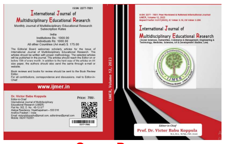

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:2(3), February: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd February 2023
Publication Date:10th March 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.02.57
www.ijmer.in

THE EFFLUENTS RELEASED IN EAST KOLKATA WETLAND, WEST BENGAL, INDIA, IMPENDING THREAT TO CULTURED FISH (*TILAPIA MOSSUMBICA*)

Monjit Paul[1], Joydeep Das[2] and Asim Kumar Giri[3]
[1&2]Department of Biological Science and [3]Department of Fishery Sciences
[1&2]Fishery Science, Midnapore City College and [3]Vidyasagar University
Midnapore, West Bengal, India

Abstract

The East Kolkata Wetland is the major sources of fish for regular consumption in urban Kolkata. The wastes released from domestic household, sanitation, hospitals, agricultural fields and different industries are used in fish production pond as the source of nutrients and food for the cultured fishes. These wastes are the potential threats for the environment, aquatic life and human health as they are released in the system without prior treatment. Due to the effect of those effluents, considerable fish mortality happens during pre and post monsoon months when the dilution of those toxic nutrients are less. Fishes are the primary bio needle as they are very sensitive towards the contamination. The current study was based on the bioassay test on fresh water fish *Tilapia* cultured in East Kolkata Wetlands and every year measurable mortality can be seen especially during summer and winter months without any traces of pathogenic infections. This study concluded that effluents released in EKW system from urban Kolkata have acute lethal toxicity.

Keywords: Effluents, East Kolkata Wet Lands, Bioassay, Toxicity Test, Wastes.

Introduction

Wetlands are the most important ecological hotspot. Wetlands are the most important ecosystem as they may create enormous floral and faunal diversities (Chase, 2007). Wetlands may also play a very important role in socio-economic form of the any region as these are used for agricultural and as well as aquaculture activities at salable level, vital for biodiversity conservation (Panthi et al.,2014) thus uphold the biological honor. Kolkata is continual by this sole and approachable water management system which is East Kolkata Wetlands (EKW) (Latitude 22˚33' - 22˚40'N; Longitude 88˚25' - 88˚35'E). East Kolkata Wetlands was declared as Ramsar site on 19th August 2002 by Ramsar Convention Bureau. Wetlands deliver an atmosphere where photosynthesis can transpire and the reprocessing of nutrients may take place thus playing a noteworthy role in supporting food chains (Adams, 1988).

The entire domestic sewage of the city Kolkata (estimated 1394.42 million liters/day) runs to the East Kolkata Wetland through a system of principal and ancillary channels. The wetland utilizes the sewage as resource of nutrients from primary and secondary production and as food to produce fishes in different ponds. The sewage is directly dumped in those ponds where the fishes are cultivated. This sewage refers to different liquid wastes coming from household kitchen, sanitation, hospital, and pharmaceutical practices. Even some industrial effluents containing heavy metals, toxic chemicals are also mixed in this sewage. Without any prior treatment those wastes are directly used in fish culture ponds. Hence, the domestic sewage may contain lots of harmful chemical wastes, microorganisms, discharged to the environments directly (Mohan et. al. 2019) The sewage fed fisheries are the major source of fish production and supply to the urban people of Kolkata and adjoining areas.

In sewage the composition and concentration of different chemicals are not known. The bioassay or toxicity test here is useful determine the quality of the water which receives from the waste discharge utilizes for fish production. Every year huge mortality of cultured fishes is observed in East Kolkata Wetlands, most of the farmers are unaware to know the exact reasons. During the study there was no such pathogens found which could indicate the probable reasons of such mortality. Therefore, the toxicity level or bioassay test is the only way to find out the exact reason of such mortality.

Materials and Methods

Site Selection

The sampling has been done in Nalban area (Latitude 22°34'3.36"N; Longitude 88°25'41.02"E).

Study period

The study has been conducted for a period of one year (May 2021 to April 2022) for analysis of bioassay of the sewage effluents discharged in the selected area.

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:2(3), February: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd February 2023
Publication Date:10th March 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.02.57
www.ijmer.in

Collection of Samples

Liquid west samples were collected from Nalban area specially from the mouth of the canals discharging wastewater directly to the pond.

Dilution of the waste

The collected samples of liquid wastes were diluted in different concentration and kept in different aquariums where the test fishes were reared for bioassay. Dechlorinated water was used to dilute the samples. During the study 1, 20, 50, 80 and 100% concentration of sewage effluents are used for the study.

Test procedure

The test animals as far as possible were maintained in the same environment as in the field. The parameters like temperature, pH, alkalinity hardness, dissolved oxygen content of water was maintained during the study as in the field. The test chambers were glass aquariums of same size of following length × breadth × height (80×57×42 cm) 150 l capacity. A control chamber was maintained in every test where the test fishes were kept in dilution water with no effluents.

Test Animals

During the test each chamber were maintained with 20 individual species of fingerling stages of *Tilapia mossumbica*, because the fingerling stages are stocked in wetlands for fish culture practices and most of the mortality of the fishes occurs after the stocking. The test animals are introduced to the test chambers within 1 hour after the effluent is added to the water. The addition of effluent into the dilution water were followed by the swirling the test solution with a glass rod to disperse the test materials immediately.

Experimental Design

The following design were maintained for the test of each species exposing with different concentrations. "T" series is the experimental tanks with different concentration of effluents with different toxicity level. "C" series is the control tanks without any effluents.

$1Ct_1$	$1T_1$	$1T_2$	$1T_3$	$1T_4$	$1T_5$
$2Ct_1$	$2T_1$	$2T_2$	$2T_3$	$2T_4$	$2T_5$
$3Ct_1$	$3T_1$	$3T_2$	$3T_3$	$3T_4$	$3T_5$

"Probit Analysis" is a commonly used parametric technique for analyzing toxicity data. To construct the response curve in the test, the percentage of mortality on vertical axis (Y-axis) against the concentration of sewage effluents on the horizontal axis (X-axis) was plotted. The following formula has been used in data analysis for probit analysis test of the samples –

$$b = \frac{\sum wxy - \bar{x}\sum wy}{\sum wx^2 - \bar{x}\sum wx}$$
$$a = (\bar{y} - b\bar{x})$$

Where, w is the weight of the sample.

In the above equations 'a' & 'b' are the constants where 'a' is the intercept of the straight line on the Y-axis and 'b' is its slope indicating the rate at which 'Y' changes with the change of 'X'.

The best fit to the points should be drawn based on the regression equation (Srinivasan, 2004) –

$$\bar{y} = a + b\bar{x}$$

$$V(m) = V(\log LC\ 50) = \frac{1}{b^2}\left[\frac{1}{\sum w} + \frac{(m-\bar{x})^2}{\sum wx^2 - \frac{(\sum wx)^2}{\sum w}}\right]$$

The upper and lower 95% confidence limits of LC50 (otherwise called fiducial limits)

$$LL\ (lower\ limit) = m - 1.96\sqrt{V(m)}$$

Cover Page

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:2(3), February: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd February 2023
Publication Date:10th March 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf

DOI: http://ijmer.in.doi./2023/12.02.57
www.ijmer.in

$$UL\ (upper\ limit) = m + 1.96\sqrt{V(m)}$$

$$r = \frac{\sum xy - \frac{\sum x \sum y}{n}}{\sqrt{\left[\sum x^2 - \frac{(\sum x)^2}{n}\right]\left[\sum y^2 - \frac{(\sum y)^2}{n}\right]}}$$

Where, n is the number of tests.

Result and Discussion

The result of bioassay is presented in following tables. The average cumulative percentage of mortality for each concentration is tabulated against the effluent concentration.

Table – 1: Mortality rate of *Tilapia mossumbica* in different concentrations of sewage effluents in bioassay experiments (Each concentration tested with 15 fishes).

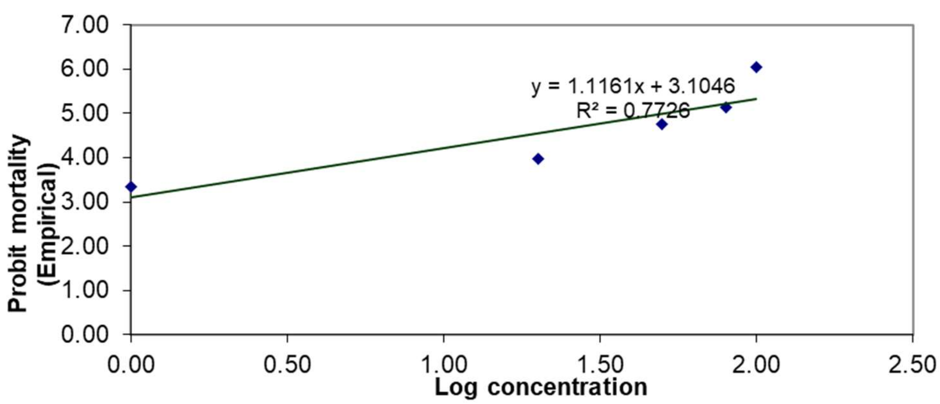
Exposure Periods	Concentration (%) vs Mortality (%)				
(hour)	**1**	**20**	**50**	**80**	**100**
12	5	15	40	55	85
24	10	25	60	85	95

Table – 2: 12 hr. LC 50 of *Tilapia mossumbica* (n=20)

Concentration (%) (x)	Death (%) (y)
1	5
20	15
50	40
80	55
100	85

a = 2.74
b = 1.31
y = 3.1046+1.116x
R^2=0.7726
LC50 = 52.73
LC95 = 941.95

Best-fit (response curve) is -



Upper limit (UL) = 85.51402372
Lower limit (LL) = 32.51286968

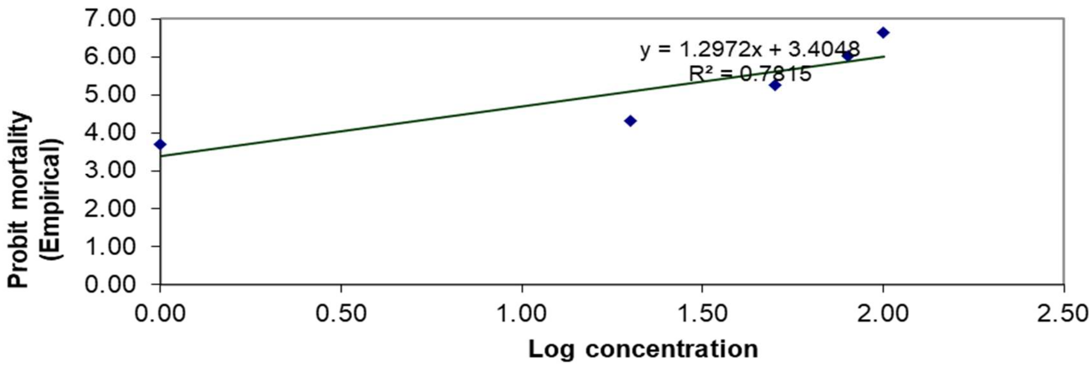
INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:2(3), February: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd February 2023
Publication Date:10th March 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf
DOI: http://ijmer.in.doi./2023/12.02.57
www.ijmer.in

Table – 3: 24 hr. LC 50 of *Tilapia mossumbica* (n=20).

Concentration (%) (x)	Death (%) (y)
1	10
20	25
50	60
80	85
100	95

a = 3.21
b = 1.34
y = 3.4048+1.2972x
R^2=0.7815
LC50 = 21.74
LC95 = 366.73

Best-fit (response curve) is -



Upper limit (UL) = 36.25507975
Lower limit (LL) = 13.03244098

The study indicates the mortality rate is high in higher concentration of effluent mixed in fresh water. The LC50 of different exposure periods along with their fiducial limits are used to construct the bet-fit response curve. The test result shows the acute toxicity at higher concentration. If the concentration is less the fish is better able to metabolize, detoxify and excrete the amount of toxicant enter in the body. Ultimately, an equilibrium can be reached when the rate of uptake of the chemicals is balanced by the loss. The equilibrium concentration is called threshold LC50 or incipient LC50 for the tests used to measure the mortality due to harmful effect.

The other statistical analyses of the bioassay results are –

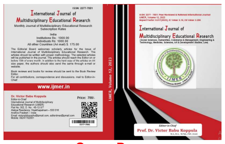
For 12 hrs. test, f = confidence limit = Upper limit/LC50 = 85.51/52.74 = 1.62 is constant.
For 24 hrs. test, f = confidence limit = Upper limit/LC50 = 36.26/21.74 = 1.66 is constant
The upper and lower 95% confidence limits of LC50 otherwise called fiducial limits.

The 95% confidence limit in both cases are narrow, then the result of this experiment is considered to be good statistically.

The current study is similar to Mohapatra, (1999); Mohapatra and Rangarajan, (2000). as he also found that higher effluent concentration is responsible for maximum fish kills.

Kori et. al., (2020) also revealed that the higher concentration waste effluents are the potential threats to the environment, and fish cultivated along with the human beings consumed those fishes. The wastes may affect the aquatic life when discharged directly to the water.

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY EDUCATIONAL RESEARCH
ISSN:2277-7881; IMPACT FACTOR :8.017(2023); IC VALUE:5.16; ISI VALUE:2.286
Peer Reviewed and Refereed Journal: VOLUME:12, ISSUE:2(3), February: 2023
Online Copy of Article Publication Available (2023 Issues)
Scopus Review ID: A2B96D3ACF3FEA2A
Article Received: 2nd February 2023
Publication Date:10th March 2023
Publisher: Sucharitha Publication, India
Digital Certificate of Publication: www.ijmer.in/pdf/e-CertificateofPublication-IJMER.pdf


Cover Page

DOI: http://ijmer.in.doi./2023/12.02.57
www.ijmer.in

The heavy metals in sewage water pose threat to aquatic life continuously because these are not biologically degradable pollutants (Emmanuel et al., 2009; Ortega et al., 2008)

In winter and summer, when the dilution of sewage water is less with freshwater, considerable 'fish kill' happen every year in East Kolkata Wetlands (EKW), when during the monsoon the 'fish kill' decreases considerably. The farmers mostly stock the ponds during the monsoon months helps them to survive maximum fishes at fingerling stages.

Conclusion

The effluents from East Kolkata Wetlands are composed of domestic kitchen wastes, sanitation wastes, agricultural wastes, biomedical wastes containing human anatomical waste, animal waste, microbiology & biotechnology waste, discarded medicines & cytotoxic drugs, heavy metals from different industries. These wastes are very perilous because of the potentially infectious in nature as it may pose a serious threat to human health, if its management is indiscriminate and unscientific. The toxicity test in this study identifies the reason of the maximum fish mortality in EKW was due to the toxic chemicals present in sewage effluents. This study also can help to identify the greater mortality of in winter and summer months when the dilution rate is much less than monsoon months. The unionized ammonia, unionized hydrogen sulphide, pesticides from nearby agriculture field, heavy metals from recycling industries, hospital effluents and others are the major factors for heavy mortality of the fishes during pre and post monsoon months in EKW area.

References

- Chase, J.M. (2007). Drought mediates the importance of stochastic community assembly. Proceedings of the National Academy of Sciences, 104(44): 17430-17434.
- Emmanuel, E., Pierre, M.G., and Perrodin, Y., (2009) Groundwater Contamination by Microbiological and Chemical Substances Released from Hospital Wastewater: Health Risk Assessment for Drinking Water Consumers. *Env Inte*., 35: 718-726.
- Kori, R., Saxsena, A., Mokhle, S., Goutam, V., Kulshreshtha, A., Ramnani, V and Parmar, M., (2020). Bioassay Study of Biomedical Liquid Waste (Treated Effluent) of Bhopal City, Madhya Pradesh, India, International Journal of Research and Review, 7(1): 164-173.
- Mohan, R.R., Nagesh, T.S., Das, A., Sahu, S., Reddy, D.R., and Paturi, A.P., (2019). Physico-Chemical Characteristics of Nalban Wetland of East Kolkata Wetlands, A Ramsar Site, West Bengal, India. *International Journal of Current Microbiology and Applied Sciences*, 8(4): 1264-1275.
- Mohapatra, B.C. (1999). Purna Saline Tract, Maharashtra State: Assessment of ground water quality thorough fish bioassay. D.Sc. Thesis Berhampur University., Berhampur: 101pp.
- Mohapatra, B.C., and Rangarajan, K., (2000). Heavy metal toxicity in the estuarine coastal and marine ecosystem of India, CMFRI Spl. Publication., 69: 1-121.
- Ortega, L.M., Lebrun, R., Blais, J.F., and Hausler, R., (2008) Removal of metal ions from an acidic leachate solution by nanofiltration membranes. *Desalination*, 227: 204-216.
- Panthi, S., Dhakal, M., Thagunna, S.S. and Thapa, B.B. (2014). Status of Wetland in Dhorpatan Hunting Reserve, Nepal. Open Journal of Ecology, 4(05): 245.
- Srinivasan, M.R., 2004. Probit analysis. In Electronic Manual on Pesticides and Environment eds. Palaniswamy, S., Kuttalam, S., Chandrasekaran.S., Kennedy, J. S. and Srinivasan, M. R. 2004. Department of Agricultural Entomology, TNAU, Coimbatore.