Accumulation of Dimethoate
Ever since the increased use of pesticides during the past 40 years, it has become apparent that these highly toxic materials did not only affect the target organisms but often harmed nontarget organisms like fish and other aquatic life by accumulating in the aquatic environment. Some of these adverse effects were so subtle that they were not recognised until analytical and biological testing methods. More recently, the attention of fish biologist has been turned towards the accumulation of pesticide in the tissues of fish by using recent technologies.

Though the accumulations of pesticide are known to occur in freshwater biota, the exact mechanism of its translocation is not well established. Palumbo, (1961) reported that most of the pollutants accumulate in aquatic organisms. The uptake of these pesticides by cellular organisms could be through absorption, where in these organisms enter into the aquatic biota through the food chain (Anderson, 1969; Butler et al., 1970).

The acquisition of pesticides by the aquatic biota occurs by three ways (Kerr and Vass, 1973).

1. Direct uptake of contaminated food.
2. Direct absorption from water through gills.
3. Absorption through integument.

Each of the above process varies with the environmental condition and type of animal. But absorption through gills and gut are the main routes in fish. In higher aquatic animals, the rate of exposure to a pesticide in the surrounding
medium is taken as a measure of the rate of contact with both polluted water and contaminated food (Edwards, 1973).

The routes of pesticide transport to different aquatic ecosystems have been well documented (Nicholson, 1970). To boost agricultural production, the forest and semi arid lands have also trapped, thereby resulting in immense use of pesticides, which has now turned out to be a source of contamination through surface run-off. Pollution of aquatic system may occur by the influx of organic and inorganic chemicals as reported by Murty, (1986).

Pesticides due to their slow decomposition rate and long half-life remain in the environment for a protracted period of time and exert deleterious effect on non-target organisms. Although many studies relating to pesticide contamination in various biological and non biological components are available Murlidharan, 2000; Nowak and Ahmad, (1989). There is extensive information on residues in fish from different parts of the globe. Palumbo, (1961) reports most of the pollutants to occur in particulate form in aquatic organisms. The uptake of these pesticides by cellular organisms could be through adsorption, distribution, physiological action, wherein these pesticides enter into other aquatic biota through the food cycle (Anderson, 1969; Butler et al., 1970).

Many fold increase in the use of pesticides in recent years indicates their significance in modern day society. Many workers have reported presence of pesticide residues in fish tissues. Phosphamidon in Oreochromis mossambicus (Jebakumar et al., 1993), methyl parathion in Labeo rohita (Ajitkumar et al., 2000) and Sandhya, (1995).
Several analytical techniques are available for the separation of pesticides including thin layer chromatography, gas liquid chromatography and more recently high performance liquid chromatography (Sandhya, 1995). In the present study an attempt has been made to determine the residue levels of dimethoate in different tissues viz., gill, muscle, and liver of fish *Cyprinus carpio* at different exposure periods under median lethal and sublethal concentrations employing High Performance Liquid Chromatographic (HPLC) technique.

**RESULTS**

The results of qualitative and quantitative determination of total dimethoate in three target organ tissues (gill, muscle and liver) under median lethal and sublethal concentration of dimethoate are presented in the table, 6 and fig. 4 (Chromatogram 1to 6). Presence of dimethoate in all the three tissues was detected in all exposure periods under lethal concentration. Among the three tissues least mean quantity of dimethoate was seen in liver 23.6% at 96 hr. Maximum in gill 6.9% on 24 hr and 27.3% on 96 hr was observed.

Under sublethal concentration maximum was witnessed in gill 20.8% on 15th day and nil amount was witnessed in liver on day 1. In gill and muscle dimethoate witnessed its presence even on day 1 of exposure up to day 15.

Total dimethoate level increased subsequently with increase in exposure periods under lethal and sublethal concentration. Maximum level of dimethoate was observed on 96 hr of lethal concentration. Maximum mean quantity of total dimethoate accumulated in the muscle 26.8%, followed by liver. (Table, 6 and Fig. 4 and Chromatogram 1 to 6).
Table: 6
Accumulation of dimethoate (pg/g wet wt) in the organs of fish, Cyprinus carpio on exposure to lethal and sublethal concentrations of dimethoate.

<table>
<thead>
<tr>
<th>Organ</th>
<th>Control</th>
<th>Exposure period in days</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lethal</td>
<td>Sub lethal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Gill</td>
<td>0.000</td>
<td>0.069</td>
<td>0.104</td>
<td>0.195</td>
<td>0.273</td>
<td>0.009</td>
<td>0.087</td>
</tr>
<tr>
<td>SD ±</td>
<td></td>
<td>0.00002</td>
<td>0.00001</td>
<td>0.00003</td>
<td>0.00001</td>
<td>0.00002</td>
<td>0.00001</td>
</tr>
<tr>
<td>% Change</td>
<td></td>
<td>6.9</td>
<td>10.4</td>
<td>19.5</td>
<td>27.3</td>
<td>0.9</td>
<td>8.7</td>
</tr>
<tr>
<td>Muscle</td>
<td>0.000</td>
<td>0.046</td>
<td>0.053</td>
<td>0.171</td>
<td>0.268</td>
<td>0.003</td>
<td>0.056</td>
</tr>
<tr>
<td>SD ±</td>
<td></td>
<td>0.00003</td>
<td>0.00002</td>
<td>0.00002</td>
<td>0.00001</td>
<td>0.00003</td>
<td>0.00001</td>
</tr>
<tr>
<td>% Change</td>
<td></td>
<td>4.6</td>
<td>5.3</td>
<td>17.1</td>
<td>26.8</td>
<td>0.3</td>
<td>5.6</td>
</tr>
<tr>
<td>Liver</td>
<td>0.000</td>
<td>0.031</td>
<td>0.042</td>
<td>0.162</td>
<td>0.236</td>
<td>ND</td>
<td>0.032</td>
</tr>
<tr>
<td>SD ±</td>
<td></td>
<td>0.00003</td>
<td>0.00003</td>
<td>0.00003</td>
<td>0.00002</td>
<td>-----</td>
<td>0.00002</td>
</tr>
<tr>
<td>% Change</td>
<td></td>
<td>3.1</td>
<td>4.2</td>
<td>16.2</td>
<td>23.6</td>
<td>-----</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Means are ± SD (n=6) for tissues in a column followed by the same letter are not significantly different (P ≤ 0.05) from each other according to Duncan's multiple range (DMR) test. ND - NOT DETECTED
DISCUSSION:

The residues that reach the hydrosphere are concentrated in certain parts of the aquatic ecosystem or remain in solution for extended periods. Simultaneously, the residues are absorbed by the aquatic organisms, bioaccumulated in the tropic chain and deposit in the tissues. Earlier studies revealed that, the accumulation of pesticides in fish tissues (David and Philip, 2005; Sharma, 1994; Tilak. et al., 2001; Gupta et al., 2001)

Presently organophosphorus insecticides are one of the most frequently utilized classes of pesticides employed both in agricultural and landscape pest control. Pesticides have an innate capacity to causes damage to biological system, which may involve human health and environment (Mushigeri and David, 2004). Dimethoate is one of the most widely used insecticides. The uptake of OP and carbamate compounds was relatively higher, because of water solubility and they are lesser than organochlorine. Motsugo fish exposed to 0.6 to 1.2 mg/l of diazinon, fenitrothion, malathion, carbaryl, attained the highest body concentrations (Kanzawa, 1975). Diazinon 17 mg/kg persisted longer than four weeks in the fish. Studies on the toxicity of dimethoate have taken depth and revealed its extremely hazardous nature to non target organisms.

Several authors have reported that, pesticide residue can cause cellular damage to the gill tissue, as it is the first organ to face pesticide medium (Bashamohideen et al., 1989; Kalavathy et al., 2001; Kanabur & Sannadurgappa, 2001, Chanchal et al., 1990), which offers support to the present findings. In fish
Fig. 4
Percent increase over control in accumulation of dimethoate (pg/g wet wt) in the organs of fish, *Cyprinus carpio* on exposure to lethal and sublethal concentrations of dimethoate.
The main visceral organ of the body is liver and is basically an organ of homeostasis. It proficiently plays an important function in regulating many metabolic activities essential for maintaining a constant blood composition. Many of its function are associated with the metabolism of food brought from the gut. Its rich blood supply also makes it to regulate activities associated with blood and the circulatory system. Bulk of blood flows through it, at any given time and food materials absorbed from the alimentary canal pass directly to the liver, where they are stored or else converted to some other form as required by the body (Hutter et al., 1968). Liver also witnessed for the accumulation of dimethoate as it is the organ of detoxification and hence, during the exposure period, it is expected that the dimethoate would reach in abundance through blood and gut content for storage, detoxification and disposal. Sandhya, (1995) reported that, the
accumulation of methyl parathion in the different organs of the fish *C. punctatus* increased with the increase in the duration of exposure period. This results supports present finding as dimethoate is also one of the OP pesticide.

Thus the results of this procedure clearly indicate that, absorption of dimethoate concentration by the tissue increased with the duration of the exposure time as dimethoate is completely absorbed by the tissue like gill, liver and muscle after 96 hr interval. Hence in the present study dimethoate is accumulated in both the lethal and sublethal concentrations.
Chromatogram of Standard technical grade dimethoate

REPORT

Sample Name: Std. Dimethoate
Method File : C:\Indtech\WinchromEx\User\shiva
Detector : UV-VIS 254 nm
Date : 2 Mar 2006
Type of Analysis : Percent on Area and Height

Chromatogram of tissues (Gill, Muscle and Liver) extracts control fish, *Cyprinus carpio*.
Chromatogram 1
Chromatogram of dimethoate accumulated in the gill tissues of fish, *Cyprinus carpio*, exposed to lethal concentration of dimethoate for 24, 48, 72 and 96hr.
Chromatogram of dimethoate accumulated in the gill tissues of fish, *Cyprinus carpio*, exposed to sublethal concentration of dimethoate for 1, 5, 10 and 15 days.
Chromatogram. 3

Chromatogram of dimethoate accumulated in the muscle tissues of fish, *Cyprinus carpio*, exposed to lethal concentration of dimethoate for 24, 48, 72 and 96hr.
Chromatogram 4

Chromatogram of dimethoate accumulated in the muscle tissues of fish, *Cyprinus carpio*, exposed to sublethal concentration of dimethoate for 1, 5, 10 and 15 days.
Chromatogram. 5

Chromatogram of dimethoate accumulated in the liver tissues of fish, *Cyprinus carpio*, exposed to lethal concentration of dimethoate for 24, 48, 72 and 96hr.
Chromatogram. 6

Chromatogram of dimethoate accumulated in the liver tissues of fish, *Cyprinus carpio*, exposed to sublethal concentration of dimethoate for 1, 5, 10 and 15 days.