OBSERVATIONS

Hematological alterations of *Clarias batrachus* after the post exposure of endosulfan, malathion and rogor for 15, 30, 45 and 60 days period

**ENDOSULFAN**

Quantitative changes of hematological parameters in fish blood exposed to sublethal concentration of endosulfan (0.3µg/l) after 15, 30, 45 and 60 days given in Table 1. Significant decrease in Hb, TEC, PCV and MCHC levels were observed, whereas the TLC, MCV and MCH levels showed an increment, with increase in the duration of exposure of endosulfan. Erythrocyte counts of fish exposed to endosulfan (0.3µg/l), indicated a 40.4% to 48.45% decrease as compared to control values at the end of the experiment. Reduction in hemoglobin as duration of exposure (40.15% to 48.45%) was accompanied by lowest hematocrit value (18.14 to 24.2%) (Fig.1). The increment in TLC values was found highest (11,651) at 60 days of exposure accompanied by blood indices MCV and MCH (Fig.2).

**MALATHION**

Hematological alterations under exposure of malathion (0.35 µg/l) after 15, 30, 45 and 60 days were given in Table 2. Results showed significant decrease in Hb, TEC, and PCV values; whereas TLC and blood indices showed an increment with the duration of malathion exposure. The decrease in Hb was found 26.14% – 34.30% and in TEC 28.40 – 44.3% and PCV value 18.87% - 26.08% as compared to relative control values (Figure 3, 4).
ROGOR

The alterations in hematological values under the exposure of rogor (0.42µg/l) after 15, 30, 45 and 60 days were given in Table 3. The decrease in Hb, TEC, PCV and blood indices MCV, MCH (except MCHC) values was observed. The reduction in hemoglobin (19.41% - 28.4%) as the exposure prolonged (15 - 60 days) as compared to relative control values. Like this, TEC decreased (14.51% - 20.02%) as the exposure period increased. Under the exposure of rogor (0.42µg/l) the increment in TLC and MCHC was observed. The increment in TLC was found highest (11,885) at the exposure of 45 days and MCHC value was also found highest (28.82 mg/dl) at the exposure of 45 days as compared to control values (Figure 5, 6).

In blood parameters, a significant difference (p<0.05) was found between control and treated groups of fish in all exposure period.

Biochemical alterations of *Clarias batrachus* after the post exposure of endosulfan, malathion and rogor for 15, 30, 45 and 60 days period

ENDOSULFAN

Biochemical analysis of fish *Clarias batrachus* under the sublethal concentration of endosulfan (0.3µg/l) after 15, 30, 45 and 60 days showed significant difference between control and treated groups (Table 4). The observations revealed that all the biochemical parameters showed increased values except protein level as compared to relative control values. The serum
protein level was significantly decreased (51.2% and 45.4%) during the 60
days and 45 days respectively. The serum glucose level was found increased in
all the exposure periods. It was found highest (108.56mg/dl) at 45 days
exposure and followed by 60, 30 and 15 days of exposure. The highest percent
increment (38.40%) in serum glucose level as compared to control was noticed
at 60 days of exposure. The serum cholesterol was also found increased till end
the experiment. It was found highest (214.46) at 60 days of exposure and
followed by 45, 30 and 15 days of exposure. The highest percent increment
(24.4%) was also found at 60 days of exposure of endosulfan. The observations
on serum urea content revealed that it was found increased from 15 days of
exposure to end of the experiment and noticed highest level (49.05mg/dl and
51.4%) at 60 days of endosulfan exposure (Table 4, Figure 7).

The serum acid phosphatase activity is observed during 15, 30, 45 and
60 days of exposure periods under toxicity of endosulfan along with control
fish. The acid phosphatase activity was found in the range of 596.27 – 842.8
IU/L and it was estimated to increase about 15% to more than 50% as
compared to control. The serum alkaline phosphatase activity is observed in
control, endosulfan treated fish during 15, 30, 45 and 60 days of exposure
periods. The activity of alkaline phosphatase is significantly increased in
endosulfan treated fish. The alkaline phosphatase activity in treated fish was in
the range of 48.81 – 64.43 IU/L and it was estimated to increase about 20% to
more than 40% as compared to control (Table 4, Figure 8).
MALATHION

Biochemical analysis of fish *Clarias batrachus* under the sublethal concentration of malathion (0.35µg/l) after 15, 30, 45 and 60 days showed significant difference between control and treated groups (Table 5). The observations revealed that all the biochemical parameters showed increased values except protein level as compared to relative control values. The serum protein level was significantly decreased (22.5% to 35.4%) during the 15 to 60 days exposure. The serum glucose level was found increased in all the exposure periods. It was found highest (91.67mg/dl) at 60 days exposure and followed by 45, 30 and 15 days of exposure. The serum cholesterol was also found increased till end the experiment. It was found highest (206.58mg/dl) at 45 days of exposure and followed by 60, 15 and 30 days of exposure. The highest percent increment (18.35%) was also found at 60 days of exposure of malathion. The observations on serum urea content revealed that it was found increased from 15 days of exposure to end of the experiment and noticed highest level (52.95mg/dl) i.e. 25.2% at 45 days of exposure as compared to control (Table 5, Figure 9).

The serum acid phosphatase activity is observed during 15, 30, 45 and 60 days of exposure periods under toxicity of malathion along with control fish. The acid phosphatase activity in malathion treated fish was found in the range of 585.52 – 696.79 IU/L and it was estimated to increase about 12% to more than 35% as compared to control. The serum alkaline phosphatase
activity is observed in control, malathion treated fish during 15, 30, 45 and 60 days of exposure periods. The activity of alkaline phosphatase is significantly increased in malathion treated fish. The alkaline phosphatase activity in treated fish was in the range of 44.62 – 61.35 IU/L and it was estimated to increase about 25% to more than 35% as compared to control (Table 5, Figure 10).

**ROGOR**

Biochemical analysis of fish *Clarias batrachus* under the sublethal concentration of rogor (0.42µg/l) after 15, 30, 45 and 60 days showed significant difference between control and treated groups (Table 6). The observations revealed that all the biochemical parameters showed increased values except protein level as compared to relative control values. The serum protein level was significantly decreased (18.2% to 35.5%) during the 15 to 60 days exposure. The serum glucose level was found increased in all the exposure periods. It was found highest (89.48mg/dl) at 60 days exposure and followed by 45, 30 and 15 days of exposure. The serum cholesterol was also found increased till the end of experiment. It was found highest (212.22mg/dl) at 60 days of exposure and followed by 30, 15 and 45 days of exposure. The highest percent increment (16.40%) was found at 60 days of exposure as compared to control. The serum urea level was found increased from 15 days of exposure to end of the experiment and observed highest (61.16mg/dl) at 30 days of exposure and highest percent increment (24.20%) as compared to control at 60 days of exposure of rogor on *Clarias batrachus* (Table 6, Figure 11).
The serum acid phosphatase activity is observed during 15, 30, 45 and 60 days of exposure periods under toxicity of rogor along with control fish. The acid phosphatase activity in rogor treated fish was found in the range of 582.22 – 697.64 IU/L and it was estimated to increase about 10% to more than 30% as compared to control. The serum alkaline phosphatase activity is observed in control, rogor treated fish during 15, 30, 45 and 60 days of exposure periods. The activity of alkaline phosphatase is significantly increased in rogor treated fish. The alkaline phosphatase activity in treated fish was in the range of 48.46 – 68.35 IU/L and it was estimated to increase about 20% to more than 35% as compared to control (Table 6, Figure 12).

Histopathological alterations of Clarias batrachus after the post exposure of endosulfan, malathion and rogor for 15, 30, 45 and 60 days period

LIVER

In liver sections of normal fish the hepatocytes form a rather cord-like pattern. These cords are arranged around tributaries of the hepatic vein. The liver cells are large in size, polygonal in shape with homogenous eosinophilic cytoplasm and centrally located nuclei. A large number of blood sinusoids were observed and separates the hepatic cords one from another. Exposure of Clarias batrachus to sublethal concentration of organochlorine (endosulfan) and organophosphate (malathion and rogor) pesticides for 15, 30, 45 and 60 days induced obvious histopathological changes in the liver. The hepatocytes have lost their normal architecture and a large number of these cells appeared with
pyknotic nuclei. The intrahepatic blood vessels were dilated and congested with blood, and inflammatory leucocytic infiltrations were observed. Numerous hepatocytes showed marked cytoplasmic vacuolization. The histopathological changes of the liver were more pronounced after 60 days exposure period. The liver cells were degenerated with necrosis which appeared as focal areas with lymphocytic infiltration.

After the 15 days of treatment till the end of the study, the detectable lesions were shown due to congestion of hepatic sinusoids and diffuse vacuolar degeneration of the hepatocytes. The necrotic focal areas were shown with some presence of Esinophilic granular cells (EG) with progression of the severity of the lesions with the progression of the experimental period.