

Determination of toxicity and LC₅₀ of methyl parathion to the fish *Anabas testudineus*

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ABSTRACT

Investigation on the impact of known Insecticides (concentration of toxic chemical and exposure time) to a particular species involves the estimation of mortality or survival rate and evaluation of sublethal exposure on growth, behaviour and other parameters (blood metabolites, tissue metabolites and enzymes. LC₅₀ of methyl parathion to the fish *Anabas testudineus* was found 1.7mg/L.

1. Introduction

Today India is engaged in the gigantic task of feeding over 1000 million people and a huge cattle population on which the poor farmers are dependent for their livelihood.

The Green Revolution of 1960 which has given reasonable hope for the country being not only self sufficient in the production of adequate food and fodder for feeding its teeming human and animal population but has become the largest producer of some important commodities.

The role played by the magic chemicals called "pesticides" are quite significant but have given rise to serious health problems (Gupta 1989).

Pesticide is a substance or mixture of substances that are used to control pests such as plant parasite, bacteria, viruses, fungi, nematodes, insects weeds, rodents and bird. Pesticides include all materials that are used to prevent, destroy, attract or reduce pest organisms, Therefore pesticide find application in different area viz: forestry, horticulture, Agriculture and Domestic use.

Pesticides have been in use for over thousands of year. Some of the early demonstrations include burning of sulphur (s) to control insects by Romans and the use of Arsenic and Pyrethrum by Chinese.

By the early 20th century two classes of pesticides were primarily used viz: Botanicals, natural chemicals derived from plant material and preparation of organic salts, which were widely used as fungicides, herbicides and insecticides.

The era of synthetic pesticides started with the discovery of DDT in 1934 which possessed insecticidal properties since then, innumerable preparations have been in use in the name of insecticides, fungicides, and herbicides.

Generation of resistant pests led to the banning of DDT in the 1960s.

Globally, about 2.5 million tons of pesticides are targeted on agricultural crops. Even though the use of pesticides had a very positive impact in the overall increase in food production, the risks associated with this include deterioration of human health, water contamination, live stock animals poisoning and death of beneficial insects, wildlife endangerment and pesticide tolerance (Gupta. 2004).

Use of pesticides in India began in 1948 when DDT was imported for malaria control and BHC for locust control. India

started pesticide production with manufacturing plant for DDT and BHC (benzene hexachloride) in the year 1952.

In 1958, India was producing over 5000 metric tonnes of pesticides and currently about 145 pesticides registered for use and production has increased to approximately 85000 metric tonnes.

Despite the fact that the consumption of pesticides in India is still very low, about 0.5 kg/ha of pesticides against 6.60 and 12.0kg./ha in Korea and Japan respectively, there has been a wider spread contamination of food commodities with pesticides residues, basically due non-judicious usage.

In India 51% of food commodities are contaminated with pesticide residues and out of these 20% have pesticide residues above the maximum residues level values on a world wide basis. (Gupta-2004, Agnihotri-1999).

It has been observed that their long-term used is linked to human health effects Such as Immune- suppression, hormone disruption (endocrine disruptors) diminished intelligence, reproductive abnormalities' and cancer.

In this light problems of pesticide safety, regulation on pesticide use of bio-technology and emergence of bio-pesticides are some of the possible future strategies for minimizing human exposure to pesticides.

So, a safe dose (exposure) of methyl parathion, is to be estimated for safety of aquatic organisms and also for human being.

2. Materials and methods

Bio-assays to determine acute toxicity of the test fish, in terms of LC₅₀ for 24,48,72 and 96 hours were performed by adopting procedure mentioned in standard methods (APHA, AWWAWPCF 1985)

20 Litre glass rectangular aquaria were used in this test and at a time 10 fish were exposed to various concentrations of the insecticide. Different concentrations of the test chemical were obtained by simple dilution technique as already mentioned. A total of ten concentration based on log-scale, were used. Side by side a control group was also run. Exposure units were static.

The fishes, in 10L of water were exposed to each of the insecticidal concentrations. Entire experiment was monitored to the extent possible and practically dead fishes were removed at once to prevent oxygen depletion and tolerance limit of the

fish. Fish showing no opercula movement and any tectile responses, were considered as dead.

Results obtained from the experiment are shown in the following tables and figures.

3. Result

Table-1

LC50 value of Methyl parathion 50% EC (Metacid 50% to fish Anabas testudineus Obtained from graphic method

Sl.No.	Exposure Period	Log Concentration (LogX)	Anti log (X)	LC50 Value (Rounded)
1.	24 hrs	0.612	4.09	4.0 mg/L
2.	48 hrs	0.505	3.19	3.2 mg/L
3.	72 hrs	0.342	2.19	2.2 mg/L
4.	96 hrs	0.204	1.59	1.6 mg/L

n= 3 readings for each exposure period

Table-2

LC₅₀ value of Methyl parathion (Metacid 50% EC) to fish Anabas testudineus Obtained from Regression method (Finney-1971)

Sl.No.	Exposure Period	Y-intercept	Slope (b)	Regression Equation	LC ₅₀ Value	95% confidence limit
1.	24 hrs	-120	40	-120+40x	4.25	5.4 –4.0
2.	48 hrs	-80	40	-80+40x	3.25	3.95 –2.55
3.	72 hrs	-60	40	-60+40x	2.25	2.95 –1.55
4.	96 hrs	-12	36	-12+36x	1.7	2.4 –1.00

Table-3

LC50 value of Methyl parathion (Metacid 50% EC) to fish Anabas testudineus obtained from Spearman Karber method (Hamilton et.al. 1977)

Sl.No.	Exposure Period	Trimmed mean (=d)	Trimmed % mortality (P)	Median lethal Concentration (\bar{X}) = LC ₅₀	Anti log E \bar{X} = LC ₅₀	95% confidence interval	
						Upper limit	Lower limit
1.	24 hrs	0.042	8	(-0.6116)	4.089mg/L	4.16(4.2)	4.018 (4.0)
2.	48 hrs	0.064	5	(-0.570824)	3.7224 mg/L	3.778 (3.8)	3.66 (3.7)
3.	72 hrs	0.092	8	(-0.32504)	2.11368mg/L	2.238(2.24)	1.984 (2.0)
4.	96 hrs	0.096	5	(-0.08586)	1.218 mg/L	1.416(1.02)	1.02

Average LC₅₀ Value obtained from Three different Methods

Table-4

Sl.No.	Method Used	24hr LC ₅₀	48 hr LC ₅₀	72 hr LC ₅₀	96 hr LC ₅₀
1.	Graphic Method	4.0 mg/L	3.2 mg/L	2.2 mg/L	1.6 mg/L
2.	Regression Method (Finney 1971)	4.25 mg/L	3.25 mg/L	2.25 mg/L	1.7 mg/L
3.	Trimmed Spearman Karber Method (Hamilton et.al. 1977)	4.089 mg/L	3.722 mg/L	2.113 mg/L	1.218 mg/L
4.	Average LC ₅₀ Value	12.339=4.113 mg/L	10.222=3.40 mg/L	6.563=1.18 mg/L	4.518=1.508 mg/L
5.	95% Confidence Interval	(4.2–4.0)	(3.66–2.14)	(2.24–2.16)	(1.7–1.3)

Calculated Sublethal Safe Dose=

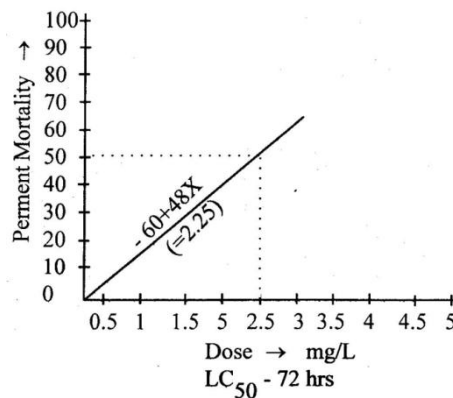
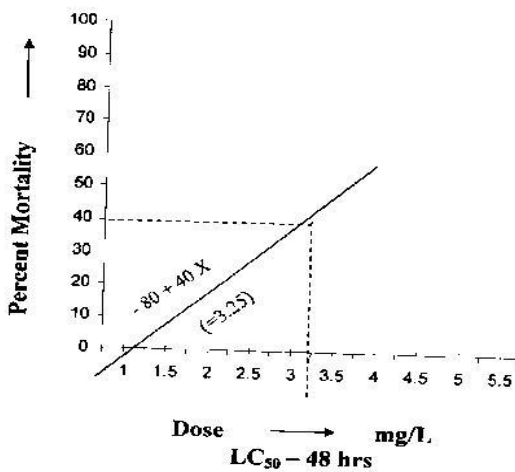
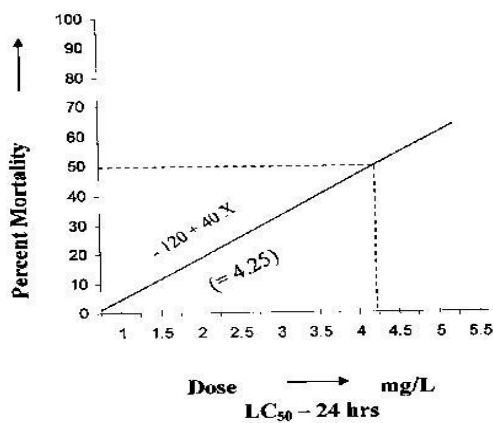
(a) $\frac{1}{4}^{th}$ of 96 hours $LC_{50} = \frac{1.508}{4} = 0.377 = 0.38 \text{ mg/L}$

(b) $\frac{1}{10}^{th}$ of 96 hours $LC_{50} = \frac{1.508}{10} = 0.1588 = 0.16 \text{ mg/L}$

(c) From formula of Hart et.al. (1945)

$$C = \frac{48hrLC_{50} \times AF}{S^2} = \frac{0.34 \times 0.1}{\left(\frac{4.113}{3.40}\right)^2} = \frac{0.34}{(1.20)^2} = \frac{0.34}{1.44} = 0.24 \text{ mg/L}$$

Graphic representation of LC_{50} values of methyl parathion (Metacid 50%) to fish *Anabas testudineus* for different exposure periods (25h, 48h, 72h, 96h).



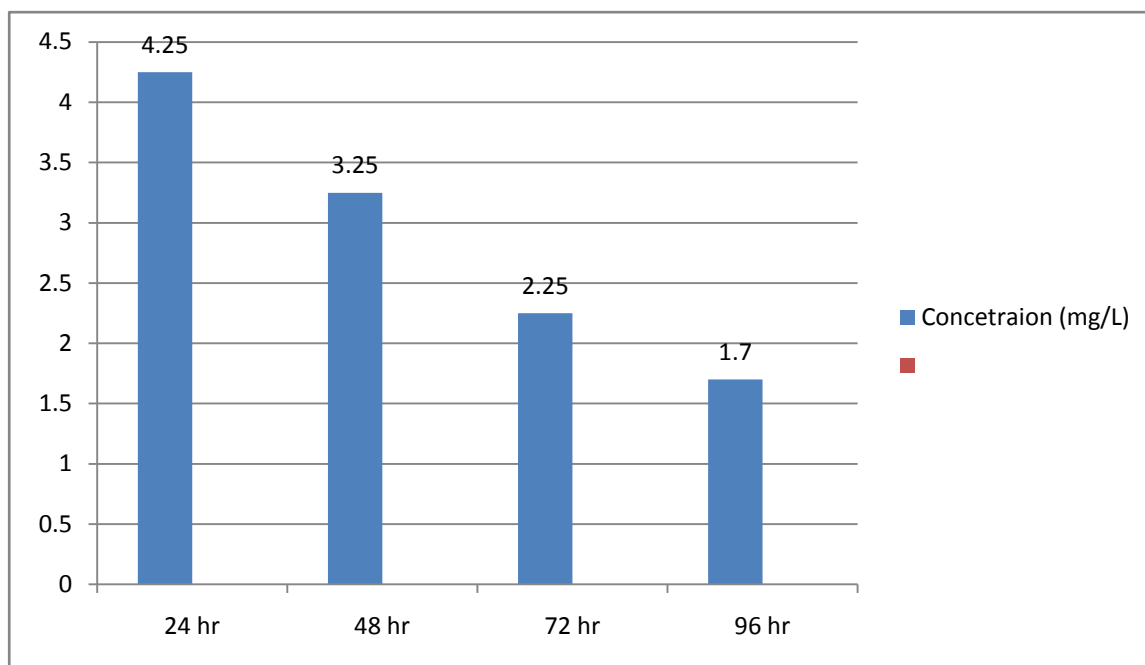
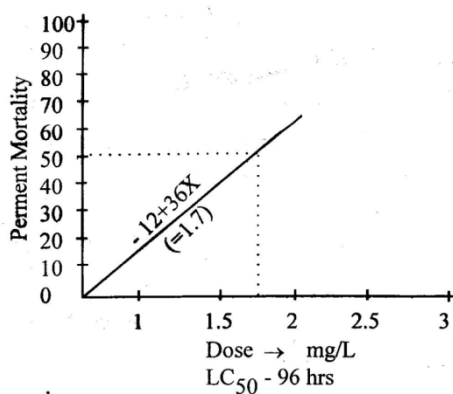


Figure: LC50 values (mg/L) of methyl parathion for different time intervals obtained from regresion method.

4. Discussion and Conclusion

LC₅₀ is the most widely accepted tool for acute toxicity study and it is the concentration of a test chemical which results in 50% mortality of the experimental animals in a particular length of exposure (viz. 96hr).

Results of LC₅₀ values for different time intervals obtained from 3 different methods (Graghic, Regresion and spearman karberz method) and in particular in regression method estimated LC₅₀ of methyl parathion to Anabas testidineus for 96h of exposure was recorded to be 1.681 (=1.7). The lower bound and upper bound 95% lethal confidence interval for methyl parathion indicated a range (1.74) -1.751).

The result confirmed that methyl parathion was toxic to the fish Anabas testudineus and that these toxic effects (mortality) are found to be both time and concentration dependent.

The test result of the 96hr Lc50 of Anabas testudineus with methyl parathion than the 96h Lc50 value of 0.5549 ppm in

chann punctatus as reported by Natrajan (1984), Veeraiah (2014) Sivaperumal (2011), Jagdeesna (2012),

The Lc50 values of Methyl parathion (Metacid- 50% EC) for 96hr in the present study finds similarity with the result of Bhawna and reddy (2016) in the fish Tilapia mossambica exposed to methyl parathion.

However, the 96hr Lc50 value of methyl parathion found in the present study was comparatively less than already reported values.

This could be due to the age of the fish and hardly nature as well as being equipped with an additional respiratory organ, the labyrinth organ, size of the animal and rearing system.

Hii et.al. (2007): also, found significant differences between 24h and 96h Lc50 value as they renewed 56% of the test solutions each day.

Low value of 96h Lc50 (median lethal concentration) of 1.681mg/L indicates that methyl parathion is highly toxic to fish.

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