SUMMARY

Environmental problems have always existed throughout human history but widespread recognition has come, understandably, only belatedly, after many years of steadily accumulating pollution. This concern is surprisingly recent and a localized phenomenon beginning only in the late 1960’s and largely confined to economically advanced countries. This economic growth accompanied by population increase and urbanization has had the deleterious effect on quality of our water resources through the addition of sheer quantity of effluents generated by high levels of industrial production, mal-agropractices and unchecked domestic activities. The quantity of varied effluents added, has overcome the neutral, self-cleansing powers of the water and the waste disposal functions of this environmental medium has become incompatible with its use for other purposes. Who is to be blamed? Man of course.

Addition of effluents to the aquatic eco-system is a worldwide problem and is more acute in industrialized countries where millions of tones of pollutants are discharged into the rivers and streams and also directly into the sea. Aquatic life is seriously affected and threatened out of existence. In turn, it affects human life through consumption of fish and other edible aquatic animals.

Pesticides are economic poisons employed to regulate the impact of noxious animals and plants upon life economy. Generally three categories of pesticides – organochlorines, organophosphates and carbamates and
organochlorines is the first generation of pesticides. Organochlorines are more toxic than others as they persist unchanged in the environment for a long period of time. So an organochlorine pesticide (endosulfan) and organophosphates (malathion, rogor) were selected for the present study. Organochlorine and organophosphates are commonly used by the agricultural sector at sublethal concentrations can alter the blood parameters and histopathological alterations in tissues of fish exposed to these for a long period of time. However, it is important that the residual effects of these pesticides in different body tissues of fish as they are ultimately consumed by the human beings. Nevertheless it is obvious that the pesticide has deleterious effects on fish as observed through the present study.

Fish is one of the staple foods of our country and is consumed on large scale as a protein source now a day. The working model for the present study is the fresh water teleost, *Clarias batrachus* selected due to its wide and continuous availability throughout the year. It can be easily acclimated to laboratory conditions.

In present study quantitative changes of hematological parameters in fish blood exposed to sublethal concentration of endosulfan (0.3µg/l) after 15, 30, 45 and 60 days showed significant decrease in Hb, TEC, PCV and MCHC levels, whereas the TLC, MCV and MCH levels showed an increment, with increase in the duration of exposure of endosulfan.

Hematological alterations under exposure of malathion (0.35 µg/l) after 15, 30, 45 and 60 days showed significant decrease in Hb, TEC, and PCV
values; whereas TLC and blood indices showed an increment with the duration of malathion exposure.

The alterations in hematological values under the exposure of rogor (0.42µg/l) after 15, 30, 45 and 60 days, found decreased in Hb, TEC, PCV and blood indices MCV, MCH (except MCHC) values. 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.

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. The observations revealed that all the biochemical parameters showed increased values except protein level as compared to relative control values. The serum acid phosphatase activity was observed 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 was observed significantly increased in endosulfan treated fish about 20% to more than 40% as compared to control.

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 acid phosphatase activity was observed 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 was observed significantly increased in treated fish, 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.

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. The observations revealed that all the biochemical parameters showed increased values except protein level as compared to relative control values.

The serum acid phosphatase activity was observed 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 was observed significantly increased in rogor treated fish 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.

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. 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.
CONCLUSION

Present study revealed that: insecticides (endosulfan, malathion and rogor) should be listed under the highly toxic pollutants to *Clarias batrachus* fish even at sublethal dose (0.3, 0.35 and 0.42 ppm respectively) where it may cause toxicity or death to fish. Prolonged exposure of *Clarias batrachus* to low doses of pesticides caused damage to biochemical constituents of blood and tissues.

1. Toxicity test revealed that endosulfan is more toxic than malathion and rogor.
2. Endosulfan, malathion and rogor accumulated highly in liver.
3. Hematological parameters showed that exposure of *Clarias batrachus* to endosulfan, malathion and rogor caused marked alterations and emphasizing anemic effect of pesticides on blood.
4. The biochemical alterations produced were neither specific to an exposure period nor to a tissue. Within the same tissue, the activities of some enzymes were elevated while others were inhibited.
5. Alterations in biochemical constituents showed that glucose, cholesterol and protein are main source of energy. Which are affected by the pesticides and it creates imbalance in body and affect the viability of animal (fish).