

Effect On Haemoglobin Concentration of Carbofuran in *Channa Punctatus* (Bloch.)

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Abstract—Carbofuran is one of the most important and widely used pesticides for agricultural practices. The excess use of Carbofuran leads to the intoxication of the water bodies and thus disturbs the aquatic environment. The present study reveals the effect of Carbofuran on the hemoglobin percentage in fresh water fish, *Channa punctatus* (Bloch.) as a physiological marker to estimate the effect of Carbofuran. It was revealed that Carbofuran is a potent haemoglobin influencer resulting the reduction in haemoglobin percentage in all the different experimental groups viz., Lower Middle, and Higher doses of Carbofuran. The results show the reduction of haemoglobin concentration (g/dl) at three Concentrations Lower Dose (CF₁), Middle Dose (CF₂) and Higher Dose (CF₃), the mean value of haemoglobin (g/dl) concentration were 6.99, 6.72 and 5.41 (g/dl) respectively. It showed significantly gradual decrease in haemoglobin with the increasing doses of Carbofuran.

Index Terms—Carbofuran, Pesticide, *Channa punctatus*, Physiological Marker, Hemoglobin Conc.

I. INTRODUCTION

An essential indicator of the overall health of every organism with a blood circulatory system is the concentration of haemoglobin. Following exposure to different pesticides, a body's physiological hormones can change from their usual value under the impact of a certain parameter, which may be interpreted as a sign of either positive or negative consequences (Ekor, 2014). As an example, exposure to sub-lethal levels of Carbofuran in fish species like *Labeo rohita* results in significant time- and dose-dependent decreases in haemoglobin (Hb) content, red blood cell (RBC) count, and hematocrit, often leading to anemia (Das & Mukherjee, 2003).

The broad-spectrum, systemic N-methyl carbamate insecticide Carbofuran poses a serious risk to aquatic environments due to its high toxicity and high-water solubility (Mishra et al., 2020). It is still in use in some regions of Asia, Australia and South America even though it is prohibited in 63 nations, including the United States and the European Union (Mishra et al., 2020; Rotterdam Convention, 2015). Carbofuran is a common pesticide used in household and agricultural applications in India, though recent regulations have significantly restricted its use on several crops (Directorate of Plant Protection, Quarantine & Storage, 2023).

Channa punctatus (Bloch), the spotted snakehead is widely used as a model organism for assessing pesticide toxicity due to its hardy nature, year-round availability, and air-breathing capability, which allows it to survive in low-oxygen or contaminated environments where other fish might perish (Agrahari et al., 2007; Mishra., et al., 2016; Waghmare & Baile, 2017 and Yadav & Trevedi, 2009).

II. MATERIALS AND METHODS

Experimental Fish

Fish weigh approximately 70 ± 5.0 g and measure 18.0 ± 5.0 cm in length. They used *Channa punctatus* (Bloch). Table 1.1 provided the treatment protocols for the various groups' hemoglobin values. The acid haematin (Sahli's approach) method was used to quantify hemoglobin (g/dl) (Wintrobe et al., 1967).

Experimental Procedure

Adult *Channa punctatus* (Bloch) weighing 70 ± 5.0 g and measuring 18.0 ± 5.0 cm was gathered from a local Bhagalpur market. For ten to fifteen days, they were kept in an aquarium with dirty water to acclimate to

lab settings and give them a healthy food (Pandey et al., 2011).

After that, the fish were moved to the University Department of Zoology Cytogenetics lab at T.M. Bhagalpur University Bhagalpur, where they were acclimated for ten to fifteen days in a glass aquarium filled with tap water at room temperature. Three times a day, the fish were fed dry prawn meal and cooked chicken eggs during acclimation. Following a fifteen-day period, the experimental fish were split up into four groups and treated Carbofuran. Each group has twenty liters of tap water and ten fish.

The experimental design for the treatment of Carbofuran at three different concentration viz. Lower dose (CF₁) at 0.09mg/L, Middle dose (CF₂) at 0.18mg/L and 0.45mg/L respectively in aqueous suspension. The LC₅₀ of Carbofuran in *Channa punctatus* (Bloch.) was estimated as 0.9mg/L by Tiwari et al., 2016. The lower dose is 1/10th, middle dose is 1/5th and the higher dose is 1/2th of the LC₅₀ concentration.

Haemoglobin Estimation

The concentration of haemoglobin (g/dl) was estimated by acid haematin (Sahli's technique) method (Wintrobe et al., 1967).

Group	Treatment Protocol	Symbol	Dose	LC ₅₀
1	Control	C	No Treatment of Carbofuran	-
2	Lower dose of Carbofuran	CF ₁	0.09 mg/L (≈ 1/10 of LC ₅₀)	0.9 mg/L (Tiwari et al., 2016)
3	Middle dose of Carbofuran	CF ₂	0.18 mg/L (≈ 1/5 of LC ₅₀)	
4	Higher dose of Carbofuran	CF ₃	0.45 mg/L (≈ 1/2 of LC ₅₀)	

Table 1.0: Experimental design for Carbofuran pesticide treatments

III. ANALYSIS OF STATISTICS

The statistical analysis at the P<0.05 level, and the data are shown as % ± S.E.

IV. RESULT AND DISCUSSION

The control group's mean hemoglobin level was 7.72 (g/dl). The mean concentration of hemoglobin (g/dl)

in the Carbofuran-treated group at three concentrations (CF₁, CF₂ and CF₃) was 6.99, 6.72, and 5.41(g/dl) respectively. It demonstrated a markedly slow decline in hemoglobin as Carbofuran dosages increased (Table 2.0).

Table 2.0: Level of Haemoglobin (g/dl) in control and treated with three different doses of Carbofuran

Group	Experimental Protocol	Symbol	Mean±S.E. {Haemoglobin (g/dl)}
1	Control	C	7.72±0.1493*
2	Lower Dose	CF ₁	6.99±0.1785*
3	Middle Dose	CF ₂	6.72±0.1629*
4	Higher Dose	CF ₃	5.41±0.1899*

Indicate significant difference at p<0.05

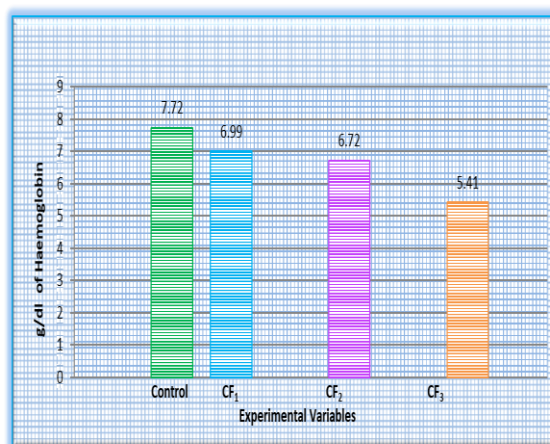


Figure 1.0: Haemoglobin value (g/dl) in control and different treated group of Carbofuran.

The present investigation reveals that all the three different experimental doses viz., Lower (CF₁), Middle (CF₂) and Higher (CF₃) proves to be potent toxic in terms of disturbing the haemoglobin concentration. Further, all the three different concentrations showed a gradual relationship in their effect on haemoglobin (Table 2.0 & 1.0).

Statistical validation of the data showed significant values for Lower, Middle and Higher dose groups for haemoglobin reduction at the probability p>0.05 (Table 2.0). All the data were calculated for mean± Standard Errors.

The present study further confirms the toxic behaviour of Carbofuran on fresh water fish *Channa punctatus* (Bloch.) similar to the earlier works of Abidi & Srivastava, (1988) and Ghazala & Mahboob (2018). Alteration in haemoglobin concentration in fresh

water fish due to toxic behaviour of Carbofuran was studied earlier in addition to *Channa punctatus*, a number of additional freshwater fish species have been investigated to see how Carbofuran affects general hematology and hemoglobin (Hb) content. The most well-known model organisms are *Sarotherodon Melano Theron* (Black-jaw Tilapia) (Ezike, 2017), *Cyprinus carpio* (Common Carp) (Mishra et al., 2020), *Clarias batrachus* (Walking Catfish) (Kumari & Yadava, 1988), and *Labeo rohita* (Rohu) (Adhikari et al., 2004).

The decrease in haemoglobin concentration (g/dL) with the exposure of Carbofuran pesticide in *Channa punctatus* (Bloch.) in the present study was found significant in a dose dependent manner, similar to findings of Mishra et al. (2016), Sawhney and Johal (2000), Chakrabarty and Banerjee (1988).

V. CONCLUSION

It was concluded from the present study that Carbofuran has the potential toxic behaviour for haematological parameters as concentration of Haemoglobin (g/dL). All the experimental groups Lower (CF₁), Middle (CF₂) and Higher (CF₃) dose group for an experimental time period of 96 hours in lab condition showed a linear progression in the decrease in Haemoglobin concentration viz., 6.99, 6.72, and 5.41(g/dL) respectively as compared to the control group hemoglobin level was 7.72 (g/dL).

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CONFLICT OF INTEREST

There are no conflicts of interest among the authors.

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