzyme assays like Superoxide dismutase, Catalase, Glutathione peroxidase and Glutathione transferase.

**Statistical analysis.** All experiments were repeated three times with duplicate samples. Data were analyzed by

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analysis of variance using the ANOVA procedure of SAS (SAS Institute, Cary, NC) for a completely randomized design (treatment, storage time and treatment×storage).

**Table 1. Antioxidant enzyme status in *C.striatus* fishes after 2,4 – D treatment.**

Group	SOD	Catalase	Glutathione peroxidase	Glutathione transferase
Control	140.00 ± 9.85	4.52 ± 0.16 <sup>a</sup>	1.54 ± 0.05 <sup>a</sup>	36.05 ± 5.06
100 mg / L	104.37 ± 7.16	6.82 ± 0.37 <sup>b</sup>	2.06 ± 0.22 <sup>b</sup>	25.19 ± 2.63 <sup>c</sup>
200 mg/L	90.8 ± 7.22 <sup>c</sup>	7.26 ± 0.32 <sup>d</sup>	2.08 ± 0.2 <sup>c</sup>	24.63 ± 1.75 <sup>c</sup>

<sup>a</sup> Data represent means±standard deviations of three measurements.

<sup>b</sup> Mean with the same letter within a row (following the values) are not significantly different ( $P < 0.05$ ).

<sup>c</sup> Mean with the same letter within a column (following the values) are not significantly different ( $P < 0.05$ ).

### Results

Table 1 shows the antioxidant status of fishes treated with 2,4-D pesticide. Superoxide dismutase (SOD) was relatively altered after 2,4-D treatment and at 200 mg the level of SOD was drastically altered

Catalase enzyme and Glutathione peroxidase enzymes are also reflected pronounced change in their level of 7.26 ± 0.32 and 2.08 ± 0.2 which is effected in 200 mg/L of 2,4-D.

Glutathione transferase also incredibly reduced after 2,4-D treatment which tends the fishes to get prone to ancillary stress.

### Discussion

Pesticides may induce oxidative stress leading to the generation of free radicals and cause lipid peroxidation as molecular mechanisms involved in pesticide-induced toxicity (Agrawal et al., 1991; Khrrer, 1993; Almeida et al., 1997). Increased lipid peroxidation and oxidative stress can affect the activities of protective enzymatic antioxidants that have been shown to be sensitive indicators of increased oxidative stress.

The 2,4-D functions by maintaining high levels of the plant hormone auxin, resulting in overstimulation of plant growth and death (Ateeq et al., 2005). It is known, that 2,4-D causes changes in the animal nervous system through complex formation with acetylcholine and inhibition of AChE (Sarıkaya and Selvi, 2005; Benli et al., 2007).

This study shows that 2,4-D has drastic effect in lowering the antioxidant enzyme status of *C.striatus* fishes where by

the fishes can prone to other diseases which tentatively cause fish mortality in aquaculture society. Hence the usage of 2,4-D on fish aquaculture should be very curious.

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