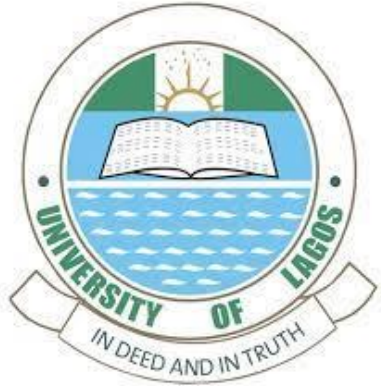


SURFACE WATER POLLUTION AND AGRICULTURAL PRODUCTION: CASE STUDIES FROM NIGERIA



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October 27, 2023

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Lecture Outline

- Introduction
- Surface Water Pollution
- Pollutants associated with Agricultural Activities
- Case Studies from Nigeria

Introduction



Ebadi et al., 2020

- Surface Waters are an inherent part of the natural environment which has capacity to rejuvenate itself to support the life forms therein and ecosystem services.
- However, man's activities mostly stemming from his quest for socio-economic development is adversely affecting the quality of surface water beyond its natural capacity to rejuvenate.

Surface Water Pollution

- Surface Water Pollution may be referred to as the introduction of substances into water bodies in amounts at which they cause harm to living organisms therein including adversely impacting the ecosystems services they provide to man.

Ebadi et al., 2020



Pollutants associated with Agricultural Activities

TABLE 1 | Categories of major water pollutants in agriculture and the relative contributions of the three main agricultural production systems

Pollutant category	Indicators/examples	Relative contribution by:		
		Crops	Livestock	Aquaculture
Nutrients	Primarily nitrogen and phosphorus present in chemical and organic fertilizers as well as animal excreta and normally found in water as nitrate, ammonia or phosphate	***	***	*
Pesticides	Herbicides, insecticides, fungicides and bactericides, including organophosphates, carbamates, pyrethroids, organochlorine pesticides and others (many, such as DDT, are banned in most countries but are still being used illegally and persistently)	***	-	-
Salts	E.g. ions of sodium, chloride, potassium, magnesium, sulphate, calcium and bicarbonate. Measured in water, either directly as total dissolved solids or indirectly as electric conductivity	***	*	*
Sediment	Measured in water as total suspended solids or nephelometric turbidity units – especially from pond drainage during harvesting	***	***	*
Organic matter	Chemical or biochemical oxygen-demanding substances (e.g. organic materials such as plant matter and livestock excreta), which use up dissolved oxygen in water when they degrade	*	***	**
Pathogens	Bacteria and pathogen indicators. E.g. <i>Escherichia coli</i> , total coliforms, faecal coliforms and enterococci	*	***	*
Metals	E.g. selenium, lead, copper, mercury, arsenic and manganese	*	*	*
Emerging pollutants	E.g. drug residues, hormones and feed additives	-	***	**

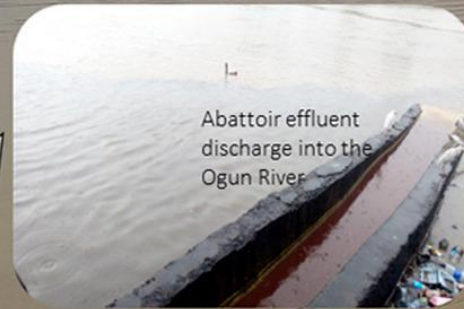
Ebadi et al., 2020

Case Studies from Nigeria



Citation: Olaniran, E.I., Sogbanmu, T.O. & Saliu, J.K. Biomonitoring, physico-chemical, and biomarker evaluations of abattoir effluent discharges into the Ogun River from Kara Market, Ogun State, Nigeria, using *Clarias gariepinus*. *Environ Monit Assess* 191, 44 (2019). <https://doi.org/10.1007/s10661-018-7168-3>

Case Studies from Nigeria, Cont'd

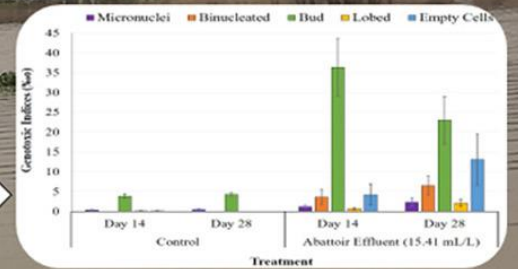


Catfish (*Clarias gariepinus*)

Sublethal abattoir effluent concentrations

Catfish (*Clarias gariepinus*)

Abattoir Effluent



Haematological indices in exposed fish significantly different ($p < 0.05$) from control fish

- Most physicochemical parameters; Fe & Pb > set limits
- Antibiotics – BDL
- 5 Microalgae spp. identified

Citation: Oyeniran, D. O., Sogbanmu, T. O., & Adesalu, T. A. (2021). Antibiotics, algal evaluations and subacute effects of abattoir wastewater on liver function enzymes, genetic and haematologic biomarkers in the freshwater fish, *Clarias gariepinus*. *Ecotoxicology and environmental safety*, 212, 111982.



Original Article

Sublethal concentrations of dichlorvos and paraquat induce genotoxic and histological effects in the *Clarias gariepinus*

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Abstract

Non-target aquatic organisms such as fish may be impacted by agricultural activities through the run-off of pesticides from farms into aquatic ecosystems. In this study, the genotoxic (erythrocytic micronuclei) and histological effects of sublethal concentrations (1% and 10% of 96-h median lethal concentration (LC₅₀) values) of two pesticides (dichlorvos and paraquat) were evaluated in *Clarias gariepinus* (the African Sharptooth Catfish) for 28 days. The 96-h LC₅₀ of dichlorvos and paraquat against fingerlings of *C. gariepinus* was 730 µg/L and 50 µg/L, respectively. There was a significant dose-dependent increase ($p < 0.05$) in micronuclei in the erythrocytes of exposed *C. gariepinus* (2.00 ± 0.82 ‰ to 3.25 ± 1.26 ‰ for dichlorvos and 2.25 ± 0.96 ‰ to 4.75 ± 0.96 ‰ for paraquat) compared to control (0.75 ± 0.96 ‰) by day 28. Gill histological alterations such as mild to severe necrosis and blunting of secondary lamellae were observed in *C. gariepinus* exposed to higher sublethal concentrations of both pesticides. This study showed that non-target aquatic organisms like *C. gariepinus* may be at risk of adverse biological effects from exposure to pesticides from non-point sources. We recommend [environmental monitoring and sensitization on responsible pesticide use to stakeholders](#). This will [forestall potential adverse ecological effects in aquatic ecosystems](#).

Keywords: Erythrocytes; Gills; Aquatic organisms; DNA damage; Pesticides, Catfish

Case Studies from Nigeria, Cont'd

Citation: Oladokun, E. I., Sogbanmu, T. O., & Anikwe, J. C. (2020). Sublethal concentrations of dichlorvos and paraquat induce genotoxic and histological effects in the *Clarias gariepinus*. *Environmental Analysis, Health and Toxicology*, 35(3): e2020013

Case Studies from Nigeria, Cont'd

Citation: Mumuni, A. A., & Sogbanmu, T. O. (2018). Embryotoxic, developmental and genotoxic evaluations of a endosulfan and deltamethrin mixture on the African sharptooth catfish (*Clarias gariepinus*). *West African Journal of Applied Ecology*, 26(1), 1-10.

The screenshot shows the journal's header with the title 'West African Journal of Applied Ecology' and the current issue 'Vol. 26 No.1 (2018)'. Below the header, there are navigation links for 'Current', 'Archives', and 'About'. The main content area features a 'DOWNLOAD PDF' button, an 'OPEN ACCESS' badge, and a metadata table. The article title is displayed in large green text, followed by the authors' names: A. A. Mumuni and T. O. Sogbanmu.

Published:	Aug 7, 2018
DOI:	
Issue	Vol. 26 No.1 (2018)

Embryotoxic, Developmental and Genotoxic Evaluations of a Endosulfan and Deltamethrin Mixture on the African Sharptooth Catfish (*Clarias gariepinus*)

A. A. Mumuni
T. O. Sogbanmu

Case Studies from Nigeria, Cont'd

Citation: Mumuni, A. A., & Sogbanmu, T. O. (2018). Embryotoxic, developmental and genotoxic evaluations of a endosulfan and deltamethrin mixture on the African sharptooth catfish (*Clarias gariepinus*). *West African Journal of Applied Ecology*, 26(1), 1-10.

Abstract

The evaluation of pesticides using early life stages of fish yields high throughput results that can inform one about the developmental effects of these toxicants. The effects of sublethal concentrations of a commercial mixture of endosulfan and deltamethrin (ratio 280:2) were evaluated in the embryos and juveniles of *Clarias gariepinus*. Embryotoxic and developmental evaluations were conducted in the embryos from 0 - 26 hours post fertilization. Genotoxic effects were assessed in the erythrocytes of the juveniles using the micronucleus assay over a period of 28 days. The acute toxicity studies revealed that the 24 hLC₅₀ and 26 hEC₅₀ (non-hatching) values for embryos were 25.25 µg/L and 12.96 µg/L respectively while the 96 hLC₅₀ value for fingerlings was 12.67 µg/L. Hatching success was lower in the exposed embryos compared to the control. The percentage developmental abnormalities and number of heartbeats per minute were statistically higher ($p < 0.05$) in the exposed embryos compared to the control. Developmental abnormalities observed included pericardial and yolk sac oedema, scoliosis and tail curvature. The genotoxicity studies showed that there was a significant increase ($p < 0.05$) in micronuclei in the erythrocytes of the exposed juveniles by days 14 and 28 compared to the control animals. These results imply that the pesticide mixture can cause a decline in the population of non-target organisms such as fish at sub-lethal or environmentally realistic

concentrations. A review of the use of this pesticide formulation and development of environmentally friendly methods for pest management are recommended to safeguard non-target organisms such as the African sharptooth catfish.

Case Studies from Nigeria, Cont'd

Citation: Sogbanmu, T. O., Sosanwo, A. A., & Ugwumba, A. A. A. (2019). Histological, microbiological, physicochemical and heavy metals evaluation of effluent from Kara Cow Market, Ogun state in guppy fish (*Poecilia reticulata*).

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Published: Mar 12, 2020
DOI: 10.4314/tzool.v17i1.9
Keywords: Effluents; histological effects; Kara Market; Ogun River; physicochemical parameters; pathogenic

Histological, microbiological, physicochemical and heavy metals evaluation of effluent from Kara Cow Market, Ogun State, Nigeria in guppy fish (<i>Poecilia reticulata</i>)

T.O. Sogbanmu
A.A. Sosanwo
A.A.A. Ugwumba

Case Studies from Nigeria, Cont'd

Citation: Sogbanmu, T. O., Sosanwo, A. A., & Ugwumba, A. A. A. (2019). Histological, microbiological, physicochemical and heavy metals evaluation of effluent from Kara Cow Market, Ogun state in guppy fish (*Poecilia reticulata*).

Abstract

The Ogun River is a sink for untreated effluents discharged from the Kara Cow Market, Ogun State. In this study, microbiological, physicochemical and heavy metals evaluation were carried out on effluent from the market. Standard methods were utilised for the examination of physicochemical and microbiological parameters of the effluent. The histological effects of sublethal concentrations of the effluent were assessed in the gills, intestine and skin of *Poecilia reticulata* (guppy fish) over a period of 56 days following standard methods and international ethical guidelines. None of the physicochemical parameters were within the set limits by the National Environmental Standards and Enforcement Agency (NESREA) for effluent discharges into surface waters. Coliforms, pathogens and fungi were observed in the effluent with a total plate count of 2.14×10^7 cfu/mL. The median lethal concentration (96 h LC₅₀) of the effluent to *P. reticulata* was 71.50 mL/L (7.15%). Histological alterations such as distorted mucosal architecture with shortening and widening of intestinal villi were observed in the intestine of exposed groups of *P. reticulata* at day 56. The observed adverse physicochemical parameters, histological alterations and pathogenic microbes may pose ecological and public health risks to aquatic organisms and humans respectively. It is recommended that an effluent treatment plant should be installed at the market to reduce the pollutants load of the effluent before discharge into the Ogun River.

Keywords: Effluents; histological effects; Kara Market; Ogun River; physicochemical parameters; pathogenic microorganisms; *Poecilia reticulata*




Case Studies from Nigeria, Cont'd

Citation: Aribisala, O. A., Sogbanmu, T. O., & Kemabonta, K. A. (2022). Genotoxic, biochemical and histological biomarkers of subacute concentrations of paraquat and glyphosate in Nile Tilapia. *Environmental Analysis, Health and Toxicology*, 37(2): 2022012



Original Article

Genotoxic, biochemical and histological biomarkers of subacute concentrations of paraquat and glyphosate in Nile Tilapia

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Abstract

The use of herbicides for increased food production may pose risk to non-target organisms. This study evaluated the acute toxicity, genotoxic, biochemical, and histological biomarkers of subacute concentrations of paraquat and glyphosate in *Oreochromis niloticus* (Nile Tilapia) for 28 days following standard methods. Glyphosate (96 hLC₅₀ value-1.23 mg/L) was 9x more toxic than paraquat (96 hLC₅₀ value-11.20 mg/L) against *O. niloticus*. Average micronucleated cells were significantly higher in the erythrocytes of *O. niloticus* exposed to the higher (1.12 mg/L) concentration of paraquat at day 14, both subacute concentrations of paraquat at day 28, and lower concentration (0.01 mg/L) of glyphosate at days 14 and 28 compared to the other treatments and controls. Biochemical biomarkers (MDA and GST) activities were significantly higher at both subacute concentrations of the herbicides in the exposed fish compared to the controls at day 28 only. GSH activity was significantly higher in the 0.11 mg/L paraquat concentration while SOD activity was significantly lower at both subacute concentrations of glyphosate in exposed fish compared to controls at day 28. Histological alterations observed were mild to severe shortening of the gill primary lamellar and hepatic portal inflammation of exposed fish compared to the controls. This study demonstrates the risk to non-target organisms due to herbicides' run-off from agricultural farmlands into aquatic ecosystems at environmentally relevant or subacute concentrations. Sensitization on the responsible use of pesticides is recommended to promote responsible consumption and production and sustain life below water (United Nations Sustainable Development Goals 12 and 14 respectively).



Analysis of bacterial composition in slaughterhouse effluent from a major livestock market in Nigeria

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ABSTRACT

Effluent discharges are point sources of pollution in aquatic ecosystems. Effluents from slaughterhouses which are often discharged untreated into the receiving ecosystem with potential adverse impacts on the ecosystem. The objective of this study was to evaluate the bacterial community profile of slaughterhouse effluent from a major livestock market in Ogun state, South-West Nigeria. The community DNA was extracted and subsequently sequenced using the illumina platform. The top (5) bacterial phyla accounting for over 94.6% of the sequences in the effluent was dominated by Firmicutes (67%) and the least was Euryarchaeota (3.2%). The top five (5) classes were Clostridia (62.11%), Bacteroidia (15.93%), Bacilli (3.97%), Actinobacteria (3.05%) and Methanobacteria (2.95%). The most abundant orders were Clostridiales (62.10%) Bacteroidales (15.90%), Lactobacillales (3.00%), Actinomycetes (2.70%) and Burkholderiales (1.50%). 52 genera were identified (29.60%) while unclassified genera were 65.90%. The results reveal the bacterial community profile of the effluent constituting genera of pathogenic, biotechnological, environmental, veterinary, and public health importance such as *Butyrivibrio*, *Clostridium*, *Staphylococcus*, *Streptococcus*, *Prevotella*, *Desulfovibrio*, *Rhodobacter*, among others. The results are of importance for holistic ecological and human health risk assessments as well as targeted interventions and proper treatment of the effluent before discharge. This will support good health and wellbeing, promote clean water and sanitation, as well as sustain life below water; relevant to the United Nations Sustainable Development Goals 3, 6 and 14 respectively.

Keywords: Abattoir Wastewater; Illumina Platform; Pathogen; Organic Pollution; *Acetivibrio acetivorans*

Case Studies from Nigeria, Cont'd

Citation: Buraimoh, O. M., Odumosu, B. T., Sogbanmu, T. O., Ojo-Omoniyi, O. A., Afolabi, O., & Akerele, O. (2023). Analysis of bacterial composition in slaughterhouse effluent from a major livestock market in Nigeria. *The Libyan Journal of Science*, 26(1).



Case Studies from Nigeria, Cont'd

Citation: BURAIMOH, O. M., SOGBANMU, T. O., OJO-OMONIYI, O. A., AFOLABI, O., & GANOBI, C. M. (2022). Morphological, Biochemical and Molecular Identification of Autochthonous Fungal Population in Slaughterhouse Effluent, Surface Water and Fish Gut from the Ogun River, Nigeria. *Food and Environment Safety Journal*, 21(2).



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MORPHOLOGICAL, BIOCHEMICAL AND MOLECULAR IDENTIFICATION OF AUTOCHTHONOUS FUNGAL POPULATION IN SLAUGHTERHOUSE EFFLUENT, SURFACE WATER AND FISH GUT FROM THE OGUN RIVER, NIGERIA

Olanike Maria BURAIMOH, Temitope Olawunmi SOGBANMU, Olusola Abayomi OJO-OMONIYI, Olumide AFOLABI, Chinwe Mary GANOBI

ABSTRACT

This study aimed to evaluate and characterize the pathogenic fungi as well as the influence of effluent from the Kara abattoir on the Ogun River, Nigeria. In this study, the fungal population of the abattoir effluent, surface water and a species of fish (*Chrysichthys nigrodigitatus*) from the Ogun River were sampled and examined during the 2018 dry and rainy seasons using morphological, biochemical and molecular methods. Several pathogenic fungi were characterized both in the effluent and fish gut during both seasons. *Penicillium* sp., *Fusarium oxysporum*, and some other unknown species were found in the fish gut during the rainy season. *Rhodotorula mucilaginosa* was found both in the fish gut and effluent during the rainy season. *Talaromyces* sp., was found in the fish gut and surface water during the rainy season. *Aspergillus flavus*, *Aspergillus* sp., *Talaromyces* sp. were found in the fish gut and effluent during the dry season. *Penicillium citrinum* was found in the fish gut and surface water during both seasons. *Saccharomyces* sp., *Candida albicans*, *Rhizopus stolonifer*, *Mucor* sp. and an unknown fungus were found in all three samples during both seasons. Only *Aspergillus niger* was present in the surface water during both seasons. The results of this study showed that anthropogenic activities at Kara Abattoir adversely impacts the Ogun River, hence constituting potential environmental and public health risks. Strategic advocacy campaigns, strong evidence - informed policies or regulations, as well as provision of adequate facilities for effluent treatment are recommended to mitigate the current non-sustainable trends at the Kara Abattoir in Ogun state, Nigeria. This will support the efforts towards achieving the United Nations Sustainable Development Goal 3 (good health and wellbeing) and 14 (sustain life below water).

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