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Research Article

Toxicity and behavioural changes in freshwater fish *Tilapia mosaambica* exposed to sugar mill effluent

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Abstract

The aim of the present study is to determine lethal concentration for 50% mortality of sugar mill effluent to fresh water fish *Tilapia mossambica* for 24to 96 hours using bioassay method. The LC50 values of the prepared concentration for 24, 48, 72 and 96 hrs were found at 11, 10.5, 10.1 and 9.5% respectively. At this concentration, erratic swimming, jerky movement, rapid opercular movement leaping out of water and thick mucous covering over the whole body surface were observed during experiments.

Keywords: Sugar mill effluent Toxicity Behaviour *Tilapia mossambica*

Introduction

Acute toxicity tests has been historically played an important role in assessing the effect of human activities on animals and such tests have wide applicability in evaluating the toxicities of various types and mixture of pollutant in fish and other aquatic species [1]. The parameters of short-term (toxicity) exposure are the most common measures of toxicity [2-3].

The importance of potential damage to aquatic ecology by effluent has been advocated and demonstrated [4], informing through various toxicity tests used in the management of water pollution as: to estimate environmental effect of waste, to compare the toxicity of different toxicants in animal, to regulate the amount of discharge pollutant [5].

Increase in industrialization currently is underway, but immediate hazard to mankind, domestic animal, fishes and wild life through its wastes is unpredictable. The sugar mill Industry is one of the oldest industries in our country and there has been tremendous expansion of these industries during last 25 years. Controversially, the sugar mill industry as it stand now, is one of the largest major Industries and contributes lot towards the pollution in our aquatic environment. Looking in to the serious nature of pollution the sugar mill industries in India has been brought under 17th categories, is highly polluting industries.

Sugar mill effluent contains carbonaceous sugar matter, fiber, ligin, cellulose, lime, phosphate of calcium, lactic acid and oil (David and Ray, 1966). Lime and Sulphur di-oxide used for clearing and bleaching processes in sugar mills contribute to the high calcium and sulphate contents of the effluent. The literature reflects that the discharge of sugar mill effluent caused deoxygenating and mortality of fish and other aquatic organisms along the course of the Palaru river.

David and Ray, 1966 [6] reviewed the sugar mill industry as it affects aquatic biology. David and Ray, 1966 **[7]** published an excellent review on the toxicity of effluents from sugar mill. Reported toxicity of kraft wastes to fish prior the work of Ebeling, [8] in Sweden. Many workers since then have confirmed that concentration of kraft mill effluents needed to kill fish ranged 10 to 100 percent.

The present sugar deals with the toxicity and behavioral changes in *Tilapia mossambicus* exposed to lethal concentration of sugar mill effluent.

Materials and Methods

Fresh water fishes *Tilapia mossambica* were collected from Ponneri lake flowing near Tiruvalluvar District. The live fishes were brought to the laboratory and kept in glass aquaria under normal conditions for a week. During acclimatization fishes were fed with earthworm pieces. The sugar mill effluent was collected directly from the Chengalpet sugar mill industries near Kancheepuram District. The Physico-chemical characteristics of test water and sugar mill effluent have been analyzed during experimentation [9] and the bioassay method [10] to knowLC values of effluent. The fishes, *Tilapia mossambica* (8 to 8.5 cm in length and 4 to 5.5gm in weight) were selected for LC determination. 50 Preliminary experiments at different percentage of sugar mill effluent were conducted to find percentage that resulted in 50% mortality in given time. For experimentation, laboratory acclimatized fishes were exposed to different dilution percentage of sugar mill effluent.

The water in test aquaria was changed every 24 hours and was supplied with full aeration. A batch of 10 fishes was also maintained along with experimental fishes as control group. The changes in behaviour of *Tilapia mossambica* exposed to effluent were critically observed during the experiment.

Results

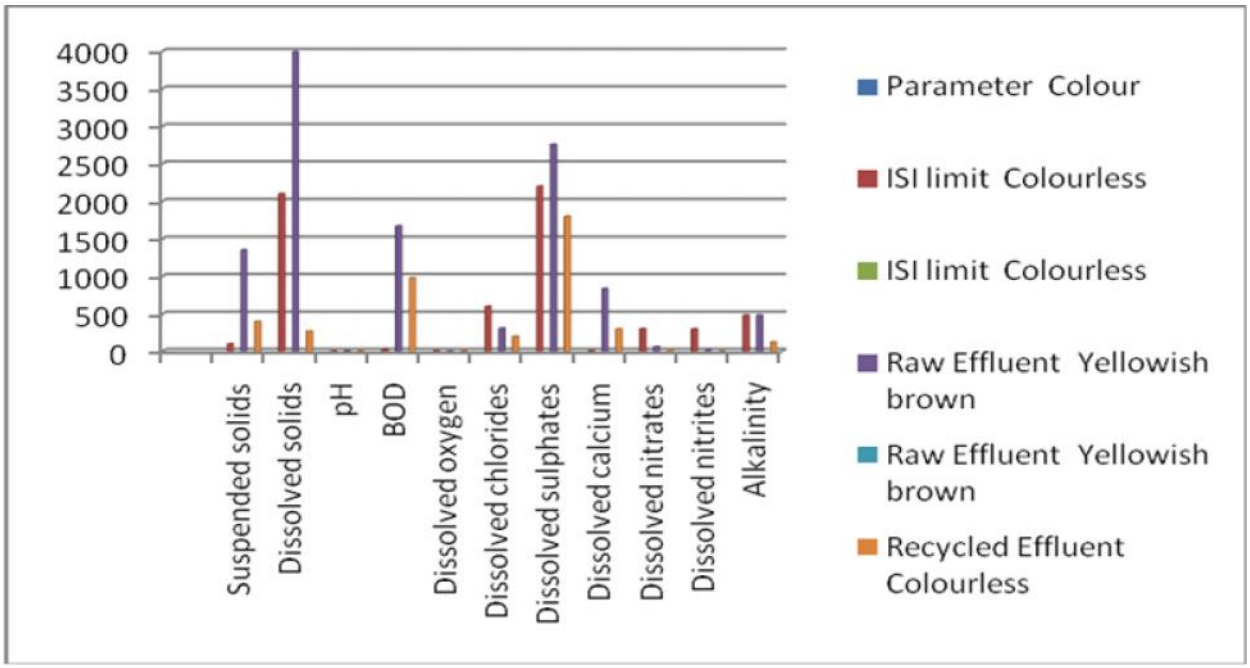
Fishes exposed to lethal concentration of sugar mill effluent for a short-term exposure were studied in terms of general behaviour, rate of survival and mortality.

The LC50 values of freshwater fish *Tilapia mossambica* exposed for 24, 48, 72 and 96hrs have been recorded at 11%, 10.5% and 10.1%. 9.5% dilution of effluent respectively. The LC50 value regression results have been calculated to support present observations.

Table. 1. Physico Chemical characteristics of raw and recycled sugar mill effluent

Parameter	ISI limit	Raw Effluent	Recycled Effluent
Colour	Colourless	Yellowish brown	Colourless
Suspended solids	100	1352	400
Dissolved solids	2100	3990	269
pH	5.5-9.0	5.0	6.5
BOD	30	1670	980
Dissolved oxygen	6.0	Nil	4.5
Dissolved chlorides	600	309	200
Dissolved sulphates	2200	2759	1800
Dissolved calcium	7.5	835	300
Dissolved nitrates	300	60	20
Dissolved nitrites	300	25	0.45
Alkalinity	482	482	125

Fig. 1. Physico Chemical characteristics of raw and recycled sugar mill effluent



The fish, *Tilapia mossambica* when exposed for 24 hrs exhibited abnormal behaviour. It is noticed that at this concentration a sudden terse was laid on the animal, which entailed in erratic swimming, convulsion, jerky movement and rapid opercular movement. The fish struggled hard for breathing some time engulfing atmospheric air and avoided to toxic medium. The fishes were tried to leap out the toxic medium and a thick mucous covering over the whole body surface.

Discussion

The freshwater environment is going to be polluted by various pollutants which have adverse effects on aquatic organisms. The effluent freshwater organisms particularly fishes are more susceptible to these pollutants. Since, their habitats are confined and escape from such polluted habitats is impossible.

The effects of pollutants are generally characterized on survival, reproduction or growth due to physiological alteration in the animal. The physical, chemical and biological components of the environment play an important role in the manifestation of biological response to pollutants. The toxicity of particular pollutants depend upon many factors such as animal weight [11], developmental stages [12], period of exposure and temperature, pH, hardness of water and dissolved content of the medium, [13-14].

The response of animal to toxic medium is important since it reflect the internal changes. Muley and Karanjkar [15] reported the electroplating effluent was more toxic than that of tannery and textile wastes and imposed the disability in test fish *Labeo rohita*. The treated fishes were shown adverse effects on body posture and colour i.e. it turns pale white with opened mouth on toxicity of organophosphate manifested by inhibition of AchE [16]. On exposure to Nuvan in *Clarias batrachus* show significant change in opercular colour were observed. Bhattacharya and Mukherjee movement, locomotory, behavioural as well as body reported that the industrial effluent affect normal vision, proper body motion and behaviour of the organism.

During present study fish, *Tilapia mossambica* showed hyper excitation, erratic swimming, convulsions, jerky movement and rapid opercular movement and thick mucous covering over the whole body surface. Similar results were observed *Labeo rohita* and *Channa punctatus* exposed to paper mill effluent.

Murthy *et al*, [17] reported the toxicity of sugar mill effluent to fish *Puntius sophor*. Tests were conducted in two groups. In first group dilution were aerated. Where, as in group second dilutions were not aerated LC50 for 96 hour was estimated at 1.5% whereas in fish, second test it was recorded at 16.5%. Kandeepan et al., [18] reported the toxicity of sugar mill effluent

to fingerlings of *Channa striatus* and reported LC50 for 96 hrs. The 96 hrs LC50 value of paper and pulp mill effluent was 6% respectively. Haniffa, *et al.,* [19] studied toxicity of sugar mill effluent. The LC50 values were found at 63.09, 80.35 and 8128 % for *Anabus testudineus, Channa punctatus and Clarias batrachus* respectively. This indicates that *Anabus testudineus* is most susceptible, while *Channa punctatus* and *Clarias batrachus* were resistive.

Stalin *et al,* [20] calculated the LC50 of synthetic pyrethroid deltamethrin and a Neem based pesticides, azadirachtin to *Poecilia reticulata.* The 96 hrs LC50 value of deltamethrin was 0.0019 and azadirachtin was 0.011 mg/l.

In the present study the LC50 values were calculated for different concentration of effluent for 24 to 96 hrs exposure period. The data indicate that decrease in LC50 concentration is associated with increase in duration of exposure. Toxicity of the effluent mostly depends on the uptake of the effluent by the body. The rate of uptake is determined by the ratio of the permeability of body surface in contact with the medium to volume or weight of exposed animal and similar with relationship persists between the rate of metabolism and weight of animal [21].

During the estimation of LC50 value for survival rate of *Tilapia mossambica* was decreased as increase in the concentration of paper mill effluent. The exact cause of death is ill defined as there are number of channels. The death may be the result of severe physiological stress at cellular level. The physiological stress may be responsible for the death of fish [22].

It is also noticed that, the toxicity of the sugar mill effluent is attributed synergistically to the physical factors of medium i.e. high COD and BOD values besides low pH and low dissolved oxygen (DO).

Thus it is concluded that the effluent is not safe to of non-target organisms like fishes. This type of study can be useful to compare the sensitivity of various species of conducted aquatic animals and potency of effluent using LC values not and to derive safe concentration. Changes in behaviour of aerated. *Tilapia mossambica* due to paper mill effluent stress can be used as a biological indicator of pollution as biological early alarm system of the paper mill effluent stress can be used as a biological indicator of pollution as biological early alarm system of the paper mill effluent.

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