J.Natn.Sci.Foundation Sri Lanka 2018 46 (4): 539 - 546
DOI: http://dx.doi.org/10.4038/jnsfsr.v46i4.8629

RESEARCH ARTICLE

Assessing toxicity of two industrial zone effluents reaching Kelani River, Sri Lanka

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Revised: 03 April 2018; Accepted: 25 May 2018

Abstract: Evaluation of the efficacy of waste treatment technologies of industrial waste is a major challenge for sustainable industrial development world-wide. Hence, new strategies are needed to assess interactive toxic effects of all substances present in the treated waste. This study assessed potential toxic hazards of treated effluents discharged from common wastewater treatment plants of two industrial zones located in the Kelani River basin using *Allium cepa* (common onion) test system. The results showed that the final effluents of both industrial zones under undiluted and diluted (1:8 v/v) conditions induced cytotoxicity on all occasions, with evidence of significant ($p < 0.05$) mito-depression in the root meristem and retardation of root growth in *A. cepa*. Genotoxic hazard of the effluents was evident by frequent increase of nuclear and chromosomal abnormalities, and occasional development of micronuclei in the root meristem. Dilution of the effluents to 1:8 reduced the genotoxic effects generated in *A. cepa* roots by the final effluents. The results revealed that waste treatment technologies in these two industrial zones need to be upgraded in order to eliminate cytotoxic and genotoxic hazards associated with the treated effluents. The results highlight the importance of incorporating practically feasible bioanalytical tools such as *A. cepa* root based test system on a regular basis for evaluating the efficacy of waste treatment technologies.

Keywords: *Allium*, industrial zone effluent, Kelani River, toxic hazard identification.

INTRODUCTION

Evaluating the effectiveness of waste treatment technologies is a major challenge for sustainable industrial development world-wide. Different types of anthropogenic chemicals including the 'contaminants of emerging concern' are being detected in treated wastewaters globally and there is increasing evidence of adverse environmental effects related to wastewater treatment plant discharges (Prasse *et al.*, 2015). Conventional effluent monitoring approach using a selected set of physico-chemical parameters is unable to detect all potentially hazardous substances present in complex industrial wastewater samples including 'transformation products' that can be formed during wastewater treatments (Vasquez & Fatta-Kassinos, 2013; Prasse *et al.*, 2015; Papa *et al*., 2016). In view of sustainable industrial development, new strategies are needed to assess interactive toxic effects of all substances present in the industrial waste even after the final treatments.

For regulatory purposes, tolerance limits have been established for a set of physico-chemical and microbiological parameters (Anonymous, 2008) of industrial effluents discharged into inland surface waters of Sri Lanka (BOI, 2011). However, no attention has yet been given in the national regulations for assessing toxic hazards of these industrial effluents using bioanalytical tools. Among the major rivers in Sri Lanka, Kelani River is considered as the largest recipient of industrial waste (Ileperuma, 2000; Mahagamage *et al*., 2016). The river serves as the habitat for diverse flora and fauna (Silva, 1996) and also as a main drinking water source to general public in the area (Mahagamage & Manage, 2014). Effluents generated from common wastewater treatment

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