ASSESSMENT OF WATER QUALITY FROM OCHECHE AND UWOWO STREAMS IN IDAH, KOGI STATE, NIGERIA

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Abstract

Water from Ocheche and Uwowo streams were studied with a view to find out which is more suitable as drinking water source as most residents use same as drinking water. Three water samples each were collected from both streams to determine their suitability for drinking in comparison with World Health Organisation (WHO) standards for drinking water. Physical, chemical and bacteriological test were carried out on all the samples. Experimental results shows that, Ocheche had suspended solids of 23 mg/l as against the permissible limits of 5mg/l by WHO, while, Uwowo had suspended solids of 6mg/l. Turbidity (Ocheche had 20.6 NTU, Uwowo had 42 NTU as against the permissible limit of 5 NTU for WHO standard). Colour (Ocheche had 85 pt. CO colour and Uwowo 28 pt. CO colour as against the permissible limit of 5 pt. CO colour for WHO Standards). E-coli X 10^5 (Ocheche had 59 cfu and Uwowo had 57 cfu as against 0 cfu permissible limit by WHO Standards). DO_2 final (Ocheche had 4.3 mg/l and Uwowo, 4.3 mg/l as against the permissible limit of 4.0 mg/l by WHO). It was concluded that water from the two streams need treatment before consumption by the inhabitants.

Keywords: Assessment, Water quality, Stream, Analysis, Ocheche, Uwowo

1. Introduction

Reports by international bodies like United Nations (UN) and World Health Organization (WHO) and other non-governmental organizations have indicated that water supply is not always commensurate with demand for water worldwide. According to WHO (2010), only 32% of rural population in developing countries have access to safe drinking water. The daily per capital consumption of water in Nigeria varies between 10-27 litres with an average of 46 litres, which is far below the international recommended minimum requirement of 115 litres per person per day. This short fall in water requirement is due to differences in availability and supply (Ayoade and Oyebande, 1978, UNICEF, 2010). Today, a large percentage of rural populations in developing countries live without adequate access to convenient water supply (Ibi, 2008). In Nigeria, more than 90% of rural area and 60% of urban areas face water related problems (Africa Development Fund, (ADF) 2007). Many surface water in Nigeria are originally polluted. One of the important criteria for good pollution bacterial indicators is that such bacteria should not multiply in water. According to Charles (1992), many bacteria including indicators do multiply in water especially organic polluted water. UNICEF (2010) stated that linear relationship between the survival of the indicators and concentration of peptone is not unusual. The increased survival as the concentration of peptone increased is in fact to be expected since the presence of adequate amounts of substrate is fundamental to bacterial growth and survival in any environment. It is well established that E-Coli forms and to some extent, faecal streptococci can multiply in the presence of organic matter (Foster et al, 1991).

Onwuka, et al., (2004) evaluated eighty samples of well water in south eastern Nigeria for bacteriological quality. The results showed evidence of sewage contamination. The work recommended improved ways of managing domestic wastes like the use of central sewer carried out in other parts of the world. Tahir and Bhatti, (1994) carried out a survey of drinking water quality of rural area of Rawalpindi District, all samples were found fit for physico-chemical parameters. However, these samples were unsafe with respect to chlorides and sodium. While, six water quality parameters were found above the desirable level by WHO. Similarly Sajjad and Rahim, (1998) analyzed the chemical quality of ground water of Rawalpindi, Islamabad. Results of chemical parameters (Nitrates, Chlorides, Sulphate, Hardness and Sodium) showed excessive level as water moved from adjoining recharge areas towards the center of the basin, which acts as a discharge area for ground water. Tahir et al (1998) analyzed the drinking water quality in the city of Karachi and found that most of the water samples were unfit for drinking purpose due to the presence of coli form and E. coli. Rontium concentration. Foster, et al. (1991) analyzed the quality of drinking water supplied to Shambad. They found that chemical quality of most CDA tube wells were satisfactory during the periods of the study (September to December). However, some were found with 1.4 strontium concentrations.

1.1 Research significance

The quality of water is assessed in terms of its physical, chemical and biological characteristics, as well as its intended uses. It has been demonstrated repeatedly that water containing dissolved constituents is far palatable than ''pure water''. The question then is, "which dissolved constituents and at what concentrations can be accepted from the stand point of health aesthetics? A careful review of literature shows that in some parts of the world, human have inadequate access to portable water and thus uses water that are contaminated with disease vectors, pathogens or unacceptable levels of toxins or suspended solids. Such water is not wholesome for drinking or food preparation as use may lead to widespread acute and chronic illness, a major cause of death and misery in many countries. It is therefore imperative to conduct rapid needs assessment of the quality of water taken by consumers as drinking water. As reduction of water borne disease is a major public health goal in developing countries. This study is aimed at assessing the quality of water in Ocheche and Uwowo streams both located in Idah, LGA of Kogi State, Nigeria. Water samples were collected from three points on each of the streams to determine its physical, chemical and biological characteristics so as to ascertain if water from these streams is fit for human consumption.

2. Experimental Programs

Samples of water collected at the upstream, midstream and downstream sections of each of the studied streams (Ocheche and Uwowo) in cleaned and dried containers to avoid foreign contaminants were taken to the laboratory. The water samples were labelled and various physical, chemical, and bacteriological tests performed. The physical parameters tested are colour, odour, taste, temperature, PH, turbidity, and suspended solid, while, total hardness, calcium, magnesium, sulphate, nitrate, chloride, initial and final dissolved oxygen, chemical oxygen demand are the chemical parameters tested. The bacteriological tests carried out on the water samples are Total Coli Form Bacteria, and Biological Oxygen Demand. The various tests were carried out in accordance with the WHO recommended standard test methods.

3. Experimental Results

3.1 Physical examination

Colour, Odour and Taste: Ordinarily and by WHO standard, water for human consumption should be colourless. Colour suggests presence of dissolved substances thus making water aesthetically unacceptable as drinking water and unsuitable for manufacturing. The presence of colour also indicates the presence of colloidal materials. Colour is measured in platinum cobalt colour (Pt co colour). From the test result obtained, colour is present in water sample from the two streams. Hence it is unfit for drinking. The range of value was within 4 to 71 Pt co colour. Odour and taste of the water from the various sampled points of the streams where observed to be unobjectionable. The objectionable odour and taste are as a result of the presence of aquatic lives (fungi, algae, spirogyra, amoeba etc) and waste disposal (waste from toilets, industries, household etc.). However, this is against the requirement for drinking water as specified by WHO.

Temperature: The temperature variations at different location on the stream as well as the equivalent WHO standards are plotted on Figure 1 below.

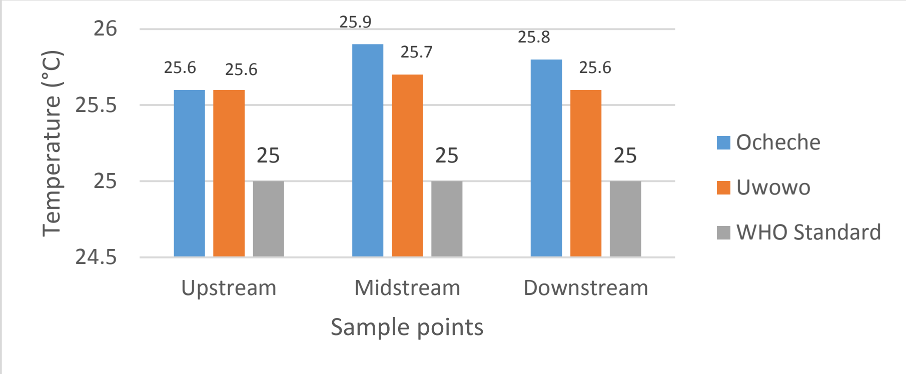

Fig. 1 Temperature variations at different locations of the streams

The temperature of water samples from both streams at all sample points are higher than the recommended WHO value of 25˚C (lbi, 2004), with the samples taken at mid points of each stream having the highest temperature. Higher temperature at midstreams is because they are the busiest locations of the streams where people always come to wash their cloth, vehicles, take their bath. Although an average temperature of 25.6 ˚C (Uwowo stream) and 25.8˚C (Ocheche stream) may be acceptable, going by NIS 554, (2007) standards. Temperatures at various sample points of the streams can be favorable to the growth of aquatic micro-organisms which can lead to the problem of colour, taste, odour and corrosiveness.

PH Values: PH is the measure of the level of acidity or alkalinity of water. It is the active hydrogen ions (H^+) or hydrogen concentration measure in a solution. If PH is less than 7 the water is acidic, while a PH above 7 is alkaline. The PH of 7 is regarded as neutral. The PH value of water is of great importance in the control of coagulation process (particle removal). Removal of iron (Fe) and manganese (Mn) and corrosion are all directly related to the PH. From WHO, NAFDAC and NPDWR standard for drinking water, maximum permissible PH value is from 6.5 to 8.5. The PH values of the water samples from different locations of the streams are presented on Figure 2 below.

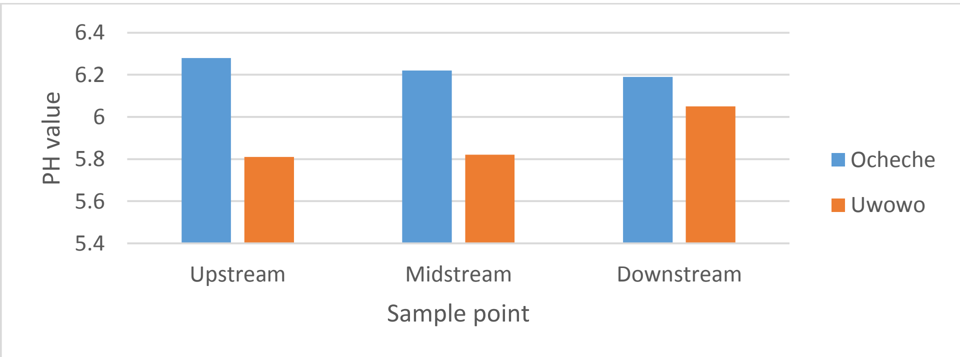

Fig. 2 Changes in PH at different locations of the stream

It can be seen from the figure that the PH for all the water samples from both streams depict high acidity and are not within WHO acceptable range of 6.5 to 8.5. Thus, the water from both streams at any location is not good for drinking. The high acidity level for both streams can be attributed to dissolved acidic pollutants. It is noted from the results that the PH of Ocheche stream indicated increasing acidity from upstream to downstream. This shows that activities along the stream keep increasing the acidic pollutants as the water flows down. While for Uwowo stream, the PH value rises from upstream to downstream, depicting a reduction in acidity as one move down the stream. This can be due to dilution effect.

Turbidity: Turbidity is caused by suspended solids in water, with a high value of turbidity showing high amount of particles in water. Turbidity is measured in NTU. The plot of the turbidity for different locations of the stream is presented in Figure 3. For Ocheche stream, the upstream which is very close to the source of the stream has higher turbidity and reduces as one goes down the stream. The obtained values are far greater than the value specified by WHO (5 NTU). Thus, water from this stream is not good for drinking purposes. On the other hand, water samples obtained from Uwowo stream have reduced turbidity and are within acceptable limit by WHO. However, the turbidity value for water samples at midstream is slightly above that specified by WHO. This slightly higher value can be attributed to human activities at this section. Self-purification of the stream at the upstream and downstream may be the reason for the turbidity values been within the WHO limits. The turbid colloidal particles were decreasing at upstream and downstream due to the self-purification.

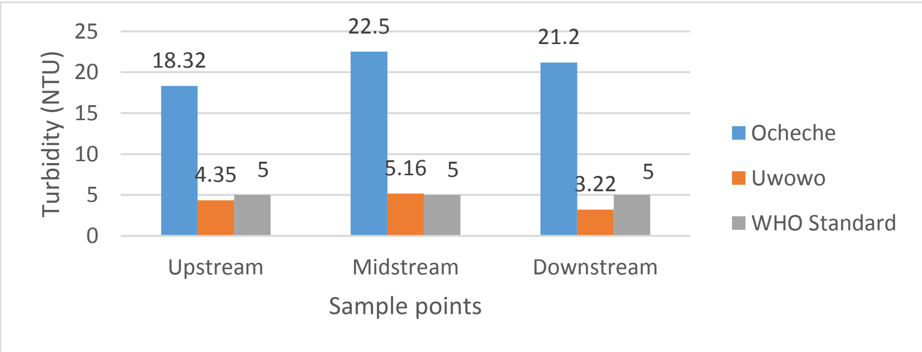

Fig. 3 Turbidity plot for the different locations of the streams

Suspended solids: Figure 4 present results of suspended solids for the different locations of the streams. The values of suspended solids in Ocheche stream are excessively far above the permissible limit by WHO standard of 5mg/l. Water from this stream should not be used for drinking purposes.

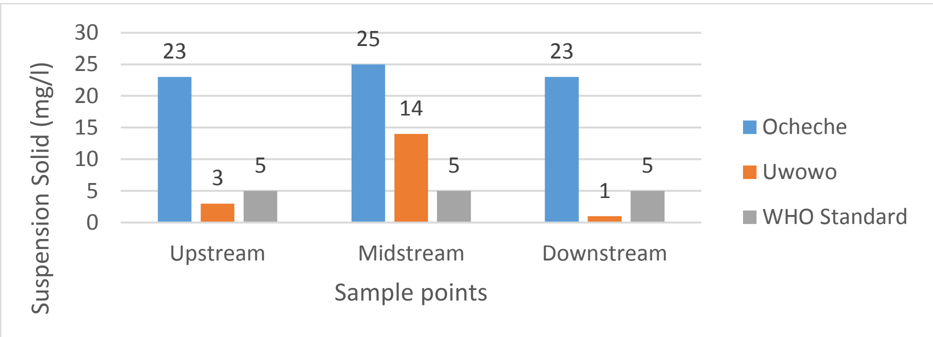

Fig. 4 Plot of Suspended Solids for the different locations of the stream

In the case of Uwowo stream, the suspended solids as tested in this work are lower than the WHO standard at the upstream and downstream section, connoting these points as suitable for drinking. However, at the midstream, there is a rise in the value for suspended solids quite above the WHO recommendation limit for drinkable water. These results may not be unconnected with the human activities such as washing of clothes and vehicles, bathing, and falling leaves and branches of trees into the stream at the said point.

3.2 Chemical Examination

Total Hardness: The total hardness for the water samples tested for both streams under investigation are presented in Figure 5. While, Table 1 gives the hardness limit for the different degree of hardness of water as specified by WHO. From the result obtained and presented in Figure 5 the Ocheche stream demonstrated soft hardness at its source or upstream section, and slightly hard at both mid and downstream, while water sample from Uwowo stream at all location shows slight hardness. Water from the upstream section of Ocheche stream is the most acceptable for drinking compare to the other tested sections.

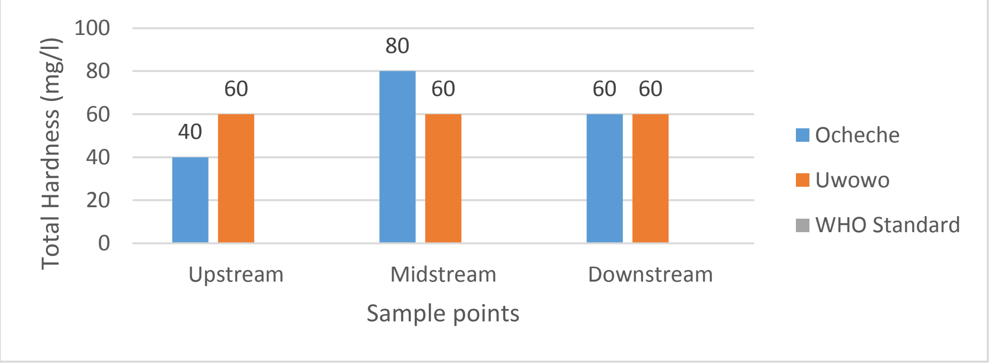

Fig. 5 Variation in total hardness for the different location of the stream

The surge in the degree of hardness midway the stream means that the human activities at that point contribute to its hardness. However, there is a reduction of the hardness by some margin downstream. This could be attributed to dissociation reactions along the flow.

Table 1 Degree of hardness of water specified by WHO

Degree of hardness	Hardness of $CaCO_3$
Soft	0-55
Slightly hard	56-100
Moderately hard	101-200
Very hard	200-500

Calcium Hardness: The test results for the calcium hardness at different locations along the two streams are presented in Figure 6. The two streams had calcium hardness values that are within the maximum permissible limit (50m/gl) as specified by WHO. However, calcium hardness value for the midstream section for Ocheche stream is above the given limits. Thus, water from this section of the stream is not fit for human consumption.

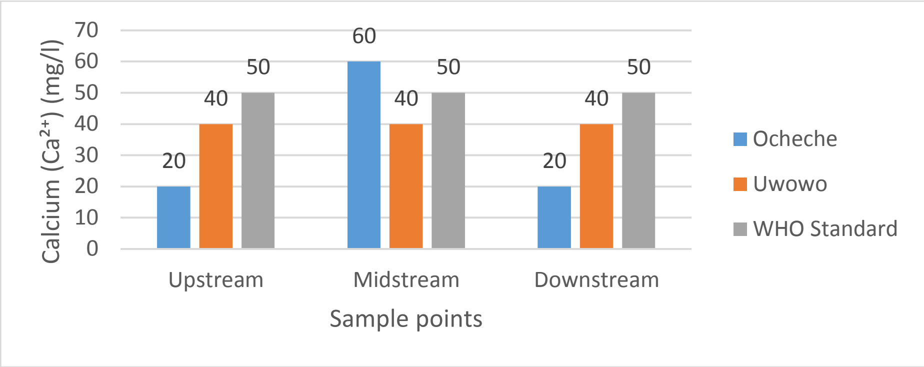

Fig.6 Variation in calcium hardness for different sections of the streams

The calcium hardness of the two streams are within the maximum permissible limit of 50mg/l by WHO, except at the midstream for Ocheche (see Fig. 6). The contribution to the calcium activities midstream of Ocheche is alarming. That disqualifies the water for drinking at that point.

Magnesium Hardness: Figure 7 shows the result of magnesium hardness of water obtained from different locations along the two streams. The magnesium hardness of the studied streams at all the sampled points are within the maximum permissible limit (50 mg/l) as given by WHO. This means that the pollutants that are making their ways into the stream have small amount of magnesium containing chemistry.

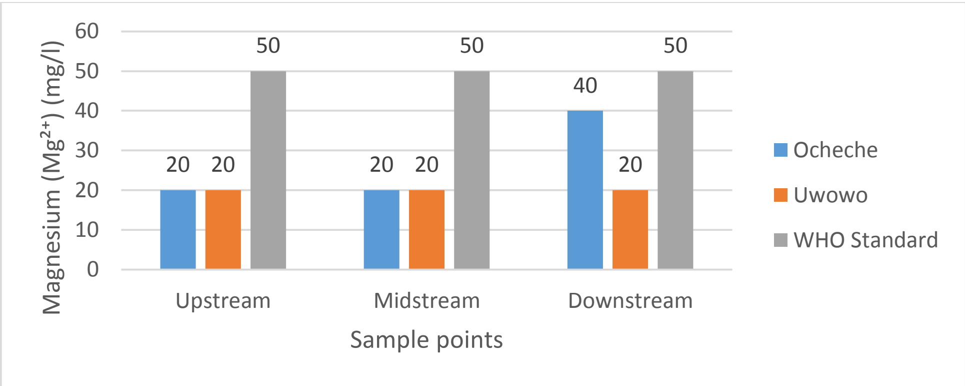

Fig.7 Plot of magnesium hardness for different locations of the streams

Nitrate (NO_3): The nitrate content of water at different locations on the streams are presented in Figure 8. The nitrate content of the two streams are within the maximum permissible limit of 50mg/l as specified by SON. This means that the water from both streams are fit for drinking at all locations from the stand point of nitrate content.

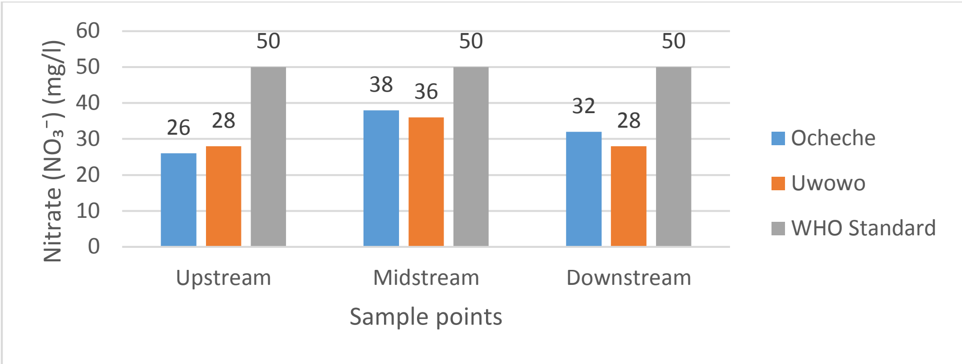

Fig.8 Plot of nitrate content for the various sections of the stream

Sulphate (SO_4^{2-}): The sulphate content obtained from all the water samples collected at different locations along both streams, is shown in Fig.9, the values obtained are all within the maximum permissible limit of 200mg/l as specified by WHO.

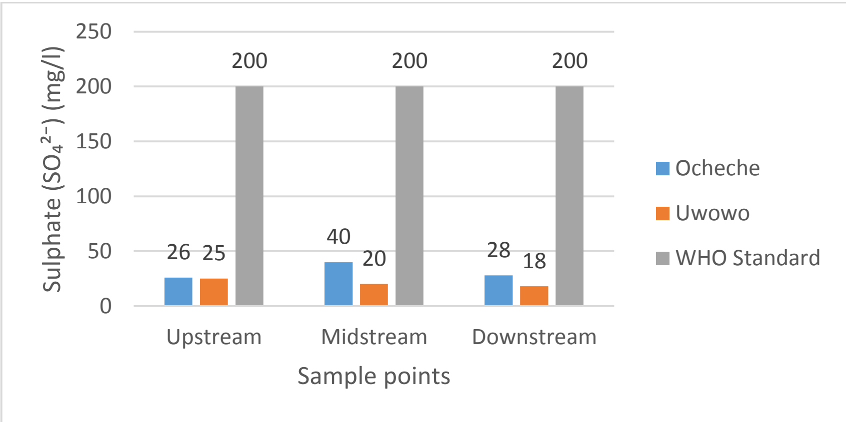

Fig.9 Plot of Sulphate contents at different locations of the streams

Initial Dissolved oxygen ($DO_2 1$): Figure 10 presents results for the initial dissolved oxygen at different locations on both streams. Values obtained are all within acceptable limits as specified by WHO.

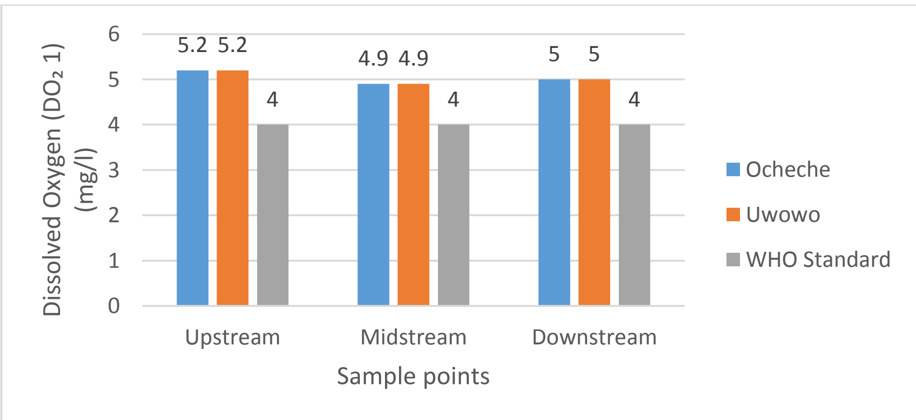

Fig.10 Plot of dissolved oxygen at different sections of the stream

Final Dissolved Oxygen (D0$_2$2): The results of the final dissolved oxygen for different locations along both streams are given in Figure 11 below. Values obtain are above the WHO standard value of 4 mg/l. Thus, both streams satisfy the oxygen demand for drinking water.

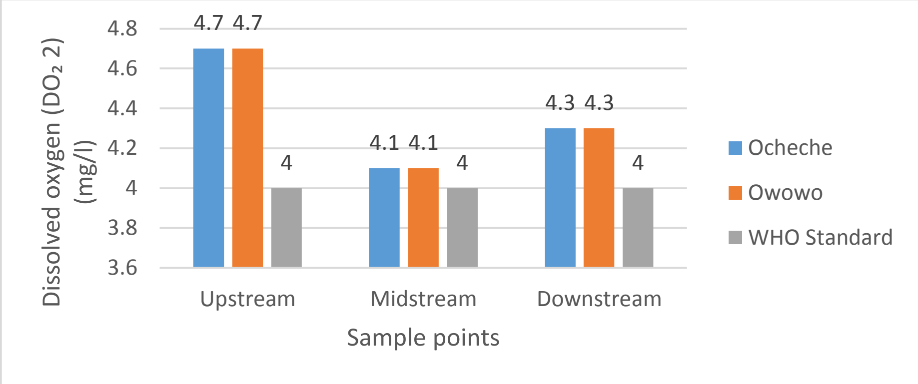

Fig.11 Plot of DO_2 (final) for different sections of the streams

Chemical Oxygen Demand (COD): Figure 12 present the values of the COD for different locations of the streams as while as the standard limits as specified by WHO. The lower the COD in relation to the standard limits the better the water. From the plots, all the values of COD for both streams along its length are within the permissible limit specified by WHO (100 mg/l). However, the COD of the two streams at the mid-section are on the high side of the limit. This is an indication of increased activities at these locations that encourage the build-up of COD.

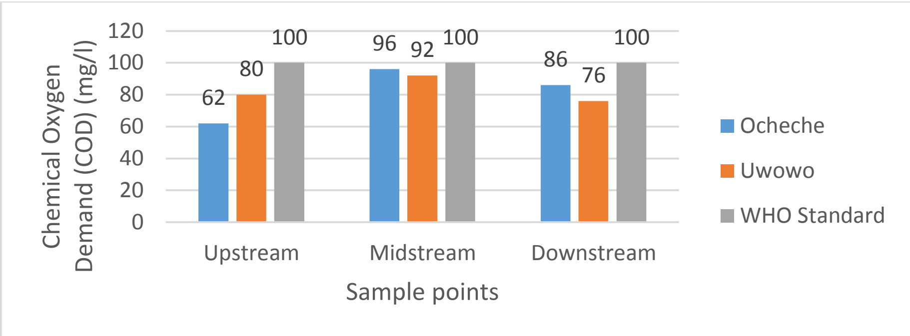

Fig.12 Plot of COD at different locations of the stream

Chloride (Cl): The test results for the chloride contents in the two streams at varying locations are plotted in Figure 13. Also plotted in the figure is the limit specified by WHO. From the plot, it is evident that the chloride contents in the two streams are within the permissible limit of 200 mg/l as specified by WHO

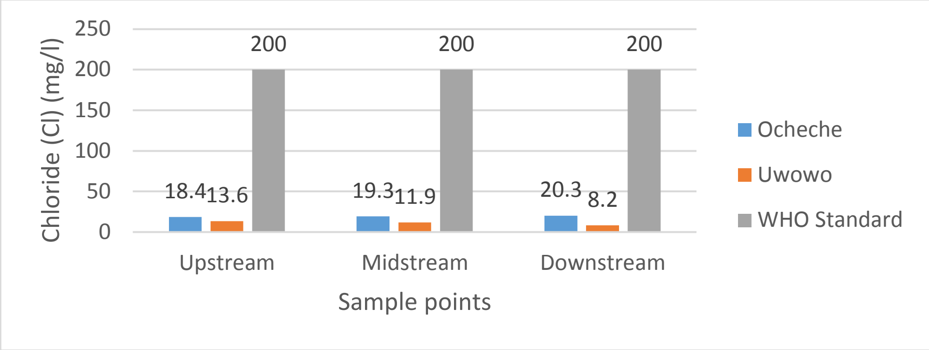

Fig.13 Plot of chloride contents for the different section of the streams

3.3 Biological Examination

Total Coli Form Bacteria: The presence of pathogen, coli form organism in water indicate contamination. From WHO guideline on drinking water, coli form must not be detectable in 100ml per sample, but must be present in 95% per sample, when taking at any 12 month period. From the laboratory test result of the total coli form bacteria of the two streams presented in Fig. 14, the total coli form bacteria count are not within the maximum permissible limit specified by WHO. The high values recorded from the tested samples taken from the two streams indicate a very high concentration of faeces pollution due to organic wastes, especially at the midstream of both streams.

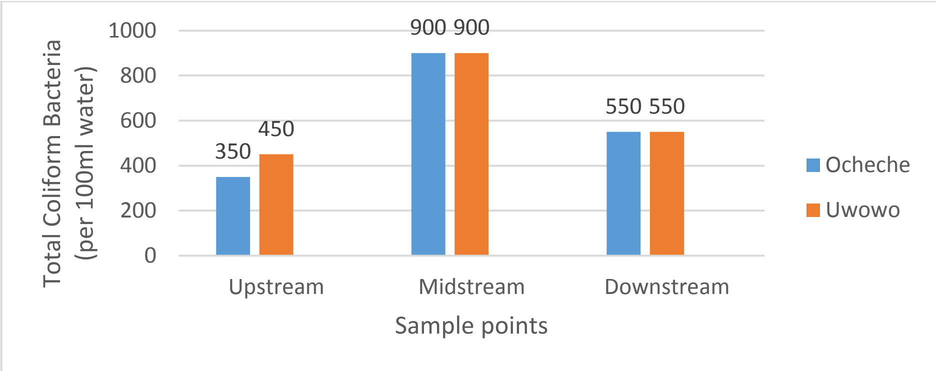

Fig.14 Plot of Total Coliform Bacteria at different location of the streams

Biological Oxygen Demand (BOD): The BOD values for water samples obtained at different locations on the streams are presented in Figure 15. Also shown on the plot is the limit (50 mg/l) as specified by WHO. From the plots, it is evident that both streams have reasonably tolerable level of BOD at all locations along the length of both streams. However, midstream BOD values for both streams may soon exceed the permissible level if the rate of contamination by organic pollutants is not regulated for both streams at the stated locations.

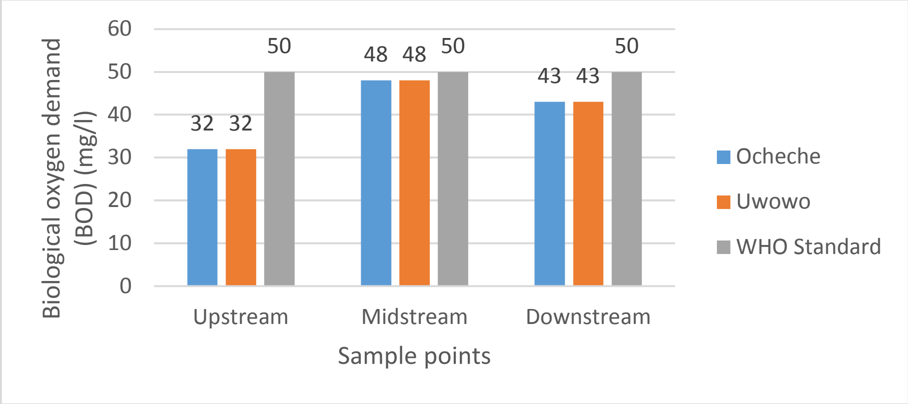

Fig.15 Plot of BOD at various sections of the streams

4. Conclusion

The outcome of the recommended physical, chemical, and bacteriological tests carried out on water samples collected at the upstream, midstream, and downstream section of both Ocheche and Uwowo streams situated in Idah, Kogi State, Nigeria, indicated that the water from the two streams have some reasonably high level of pollution, which are beyond the permissible limit of pollutants for drinking water as recommended by WHO. Hence, water from the two studied streams is not fit for human consumption in the natural state as is being presently consumed by the inhabitants of Idah, without proper treatment.

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