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# SUB LETHAL EFFECTS OF METHOMYL PESTICIDE ON TISSUE-SPECIFIC ANTIOXIDATIVE RESPONSES IN A *CHANNA STRIATUS*

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**Abstract:**

*The aim of this study was to investigate the sub-lethal toxicity of a Methomyl-based insecticide effect of muscle, liver, gill, and kidney antioxidant enzyme activities of Channa striatus. Methomyl-based insecticides were treated sub-lethal concentration of 96 hours of methomyl exposure was 10% and 30% duration of 15 days and 30 days for murrel, Channa striatus. The muscle, liver, gill, and kidney antioxidant enzyme were analyzed. In muscles liver, gill and kidney tissue estimation of methomyl effects significantly (P>0.05) increased MDA, CAT and GST. MDA (Malondialdehyde), CAT (Catalase) and GST (Glutathione-s-transferase), of C.striatus increase in highest concentration of 0.162 for 30 days in different tissue when compared to control. The level of CAT (Catalase) in all groups and tissue not changed except (methomyl 40%). Estimation of all tissue GSH (Reduced glutathione) was significantly (P>0.05) decreased level of methomyl 40% insecticide-treated groups when compared to control. Simultaneously, MDA, CAT, and GST increased in muscle, liver, gill, and kidney tissue of 0.054ppm 15 days and 0.162ppm 30days, when compared to control, respectively. In the present study suggests that reactive oxygen species (ROS)-induced oxidative damage could be one of muscle, liver, gill and kidney toxic effect of methomyl 40% insecticide. The increase and alterations in the antioxidant defense system can be used as the pesticide-contaminated aquatic streams.*

**Key words**: *sub-lethal concentration; MDA, CAT, GST, GSH, Channa striatus.*

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## INTRODUCTION:

Methomyl and methiocarb are carbamate pesticides used worldwide in agriculture due to their high activity against a broad spectrum of insect pests and land snails. Methomyl has high water solubility (57.9 g/ L at 25C) and a weak-to-moderate adsorption to soils, and therefore poses a contamination risk to surface and groundwater, especially the methomyl applied in the agricultural area is expected to infiltrate into the groundwater and threatens the safety of the resource for drinking water [1]. Methomyl (C5H10N2O2S), S-methyl-1-N-[(methylcarbamoyl)-oxy]-thioacetimidate, is an insecticide belonging to the family of carbamate pesticides, and it is one of the environmental estrogens having endocrine disrupting effects. They were known to act as nerve poisons by the inhibition of cholinesterase [2]. They were also shown to alter the activity of other nonspecific serine-containing enzymes or nonenzymatic biochemical constituents of land snails [3, 4]. It is worthy to mention that the snail nervous system has been proven to be sensitive to many toxic materials and cytotoxins that may induce injurious consequences [5, 6]. Pesticides are used worldwide in agricultural activity, mostly to promote the harvest of products. However, these compounds are released into the environment and due to their physicochemical properties, such as water solubility, vapor pressure or partition coefficients between organic matter (in soil or sediment) and water, they can disperse in various environmental media provoking serious health problems [7].

Report that [8] reported that iron overload means an excess of total body iron, most of which is located in the storage compounds ferritin and hemosiderin. Aside from the pathologic forms of primary and secondary iron overload moderately elevated iron stores may be of concern because of a possible association with several chronic diseases, such as heart disease, cancer, and diabetes. Metals are one of the main inducers of oxidative stress in aquatic organisms, promoting formation of reactive oxygen species through two mechanisms. Redox active metals generate reactive oxygen species through redox cycling, while metals without redox potential impair antioxidant defenses, especially that of thiol-containing antioxidants and enzymes.

In fishes, irrespective of their thermoregulatory capacity or metabolic rate, the main physiological source of reactive oxygen species (ROS) in mitochondria. During active swimming, ROS is provided by red muscle mitochondria. Other issues such as lens, liver, heart, swimbladder, roe and blood also afford important ROS production and antioxidant levels in resting fish. Fish are also susceptible to the attack of reactive oxygen species and, as a consequence, have an antioxidant defense system, as demonstrated by works dating primarily to the 1970s. Several circumstances promote the antioxidant defense response in fish. Factors intrinsic to the fish itself, such as age, phylogenetic position, and feeding behavior, as well as environmental factors such as the type of diet supplied, daily or seasonal changes in temperature, dissolved oxygen, toxins present in the water, pathologies, or parasites, can either fortify or weaken antioxidant defenses. The decreases in RBC might be due to the effect of pesticides on blood-forming organs (Bone marrow and liver) and inhibition of many steps of biosynthesis of fish, as the results of pesticide exposure[9]. Pesticides destroy,prevent or repel pests such as insects, weeds and rodents but May causes a range of harmful health effects in humans, including cancer, short and long-term injury to the nervous system etc.,[10] Apart from formation of protoplasm, protein is an important constituent of the various cellular membranes in conjugation with lipids. Most of the biological active compounds are proteins including enzymes[11]. The cellular damage observed in the gills in terms of epithelial proliferation, separation of the epithelial layer from supportive tissues and necrosis can adversely affect the gas exchange and ionic regulation [11, 12]. Proteins are complex substance with high molecular compound weight form not only the structural framework, but also gears and levers of the operating mechanism in the living wage body[10, 12]. Pesticide toxicants are known to induce anaemia in fish. In the present study, it is found that a reduced RBC count and Hb contents in the *chlorpyrifos* exposed fish, may be due to inhibition of erythrocyte production or increase in the rate of erythrocyte destruction[13]. Water is an essential requirement of human and activities development and it is one of the most delicate part of the environment [14].

Oxidative stress occurs when there is an imbalance between the production of reactive oxygen species (ROS) and antioxidant defenses in living organisms [15], and toxicity of transition metals is often due to their great participation and action as catalysts in the production of the ROS through the Fenton/Haber-wises reactions, which are highly reactive chemicals containing oxygen (e.g. hydroxyl free radical OH) that reacts easily with other molecules, resulting in potentially damaging modifications. Changes in the chemical composition of natural aquatic environments can affect the non-target organisms, particularly fish. Fish have been largely used to evaluate the quality of aquatic systems as bioindicators for environmental pollutants [16]. The reaction of glutathione (GSH) with electrophilic

substrates can be represented by the following general scheme:

$$GSH + R\text{-}X \rightarrow GSR + HX$$

The function of GSTs is to bring the substrate into close proximity with GSH by binding both the electrophilic substrate and GSH to the active site and to activate the sulfhydryl group of GSH, thereby allowing nucleophilic attack of glutathione on the substrate.

GSTs can catalyze nucleophilic aromatic substitutions, michael additions to α,β-unsaturated ketones, and epoxide ring-opening reactions, all of which result in the formation of GSH conjugates and the reduction of hydroperoxides, resulting in the formation of oxidized glutathione (GSSG). Numerous non-enzymatic low-molecular-weight antioxidants, such as ascorbate, β-carotene, α-tocopherol and GSH, have also been described. The α-tocopherol and β-carotene are lipid-soluble antioxidants which play a major role in protecting membranes from lipid per oxidation[2]. Glutathione reduced (GSH) is the most abundant cellular thinly and it is involved in several metabolic processes [17], playing a central role in the detoxification of ROS. The chemical and toxicological evaluations of sediments can indicate the hazard and the most appropriate disposal strategy to some degree, but they do not reflect the risks during the dredging operations. Aquatic pollution due to pesticide needs considerable attention because of its harmful effects on aquatic organisms which may cause fish mortality. The surface run-off from the agriculture lands carries the pesticide into the aquatic ecosystem, which enters the organisms through food webs and also through contact water. Water pollution by pesticides has resulted in the marked increase in the incidences of mass mortality and adversely affects the fish life [18].The fishes are best indicator of water body pollution, is the most sensitive of all the aquatic animals, towards the pollutant poisoning through the river water from adjoining settlement and industries. The accumulation of effluents becomes hazardous to the aquatic organisms and to surrounding human population because the fishes are the most important factors of the food chain which have great nutritive value in the environment.

The chronic toxic effects of methomyl on aquatic organisms, especially on fish, were scarcely investigated. Taking into account the great relevance of effect-biomarkers when no levels of pesticides can be detected in the environment, the aim of this study was to evaluate the alterations in different biochemical parameters in several tissues of *Channa striatus* ( MDA (Malondialdehyde), CAT (Catalase), GST (Glutathione-s-transferase), GSH (Reduced glutathione) activity in muscle, liver, gill and kidney enzymatic activities ) exposed to methomyl.

## MATERIALS AND METHOD:

### Fish collection and laboratory conditions

The freshwater healthy fish *Channa striatus* of the weight 22.34±0.79g and length 17 to 20cm were selected for the experiment and were collected from ponds in and around Thanjavur. Fish was screened for any pathogenic infections. A Glass aquarium was washed with 1% $KMnO_4$ to avoid fungal contamination and then sun-dried. The fishes were maintained in 300 L tank containing dechlorinated tap water (Temperature 26°C). Fish was acclimated to laboratory conditions for 15 to 30 days prior to experimentation. They were regularly fed with commercial food and the medium (tap water) was changed daily to remove fasces and food remnants.

### Chemical and Experimental design

The insecticide used in this experiment was Methomyl 40% W/W (Reg.no.CIR.31, 760/99/METHOMYL (SP)-71) were purchased from Thanjavur, Tamilnadu, India. The Methomyl insecticide was used only for the present experiment. The experimental group was vulnerable to a sublethal concentration of the insecticide (0.54ppm $L^{-1}$) during 15 and 30 days. Toxicity tests carried out in accordance within standard methods [19]. A stock solution of methomyl with a concentration of 1g per liter (equivalent to 1 ppm) was prepared in distilled water and different dilutions were prepared by adding the required amount of distilled water. Based on the progressive bisection of intervals on a logarithmic scale, log concentrations were fixed after conducting the range-finding test. The fishes were starved for 24 hours prior to their use in experiments as recommended by storage, to avoid any interference in the toxicity of pesticides by excretory products. After the addition of the toxicant into the test tank with 10 liters of water having twenty fish, mortality was recorded after 24, 48, 72 and 96 hours. Five replicates were maintained simultaneously.

### Sub-lethal concentration

Based on acute toxicity test (96h LC50) sub-lethal concentrations (15 & 30 days) were derived from methomyl which served as the experimental concentration of the methomyl in the subsequent experiments. Ten fish were exposed to each concentration for a period of 15 and 30 days. Control batch was maintained simultaneously.

### Fish dissection and preservation

After Morphometric measurements, each fish was dissected to collect diverse organs and tissues. These

fish organs like muscle, liver, gill and kidney were transferred to mark sterilized polythene bags and stored in a freezer at 20°C un for further analysis.

**Estimation of Malondialdehyde/ Lipid peroxidation (MDA/LPO):**

Malondialdehyde / Lipid peroxidation was estimated by the thiobarbituric acid assay method of [20]. The MDA reacts with 2.0ml of TCA-TBA-HCl reagent and mixed thoroughly. The solution was heated for 15minutes in a boiling water bath. The flocculants centrifuged at 1000 ×g at 4 ◦C for 10 minutes. The absorbance of the sample was read at 535nm against a blank without a sample. Values were expressed as nmol of MDA formed/mg protein in tissues.

**Assay of Catalase:**

The activity of Catalase was assayed by the method of [21]. Distilled water 1.9 ml and 1ml of the hydrogen peroxide reagent, a substrate was added and incubated for 4-5minutes. Added 0.1 ml of sample and recorded the decrease in absorbance for 2-3minutes at 240nm. Enzyme activity was expressed as µmols $H_2O_2$ consumed/min/mg tissue.

**Assay of glutathione-s-transferase:**

Glutathione S-transferase (GST) activity was determined using the method of[22]**.** The reaction mixture contained 1.0ml of phosphate buffer, 0.01ml of CDNB, 0.1ml of sample and 0.7ml of distilled water. This mixture was preincubated at 37ºC for 5 minutes, and then the reaction was started by the addition of 0.1ml of GSH. The change in the absorbance was read at 340nm for 5minutes, the reaction mixture without the enzyme used as the blank. The enzyme activity was expressed as µmoles CDNB conjugated/min/mg protein.

**Determination of Reduced glutathione (GSH):**

Reduced glutathione was estimated by the method of [23]. Sample 0.5ml was precipitated with 1ml of 10% TCA and the precipitate was removed by centrifugation. To 0.5ml of the supernatant 1ml of DTNB was added and the total volume was made up to 3ml with phosphate buffer. The absorbance was read at 412nm.

The level of glutathione was expressed as µg/mg protein in tissues.

**Statistical Analysis**

All the data were subjected to one way ANOVA using statistical software of SPSS version 16.0. Duncan's Multiple Range test was used to establish the difference among treatment means at 5% level of significance.

## RESULT:

**Muscle antioxidant enzyme activities**

The levels of MDA, CAT and GST muscles composition were increased in the insecticide methomyl treatment group in significant ($p<0.05$) high increase in 0.162ppm 30 days (12.20±0.59, 30.60±0.79, 11.10±0.79) when compare to another concentration and 0.054ppm 30 days (10.83±0.82, 28.40±0.72, 9.85±0.73) and control (9.10±0.95, 26.80±0.84, 8.18±0.68) respectively. GSH composition was reduced in treated groups when compared to control (2.00±0.50, 1.69±0.42) respectively (Table 1).

**Liver antioxidant enzyme activities**

The levels of MDA, CAT, and GST in liver tissues were increased in the methomyl treatment group in significant ($p<0.05$) high increase in 0.162ppm 30 days (15.46±0.82, 31.72±0.82 and 17.46±0.72) when compare to another concentration and 0.054ppm 30 days (13.79±0.82, 29.95±0.82 and 12.97±0.79) and control (10.76±0.91, 27.43±0.76, 9.23±0.94) respectively. GSH composition was reduced in treated groups when compared to control (4.03±0.76, 2.58±0.33) respectively (Table 2).

**Table: 1** Activities of antioxidant enzymes in the muscles of *Channa striatus* exposed to sub lethal concentration of *methomyl* (40%) pesticide.

| Parameters | MUSCLES | | | | |
|---|---|---|---|---|---|
| | **Control** | **0.054ppm15 days** | **0.054ppm 30 days** | **0.162ppm 15 days** | **0.162ppm 30 days** |
| **MDA (nmol /mg/protein/min)** | 9.10±0.95$^{b}$ | 9.65±1.21$^{ab}$ | 10.83±0.82$^{ab}$ | 10.20±0.72$^{ab}$ | 12.20±0.59$^{a}$ |
| **CAT (µ moles /mg/protein/min)** | 26.80±0.84$^{b}$ | 27.40±0.82$^{b}$ | 28.40±0.72$^{a}$ | 27.80±0.77$^{b}$ | 30.60±0.79$^{a}$ |
| **GST (µ moles /mg/protein/min)** | 8.18±0.68$^{b}$ | 9.20±0.82$^{ab}$ | 9.85±0.73$^{ab}$ | 9.50±0.82$^{ab}$ | 11.10±0.79$^{a}$ |
| **GSH (µ moles /mg/protein/min)** | 2.00±0.50$^{a}$ | 1.84±0.21$^{a}$ | 1.70±0.07$^{a}$ | 1.75±0.34$^{a}$ | 1.69±0.42$^{a}$ |

Values are mean ± SD of even experiments in each groups

MDA - Malondialdehyde, CAT - Catalase, GST - Glutathine-s-transferase,GSH - Reduced glutathione

**Table: 2** Activities of antioxidant enzymes in the liver of *Channa striatus* exposed to sub lethal concentration of *methomyl* (40%) pesticide.

| Parameters | LIVER | | | | |
|---|---|---|---|---|---|
| | Control | 0.054ppm15 days | 0.054ppm 30 days | 0.162ppm 15 days | 0.162ppm 30 days |
| MDA (nmol /mg/protein/min) | 10.76±0.91$^{c}$ | 11.78±0.82$^{bc}$ | 13.79±0.82$^{ab}$ | 12.83±0.89$^{bc}$ | 15.46±0.82$^{a}$ |
| CAT (µ moles/mg/protein/min) | 27.43±0.76$^{b}$ | 28.85±0.92$^{b}$ | 29.95±0.82$^{b}$ | 29.10±0.89$^{ab}$ | 31.72±0.82$^{a}$ |
| GST (µ moles /mg/protein/min) | 9.23±0.94$^{c}$ | 11.28±0.76$^{bc}$ | 12.97±0.79$^{b}$ | 12.10±0.75$^{b}$ | 17.46±0.72$^{a}$ |
| GSH (µ moles /mg/protein/min) | 4.03±0.76$^{a}$ | 3.61±0.70$^{a}$ | 2.68±0.50$^{b}$ | 3.14±0.47$^{b}$ | 2.58±0.33$^{b}$ |

Values are mean ± SD of even experiments in each groups

MDA - Malondialdehyde, CAT - Catalase, GST - Glutathine-s-transferase, GSH - Reduced glutathione

**Table: 3** Activities of antioxidant enzymes in the gill of *Channa striatus* exposed to sub lethal concentration of *methomyl* (40%) pesticide.

| Parameters | Gill | | | | |
|---|---|---|---|---|---|
| | Control | 0.054PPM15 days | 0.054ppm 30 days | 0.162ppm 15 days | 0.162ppm 30 days |
| MDA (n mol /mg/protein/min) | 9.58±0.83$^{b}$ | 10.10±0.99$^{b}$ | 12.20±0.85$^{ab}$ | 11.40±0.91$^{ab}$ | 13.59±0.76$^{a}$ |
| CAT (µ mol /mg/protein/min) | 27.18±0.97 | 27.18±0.82 | 27.19±0.89 | 27.19±0.97 | 29.10±0.79 |
| GST (µ mol /mg/protein/min) | 9.18±0.82$^{c}$ | 10.80±0.95$^{bc}$ | 11.40±0.80$^{bc}$ | 12±0.78$^{b}$ | 15.13±0.70$^{a}$ |
| GSH (µ moles /mg/protein/min) | 3.85±0.59$^{a}$ | 3.43±0.66$^{a}$ | 2.48±0.50$^{b}$ | 3.10±0.45$^{b}$ | 2.52±0.23$^{b}$ |

Values are mean ± SD of even experiments in each groups

MDA - Malondialdehyde, CAT - Catalase, GST - Glutathine-s-transferase

GSH - Reduced glutathione

**Table: 4 Activities of antioxidant enzymes in the kidney of *Channa striatus* exposed to sub lethal concentration of *methomyl* (40%) pesticide.**

| Parameters | KIDNEY | | | | |
|---|---|---|---|---|---|
| | Control | 0.054ppm15 days | 0.054ppm 30 days | 0.162ppm 15 days | 0.162ppm 30 days |
| MDA (nmol /mg/protein/min) | 8.56±0.82$^{b}$ | 8.78±0.98$^{b}$ | 10.95±0.91$^{a}$ | 10.10±0.93$^{ab}$ | 11.70±0.55$^{a}$ |
| CAT (µ moles /mg/protein/min) | 6.42±0.74$^{b}$ | 7.30±0.53$^{ab}$ | 8.10±0.81$^{ab}$ | 7.50±0.77$^{ab}$ | 9.10±0.82$^{a}$ |
| GST (µ moles /mg/protein/min) | 6.20±0.82$^{b}$ | 7.05±0.84$^{ab}$ | 9.30±0.76$^{a}$ | 7.29±0.88$^{ab}$ | 8.82±0.71$^{a}$ |
| GSH (µ moles /mg/protein/min) | 2.60±0.66$^{a}$ | 1.42±0.16$^{b}$ | 2.20±0.49$^{b}$ | 2.50±0.36$^{a}$ | 1.44±0.35$^{b}$ |

Values are given as MEAN ± SE of even experiments in each groups

MDA - Malondialdehyde, CAT - Catalase, GST - Glutathine-s-transferase
GSH - Reduced glutathione

**Gill antioxidant enzyme activities**

The chemical composition levels of MDA and GST were increased in the methomyl treatment group in significant ($p<0.05$) high increase in 0.162ppm 30 days (13.59±0.79 and 15.13±0.70) when compare to another concentration and 0.054ppm 30 days (12.20±0.85 and 11.40±0.80) and control (9.58±0.83 and 9.18±0.87). CAT activity in not changed at low concentration when compare to control (27.18±0.97 and 27.19±0.89) where at high concentration there is an increase in 0.162ppm 30days when compare to control (27.18±0.97 and 29.10±0.79). GSH composition was reduced in treated groups when compared to control (3.85±0.59, 2.52±0.23) respectively (Table 3).

**Kidney antioxidant enzyme activities**

The levels of MDA, CAT, and GST in kidney tissues were increased in the methomyl treatment group significant ($p<0.05$) high increase in 0.162ppm 30 days (11.70±0.55, 9.10±0.82 and 8.82±0.71) when compare to another concentration and 0.054ppm 30 days (10.95±0.91, 8.10±0.81 and 9.30±0.76) and control (8.56±0.82, 6.42±0.74, 6.20±0.82) respectively. GSH composition was reduced in treated groups when compared to control (2.60±0.66, 1.44±0.35) respectively (Table 4).

## DISCUSSION:

Effect of toxin methomyl is 40% insecticide causes significant economic losses in the fish industry every year. Hence, contamination of the environment with methomyl based insecticides might cause serious harm to nontarget organisms [24] reported that the fish play an important role in human nutrition. The biochemical in this study agreed with result report that [25] MDA is one of the main manifestations of oxidative damage and has been found to play an important role in the toxicity of methomyl. Methomyl intoxicated fish could be possibly due to excessive formation of free radicals which leads to the deterioration of biological macromolecules. Enhanced levels of MDA in the liver of methomyl treated fish indicated the increased levels of lipid peroxidation. Reports have shown that methomyl promotes the formation of ROS by Fenton transition equation, such as hydrogen peroxides and enhances the subsequent iron and copper-induced production of lipid peroxidations and the highly reactive hydroxyl radical. Simultaneously administration of haruan extract decreased the formation of lipid per oxidation products, and it possesses antioxidant activity. The ability of haruan extract, consumed within a balanced controlled diet, to improve overall the antioxidants status and to protect against oxidative damage in humans [26, 27].

The increase in CAT activities in the liver as observed in the present study might be in response to $H_2O_2$ produced by SOD activity since CAT is responsible for the detoxification of $H_2O_2$ to oxygen

and water. Our results were accordant to the previous reports by [28] and [29] where hepatic CAT activities were elevated in fish after chronic exposure to 2, 4-dichlorophenol and alachlor, oxidative stress levels in fish from waters contaminated by different concentrations of pesticides were entirely different, and in some cases, a clearly inhibitory effect was observed. [30] for instance, observed a reduction in CAT activity in the liver of silver catfish exposed to the herbicide clomazone. Similar effects were found in the liver of the freshwater fish *Channa punctatus* evaluated after 24 h of treatment with endosulfan observed a significant decline in CAT activity in zebrafish exposed to atrazine. Curiously, this same xenobiotic was assayed by [31] who noticed an elevation of liver CAT activity after the exposure of *Channa punctatus*.

The results of present study in agreed with result of [32] GST is a group of widely distributed enzymes that catalyze the conjugation of glutathione (GSH) with various electrophilic substances. GST-mediated conjugation is involved in the detoxification of many xenobiotics, which play an important role in protecting tissues from oxidative stress. It has been demonstrated that GST activity can be altered in polluted locations, and that the presence of organic contaminants may lead to the increased activity of this enzyme [33]. This increase of enzyme activity is consistent with the findings of [34].

GSH acts as the main non-enzymatic antioxidant of cells, in addition to being a substrate for GST and GPx activity; hence, depending on the situation, there may be a lack of this tripeptide for some of these processes [35]. Both GST and GPx contribute to the detoxification of oxidative stress products, and the contribution of GST is more significant than that of GPx. In the present study, the high levels of antioxidant enzymes (SOD, CAT and GST) demonstrate an MPc-induced adaptive response in attempting to neutralize the generated ROS. However, the enhanced lipid peroxidation in white muscle and gills of *B. cephalus* shows that insecticide-induced ROS are not totally scavenged by the antioxidant enzymes. This was aggravated by the decrease in GPx activity and GSH levels in these tissues. Organophosphate-induced oxidative stress was also observed after exposure to the OP dichlorvos in other fish species such as the eel, *Anguilla anguilla*, carp, *Cyprinus carpio* and catfish, *Ictalurus nebulosus* [36]. GST is a cytosolic or microsomal enzyme catalyzing the conjugation of electrophilic xenobiotics to GSH [37] and plays a key role in protecting tissues from oxidative stress. Despite the diet, the increased GST activity in all tissues after exposure to MPc indicates that this enzyme was induced either by the detoxification of hydroperoxides or by the GSH conjugation as part of Phase II of xenobiotic biotransformation. The concentration in different organs depends on the characteristics of the considered tissue, the amount and form of Se in the diet, the treatment duration and the studied species [38] Tissues ranked by Se concentration, generally follow the order: kidney liver pancreas and hearts keletal muscle. This is remarkably similar among species. The greater portion of the absorbed selenium is stored in the liver Underwood and in rainbow trout, liver and kidney are the primary Se storage sites [39].

GSH protects cells from oxidative stress and plays a critical role in detoxification reactions by acting both as a nucleophilic scavenger of various undesired compounds and their toxic metabolites, and as a specific substrate for the enzyme glutathione peroxides and glutathione S-transferase. There were much higher changes in the level of MDA, CAT, GST, GSH of *C.striatus* although they have similar changes in MDA, GST in response to methomyl 40% insecticide exposure.

## CONCLUSION:

From the study it can be concluded that *C.striatus* can be used in the effect of methomyl 40 % on chemical composition and Antioxidant Enzymes. This results in the mortality of fish at sub- lethal exposures to the pesticide. Furthermore, the pesticide can be deposited in fish tissues by coincidence or through contaminated water which could lead to changes in overall fish health.

This opens new avenues for investigations of adaptive mechanisms in animals, particularly in fish, to environmental hazards. Moreover, these findings document the effects of regular methomyl 40% exposure to *C.striatus* and the adverse effects of pesticide in aquatic ecosystems.

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