TERATOGENICITY OF WHOLE PULP AND PAPER MILL EFFLUENT ON ENDEMIC *XENOPUS LAEVIS* IN RIVER NZOIA, KENYA.

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ABSTRACT

Pulp and paper mill effluent contamination is a potential hazard on aquatic organisms and humans downstream of River Nzoia. Although attempts to detoxify the effluent by biological treatment is carried out at Pan African Paper Mill factory, further studies to innovate effective means to remove effluent color are needed in view of the massive discharge of effluent and importance of the river. The general objective of this study was to evaluate whole effluent toxicity (WET) of pulp and paper mill into River Nzoia and evaluate the efficacy of detoxification of effluent by use of a Moi University's Innovative color removal technology - using sensitive *Xenopus laevis* embryos at midblastula to early gastrula developmental stages.

Embryotoxic, developmental and teratogenic effects were assessed in the frog embryo teratogenesis assay-*Xenopus* (FETAX). Decolorization was achieved by electrochemical color removal methods. Embryos were exposed to serial dilution (1.5, 3, 6, 12, 25, 50 and 100%) concentrations of whole effluent, whole effluent-ELCASH decolorized and whole effluent ELCMIJ decolorized. FETAX media was electrochemically treated. In the standard FETAX test, 25 embryos were placed in a 10 ml test media that was renewed daily, and incubated at 22 ± 2°C for 96-h. Upstream water was used to check the status of the river and was also electrochemically treated.

Whole effluent elicited embryotoxicity, 96-h LC_{50} 16.60 ± 0.3% (95% CI 15.4 – 17.8) and TI = 1.3, however, toxicity was reduced 1.5 folds in both whole effluent-ELCASH decolorized and whole effluent-ELCMIJ decolorized. The EC_{50} values for whole effluent, whole effluent-ELCASH decolorized and whole effluent-ELCMIJ decolorized were 12.3 ± 0.3% (95% CI 10.4- 13.9), 17.8 ± 0.4% (95% CI 16.1 – 19.4) and 15.8% (95% CI 14.2–17.4), respectively. Decolorized and whole effluent induced malformations in *X. laevis* embryos with gut malformation as the most frequent abnormality. Single gut coiling extruding from the embryo was unique to whole effluent. There was significant difference in embryo lengths exposed to whole effluent. Treatment of upstream water reduced embryo mortality and improved growth of embryos except in upstream-ELCONL treated water with edema and tail flexures as the predominant aberrations.

These observations indicate that whole effluent contains one or more chemicals or mixtures that induce embryotoxicity in *Xenopus.* It is postulated that decolorization of the effluent reduces the effluent toxicity and enhances growth of embryos. It is therefore necessary for Pan Paper to incorporate the coagulant-electrochemical color removal method to reduce harmful effects to aquatic organisms in River Nzoia.