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Abstract- Fresh water fish has made a substantial contribution as food to the growing population. Fish proteins occupy an important place in human nutrition. They have high digestibility, besides biological and growth promoting value. However, indiscriminate use of pesticides in agricultural operations poses many problems to the aquatic environment and causes serious contamination. Continuous exposure of fish to these toxic chemicals is hazardous to their health and causing massive fish kills. In this investigations, Mastacembelus armatus a cauvery riverine fish was exposed to endosulfan an organochlorine pesticide widely used in agricultural areas in cauvery delta. It was found that the toxicity of this pesticide had caused a deleterious effects in the ionic regulations of the fish monovalent cations like Na+, K+ and divalent cations like Ca++and Mg++ play a significant role in the physiological functions of fishes. Prolonged exposure of the fish to the endosulfan toxicity had altered the ionic regulations and resulted to the morbidity of fish and finally lead to the mortality of the fish from the pesticide polluted water.

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Abstract- Fresh water fish has made a substantial contribution as food to the growing population. Fish proteins occupy an important place in human nutrition. They have high digestibility, besides biological and growth promoting value. However, indiscriminate use of pesticides in agricultural operations poses many problems to the aquatic environment and causes serious contamination. Continuous exposure of fish to these toxic chemicals is hazardous to their health and causing massive fish kills. In this investigations, *Mastacembelus armatus* a cauvery riverine fish was exposed to endosulfan an organochlorine pesticide widely used in agricultural areas in cauvery delta. It was found that the toxicity of this pesticide had caused a deleterious effects in the ionic regulations of the fish monovalent cations like Na^+, K^+ and divalent cations like $Ca^{++}$and Mg^{++} play a significant role in the physiological functions of fishes. Prolonged exposure of the fish to the endosulfan toxicity had altered the ionic regulations and resulted to the morbidity of fish and finally lead to the mortality of the fish from the pesticide polluted water.

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I. Introduction

Fresh water fish has made a substantial contribution as food to the growing population. Fish proteins occupy an important place in human nutrition. They have high digestibility, besides biological and growth promoting value (Idyl, 1972 and Tont 1977). However, indiscriminate use of pesticides in agricultural operations poses many problems to the aquatic environment and causes serious contamination (Cremlyn,1978). Continuous exposure of fish to these toxic chemicals is hazardous to their health and causing massive fish kills (Saunders, 1969). In this investigations, *Mastacembelus armatus* a cauvery riverine fish was exposed to Endosulfan an organochlorine pesticide widely used in agricultural areas in cauvery delta. It was found that the toxicity of this pesticide had caused a deleterious effects in the ionic regulations of the fish. Monovalent cations like Na^+, K^+ and divalent cations like Ca^{++} and Mg^{++} play a significant role in the physiological functions of tissues. Prolonged exposure of the fish to the endosulfan toxicity had altered the ionic regulations and resulted to the morbidity of fish and finally lead to the mortality of the fish from the pesticide polluted water.

Fresh water fishes maintain the internal homeostasis through the influx and efflux of ions, which exist in bound and free form and are essential for cell metabolism. Sodium and potassium pump mechanisms maintain the normal cell volume and pressure. They are also important in the regulation of water and electrolyte balance and acid-base balance in the body. Sodium ions concentration in the tissues depends primarily on the permeability of the membrane and also on the functional efficiency of the sodium pump, which regulates the ionic content of the tissues. Calcium has been recognized as an important factor in influencing the survival of fishes. Physiological functions including muscular contractions, hormonal release, maintaining cellular structure, membrane stability and cytoplasmic compositions are regulated by calcium ions in the tissues of fishes. Calcium homeostasis is achieved by a balance between absorption in the intestine and excretion by the kidney.

II. Materials and Methods

a) Collection of samples

Laboratory acclimatized female fishes *M. armatus* of 15-17.5 gm. weight were grouped into sets of 10 fish and was introduced into the sub lethal concentration of 1/30 Lc 50 of endosulfan. A control of 10 fish, not exposed to endosulfan pesticide was also maintained. Earth worms and fish feeds were provided throughout the experimental period, but feeding was stopped 24 hours prior to the sampling day. The total period of exposure was 30 days. Sampling was done on 96 hours.

i. Estimation of Calcium and Magnesium

The total calcium and magnesium ions in the samples were determined by titrating with disodium Ethylene Diamine Tetra Acetate (EDTA). Eriochrome black I was an indicator. Calcium was estimated by titrating with EDTA using Muroxide as indicator (Kacz *et al.,*1964)

200mg of tissue from liver, ovary, and muscle were taken for analysis. The tissues were digested in 2ml of concentrated HNO3, kept overnight and were

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diluted with 10 ml of distilled water. This solution was taken for the estimation of calcium and magnesium. 1 ml of the sample was taken in a China dish and 9 ml of distilled water was added. 5 ml of Ammonia buffer was added followed by 2 drops of Erichrome black I indicator and titrated against 0.01m EDTA. The end point was the appearance of Sky blue colour. Titre value was common for the Ca^{++} and Mg^{++}ions .

To 1ml of the same sample 9ml of distilled water was added in a China dish, 5ml of 10% NaOH solution was added and 2 drops of Muroxide indicator was added and titrated against 0.01m EDTA. The end point was the appearance of violet colour.

III. Calculation

Titre value of Mg^{++} = Titre value of Ca^{++} and Mg^{++} - Titre value of Ca^{++}

$$\% \text{ of Calcium} = \text{Titre value of Ca} \times \text{Molarity of EDTA} \times \frac{\text{Volume made} \times \text{dilution} \times 100}{\text{Weight of the sample (mg)}}$$

$$= \% \text{ of } Ca^{++} \times 10^4 / \text{Equivalent wt. of calcium}$$

$$= \text{Milli Equivalent } Ca^{++}/\text{ Kg}$$

Magnesium ions were also estimated employing the same calculation method after substituting, the appropriate titre value and equivalent weight of magnesium.

a) Estimation of Na^+ and K^+

200 mg of wet tissue from liver, ovary, and muscle were taken from the enosulfan treated and untreated fish. To each of the tissue 2 ml of concentrated HNO3 was added, followed by 10 ml of distilled water and filtered. The filtrate was used for the analysis of Na^+ and K^+ in an automatically controlled G.BC 906 (Australia). Atomic Absorption Spectro-photometer. Na^+ was estimated at 588.6 nm and K^+ was estimated at 766 nm. The ionic levels were calculated and expressed in meq/ kg of tissues.

IV. Results and Discussion

In this investigation, *Mastacembelus armatus* a Cauvery riverine fish was exposed to endosulfan an organochlorine pesticide which is widely used in agricultural areas of Cauvery Delta. It was found that the toxicity of this pesticide caused deleterious changes in the ionic regulations of the fish and the excretion by the kidney. Mg++ also plays a key role in the action of many enzymes, particularly those of glycolysis and ATP dependent reactions.

But the ionic regulations of the fresh water fishes are altered by the additions of metals and pesticide pollutants. These pollutants change the ionic concentration in the tissues which could result in physiological, behavioral and hormonal abnormalities. The disturbance in the ionic regulations has been established in the fresh water *Mastacembelus armatus.* These fishes were subjected to sub lethal concentration of endosulfan. The exposed fishes showed hypocalcemic condition in liver, ovary and muscles. This declining trend is due to the structural and functional changes of the mitochondrial membrane of the tissues.

Pesticide toxicity inhibits the binding of calcium to the phospholipid moiety of the ATPase enzyme, thus inhibiting the normal movement of Ca++ across the nerve membrane, resulting in hypocalcemic condition in the peripheral tissues such as liver, ovary and muscle (Table 1).

Table 1: Cation in M. armatus treated with endosulfan

M. armatus untreated	Organs of *M. armatus*	Concentration of cation in MEq/Kg			
		K^+	Na^+	Ca^{++}	Mg^{++}
	Liver	37.5	151.12	9.83	13.17
	Ovary	31.17	140.83	7.50	11.33
	Muscle	103.87	125.50	9.50	11.14
M. armatus treated with endosulfan	Liver	11.17	180.17	2.40	25.03
	Ovary	16.67	195.00	1.67	24.00
	Muscle	77.83	149.83	2.83	22.83

The muscle of the fishes showed a declining trend of Ca^{++} ions due to the inhibition of Ca^{++} ATP ase enzyme. This condition of the tissue results in vigorous muscular spasms and neuro muscular effects.

Endosulfan toxicity also increases the Mg^{++} concentration in the tissues. This alteration of Mg^{++} transport is due to the changes of the permeability of the membrane systems and damage of gills, intestinal mucosa and the failure of renal tubular reabsorption caused by the pesticide residues. The pesticide toxicity also inhibits Na and K, ATPase enzymes and disturbs osmoregulation, muscular activity and physiological functions. Prolonged changes in cationic regulations may result in the morbidity and extinction of these organisms from polluted waters.

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