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Assessment of organic pollutants of water samples in River Getsi and River Gwagwarwa in Kano State Nigeria

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Abstract: Water samples of River Gwagwarwa and River Jakara were 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). Thirteen different organic compounds were detected at different percentage values at the two sampling stations. 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 pollutant at the two sampling stations depict the pattern; River Gwagwarwa > River Getsi .The study shows that organochloride was the predominant organic pollutant present in the samples

Keywords: Gas Chromatography, Mass Spectrometer, Carboxylic Acid, Acid Chloride, Ester, Aldehyde, Organochloride, Organic Pollutant

1. Introduction

Water is the most common liquid on our planet, vital to life form. The total water on earth is enormous, estimated to 1.5 x 1018 metric tons; this quantity is 300 times larger than the mass of the entire atmosphere [1]. Unfortunately, most of these are not accessible because they appear in ice-caps, oceans, in underground aquifer (ground water-bearing beds) and some are even in the air as moisture .Only a small fraction of water is on earth surface and directly accessible to man as rivers, streams and springs [2].

Water can sometimes be said to be pure but it can never entirely 100% pure. It inevitably carries traces of other substances – various organic compounds, particles, gases, minerals and ions which impart to its physical, chemical and bacteriological characteristics [3].

In cities of Nigeria, with particular reference to Kano state, a major industrial and commercial centre with a population of over 7,000,000 people according to the national census figure of 2006.The various component of the natural environment are often adversely affected by these human activities resulting in the devastation of components of the environment such as air, land and water [4].

The quality of water is continuously changing as a result of the reaction of water with contact media affected by anthropogenic influences, such as domestic or municipal waste [5]. The behavior of organic compounds is dependent upon their molecular structures, size and shape and the presence of functional groups that which are important determinants of toxicity, (Adeola, 2004). There are many different types of organic pollutants, examples are:- Hydrocarbons, Polu Aromatic Hydrocarbon's, Polycyclic Biphenyl's, Detergents,plastic, persistent organic pollutant,pesticide among others.

Many organic compounds, to a varying degree, resist photolytic, biological and chemical degradation. These are referred to as persistent organic pollutants (POPs). POPS are often halogenated and characterized by low water solubility and high lipid solubility, leading to their bioaccumulation in fatty tissues. They are also semi-volatile, enabling them to move long distances in the atmosphere before deposition occurs, (Ritter et al., 2007).

Although many different forms of POPs may exist, both natural and anthropogenic, many of these compounds have been or continue to be used in large quantities and, due to their environmental persistence, have the ability to bioaccumulate and biomagnify. Some of these compounds such as polycyclic biphenyls (PCBs), may persist in the environment for periods of years and many bioconcentrate by factors of up to 70,000 fold, (Ritter et al., 2007).

Pesticides (synthetic organic chemicals) are widely used in fruit and vegetable production because of their susceptibility to insects and diseases attack. Consequently, food safety is a major public concern worldwide as residues of pesticides could affect the ultimate consumers especially when these commodities are freshly consumed. Given the potential risk of pesticides and heavy metals for public health, the use of pesticides in fruit and vegetable production is subjected to constant monitoring.

An assessment report carried out by Ritter et al., (2007) on several organic pollutants concluded that a number of the organic substances assessed in the report have been implicated in a broad range of adverse human health environmental effects including impaired reproduction and endocrine dysfunction, immunosuppression and cancer. In many cases, the substances are considered as possible human carcinogens by the International Agency for Research on Cancer consumed [11,12,13&14]..

2. Study Site

River Gwagwarwa originate from Gwagwarwa quarter under Nassarawa local government area of Kano State. Gwagwarwa is a highly populated town in Kano. This is because of its semi-industrial nature and proximity to Sabon Gari (a densely residential and commercial settlement) in Kano. Therefore the River cut across domestic, industrial and agricultural areas which makes it to carry along pollutant due to the activities of the areas it pass through.

River Getsi originate from Bompai industrial areas, Bompai in Nassarawa local government area of Kano State. Pollution loads in River Getsi are through industrial operations in Bompai and proximate localities.

3. Material and Method

Water samples were collected at various points along River Getsi and River Gwagwarwa in the morning and evening on each sampling day. 100 cm3 of water sample was collected at each designated point which is 20 metres to the next point[8,9]. 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[8,9,10]. This procedure was repeated throughout the sampling. Appropriate quantities of the composite samples were measured and treated according to the standard methods of American Public Health Agency (APHA).

4. Procedure

50cm^3 of each composite water sample was measured and added into a cleaned 250 cm^3 separatory funnel. 50cm^3 each of diethyl ether and trichloromethane were measured and added into the separatory funnel.. The resultant mixtures was 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.

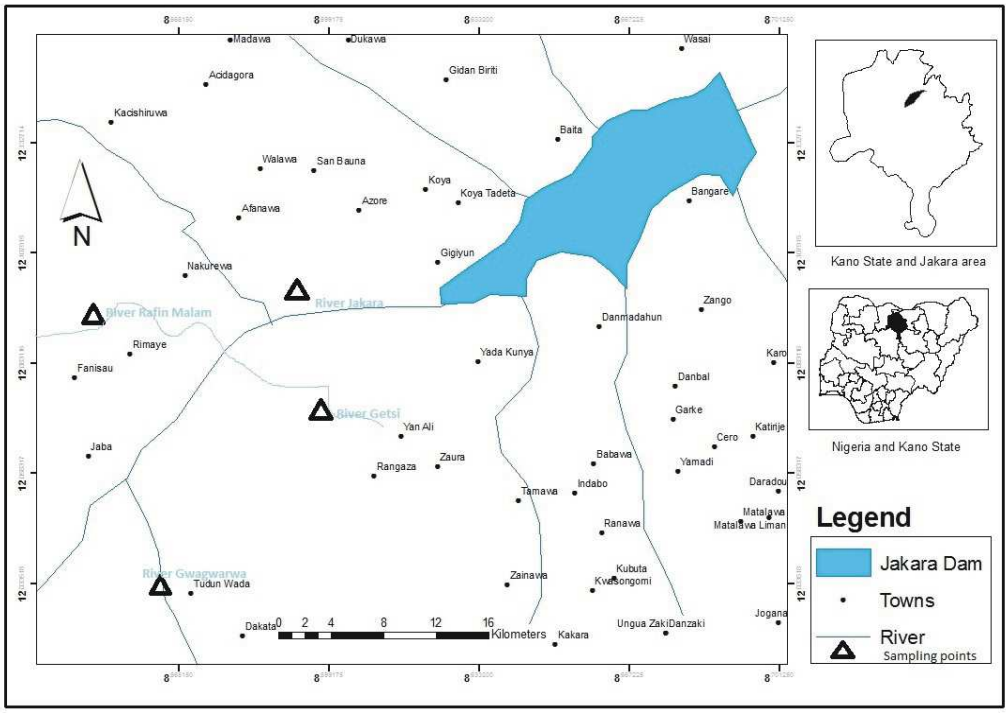

Figure 1. *Map Showing River Getsi and River Gwagwarwa with other Rivers across River Jakara*

Table 1. *Average Percentage (%) Value of Organic Compound Detected at River Getsi Samples*

S/No	Compound Detected	% Value
1	Dodecanoic Acid	1.98 ±0.47
2	Tetradecanoic Acid	2.39 ±0.48
3	Palmitic Acid	9.59 ±2.86
4	Methyl Octadecanoate	7.03 ±1.65
5	Oleic Acid	34.07 ±5.88
6	Docosanoic Anhydride	9.75 ±1.37
7	Octadecanoic acid 1,2,3 Propanetriyl Ester	31.93 ±8.13
8	9- hexadecanoic Acid	11.58 ±2.79
9	Octadecadienoyl Chloride	55.19 ±0.0
10	Hexadecanoic Acid 1 – {{{2-Aminoethylhodroxy Phosphinyl} Oxy} Methyl }– 1 , 2 Ethenediyl Ester	9.32 ±0.0

Table 2. *Average Percentage (%) Value of Organic Compound Detected at River Gwagwarwa*

S/No	Compound Detected	% Value
1	Dodeconoic Acid	1.93 ±0.51
2	Tetradecanoic Acid	2.39 ±0.40
3	Palmitic Acid	9.17 ±2.47
4	Methyl Octadecanoate	7.39 ±1.39
5	Oleic Acid	29.46 ±6.42
6	Docosanoic Anhydride	12.03 ±1.44
7	Octadecanoic acid 1,2,3 Propanetriyl Ester	41.05 ±8.66
8	9-Hexadecanoic Acid	24.81 ±0.0
9	1, 3 Octadecanal	12.94 ±0.0
10	Octadecadienoyl Chloride	66.66 ±0.0

5. Result and Discussion

The % values of the various organic compounds detected in the composite water sample collected from River Getsi are presented in table 1.0. Ten different organic compounds were detected at different % value. The compounds falls within four classes of organic compounds viz, carboxylic acid, acid chlorides, acid anhydride and esters. The distribution of the compounds depicts a pattern; carboxylic acid > esters > acid chlorides = acid anhydride. Highest percentage value of 55.19 was recorded for octadecadienoyl chloride and the least % value of 2.31 was recorded both for dodecanoic acid and tetradecanoic acid.

Exposures to Dodecanoic acid and tetradecanoic 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 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, possible or confirmed human carcinogen by International Agency for Research on Cancer (IARC).

These classes of organic compound arises in the wastewater due to discharges of complex chemicals and solvent used in commercial, agricultural and industrial operations[15&16].

The % values of the various organic compounds detected in the composite water sample collected from River Gwagwarwa are presented in table 2.0. Ten different organic compounds were detected at different % value. The compounds falls within five classes of organic compounds viz, carboxylic acid, esters, acid anhydride, acid chlorides and aldehyde. The distribution of the compounds depicts a pattern; carboxylic acid > esters > acid chlorides = aldehyde = acid anhydride. Highest percentage value of 66.66 was recorded for octadecadienoyl chloride and the least % value of 1.76 was recorded for dodecanoic acid.

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 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, possible or confirmed human carcinogen by International Agency for Research on Cancer (IARC).

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