REVIEW

OF

LITERATURE
Today India is the largest fish producing country in the world with an annual output exceeding more than 61.8 lac tonnes. In farmed fish production India ranks second after China. The ecological health of most of rivers, wetlands and estuarine ecosystems has impaired and their ability to support fish stock is diminishing years after years. These valuable resources are losing their biogenic potentialities due to several reasons but the environmental degradation and water pollution are of the most important reasons. Fish are also more susceptible to environmental contamination. Since they already live in a dynamic environment, environmental contamination acts as an added stress which the fish may or may not be able to withstand (Schoettger, 1970; Wendelaar Bonga, 1997). Fish are exposed to aquatic toxicants through their extensive and delicate respiratory surface and, as in case of sea water fish, also via water-drinking (Wendelaar Bonga, 1997). Hence, fish serves as an excellent bioassay animal for toxicological impact and has been widely used for this purpose (Ruggieri, 1975;
Swarup et al., 1977; Barton, 1998; Blaxter and Hallers-Tjabbes, 1992; Espelid et al., 1996; Wendelaar Bonga, 1997; Hollis et al., 1999; Pratap, 1999; Kumar et al., 1999). In fact fish forms an important part of aquatic toxicology and various kinds of biological effects of different environmental toxicants have been studied in a wide variety of fish (Haya, 1989; Ballint et al., 1995; Boone and Chambers, 1997; Carr et al., 1997; Rice et al., 1997; Black et al., 1998; Orn et al., 1998; Jyothi and Narayan, 1999; Poleksic and Karan, 1999; Orue and Uner, 1999; Valigo and Landriscina, 1999).

Extensive use of pesticides has facilitated increases in agricultural productivity, despite a decrease in the total acreage of land cultivated. Mass mortality of aquatic organisms has often been caused by pesticide exposure, especially from accidental or direct spraying of water bodies. More commonly, aquatic organisms are subjected to long-term stresses from exposure to sub-lethal concentrations. However in the long run, these sub-lethal concentrations may also prove to have deleterious effects as do lethal concentrations, because sub-lethal and small effects on aquatic organisms may alter behaviors, feeding habits, school group positions, reproduction rates, etc. (Murty,
1986). In addition, pesticides that do reach the water body can accumulate in fish and mollusks which are then harmful to humans when ingested (Hayes, 1982).

Fish are also more susceptible to environmental contamination. Since they already live in a dynamic environment, environmental contamination acts as an added stress which the fish may or may not be able to withstand (Schoettger, 1970; Wendelaar Bonga, 1997). Hence, fish serves as an excellent bioassay animal for toxicological impact and has been widely used for this purpose (Ruggieri, 1975; Swarup et.al., 1977; Barton, 1998; Blaxter and Hallers-Tjabbes, 1992; Espelid et.al., 1996; Wendelaar Bonga, 1997; Hollis et.al., 1999; Pratap, 1999; Kumar et.al., 1999). In fact fish forms an important part of aquatic toxicology and various kinds of biological effects of different environmental toxicants have been studied in a wide variety of fish (Haya, 1989; Ballint et.al., 1995; Boone and Chambers, 1997; Carr et.al., 1997; Rice et.al., 1997; Black et.al., 1998; Orn et.al., 1998; Jyothi and Narayan,
The intake of insecticides affects the biochemical composition of fishes (Jebakumar et al., 1990; Sultatos, 1998; Kumble and Muley, 2000; Prasad et al., 2002), alterations in the blood biochemistry of Salmo Trutta Fario exposed to Cobalt Chlorite (Atamanalp, M., A. Ucar, E.M. Kocaman, S. Keles, T. Sisman and H. Turkez, 2009). It has been shown by many scientists that insecticides mainly affect liver of fishes (Murty and Devi, 1982; Anthony et al., 1986; Bhushan et al., 2002). This is because of its relatively slow blood flow as compared to cardiac output (Gingerich, 1982) as well as the much closer association of hepatocytes to biliary system than is found in mammals.

The maintenance of physiological balance under stress conditions requires additional energy. It is also established (Suarez and Mommsen, 1987) that gluconeogenesis (production of glucose from non-carbohydrate sources) is the most likely alternative pathway in case of fishes, and that it accounts for a substantial part of the glucose produced for satisfying the needs of the body. In stress conditions, demand for added glucose...
increases to meet the high energy demand. Production of glycogenolysis and gluconeogenesis, as a part of homeostasis following stress, is well known (Gorbman and Bern, 1962; Martin et al., 1981; Hoar, 1984). Stimulation of gluconeogenetic pathways for supplementary energy demand could result into protein break down to enrich the amino acid pool for conversion to glucose. This may explain the decrease in protein and gain in amino acid concentration observed in the liver of stressed *Heteropneustes fossilis* because liver is the major gluconeogenetic organ in teleosts (Moon et al., 1985; Suarez and Mommsen, 1987).

A decrease in blood protein content has also been reported in a variety of stressed fish. For example; *Ictalurus punctatus* exposed to zinc and copper (Lewis and Lewis, 1971); *Salmo gairdneri* exposed to DDT (Mehrle et al., 1971) and dieldrin (Grant and Mehrle, 1973); *Clarias batrachus* exposed to mercury (Bilgrami and Qayyum, 1978) and malathion (Mukhopadhyay and Dehadrai, 1980 a, b); *Heteropneustes fossilis* exposed to sewage, BHC and endrin (Srivastava and Narain, 1985); *Catla catla* exposed to mercury (Rai, 1987).

Alteration in the protein content of liver has been observed by a number of workers in fishes exposed to a variety of environmental pollutants and other stress factors. For example, *Tilapia mossambica* exposed to dichlorovos (Rath and Mishra, 1981), malathion (Kabeer et.al., 1984) and heptachlor (Rao et.al., 1990); *Heteropneustes fossilis* exposed to dimethoate (Dubale and Awasthi, 1982, 1984) and Formothion propoxur (Singh et.al., 1997a, 1997b); *Puntius conchonius* exposed to phosphamidon (Gill, 1990); *Channa punctatus* exposed to cythion (Narayan and Sathyaneshan, 1985) and zinc
(Shukla and Pandey 1986); Brachydanio rerio exposed to malathion (Kumar and Ansari, 1986); Oreochromis mossambicus exposed to endosulfan (Ganesan et.al., 1989) Colisa fasciatus exposed to paper mill effluent (Mishra, 1992) Clarias batrachus exposed in organophosphate insecticide rogar (Begum et.al., 1999).

Regarding the underlying causes of decrease in total protein content in pollutant treated fish, it has been suggested (Holbrooke, 1980; Krishnamohan et.al., 1985) that it may be due to interference to metabolites of the toxicant with the pathways of protein biosynthesis either through the inhibition of RNA synthesis at the transcription level or diminished incorporation of amino acid into polypeptide chain; this suggestion is supported by Hellman and Laryea (1990), who reported that the degradation product of the carbamate fungicide benomyl impaired the synthesis of macromolecules such as enzymes and nucleic acids in the mice.

Workers like Durairaj and Selvarajen (1992) have actually observed decrease in RNA and DNA content accompanying hypoproteinemia in stressed fish like