ESTIMATION OF OXYGEN CONSUMPTION IN INDIAN MAJOR CARP, *CATLA CATLA* (HAMILTON) EXPOSED TO ACEATAMIPRID 20%SP(NEONICOTINOID)

Aswartha Narayana. A[1], Dr. K.V. Chamundeswaramma[2], Dr. Lalitha V,[3] Prof. V. Venkata Rathnamma[3]

[1&3]Research Scholar Department of Zoology & Aquaculture Acharya Nagarjuna University, Andhra Pradesh-522510, India
[2] Zoology Lecturer in S.V.G.M. Govt. Degree College. Kalyandurg, Anantapur-515761
[3]Professor Zoology & Aquaculture Acharya Nagarjuna University, Andhra Pradesh-522510, India
Email address: aswarthnarayan225@gmail.com

Abstract:

Numerous pesticides are carelessly used to increase crop output to feed the growing global population, but their optional metabolites have a major biochemical negative impact on non-target species. Pesticides have been used widely without being properly disposed of, and as a result, their surplus residues have gotten into the local aquatic ecosystem and its inhabitants, particularly fish. Using a short-term definitive test by static renewal method, the acute toxicity (LC_{50}) of the neonicotinoid pesticide acetamiprid (20%SP) and its effects on oxygen consumption in the freshwater edible fish *Catla catla* were examined. Fingerlings were given acetamiprid for 96 hours at lethal (50 mg/L) and sublethal (0.5 mg/L) levels. Examined fish During the initial exposure period of 2 to 6 hours, *Catla catla* tended to consume more oxygen, and fish displayed a continuous decrease in oxygen consumption at the sublethal dose throughout the exposure time and until the trial's conclusion. A malfunctioning oxidative metabolism that causes respiratory distress may cause changes in oxygen consumption.

Keywords: Acetamiprid 20%SP, Lethal and Sublethal Concentration, *Catla catla*, and Oxygen-consumption.

Introduction:

Recent years have seen a rise in the global problem of aquatic pollution. Lakes, ponds, and rivers all around the world have experienced measurable changes in water quality as a result of extensive industrialization. In the current review, various pesticide kinds are recklessly applied to boost crop productivity for the expanding world population, but their optional metabolites seriously damage non-target organisms, particularly amphibian living creatures, enzymatically and biochemically. Respiration is a necessary function of life, and the rate at which oxygen is consumed regulates the metabolic processes. Dharmalata and Namitha Joshi (2002) exploited changes in respiratory rates as a stress indicator in organisms exposed to pollutants. Depending on their metabolic rate, the temperature, pH, and CO2 level of the water, fish require various amounts of oxygen. The amount of oxygen consumed by fish per hour is typically measured in milligrams per kilogram of body weight.

The quantity of oxygen a fish consumes without moving or being cared for is referred to as standard oxygen consumption (amount of oxygen required for resource), however, this has little influence on how oxygen is often used. If gills or membrane functions are destroyed due to xenobiotic chemicals or the membrane functions are disturbed by a change in permeability the oxygen uptake rate would rapidly decrease (Lalitha *et al.,* 2021). Secretion of mucus over the gill curtails the diffusion of oxygen which may ultimately reduce the oxygen uptake by the animal (Lalitha *et al.* 2018). Since gill is the target organ for synthetic pyrethroid toxicity in fish, the toxicant will pass through the gills, and interfere with the gill movements which are directly proportional to the respiratory activity of the fish, primarily affecting the oxygen uptake (Chaithanya *et al.,* 2021).

Changes in the gill architecture and increased mucus production under acetamiprid stress are consistent with the observed histological effects such as hyperplasia, necrosis, and lamellar aneurysms in *Catla catla* exposed to sublethal concentrations of the toxicant, acetamiprid.Gills are the major respiratory organs and all metabolic pathways depend upon the efficiency of the gills for their energy supply and damage to these vital organs causes a chain of destructive events, ultimately leading to respiratory distress Anitha *et al.*, (2021). Pesticides are indicated to cause respiratory distress or even failure by affecting the respiratory centers of the brain or the tissue involved in breathing. Numerous studies such as *Cirrhinus mrigala* (Mushigeri and David, 2003), *Labeo rohita* (Patil and David, 2008), *Oreochromis mossambicus* (Logaswamy and Remia, 2009), *Ctenopharyngodon idella* (Tilak and Vardhan, S.K,2002); *Oreochromis niloticus* (Barbieri and Ferriera, 2010) and *Cyprinus carpio* (Singh *et al.*, 2010) reported either increase or decrease their respiration rate in response to a variety of pesticides. Hence the present investigation undertaken to evaluate the effect of Acetamiprid 20%SP on the oxygen consumption rate of the freshwater fish *Catla catla.*

Materials and Methods:

Freshwater fish *Catla catla* were delivered to the lab and stored in sizable plastic compartments filled with water from the fish incubation facilities of Kuchipudi, Tenali mandal, Guntur (dt), A.P, India, which is about 40 km distance from the Acharya Nagarjuna university. The fish typically measured 6 to 7 cm in length and weighed 6.5 to 7.5 grams. To prevent any skin disorders, fish were initially given prophylactic therapy by being washed twice in 0.05% $KMnO_4$ solution for 4-5 minutes. Before being exposed to the pesticide for 15 days to observe mortality, the fish were acclimated to the laboratory conditions at 28 ±2ºC. At the time of acclimatization, all safety precautions were outlined by the APHA (1995). These fish were later exposed to lethal and sublethal concentrations of Acetamiprid 20%SP. In the respiratory apparatus developed by work, the investigation into O_2 utilization in the fish *Catla catla* was finished.

The amount of dissolved oxygen consumption was calculated per gram body weight

$$O_2 \text{ consumed by fish/ Gram body weight / hour} = \frac{\text{a-b } \mathbf{x} \text{ N of hypo } \mathbf{x} \text{ 8 } \mathbf{x} \text{ 1000}}{\text{Vol. of the sample taken } \mathbf{x} \text{ Correction factor } \mathbf{x} \text{ Wt. of the fish } \mathbf{x} \text{ Time interval for each sample}}$$

Where: α**=** hypo rundown before exposure

β=hypo rundown after exposure

The measure of oxygen consumed by fish **=** α-β **x** N of hypo **x** 8 **x** 1000 Gram body weight/hour - - - - - - - - - - - - -

V× Revision factor × W ×T

V= Volume of the example taken α=hypo overview before openness;

β = hypo overview after openness N= Ordinariness of Hypo;

T= Time span between each example

Results:

The fish *Catla catla* showed a tendency to increase oxygen consumption in the early hours of exposure, such as 2 to 6 hours, then a constant decrease during the perception period is represented in Table 1 and Fig 1. In such circumstances, lethal and sub-lethal toxicant concentration will inevitably occur; the fish *Catla catla* was more susceptible to toxicity. As low oxygen content negatively affects both food intake and usage, the harmful pressure of oxygen utilization. Acetamiprid 20%SP was evaluated in the continuing investigation would affect *Catla catla's* respiratory system gram per body weight, table 1 shows the total oxygen consumption of the control and test fish at sub-lethal and lethal concentrations of the specified compound acetamiprid for the fish *Catla catla* a period of 20 hrs. In Fig. I, the test results and control values are depicted visually. By charting the amount of oxygen consumed per gram of body weight on the Y-hub and time on the X-hub, respectively.

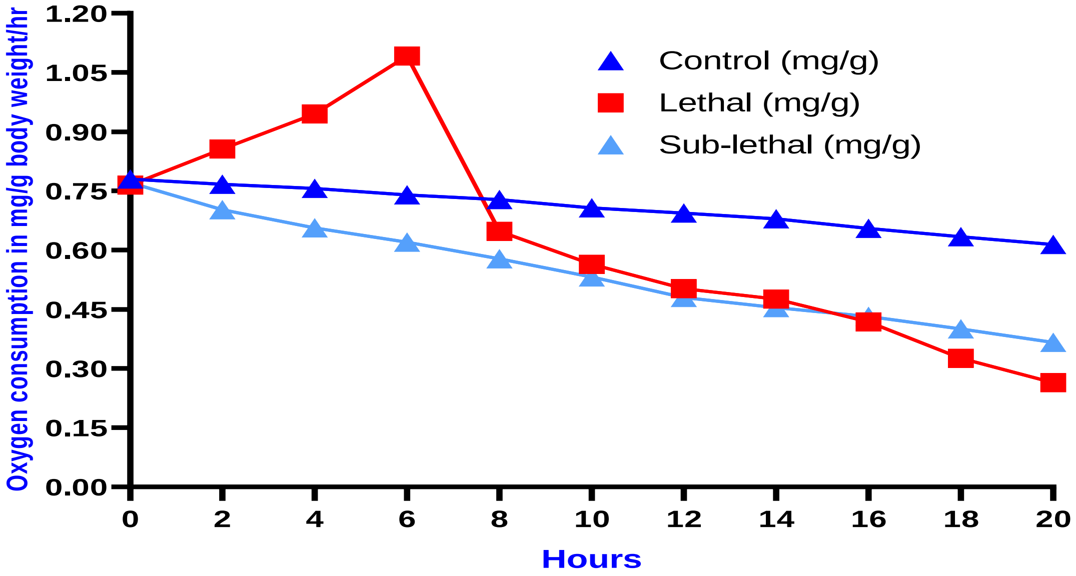
Hour	**Control**	**Lethal**	**% Change**	**Sub Lethal**	**% Change**
0	0.780 ±0.005	0.765± 0.003	**1.923**	0.771 ± 0.007	**1.153**
2	0.767 ±0.003	0.856± 0.004	**- 11.60**	0.702 ± 0.006	**8.474**
4	0.756 ±0.007	0.945±0.006	**- 25.00**	0.656 ± 0.004	**13.22**
6	0.740 ±0.006	1.092±0.005	**- 47.56**	0.620 ± 0.005	**16.21**
8	0.728 ±0.004	0.648± 0.002	**10.98**	0.578 ± 0.003	**20.60**

10	0.707 ±0.003	0.564± 0.001	**20.22**	0.532 ± 0.001	**24.75**
12	0.694 ±0.006	0.502± 0.003	**27.66**	0.480 ± 0.006	**30.83**
14	0.679 ±0.004	0.476± 0.004	**29.89**	0.454 ± 0.004	**33.13**
16	0.655 ±0.001	0.418± 0.006	**36.18**	0.432 ± 0.002	**34.04**
18	0.634 ±0.006	0.326± 0.005	**48.58**	0.400 ± 0.006	**36.90**
20	0.614 ±0.002	0.264± 0.003	**57.00**	0.366 ± 0.003	**40.39**

Table. 1: The amount of oxygen consumed in mg/g body weight/hr of the fish *Catla catla* exposed to sub-lethal and lethal concentration of Acetamiprid 20% SP:

Values are the mean of five observations: Standard Deviation is indicated as (±)., Value are significant at $p < 0.05$

Fig.1: The amount of oxygen consumed in mg/g body weight/ hr of the fish *Catla catla* exposed to sub-lethal and lethal concentration of Acetamiprid 20% SP



The current study examines O_2 consumption in test fish *Catla catla* when given the acetamiprid 20%SP in lethal and sublethal concentrations for a period of 20 hours alongside controls. The Lethal focus was in control (0.780) ppm, with 0 hr. in charge at lethal (0.765) ppm and sublethal at (0.771) ppm. After then, for the next two hours to six hours, the rate of oxygen consumption increased in lethal concentration (0.856, 0.945, 1.092) and sub lethal concentration (0.702, 0.656, 0.620) but it was normal in controls (0.767, 0.756, 0.740).In controls, O_2 consumption in 0h was (0.780), 2h (0.767), 4h (0.756), 6h (0.740), 8h (0.728), 10h (0.707), 12h (0.694), 14h (0.679), 16h (0.655), 18h (0.634) and 20h (0.614) whereas 20h in lethal concentrations, O_2 consumption of *Catla catla* exposed to Acetamiprid 20%SP for a period of 24hrs; 0h was (0.765), 2h (0.856), 4h (0.945), 6h (1.092), 8h (0.648), 10h (0.564), 12h (0.502), 14h (0.476), 16h (0.418), 18h (0.326) and 20h (0.264). Whereas 20 h in Sub lethal concentrations, O_2 consumption of *Catla catla* exposed to Acetamiprid 20%SP for period of 20hrs; 0 h was (0.771), 2h (0.701), 4h (0.656), 6h (0.620), 8h (0.578), 10h (0.532), 12h (0.480), 14h (0.454), 16h (0.432), 18h (0.400) and 20h (0.366).

Discussion:

A recent study looked at the effects of giving acetamiprid (20%SP) in lethal and sublethal doses to *Catla catla* fingerlings for 20 hours. In comparison to the sublethal dose in the current evaluation, there was a sudden increase in O_2 utilization levels that was visible in the lethal concentration for 2 to 6 hours. The rate of oxygen consumption was increased in lethal focuses when compared to control and sublethal fish. According to Marigoudar *et al.*, (2009) the respiratory changes caused by cypermethrin in *Labeo rohita*. Fish exposed for 1, 2, 3, and 4 days to the lethal dose (4 g/l) showed increased oxygen consumption on days 1,2 and 4days (8.597%), (17.409%), it dropped (1.289%) on the 4th day.Fish treated 24 hours after treatment demonstrated increased oxygen consumption in concentrations of dimethoate of 0.15 ppm, 0.2 ppm, 0.3 ppm, and 0.6 ppm, respectively, the values reported were 0.5440.04, 0.4500.04, 0.3930.02, and 0.2790.06 ml/g/hr according to Shereena *et al.*, (2009). According to Shambanagound *et al.*, (2009), cypermethrin causes respiratory and behavioural changes in the young water teleost *Catla catla* (Hamilton) and increases oxygen consumption when exposed to lethal concentrations of the chemical. On *Ctenopharyngodon idella*, sub-lethal concentrations of Pyraclostrobin (25%WG) were shown to cause a decrease in oxygen consumption, while deadly doses were found to significantly increase in the first 1-6 hours of exposure (Ravibabu Katti 2021).

Pesticides at sub-lethal concentrations in aquatic environments cause morphological and functional alterations in aquatic animals, which are more normal than lethality. Stressed fish were discovered in sub-lethal concentrations, but they were not fatal (Murthy *et al.*, 2013). The rate of metabolism is inversely correlated with oxygen consumption in fish *Catla catla* exposed to Profenofos at levels below the lethal threshold. There is a rapid drop in oxygen consumption with a rise in profenofos concentrations after 5, 10, and 15 days of toxicants (Maharajan *et al.*, 2013). The impact of cypermethrin on *Tilapia mossambica's* observed changed rates of oxygen consumption at sublethal concentrations at 24, 48, 72, and 96h (0.446, 0.094, 0.194, and 0.197 ml/g/h) compared to control (0.462ml/g/h) was studied by Jipsa *et al.*, (2014).

The rate of oxygen consumption in the test fish *Labeo rohita* increased in sublethal concentrations of 0.856, 1.020, 1.242 and 0.823, 0.856, 0.794 in lethal concentrations, whereas it was normal in controls of 0.753, 0.744, 0.727 (Chaithnya kumari V 2022). Manjula Sree Veni and Veeraiah, (2014), either increase or decrease in oxygen consumption studied vital tissue damage caused by lethal and sublethal doses of cypermethrin in freshwater fish *Cirrhinus mrigala*. Toxicity of cypermethrin on oxygen consumption of *Cirrhinus mrigala* and reported increased respiratory activity, resulting in increased ventilation and increased uptake of the toxicant, due to stress. P. Neelima *et al.*, (2016), study the experimental fish *Cyprinus carpio* were shown to have an increasing tendency in oxygen consumption during the early time of exposures, i.e., 2 to 4 hours, and a steady decline was noted throughout the succeeding research period in sub-lethal doses of cypermethrin 25% EC. Lalitha V. (2022) studied the toxic stress of freshwater fish *Labeo rohita* exposed to Azoxystrobin 23% SC, Copper, and Combine Synergism of Az+ Cu where oxygen consumption with oxygen depletion in aquaculture operations makes them less fit and stunts their development because they don't have enough metabolism, as low oxygen content negatively affects both food intake and utilization.

The rate of oxygen consumption initially increases, then gradually decreases until the end of the study in fish *Rasbora Antonius* exposed to a lethal concentration exposed dimethoate, according to Lokhande, M. V. (2017). According to Sathick O *et al.,* (2019) observed on exposure to monocrotophos during sub-lethal treatment produces severe toxic effects on the respiratory organs of estuarine fish *Magil Cephalus,* the fish were more anxious for the first hour, but after that, they began to feel better. As the ingestion of the poison portion is extended in time during the initial 24 hours, recovery is apparent. With the other exploration creators, it meshes well. According to Taufiq Ihsan *et al.*, (2019), when exposed to chlorpyrifos pesticides, Tilapia's oxygen consumption decreased from day one to day fourteen at concentrations of 0.0054 mg/L, which was 0.0159 mg O_2/L, and 0.0108 mg/L, which was 0.0213 mg O_2/L.

Ch. Prasanna *et al.*,(2020) study the O_2 consumption of fish *Labeo rohita* exposed to Ethion 50%EC. 0hr in control (0.892), in sublethal (0.880), and lethal concentration was in (0.846) and sublethal (0.952) lethal (8.18) respectively, and 6hrs O_2 consumption in control (0.718) and sublethal (1.360) lethal (0.712) i.e. sudden change in O_2 consumption levels were observed in the sublethal concentrations to compare with lethal concentration after other hrs, the O2 consumption levels were gradually decreased in all exposure of the fish *Labeo rohita*. The decrease in dissolved oxygen consumption could be attributed to gill injury, which lowers the efficiency of oxygen uptake.

Priyanka Kumari and M. M. R. Nomani (2021), was found that the parasites caused some parts of the epithelium to erode because they were related to lamellar tissues in the gills. In the secondary lamellar epithelium, the parasites caused significant tissue-level effects such as hyperplasia and the merging of nearby secondary lamellae. Tristan J. *et al.,* (2021) in their respective fields hyperoxia is a condition in which the amount of oxygen (O_2) in the blood exceeds the safe level for the environment (i.e., >100% saturation in the air). Pallewad S.G and Mali R.P(2022) investigated the total oxygen consumption of *Channa punctatus* fish to the effect of automobiles effluent was 2.68, 3.10, 1.84 and 1.01-ml CC of O_2/animal/hr. *Labeo rohita* and *Ctenopharyngodon idella* show a considerable increase in the first 1-6 hours after exposure to the sublethal dosage of Fipronil 5%SC, according to Ch Anitha (2022).

Conclusion:

In conclusion, the data analysis for this investigation showed that acetamiprid 20%SP is toxic and significantly affects the oxygen consumption of *Catla catla* at both fatal and sublethal concentrations. The fluctuation in oxygen consumption in fish exposed to acetamiprid(20%SP) was mirrored in the amount of oxygen used by the total metabolic rate. As a result of acetamiprid stress, the gills' capacity for diffusing oxygen would change, resulting in hypoxic or anoxic conditions that could make it difficult for the fish to breathe. According to these findings, the altered oxygen levels in *Catla catla* may also be utilized as a fast-biological indicator to assess the impacts of pesticides like acetamiprid(20%SP). The amount of oxygen that fish take in is a good indicator of their overall metabolic rate. Fish exposed to acetamiprid showed a variation in oxygen consumption that was examined.

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