Cytogenotoxicity of raw and treated dairy manure slurry by two-stage chemical and electrocoagulation: An application of the Allium cepa bioassay

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Abstract

Livestock farming is an essential agricultural practice. However, the improper management of livestock wastes and discharge of untreated or partially treated livestock manure slurry poses significant environmental problems. In this study, we aimed to compare the cytogenotoxic potential of untreated and treated dairy manure slurry treated with a two-stage chemical and electrocoagulation (EC) using the Allium cepa bioassay. The A. cepa bioassay is a well-established standard tool for assessing the cytogenotoxic effects of environmental contaminants, especially those that are occurred as complex contaminant mixtures. The dairy manure slurry was subjected to chemical treatment utilizing polyaluminum chloride (PAC) and cationic polyacrylamide (CPAM) at optimized conditions, followed by EC utilizing either aluminum (Al) or steel anodes. The treated and untreated samples were then evaluated for their potential cytogenotoxicty using the A. cepa bioassay, by measuring the nuclear abnormalities (NAs) and chromosomal aberrations (CAs), along with the mitotic indices (MIs). Our findings revealed a significant reduction in cytogenotoxic indicators in the treated liquid fraction compared to the untreated dairy manure slurry. Specifically, the frequency of total NAs showed a significant reduction from 154 ‰ to 37 ‰ when the dairy manure slurry was treated with chemical coagulation followed by EC utilizing an Al anode. Moreover, the MI exhibited a significant improvement from 7 ‰ to 123 ‰,

suggesting the mitigation of toxic effects. These results collectively demonstrate the effectiveness of the two-stage chemical and EC treatment under optimal conditions in treating diary manure slurry while reducing its cytogenotoxicity for living systems. The A. cepa bioassay proved to be a sensitive and reliable method for assessing the toxicity of the treated samples. The efficient solid–liquid separation and the reduction of toxicity in the liquid fraction for biological systems achieved through this treatment process highlight its potential for sustainable management of livestock waste and the preservation of water quality. Nevertheless, further studies are required to assess the toxicity of solid fraction.

Citation

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