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Full Length Research Paper

Influence of Distillery Effluent on Survivability, Growth, Limb Bud Emergence and Metamorphosis on Tadpoles of *Fejervarya limnocharis* (Anura: Ranidae)

Mahesh, M.
Department of Environmental Science, Kuvempu University, Shivamogga, Karnataka-577451, India

Abstract
Approximately around 40 billion liters of distillery effluents is producing in India and the disposal of these effluents contaminated with high organic load is causing a serious problem. Distillery effluents contain many contaminants such as sulphate, phosphate, cadmium, lead, copper etc., that may affect the normal functioning of terrestrial and aquatic life. As part of land application of effluent contribute to the direct contact of contaminants and amphibians. The paper discuses the effect of five different sub lethal concentrations of distillery effluents (0%, 1%, 2%, 5% and 10%) on survivability, growth and metamorphosis of Fejervarya limnocharis . In the present investigation, it was found that as the concentration of effluent increased the survivability; growth rate and metamorphosis were decreased when compared to control. Similarly, compared to higher concentration (10%) the effect of effluents is reduced in the lower concentrations (1%, 2%, and 5%) of effluents. Although, limited work and information available on the influence of distillery effluent on amphibians, attempt has been made to know the effect of different concentration of effluent on amphibians. The result indicates that, the survivability, growth and metamorphosis were affected in higher concentration of distillery effluents rather than in its lower concentration.

Key words: *Distillery effluent, Fejervarya limnocharis, Growth, Metamorphosis, Survivability, Tadpoles.*

Introduction

Industrial revolution has been a great asset to mankind but at the same time there is a wide range of environmental impacts created by industrial sector. In India large scale efforts are on for agro-based sector to utilize the agro wastes and to add value to agriculture (Sharma et al., 2007). The major agro-based industry in India is distillery and sugar mills. Distilleries are considered to be one of the largest waste water sources when compared to other industries (Malaviya and Sharma, 2011). Alcohol Production from distillery industry from sugarcane based molasses is considered as one of the popular industrial sectors in India and these industries plays major role in the environment pollution (Rita et al., 2008). In distillery for every litre of alcohol produce, nearly 12-15 litres of spent wash generally know as effluent, so nearly 40 billion liters of effluents with high organic load and salts are produced annually and its safe disposal is a great problem (Padmaja and Joshi, 2010). As distilleries are one of the 17 most pollution industries listed by Central Pollution Control Board (Malaviya and Sharma, 2011), the discharge of these effluents into aquatic ecosystems and even into the adjoining field without any pretreatment has been increasing in most of the developing countries (Ramakritinan et al., 2005). The contaminants such as heavy metals, sulphate, phosphate, chloride, magnesium and other trace elements has been contributed for the pollution of both soil and aquatic body . Discharge of effluents into aquatic body depletes the dissolved oxygen content and by interfering with respiratory metabolism cause heavy mortality of many living organisms (Quesim and Siddique, 1960; Venkataraman, 1966; Hingoroni et al., 1979). Generally most of it is either discharged in natural water courses causing the problem of water pollution and directly effecting on survivability aquatic organisms. At the same time farmers have been extensively using these effluents for irrigation, and it as noted that the growth, yield and soil fertility were reduced (Ayyasamy et al., 2008), meanwhile after the saturation point these effluents will reach nearer aquatic body and contaminates it. Various agro-chemicals which are increasingly used by the farmers also contribute to the contamination of aquatic ecosystem.

Amphibians and in particular frogs are widely used as bioindicators of accumulation of pollutants (Vogiatzes and Loumbourdis, 1998; Loumbourdis and vogiatzes, 2002; Papadimitriou and loumbourdis, 2003). Amphibians because of their unique nature they are found both in aquatic and terrestrial habitats and get exposed to various kinds of chemical contaminates like the one discharged by distillery effluent into the agricultural land. Consequently, the organisms present in the aquatic body can get exposed to either to single and multiple contaminants. In the present experiment attempt has been made to examine the influence of different concentrations of distillery effluents on survivability, growth and metamorphosis of a common Indian toad *Fejervarya limnocharis* in the laboratory mesocosm and this experimental study also compares the effects of five subleathal concentrations of distillery effluent.

Materials and Methods

Egg mass

Egg mass of *F. limnocharis* were collected during monsoon in a pond near Shankaraghatta, Shimoga, Karnataka. The egg mass were transported to the laboratory and maintained at 22-23ºC in chlorine free tape water till hatching. After hatching the tadpoles were maintained in aged chlorine free tap water until it reaches Gosner 25stage (Gosner, 1960). The tadpoles were fed with boiled leaves

and acclimatized to laboratory condition. After reaching gosner 25 stage, 20 randomly selected almost equal sized tadpoles were released into the test solution.

Preparation of test Concentrations

The effluent samples were collected from Mandy distillery unit located in Karnataka. It was transported to the laboratory and it was kept for aeration to reduction the foul odour. After the reduction in odour the test concentrations such as 0, 1, 2, 5%and 10% were prepared in duplicate using aged chlorine free tap water and after acclimatization 20 tadpoles are released in each container of different concentrations distillery effluents. Test solutions are aerated through 30 minutes for each day. The number of tadpoles survived, weight, limb bud emergence and metamorphosis were recorded till the end of the experiment. Frogs were fed every alternate day ad libitum before metamorphosis and with insects after metamorphosis collected from nearby naturally grown grass. The pH and temperature of the test solution throughout the experiment was maintained at 7.0 - 7.2 and 22 - 24ºC respectively.

Result

In the present study, the tadpoles of *Fejervarya limnocharis* were released into five sublethal concentrations of distillery effluent to assess its survivability, growth and metamorphosis rate in the laboratory mesocosm. Tadpoles exposed to lower concentrations (0, 1, 2, and 5%) of effluent not showed much deviation in survivability when compared to its higher (10%) concentration (Figure 1). Meanwhile not much difference was observed till 21 days, but after 28 days the survivability tends to decrease gradually in all concentrations except control. But on the other hand after 35 days the survivability of tadpoles shows marked decrease in the higher (5 and 10%) concentration (Figure 1). No much difference was in survival of tadpoles among the treatments of lower concentrations (1 and 2%).

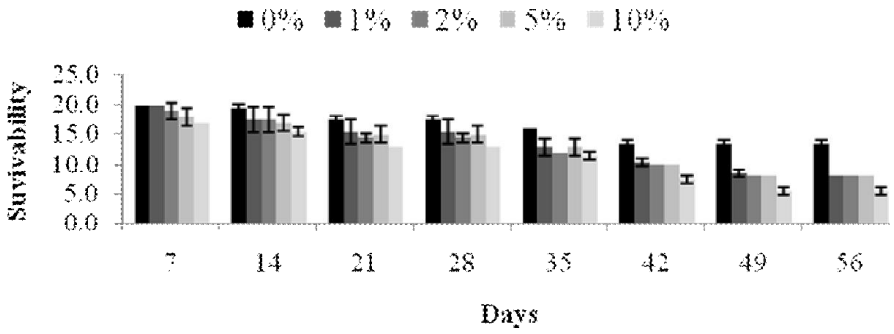

Fig 1. Survivability of Tadpoles in different concentration of Distillery effluent

The body weight of *Fejervarya limnocharis* shows not much difference those reared in lower concentrations concentration (0%, 1%, 2%, and 5%), when compared to its higher effluent concentration (10%) Figure 2. It is noted that compared to its lower concentration (0, 1, 2, and 5%) the weight of the tadpoles were decreased in the higher (10%) concentration (Figure 2). It was also observed that the weight of the tadpoles in the lower concentrations (0, 1, 2, and 5%) was showed not much difference till 35 days (Figure 2), but there was found to be significant decrease in the weight of tadpoles in higher concentration (10%) throughout the experiment.

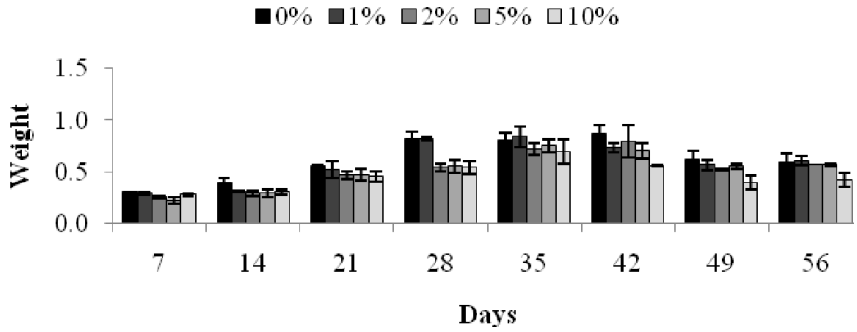

Fig 2. Mean weight of Tadpoles in different concentration of Distillery effluent

Emergence of hind limb bud took 30 days for the tadpoles exposed to control (0%), followed by those reared in, 2, 5% and 10% (42nd, 43rd and 48th day) Figure 3. The tadpoles exposed to higher concentration (10%) showed much slow emergence in hind limb when compared to lower concentration (0, 1, 2 and 5%). Emergence of fore limb was also much earlier (45th day) for tadpoles exposed in control (0%), on the other hand it took 49th, 53rd and 59th days in, 2, 5 and 10% respectively. Throughout the experiment it was noted that, there was no significant differences found in the weight of tadpoles those exposed to lower concentration (0, 1, 2 and 5%) compared to those exposed to its higher concentration (10%) Figure 3.

Figure 4 shows the complete metamorphosized tadpoles of *F. limnocharis*. Among all the concentrations the tadpoles those reared in control (0%) took shortest period of 49 days to complete metamorphosis and as the concentration increased (1, 2, 5 and 10%) the tadpoles took longer time to complete metamorphosis (Figure 4).

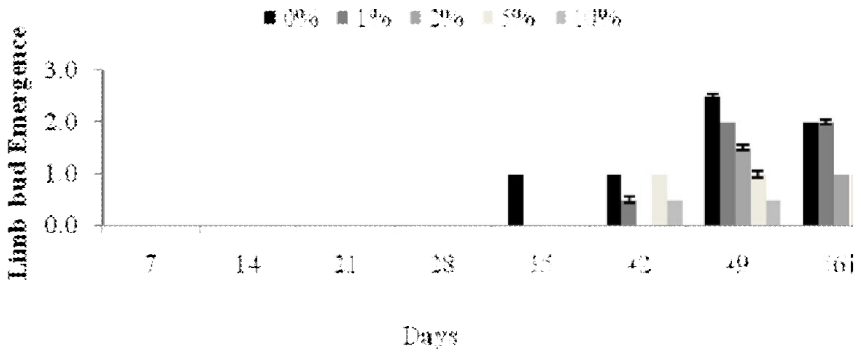

Fig 3. Limb bud emergence of Tadpoles in different concentration of Distillery effluent

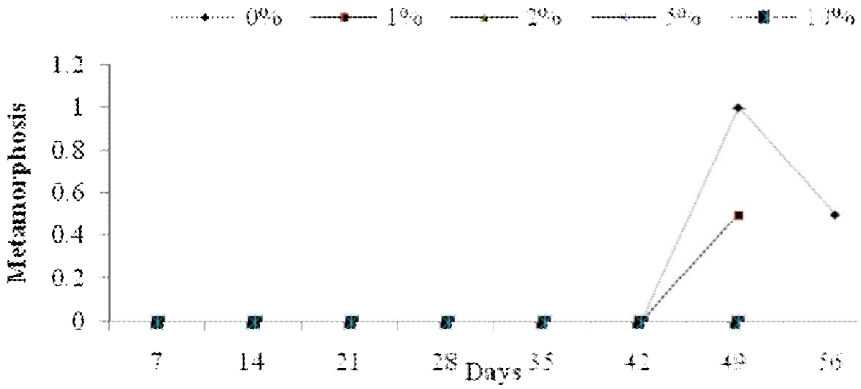

Fig 4. Metamorphosis of Tadpoles in different concentration of Distillery effluent

Discussion

The present investigation was taken to study the effects of distillery effluent in different concentrations on *F. limnocharis* particularly with regard to the tadpoles and its metamorphosis. Body size in poilkilotherms is controlled by differences in environmental circumstances such as food availability and larval density (Hota and Dash, 1981). We observed if there is increase in the concentration of distillery effluent showed decrease in survivability and growth rate of tadpoles. David in 1956 showed that, the total dissolved solids present in high concentration in the distillery effluent contribute to impairment of respiratory metabolism. Discharge of spent wash into the fresh water system results in the formation of ferric ions, which affect respiratory activity in fish (Sharma et al., 1973). Only few reports are available on the impact of distillery effluents on amphibian larvae (Gate et al., 1978) and those reports only deals with teratogenic and embryological properties and do not reveal any information on growth and metamorphosis. Haniffa et al., (1985) showed that toxic agents inhibit the development of the animal are likely to be destructive even if the adults of a particular species are apparently unaffected. Pesticides (malathion) showed the delayed metamorphosis in *B. americanus* and *R. sylvatica* (Smith et al., 2011).

The present experiment reveals that Survivability and growth of tadpoles showed a marked difference in the higher concentration (10%) when compared to its lower concentrations. In its lower concentration the survivability and growth was increased and that of higher concentration was decreased. Haniffa and Sundaravadhanam (1984) through their experiment showed increased growth rate of *Barbus stigma* due to more food consumption which were exposed to lower concentration of distillery effluents. Limb bud emergence and metamorphosis occurred earlier in control group when compared to the different concentration of effluents, however when compared to its higher concentration (10%) of effluents the tadpoles in lower concentration showed quick metamorphosis. It has also been confirmed by Barnabas (1983), that decrease in the duration of metamorphosis and an increase in body weight of *R. malabarica* exposed to lower concentrations(up to 12%) and at higher concentrations (15% and above).

Conclusion

Our experiment also suggests that *F. limnocharis* is very susceptible to higher concentration of distillery effluent (10%) when compared to its lower concentration (0%, 1%, 2% & 5%) with respect to survivability, growth. limb bud emergence and

metamorphosis. Hence, the outcome of the present experiment suggests that, any increase in the concentration of distillery effluent either on land or on aquatic ecosystem will be lethal to amphibians population.

References

Ayyasamy P.M, Yasodha R, Rajakumar S, Lakshmanaperumalsamy P, Rahman P.K.S.M and Sanghoon Lee. (2008). Impact of sugar factory effluent on Hrowth and biochemical characteristics of terrestrial and aquatic plants. Bull. Environ. Contam. Toxicol. 81:449-454.

Barbnabas X. (1983). Studies on the effect of distillery effluent on the metamorphosis of Rana malabarica. M.Sc. Dissertation, Madurai Kamaraj University, Madurai.

David A. (1956). Studies on Pollution of Bhadravathi (Mysore State) with industrial effluents Proc. Inst. Sci. India 228: 122-60.

Ghate H.V, Dodakundi G.B and Leela Mulherkar. (1978). Effect of dye factory effluent on the developing embroyes of Microhyla ornate. Indian J. Environ. Health. 20: 359-365.

Gosner K.L. (1960). A simplified table for staging anuran embryos and larval with notes on identification. Herpetological 16: 189-190.

Haniffa M .A, Stephen T De Souza S.J, Murugesan A.G and Barnabas Xavier. (1985). Influence of distillery effluent on growth and metamorphosis of Rana malabarica (Bibron). Proc. Indian Acad. Sci. (Anim. Sci.). 94: 111-116.

Haniffa M.A and Sudaravadhanam S. (1984). Effect of distillery effluent on histopathological changes in certain tissues of Barbus stigma. J. Environ. Biol. 5: 57-60.

Hingorani H.G, Divan A.D and Chandrasekhran N (1979). Oxygen consumption in fish Labeo rohita under exposition to different concentration of industrial effluents.Comp. Physiol. Ecol. 4: 272-276.

Hota A.K and Dash M.C. (1981). Growth and metamorphosis of Rana tigrina larvae; effects offood level and larval density; Oikos 37: 349-352.

Loumbourdis N.S and Vogiatzis A. (2002). Exposure of the frog Rana ridibunda to copper. The impact on two biomarkers, the lipid peroxidation and glutathione. Bull. Environ. Contam. Toxicol. 69:885-891.

Malaviya P and Sharma A. (2011): Impact of distillery effluent on germination behavior of Brassica napus L. J. Environ. Biol. 32(1). 91-94.

Papadimitriou and Loumbourdis (2003). Impact of cadmium on liver pigmentary system of the frog Rana rudibunda.Arch. Environ. Contam. Toxicol. 34(1):64-8.

Padmaja V.K and Joshi H.C. (2010). Application of Distillery effluents on agricultural land: Is it a win-win option for soil and environment. 19th World Congress of soil science, Aug 2010, Brisbane.

Quesium S.Z and Siddique R.H (1960). Preliminary observations on the river kali caused by the effluents of industrial waste. Currnt. Sci 29:310-311.

Rita A, Jha P.K and Belbase N. (2008). Effects of distillery effluent on some agricultural crops: a case of environmental injustice to local farmers in khajura vdc, banke. Scientific World, Vol. 6.

Ramakritinan C.M, Kumaraguru and Balasubramanian. (2005). Impact of distillery effluent on Carbohydrate metabolism of freshwater fish, Cyprinus carpio. Springer Science + Business media, Inc. printed in the U.S.A 14: 693-707.

Sharma P, Setia R.K and Dutta S.K. (2007). Potential use of Distillery effluent in agriculture: An appraisal. Indian J. Ecol.34 (1): 50-53

Sharma K.D, Bhatt N.M, Kantawala D and Lyengar M.R.S. (1973). Studies on aerobic cultivation of yeast to reduce pollution potential of distillery wastes. Indian J. Environ. Health 15: 116-8.

Venkataraman G. (1966). A note on the occurrence of large scale fish mortality along the Chaliyar River near Beypore .J Mar. Biol. Assoc. India. 8: 224.

Vogiatzis A and Loumbourdis N.S (1998). Cadmium accumulation in liver and kidney and hepatic metallothionein and glutathione levels in *Rana ridibunda*, after exposure to $CdCl_2$. Arch. Environ. Contam. Toxicol, 34: 64-68.