CHAPTER-3

BEHAVIORAL STUDY
Introduction:

In India as a consequence of extensive use of pesticide in agriculture, veterinary and medical fields, no water bodies are free from pollutants which affect aquatic life (Konar; 1977, Amminikutty and Rege; 1977). The pesticides possess a constant threat to non-target organisms specially to the fishes by altering their behaviour pattern (Ware; 1980, Ghose; 1986), growth and nutritional value (Manoharan and Subbiah; 1982).

Environmental pollutants such as insecticides in very small quantities have been found to affect the physiological status and behaviour of fish. DDT is known to affect the nervous system of fish (Metlev et al., 1983). Such toxicants reduce the ability of the species to compete to the natural environment by altering the physiological status and inducing morbidity. Toxic chemicals have marked harmful effect on aquatic fauna when released in water bodies. Pollutants have observed to affect the physical and physiochemical properties of the water bodies and the planktonic life. Thereby they disrupt the ability of self-rejuvenation nature and detoxification to a considerable extent. (Devi; 1994).

Review of literature:

Different workers highlight the changes of behavioural and morphological aspects due to the application of different pesticides. There are number of reports on the relationship between the sub-lethal treatment with insecticides and behavioral changes in fishes. In sub-lethal malathion exposure, there is
impairment in mechanisms, which reduce the ability of the fish to perform normal functions (Heath; 1961). Warner et al., 1966 studied the effects of Texaphene on gold fish (*Carassius carassius*) and found many dose dependence behaviour. Anderson and Peterson; 1969 and Davy et al., 1972 noted behavioral changes, directed by the Central Nervous System (CNS), in brook trout and gold fish treated with low dose of DDT. Das and Konar; 1974 and Chakraborty and Konar; 1974 investigated the effects of sub-lethal level of insecticides on behavioral, survival, growth, breeding and histopathology of the fish, *Mollienisia sphnops*. Bull and Minerney; 1974, conducted a behavioral study of Sumithion exposed juvenile coho salmon. Depression of brain AchE (acetyl cholinesterase) may cause numerous physiological and behavioral modifications that reduce the survival ability of animals (Richmond and Dutta; 1989).

Some investigators have also reported general morphological changes in liver, kidney and testis by various pesticides (Munro et al., 1974, Sarin and Saxena; 1978, Dikshit et al., 1980). The polycyclic chlorinated insecticide cause neurotoxic symptoms, such as ataxia, slurred speech, mental changes, irritability and exaggerated startle response (Chetty; 1985).

The organochlorine insecticides act by interference with axonal transmission by binding to the nerve membrane and unbalancing sodium-potassium ion producing prolonged valleys of impulses resulting in tremors and finally paralysis, (Moore and Moore; 1976, Cremlyn; 1978). The pesticides are generally toxic to insects and other animals due to their inhibiting properties of
cholinesterase resulting into disruption of cholinergic sites in nervous system (Ghose et al., 1986).

Metabolic transformation plays a major role in the mechanism of toxicity of chlorinated hydrocarbons-organochloride insecticide –endosulfan (thiodon). This toxicity of organochlorine insecticides lie in their inhibiting Na, K and Mg adenosine triphosphatase activity in the nerve endings of animal particularly insects. It affects sensory, motor nerve fibres and the motor cortex (Matsuma and Patel; 1961). Endosulfan and other organic insecticides are inhibitors of acetyl cholinesterase in insects and mammals. It causes tremors, convulsions, muscle paralysis and finally death. (Shukla and Upadhyay; 1998).

**Materials and Methods:**

The fishes were collected from local market and weights were taken by electronic balance. Then the fishes were acclimatized in the experimental medium for two weeks prior to the experiment. General behavioral changes of the fishes of the three groups such as normal, control and treated groups of fishes were observed throughout the period of the experiment and recorded. The weights were again measured and recorded from the three groups after 96 hr, prior to the experiment.

**Results:**

After the application of endosulfan to the acclimatized fishes, the general behavioral pattern was changed. It was also observed that the mortality rate was higher in winter season than in summer. But, no specific changes were
observed in case of morphological structures. The organs like skin, gills, fins, scales etc showed no remarkable change.

The weights of the normal fishes were $22.78 \pm 2.38$ gm and $22.83 \pm 2.0$ gm in control fishes, which were found to reduce slightly e.g $21.57 \pm 2.35$ gm in treated group (Table no-3.1). It seems that in normal and in control groups of fishes the weight was almost similar, but in treated group the weight was reduced with average of 1-1.5gm for each fish. However, the changes of weight were statistically not significant. The reducing trend of weight may be due to stress condition of the fishes in aquaria and due to stopping of food supply during the experimental period.

**Table no-3.1: Average Weight Variations for different groups of specimens.**

<table>
<thead>
<tr>
<th>Normal (gm)</th>
<th>Control (gm)</th>
<th>Treated (gm)</th>
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<tbody>
<tr>
<td>$22.78 \pm 2.38^*$</td>
<td>$22.83 \pm 2.0^*$</td>
<td>$21.57 \pm 2.35^*$</td>
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$^*$ ± S.D., p<0.05 not significant

At very low concentration of 0.0004ppm, _Channa punctatus_ were seen to be highly uncomfortable, irritated and were jumping out of the water for breathing. Devi _et al._, 2001, also reported that after exposure of effluent of galvanized industry, the fishes show excitation, rapid movement, fast operculum movement, loss of balance and occasional jerking and fishes tend to remain on the surface of polluted water. The same changes were observed by Devi, _et al._, (2001), on the application of endosulfan at 0.0003 ppm in _Heteropneustes fossilis_.

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If the insecticides were given at 1ppm dose to the fishes, they died within one to one and half hours in that environment. The physiological and behavioral changes were occurred due to endosulfan intoxication. Physiological and behavioral changes in aquatic organisms due to the presence of pesticides were also reported by Mattison and Thomford; 1989. Jonsson et al., 1993 observed the apparent behavioral effects of endosulfan on *Hyphessobrycon bifasciatus* and *Brachydanio rerio* at 2 h to the highest doses.

The physiological and behavioral changes may be observed as the organochlorine insecticides affect on Central Nervous System. These compounds may bind with neurotransmitter in specific receptors and change the behavioral pattern of the fishes. Similar observations were recorded by WHO-1984, Pascoe et al., 1986, Nemcosk et al., 1988.

The sequence of intoxication symptoms were excitation, erratic swimming with increment in respiratory frequency, swimming near the surface for oxygen uptake, convulsion and death. Similar behavioral effects have been observed in fish exposed to other organochlorine insecticides such as DDT and BHC (Joshi and Rege; 1980), Pyrethroids (Haya; 1989) and organophosphate (Naqvi and Hawkins; 1988). Such behavioural effects were also noticed by Srivastava; (1981) and Joshi and Semwal; (1992) in the presence of various pollutants. Organophosphate pesticides reach water bodies in sub-lethal concentration and their bioaccumulation in aquatic animals cause alternation in their normal behavior. (Ravi and Selvarajan; 1990).
Again, hyperactivity of the fishes was observed after application of endosulfan, which was also reported by Swarup, 1981. It was supposed that hyperactivity and convulsions of the exposed fish may be due to the consequence of alterations in the levels of intra and extra cellular sodium and potassium.

Breathing distress and rapid movement were observed in fish, which may be caused due to excessive secretion of mucous due to toxic effect of endosulfan that clogged the gill tissue resulting anoxia, carbon dioxide retention and collapse of blood vessels. Again the mucous layer reduced normal gaseous exchange between the blood and water, resulting depletion of oxygen and carbon dioxide accumulation in the body of the fish and lead to suffocation and death of the fish. Such types of results were also reported by Ellis (1937), Lloyd (1965), Manoj et al.,(1999). Gardener and Yevich (1970) reported the impairment in the respiration of an estuarine teleost fish, *Fundulus heteroclitus* and a fresh water fish, *Anabas testudineus* after the treatment of cadmium. Workers like Baron;1967, Risher et al.,1987 also described the pesticides toxicity to the aquatic animals including fishes.

The equilibrium of the organisms is also lost. Pawar;1994 observed various abnormalities such as curvature of body axis, poor body and eye pigmentation, blisters on body, enlargement of pericardial sac, circulatory failure, loss of balance and abnormal behaviour in pesticidal stress. These chemicals also produce other symptoms like vomiting, diarrhea, sweating, cyanosis, twitching of muscle.
The feeding rate, food absorption and conversion efficiency, metabolism and growth of fish are significantly hampered in pesticide stress environments (Ponmani et al., 1997). Spiral movements, swimming in jerk, disorderly sprints and attempts to jumps out of the water are common symptoms of intoxication of pesticides in case of fish (Srikanta; 2007).