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EFFECT OF MALATHION TOXICITY ON FRESH WATER FISH *LABEO ROHITA*

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Abstract- Malathion is a nonsystemic, wide-spectrum organophosphate insecticide. It was one of the earliest organophosphate insecticides developed (introduced in 1950). Malathion is suited for the control of sucking and chewing insects on fruits and vegetables, and is also used to control mosquitoes, flies, household insects, animal parasites (ectoparasites), and head and body lice. Malathion may also be found in formulations with many other pesticides. However, Malathion is found to be highly toxic to various non-targeted aquatic organisms including fish. Contributing factor to the sensitivity of fish to malathion exposure seems to be its high rate of gill absorption due to the lipophilicity. The main mode of its action is neurotoxicity, and its capacity to induce oxidative stress or alteration of antioxidant system and lipid peroxidation. Thus, the main aim of this study is to review the toxic effect of non-synthetic, malathion in fish.

KEYWORD: - Acute, chronic, pesticides, toxicity, *Labeo rohita*

INTRODUCTION-
In recent years, the high rate of increase in human population and rapid pace of industrialization have created problem of disposal of waste waters. The domestic wastes and untreated or partially treated industrial effluents, supplemented with pollutants like heavy metals, pesticides and many organic compounds, have greatly contributed to massive fish death of aquatic ecosystems. These toxic chemicals and metals have changed the quality of water that affects the fish and other aquatic organisms.

Pesticides are the major potential environmental hazards to humans and animals as these are present and concentrated in the food chain. The long-term ecological hazards associated with the use of organochlorine, organophosphate and carbamate pesticides has led to the introduction of a new generation of pesticides with a lesser degree of persistence. Malathion is a nonsystemic, wide-spectrum organophosphate insecticide. It was one of the earliest organophosphate insecticides developed (introduced in 1950). Malathion is suited for the control of sucking and chewing insects on fruits and vegetables, and is also used to control mosquitoes, flies, household insects, animal parasites (ectoparasites), and head and body lice. Malathion may also be found in formulations with many other pesticidesdiethyl(dimethoxythiophosphorylthio)succinate *S*-1,2-bis(ethoxycarbonyl)ethyl *O,O*-dimethyl phosphorodithioate ***Chemical Formula:*** $C_{10}H_{19}O_6PS_2$ (Fig 1). The extensive use of malathion on land may be washed into surface water and can adversely influence or kill the life of aquatic organisms and other higher animals. Aquatic organisms, particularly fish, are highly sensitive to malathion (Ural et al., 2005; Assis et al., 2009).

LD50/LC50: Malathion is slightly toxic via the oral route, with reported oral LD50 values of 1000 mg/kg to greater than 10,000 mg/kg in the rat, and 400 mg/kg to greater than 4000 mg/kg in the mouse. It is also slightly toxic via the dermal route, with reported dermal LD50 values of greater than 4000 mg/kg in rats.

It has been reported that single doses of malathion may affect immune system response. Symptoms of acute exposure to organophosphate or cholinesterase-inhibiting compounds may include the following: numbness, tingling sensations, incoordination, headache, dizziness, tremor, nausea, abdominal cramps, sweating, blurred vision, difficulty breathing or respiratory depression, and slow heartbeat. Very high doses may result in unconsciousness, incontinence, and convulsions or fatality. The acute effects of malathion depend on product purity and the route of exposure. Other factors which may influence the observed toxicity of malathion include the amount of protein in the diet and gender. As protein intake decreased, malathion was increasingly toxic to the rats. Malathion has been shown to have different toxicities in male and female rats and humans due to metabolism, storage, and excretion differences between the sexes, with females being much more susceptible than males. Numerous malathion

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poisoning incidents have occurred among pesticide workers and small children through accidental exposure. In one reported case of malathion poisoning, an infant exhibited severe signs of cholinesterase inhibition after exposure to an aerosol bomb containing 0.5% malathion.

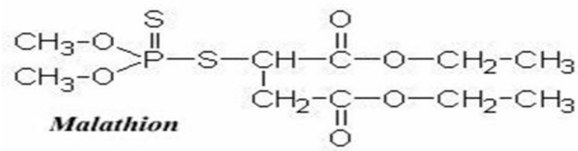
Effects on aquatic organisms: Malathion has a wide range of toxicities in fish, extending from very highly toxic in the walleye (96-hour LC50 of 0.06 mg/L) to highly toxic in brown trout (0.1 mg/L) and slightly toxic in goldfish (10.7 mg/L). Malathion is highly toxic to aquatic invertebrates and to the aquatic stages of amphibians. Because of its very short half-life, malathion is not expected to bioconcentrate in aquatic organisms. However, brown shrimp showed an average concentration of 869 and 959 times the ambient water concentration in two separate samples.

Effects on other organisms: The compound is highly toxic to honeybees.

Breakdown in soil and groundwater: Malathion is of low persistence in soil with reported field half-lives of 1 to 25 days. Degradation in soil is rapid and related to the degree of soil binding. Breakdown occurs by a combination of biological degradation and nonbiological reaction with water. If released to the atmosphere, malathion will break down rapidly in sunlight, with a reported half-life in air of about 1.5 days. It is moderately bound to soils, and is soluble in water, so it may pose a risk of groundwater or surface water contamination in situations which may be less conducive to breakdown.

Breakdown in water: In raw river water, the half-life is less than 1 week, whereas malathion remained stable in distilled water for 3 weeks. Applied at 1 to 6 lb/acre in log ponds for mosquito control, it was effective for 2.5 to 6 weeks. In sterile seawater, the degradation increases with increased salinity. The breakdown products in water are mono- and dicarboxylic acids.

Malathion (O-dimethyl-S1-2-di (ethoxycarbonyl) -ethylphosphorodithioate) is an organophosphorus insecticide widely used in agriculture and houses to control variety of insects including aphids, beetles, scales and pill bugs. Apart from target specimens, non-target animals including fish are greatly affected by these pesticides (Al-Akel et al., 2010; Alkahem Al-Balawi, 2011). It is believed that the fish possess the same biochemical pathways to deal with the toxic effects of endogenous and exogenous agents as do mammalian species (Lackner, 1998; Al-akel et al., 2010; Ahmad, 2011). Therefore, it is important to examine the toxic effects of pesticides on fish since they constitute an important link in food chain and their contamination by pesticides imbalance the aquatic system. Survey of literature indicates that only few investigations (Osman et al., 2010, 2011) describing the concentration of this pesticide in the green vegetables (Qaseem region) has been published from Saudi Arabia. Degradation of malathion in aqueous solution has been worked out by Mohamed et al. (2009) and Zhang et al. (2010). Author is not aware of any literature pertaining to the contamination of Arabian surface and ground water with malathion. Its effects on animals other than fish were described by Relyea (2004), Uzun et al. (2009), Bakry et al. (2011) and Moore et al. (2011).



Toxicological tests have shown that malathion affected central nervous system, immune system, adrenal gland, liver and blood. In present study effect of malathion on detoxifying organ like kidney and liver was studied.

MATERIAL & METHODS

Healthy adult fishes *Labeo rohita* were collected from local Dal sagar Lake Seoni Dist. Washed with 0.1% of potassium permagnate solution .Rinsed in water and acclimatized to the laboratory conditions for two weeks in glass aquaria. During acclimatization fishes were fed with pieces of live earthworm on alternate days. For studying histopathology of the various tissues, Ten fishes were exposed to sublethal concentration of malathion (0.8 ppm) for four days. Control group were also maintained separately. After 96 hours fishes were removed from both group and immediately stunned with a blow on the head, kidney and liver were dissected out and fixed for 24 hr in aqueous Bouin's fixative.

The material was thoroughly washed in running tap water till yellow color of picric acid went off. The material was then dehydrated in different grades of alcohol, cleaned in xylene and paraffin blocks were prepared. Paraffin sections cut at 6 μm thicknesses with help of microtome. The sections were stained with hematoxyline and Eosin, mounted in DPX and observed under microscope.

RESULTS-

Under sublethal concentration of malathion toxicity, renal tissue of the fish Labeo rohita showed marked pathological changes. Highly degenerative changes in renal tubules which include severe necrosis and spaces in bowman's capsule were observed. Liver sections showed the hepatocytes with cordlike pattern. These cords were arranged around tributaries of the hepatic vein. Liver cells were large in size, polygonal in shape with homogenous eosinophilia cytoplasm and centrally located nuclei. A large number of blood sinusoids were observed which seperated hepatic cords one from another. Exposure of *Labeo rohita* to malathion for 4 days induced degeneration of cytoplasm and vacuolization of hepatocytes.

DISCUSSION-

In fish, as in higher vertebrates, the kidney performs an important function related to electrolyte and water balance and maintenance of stable internal environment. Following exposure to fish to toxic agent such as pesticide, histological alteration has been found at the level of the tubular epithelium and glmerolus. In present investigation kidney of Labeo rohita showed shrinkage of glomeruli and renal tubules. Degeneration of renal tubules and collecting tubules were observed. Due to shrinkage of glomeruli spaces in bowman's capsule increased. Kidney is affected indirectly by the pesticides through the blood circular system. Konar (1970) reported the rapture of renal epithelium, collapse of renal tubules, swelling and nuclear changes in Labeo rohita treated with hepatochlor. According to Jayantha Rao (1982) severe pathological changes were noticed in kidney of exposed fresh water fish Tilapia mosambica which may be due to renal excretion of toxified fenvalerate. Dubale and Shah (1984) noted vacuolation and consequent necrosis of kidney of a fresh water teleost, Channa punctatus under toxic effect of malathion. Bhatnagar et al., (1987) observed desquamation of epithedial cells, migration of nuclei towards lumen and complete dissolution of cellular wall of renal tubules in Channa gachua exposed to endosulfan. Basi et al., (1990) observed extensive damage in the kidney of Channa punctatus exposed to DDT. Dhanapkiam and Premaltha (1994) worked on histopathological changes in the kidneys of Cyprinus carpio exposed to malathion and sevin and observed the loss of nuclei and appearance of vacuoles. Sastry and Gupta (1996) observed tubular necrosis, necrosis of haemopioetic tissue and inflammation in Channa punctatus exposed to dimethoate. In present investigation malathion exposure in Channa punctatus resulted in Shrinkage of glomeruli and renal tubule. Degeneration of renal tubules was observed. The results were similar to those by earlier studies. Das and Mukherjee (2000) showed disintegration of kidney, with necrosis of tubular cells in Labeo rohita exposed to hexachlorocyclohexane. Different investigators and authors noticed toxical changes in the liver of catfish after Exposure to organophosphate and allied group of pesticides. Elezaby et al. (2001) studied the effect of Malathion on the fish Oreochromis niloticus and has observed that Malathion induced many histopathological changes in the liver and gills of the fishes. These changes were hemorrhage, necrosis and destruction of lamellae of the lungs, and necrosis and lipidosis in the liver. Shukla et al. (2005), noticed in his observation that when the catfish *Clarias batrachus* is exposed to the increased concentration (0.16/mL) of the organophosphate pesticide Nuvan, the hepatocytes exhibited reduction in their size and peripheral accumulation of cytoplasm. The nuclei of the hepatocytes lost their rounded appearance and the cell boundaries became obliterated at places after 20 days of pesticide exposure. The hemorrhage in liver was evident by increased volume of sinusoidal space.6 The hazardous effect of the pyrethroid insecticide, fenvalerate on the histology and histochemistry of the liver of the catfish (Clarias gariepinus) after exposure to 1/10LC for 5 and 10 days was investigated by S.A.Sakr et al. (2005). The results showed that the histopathological changes induced in the liver were mainly represented by cytoplasmic vacuolization of the hepatocytes, blood vessel congestion, inflammatory leucocytic infiltration, necrosis and fatty infiltrations. The effect of insecticides on the liver of different fish species were studied by many investigators. Mandal and Kulshrestha studied the effects of sublethal concentration of sumithion on liver, kidney and intestine of Clarias batachus. They observed liver necrosis, vacuolization and breakdown of the cell boundaries. They also observed vacuolization of epithelial cell of uriniferous tubules and degeneration of the glomeruli in the kidney, while in the intestine, they noticed lesion formation in the villi and enlargement of mucous cells. Histological, changes in the liver of Tilapia mossambica after exposure to the organophosphate monocrotophos were reported by Desai et al.. Sakr et al. studied the effect of the organophosphorous insecticide (Hostathion) on the liver of the carfish (Clarias gariepinus). Their results showed that this insecticide produced histopathological changes in the liver represented by liver cord disarray, cytoplasmic vacuolization of the hepatocytes, damage of blood sinusoids, blood vessel congestion and inflammatory leucocytic infiltrations. Couch (1975) reported perivascular lesions in liver of fishes exposed to organic contaminants and pesticides. According to Gingerich (1982) the vacuolization of hepatocytes might indicate an imbalance between rate of synthesis and rate of release of substance in hepatocytes. In this study, all effects that were observed in the liver reduce the general state of health of H. fossilis at sublethal concentration. It may therefore, be said that a sublethal concentration may be safe however, it cannot be used indiscriminately. It is concluded that organophosphorous insecticide like malathion affected detoxifying organ like kidney and liver of *Labeo rohita* which could be used as a good response of aquatic pollution with effect of organophosphorous compound on fish.

CONCLUSION-

Long term exposure of organisms to pesticides means a continuous health hazard for the population. So, human population is at high risk by consuming these toxicated fishes. This implies that one should take the necessary precaution in the application of pesticides to protect the life of fish and other aquatic fauna. It is likely that approaches using molecular biology techniques will revolutionize toxicological applications that are cheaper and do not require the use of animals to detect environmental stressors. Pesticide toxicity in fish has been studied by several workers who have shown that at chronic level, it causes diverse effects including oxidative damage, inhibition of AchE activity, histopathological changes as well as developmental changes, mutagenesis and carcinogenicity. With reports of toxicants usage and its adverse effects on non-target organisms like fish, it has become essential to formulate stringent rules against indiscriminate use of this pesticide. Since pesticide is present in the environment with other similar organophosphate compounds, additive responses to organophosphate compounds may induce lethal or sublethal effects in fish. It is, therefore, a matter of great public health significance to regularly monitor the pesticide residues in foods and humans in order to assess the population exposure to this pesticide. Besides, for a safe use of this pesticides more experimental work should be performed to determine the concentration and time of exposure that do not induce significant sub-lethal effects on fish.

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