

CYFLUTHRIN TOXICANT STRESS ON THE OXYGEN CONSUMPTION IN THE FISH CATLA CATLA, A BIOMARKER STUDY

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ABSTRACT:

One of the synthetic pyrethroid, Cyfluthrin technical grade and 10% WP is selected for study the stress as impact on oxygen consumption in the fish Catla catla which is a biomarker study. The fish is exposed at lethal and sublethal concentrations ($1/10^{\text{th}}$ of 96 hrs LC₅₀ value) of both technical grade 2.2 µg/L and 0.22 µg/L respectively and for 10% WP 1.4 µg/L and 0.14 µg/L respectively. Due to the inhibition of the enzyme AChE, the respiratory stress leads to variations in the oxygen consumption, Of inspiration of respiration. Any change in the consumption of the gas leads to impairment of metabolism which is detrimental for growth. This is important in aquacultural practices because it will be having an impact on the venture of the culture. Hence, the levels of the concentrations are to be monitored and uncontaminated water only should be used as the medium of water for culture.

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INTRODUCTION :

The use of pest controlling chemicals, the pesticides is inevitable not only in developing countries but also in the developed countries. When such usage in there the ecological consequences imparted by them, sometimes indiscriminately are much worried when the global ecosystem is taken into consideration. According to Tudi et al (2021) the application is on a large scale to control-wise variety of pests damage that substantially reduced the agricultural yield. According to Sinha et al (2022), these spraying of different chemicals apart from significant and association which is inseparable due to advancement of agricultural operations as achievements in our country, like India. According to Devi et al (2017), our country is biggest in Asia, 12th in the world and occupies at 4th position for export,

production and consumption. Even Shefali et al (2021) reiterated the point that the urbanization as well as industrialization, made the loss of natural resources apart from several anthropogenic activities, all resulted an increase of the pollution. Among the pollutants, the toxicants caused not only death in acute concentration but even in chronic concentrations when present in the aquatic water bodies had an impact on the oxygen carrying capacity. Water is the ultimate sink for all pollutants/toxicants due to runoff to nearby aquatic bodies (lotic/leutic) and all the ambient organisms, had

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absorption/adsorption of the chemicals directly as a primary poisoning. In other aspect, Eating the pesticide contaminated prey, which is a secondary Poisoning also all had an impact on the fish, nektonic, poikilothermic organisms (Shefali et al 2021). Zeeshan and Parveen (2022), the agrochemicals that are sprayed left in the environment without any change and quantitatively it is about 90%. These with such long duration of persistence can cause deleterious effects on non-target organisms especially fish. Hence, they recommended certain biomarker studies of oxidative stress nature to monitor the pesticidal pollution. Pradip et al (2019) cautioned that pesticide sprayings are legally responsible for the contamination of downstream fish mortality resulted finally.

While the concentrations are not acute, the chronic levels pose the problem of fish inspiration and finally metabolisms, the growth is effected. Defilamented water when used the culture of the fish, the growth can be a hindrance and as such the very purpose of 'blue revolution' is a failure. Hence, the chronic levels are really lethal in the long run. According to Kaushlendra Kumar (2019), the very sensitive physiological process that got effected is none other than oxygen consumption and any modification of the respiratory activity is a biomarker study of stress. According to Prusty et al (2015), pyrethroids, the new generation class of compounds and can be also called, IV generation ones and they are highly effective in their use. They are more toxic to lower level vertebrates (Fishes and Amphibians) whereas less toxic to birds and mammals, the homeotherms. The toxic variation is due to absence of the enzyme hydrolase in fishes and Amphibians the poikilotherms. They form an important link in the food chain, connected to the Terrestrial environment. According to Sana Ullah et al (2019a), the pyrethroids when ecotoxicological studies can be of several biomarker studies and oxygen/respiration study is one among them. As the earth's subdivision the hydrosphere (largest), when transported into non-point source, the effects are many fold and the quantum

of them use is appended in table 1. Even Kaviraja and Gupta (2014) too mentioned in the review article, the studies pertaining to respiration can be a biomarker study, apart from others. It serves as the indices of metabolism effect because all animals are heterotrophic organisms only. The presence of the toxicants as residues occur both in lethal (acute) as well as in sublethal concentration (chronic), while in chronic levels it had a bearing on the oxygen consumption and such studies proved that pollutants of all kinds need not be toxicants but reverse is true.

The fish, heterotrophic organism, metabolism depends on the respiring gas and is also a growth factor. Hence among the cultivable major carps, one among them (*Catla catla*) is the organism that was tested as a biomarker study. Both in lethal as well as sublethal concentrations, the experimentation is made to know how much quantity of intake had an impact of Cyfluthrin technical grade and the commercial formulation that was marketed as 10% WP.

MATERIALS AND METHODS :

Experiments on the oxygen consumption of the fish *Catla catla* were carried out in a respiratory apparatus developed by Job (1955). The fish were brought from local fish farms, Nandivelugu, Guntur (dt.), A.P., India and stored in the laboratory conditions in well aerated water for 10 days. They were acclimatized fish and are used for the laboratory condition and such acclimatised fish for experimentation. The water that was used in the toxicity experiments and for acclimatization was same. It has the following physical and chemical characteristics; Turbidity 8 silica units, Electrical conductivity at 28°C-8.16 Micro ohms/cm, pH at 28 deg * C – 8.2

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Alkalinity: Phenolphthalein-Nil, Methyl orange as CaCO_3 -472, Total Hardness-320, Calcium Hardness-80, Magnesium Hardness-40, Nitrite nitrogen (as N) Nil, Sulphate (as SO_4) Trace, Chloride (as Cl) 40. Fluoride (as F-) -I.S., Iron (as Fe)-Nil, ("All these values are micrograms/liter), Dissolved Oxygen 8-10 ppm, Temperature 28 plus/minus 2 deg * C

During the experimentation period, the fish were regularly fed, but the feeding was stopped for about two days prior to the experimentation. The fish measuring 8 to 10 cm in length and 8 to 10g in weight were used in the experiment. All the precautions mentioned by APHA (1998, 2005 & 2012),

OECD (2019) are followed, for maintaining the fish. The fish were exposed to 96h $\text{L} \times \text{C}_{50}$ lethal $2.2 \mu\text{g} / \text{L}$ and also sub-lethal ($1/10^{\text{th}}$ of 96h $\text{L} \times \text{C}_{50}$) as $0.22 \mu\text{g} / \text{L}$ of technical grade and for 10% WB lethal $1.4 \mu\text{g} / \text{L}$ and $0.14 \mu\text{g} / \text{L}$ EC as sub-lethal ($1/10^{\text{th}}$ of 96h LC_{50}) respectively in the respiratory chamber. The pure (almost was earlier obtained from a reputed company, the manufacturers of the Cyfluthrin, from a Agro Chemical multinational Company by name M/s. Bayer India Ltd., (Bombay. Maharashtra-400 079, India) and the formulation was purchased from the available pesticides shops, local of Guntur, Andhra Pradesh, India. The samples for the estimation were taken from the respiratory chamber, at every two hours intervals for a total period of 24 hours apart from the control (total 13 samples of each test determination and five of each to have averages).

Description of the respiratory chamber: The chamber used for the measurement of the whole animal oxygen consumption is a wide mouthed bottle which is called a respiratory chamber (RC). Its mouth was fitted with a four holed rubber stopper (S) and through one of the holes a thermometer (T) was placed to know the temperature of the medium in the

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respiratory chamber. From the remaining three holes three glass tubes were passed whose outer ends were fitted with the rubber tubes. These three tubes serve as delivery tubes and are designated as T₁, T₂ and T₃ respectively. They were fitted with pinch cocks P₁, P₂ and P₃. T₁ was connected with the reservoir ('R') and through this water could be drawn (inlet) into the respiratory chamber. T₂ was the atmospheric tube useful for testing the air tightness of the respiratory chamber which is taken into account as the fish is having the bi-model respiration hence extra care not to allow any air. Through the T₃ tube (outlet) samples from the respiratory chamber were taken for the estimation of the dissolved oxygen. The respiratory chamber was coated black to avoid any photo chemical reactions and to keep the animal activity at normal, during the entire period of the experiment.

Collection of the initial and final samples: After allowing the animal to settle in the chamber, the initial sample was collected from the respiratory chamber through T₃. After collection of initial sample, the respiratory chamber was closed by closing P₃ first and then P₁ after two hours, until the next sample was collected from the respiratory chamber. Likewise, other samples also were collected at the end of each two hours for a period of 24 hrs. To calculate the amount of oxygen present in the water, the method followed is popularly known as the modified method of Winklers that was given by Golterman and Clymo (1969). Along with the experimental fish chamber, one respiratory chamber without the fish (control) was maintained. The control serves to estimate the initial amount of oxygen that was consumed by the fish. The experiments were conducted in sub-lethal as well as in lethal concentrations of both the technical grade and 20% EC of the chlorpyrifos that were used as the toxicants.

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After checking the air tightness pinch cock P₂ was closed, to avoid any air to enter checked twice and the pinch cock P was opened slightly so that a very gentle and even flow of water was maintained through the respiratory chamber. This was continued for 15 minutes to facilitate the animal in returning to a state of normal from the state of experiment, if any, difficulty due to the handling and also to allow the animal to adjust to darkness in the chamber (acclimatization).

RESULTS :

Comparative data on the whole animal oxygen consumption of control and experimental fish calculated per gram body weight in lethal and sub-lethal concentration of the technical grade and 10% WP for *Catla catla* and their percent variations are graphically represented as figures 1A & 1B and 2A & 2B. By taking time on X- axis and the amount of O₂ consumed per gram body weight on the Y- axis and both the line and bar modes are shown.

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Duration (hrs) : Figure 1A. The amount of oxygen consumed in mg/gr body weight/hr of the fish *Catla catla* exposed to sublethal and lethal concentrations of Cyfluthrin, technical grade

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The toxicant and the fish study are first of its kind in the methodology when the type II synthetic pyrethroid Cyfluthrin is studied and that gives information about the candidate species for culture to have natural care. Hence, all the toxicants have to be tested for all the fish to monitor the pollution in environmental policy and planning and the present study can be inferred that sublethal are really lethal as in the case of failure of normal oxygen intake while in respiration.

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