Observation:

4.a: Procurement and Maintenance of the Fish:

The pesticides are polluting entire environment moreover they cause an ecological imbalance, and leads to the breakdown of food chains as a result of their toxic effect. In the present study, the effects of Profenofos (Curacron) 50% EC on the behavioral, histological, biochemical and haematological changes were observed in the fresh water fish *Notopterus notopterus*.

The fish is available in large numbers in the aquatic bodies in and around Kalaburagi and are quite common in aquatic bodies throughout the year. The fish was collected from Bhima River for the present study. Feeding of the fish comprises of some aquatic insects, weeds, small fishes, and feeding activity increases after spawning in this fish. Aquatic weeds including submerged branches of acacia plant was used to builds nest for spawning. Sex of the fish cannot be identified based on the morphological characters. However, after observing gonads they were differentiated as male and female Fig. 2 and 3.

4.b: Determination of Lethal and Sub-lethal Concentration:

The sub-lethal concentration of pesticide is determined by calculating the LC$_{50}$ values. The percent mortalities obtained were converted into probit kills according to Finney (1971). The probit kill values were plotted against pesticide concentration. The graph for this method of analysis at 24 and 96 hours (Fig. 1) were plotted and LC$_{50}$ value was derived. The LC$_{50}$ value at 96 hours by this method is 0.7ppm. The 1/10th of average 96 hours LC$_{50}$ value was taken as sub-lethal concentration. The sublethal concentration of profenofos is 0.07 ppm. (Table 1, Fig. 1)
4.c: Behavioural Observation:

Behavioural Changes after Exposure to Profenofos at Lethal and Sub-lethal Concentration:

The experimental fish in response to pesticide exposure exhibited the behavioral changes. The control fishes were very active in the aquarium and found well co-ordinated manner and were alert to the slightest disturbances. But the fishes administered with the Profenofos (Curacron) 50% EC showed restlessness this is the primary sign of pesticide poisoning. The experimental fishes secreted unusual amount of mucous over the surface of their body. The body color also became pale. After lethal concentration exposure, the experimental fishes lost their balance and some of them tried to jump out of the aquarium initially and failed and died. Abdominal bulging due to retention of water was also observed in fishes exposed to lethal concentration of pesticide. As the period of exposure increased, fishes were found to settle down to bottom and towards the final phase of exposure, fishes showed barrel-rolling indicating loss of equilibrium. They showed altered behavioural responses such as restlessness, hyperactivity and some jerky swimming, discoloration of skin with belly upwards and gradually became lethargic. The sub lethal dose of the pesticide also produced similar behavioral changes, only to a lesser extent.

4.d: Biochemical, Haematological and Histological Observations

Biochemical Observation:

Biochemical composition was estimated in Kidney and gonads, which represent the site for most of vital activities in fishes. Based on local availability of the fish present study deals with the biochemical changes in the fish Notopterus notopterus in acute and chronic exposure of Profenofos (Curacron) 50% EC. The
observation thus obtained were compared with their respective control group and represented in tables and graphs.

Pesticide induced alterations in the biochemical constituents, the teleost fish *Notopterus notopterus* was taken in to the consideration to investigate the changes in biochemical content like, protein, cholesterol, glucose and DNA in kidney and gonads due to short and long term toxicity of Profenofos (Curacron). Changed biochemical content have been represented in the form of tables and graphs which gives an idea about biochemical content has been changed and that was estimated by using various methods. The data obtained out of study was analyzed by various statistical tools such as mean, SD, SE, and ANOVA.

**Protein Content in Gonads:**

In the present study protein content was observed in the gonad during acute, chronic and reproductive phase exposure to Profenofos (Curacron) 50% EC.

**Acute Exposure:**

Proteins are considered to be important, as the food value of the fish directly depends upon protein quantity. In present investigation decreased level of protein in the gonad during 24 and 96 hrs exposure under lethal and sub lethal concentration of Profenofos (Curacron) was recorded, the data found during the study was compared with control group. And the amount of protein obtained was presented in Table. 3, Fig. 57, 58 (mg/g wet weight of the tissue).
**Chronic Exposure:**

In the present investigation when fishes were exposed to sub-lethal concentration of profenofos lower protein content was found during 14, 21, 30, 45 and 90 days exposure, whereas some changes was noticed on 7th day in profenofos exposed fishes the data found during the study was compared with control group. And the amount of protein obtained was presented in Table 5, Fig. 59 (mg/g wet weight of the tissue).

**Profenofos Exposure during Reproductive Phase of Male Fish:**

**Preparatory Phase:**

In the present experiment it is revealed that the exposure of sub lethal concentration of Profenofos (Curacron) during preparatory phase of reproductive cycle shows decreased protein content in gonad of the male fish *N.notopterus* compare to control group and data obtained was represented in Table 6, Fig. 49 (mg/g wet weight of the tissue).

**Prespawning Phase:**

In the present experiment it is revealed that the exposure of sub lethal concentration of Profenofos (Curacron) during prespawning phase of reproductive cycle shows decreased protein content in gonad of the male fish *N.notopterus* compare to control group and data obtained was represented in Table 6, Fig. 49 (mg/g wet weight of the tissue).
**Spawning Phase:**

In the present experiment it is revealed that the exposure of sub lethal concentration of Profenofos (Curacron) during spawning phase of reproductive cycle shows decreased protein content in gonad of the male fish *N. notopterus* compare to control group and data obtained was represented in Table 6, Fig. 49 (mg/g wet weight of the tissue).

**Post spawning Phase:**

In the present experiment it is revealed that the exposure of sub lethal concentration of Profenofos (Curacron) during spawning phase of reproductive cycle shows decreased protein content in gonad of the male fish *N. notopterus* compare to control group and data obtained was represented in Table 6, Fig. 49 (mg/g wet weight of the tissue).

**Profenofos Exposure during Reproductive phase of Female fish:**

**Preparatory phase:**

In present study it is revealed that under sub lethal concentration of Profenofos (Curacron) lower protein content was recorded during preparatory phase of female gonad of the fish *N. notopterus* compare to control group. The data obtained was presented in Table 7, Fig. 53 (mg/g wet weight of the tissue).

**Pre spawning phase:**

In present study it is revealed that under sub lethal concentration of Profenofos (Curacron) lower protein content was recorded during pre spawning phase of female gonad of the fish *N. notopterus* compare to control group. The data obtained was presented in Table 7, Fig. 53 (mg/g wet weight of the tissue).
**Spawning phase:**

In present observation it is revealed that under sub lethal concentration of Profenofos (Curacron) lower protein content was recorded during Spawning phase of female gonad of the fish *N. notopterus* compare to control group. The data obtained was presented in Table 7, Fig. 53 (mg/g wet weight of the tissue).

**Post spawning phase:**

In present study it is revealed that under sub lethal concentration of Profenofos (Curacron) lower protein content was recorded during post spawning phase of female gonad of the fish *N. notopterus* compare to control group. The data obtained was presented in Table 7, Fig. 53 (mg/g wet weight of the tissue).

A protein plays a significant role in the structure and functions of the cell and occupies a major position in cellular metabolism. The reduction in the protein content in tissues as compared to control group reveals that the gluconeogenetic pathway has been initiated to supplement reduction of sugar by breaking down of protein to yield sugar.

**Cholesterol Content in Gonads:**

**Acute Exposure:**

Polluted water having pesticide has large impact on the concentration of cholesterol in the fish body. In the present investigation higher level of cholesterol was noticed under lethal concentration of Profenofos (Curacron) for 24 and 96 hrs, where as sub-lethal concentration shows some marginal differences in profenofos exposed fish *N. notopterus*, the data obtained was compared with control group and presented in Table 3, Fig. 57, 58 (mg/g wet weight of the tissue).
**Chronic Exposure:**

Present observation shows lower values of cholesterol in sub-lethal concentration of Profenofos (Curacron) exposed fishes *N. notopterus* during 7, 14, 21, 30, 45 and 90 days exposure compare to control fishes. The obtained data was compared with control group of fish and presented in Table 5, Fig. 60 (mg/g wet weight of the tissue).

**Profenofos Exposure during Reproductive Phase of Male Fish:**

**Preparatory phase:**

In the present study lower cholesterol values were recorded during preparatory phase of reproductive cycle in mal gonad of the fish *N. notopterus* under sub-lethal concentration of Profenofos (Curacron) compare to control group of fishes. The data obtained was presented in Table 6, Fig. 50.

**Pre spawning phase:**

In the present study lower cholesterol values were recorded during pre spawning phase of reproductive cycle in mal gonad of the fish *N. notopterus* under sub-lethal concentration of Profenofos (Curacron) compare to control group of fishes. The data obtained was presented in Table 6, Fig. 50.

**Spawning phase:**

In the present study lower cholesterol values were recorded during p spawning phase of reproductive cycle in mal gonad of the fish *N. notopterus* under sub-lethal concentration of Profenofos (Curacron) compare to control group of fishes. The data obtained was presented in Table 6, Fig. 50.
Post spawning phase:

In the present study increased cholesterol values were recorded during post spawning phase of reproductive cycle in male gonad of the fish *N. notopterus* under sub lethal concentration of Profenofos (Curacron) compare to control group of fishes. The data obtained was presented in Table 6, Fig. 50.

Profenofos Exposure during Reproductive Phase of Female Fish:

Preparatory phase:

Present observation shows lower cholesterol values during preparatory phase of reproductive cycle in female gonad of the fish *N. notopterus* under sub lethal concentration of Profenofos (Curacron) compare to control group of fishes. The data obtained was presented in Table 7, Fig. 54 (mg/g wet weight of the tissue).

Pre spawning phase:

In the present study lower cholesterol values were recorded during Pre spawning phase of reproductive cycle in female gonad of the fish *N. notopterus* under sub-lethal concentration of Profenofos (Curacron) compare to control group of fishes. The data obtained was presented in Table 7, Fig. 54 (mg/g wet weight of the tissue).

Spawning Phase:

In the present study lower cholesterol values were recorded during Spawning phase of reproductive cycle in female gonad of the fish *N. notopterus* under sub lethal concentration of Profenofos (Curacron) compare to control group of fishes. The data obtained was presented in Table 7, Fig. 54 (mg/g wet weight of the tissue).
**Post spawning phase:**

In the present study lower cholesterol values were recorded during Post spawning phase of reproductive cycle in female gonad of the fish *N. notopterus* under sub lethal concentration of Profenofos (Curacron) compare to control group of fishes. The data obtained was presented in Table 7, Fig. 54 (mg/g wet weight of the tissue).

Profenofos toxicity causes damage and blockage of enzyme system for steroidogenesis in ovary and testis and also causes damage to the liver. Due to this damage cholesterol level decreases.

**Glucose Content in Gonads:**

**Acute Exposure:**

In the present study increased level of glucose was found in gonads under lethal and sub-lethal exposure of Profenofos during 24 and 96 hrs exposure to the fish *N. notopterus* the values found was compare with their respective control group and presented in Table 3, Fig. 57, 58 (mg/g wet weight of the tissue).

**Chronic Exposure:**

In the present experiment the level of glucose was found decrease in gonad of the fishes *N. notopterus* exposed to sub-lethal concentration of Profenofos during 7, 14, 21, 30, 45 and 90 days the data obtained was compared with control fishes and presented in Table 5, Fig. 61 (mg/g wet weight of the tissue). Biochemical changes induced by Profenofos (Curacron) stress leads to disturbance in the metabolism of the glucose content of the tissue.
Reproductive Phase Exposure of Profenofos in Male Fish:

Preparatory Phase:

In the present experiment higher glucose level was observed in gonad of the male fish exposed to sub-lethal concentration of Profenofos (Curacron) during preparatory phase of reproductive cycle of the fish *N. notopterus* compare to control group and the data obtained in the study was presented in Table 6, Fig. 51 (mg/g wet weight of the tissue).

Pre spawning Phase:

In the present experiment lower glucose level was observed in gonad of the male fish exposed to sub-lethal concentration of Profenofos (Curacron) during pre spawning phase of reproductive cycle of the fish *N. notopterus* compare to control group and the data obtained in the study was presented in Table 6, Fig. 51 (mg/g wet weight of the tissue).

Spawning Phase:

In the present experiment higher glucose level was observed in gonad of the male fish exposed to sub-lethal concentration of Profenofos (Curacron) during Spawning phase of reproductive cycle of the fish *N. notopterus* compare to control group and the data obtained in the study was presented in Table 6, Fig. 51 (mg/g wet weight of the tissue).

Post Spawning Phase:

In the present observation lower glucose level was recorded in gonad of the male fish exposed to sub-lethal concentration of Profenofos (Curacron) during post spawning phase of reproductive cycle of the fish *N. notopterus* compare to control
group and the data obtained in the study was presented in Table 6, Fig. 51 (mg/g wet weight of the tissue).

**Profenofos Exposure during Reproductive Phase of Female fish:**

**Preparatory phase:**

In the present study lower glucose level was observed in gonad of the female fish exposed to sub-lethal concentration of Profenofos (Curacron) during preparatory phase of reproductive cycle of the fish *N. notopterus* compared to control group and the data obtained in the study was presented in Table 7, Fig. 55 (mg/g wet weight of the tissue).

**Pre spawning phase:**

In the present study lower glucose level was observed in gonad of the female fish exposed to sub-lethal concentration of Profenofos (Curacron) during pre spawning phase of reproductive cycle of the fish *N. notopterus* compared to control group and the data obtained in the study was presented in Table 7, Fig. 55 (mg/g wet weight of the tissue).

**Spawning phase:**

In the present observation lower glucose level was recorded in gonad of the female fish exposed to sub-lethal concentration of Profenofos (Curacron) during Spawning phase of reproductive cycle of the fish *N. notopterus* compared to control group and the data obtained in the study was presented in Table 7, Fig. 55 (mg/g wet weight of the tissue).
Post spawning phase:

In the present experiment lower glucose level was observed in gonad of the female fish exposed to sub-lethal concentration of Profenofos (Curacron) during post spawning phase of reproductive cycle of the fish *N. notopterus* compare to control group and the data obtained in the study was presented in Table 7, Fig. 55 (mg/g wet weight of the tissue).

Glycogen is the first constituent to be utilized under stress condition. Decreased level of glucose during the entire exposure indicating its utilization during exposure to profenofos.

DNA content in gonads:

**Acute Exposure:**

Nucleic acid plays an important role in protein synthesis. In the present study the level of DNA was found decreased under the lethal and sub-lethal concentration of Profenofos to the fresh water fish *N. notopterus* during 24 and 96 hrs compare to control group the data obtained is presented in Table 3, Fig. 57, 58 (mg/g wet weight of the tissue).

**Chronic Exposure:**

In the present investigation lower DNA content was recorded in fish *N. notopterus* exposed to sub-lethal concentration of profenofos during 7, 14, 21, 30, 45 and 90 days compare to control groups. The data found in the present study was represented in the Table 5, Fig. 62 (mg/g wet weight of the tissue).
Reproductive Phase Exposure of Profenofos in Male fish:

Preparatory phase:

In the present study lower DNA values were observed during preparatory, phase of reproductive cycle in the male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data found is presented in Table 6, Fig. 52 (mg/g wet weight of the tissue).

Pre spawning phase:

In the present observation lower DNA values was recorded during pre spawning, phase of reproductive cycle in the male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data found was presented in Table 6, Fig. 52 (mg/g wet weight of the tissue).

Spawning phase:

In the present study lower DNA values were observed during spawning, phase of reproductive cycle in the male fishes exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data found is presented in Table 6, Fig. 52 (mg/g wet weight of the tissue).

Post spawning phase:

In the present study higher DNA values were observed during Post spawning, phase of reproductive cycle in the male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data found is presented in Table 6, Fig. 52 (mg/g wet weight of the tissue).
Reproductive Phase Exposure of Profenofos in Female Fish:

Preparatory phase:

In the present study lower DNA values were observed during preparatory, phase of reproductive cycle in the female fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data found is presented in Table 7, Fig. 56 (mg/g wet weight of the tissue).

Pre spawning phase:

In the present experiment lower DNA values were observed during pre spawning, phase of reproductive cycle in the female fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data found is presented in Table 7, Fig. 56 (mg/g wet weight of the tissue).

Spawning phase:

In the present observation lower DNA values were recorded during spawning, phase of reproductive cycle in the female fishes exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data found is presented in Table 7, Fig. 56 (mg/g wet weight of the tissue).

Post spawning phase:

In the present study higher DNA values were observed during Post spawning, phase of reproductive cycle in the female fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data found is presented in Table 7, Fig. 56 (mg/g wet weight of the tissue).

Any variation in DNA content reflects on protein synthesis and thereby protein level in the body of an animal.
Protein content in Kidney:

In the present investigation biochemical content was observed during acute and chronic exposure in the kidney of the fresh water fish *N. notopterus* under lethal and sub lethal concentration of Profenofos (Curacron) 50% EC.

Acute treatment:

Protein is a complex high molecular weight organic compound that consists of amino acid. In the present investigation lower protein content was observed under lethal and sub-lethal concentration of profenofos during 24 and 96 hrs exposure to the freshwater fish *N. notopterus* compared to control group and the amount of protein content in the kidney tissue in the control and profenofos treated fish was presented in Table 2, Fig. 63, 64 (mg/g wet weight of the tissue). Kidney is the site of degradation of detoxification of toxic substances. The decrease protein level in the kidney tissue at sub-lethal concentration of profenofos may be due to the enhanced proteolysis.

Chronic Treatment:

When fishes were exposed to sub-lethal concentration of profenofos during chronic exposure of 7, 14, 21, 30, 45 and 90 days lower protein value was recorded in the kidney of the fresh water fish *N. notopterus* compare to control group. The amount of protein content present in the tissue in the control and profenofos treated fish was represented in the Table 4, Fig. 65 (mg/g wet weight of the tissue). The decreased trend of may be due to metabolic utilization of the kitoacids to gluconeogenesis pathway for the synthesis of glucose. The protein content was decreased in respective exposure to pesticide profenofos.
Cholesterol content in kidney:

Acute Exposure:

Cholesterol forms a major component of lipids. It plays an important role in the physiological and metabolic process of the animal. In the present experiment, Cholesterol was found increased in lethal and sub-lethal concentrations under 24 and 96 hours exposure compared to the control group. And the amount of cholesterol content in the kidney tissue in the control and profenofos treated fish was presented in Table 2, Fig. 63, 64 (mg/g wet weight of tissue) in kidney of the fish *N. notopterus*.

Chronic Exposure:

In the present experiment lower values of cholesterol were observed in kidney of the fishes exposed to sub-lethal concentration of profenofos during 14, 21, 30, 45 and 90 days, however, some marginal changes was noticed on 7th day of exposure compared to control group. The amount of cholesterol content in the kidney of fish *N. notopterus* in control and profenofos treated fish was given in Table 4, Fig. 66 (mg/g wet weight of the tissue).

Glucose content in kidney:

Acute Exposure:

Glucose is the chief source of stored fuel in the body. They are chemical compound that acts as the primary biological and consuming energy. During lethal and sub-lethal concentration of profenofos for 24 and 96 hours to the fish shows increased glucose values in kidney of the fish *N. notopterus*. The data found was compared to the control groups and the amount of glucose content in the kidney of the fish is presented in Table 2, Fig. 63, 64 (mg/g wet weight of the tissue).
Chronic Exposure:

In the present investigation higher values of glucose was observed during chronic exposure of 14, 21, 30 and 90 days, where as some marginal difference was observed on 7th and 45 days in the kidney of profenofos treated fishes compare to control group and the amount of glucose present in the tissue is presented in Table 4, Fig. 67 (mg/g wet weight of the tissue). Due to the action of pesticide the disturbance in glycogen profile was considered as one of the most outstanding biochemical lesions.

DNA content in kidney:

Acute Exposure:

The nucleic acid plays a significant role in all biological activities which are regulators of all biological synthesis. In the present investigation lower DNA content was observed when fishes were exposed to lethal and sub-lethal concentration of profenofos for 24 and 96 hrs in kidney of the fish N. notopterus. The data found in the present study was compared with the respective control group and the amount of DNA present in the tissue is presented in Table 2, Fig. 63, 64 (mg/g wet weight of the body).

Chronic Exposure:

When the fishes were exposed to sub-lethal concentration of profenofos lower values of DNA was observed in 7, 14, 21, 30, 45 and 90 days exposure compare to control group and the amount of DNA content in the tissue is presented in Table 4, Fig. 68 (mg/g wet weight of the tissue). The alterations in DNA levels in the present study could be due to the normal synthesis and turnover rate of DNA beside degenerative changes.
The biochemical changes in the tissue in response to profenofos can be considered as indicators of stress in the fish *N. notopterus*.

The observation of kidney and gonad biochemical contents of both male and female fish during different phase of reproductive cycle it is witness that protein and nucleic acid in both the tissue was found decreased in all exposure, whereas, some fluctuation in cholesterol and glucose content was observed. The fluctuation is because of the impact of Profenofos (Curacron) and differences in values observed is may be to the rate of their high metabolic activity, and due to difference in sex.

**Haematological Parameters:**

For haematological parameters blood was collected from caudal peduncle with the help of sterilized syringe (Fig. 4). After collection of the sample, it was transferred to the centrifuge tubes, each tube was lifted undisturbed in slanting position for about 45 min. Now these tubes were centrifuge at 2500rpm and the supernatant serum was separated (Fig. 5).

**Haemoglobin Concentration after Profenofos exposure:**

**Acute exposure:**

In the present study lower values of haemoglobin was observed during lethal and sub-lethal concentration of profenofos in the fish *Notopterus notopterus* during 24 and 96 hrs exposures, the data obtained was compared with the control fish data and presented in Table 8, Fig. 69, 70.
Chronic Exposure:

In the present investigation the haemoglobin content was found decreased during chronic exposure of 7, 14, 21, 30, 45 and 90 days under sub-lethal concentration of profenofos treated fishes compare to control group and the data obtained was presented in the Table 9, Fig. 71. Lowering of Hb, might cause anemia. This may be due to increased loss of red blood cells or decreased rate of these cells.

Reproductive Phase Exposure of Profenofos in Male Fish:

Preparatory phase:

In the present experiment lowered values of haemoglobin was observed during preparatory phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the (Table 10, Fig. 84).

Pre spawning phase:

In the present investigation lowered values of haemoglobin was observed during pre spawning phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the (Table 10, Fig. 85).

Spawning phase:

In the present observation lowered values of haemoglobin was recorded during Spawning phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the Table 10, Fig. 86.
Post spawning phase:

In the present study lowered values of haemoglobin was observed during post spawning phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the Table 10, Fig. 87.

Reproductive Phase Exposure of Profenofos in Female Fish:

Preparatory phase:

In the present observation lowered values of haemoglobin was recorded during preparatory phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the Table 11, Fig. 88.

Pre spawning phase:

In the present investigation lowered values of haemoglobin was observed during pre spawning phase of reproductive cycle in the female fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the Table 11, Fig. 89.

Spawning phase:

In the present experiment lowered values of haemoglobin was observed during Spawning phase of reproductive cycle in the female fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the Table 11, Fig. 90.
Post spawning phase:

In the present study lowered values of haemoglobin was observed during post spawning phase of reproductive cycle in the female fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the Table 11, Fig. 91.

Reduction in the haemoglobin content in the present study results from rapid oxidation of Hb to methaemoglobin or release of oxygen radical brought about by the toxic stress of profenofos.

WBC Count after Profenofos Exposure:

Acute exposure:

In the present investigation higher values of WBC was observed under lethal and sub-lethal exposure of profenofos treated fishes during 24 and 96 hrs compare to control fishes Table 8, Fig, 69, 70.

Chronic exposure:

The present study shows increased values of WBC during 7, 14, 21, 30, 45 and 90 days under sub-lethal exposure of profenofos exposed fishes compare to control group of fishes Table 9, Fig 72. WBC is involved in the regulation of immunological function and their number increase as a result of protective response in fishes to stress.
Reproductive Phase Exposure of Profenofos in Male Fish:

Preparatory phase:

In the present study higher values of WBC was recorded during preparatory, phase of reproductive cycle in the male fish exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 10, Fig. 84.

Pre spawning phase:

In the present investigation higher values of WBC was recorded during pre spawning phase of reproductive cycle in the male fish exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 10, Fig. 85.

Spawning phase:

In the present observation higher values of WBC was recorded during spawning phase of reproductive cycle in the male fish exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 10, Fig. 86.

Post spawning phase:

In the present study higher values of WBC was recorded during post spawning phase of reproductive cycle in the male fish exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 10, Fig. 87.
Reproductive Phase Exposure of Profenofos in Female Fish:

Preparatory phase:

In the present study higher values of WBC was recorded during preparatory, phase of reproductive cycle in the female fish exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 11, Fig. 88.

Pre spawning phase:

In the present study higher values of WBC was recorded during pre spawning phase of reproductive cycle in the female fish exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 11, Fig. 89.

Spawning phase:

In the present investigation higher values of WBC was recorded during spawning phase of reproductive cycle in the female fish exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 11, Fig. 90.

Post spawning phase:

In the present study higher values of WBC was recorded during post spawning phase of reproductive cycle in the female fish exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 11, Fig. 91.

The increased in WBC count in the present study indicated the stress condition of the fish caused by profenofos which might have produced gill damage and hypoxia.
**RBC Count after Profenofos Exposure:**

**Acute exposure:**

In the present study Lower values of RBC was observed in the fishes during lethal and sub-lethal concentration of profenofos during 24 and 96 hrs compare to control group Table 8, Fig, 69, 70.

**Chronic exposure:**

In the present investigation lower values of RBC was observed during 7, 14, 21, 30, 45 and 90 days under sub-lethal exposure of profenofos treated fishes compare to control group Table 9, Fig, 73.

**Reproductive Phase Exposure of Profenofos in Male Fish:**

**Preparatory phase:**

In the present observation lowered values of RBC was recorded during preparatory phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the Table 10, Fig, 84.

**Pre spawning phase:**

In the present study lowered values of RBC was observed during pre spawning phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the Table 10, Fig. 85.
**Spawning phase:**

In the present investigation lowered values of RBC was observed during spawning phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos compared to control fish, the data found was presented in the Table 10, Fig. 86.

**Post spawning phase:**

In the present study lowered values of RBC was observed during post spawning phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos compared to control fish, the data found was presented in the Table 10, Fig. 87.

**Reproductive Phase Exposure of Profenofos in Female Fish:**

**Preparatory Phase:**

In the present study lowered values of RBC was observed during preparatory phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos compared to control fish, the data found was presented in the Table 11, Fig. 88.

**Pre spawning phase:**

In the present observation lowered values of RBC was recorded during pre spawning phase of reproductive cycle in the female fish *N. notopterus* under sub-lethal concentration of profenofos compared to control fish, the data found was presented in the Table 11, Fig. 89.
Spawning phase:

In the present study lowered values of RBC was observed during Spawning phase of reproductive cycle in the female fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the Table 11, Fig. 90.

Post spawning phase:

In the present study lowered values of RBC was observed during post spawning phase of reproductive cycle in the female fish *N. notopterus* under sub-lethal concentration of profenofos compare to control fish, the data found was presented in the Table 11, Fig. 91.

In the present study, significant decrease in RBCs and haemoglobin content might have resulted from the lowering of the oxygen content of water due to the presence of profenofos in the test media.

Blood Sugar level after Profenofos Exposure:

Acute exposure:

Changes in carbohydrate metabolism measured as plasma glucose, it can be used as general indicator of stress in fishes. In the present study lower values of blood sugar was observed in 96 hrs exposure, whereas, some marginal changes was recorded in 24 hrs exposure of the fish under lethal and sub-lethal concentration of profenofos compare to control group Table 8, Fig. 69, 70.
Chronic exposure:

The level of blood sugar was found increased in chronic exposure during 7, 14, 21, 30, 45 and 90 days treatment of the fishes Notopterus notopterus under sub-lethal exposure of profenofos compare to control group Table 9, Fig. 74. Significant rise of blood glucose of the exposed fish may be due to break down of glycogen into glucose. It is well known fact that stress stimuli bring out rapid secretion of glucocorticoids and catecholamines from adrenal tissue of the fish. Both these hormones are well-known to produce hyperglycemia in animals

Reproductive Phase Exposure of Profenofos in Male Fish:

Preparatory phase:

In the present study higher values of Blood sugar was recorded during preparatory, phase of reproductive cycle in the male fish N. notopterus exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 10, Fig. 84.

Pre spawning phase:

In the present study higher values of Blood sugar was recorded during pre spawning phase of reproductive cycle in the male fish N. notopterus exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 10, Fig. 85.
Spawning phase:

In the present study higher values of Blood sugar was recorded during spawning phase of reproductive cycle in the male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 10, Fig. 86.

Post spawning phase:

In the present study higher values of Blood sugar was recorded during post spawning phase of reproductive cycle in the male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 10, Fig. 87.

Reproductive Phase Exposure of Profenofos in Female Fish:

Preparatory Phase:

In the present study higher values of Blood sugar was recorded during preparatory, phase of reproductive cycle in the female fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 11, Fig. 88.

Pre spawning phase:

In the present study higher values of Blood sugar was recorded during pre spawning phase of reproductive cycle in the female fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 11, Fig. 89.
**Spawning phase:**

In the present study higher values of Blood sugar was recorded during spawning phase of reproductive cycle in the female fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 11, Fig. 90.

**Post spawning phase:**

In the present study higher values of Blood sugar was recorded during post spawning phase of reproductive cycle in the female fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to their respective control group and the data found is presented in Table 11, Fig. 91.

In the present study decreased level of plasma glucose during the treatment might have effect from hypoxic condition caused by pesticide profenofos.

**Blood Urea level after Profenofos Exposure:**

**Acute exposure:**

Urea is the end product of protein and amino acid catabolism and it is formed in the liver. Urea level is a rough analytical index of symptomatic renal failure. In the present investigation Blood urea was found increase in fishes under lethal and sub-lethal concentration of profenofos during 24 and 96 hrs, compare to control group Table 8, Fig. 69, 70.
**Chronic exposure:**

Any factor that reduce glomerular filtrate rate will cause an increase in serum urea. In present investigation higher level of blood urea was observed during 7, 14, 30, 45 and 90 days exposure, where as some marginal difference was noticed in 21 days under sub-lethal exposure of profenofos treated fishes compare to their respective control group Table 9, Fig. 75.

**Reproductive Phase Exposure of Profenofos in Male Fish:**

**Preparatory phase:**

In the present study it is revealed that the higher level of blood urea was observed during preparatory phase of reproductive cycle in male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data obtained was presented in Table 10, Fig. 84.

**Pre spawning phase:**

In the present study it is revealed that the lower level of blood urea was observed during pre spawning phase of reproductive cycle in male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data obtained was presented in Table 10, Fig. 85.

**Spawning phase:**

In the present study it is revealed that the higher level of blood urea was observed during Spawning phase of reproductive cycle in male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data obtained was presented in Table 10, Fig. 86.
Post spawning phase:

In the present study it is revealed that the higher level of blood urea was observed during post spawning phase of reproductive cycle in male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data obtained was presented in Table 10, Fig. 87.

Reproductive Phase Exposure of Profenofos in Female Fish:

Preparatory phase:

In the present study it is revealed that the higher level of blood urea was observed during preparatory phase of reproductive cycle in female fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data obtained was presented in Table 11, Fig. 88.

Pre spawning phase:

In the present study it is revealed that the lower level of blood urea was observed during pre spawning phase of reproductive cycle in female fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data obtained was presented in Table 11, Fig. 89.

Spawning phase:

In the present study it is revealed that the higher level of blood urea was observed during Spawning phase of reproductive cycle in female fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data obtained was presented in Table 11, Fig. 90.
Post spawning phase:

In the present study it is revealed that the higher level of blood urea was observed during post spawning phase of reproductive cycle in female fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data obtained was presented in Table 11, Fig. 91.

Serum Creatinine after Profenofos Exposure:

Acute exposure:

In the present investigation higher creatinine value was recorded during 24 and 96 hrs period, and some changes were noticed during the experiment in fishes exposed to lethal and sub-lethal concentration of profenofos compare to control group Table 8, Fig. 69, 70.

Chronic exposure:

In the present study higher level of serum creatinine was observed during chronic exposure of 7, 14, 21, 30, 45 and 90 days in the fishes treated with sub-lethal concentration of profenofos, the data found was compared with their respective control group Table 9, Fig. 76.

Reproductive Phase Exposure of Profenofos in Male Fish:

Preparatory phase:

In the present study data obtained reveals that higher values of serum creatinine was recorded during preparatory phase of reproductive cycle in the male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron)
compare to control group and the data found is presented in Table 10, Fig. 84.

**Pre spawning phase:**

In the present study data obtained reveals that higher values of serum creatinine was recorded during pre spawning phase of reproductive cycle in the male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data found is presented in Table 10, Fig. 85.

**Spawning phase:**

In the present study data obtained reveals that higher values of serum creatinine was recorded during spawning phase of reproductive cycle in the male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data found is presented in Table 10, Fig. 86.

**Post spawning phase:**

In the present study data obtained reveals that higher values of serum creatinine was recorded during post spawning phase of reproductive cycle in the male fish *N. notopterus* exposed to sub-lethal concentration of Profenofos (Curacron) compare to control group and the data found is presented in Table 10, Fig. 87.
Reproductive Phase Exposure of Profenofos in Female Fish:

Preparatory Phase:

In the present study it is revealed that lower values of serum creatinine was observed during preparatory phase of reproductive cycle under sub lethal concentration of Profenofos (Curacron) in the female fish *N. notopterus* compare to control group and the data obtained was presented in Table 11, Fig. 88.

Pre spawning phase:

In the present study it is revealed that higher values of serum creatinine was observed during pre spawning phase of reproductive cycle under sub lethal concentration of Profenofos (Curacron) in the female fish *N. notopterus* compare to control group and the data obtained was presented in Table 11, Fig. 89.

Spawning phase:

In the present study it is revealed that higher values of serum creatinine was observed during spawning phase of reproductive cycle under sub lethal concentration of Profenofos (Curacron) in the female fish *N. notopterus* compare to control group and the data obtained was presented in Table 11, Fig. 90.

Post spawning phase:

In the present study it is revealed that lower values of serum creatinine was observed during Post spawning phase of reproductive cycle under sub lethal concentration of Profenofos (Curacron) in the female fish *N. notopterus* compare to control group and the data obtained was presented in Table 11, Fig. 91.
Total Cholesterol content after Profenofos Exposure:

Acute exposure:

In the present experiment lower blood cholesterol was recorded in the fishes exposed to lethal and sub-lethal concentration of profenofos during 24 and 96 hrs the data found was compared with their respective control group of fishes Table 8, Fig. 69, 70.

Chronic exposure:

In the present investigation lower values of serum cholesterol was observed during 7, 14, 21, 30, 45 and 90 days under sub-lethal concentration of profenofos exposed fishes and the data found was compared to control group of fishes Table 9, Fig. 77.

Reproductive Phase Exposure of Profenofos in Male Fish:

Preparatory phase:

In the present study increased values of serum cholesterol in the male fish *N. notopterus* was observed during preparatory phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) the values found were compared with their respective control group and the data found was presented in Table 10, Fig. 84.

Pre spawning phase:

In the present study increased values of serum cholesterol in the male fish *N. notopterus* was observed during pre spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) the values found were compared with
their respective control group and the data found was presented in Table 10, Fig. 85.

**Spawning phase:**

In the present study increased values of serum cholesterol in the male fish *N. notopterus* was observed during spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) the values found were compared with their respective control group and the data found was presented in Table 10, Fig. 86.

**Post spawning phase:**

In the present study increased values of serum cholesterol in the male fish *N. notopterus* was observed during post spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) the values found were compared with their respective control group and the data found was presented in Table 10, Fig. 87.

**Reproductive Phase Exposure of Profenofos in Female Fish:**

**Preparatory phase:**

In the present investigation the content of serum cholesterol was found decreased in the female fish *N. notopterus* during preparatory, phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) the data obtained was compared with the control group of fish and represented in Table 11, Fig. 88.

**Pre spawning phase:**

In the present investigation the content of serum cholesterol was found decreased in the female fish *N. notopterus* during pre spawning phase of reproductive
cycle under sub-lethal concentration of Profenofos (Curacron) the data obtained was compared with the control group of fish and represented in Table 11, Fig. 89.

**Spawning phase:**

In the present investigation the content of serum cholesterol was found increased in the female fish *N. notopterus* during spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) the data obtained was compared with the control group of fish and represented in Table 11, Fig. 90.

**Post spawning phase:**

In the present investigation the content of serum cholesterol was found decreased in the female fish *N. notopterus* during post spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) the data obtained was compared with the control group of fish and represented in Table 11, Fig. 91.

**Serum Triglycerides after Profenofos Exposure:**

**Acute exposure:**

Serum triglyceride is used to evaluate lipid metabolism. In the present study the freshwater fish *Notopterus notopterus* shows higher values of serum triglycerides under lethal and sub-lethal concentration of profenofos exposed fishes during 24 and 96 hrs and the data found was compared with control values, the values obtained in the present study was presented in the Table 8, Fig. 69, 70.

**Chronic Exposure:**

In the present investigation it is revealed that the fish *Notopterus notopterus* shows higher values of serum triglycerides during 7, 14, 21, 30, 45 and 90 days
exposure under sub-lethal concentration of profenofos and the values obtained were compared to control group, the data found in the present study was presented in the Table 9, Fig. 78.

**Reproductive Phase Exposure of Profenofos in Male Fish:**

**Preparatory phase**

In the present investigation higher values of serum triglycerides was observed during preparatory phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos, the values found were compared with control fish and the data obtained in the present investigation was presented in Table 10, Fig. 84.

**Pre spawning phase:**

In the present investigation higher values of serum triglycerides was observed during pre spawning phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos, the values found were compared with control fish and the data obtained in the present investigation was presented in Table 10, Fig. 85.

**Spawning phase:**

In the present investigation higher values of serum triglycerides was observed during, spawning phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos, the values found were compared with control fish and the data obtained in the present investigation was presented in Table 10, Fig. 86.
Post spawning phase:

In the present investigation higher values of serum triglycerides was observed during Post spawning phase of reproductive cycle in the male fish *N. notopterus* under sub-lethal concentration of profenofos, the values found were compared with control fish and the data obtained in the present investigation was presented in Table 10, Fig. 87.

Reproductive Phase Exposure of Profenofos in Female Fish:

Preparatory phase:

In the present investigation higher values of serum triglycerides was observed during preparatory phase of reproductive cycle in the female fish *N. notopterus* under sub-lethal concentration of profenofos, the values found were compared with control fish and the data obtained in the present investigation was presented in Table 11, Fig. 88.

Pre spawning phase:

In the present investigation higher values of serum triglycerides was observed during pre spawning phase of reproductive cycle in the female fish *N. notopterus* under sub-lethal concentration of profenofos, the values found were compared with control fish and the data obtained in the present investigation was presented in Table 11, Fig. 89.

Spawning phase:

In the present investigation higher values of serum triglycerides was observed during, spawning phase of reproductive cycle in the female fish *N. notopterus* under sub-lethal concentration of profenofos, the values found were compared with control
fish and the data obtained in the present investigation was presented in Table 11, Fig. 90.

**Post spawning phase:**

In the present investigation higher values of serum triglycerides was observed during Post spawning phase of reproductive cycle in the female fish *N. notopterus* under sub-lethal concentration of profenofos, the values found were compared with control fish and the data obtained in the present investigation was presented in Table 11, Fig. 91.

**Serum Uric acid after Profenofos Exposure:**

**Acute exposure:**

In the present study it is revealed that higher level of serum uric acid was observed during lethal and sub-lethal concentration of profenofos during 24 and 96 hrs in the fish *Notopterus notopterus*, the values found was compare with control group and the data obtained in the present investigation was represented in Table 8, Fig. 69, 70.

**Chronic exposure:**

In the present investigation the fish *Notopterus notopterus* shows higher content of serum uric acid during 7, 14, 21 and 30 days exposure and some marginal changes was noticed during 45 and 90 days under sub-lethal concentration of profenofos treated fishes, the values found were compared with control group and the data obtained in the present investigation was represented in the Table 9, Fig. 79.
Reproductive Phase Exposure of Profenofos in Male Fish:

Preparatory phase:

In the present investigation it is revealed that higher level of serum uric acid was found during preparatory phase, of reproductive cycle of the male fish *N. notopterus* under sub-lethal concentration of profenofos, the data obtained was compared to control group and the values obtained in the present investigation was represented in the Table 10, Fig. 84.

Pre spawning phase:

In the present investigation it is revealed that higher level of serum uric acid was found during prespawning phase of reproductive cycle of the male fish *N. notopterus* under sub-lethal concentration of profenofos, the data obtained was compared to control group and the values obtained in the present investigation was represented in the Table 10, Fig. 85.

Spawning phase:

In the present investigation it is revealed that higher level of serum uric acid was found during spawning phase of reproductive cycle of the male fish *N. notopterus* under sub-lethal concentration of profenofos, the data obtained was compared to control group and the values obtained in the present investigation was represented in the Table 10, Fig. 86.

Post spawning phase:

In the present investigation it is revealed that higher level of serum uric acid was found during post spawning phase of reproductive cycle of the male fish *N. notopterus* under sub-lethal concentration of profenofos, the data obtained was
Reproductive Phase Exposure of Profenofos in Female Fish:

Preparatory phase:

In the present investigation it is revealed that higher level of serum uric acid was found during preparatory phase, of reproductive cycle of the female fish *N. notopterus* under sub-lethal concentration of profenofos, the data obtained was compared to control group and the values obtained in the present investigation was represented in the Table 11, Fig. 88.

Pre spawning phase:

In the present investigation it is revealed that higher level of serum uric acid was found during prespawning phase of reproductive cycle of the female fish *N. notopterus* under sub-lethal concentration of profenofos, the data obtained was compared to control group and the values obtained in the present investigation was represented in the Table 11, Fig. 89.

Spawning phase:

In the present investigation it is revealed that higher level of serum uric acid was found during spawning phase of reproductive cycle of the female fish *N. notopterus* under sub-lethal concentration of profenofos, the data obtained was compared to control group and the values obtained in the present investigation was represented in the Table 11, Fig. 90.
Post spawning phase:

In the present investigation it is revealed that higher level of serum uric acid was found during post spawning phase of reproductive cycle of the female fish *N. notopterus* under sub-lethal concentration of profenofos, the data obtained was compared to control group and the values obtained in the present investigation was represented in the Table 11, Fig. 91.

**Serum Potassium after Profenofos Exposure:**

**Acute exposure:**

Potassium is the main intracellular cat-ion involved in several physiological functions such as muscle and nerve function acid base balance in the body and maintenance of osmotic pressure.

In the present investigation lower values of potassium was recorded under lethal and sub-lethal concentration of profenofos during 24 and 96 hrs exposure to the freshwater fish *N. notopterus* compare to control group and the data obtained was presented in the Table 8, Fig. 69, 70.

**Chronic exposure:**

In the present study it is revealed that serum potassium was increased during chronic exposure of 7, 14, 21, 30, 45 and 90 days, when the fresh water fish *N. notopterus* was exposed to sub-lethal concentration of profenofos, the values found were compared with the respected control group of fishes and the data found was presented in the Table 9, Fig. 80.
Reproductive Phase Exposure of Profenofos in Male Fish:

Preparatory phase:

In the present investigation it is revealed that the sub-lethal concentration of profenofos increases the level of serum potassium during preparatory phase of reproductive cycle of the male fish *N. notopterus*, the data found was compared with control group respectively and the values obtained was presented in the Table 10, Fig. 84.

Pre spawning phase:

In the present investigation it is revealed that the sub-lethal concentration of profenofos increases the level of serum potassium during pre spawning phase of reproductive cycle of the male fish *N. notopterus*, the data found was compared with control group respectively and the values obtained was presented in the Table 10, Fig. 85.

Spawning phase:

In the present investigation it is revealed that the sub-lethal concentration of profenofos increases the level of serum potassium during Spawning phase of reproductive cycle of the male fish *N. notopterus*, the data found was compared with control group respectively and the values obtained was presented in the Table 10, Fig. 86.

Post spawning phase:

In the present investigation it is revealed that the sub-lethal concentration of profenofos increases the level of serum potassium during Post spawning phase of reproductive cycle of the male fish *N. notopterus*, the data found was compared with
control group respectively and the values obtained was presented in the Table 10, Fig. 87.

**Reproductive Phase Exposure of Profenofos in Female Fish:**

**Preparatory phase:**

In the present investigation it is revealed that the sub-lethal concentration of profenofos increases the level of serum potassium during preparatory phase of reproductive cycle of the female fish *N. notopterus*, the data found was compared with control group respectively and the values obtained was presented in the Table 11, Fig. 88.

**Pre spawning phase:**

In the present investigation it is revealed that the sub-lethal concentration of profenofos increases the level of serum potassium during pre spawning phase of reproductive cycle of the female fish *N. notopterus*, the data found was compared with control group respectively and the values obtained was presented in the Table 11, Fig. 89.

**Spawning phase:**

In the present investigation it is revealed that the sub-lethal concentration of profenofos increases the level of serum potassium during Spawning phase of reproductive cycle of the female fish *N. notopterus*, the data found was compared with control group respectively and the values obtained was presented in the Table 11, Fig. 90.
Post spawning phase:

In the present investigation it is revealed that the sub-lethal concentration of profenofos increases the level of serum potassium during Post spawning phase of reproductive cycle of the female fish *N. notopterus*, the data found was compared with control group respectively and the values obtained was presented in the Table 11, Fig. 91.

The increase in the potassium could be due to the possible inhibition of ATP-ase by Profenofos (Curacron) 50% EC.

Alkaline Phosphate after Profenofos Exposure:

**Acute exposure:**

In the present study the freshwater fish shows higher level of alkaline phosphate during 24 and 96 hrs exposures under lethal and sub-lethal concentration of profenofos with some marginal difference during the exposure period was noticed, the data found was compared with control group and presented in Table 8, Fig. 69, 70.

**Chronic exposure:**

In the investigation the lower values of alkaline phosphate was observed in the fish *Notopterus notopterus* during 7, 14, 21, 30, 45 and 45 days alkaline phosphate was found increased and some changes were recorded in 90 days fish under sub-lethal concentration of profenofos. The data found was compared with control group and presented in Table 9, Fig. 81.
Reproductive Phase Exposure of Profenofos in Male Fish:

Preparatory phase:

In the present investigation lower values of alkaline phosphate was recorded during preparatory phase of reproductive cycle of the male fish *Notopterus notopterus* under sub-lethal concentration of Profenofos (Curacron) and values were compared with the control group of fish and the compared data was presented in the Table 10, Fig. 84.

Pre spawning phase:

In the present investigation higher values of alkaline phosphate was recorded during pre spawning phase of reproductive cycle of the male fish *Notopterus notopterus* under sub-lethal concentration of Profenofos (Curacron) and values were compared with the control group of fish and the compared data was presented in the Table 10, Fig. 85.

Spawning phase:

In the present investigation higher values of alkaline phosphate was recorded during Spawning phase of reproductive cycle of the male fish *Notopterus notopterus* under sub lethal concentration of Profenofos (Curacron) and values were compared with the control group of fish and the compared data was presented in the Table 10, Fig. 86.

Post spawning phase:

In the present investigation lower values of alkaline phosphate was recorded during post spawning phase of reproductive cycle of the male fish *N. notopterus* under sub lethal concentration of Profenofos (Curacron), the values were compared
with the control group of fish and the compared data was presented in the Table 10, Fig. 87.

**Reproductive Phase Exposure of Profenofos in Female Fish:**

**Preparatory phase:**

In the present study higher values of alkaline phosphate was observed during preparatory phase of reproductive cycle of the female fish *N. notopterus* under sub lethal concentration of Profenofos (Curacron) the values were compared with the control group of fish and the compared data was presented in the Table 11, Fig. 88.

**Pre spawning phase:**

In the present study higher values of alkaline phosphate was observed during pre spawning phase of reproductive cycle of the female fish *N. notopterus* under sub lethal concentration of Profenofos (Curacron) the values were compared with the control group of fish and the compared data was presented in the Table 11, Fig. 89.

**Spawning phase:**

In the present study higher values of alkaline phosphate was observed during Spawning phase of reproductive cycle of the female fish *N. notopterus* under sub lethal concentration of Profenofos (Curacron) the values were compared with the control group of fish and the compared data was presented in the Table 11, Fig. 90.

**Post spawning phase:**

In the present study higher values of alkaline phosphate was observed during Post spawning phase of reproductive cycle of the female fish *N. notopterus* under sub lethal concentration of Profenofos (Curacron) the values were compared with the control group of fish and the compared data was presented in the Table 11, Fig. 91.
**SGPT after Profenofos Exposure:**

The enzyme SGPT and SGOT are medicinally important diagnostic tools and they are used to detect the toxic effects of pollutants.

**Acute exposure:**

The enzyme SGPT during 24 and 96 hrs under lethal and sub-lethal exposure of profenofos to the fish *N. notopterus* shows lower values, the data obtained was compare with control group Table 8, Fig. 69, 70.

**Chronic exposure:**

In the present study the fish *Notopterus notopterus* shows higher values of SGPT during the exposure for 30, 45 and 90 days, whereas, some marginal difference was noticed in 7, 14 and 21 days under sub-lethal concentration of profenofos exposed fishes, the data found was compared with control group Table 9, Fig. 82.

**Reproductive Phase Exposure of Profenofos in Male Fish:**

**Preparatory phase:**

In the present study lower content of enzyme SGPT was recorded during preparatory phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the male fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was represented in Table 10, Fig. 84.

**Pre spawning phase:**

In the present study higher content of enzyme SGPT was recorded during pre spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the male fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 10, Fig. 85.
Spawning phase:

In the present study higher content of enzyme SGPT was recorded during Spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the male fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 10, Fig. 86.

Post spawning phase:

In the present study higher content of enzyme SGPT was observed during post spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the male fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 10, Fig. 87.

Reproductive Phase Exposure of Profenofos in Female Fish:

Preparatory phase:

In the present study lower content of enzyme SGPT was observed during preparatory phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the female fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was represented in Table 11, Fig. 88.

Pre spawning phase:

In the present study higher content of enzyme SGPT was observed during prespawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the female fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 11, Fig. 89.
**Spawning phase:**

In the present study higher content of enzyme SGPT was observed during Spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the female fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 11, Fig. 90.

**Post spawning phase:**

In the present study higher content of enzyme SGPT was observed during post spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the female fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 11, Fig. 91.

**SGOT after Profenofos Exposure:**

**Acute exposure:**

In the present study decreased values of the enzyme SGOT was recorded during 24 and 96 hrs under lethal and sub-lethal concentration of Profenofos (Curacron) exposed fish *N. notopterus*, the data found was compared with control group of fish and the compared data was presented in the Table 8, Fig. 69, 70.

**Chronic exposure:**

During the exposure for 7, 14, 21, 30, and 45 days lower values were observed, whereas some marginal difference was noticed in 90 days under sub-lethal concentration of Profenofos (Curacron) exposed fish *N. notopterus* the data obtained in the present study was compared with the control group of fish and the compared data was presented in Table 9, Fig. 83
Reproductive Phase Exposure of Profenofos in Male Fish:

Preparatory phase:

In the present study lower content of enzyme SGOT was recorded during preparatory phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the male fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was represented in Table 10, Fig. 84.

Pre spawning phase:

In the present study higher content of enzyme SGOT was recorded during pre spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the male fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 10, Fig. 85.

Spawning phase:

In the present study higher content of enzyme SGOT was recorded during Spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the male fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 10, Fig. 86.

Post spawning phase:

In the present study higher content of enzyme SGOT was observed during post spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the male fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 10, Fig. 87.
Reproductive Phase Exposure of Profenofos in Female Fish:

Preparatory phase:

In the present study lower content of enzyme SGOT was observed during preparatory phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the female fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was represented in Table 11, Fig. 88.

Pre spawning phase:

In the present study higher content of enzyme SGOT was observed during prespawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the female fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 11, Fig. 89.

Spawning phase:

In the present study higher content of enzyme SGOT was observed during Spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the female fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 11, Fig. 90.

Post spawning phase:

In the present study higher content of enzyme SGOT was observed during post spawning phase of reproductive cycle under sub-lethal concentration of Profenofos (Curacron) to the female fish *N. notopterus*, the data obtained was compared with the control group of fish and the compared data was presented in Table 11, Fig. 91.

An increase in the enzyme SGPT and SGOT after profenofos exposure is a sign of cellular damage.
**Histology:**

In fishes, it is observed that, the external organs are affected due to toxic chemicals, causing loss of equilibrium, and increase in opercular movements, with irregular vertical movements, finally leading to death. This may be due to the significant damage to the internal organs. Histopathological study gives us useful information concerning tissue change earlier to external sign. The normal histology of different organs (Kidney and gonads) studied and various histopathological changes produced by the sub-lethal concentration of the pesticide, Profenofos (Curacron) on these organs of *N. notopterus* are explained below.

**Seasonal Gonadal Cycle of *N. notopterus:***

The seasonal reproductive cycle of *N. notopterus* was studied first before utilizing this fish for the present study to identify the condition of gonadal development in four generally applied phases.

The identification of reproductive phase during one year period is based on the morphological examination of gonads in both male and female. Collection of the fish during rainy season was difficult since the fish goes to the deeper portion of the water body. However, they use to be found near the weeds and their submerged branches of acacia plants. This may because of their participation in the spawning activity.

**Morphology of Gonads:**

The study of the gonads is based on the morphological examination in both male and female fish during four reproductive phase of the cycle.

The four phases of the one year cycle in which gonadal condition observed are

1. Preparatory phase (January to March).
2. Pre spawning phase (April to July).

3. Spawning phase (August to October)

4. Post spawning phase (November to December).

The conditions of the gonads are at the developing stage while in the pre spawning phase, the gonads are at the different stages of maturity comprising of maturing and mature stages. In spawning phases the gonads are ripe and some are in the spent stages and post spawning phases includes immature stage.

The morphological examination of the gonads in both the sexes male and female shows that the gonads are in single, broad and slightly elongated. The morphology of the gonads and data comparisons suggested that the gonads underwent a distinct rhythm of growth and depletion.

Seasonal Testicular Cycle:

The testicular cycle shows four reproductive phases as of ovarian cycle. In preparatory phase testis consist of lobules having primary and secondary spermatogonial cells. In prespawning phase the concentration of spermatozoa in the lobular lumen after the result of increased gametogenic activity. During spawning seminiferous lobules become empty. The post spawning phase testis is characterizes by the presence of spermatogonia and spermatocytes which are not in the process of division.

Exposure of Profenofos during different Phases of Testicular Cycle:

Spermatogenesis in fish has been studied extensively using conventional methods of histology.
a) Preparatory phase:

i. **Histology of Testis:** In preparatory phase the histological section of the testis consist of lobules having primary and secondary spermatogonial cells and actively dividing primary and secondary spermatocytes (Fig. 6)

ii. **Changes in the histology of testis after exposure to Profenofos:** In preparatory phase the histological section of the testis after exposure to Profenofos (Curacron) lobules become small and the interstitium of lobules increases (Fig. 10)

b) Pre spawning phase:

i. **Histology of Testis:** In pre spawning phase the concentration of spermatozoa in the lobular lumen by the result of the increase activity of gamatogenesis. The primary spermatogonia are decreased. During initial two months of this phase the primary and secondary spermatocytes were more numerous and during later months they were reduced as they have converted in to spermatozoa (Fig. 7).

ii. **Changes in the histology of testis after exposure to Profenofos:** In pre spawning phase the histological section of the testis after the exposure of Profenofos to the fresh water fish *N. notopterus* shows degenerated changes such as degenerated lobules was noticed the process of spermatogenesis was not observed in the section (Fig. 11)
c) **Spawning Phase:**

i. **Histology of Testis:** In spawning phase the histological section of the testis shows either packed lobular lumen with spermatozoa or in some lobules are empty (Fig. 8)

ii. **Changes in the histology of testis after exposure to Profenofos:** In spawning phase the histological section shows completely damaged testis without any spermatogenesis, disorganized lobules were observed and the connection between the lobules was also lost (Fig. 12)

d) **Post spawning Phase:**

i. **Histology of Testis:** In post spawning phase the histological section of the testis shows the presence of spermatogonia and spermatocytes which are not in the process of division (Fig. 9)

ii. **Changes in the histology of testis after exposure to Profenofos:** In the post spawning phase after exposure to Profenofos damaged testis was observed with lost interlobular connection and cyst containing different spermatogenic elements was not observed (Fig. 13)

**Experimental Studies:**

**Histology of Control Testis:**

The histological changes of the testis for 12 month period were studied under laboratory control and profenofos exposed conditions. The fishes were exposed to profenofos during acute and chronic treatment. The normal testis consist two principal elements those are seminiferous tubules and interstitial tissue consisting of connective tissues, steroid secreting leydig cells, and blood capillaries. The sertoli cells are the only somatic elements in the seminiferous tubules. Seminiferous tubules are different
in their shape and size (Fig. 22). They can be identified in histological preparation during prespawning and spawning phase.

The cysts of the lobules contain different spermatogenic step. The primary spermatogonia are larger in size with distinct round to oval vesicular prominent nucleus. The secondary spermatogonia are smaller than primary spermatogonia which contain round to oval nucleus. The primary spermatocytes are smaller than spermatogonial cells having small and round nucleus. The spermatids are still smaller cells having distinctly stained nucleus. These cells form separate group inside the lobule. Spermatozoa are the smallest cells of the spermatogonial cells and are produced from spermatids.

Pathology of Testis under Profenofos (Curacron) Toxicity:

The sub-lethal concentration of Profenofos (Curacron) during acute exposure for 24 hrs caused initial damaged to primary spermatocyte wall, sperm, interstitial cells, lumen and connective tissue (Fig. 23). While 96 hrs exposure shows reduction in spermatozoa formation, thick tubular wall, damaged lobules, increase in interstitial cells and inactive interstitial leyding cells with blocked spermatogenesis (Fig. 24). During chronic exposure of 7 day there was missing connective tissue, degenerative changes were observed with disorganized lobules (Fig. 25). On 14th day there were further degenerative changes like tubular disorganization, inhibition of spermatogenesis and intertubular vacuolization was seen (Fig. 26). At 21st day testis becomes completely degenerated showing mass of degenerative cells in lobular lumen inflammation and necrosis was observed (Fig. 27). On 30th day there were completely damaged testis, all spermatogenic elements were degenerated necrosis and haemorrhage was visible in some areas with intertubular vacuolization (Fig. 28). After
45 days the compact nature of testis was lost. There were no sperm and active spermatogonial cells and necrosis was observed (Fig. 29). After 90 days severe damage to the interstitial tissue were found in testis. The spermatids were found vacuolated and degenerated. There was exfoliation and agglutination of sperm bundles in some cells, general necrosis was observed with completely damaged testis (Fig. 30).

**Seasonal Ovarian Cycle:**

The morphological and histological changes in the ovary indicate that the fish *N. notopterus* passed through different phases of breeding cycle as explained below.

In preparatory phase the ovary is characterized by the presence of large number of growing oocytes belonging to early and late perinucleolus stage. In prespawning phase the ovary showed the presence of all stages of oocytes and large number of the oocytes belonging to vitellogenic group. The presence of very few migratory nucleolus stage oocytes are seen while their number increases that indicates the final maturation. In post spawning phase the ovary consisting of oogonium, chromatin nucleus and early perinucleus stage of oocytes and that ovary can be categorized as immature stage.

**a) Preparatory Phase:**

i. **Histology of Ovary:** In preparatory phase the histological section of the ovary is characterized by the presence of large number of oocytes belonging to early and late perinucleolus stages (Fig. 14).

ii. **Changes in the histology of ovary after exposure to Profenofos:** in preparatory phase the histology of ovary the vitellogenesis is not seen in young follicles (Fig. 18).
b) Pre spawning phase:

i. **Histology of Ovary:** In the pre spawning phase the histology is characterized by the presence of all stages of oocytes with large number of oocytes belonging to vitellogenic group. In this phase of reproductive cycle ovary shows the transformation of oocytes from primary yolk globule stage to secondary yolk globule and to tertiary yolk globule stage and the presence of very few migratory nucleolus stage oocytes was observed (Fig. 15).

ii. **Changes in the histology of ovary after exposure to Profenofos:** In pre spawning phase the histological section of the ovary after Profenofos exposure shows atretic follicles and vitellogenic follicles are not under the process of vitellogenesis. Although these oocytes were visible they exhibit poor staining (Fig. 19).

c) Spawning Phase:

i. **Histology of Ovary:** In spawning phase the histology of ovary shows increased number of migratory nucleolus stage oocytes indicating final stage of maturation the breakdown of germinal vesicle takes place (Fig. 16).

ii. **Changes in the histology of ovary after exposure to Profenofos:** In spawning phase the histology of ovary shows oocytes which are remained inside the ovary. Some of the vitellogenic oocytes are under the process of degeneration as compared to normal vitellogenic oocytes (Fig. 20).
d) Post spawning Phase:

i. **Histology of Ovary:** In the post spawning phase the histology of ovary consisting Oogonium, chromatin nucleolus and perinucleolus stage of oocytes and the ovary can be categorized as immature stage (Fig. 17).

ii. **Changes in the histology of ovary after exposure to Profenofos:** In post spawning phase the histology of ovary after exposure to Profenofos shows vitellogenic oocytes have undergone degeneration (Fig. 21).

**Histology of Control Ovary:**

The histological changes of the ovary for 12 month period were studied under laboratory unexposed, and profenofos (Curacron) exposed conditions. The fishes were exposed to profenofos during acute and chronic exposure. The normal mature ovaries consisting of fully grown yolky oocytes, several small previtellogenic primary oocytes and large early vitellogenic oocytes. The ovary consisting of different stages of oocytes embedded inside the loosely connective tissue. The different oocytes of the ovary have been classified they are (Fig. 31).

i) Oogonium  (ii) chromatin nucleolus (iii) early perinucleolus (iv) late perinucleolus (v) cortical alveoli (vi) primary yolk globule (vii) secondary yolk globule (viii) tertiary yolk globule and migratory nucleus.

**Pathology of Ovary under Profenofos (Curacron) toxicity**

The ovaries of *N. notopterus* have shown significant changes on exposure to test chemical profenofos. Fish exposed during acute exposure (24 and 96 hrs) shows initial changes like damaged oocytes which are undergoing initial vitellogenic stages, atretic follicles with vitellogenic oocytes was observed (Fig. 32, 33). In chronic
exposure after 7th 14th and 21 day shows effected vitellogenic follicle. There was a reduction in the number of oocytes and increased oocyte immaturity in addition to increased number of atretic follicles (Fig. 34, 35, 36). Ovaries exposed to 30 days showed follicular atresia and increase in interstitium was observed (Fig. 37). At 45 days follicles and oocytes are not undergoing vitellogenic activity and interstitium was increased, edema in stroma and presence of denatured yolk were noticed (Fig. 38). After 90 days of exposure showing most of the follicles belonging to different stages are undergoing degeneration forming atresia in all the oocytes, shrinkage of yolky material in yolky oocytes (Fig. 39).

Effect of Profenofos on other Organ with special reference to Kidney:

Histology of Kidney:

The histological changes of the kidney for 12 month period were studied under laboratory unexposed, and Profenofos (Curacron) exposed conditions. The fishes were exposed to profenofos during acute and chronic exposure. The normal kidney comprises of numerous functional units, the nephron and the haemopoetic tissue occupying the intertubular space, and is parenchymatous in nature. The control group showing compact renal mass and renal tubules (Fig. 40).

Pathology of Kidney under Profenofos (Curacron) Toxicity:

The sub-lethal concentration of Curacron during acute exposure (24 and 96 hr) shows remarkable histopathological changes such as inactive hepatic cells, pycnotic nucleus, widen uriniferous tubules, vesicular type of nucleus with intratubular space was noticed (Fig. 41, 42). During chronic exposure several pathological changes were observed throughout the experiment, on 7th day of exposure damaged kidney cells, general necrosis was observed with vacuolar
degeneration (Fig. 43). At the end of 14\textsuperscript{th} day haemorrhage of renal tissue in addition to the previous changes and damaged tubular epithelium and pycnosis was observed (Fig. 44). At 21 day crumpled and pycnotic uriniferous epithelium and haemorrhage was noticed (Fig. 45). At 30\textsuperscript{th} and 45 day, widening of tubules due to flattening of tubular epithelium and tubules reduced in their volume forming intertubular space, vacuolar degeneration and haemorrhage was observed (Fig. 46, 47). At 90 days of exposure extensive damage in haemopoietic tissue, widening of renal tubules, focal collection of inflammatory cells, necrosis and lesion of haemopoietic tissue was observed. The other nephronic changes observed are thinned out lining of epithelium of renal tubules and crowding with other renal tubules (Fig. 48).
Fig. 2: Showing Male Fish with Male Gonad (Testis)

Fig. 3: Showing Female Fish with Female Gonad (Ovary)
Fig. 4: Showing collection of blood sample from caudal peduncle of the freshwater fish *N. notopterus*.

Fig: 5: Photograph showing the blood sample.

Test tube “A” showing the plasma content of blood sample.  
Test tube “B” showing the serum content of blood sample.
Fig. 6: Microphotograph of part of control testis during Preparatory phase (H/E×100) showing lobules with primary and secondary spermatogonial cells.

Fig. 7: Microphotograph of part of control testis during pre spawning phase (H/E×100) showing less numbers of primary spermatogonia and secondary oocytes were numerous.

Fig. 8: Microphotograph of part of control testis during Spawning phase (H/E×100) showing packed lobular lumen with spermatozoa.

Fig. 9: Microphotograph of part of control testis during Post spawning phase (H/E×100) showing spermatogonia and spermatocytes which are not in the process of division.
**Fig.-10:** Microphotograph of part of testis during Preparatory phase Exposure (H/E×100) showing small lobules, increased lobular interstitium.

**Fig.-11:** Microphotograph of part of testis during pre spawning phase Exposure (H/E×100) showing degenerated lobules, spermatogenesis was not observed.

**Fig.-12:** Microphotograph of part of testis during Spawning phase Exposure (H/E×100) showing disorganized lobules with completely damaged testis.

**Fig.-13:** Microphotograph of part of testis during Post spawning phase Exposure (H/E×100) showing lost interlobular connection, cyst containing different spermatogenic elements was not observed.
Fig.-14: Microphotograph of part of control ovary during Preparatory phase (H/E×100) showing early and late perinucleolus stage oocytes.

Fig.-15: Microphotograph of part of control ovary during pre spawning phase (H/E×100) showing vitellogenic oocyte.

Fig.-16: Microphotograph of part of control ovary during spawning phase (H/E×100) showing increased number of migratory nucleolus stage oocytes.

Fig.-17: Microphotograph of part of control ovary during Post spawning phase (H/E×100) showing chromatin nucleolus and perinucleolus stage oocytes and immature ovary.
**Fig.-18:** Microphotograph of part of ovary during Preparatory phase Exposure (H/E×100) showing vitellogenesis is not seen in young follicles.

**Fig.-19:** Microphotograph of part of ovary during pre spawning phase Exposure (H/E×100) showing number of atretic follicles, arrested vitellogenesis.

**Fig.-20:** Microphotograph of part of ovary during Spawning phase Exposure (H/E×100) showing degenerated vitellogenic oocytes, and some atretic follicles.

**Fig.-21:** Microphotograph of part of ovary during Post spawning phase Exposure (H/E×100) showing degenerated vitellogenic oocytes.
**Fig.-22:** Microphotograph of part of control testis (H/E×100) showing connective tissue, seminiferous tubules and sertoli cells with primary spermatocytes.

**Fig.-23:** Microphotograph of part of testis after 24 hr exposure (H/E×100) showing initial damage to primary spermatocyte, sperm, sertoli cells and connective tissue.

**Fig.-24:** Microphotograph of part of testis after 96 hr exposure (H/E×100) showing reduction in spermatozoa formation, damage to lobules, blocked spermatogenesis, increase in interstitial cells, inactive interstitial cells and thick lobular wall is observed.
Fig.-25: Microphotograph of part of testis after 7 day exposure (H/E×100) showing disorganization of lobules with other degenerative changes.

Fig.-26: Microphotograph of part of testis after 14 days exposure (H/E×100) showing further degenerative changes, disorganized lobules, inhibition of spermatogenesis and intertubular vacuolization.

Fig.-27: Microphotograph of part of testis after 21 days exposure (H/E×100) showing degenerative cells in lobular lumen.
Fig.-28: Microphotograph of part of testis after 30 days exposure (H/E×100) showing, completely damage testis and damaged spermatogenic element.

Fig.-29: Microphotograph of part of testis after 45 days exposure (H/E×100) showing, small lobules inactive spermatogonial cells and necrotic testis.

Fig.-30: Microphotograph of part of testis after 90 days exposure (H/E×100) showing completely damage testis and general necrosis.
Fig.-31: Microphotograph of part of control ovary (H/E×100) showing all oocytes with initial vitellogenic stage.

Fig.-32: Microphotograph of part of ovary after 24 hr exposure (H/E×100) showing initial changes, damage to oocytes which are undergoing initial vitellogenic stage.

Fig.-33: Microphotograph of part of ovary after 96 hr exposure (H/E×100) showing degenerated granulose layer, mature oocytes. Atretic follicles are seen in vitellogenic oocytes.
Fig.-34: Microphotograph of part of ovary after 7 day exposure (H/E×100) showing degeneration of epithelial cells, vacuolation, developing oocytes.

Fig.-35: Microphotograph of part of ovary after 14 days exposure (H/E×100) showing, atretic follicles, vacuolization.

Fig.-36: Microphotograph of part of ovary after 21 days exposure (H/E×100) showing inflammation, immature oocytes, necrosis. Vitellogenic follicles are affected.
**Fig.-37:** Microphotograph of part of ovary after 30 days exposure (H/E×100) showing atretic follicles in interstitium.

**Fig.-38:** Microphotograph of part of ovary after 45 days exposure (H/E×100) showing reduced vitellogenic activity in oocytes with numerous atretic follicles.

**Fig.-39:** Microphotograph of part of ovary after 90 days exposure (H/E×100) showing vacuolation, most of the follicles belonging to different stage are undergoing degeneration forming atresia in all oocytes.
**Fig.-40:** Microphotograph of part of control kidney (H/E×100) showing Bowman’s capsule (BC), Glomerulus (G), Haemopoietic tissue (HPT) and kidney tubules (KT).

**Fig.-41:** Microphotograph of part of kidney after 24 hr exposure (H/E×100) showing pycnotic nucleus, inactive hepatic cells.

**Fig.-42:** Microphotograph of part of kidney after 96 hr exposure (H/E×100) showing wide tubules, inactive hepatic cells, vesicular type of nucleus and intratubular space is observed.
Fig.-43: Microphotograph of part of kidney after 7 days exposure (H/E×100) showing renal tubules with dilated lumen and fragmentation of glomeruli and haemorrhage.

Fig.-44: Microphotograph of part of kidney after 14 days exposure (H/E×100) showing dilation of tubules, haemorrhage of renal tissue and mild haemorrhage.

Fig.-45: Microphotograph of part of kidney after 21 days exposure (H/E×100) showing shrunken glomerulus and necrosis, crumpled and pycnotic nucleus was observed.
Fig.-46: Microphotograph of part of kidney after 30 days exposure (H/E×100) showing marked collapse of glomerulus, proliferation of haematopoietic tissue and focal necrosis.

Fig.-47: Microphotograph of part of kidney after 45 days exposure (H/E×100) showing haemorrhage, shrunken glomerulus and vacuolation.

Fig.-48: Microphotograph of part of kidney after 90 days exposure (H/E×100) showing dilation of renal tubules, necrosis, deshaped glomeruli.
**Table –1:** Showing 96 hrs. mortality rate of *N. notopterus* expressed as percentage exposed to Profenofos (Curacron) 50% EC.

<table>
<thead>
<tr>
<th>Aquarium No.</th>
<th>No. of Test Animals <em>N. notopterus</em> Fish</th>
<th>Concentration of the Toxicant (Mg/L)</th>
<th>96 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>No. of Fishes Dead</td>
</tr>
<tr>
<td>1.</td>
<td>10</td>
<td>Control (No Toxicant)</td>
<td>Nil</td>
</tr>
<tr>
<td>2.</td>
<td>10</td>
<td>0.1</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>10</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>10</td>
<td>0.3</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>10</td>
<td>0.4</td>
<td>1</td>
</tr>
<tr>
<td>6.</td>
<td>10</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>10</td>
<td>0.6</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>10</td>
<td>0.7</td>
<td>5</td>
</tr>
<tr>
<td>9.</td>
<td>10</td>
<td>0.8</td>
<td>7</td>
</tr>
<tr>
<td>10.</td>
<td>10</td>
<td>0.9</td>
<td>8</td>
</tr>
<tr>
<td>11.</td>
<td>10</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

**Table–2:** Showing Biochemical contents in kidney of the fish *Notopterus notopterus* exposed to Profenofos (Curacron) technical grade 50% EC under sub-lethal concentrations.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>24 Hrs 0.7</th>
<th>24 Hrs 0.07</th>
<th>96 Hrs 0.7</th>
<th>96 Hrs 0.07</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protein</strong></td>
<td>0.99 ± 0.06</td>
<td>0.75 ± 0.03 NS</td>
<td>0.94 ± 0.07 NS</td>
<td>0.82 ± 0.03 NS</td>
<td>0.77 ± 0.02**</td>
</tr>
<tr>
<td><strong>Cholesterol</strong></td>
<td>0.36 ± 0.03 NS</td>
<td>0.43 ± 0.04 NS</td>
<td>0.64 ± 0.02***</td>
<td>0.53 ± 0.03 ***</td>
<td>0.41 ± 0.03 NS</td>
</tr>
<tr>
<td><strong>Glucose</strong></td>
<td>0.50 ± 0.02 NS</td>
<td>0.68 ± 0.02 NS</td>
<td>0.72 ± 0.08 NS</td>
<td>0.60 ± 0.01***</td>
<td>0.63 ± 0.02***</td>
</tr>
<tr>
<td><strong>DNA</strong></td>
<td>1.40 ± 0.04 NS</td>
<td>1.25 ± 0.06 NS</td>
<td>1.30 ± 0.06 NS</td>
<td>1.34 ± 0.03 NS</td>
<td>1.40 ± 0.08 NS</td>
</tr>
</tbody>
</table>

Protein, Cholesterol, Glucose and DNA are expressed as µg/mg wet wt. of tissue. Each value is expressed as mean and standard error. n=6, Students’ t’ Test. NS – not Significant, * – Significant P < 0.05, ** – Significant P < 0.01, *** – Significant P < 0.001, when compared with control.
Table 3: Showing Biochemical contents in gonads of the fish *Notopterus notopterus* exposed to Profenofos (Curacron) technical grade and 50% EC under lethal and sub-lethal concentration.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>24 Hrs 0.7</th>
<th>24 Hrs 0.07</th>
<th>96 Hrs 0.7</th>
<th>96 Hrs 0.07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>1.35 ± 0.06</td>
<td>0.91 ± 0.03</td>
<td>0.96 ± 0.02</td>
<td>0.44 ± 0.03***</td>
<td>0.78 ± 0.02***</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>0.54 ± 0.03</td>
<td>0.56 ± 0.02**</td>
<td>0.43 ± 0.03</td>
<td>0.58 ± 0.02</td>
<td>0.41 ± 0.03**</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.58 ± 0.01</td>
<td>0.90 ± 0.02**</td>
<td>0.63 ± 0.02</td>
<td>0.63 ± 0.02*</td>
<td>1.41 ± 0.04***</td>
</tr>
<tr>
<td>DNA</td>
<td>1.71 ± 0.02</td>
<td>1.33 ± 0.07***</td>
<td>1.30 ± 0.07***</td>
<td>1.71 ± 0.03***</td>
<td>1.65 ± 0.14*</td>
</tr>
</tbody>
</table>

Protein, Cholesterol, Glucose and DNA are expressed as µg/mg wet wt. of tissue. Each value is expressed as mean and standard error. n=6, Students 't' Test. Ns – not Significant, * – Significant P < 0.05, ** – Significant P < 0.01, *** – Significant P < 0.001, when compared with control.
**Table-4:** Showing Biochemical contents in kidney of the fish *Notopterus notopterus* exposed to Profenofos (Curacron) technical grade 50% EC under sub-lethal concentration.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>7 Days exposed</th>
<th>14 Days exposed</th>
<th>21 Days exposed</th>
<th>30 Days exposed</th>
<th>45 Days exposed</th>
<th>90 Days exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>0.91±0.01</td>
<td>0.74±0.04 NS</td>
<td>0.83±0.04*</td>
<td>0.64±0.02***</td>
<td>0.63±0.01***</td>
<td>0.70±0.01 NS</td>
<td>0.46±0.004***</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>1.46±0.04</td>
<td>0.52±0.02 NS</td>
<td>0.55±0.02***</td>
<td>0.66±0.01***</td>
<td>1.31±0.04 NS</td>
<td>0.41±0.3 NS</td>
<td>0.24±0.01***</td>
</tr>
<tr>
<td>Glucose</td>
<td>0.69±0.02</td>
<td>1.23±0.06***</td>
<td>0.47±0.02**</td>
<td>0.59±0.02*</td>
<td>0.63±0.004**</td>
<td>1.15±0.05***</td>
<td>0.27±0.04***</td>
</tr>
<tr>
<td>DNA</td>
<td>1.71±0.02</td>
<td>1.25±0.14 NS</td>
<td>1.41±0.06 NS</td>
<td>1.37±0.08*</td>
<td>1.69±0.03 NS</td>
<td>0.61±0.03***</td>
<td>1.14±0.16 NS</td>
</tr>
</tbody>
</table>

Protein, Cholesterol, Glucose and DNA are expressed as µg/mg wet wt. of tissue. Each value is expressed as mean and standard error. n=6, Students ‘t’ Test. NS – not Significant, * – Significant P < 0.05, ** – Significant P < 0.01, *** – Significant P < 0.001, when compared with control.
Table 5: Showing Biochemical contents in gonads of the fish *Notopterus notopterus* exposed to Profenofos (Curacron) technical grade 50% EC under sub-lethal concentration.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>7 Days exposed</th>
<th>14 Days exposed</th>
<th>21 Days exposed</th>
<th>30 Days exposed</th>
<th>45 Days exposed</th>
<th>90 Days exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>0.97 ± 0.02</td>
<td>1.25 ± 0.03*</td>
<td>0.71 ± 0.02***</td>
<td>0.95 ± 0.01***</td>
<td>0.52 ± 0.01**</td>
<td>0.62 ± 0.01***</td>
<td>0.50 ± 0.02*</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>1.22 ± 0.06</td>
<td>0.70 ± 0.08*</td>
<td>0.56 ± 0.02***</td>
<td>0.91 ± 0.03***</td>
<td>1.10 ± 0.02 NS</td>
<td>0.75 ± 0.08*</td>
<td>0.24 ± 0.03***</td>
</tr>
<tr>
<td>Glucose</td>
<td>1.09 ± 0.06</td>
<td>0.84 ± 0.4 NS</td>
<td>0.48 ± 0.02*</td>
<td>0.61 ± 0.02**</td>
<td>0.74 ± 0.004**</td>
<td>0.63 ± 0.07 NS</td>
<td>0.29 ± 0.04***</td>
</tr>
<tr>
<td>DNA</td>
<td>1.80 ± 0.16</td>
<td>1.27 ± 0.07 NS</td>
<td>1.69 ± 0.04***</td>
<td>1.45 ± 0.01*</td>
<td>1.62 ± 0.004***</td>
<td>1.14 ± 0.03 NS</td>
<td>1.52 ± 0.02 NS</td>
</tr>
</tbody>
</table>

Protein, Cholesterol, Glucose and DNA are expressed as µg/mg wet wt. of tissue. Each value is expressed as mean and standard error. n=6, Students ‘t’ Test. Ns – not Significant, * – Significant P < 0.05, ** – Significant P < 0.01, *** – Significant P < 0.001, when compared with control.
**Table 6:** Showing Biochemical contents in reproductive phase in gonad of the male fish *Notopterus notopterus* exposed to Profenofos (Curacron) technical grade 50% EC under sub-lethal concentration.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Preparatory phase exposed</th>
<th>Prespawning phase exposed</th>
<th>Spawning phase exposed</th>
<th>Postspawning phase exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protein</strong></td>
<td>0.69 ± 0.03</td>
<td>0.57 ± 0.04 NS</td>
<td>0.58 ± 0.01 NS</td>
<td>0.40 ± 0.02*</td>
<td>0.74 ± 0.02 NS</td>
</tr>
<tr>
<td><strong>Cholesterol</strong></td>
<td>0.55 ± 0.02</td>
<td>0.27 ± 0.01**</td>
<td>0.54 ± 0.04*</td>
<td>0.47 ± 0.02*</td>
<td>0.58 ± 0.02***</td>
</tr>
<tr>
<td><strong>Glucose</strong></td>
<td>0.68 ± 0.02</td>
<td>0.98 ± 0.06***</td>
<td>0.60 ± 0.01***</td>
<td>0.88 ± 0.02***</td>
<td>0.59 ± 0.03*</td>
</tr>
<tr>
<td><strong>DNA</strong></td>
<td>1.45 ± 0.04</td>
<td>1.12 ± 0.22 NS</td>
<td>1.32 ± 0.02*</td>
<td>0.49 ± 0.02***</td>
<td>1.65 ± 0.03***</td>
</tr>
</tbody>
</table>

Protein, Cholesterol, Glucose and DNA are expressed as µg/mg wet wt. of tissue.

Each value is expressed as mean and standard error. n=6, Students ‘t’ Test. Ns – not Significant, * – Significant P < 0.05, ** – Significant P < 0.01, *** – Significant P < 0.001, when compared with control.
Table 7: Showing Biochemical contents in reproductive phase in gonad of the female fish *Notopterus notopterus* exposed to Profenofos (Curacron) technical grade 50% EC under sub-lethal concentration.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Preparatory phase exposed</th>
<th>Prespawning phase exposed</th>
<th>Spawning phase exposed</th>
<th>Postspawning phase exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protein</strong></td>
<td>0.74 ± 0.02</td>
<td>0.58 ± 0.03 NS</td>
<td>0.62 ± 0.02 NS</td>
<td>0.45 ± 0.01 NS</td>
<td>0.71 ± 0.01 NS</td>
</tr>
<tr>
<td><strong>Cholesterol</strong></td>
<td>0.72 ± 0.02</td>
<td>0.25 ± 0.01***</td>
<td>0.45 ± 0.01***</td>
<td>0.46 ± 0.02 NS</td>
<td>0.64 ± 0.02*</td>
</tr>
<tr>
<td><strong>Glucose</strong></td>
<td>1.17 ± 0.03</td>
<td>0.99 ± 0.03***</td>
<td>0.94 ± 0.05**</td>
<td>0.84 ± 0.07 NS</td>
<td>0.61 ± 0.02*</td>
</tr>
<tr>
<td><strong>DNA</strong></td>
<td>1.71 ± 0.03</td>
<td>1.69 ± 0.02**</td>
<td>1.20 ± 0.05**</td>
<td>0.15 ± 0.01***</td>
<td>1.82 ± 0.03***</td>
</tr>
</tbody>
</table>

Protein, Cholesterol, Glucose and DNA are expressed as µg/mg wet wt. of tissue. Each value is expressed as mean and standard error. n=6, Students ‘t’ Test. NS – not Significant, * – Significant P < 0.05, ** – Significant P < 0.01, *** – Significant P < 0.001, when compared with control.
Table 8: Showing haematological parameters of the fish *Notopterus notopterus* exposed to Profenofos (Curacron) technical grade 50% EC under sub-lethal concentration.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>24 Hrs 0.7</th>
<th>24 Hrs 0.07</th>
<th>96 Hrs 0.7</th>
<th>96 Hrs 0.07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hb g/dl</td>
<td>12.79 ± 0.09</td>
<td>9.70 ± 0.18***</td>
<td>12.25 ± 0.39**</td>
<td>12.65 ± 0.31 NS</td>
<td>10.45 ± 0.31***</td>
</tr>
<tr>
<td>WBC millions/mm³</td>
<td>124.79 ± 0.25</td>
<td>161.65 ± 0.66***</td>
<td>188.70 ± 0.43***</td>
<td>167.93 ± 1.35**</td>
<td>154.40 ± 3.77 NS</td>
</tr>
<tr>
<td>RBC millions/mm³</td>
<td>1.89 ± 0.03</td>
<td>1.85 ± 0.13**</td>
<td>1.78 ± 0.05***</td>
<td>1.45 ± 0.01***</td>
<td>1.63 ± 0.04***</td>
</tr>
<tr>
<td>Blood Sugar mg/dl</td>
<td>52.95 ± 0.21</td>
<td>53.45 ± 0.55 NS</td>
<td>66.15 ± 0.23***</td>
<td>46.80 ± 1.35***</td>
<td>49.65 ± 1.46***</td>
</tr>
<tr>
<td>Blood Urea mg/dl</td>
<td>24.15 ± 0.81</td>
<td>25.75 ± 0.43 NS</td>
<td>29.60 ± 1.96 NS</td>
<td>33.70 ± 0.74 NS</td>
<td>25.85 ± 1.0***</td>
</tr>
<tr>
<td>Serum Creatinine mg/dl</td>
<td>1.25 ± 0.06</td>
<td>1.20 ± 0.08*</td>
<td>1.60 ± 0.17 NS</td>
<td>1.75 ± 0.15*</td>
<td>1.45 ± 0.09 NS</td>
</tr>
<tr>
<td>Total Cholesterol mg/dl</td>
<td>147.06 ± 0.82</td>
<td>38.75 ± 0.46***</td>
<td>88.95 ± 1.42***</td>
<td>60.45 ± 1.42***</td>
<td>75.75 ± 1.06***</td>
</tr>
<tr>
<td>Serum Triglycerides mg/dl</td>
<td>19.99 ± 0.15</td>
<td>45.25 ± 0.46***</td>
<td>88.15 ± 1.65***</td>
<td>38.20 ± 1.05***</td>
<td>87.90 ± 4.70***</td>
</tr>
<tr>
<td>Serum Uric Acid mg/dl</td>
<td>1.0 ± 0.02</td>
<td>4.85 ± 0.15***</td>
<td>4.70 ± 0.30***</td>
<td>2.95 ± 0.99***</td>
<td>3.40 ± 0.22***</td>
</tr>
<tr>
<td>Serum Pottasium mmol/l</td>
<td>13.83 ± 0.18</td>
<td>10.75 ± 0.37 NS</td>
<td>12.70 ± 0.33**</td>
<td>11.40 ± 0.29***</td>
<td>11.10 ± 0.20***</td>
</tr>
<tr>
<td>Alkaline Phosphate IU/L</td>
<td>45.0 ± 0.16</td>
<td>34.30 ± 0.39***</td>
<td>56.95 ± 0.19***</td>
<td>54.85 ± 1.05***</td>
<td>51.17 ± 0.23***</td>
</tr>
<tr>
<td>SGPT U/L</td>
<td>21.62 ± 0.26</td>
<td>9.40 ± 0.16***</td>
<td>11.63 ± 0.15***</td>
<td>11.30 ± 0.22***</td>
<td>12.35 ± 0.15***</td>
</tr>
<tr>
<td>SGOT U/L</td>
<td>21.48 ± 0.38</td>
<td>11.80 ± 0.18***</td>
<td>13.33 ± 0.16***</td>
<td>14.82 ± 0.25***</td>
<td>14.25 ± 0.29***</td>
</tr>
</tbody>
</table>

* Each value is expressed as Mean, and Standard Error of six observations.

**Tukey method used:**

* P < 0.05, ** P < 0.01, *** P < 0.001

NS = No significant.
Table 9: Showing haematological parameters of the fish *Notopterus notopterus* exposed to Profenofos (Curacron) technical grade 50% EC under sub-lethal concentration.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>7 Days exposed</th>
<th>14 Days exposed</th>
<th>21 Days exposed</th>
<th>30 Days exposed</th>
<th>45 Days exposed</th>
<th>90 Days exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hb g/dl</td>
<td>13.37 ± 0.16</td>
<td>11.05 ± 0.19***</td>
<td>11.40 ± 0.28**</td>
<td>12.30 ± 0.13 NS</td>
<td>12.68 ± 0.13**</td>
<td>1.55 ± 0.15***</td>
<td>10.15 ± 0.17***</td>
</tr>
<tr>
<td>WBC millions/mm³</td>
<td>123.82 ± 8.43</td>
<td>137.65 ± 1.57 NS</td>
<td>160.90 ± 4.98 NS</td>
<td>166.05 ± 0.28***</td>
<td>198.10 ± 0.20***</td>
<td>193.85 ± 0.29***</td>
<td>164.10 ± 1.80*</td>
</tr>
<tr>
<td>RBC millions/mm³</td>
<td>2.27 ± 0.08</td>
<td>1.30 ± 0.05 NS</td>
<td>1.68 ± 0.10 NS</td>
<td>1.64 ± 0.004***</td>
<td>1.94 ± 0.05*</td>
<td>1.19 ± 0.01**</td>
<td>1.74 ± 0.004***</td>
</tr>
<tr>
<td>Blood Sugar mg/dl</td>
<td>23.39 ± 0.35</td>
<td>60.05 ± 1.76 NS</td>
<td>67.0 ± 4.99 NS</td>
<td>56.05 ± 0.20***</td>
<td>29.38 ± 0.17***</td>
<td>25.75 ± 0.27***</td>
<td>23.65 ± 0.27***</td>
</tr>
<tr>
<td>Blood Urea mg/dl</td>
<td>22.70 ± 0.22</td>
<td>28.75 ± 0.85***</td>
<td>29.35 ± 1.77**</td>
<td>20.95 ± 0.16***</td>
<td>40.29 ± 0.17***</td>
<td>32.25 ± 0.31 NS</td>
<td>23.15 ± 0.36***</td>
</tr>
<tr>
<td>Serum Creatinine mg/dl</td>
<td>1.05 ± 0.04</td>
<td>1.55 ± 0.15**</td>
<td>1.15 ± 0.10 NS</td>
<td>1.15 ± 0.05**</td>
<td>1.50 ± 0.03**</td>
<td>1.26 ± 0.04 NS</td>
<td>1.25 ± 0.09***</td>
</tr>
<tr>
<td>Total Cholesterol mg/dl</td>
<td>163.05 ± 0.67</td>
<td>47.80 ± 0.26***</td>
<td>49.26 ± 1.62 NS</td>
<td>31.30 ± 0.16***</td>
<td>160.75 ± 0.27***</td>
<td>151.50 ± 0.38***</td>
<td>55.42 ± 0.19***</td>
</tr>
<tr>
<td>Serum Triglycerides mg/dl</td>
<td>32.88 ± 0.22</td>
<td>35.15 ± 1.04***</td>
<td>49.50 ± 2.46*</td>
<td>66.35 ± 0.20***</td>
<td>39.14 ± 0.16***</td>
<td>33.23 ± 0.19 NS</td>
<td>100.65 ± 0.27***</td>
</tr>
<tr>
<td>Serum Uric Acid mg/dl</td>
<td>0.87 ± 0.04</td>
<td>3.80 ± 0.15 NS</td>
<td>4.10 ± 0.22 NS</td>
<td>3.35 ± 0.07***</td>
<td>0.96 ± 0.03***</td>
<td>0.81 ± 0.07***</td>
<td>0.75 ± 0.04 NS</td>
</tr>
<tr>
<td>Serum Pottasium mmol/l</td>
<td>10.05 ± 0.10</td>
<td>11.35 ± 0.14 **</td>
<td>11.15 ± 0.25***</td>
<td>12.55 ± 0.12 NS</td>
<td>14.32 ± 0.07***</td>
<td>10.60 ± 0.15***</td>
<td>10.65 ± 0.14**</td>
</tr>
<tr>
<td>Alkaline Phosphate IU/L</td>
<td>73.15 ± 2.12</td>
<td>62.75 ± 0.89***</td>
<td>33.90 ± 0.37***</td>
<td>29.65 ± 0.22**</td>
<td>44.63 ± 0.14***</td>
<td>39.75 ± 0.16***</td>
<td>84.30 ± 0.19***</td>
</tr>
<tr>
<td>SGPT U/L</td>
<td>30.44 ± 0.48</td>
<td>14.45 ± 0.17***</td>
<td>14.05 ± 0.37***</td>
<td>12.60 ± 0.18***</td>
<td>41.15 ± 0.14***</td>
<td>36.25 ± 0.20***</td>
<td>44.44 ± 0.15***</td>
</tr>
<tr>
<td>SGOT U/L</td>
<td>41.00 ± 0.30</td>
<td>18.85 ± 0.19***</td>
<td>17.75 ± 0.14***</td>
<td>14.60 ± 0.19***</td>
<td>37.48 ± 0.15***</td>
<td>31.25 ± 0.20***</td>
<td>56.54 ± 0.15***</td>
</tr>
</tbody>
</table>

* Each value is expressed as Mean, and Standard Error of six observations.

**Tukey method used:**

* = P < 0.05, ** = P < 0.01, *** = P < 0.001

NS = No significant.
Table—10: Showing haematological parameters of reproductive phase of the Male fish *Notopterus notopterus* exposed to Profenofos (Curacron) technical grade 50% EC under sub-lethal concentration.

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Preparatory phase exposed</th>
<th>Prespawning phase exposed</th>
<th>Spawning phase exposed</th>
<th>Postspawning phase exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hb g/dl</td>
<td>13.10 ± 0.10</td>
<td>10.64 ± 0.15**</td>
<td>11.10 ± 0.14***</td>
<td>10.95 ± 0.23***</td>
<td>12.00 ± 0.14 NS</td>
</tr>
<tr>
<td>WBC millions/mm³</td>
<td>141.68 ± 0.46</td>
<td>169.99 ± 0.28***</td>
<td>290.75 ± 0.48***</td>
<td>309.35 ± 1.12***</td>
<td>122.75 ± 0.26***</td>
</tr>
<tr>
<td>RBC millions/mm³</td>
<td>2.34 ± 0.004</td>
<td>1.35 ± 0.004***</td>
<td>1.79 ± 0.004***</td>
<td>1.09 ± 0.01***</td>
<td>1.83 ± 0.004 NS</td>
</tr>
<tr>
<td>Blood Sugar mg/dl</td>
<td>61.95 ± 0.27</td>
<td>46.45 ± 0.26***</td>
<td>34.29 ± 0.18***</td>
<td>45.95 ± 0.25***</td>
<td>65.25 ± 0.27***</td>
</tr>
<tr>
<td>Blood Urea mg/dl</td>
<td>36.90 ± 0.22</td>
<td>33.01 ± 0.22***</td>
<td>49.30 ± 0.33***</td>
<td>26.95 ± 0.25***</td>
<td>22.05 ± 0.19***</td>
</tr>
<tr>
<td>Serum Creatinine mg/dl</td>
<td>0.90 ± 0.04</td>
<td>1.00 ± 0.02**</td>
<td>1.40 ± 0.04**</td>
<td>1.50 ± 0.04**</td>
<td>1.10 ± 0.04**</td>
</tr>
<tr>
<td>Total Cholesterol mg/dl</td>
<td>45.74 ± 0.27</td>
<td>52.30 ± 0.22***</td>
<td>63.75 ± 0.42***</td>
<td>175.25 ± 0.26***</td>
<td>46.15 ± 0.18***</td>
</tr>
<tr>
<td>Serum Triglycerides mg/dl</td>
<td>40.05 ± 0.24</td>
<td>44.40 ± 0.21***</td>
<td>96.20 ± 0.17***</td>
<td>97.20 ± 0.22***</td>
<td>55.25 ± 0.19***</td>
</tr>
<tr>
<td>Serum Uric Acid mg/dl</td>
<td>1.90 ± 0.04</td>
<td>3.15 ± 0.06***</td>
<td>0.25 ± 0.02**</td>
<td>2.10 ± 0.04**</td>
<td>4.50 ± 0.08***</td>
</tr>
<tr>
<td>Serum Pottasium mmol/l</td>
<td>10.05 ± 0.10</td>
<td>10.62 ± 0.14***</td>
<td>13.45 ± 0.12 NS</td>
<td>15.95 ± 0.11***</td>
<td>11.63 ± 0.13***</td>
</tr>
<tr>
<td>Alkaline Phosphate IU/L</td>
<td>59.10 ± 0.22</td>
<td>35.33 ± 0.16***</td>
<td>62.95 ± 0.24***</td>
<td>77.70 ± 0.26***</td>
<td>33.95 ± 0.19***</td>
</tr>
<tr>
<td>SGPT U/L</td>
<td>13.15 ± 0.12</td>
<td>12.25 ± 0.22***</td>
<td>62.63 ± 0.23***</td>
<td>24.90 ± 0.25***</td>
<td>14.88 ± 0.13***</td>
</tr>
<tr>
<td>SGOT U/L</td>
<td>16.17 ± 0.15</td>
<td>15.30 ± 0.22***</td>
<td>51.47 ± 0.23***</td>
<td>44.70 ± 0.23***</td>
<td>18.87 ± 0.15***</td>
</tr>
</tbody>
</table>

* Each value is expressed as Mean, and Standard Error of six observations.

Tukey method used:

* = P < 0.05,  ** = P < 0.01,  *** = P < 0.001

NS = No significant.
### Table 11: Showing haematological parameters of reproductive phase of the Female fish *Notopterus notopterus* exposed to Profenofos (Curacron) technical grade 50% EC under sub-lethal concentration.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Control</th>
<th>Preparatory phase exposed</th>
<th>Prespawning phase exposed</th>
<th>Spawning phase exposed</th>
<th>Postspawning phase exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hb g/dl</strong></td>
<td>12.40 ± 0.17</td>
<td>10.64 ± 0.15**</td>
<td>11.15 ± 0.20***</td>
<td>10.95 ± 0.23***</td>
<td>11.10 ± 0.29** NS</td>
</tr>
<tr>
<td><strong>WBC millions/mm³</strong></td>
<td>140.50 ± 2.32</td>
<td>170.44 ± 0.90***</td>
<td>291.95 ± 3.26***</td>
<td>310.35 ± 2.20***</td>
<td>149.00 ± 6.01 NS</td>
</tr>
<tr>
<td><strong>RBC millions/mm³</strong></td>
<td>184.35 ± 0.24</td>
<td>135.39 ± 0.82***</td>
<td>1.325 ± 0.03***</td>
<td>1.09 ± 0.02***</td>
<td>183.40 ± 283.31**</td>
</tr>
<tr>
<td><strong>Blood Sugar mg/dl</strong></td>
<td>61.95 ± 0.37</td>
<td>46.45 ± 17.46***</td>
<td>34.615 ± 0.24***</td>
<td>45.00 ± 1.11***</td>
<td>57.50 ± 2.46***</td>
</tr>
<tr>
<td><strong>Blood Urea mg/dl</strong></td>
<td>37.15 ± 0.22</td>
<td>33.01 ± 0.22***</td>
<td>49.45 ± 0.34***</td>
<td>26.85 ± 0.47***</td>
<td>22.25 ± 0.52***</td>
</tr>
<tr>
<td><strong>Serum Creatinine mg/dl</strong></td>
<td>1.25 ± 0.06</td>
<td>1.05 ± 0.04***</td>
<td>1.4 ± 0.04***</td>
<td>1.50 ± 0.04***</td>
<td>1.15 ± 0.09 NS</td>
</tr>
<tr>
<td><strong>Total Cholesterol mg/dl</strong></td>
<td>128.95 ± 2.03</td>
<td>52.15 ± 0.41***</td>
<td>63.85 ± 0.32***</td>
<td>172.25 ± 1.90***</td>
<td>46.00 ± 0.30***</td>
</tr>
<tr>
<td><strong>Serum Triglycerides mg/dl</strong></td>
<td>40.05 ± 0.24</td>
<td>44.25 ± 0.20***</td>
<td>94.6 ± 1.10***</td>
<td>94.70 ± 1.29***</td>
<td>53.89 ± 1.05***</td>
</tr>
<tr>
<td><strong>Serum Uric Acid mg/dl</strong></td>
<td>1.85 ± 0.07</td>
<td>3.2 ± 0.09***</td>
<td>2.05 ± 0.02**</td>
<td>2.10 ± 0.04*</td>
<td>4.55 ± 0.08***</td>
</tr>
<tr>
<td><strong>Serum Pottasium mmol/l</strong></td>
<td>10.05 ± 0.26</td>
<td>10.59 ± 0.14***</td>
<td>13.45 ± 0.12 NS</td>
<td>15.95 ± 0.11***</td>
<td>11.74 ± 0.08***</td>
</tr>
<tr>
<td><strong>Alkaline Phosphate IU/L</strong></td>
<td>31.29 ± 0.40</td>
<td>35.01 ± 0.16***</td>
<td>62.6 ± 0.57***</td>
<td>77.25 ± 1.36***</td>
<td>34.25 ± 0.19***</td>
</tr>
<tr>
<td><strong>SGPT U/L</strong></td>
<td>13.20 ± 0.10</td>
<td>12.0 ± 0.20***</td>
<td>62.22 ± 0.15***</td>
<td>34.40 ± 0.32***</td>
<td>15.10 ± 0.11***</td>
</tr>
<tr>
<td><strong>SGOT U/L</strong></td>
<td>16.25 ± 0.16</td>
<td>15.55 ± 0.21***</td>
<td>51.4 ± 0.36***</td>
<td>44.75 ± 0.50***</td>
<td>18.99 ± 0.09***</td>
</tr>
</tbody>
</table>

* Each value is expressed as Mean, and Standard Error of six observations.

**Tukey method used:**

* =  P < 0.05,  ** =  P < 0.01,  *** =  P < 0.001

NS = No significant.
Fig. 1: Determination of LC\textsubscript{50} by Straight Line Graphical Interpolation
Fig. 49: Showing Protein Content in Gonad of the Male Fish *N. notopterus* during different Reproductive Phase under Sub-lethal Concentration of Profenofos (Curacron)

![Bar Chart showing Protein Content](image)

Fig. 50: Showing Cholesterol Content in Gonad of the Male Fish *N. notopterus* during different Reproductive Phase under Sub-lethal Concentration of Profenofos

![Bar Chart showing Cholesterol Content](image)
Fig. 51: Showing Glucose Content in Gonad of the Male Fish *N. notopterus* during different Reproductive Phase under Sub-lethal Concentration of Profenofos

![Glucose Content Chart](chart1.png)

Fig. 52: Showing DNA Content in Gonad of the Male Fish *N. notopterus* during different Reproductive Phase under Sub-lethal Concentration of Profenofos

![DNA Content Chart](chart2.png)
Fig. 53: Showing Protein Content in Gonad of the Female Fish *N. notopterus* during different Reproductive Phase under Sub-lethal Concentration of Profenofos

![Protein Content Graph]

Fig. 54: Showing Cholesterol Content in Gonad of the Female Fish *N. notopterus* during different Reproductive Phase under Sub-lethal Concentration of Profenofos

![Cholesterol Content Graph]
Fig. 55: Showing Glucose Content in Gonad of the Female Fish *N. notopterus* during different Reproductive Phase under Sub-lethal Concentration of Profenofos

![Glucose Content Graph](image)

Fig. 56: Showing DNA Content in Gonad of the Female Fish *N. notopterus* during different Reproductive Phase under Sub-lethal Concentration of Profenofos

![DNA Content Graph](image)
Fig. 57: Showing Biochemical Contents in Gonads of the Fish *N. notopterus* during 24 Hours Exposure under Lethal and Sub-lethal Concentration of Profenofos

![Graph showing biochemical contents in gonads of N. notopterus during 24 hours exposure under lethal and sub-lethal concentration of Profenofos.](image1)

Fig. 58: Showing Biochemical Contents in Gonads of the Fish *N. notopterus* during 96 Hours Exposure under Lethal and Sub-lethal Concentration of Profenofos

![Graph showing biochemical contents in gonads of N. notopterus during 96 hours exposure under lethal and sub-lethal concentration of Profenofos.](image2)
Fig. 59: Showing Protein Content in Gonads of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos

![Bar chart showing protein content](chart1.png)

Fig. 60: Showing Cholesterol Content in Gonads of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos

![Bar chart showing cholesterol content](chart2.png)
Fig. 61: Showing Glucose Content in Gonads of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos

![Graph showing Glucose Content in Gonads](image)

Fig. 62: Showing DNA Content in Gonads of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos

![Graph showing DNA Content in Gonads](image)
Fig. 63: Showing Biochemical Contents in Kidney of the Fish *N. notopterus* during 24 Hours Exposure under Lethal and Sub-lethal Concentration of Profenofos

![Bar chart showing biochemical contents in kidney of N. notopterus during 24 hours exposure under lethal and sub-lethal concentration of Profenofos.](chart1)

Fig. 64: Showing Biochemical Contents in Kidney of the Fish *N. notopterus* during 96 Hours Exposure under Lethal and Sub-lethal Concentration of Profenofos

![Bar chart showing biochemical contents in kidney of N. notopterus during 96 hours exposure under lethal and sub-lethal concentration of Profenofos.](chart2)
Fig. 65: Showing Protein Content in Kidney of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos

![Graph showing protein content over days of exposure.](image)

Fig. 66: Showing Cholesterol Content in Kidney of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos

![Graph showing cholesterol content over days of exposure.](image)
Fig. 67: Showing Glucose Content in Kidney of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos

![Graph showing glucose content in kidney of the fish](image)

- X-axis: Days of Exposure
- Y-axis: Glucose Content in Kidney (mg/g)
- Control vs Expose

Fig. 68: Showing DNA Content in Kidney of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos

![Graph showing DNA content in kidney of the fish](image)

- X-axis: Days of Exposure
- Y-axis: DNA Content in Kidney (mg/g)
- Control vs Expose
Fig. 69: Showing Haematological Parameters of the Fish \textit{N. notopterus} during 24 Hours Exposure under Lethal and Sub-lethal Concentrations of Profenofos

![Graph showing haematological parameters for 24 hours exposure under lethal and sub-lethal concentrations of Profenofos.]

Fig. 70: Showing Haematological Parameters of the Fish \textit{N. notopterus} during 96 Hours Exposure under Lethal and Sub-lethal Concentrations of Profenofos

![Graph showing haematological parameters for 96 hours exposure under lethal and sub-lethal concentrations of Profenofos.]

Fig. 71: Showing Haemoglobin content of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).

![Graph showing Haemoglobin content of *N. notopterus*](image)

Fig. 72: Showing WBC content of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).

![Graph showing WBC content of *N. notopterus*](image)
Fig. 73: Showing RBC content of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).

![Graph showing RBC content](image)

Fig. 74: Showing Blood sugar content of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).

![Graph showing Blood sugar content](image)
Fig. 75: Showing Serum urea content of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).

Fig. 76: Showing Serum creatinine of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).
Fig. 77: Showing Serum cholesterol content of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).

Fig. 78: Showing Serum triglycerides of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).
Fig. 79: Showing Serum Uric acid of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).

![Graph showing Serum Uric acid levels of *N. notopterus* over time with control and exposed groups.]

Fig. 80: Showing Serum Potassium of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).

![Graph showing Serum Potassium levels of *N. notopterus* over time with control and exposed groups.]

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Legend:
- **Control**
- **Exposed**
Fig. 81: Showing Alkaline phosphate of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).

Fig. 82: Showing SGPT of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).
Fig. 83: Showing SGOT of the Fish *N. notopterus* during Chronic Exposure under Sub-lethal Concentration of Profenofos (Curacron).

Fig. 84: Showing Haematological Parameters of the Male Fish *N. notopterus* during Preparatory phase Exposure under Sub-lethal Concentration of Profenofos
Fig. 85: Showing Haematological Parameters of the Male Fish *N. notopterus* during Prespawning phase Exposure under Sub-lethal Concentration of Profenofos

![Graph showing haematological parameters during prespawning phase exposure](image)

Fig. 86: Showing Haematological Parameters of the Male Fish *N. notopterus* during Spawning phase exposure under sub-lethal concentration of profenofos

![Graph showing haematological parameters during spawning phase exposure](image)
Fig. 87: Showing Haematological Parameters of the Male Fish *N. notopterus* during Post spawning phase Exposure under Sub-lethal Concentration of Profenofos

![Graph showing haematological parameters of male fish](image)

Fig. 88: Showing Haematological Parameters of the Female Fish *N. notopterus* during Preparatory phase Exposure under Sub-lethal Concentration of Profenofos

![Graph showing haematological parameters of female fish](image)
Fig. 89: Showing Haematological Parameters of the Female Fish *N. notopterus* during Prespawning phase Exposure under Sub-lethal Concentration of Profenofos

Fig. 90: Showing Haematological Parameters of the Female Fish *N. notopterus* during Spawning phase Exposure under Sub-lethal Concentration of Profenofos
Fig. 91: Showing Haematological Parameters of the Female Fish *N. notopterus* during Post spawning phase Exposure under Sub-lethal Concentration of Profenofos