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Review of Organic Pollutants in Wastewater along the Course of River Gwagwarwa and River Rafin Malam in Kano State – Nigeria

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Abstract: Water samples of River Gwagwarwa and River Rafin Malam were subjected to liquid-liquid extraction and analyzed for organic pollutants. The organic parameters were determined using the standard methods of America Public health Agency (APHA) and was extracted and analyzed using Gas chromatography-mass spectrometer (GC-MS). Ten different organic compounds were detected at different percentage values at River Gwagwarwa while only seven different compounds were detected in River Rafin Malam. The compounds fall within five classes of organic compounds, which include carboxylic acid, acid chloride, ester, aldehyde and acid anhydride. The distribution pattern of the organic pollutants at the two sampling stations depict the pattern; River Gwagwarwa > River Rafin Malam. The study shows that organochlorine was the predominant organic pollutant present in River Gwagwarwa sample which is a hazardous pollutant while River Rafin Malam has no toxic pollutant which is attributed to lack of activity of the River.

Keywords: Wastewater, Pollutants, River, Kano.

INTRODUCTION

Effective management of surface water requires monitoring and restricting the contamination loading that enters a water body [1]. The increasing demands for fresh water has raised environmental issues of surface water quality impacted by anthropogenic activities and natural crustal weathering, impairing its usage for drinking, recreation, agriculture, industrial and other purposes [2].

River constitutes the main inland water body for domestic, industrial and agricultural activities, and often carries large municipal sewage, industrial wastewater discharges and seasonal runoff from agricultural fields [3]. The River waters are normally contaminated as a result of the discharge of waste waters which contain various type of pollutant such as organic pollutants, nutrients, domestic effluent and agricultural waste etc [4,5]. River water pollution can be linked to the type of waste water produced by urban, industries and agricultural activities that flows into surface and subsurface water.

One of the most critical problems of developing countries is improper management of waste generated by anthropogenic activities, more challenging is the usage and disposal of these waste into the ambient environment. Water bodies especially rivers, streams, lakes among others are the most affected. This has often rendered these natural resources unsuitable for both primary and secondary usage.

Organic pollutants include pesticides, fertilizers, hydrocarbons, phenols, plasticizers, biphenyls, detergents, oils, greases, pharmaceuticals, proteins and carbohydrates etc. Organic pollution is the term used when large quantities of organic compounds which may originate from domestic activities, sewage, urban run-off, industrial effluents and agriculture waste are discharged into drain. Organic compounds are compounds that contain carbon, usually in combination with elements such as hydrogen, oxygen, nitrogen and sulphur. It is also compounds that consist of long bonds, usually made up of carbon and mostly from living origin. During the decomposition process of the organic pollutants, the dissolved oxygen in the receiving water may be consumed at a greater rate than it can be replenished, causing oxygen depletion and having severe consequences on the stream biota. Wastewater with organic pollutants contains large quantities of suspended solids which reduce the light available to photosynthetic organisms, on settling out, alter the characteristics of the river bed, rendering it unsuitable habitat for many invertebrates.

The most common toxic organic pollutants are persistent organic pollutants (POPs). POPs are compounds of great concern due to their toxicity, persistence, long-range transport ability, bio magnifications and bioaccumulation in living organisms. POPs are carbon-based chemical compounds and mixtures that include industrial chemicals such as polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs), and some organo chlorine pesticides (OCPs) among others.

Adeola [17]; in his work on "The Environmental and Health Impact of Persistent Organic Pollutants", also confirmed that "given their ubiquity and persistence in the environment, there is no safe place for escaping persistent organic pollutants contamination. Typical routes of exposure include workplace (in agriculture and industries), dietary exposure, and direct contact with contaminants in the air, buildings, water, lawns, parks, and soil, including but not limited to accident release.

Laboratory investigations and environmental impact studies in the wild have implicated POPs in endocrine disruption, reproductive and immune dysfunction, neurobehavioral and disorders and cancer. The aim of the study is to determine the presence of some organic pollutants in River Getsi and River Rafin Malam.

Study site

Jakara River originated from Jakara quarter in Kano city of Kano State, Nigeria. Many other rivers flow into it from different locations such as River Rafin Malam, River Gwagwarwa and River Cijaki among others before finally reaching Jakara Dam. Therefore the River cut across domestic, industrial and agricultural areas which makes it to carry along pollutants due to the activities of the areas it passes through. River Rafin Malam originated from Gwarzo town Kano and pass through mainly the agricultural zone before joining River Jakara [6].

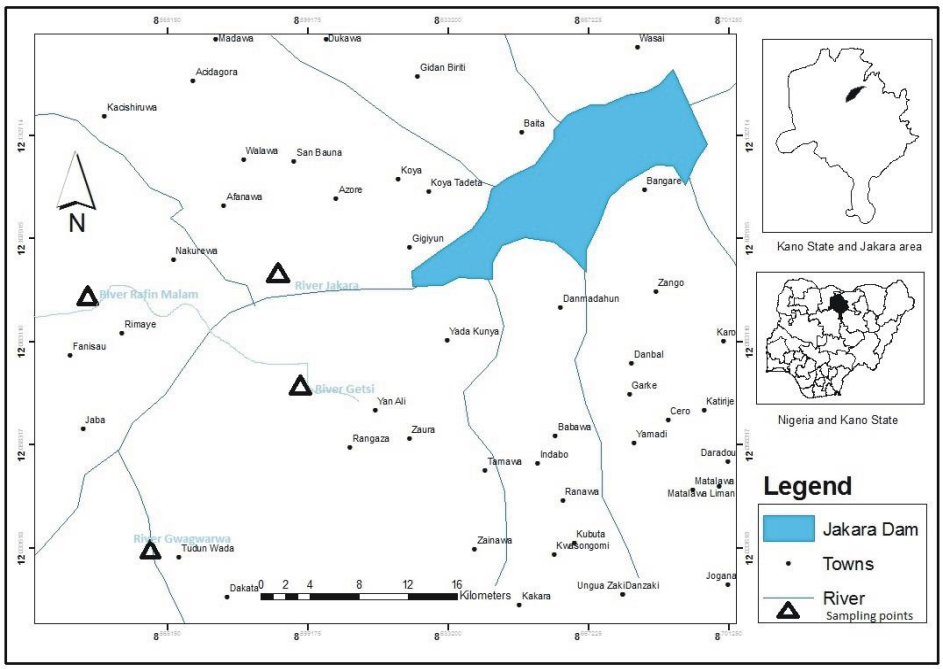

Fig-1: Map showing the various rivers across river jakara

MATERIALS AND METHODS

Water samples were collected at various points along River Gwagwarwa and River Rafin Malam in the morning and evening on each sampling day. 100 cm^3 of water sample was collected at each designated point which is 20 metres to the next point. Ten [10] samples were collected in each sampling session which are composited to a total of 1 litre. The samples were labeled and taken to the laboratory for further analysis. This procedure was repeated throughout the sampling session. Appropriate quantities of the composite samples were measured and treated according to the standard methods of American Public Health Agency (APHA).

Procedure

Fifty ($50cm^3$) of each composite water sample was measured and added into a cleaned 250 cm^3 separatory funnel. Also $50cm^3$ each of diethyl ether and trichloromethane were measured and added into the separatory funnel. The resultant mixtures were vigorously shaken and gas released intermittently by controlling the lid. The mixture was allowed to stand on a retort stand for 5 minutes and the organic layer was collected in a cleaned glass sample bottle, labeled and kept for further GC-MS analysis [7].This process was repeated for all the composite samples.

RESULTS AND DISCUSSION

Table-1: Average percentage (%) value of organic compound detected at River Gwagwarwa

S/NO	COMPOUND	% VALUE
1	Dodecanoic acid	1.77 ±0.0
2	Tetradecanoic acid	2.51±0.944
3	Palmitic acid	9.35 ±4.13
4	Methyl octadecanoate	6.54 ±2.99
5	Oleic acid	30.14 ±8.91
6	9- Octadecanoic acid 1,2,3 propanetriyl ester	35.54 ±10.01
7.	Octadecadienoyl chloride	52.68 ±2.99
8.	Hexadecanoic acid 1-{{{ 2- Aminoethylhydroxy phosphinyl}oxy}methyl} -1,2 Ethenediyl Ester	20.02 ±4.18
9.	Methyl Hexadecanoate	1.84 ±0.0
10.	Dodecanoyl chloride	39.69±18.28

The % values of the various organic compounds detected in the composite water sample collected from River Gwagwarwa presented in the table above, ten different organic compounds were detected at different % value. The compounds falls within three classes of organic compounds viz, carboxylic acid, acid chlorides and esters. The distribution of the compounds depicts a patterm; carboxylic acid = esters > acid chlorides. Highest percentage value of 52.51% was recorded for octadecadienoyl chloride and the least % value of 1.77 was recorded for dodecanoic acid. This result has linear relationship with studies done by Wyasu and Kure in Zaria 2012.

Exposures to Dodecanoic acid can cause mild irritation of the upper respiratory tract and mucous membrane at higher concentration which is in accordance with US Department of Health and Human Behaviour. While exposures to Octadecadienoyl chloride are very toxic and dangerous, it causes severe burns and eye damage. Human exposure present at level greater or equal to 0.1% is identified as probable or confirmed human carcinogen by International Agency For Research on Cancer (IARC).

This class of organic compound arises in the waste water due to the discharges of complex, chemicals and solvent used in industries, domestic and agricultural activities [10-13].

Table-2: Average percentage (%) value of organic compound detected at River Rafin Malam samples

S/NO	COMPOUND	% VALUE
1	Dodecanoic acid	14.3±6.04
2	Tetradecanioc acid	2.22 ±0.16
3	Palmitic acid	10.21 ±0.13
4	Methyl octadecanoate	8.43 ±1.27
5	Oleic acid	31.06 ±0.74
6	Docosanoic anhydride	9.48 ±0.85
7.	Octadecanoic acid 1,2,3 propantriyl Ester	36.89 ±2.14

The % value of the various organic compounds detected in the composite water sample collected from River Rafin Malam is presented in the above table. Seven different organic compounds were detected at different % value. The compounds falls within three classes of organic compounds viz, carboxylic acid, acid anhydride and esters. The distribution of the compounds depicts a pattern, carboxylic acid > ester > acid anhydride. Highest percentage value of 36.78 was recorded for octadecanoic acid 1,2,3 propanetriyl esters and the least % value of 1.83 was recorded for dodecanoic acid. The result obtained correlate with studies done by Said in 2008.

Exposures to dodecanoic acid can cause mild irritation of the upper respiratory tract and mucous membrane at higher concentration which is in accordance with U.S Department of Health and Human Behaviour. While octadecanoic acid 1,2,3 Propanetriyl ester is a fatty acid methyl ester. Long chained fatty acid methyl ester is practically non-toxic. The non-toxic and safety of the fatty acid methyl ester is recognized by the U.S Food and Drugs administration.

These classes of organic compounds arise in the waste water due to the discharges of chemicals via agricultural operations. River Rafin Malam has no activity except agricultural operation which includes livestock grazing, pesticide and fertilizer application among others [13-16].

CONCLUSION

Generally, the organic pollutants investigated in this study especially the organochloride are alarming and therefore need immediate attention to reduce the activities leading to the discharge in the environment. It

is important that the relevant authorities should identify the specific sources of this organochlorides and impose quick and stringent measures to deter there discharge into the water bodies and the environment in general.

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