5. SUMMARY and CONCLUSION
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The increasing awareness of the environmental problems during the last two decades kindled much interest on the environmental fate and behaviour of the Xenobiotic chemicals. This is evident from the fact during last twenty years or so, almost all international journals have been launched to focus attention on environmental problems. Environmental disasters like collapse of different fisheries, man's mortality of fish are number of live stock death and harmful effects on human skin in the form of malignant patches on skin (April/May 1991 from Thane-Bombay) of fisherman, clearly established the toxicity of pesticides to man and aquatic organisms. Further, the realisation that the aquatic environment is the ultimate sink for all pollutants stimulated studies on the toxicity of man made chemicals to the aquatic organisms, especially pesticides toxicity to snail, *B. bengalensis F. typica*. Much of the information on Toxicity of pesticide to fish is available in large number, however very less attempts have been made on aquatic invertebrates particularly animal like gastropod, molluscs, etc.

The purpose of the present study is to evaluate the toxicity of pesticide on different aspects in the freshwater snail, *B. bengalensis F. typica* (Lamark) Comparative Toxicity was studied of six pesticides, two organochlorine (aldrin, chlordane) and three organophosphate (rogor, dimecron, nuvacron) and a fungicide (thiram). The static bioassay method revealed that aldrin was the most Toxic insecticides amongst all the pollutants used and within the organochlorine group, from organophosphate group (tested) rogor was found to be most toxic. The fungicide, thiram was found to be least toxic.
Exposure to different concentration of aldrin showed the following trend:
At 24 hours treatment, the 25, 50, 75 and 90 percent mortality values were 0.0018, 0.0044, 0.011 and 0.0237 ml/l respectively.
At 48 hours exposure, the 25, 50, 75 and 90 percent mortality values were 0.0015, 0.0036, 0.0091 and 0.0209 ml/l respectively.
During 72 hours of treatment the values were 0.0014, 0.0031, 0.0067 and 0.0137 ml/l for 25%, 50%, 75% and 90% respectively.
The treatment for 96 hours indicated following trend:
0.0010, 0.0020, 0.0041 and 0.0078 ml/l values for 25, 50, 75 and 90% mortality respectively. Correlation coefficient values were 0.9556, 0.8465, 0.9341 and 0.9450 for 24, 48, 72 and 96 hours of exposure period respectively.

The probit analysis calculation for aldrin exhibited clearly that LC value decreased along the increase in exposure period and increase in mortality was directly proportional to the LC value for all hours of exposure.

Exposure to different concentration of chlordane showed the following trends:
25% mortality at 0.1120 ml/l, 50% mortality at 0.2765 ml/l, 75% mortality at 0.6222 ml/l and 90% mortality was at 1.2911 ml/l for 24 hours of exposure period. For 48 hours of treatment 25% mortality at 0.0636 ml/l, 50% at 0.1618 ml/l, 75% at 0.5191 ml/l and 90 percent mortality was at 1.3351 ml/l.

In 72 hours of exposure the values were 0.0629, 0.1103, 0.2494 and 0.4635 ml/l for 25%, 50%, 75% and 90% mortality respectively.

The regression equation and correlation coefficient ($r^2$) for chlordane pesticide were 0.9192, 0.9753, 0.9799 and 0.8958 for 24, 48, 72 and 96 hours of treatment period.

The probit analysis table for chlordane pesticide
showed that LC values progressively decreased along the increase in exposure period. Increase in mortality was accompanied with increase in LC values for all treatment hours.

Exposure to different concentration of rogor showed the following trends:

25% mortality for 24, 48, 72 and 96 hours of treatment period were 0.2912, 0.1809, 0.1030 and 0.0925 ml/l respectively.

50% mortality for 24, 48, 72 and 96 hours of treatment period were 0.3449, 0.2954, 0.1740 and 0.1219 ml/l respectively.

75% mortality values were 0.3928, 0.3018, 0.2328 and 0.1810 for 24, 48, 72 and 96 hours of treatment period respectively. 96% mortality values were 0.4514 for 24h, 0.3816 for 48h, 0.3137 for 72h and 0.2324 ml/l for 96h of exposure period.

The probit analysis calculation for rogor, an organophosphate indicated clearly that LC value decreased along the increase in exposure period and increase in mortality was directly proportional to the LC value for all hours of exposure.

Different concentration of dimecron showed changes in mortality as:

25% mortality at 96 hours of treatment period was 0.7770 ml/l

50% at 96 hours was 0.1522 ml/l, 75% at 96 hours 0.3162 and 90% mortality at 96 hours treatment hours were 0.5132 ml/l.

The probit analysis table for dimecron pesticide showed that LC value progressively decreased along the increase in exposure period. Increase in mortality was accompanied with increase in LC value for all hours of treatment.

The probit analysis calculation for nuvacron indicated clearly that LC value decreased along the increase in exposure period interval from 24 to 96 hours and increase in
mortality was directly proportional to the LC values for all hours of exposure.

The thiram probit analysis showed that LC values progressively decreased along the increase in exposure period and increase in mortality was accompanied with increase in LC value for all hours of treatment.

The present work is mainly devoted to an overview of the fundamental responses of organism, \textit{B. bengalensis F. typica} with environmental parameters interaction. The word "Environment" has a broad enough meaning to encompass factors in the intracellular, the extracellular and traorganismic milieu. A primary goal of this project is to investigate the interaction effects of environmental factors stress along the Environmental pollutants on organism.

The thermal stress is an unavoidable and obligatory condition for the existence of any organism. The structural and functional effect of environmental temperature on the biological organism have been summarised excellently by Hochachk and Somero (1979). In the majority of organism which are poikiotherms and confirm their internal temperature to the environmental temperature; the rate of biological function should ideally fluctuate with alternation of temperature of the surrounding. Apparently such poikilothersms are at the mercy of nature and have to be restricted in their activity and ecological distribution to a narrow thermal zone of habitat.

Organochlorine pesticide toxicity in combination with environmental factor (Temperature and pH) was evaluated. These studies were mainly performed to observe the combination effect on toxicity in the snail \textit{B. bengalensis F. typica}. The lethal values of LC 50 of aldrin for control group were 0.0044 ml/l, 0.0036 ml/l, 0.0031 ml/l and 0.0020 ml/l
for 24, 48, 72 and 96 hours of exposure period respectively and that at high temperature (38°C) lethal values of LC50 for aldrin were 0.0037, 0.0029, 0.0017 and 0.0010 ml/l for 24, 48, 72 and 96h. At low temperature the values were 0.0053, 0.0042, 0.0031 and 0.0021 ml/l for 24, 48, 72 and 96 hours exposure. It showed that the change in temperature changed the rate of mortality or toxicity of the pesticide to the animal.

In acidic medium, LC50 values for aldrin exposed snail B. bengalensis F. typica were 0.0041, 0.0036, 0.0029 and 0.0019 ml/l for 24 to 96 hours of exposure respectively. The lethal values of LC50 for aldrin exposed snail in alkaline (pH9) medium were 0.0041, 0.0040, 0.0030 and 0.0022 ml/l for 24 to 96 hours of treatment period respectively.

To summarise the effect of temperature and pH combination on the toxicity, suggested that the snail became very sensitive to pesticide and alkaline medium had less effect.

Exposure of the snail B. bengalensis F. typica to chlordane, the LC50 for control groups at 24, 48, 72 and 96 hours of treatment period were 0.3449, 0.2595, 0.1740 and 0.1219 respectively and at high temperatures, the lethal values of LC50 were 0.2928, 0.2013, 0.1316 and 0.0998 ml/l for 24, 48, 72 and 96 hours of exposure and at low temperature the LC50 values were 0.3643, 0.2748, 0.1936 and 0.1465 ml/l at 24, 48, 72 and 96 hours of exposure respectively.

The LC50 values at acidic medium at 24, 48, 72 and 96 hours exposure were 0.3018, 0.2316, 0.1564 and 0.1054 ml/l and alkaline medium were 0.3538, 0.2685, 0.1894 and 0.1345 ml/l respectively.

To summarise the effect of temperature and pH combination on the toxicity suggested that the snail became
very sensitive to pesticide chlordane in acidic medium and at high temperature and with low temperature and an alkaline medium had less effect.

Exposure of the snail *B. bengalensis F. typica* to rogor (organophosphate insecticide) shows the LC50 for control group were 0.2765 ml/l for 24h, 0.1818 ml/l for 48h, 0.1163 ml/l for 72h and 0.1049 ml/l for 96 hours of exposure period and that LC50 values at 24, 48, 72 and 96 hours exposure were 0.1986, 0.1006, 0.886 and 0.6843 ml/l for high temperature and 0.2896, 0.2078, 0.1299 and 0.1448 ml/l for low temperature respectively.

The LC50 values also showed the fluctuation or change when the test medium were acidic and basic. In acidic medium the LC50 values were 0.2083, 0.2010, 0.1012 and 0.9860 for 24, 48, 72 and 96 hours exposure respectively and in alkaline medium the LC50 values for 24, 48, 72 and 96 hours exposure were 0.2816, 0.197, 0.1253 and 0.1136 ml/l respectively. These values suggested that the snail became very sensitive to pesticide rogor in high temperature and acidic medium whereas at low temperature and alkaline medium had less effective.

In case of the nucracron the LC50 values for control group were 0.3610, 0.3610, 0.3133, 2.450 and 0.1552 ml/l for 24, 48, 72 and 96 hours of exposure time period. These values showed the changes when the animal exposed to the different environmental parameters like temperature and pH.

At high temperature (38°C), the lethal values of LC50 for dimecron were 0.3401, 0.1890, 0.1590 and 0.0828 ml/l for 24, 48, 72 and 96 hour of exposure.

At low temperature the LC50 values for dimecron exposed snail were 0.0485, 0.3893, 0.3340 and 0.1853 ml/l for 24, 48, 72 and 96 hour of exposure period respectively.
With different pH medium LC 50 values for dimecron exposed snail for 24, 48, 72 and 96 hours of exposure period were 0.3921, 0.2894, 0.2299 and 0.1548 ml/l respectively for acidic medium and 0.3970, 0.3880, 0.2879 and 0.1684 ml/l respectively for alkaline medium. These values suggested that the snail became very sensitive to pesticide dimecron at high temperature and acidic medium; Low temperature and alkaline medium had less effects.

Exposure of the snail B. bengalensis F. typica to nuvacron in combination with different environmental parameters like temperature and pH showed the following trends:

The lethal values of LC 50 for control group were 0.5657 ml/l for 24h, 0.4153 ml/l for 48h, 0.3489 ml/l for 72h and 0.2637 ml/l for 96 hours of exposure period.

The LC 50 values for nuvacron exposed snail at high temperature at (38°C) were 0.5201, 0.3716, 0.3146 and 0.2501 ml/l for 24, 48, 72 and 96 hours of treatment time interval respectively.

The LC 50 values for nuvacron exposed snail at low temperature at (25°C) were 0.5732 ml/l for 24h, 0.4286 ml/l for 48h, 0.3506 ml/l for 72h and 0.2686 ml/l for 96 hours exposures.

In different pH medium LC 50 values for nuvacron exposed snail for 24, 48, 72 and 96 hours of treatment period were 0.5548, 0.4108, 0.3391 and 0.2591 ml/l for acidic (pH4) medium and 0.5696, 0.4216, 0.3495 and 0.2664 ml/l for alkaline (pH5) medium respectively.

To summarise the effect of temperature and pH combination on the toxicity, suggested that the snail became very sensitive to pesticide nuvacron in high temperature and acidic medium where on low temperature and alkaline medium
had less effect.

Exposure of the snail *B. bengalensis F. typica* to thiram in combination with different temperature and pH showed the following results:

The LC 50 values for control group were 7.094, 6.983, 5.6170 and 3.8104 ml/l for 24, 48, 72 and 96 hours of exposure period respectively.

The lethal values of LC 50 for thiram exposed snail at high temperature at (38°C) were 4.0283 ml/l for 24h, 4.0445 ml/l for 48h, 3.2189 ml/l for 72h and 2.180 ml/l for 96 hours of exposure period.

The LC 50 values for thiram exposed snail at low temperature at 25°C were 9.445, 8.225, 8.892 and 6.321 ml/l for 24, 48, 72 and 96 hours of treatment period respectively.

With acidic medium (pH4) LC 50 values for thiram exposed snail for 24, 48, 72 and 96 hours of treatment period were 6.8628, 5.3189, 4.822 and 3.999 ml/l respectively.

The lethal values for LC 50 for thiram exposed snail *B. bengalensis F. typica* in alkaline (pH9) medium were 8.6956 ml/l for 24h, 7.879 ml/l for 48h, 7.022 ml/l for 72h and 4.016 ml/l for 96 hours treatment period.

To summarise the effect of pesticide with environmental parameter the LC 50 values suggested that the snail became very sensitive to pesticide to high temperature and acidic medium and had less sensitive to pesticide in low temperature and alkaline medium.

Respiratory metabolism in the snail *B. bengalensis F. typica* had been observed under two heads i.e. exploratory oxygen consumption for three LC 50 concentration of each selected pesticide and one concentration of two temperature and one low 25°C and high 38°C and two pH (acidic & basic).
In the freshwater snail *B. bengalensis F. typica* exposed to organochlorine aldrin with 48hr LC 50 concentration the oxygen consumption decreased by -6.578% at low temperature and increased by 17.105% at high temperature. At 72h LC 50 oxygen consumption decreased by -9.859% at low temperature and increased to about 21.120% at high temperature. At 96h LC 50 oxygen consumption decreased by -9.090% at low temperature and increased by 18.181% at high temperature.

In chlordane treated snail the oxygen consumption decreased by -6.849, -7.462 and -4.918% for 48, 72 and 96 hours at low temperature respectively and it increased for 48, 72 and 96 hours at high temperature by 12.328, 13.432 and 19.672% respectively.

With (organophosphate), rogor exposed snail, the oxygen consumption decreased at low temperature by -2.614, -3.846 and -4.054 at 48, 72 and 96 hours respectively and increased at 48, 72 and 96 hours by 6.024, 3.846 and 4.054 at high temperature respectively.

In democron exposed snail, the decreased value of oxygen consumption was -11.764% at low temperature and high temperature it increased to 16.176% at 48h, LC 50 value. In the 72h LC50 value the oxygen consumption decreased to -9.375% at low temperature and increased to 14.062% at high temperature. The oxygen consumption was -5.263% less at low temperature and at high temperature it was 21.053% more than that of normal temperature at 96 hours of LC 50 values.

In nuvacron treated snail the oxygen consumption decreased by -21.142, -21.875 and -21.666% at low temperature and increased at high temperature by 12.857, 17.187 and 18.33% at 48, 72 and 96 hours LC 50 values of medium concentration respectively.
With fungicide thiram exposed snail, the oxygen consumption at 48h, 72h and 96 hours LC 50 values decreased to -25%, -21.202% and -21.621% at low temperature and increased to 4.761%, 5.405% and 5.40% at high temperature respectively.

The LC 50 values also shown marked increased at both acidic and alkaline medium. The oxygen consumption increased by 4.819%, 7.894% and 6.849% at pH 4 and at pH 9 it increased to 3.614%, 6.024% and 4.545% along 48h, 72h and 96h LC 50 value of medium concentration respectively, in aldrin treated snails.

In chlordane treated snail the oxygen consumption increased in acidic medium (pH 4) at 48h, 72h and 96h LC 50 to 10.606, 11.290 and 10.344% and in alkaline medium to 4.545, 1.612 and 1.724% respectively.

In (organophosphate) rogor with acidic medium, the oxygen increased to 5.405, 5.797 and 6.451 and in alkaline medium it also increased to 4.054, 2.896 and 4.838% respectively according to 48h, 72h and 96h LC50 values of concentration respectively.

In nuvacron treated snail the oxygen consumption was increased by 15.254%, 16.363% and 25.925% in acidic (pH 4) and it increased to 6.779, 6.779 and 3.703% in alkaline medium at 48h, 72h and 96h LC 50 values of medium concentration respectively. In fungicide thiram exposed snail, at 48h, 72h and 96h LC 50 values the oxygen consumption increased to 8.571, 6.060 and 16.363% in acidic medium and 4.285, 3.030 and 7.272% in alkaline medium respectively. Oxygen consumption of the snail B. bengalensis F. typica was measured with 2/3 LC 50 96hours pesticide concentration with temperature and pH.

In aldrin exposed snail, oxygen consumption
progressively decreased to -40.740, -37.500, 30.952 and -20.00% at low temperature (25°C) and high temperature it increased to 40.740, 29.166, 26.190 and 11.428% along the exposure of hours 24, 48, 72 and 96 respectively.

With chlordane at 24, 48, 72 and 96 hours of exposure oxygen consumption decrease to -25, -20, -10.909 and -9.303% at low temperature and increased by 30.555, 23.333, 20.00 and 4.651% at high temperature respectively.

The organophosphate rogor exposed snail, showed decreased the oxygen consumption by -9.523, -3.125, -6.666 and -3.571 percent at low temperature along 24, 48, 72 and 96 hours of exposure respectively. But at high temperature with 24 hours of exposure there was no change in oxygen consumption though it increased at later hours of treatment.

In demecron exposed snail, the oxygen consumption decreased by -12.500, -13.207, -15.709 and -8.571% at 24h, 48, 72 and 96 hours at low temperature and at high temperature it increased to 22.562, 22.641, 13.636 and 11.428% respectively.

With nuvacron treated snail there was much decrease in oxygen consumption at low temperature but at high temperature the oxygen consumption was increased much at early hours (24h) of exposure. This increase in oxygen consumption progressively become less according to the increased (48, 72 and 96 h) in exposure hours. In thiram exposed snail the oxygen consumption the decreased at low temperature and increased at high temperature the percent range was same on that of dimecron. The oxygen consumption of the snail was measured with 2/3 of LC 50 96 h pesticide concentration with pH showed in alkaline medium at 24, 48, 72 and 96 h of treatment period.
The hypothological result were observed in hepatopancreas gill, mantle and gonad after exposure to the different pollutants and it was observed that the effects induced by aldrin was more severe as compared to the effects induced by other tested pollutants in almost all tissues examined.

Histopathological changes in hepatopancreas showed various lesions after exposure of snail \textit{B. bengalensis F. typica} to the lethal concentration of six pesticides i.e. aldrin, chlordane, rogor, dimecron nuvacron and thiram the severity was highest in prescide aldrin and progressively decreased >aldrin > chlordane> rogor> thiram> dimecron> nuvacron.

In the hepatopancreas many histopathological changes were observed when the snails were exposed to lethal concentration as well as to different pH the changes were such as tubules showed hypertrophy, cells were denucleated, basement membrane showed degeneration, connective tissue ruptured, intertubular spaces formation, vacuolation in the cells of tubules. The severity of the pesticides tested progressively increased along with increase in exposure period. The action of pesticides is favoured by the both the acidic and alkaline medium; the action was very severe and destructive in acidic medium as compared to the alkaline medium.

The Snails were exposed to the lethal concentrations of six pollutants (aldrin, chlordane, rogor, dimecron, nuvacron and thiram). The observation on the gill histology suggested that the seventy was highest in pesticides aldrine and progressively decrease in remaining pesticides. The action of the pesticide on the histopathology of the gill was very
severe and destructive in acidic medium as compared to the alkaline medium. The gill shows the many histopathological changes such as the gill filament hyperpophied, the connective tissue cell vacuolated and ruptured; severe necrosis, swelling in the distal part of gill filaments, rupture in connective tissue. Since the gill comes in direct contact with the medium in which the pesticide is present.

The histopathological changes were observed in the mantle of the different pesticide exposed snail, the severity of the pesticide action of the different pesticide in various pH medium were same as that of the hepatopancreas and gills. The mantle shows the histopathological changes such as epithelial cells were swollen, epithelial cells broken, vacuolation in parenchyma, mantle epithelium becomes loose, eatile destroyed, parenchyma showed the extensive recrost with large spaces in connective tissue etc.

The histopathological changes were observed in the testis of the snail, *B. bengalensis F. typica* exposed to different pesticides and in various pH medium. The result showed the destructive action of pesticide that at early hours there was no change. In destructive action of pesticides tested showed progressive change from middle hours to late hours of treatment. Moreover, it was noted that the necrotic action of pesticides tested began from peripheral part of the vesicles of testis to their central part. The histopathological changes includes progressive destruction of spermatocyte to spermatozoa along with increase in exposure period.

The acidic (pH4) medium was favourable for the destructive action of pesticide tested. The testes which showed no changes with pesticide alone at early period was found to be under the bad effect of pesticide right from the
early hours and in late hours of exposure acidic pH, there was
necrosis of in capsules of testicular vesicles unlike that of
pesticide alone.

The action of alkaline medium was found to be different in
pesticide medium (pH 9) was stimulating spermatogenesis up to middle hours of treatment.

Only at late hours of exposure the pesticide in alkaline
medium showed necrotic changes on different stages of
dividing cells but the capsular wall remained intact in all
pesticides tested.

The severity of necrotic action of pesticides alone and
in combination with different pH media ranged from
aldrin > chlordane > rogor > dimecron > nuvacron.

The purpose of the present study was to investigate the
effect of pesticides on different aspects in the snail
Belonia bangalensis E. typica. Comparative toxicity was
studied of six pesticides - the two organochlorines (aldrine, chlordane), three organophosphates (rogor, dimecron, nuvacron) and a fungicide (thiram). Out of these three groups
organochlorine was the most toxic, followed by organophosphate and lastly thiram. The toxicity of aldrin was highest and it decreased progressively as aldrin > chlordane
> rogor > dimecron > nuvacron > thiram.

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