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Comparative Study of Biochemical Alterations Induced by Carbofuran and Malathion on *Channa punctatus* (Bloch.)

Muddassir Ahmad Thoker
Department of Zoology, PMB Gujrati Science College Indore, Devi Ahliya University, Indore, M.P., INDIA

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Abstract

Channa punctatus, fish were exposed to sub lethal concentrations of carbofuran (0.1ml) and malathion (0.09ml) for 28 days. The biochemical effect induced by carbofuran and malathion pesticides on liver of fish, Channa punctatus (Bloch.) at different time intervals 7,14,21 and 28 days showed statistically significant increase value in liver glucose and significant decrease value in total protein level.

Keywords: Channa punctatus, carbofuran, malathion, biochemical parameters.

Introduction

Pesticides are widely used substances in agriculture practices. The use of pesticides has resulted in increased crop production and has raised concerns about potential adverse effects on the environment and human health. In the dry season, pesticides are known to cause serious environmental problems because during this period, the dilution capacity of water system is low and thus increasing the risk of high concentrations of toxic chemicals[1].

Aquatic ecosystems that run through agricultural areas have high probability of being contaminated by runoff and ground water leaching by a variety of chemicals. Pesticides are used tremendously, which on entering the aquatic environment lead toxic effects on aquatic organisms and alters biochemical changes in aquatic organisms. Among aquatic organisms fishes are the main and best source of food, so it is essential to secure the health of fishes[2].

Carbamate and organophosphate pesticides are used widely for agricultural and residential applications as insecticides and fungicides. The toxicity of carbamate and organophosphate pesticides results inhibition of acetyl cholinesterase (AChE), a key enzyme of the nervous system. The inhibition causes an accumulation of acetylcholine in synapses with disruption of the nerve functions, which can result in death[3].

Bio chemicals are the accessible body contents for checking the toxicity of any chemical[4]. The results of such biochemical parameters results in serious outcome in the form of various diseases in fishes / animals and also reveals underlying physiological conditions of the organs / tissues of organism[5]. The fish Channa punctatus is selected for the study because of its availability and commercial importance. The aim of the study is to investigate the effect of carbofuran and malathion on liver biochemistry with particular reference to glucose and total protein.

Material and Methods

The fresh water catfish, *Channa punctatus* was obtained from the local fish market of Indore. It was acclimatized in glass aquaria for two weeks prior to experimentation. The weight and length of the experimental animals varied between 55 – 65g and 14 – 20 cm respectively. The experiment was conducted in ten aquariums two was used for control and other aquaria used for the pollution study. Each aquarium contains ten fishes. The experimental fishes were exposed to sub-lethal concentration 0.1 ml (1/5 of LC_{50}) of carbofuran and 0.09 ml (1/5 of LC_{50}) of malathion separately at different time intervals 7, 14, 21 and 28 days. The acclimated fish were starved for 24 hrs prior to their use in the experiment and were not fed during the course of experiments[6]. The water was changed after every 24 hrs. The fishes were killed by striking blow on the head and dissected to remove the liver for biochemical estimation. The liver was used for the biochemical estimation of glucose by GOD/POD kit method by Trinder[7] and total protein by Biuret and Dumas described by Dumas *et al.*[8] of experimental fish. The LC50 of carbofuran and malathion were determined by the method of Finney[9].

The experimental data were analyzed by student's t test for determining the significance of the changes from control.

Results and Discussion

Channa punctatus exposed to concentrations of 0.1 ml of carbofuran and 0.09 ml of malathion separately exhibit many biochemical alterations (liver) have been summarized in tables.

Table-1
Liver glucose and total protein content of *Channa punctatus* exposed to sub lethal concentration of carbofuran

Biochemical parameter	Control groups Range Mean ± S.Em.	Exposure in hours			
		7 days range Mean ± S.Em.	14 days range Mean ± S.Em.	21 days range Mean ± S.Em.	28 days range Mean ± S.Em.
Glucose (mg/dl)	35.20 – 38.40	39.25 – 43.45	44.65 – 47.15	50.36 – 56.25	66.00 – 69.30
	36.60 ± 1.90	41.70 ± 0.80^{NS}	46.20 ± 0.71*	53.65 ± 0.62**	68.10 ± 0.54***
Total protein (gm/dl)	4.50 – 5.70	3.72 – 4.63	3.40 – 4.12	3.10 – 3.95	2.96– 3.60
	4.80 ± 0.25	3.95 ± 0.28*	3.65 ± 0.32*	3.42 ± 0.35*	3.25 ± 0.37***

Results are expressed as ± S.Em. NS = Non-significant at p > 0.05;* = Significant at p < 0.05 ** = Highly significant at p < 0.01; *** = Very highly significant at p < 0.01

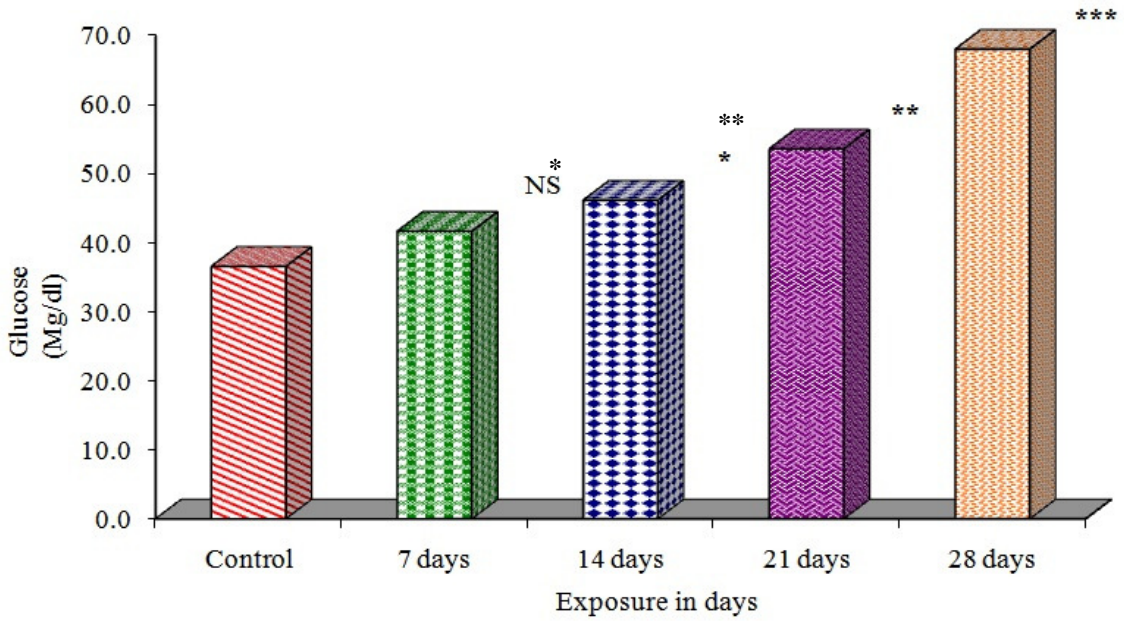

Figure-1
Biochemical estimation of Liver glucose (gm/dl) after carbofuran intoxication in experimental fish *Channa punctatus*

Table-2
Liver glucose and total protein content of *Channa punctatus* exposed to sub lethal concentration of Malathion

Biochemical parameter	Control groups Range Mean ± S.Em.	Exposure in hours			
		7 days range Mean ± S.Em.	14 days range Mean ± S.Em.	21 days range Mean ± S.Em.	28 days range Mean ± S.Em.
Glucose (mg/dl)	36.30 – 39.40	40.15 – 44.45	45.55 – 48.35	51.16 – 57.33	66.00 – 70.10
	37.60 ± 1.96	42.60 ± 0.74^{NS}	47.10 ± 0.66*	54.54 ± 0.62**	65.10 ± 0.53***
Total protein (gm/dl)	5.84 – 6.40	5.25 – 6.00	4.84 – 5.65	4.20 – 5.35	3.85 – 5.10
	5.95 ± 0.23	5.70 ± 0.25*	5.35 ± 0.29**	4.93 ± 0.32***	4.27 ± 0.35***

Results are expressed as ± S.Em. NS = Non-significant at p > 0.05;* = Significant at p < 0.05 ** = Highly significant at p < 0.01; *** = Very highly significant at p < 0.01

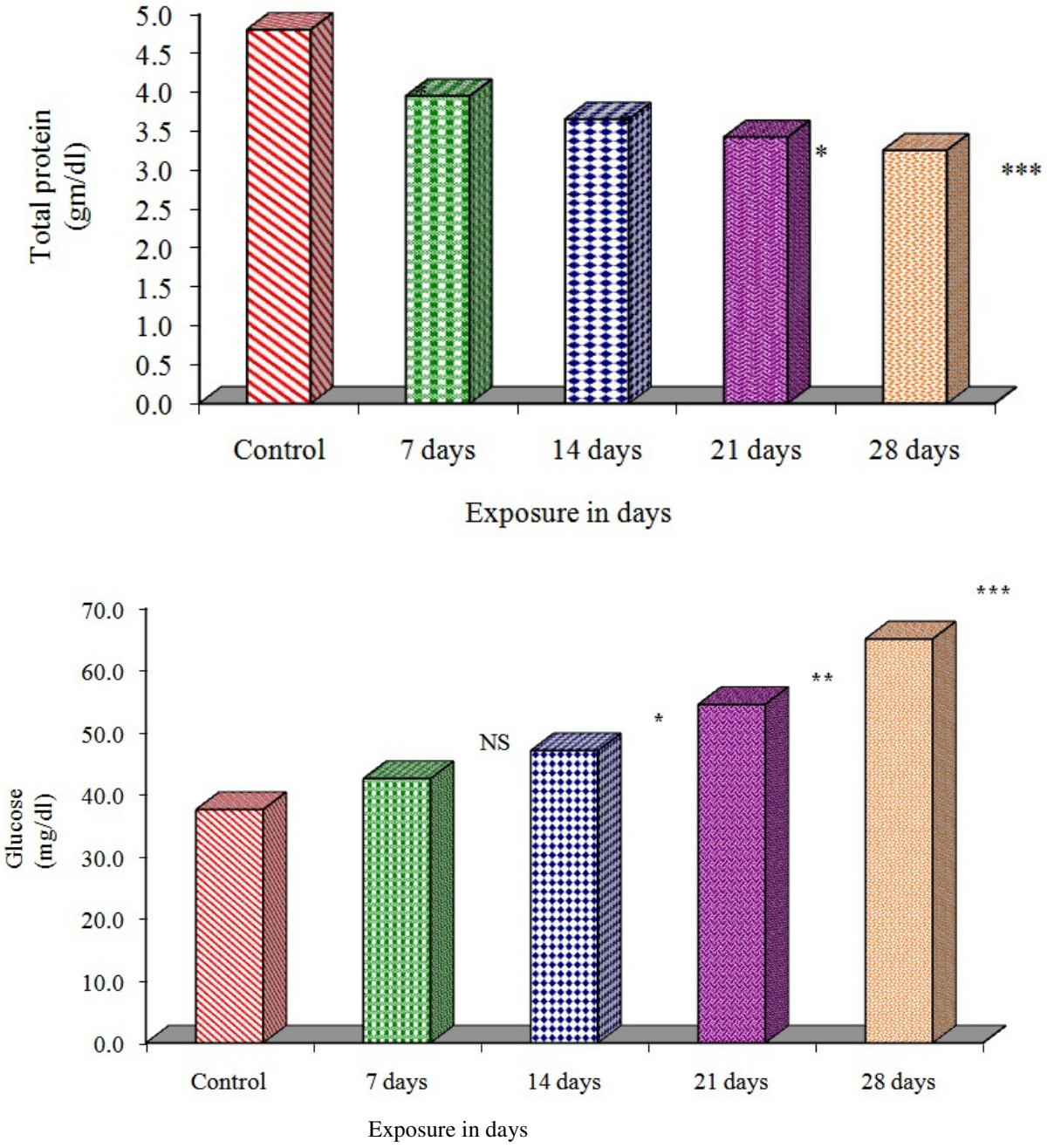

Figure-3
Biochemical estimation of Liver glucose (gm/dl) after Malathion intoxication in experimental fish *Channa punctatus*

Discussion: Effect of carbofuran and malathion on liver glucose: The liver glucose in the experimental animals after carbofuran and malathion sub lethal intoxication separately shows an increasing trend at different time intervals (7, 14, 21 and 28 days). The elevated glucose level (hyperglycemia) is indicative of disrupted carbohydrate metabolism. The hyperglycemic condition observed on exposure to pesticide may be due to the increased liver glycogenolysis or toxicant may have damaged islets of Langerhans which in turn reduce the insulin secretion due to which glucose level may have increased. Present finding gain support with the finding of Dalela *et al*.[6] who observed hyperglycemia in *Mystus vittatus* exposed to three different pesticides – thiotox, dichlorvos and carbofuran and their combination. They suggested that hyperglycemia indicates the disrupted carbohydrate metabolism which might be due to enhanced breakdown of liver glycogen, perhaps mediated by adrenocorticotropic hormone (ACTH), glycogen hormone and reduced insulin activity.

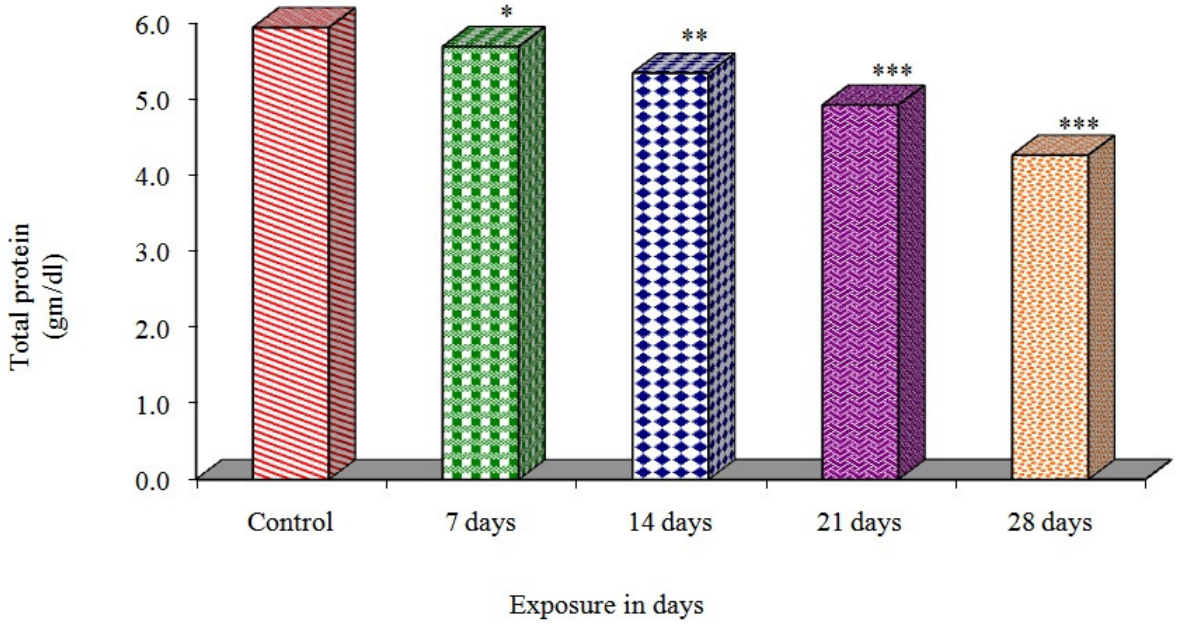

Figure-4
Biochemical estimation of total protein (gm/dl) after Malathion intoxication in experimental fish *Channa punctatus*

Hanke *et al.*[10] showed elevation in glucose level is a typical response in carps exposed to various pollutants. Begum and Vijayaraghavan[11] find an increase in blood glucose levels in *Clarias batrachus* exposed to ragor. Similarly Geetha *et al.*[12] indicated hyperglycemic condition in the pesticide treated fish may be due to nonspecific response to pesticide induced stress.

Glucose concentration is regulated by complex interaction of hormones such as glucagons and cortisol. Ramesh and Saravanan[13] resulted significant increase of fish plasma glucose level might have showed from gluconeogenesis to provide energy for the increased metabolic demands imposed by chlorpyrifos stress, particularly in osmoregulation which may contribute to the restoration of plasma osmoregularity in the face of failing blood levels of Na^+ and Cl^-.

Effect of carbofuran and malathion on total protein: The total protein shows decreasing trend on exposure to sub-lethal concentration of carbofuran and malathion at different time intervals (7, 14, 21 and 28 days). The decrement of total protein may be due to the inhibition of RNA synthesis disturbing the protein metabolism or this may be due to liver damage where most protein synthesis usually occurs, these results agreed with that of Sing *et al.*[14] carbosulfan induced biochemical changes in *Clarias batrachus* treatment resulted in drastic decrease in the protein content in gill, brain, muscle, liver, kidney and heart of magur fish. Under conditions of stress many organisms will mobilize proteins as an energy source via oxidation of amino acids. The depletion in total protein content may be due to augmented proteolysis and possible utilization of their product for metabolic purposes as reported by Ravichandran *et al.*[15].

In the present investigation, total protein may be depleted probably because of excessive renal excretion (Albuminuria) or due to the liver disorder after the pesticide exposure. This is correlated with the finding of Maya[16] and Garg *et al.*[17].

Maya[16] evaluated the toxicity of rogor to *Clarias batrachus* by studying its morphological and physiological impact and found that it causes depletion in the serum total protein.

Garg *et al.*[17] observed that fall in serum protein may be due to the impaired function of kidney or due to reduced protein synthesis owing to liver cirrhosis.

In the present investigation reduction in the total protein may also be attributed to intensive proteolysis which contributes to the increase in the free amino acids to be fed into TCA cycle as keto acids. This view is supported by the findings of Velisek *et al.*[18] reported significantly lower plasma total protein in rainbow trout after metribuzin toxicity. Shaikh *et al.*[19] also reported decrease in serum protein level of *Channa punctatus* after nuvan treatment.

Conclusion

In the present study after sub lethal exposure of carbofuran and malathion on fresh water fish Channa punctatus (Bloch.) shows increasing trend of live glucose after different time intervals because pesticides led increased liver glycogenolysis , damage to islets of Langerhans which led to decreased insulin secretion and on the other hand respective pesticides show decreasing trend in total protein of liver because of inhibition of RNA synthesis, liver damage where most protein synthesis usually

occurs, excessive renal excretion (Albuminuria) and proteolysis.

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