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# EFFECTS OF ORGANOPHOSPHATE PESTICIDE ABATE ON THE OVARY OF THE CAT FISH, *HETEROPNEUSTES FOSSILIS* (BLOCH.)

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**Abstract:** The effects of the pesticide Abate on the ovary of the cat fish *Heteropneustes fossilis* (Bloch.) was studied by observing the vitellogenesis of the fish. The $LC_{50}$ of Abate (0.64 ppm) after 24, 48, 72 and 96 hours of exposure to the fish was determined to be 14.3, 10.0, 6.61 and 5.13 ppm, respectively. The glycogen contents in the normal fish were lowest (6.0 mg/g) and highest (21.96 mg/g) in December and August, respectively; the protein contents were lowest (102.65 mg/g) in August and highest (424.17 mg/g) in December; whereas, the cholesterol was the lowest (9.32 mg/g) in November and highest (15.76 mg/g) in August. In the Abate treated fish, the lowest and highest contents of biochemicals were: 3.58 and 17.10 mg/g of glycogen in December and August, respectively; 80.44 and 378.34 mg/g of protein in December and August, respectively; and 7.15 and 12.92 mg/g of cholesterol in December and August respectively. The results show that the pesticide Abate has the potentiality to alter the vitellogenesis of the fish.

***Key words:*** Pesticide, Abate, organophosphate, ovary, vitellogenesis.

## INTRODUCTION

Indiscriminate use of pesticides in crop fields and its disposal to water bodies cause various ecological imbalances including hydro-ecosystem which is exclusive habitat of fish fauna. From the work of Scott (1967) and Konar (1981), it appears that the insecticides run off and drift during insect control operations may be sufficient to kill fish immediate target as they are comparatively more sensitive to such pesticidal dose. The place of our report is done for rural areas of District Muzaffarpur, Bihar, India.

Several workers have reported seasonal variations in major biochemical constituents in muscle, liver and blood of fish, and correlated these values with that of fish ovary; they conclude that some biochemical contents of these organs of fish fluctuate in a sequential manner that can be attributed to have their role in governing the reproductive cycle of fishes. The organophosphorus pesticides cause the accumulation of acetylcholine with a simultaneous increase in the secretion of catecholamines (Brzezineski and Ludwick 1973) and exogenous acetylcholine in fish leading to an increased secretion of catecholamine (Nilsson *et al.* 1976). Whereas, carbamate pesticides are known to be anticholinesteraze pesticide. Though, the physiological and ecological significance of the pesticides

induced disturbance in carbohydrate metabolism of fish is difficult to evaluate, but such prominent alteration including hormonal imbalance ought to have serious consequences for the general body metabolism and the energy economy of the fish.

Several reports are available on the toxicity of various pesticides/biocides to fish, viz. Shukla *et al.* (1984), Sahai *et al.* (1987), Kumari (2005), and Kumari (2007). Most of these workers used either technical grade insecticides or their isomers in their studies, but a few workers used with commercial formulation of pesticides in the field experiments.

Recently, developing trends among fish farmers for farming fish in low lying area has drawn attention of biologists to examine the effects of these pesticides / biocides on different vital organs of the fish. Since ovary in fishes is directly related to fish production, I have present here the selected ovary of the catfish, *Heteropneustes fossilis* as the target organ for assessing the toxicities of a commercial grade organophosphate biocide, Abate.

## MATERIAL AND METHODS

The healthy and adult specimens of *Heteropneustes fossilis* (Bloch.) (average body wt. 24±2.5g) were collected from local market. The fishes were kept in aquaria containing water and were acclimatized in the laboratory conditions at least 15 days prior to the experiment. The physico-chemical properties of the water of the aquaria were as follow: Dissolved oxygen, 7.06 ± 1.04 ppm; Free $CO_2$, 3.1 ± 0.6 ppm; pH, 7.24 ± 0.12; Temperature, 24 ± 2.6 °C; Total hardness (as Carbonate $CaCO_3$), 153.45 ± 4.96 ppm; Total alkalinity (as $CaCO_3$), 138.72 ± 5.22 ppm; and Chlorides, 11.10 ± 1.22 ppm.

*Preparation of solution:* Reagent grade Abate was obtained from local market. A known weight of Abate was dissolved in a reagent bottle with 100 ml of distilled water and was kept as stock solution. The $LC_{50}$ of the pesticide, after 24, 48, 72 and 96 hours of exposures, was determined by applying 0.64 ppm dose of Abate to 10 fishes taken in a battery jar. A control set up using normal water was also run with the experiment. The $LC_{50}$ values were determined using straight line graphical interpolation and following the Dragstedt Behren's methods.

*Biochemical determinations***:** The biochemical determination of protein, lipid, and carbohydrate and glucose was made at monthly intervals using experimental fish frozen tissue collected from the treated fish were subjected to different biochemical tests (Natelson 1971, Oscer 1976, and Verley 1980). Data were analyzed statistically and significance level was determined by the student's t-test.

## RESULTS AND DISCUSSION

$LC_{50}$ values after 24, 48, 72 and 96 hours exposure to Abate at 0.64 ppm were determined to be 14.3, 10.00, 6.61 and 5.13 ppms, respectively. Glucose/glycogen, total protein and cholesterol in normal and Abate treated fish are described as follows:

*Glycogen*: In normal fish, glycogen content in the ovary was recorded lowest (6.00 mg/g) in December; it gradually increased from January and became highest (21.96 mg/g) in August followed by a sharp decrease (8.05 mg/g) in September and onwards (Table 1). The pesticide induced fish also showed the same trends as it was lowest (3.58 mg/g) in December and highest (17.10 mg/g) during August followed by sharp decrease (4.93 mg/g) in September. Further, the values obtained during different months of the year in the fish exposed to Abate was found significantly ($P<0.01$) low when compared with their normal value.

**Table 1. Monthly variation in the amount of total glycogen, protein and cholesterol contents in the ovary of *H. fossilis* during control and pesticide Abate (0.64 ppm) treated conditions after 96 hours exposure.**

| Month | Biochemicals in the ovary | | | | | |
|---|---|---|---|---|---|---|
| | Glycogen (mg/g) (Mean ± SD) | | Protein (mg/g) (Mean ± SD) | | Cholesterol (mg/g) (Mean ± SD) | |
| | Control | Abate | Control | Abate | Control | Abate |
| January | 6.10±0.26 | 4.28±0.24 | 110.76±3.14 | 98.40±2.16 | 9.44±10.32 | 82.40±0.20 |
| February | 6.24±0.30 | 4.40± 0.31 | 117.38±2.76 | 96.74±2.32 | 9.96± 0.29 | 8.60±0.24 |
| March | 6.85±0.36 | 4.68± 0.27 | 130.65±3.10 | 101.50±2.44 | 9.75± 0.25 | 8.75±0.33 |
| April | 10.28±0.52 | 7.10± 0.44 | 205.28±4.56 | 169.42±3.48 | 10.58±0.31 | 8.90±0.21 |
| May | 15.50±0.74 | 10.38± 0.65 | 312.72±4.96 | 285.65±3.74 | 11.46±0.37 | 8.98±0.48 |
| June | 18.26± 0.65 | 13.96± 0.58 | 394.88±5.32 | 333.71±4.75 | 13.10±0.42 | 9.65±0.49 |
| July | 20.60±0.78 | 15.82±0.66 | 410.50±3.76 | 360.95±4.98 | 14.25±0.38 | 11.10±0.46 |
| August | 21.96±0.68 | 17.10±0.59 | 424.17±4.38 | 378.34±3.52 | 15.76±0.44 | 12.92±0.58 |
| September | 8.05±0.40 | 4.92±0.38 | 212.69±3.00 | 226.10±2.54 | 11.20±0.32 | 10.54±0.58 |
| October | 7.28±0.25 | 4.06±0.22 | 168.30±1.81 | 146.46±1.68 | 9.78±0.29 | 8.42±0.25 |
| November | 6.92±0.31 | 3.65±0.20 | 134.44±1.20 | 102.67±1.25 | 9.32±0.35 | 7.56±0.34 |
| December | 6.00±0.27 | 3.58±0.25 | 102.65±1.16 | 80.44±1.08 | 9.37±0.28 | 7.15±0.34 |

*Protein:* The total protein content in the ovary of the normal fish as well as pesticide induced fish showed the same trend. In normal fish, the lowest amount of total protein was obtained in December as it was recorded to be 102.65 mg/g in the ovary which gradually increased and became maximum 424.17 mg/g in August followed by a decrease. Further, the total protein content in the ovary of pesticide induced fish showed a significant ($P<0.01$) decline in each month when compared with their normal value.

*Cholesterol*: The cholesterol level in the ovary of normal fish was recorded lowest in the month of November (9.32 mg/g), which gradually increased and became maximum in the month of August (15.76 mg/g) followed by a sharp decrease in September (11.20 mg/g) and October (9.78 mg/g). Similarly, the pesticide induced fish also showed lowest ovarian cholesterol level in December 8.15 mg/g and maximum in August 12.92 mg/g, respectively. Though the pesticides induced fishes showed less cholesterol level in all the months of the year, but the decreases were found statistically significant only in February and April to August when compared with the respective normal values.

The fish oocytes undergo a prolonged growth phase on account of yolk deposition, which is an important constituent of oocytes. Generally, yolk contains protein, lipid and carbohydrate separately or in combination of two or more than two. Melone and Hisaoka (1963) observed two types of yolk inclusions in *Brachydanio rerio,* i.e. intra-vesicular yolk which stains positively for polysaccharide and extra vesicular yolk which is of mitochondrial origin rich with protein and lipid substances, but a reduced level of protein and lipid substances as found in the present experiment reveals a reduced level of yolk deposition in the oocytes of pesticide induced fishes. Similar results were also reported by several workers, i.e. Saxena and Garg (1978) in *Channa punctatus* exposed to fenitrothion and corbaryl; Shukla *et al.* (1984) in *Sarotherodon mossambicus* exposed to malathion; Sahai and Singh (1987) in *Rasbora daniconius* exposed to lindane, and Sukumar and Karpaganapathy (1992) in *Colisa latia* exposed to carbofuran. As the hepatocytes are known to produce yolk precursors, the pesticides may exert influence in retarding the production of such precursors.

A significant increase in the present study in the glycogen content in the ovary during breeding season in the normal fish suggests that the carbohydrate content of the ovary is perhaps synthesized from monomeres during breeding season which is used in vitellogenesis and other metabolic activities of the fish. Though, the pesticides induced fishes showed the similar trend, but in these fishes the glycogen content in ovary are found significantly decreased in all the months of the year when compared with their respective normal values. Yanni (1961) in *Clarias batrachus* and Verma *et al.* (1985) in *Channa punctatus* and *Heteropneustes fossilis* have reported the highest level of glucose in the ovary during spawning and lowest during spend and resting phase and suggested that the elevated level of carbohydrate in the ovary during breeding phase is to meet the high demand of energy to be used for vitellogenesis and/or general metabolism in the fish.

Several workers have reported seasonal variations in the major biochemical constituents in muscle, liver and blood and correlated these values with that of ovary and attempted to conclude that some biochemical contents of these organs fluctuate in a sequential manner that can be attributed to have their role in governing the reproductive cycle of the fishes. The organophosphorus pesticides cause accumulation of acetylcholine with a simultaneous increase in the secretion of catecholamines (Brzezineski and Ludwick 1973) and exogenous acetylcholine to fish leads to an increased secretion of catecholamine (Nilsson *et al.* 1976). Whereas, the carbamate pesticides are known anticholinesterate pesticide. Though the physiological and ecological significance of the pesticides induced disturbance in carbohydrate metabolism of fish is difficult to evaluate, but such prominent alteration including hormonal imbalance ought to have serious consequences for the general body metabolism and the energy economy of the fish.

In the present study, control fish shows maximum protein content in ovary during spawning period and minimum during resting phase. Though, the pesticide induced fishes also showed the same trend, but the protein content in the ovary are found significantly decreased in all the months of the year, when compared with their normal values.

The ovarian cholesterol was maximum during spawning and minimum during post spawning and resting phase in the normal fish. The pesticide induced fishes also showed the same trend.

The present finding is in close agreement with the findings of Sarkar and Nandi (1991). The decrease in the cholesterol content during the present study might be due to increased breakdown of cholesterol into free fatty acids. Further, a gradual increase in cholesterol content in the ovary during pre-spawning and spawning phases with a decrease in serum cholesterol level might be due to its supply to the ovary for increased steroidogenesis, necessary for augmenting the process of vitellogenesis.

The results showed the potentiality of Abate that altered the vitellogenesis of the fish. Alteration in vitellogenesis can badly influence the farming of fish. Frequent use of this pesticide in paddy fields and its disposal in water bodies is very hazardous and unwarranted to the freshwater ecosystem. On the basis of above mentioned findings, it may be suggested that indiscriminate use of this pesticides in water bodies should not be encouraged by the farmers particularly those who are planning for farming catfishes in their paddy fields.

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