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Physicochemical analysis and enumeration of total heterotrophic/Coliform community in some selected surface water (stream and river) in Afikpo North L.G.A of Ebonyi State Nigeria

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Abstract

Water contamination is a major area of concern to the environmental scientist and calls for continuous assessment to reduce health hazard pose by this polluted water. Here in, the assessment of physicochemical and microbiological quality of water from two primary sources during the dry and wet season in Afikpo, Nigeria was performed using standard procedures. The results revealed that, the microbiological quality observed from the two water samples from different locations were higher during the wet season compared with the dry season. Water from Unwana River has higher microbial quality during the wet and dry season compared to the water samples collected from Iyioka stream. The physicochemical evaluation showed that, total suspended solid, turbidity, electrical conductivity and biochemical oxygen demand values were higher than the WHO recommended value. Other physicochemical parameters (pH, temperature, total dissolve solid, dissolve oxygen, and nitrate) were within the WHO and SON recommended limit. Only iron (Fe), and lead (Pb) were observed to be higher than the WHO maximum limit, other metallic ions such as Ca^{2+}, Mg^{2+}, and $CaCO_3$ were within the recommended limit. Overall, the high microbial quality and some physicochemical parameters above the recommended limits make the water from these sources unfit for drinking. Hence, environmental awareness should be urgently organize to educate the community on the health hazard of these water bodies in other to reduce water related diseases, which is endemic to the health of people in this part of Nigeria.

Keywords: Physicochemical Analysis; Microbiological quality; Surface water; Wet and Dry season; Afikpo North; Nigeria.

1. Introduction

Safe drinking water is a fundamental human right and if contaminated with obligate or opportunistic pathogenic bacteria, it may become a source of infection to consumers [10, 22]. Human health should therefore be protected by preventing microbial contamination of water that is intended for direct consumption [21]. In rural communities, untreated surface water from rivers, wells and streams are directly used for drinking and other domestic purposes [13]. These unprotected water sources can be contaminated with microorganisms through rainfall runoff and agricultural

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inputs, mixing with sewage, industrial/mining effluents and droppings of animal origin [10, 13, 19] which render them unwholesome. Water pollution and reduction in quality is a major contributor to global freshwater scarcity, stressing the need for more integrated water management and monitoring [4]. Microbial pollution have been documented to be significant concern for springs, bore hole water, rivers, ponds and streams. Pathogens have also been known to impair or threaten more water bodies than any other aquatic pollutant. In the same vein, bacterial contamination of water has been known to result in unsafe drinking water, restrictions on recreation opportunities and closure of shellfish beds [2]. Water is essential to human life, as the body needs water for hydration and to facilitate various functions of the body such as digestion, metabolism and elimination of waste. However, one of the biggest problems of mankind today is the scarcity of potable water in many parts of the world, especially in the rural parts of the developing countries. This is the case in Unwana, Afikpo south east Nigeria. Several research on water quality, water activities, water usage and sources have been carried out in the study areas. However, none of those studies has specially determined the pathogenic bacteria species common in Unwana and Afikpo as a whole. In addition, the physicochemical properties of the various water bodies have not been assessed simultaneously. This study therefore assessed the mineral element, Physicochemical and bacteriological quality of drinking water sources in Unwana south east Nigeria

2. Materials and method

2.1. Study Area

The study area, Afikpo lies in the typical Guinea Savannah region of the tropical climate zone of Nigeria and has two distinct seasons - rainy and dry seasons. The rainy season months are April to September while the dry season lasts from October to February.

2.2. Sample Collection

Sampling was carried out in two different surface water bodies which are Unwana (Akpghara) river and Iyioka stream, both located in Afikpo North Local Government Area of Ebonyi State Nigeria. Unwana River popularly known as Akpaghara River is located at Unwana after Federal Polytechnic Unwana. In Akpaghara River, so many activities like, means of transportation of goods and services from Unwana to cross river, fetching of sands for building, washing of cloths and bathing are done in the river. The source of the water is popularly known as 'Isimmini', the center point is called 'Achiewo' that involves more anthropogenic activities, while the last point is known as 'Ihiotu'. From Afikpo to Unwana road, Iyioka stream is situated after Akinola secondary school by left. The stream takes its source from the ground and flow down through the sloppy direction of the area. During raining season, water letus grows on the surface and it causes infection like schistosomiasis. People leaving in this area use the river and the stream as their source of drinking water, washing of their cloths and bath due to the open water environment.

2.3. Materials, Chemicals and Equipment used

The materials and equipment used in the study are petri dishes, test tubes, pipettes, burettes, measuring cylinders, beakers, conical flasks, sample bottles, slides, membrane filtration machine, Bunsen burner, pressure pot, wire loop, disposable hand gloves, weighing balance, autoclave, incubator, microscope, turbidity meter, etc. The chemicals and media used were ethanol, Mac-Conkey broth, Eosine Methylene Blue (EMB), etc.

2.4. Sample Collection

The samples were collected from one river and one stream both located within Afikpo North L.G.A. of Ebonyi State. A total of eighteen water samples were collected, nine from each sampled surface water bodies. The water samples were collected at three different points at measurable distances apart to ensure proper representation of the water bodies. Samples were collected three times daily, that is, morning, afternoon and evening from each of the three sampling points in each of the two sampled surface waters. The samples were collected in glass bottles which have been sterilized. All the sample bottles were rinsed severally with the sampling stream and river waters. The bottles were covered immediately after each collection. The water samples were collected in 0.5m depth. All the samples were collected in triplicates, labeled accordingly and transported to the Microbiology Laboratory of Federal Polytechnic Unwana in an ice box at -4^0c.

2.5. Laboratory analysis

2.5.1. Enumeration of total heterotrophic bacteria

The populations of bacteria in the water samples were isolated using serial dilution pour plate method. About 0.1ml of water sample was serially diluted in sterile distilled water and aliquots of the dilutions aseptically plated into nutrient

agar. The serial dilution of the water sample was carried out aseptically up to 10^{-4}. The agar plates were then incubated inverted at 37^0c for 24 – 48 hours to enumerate the bacteria. The resultant colonies on the plates were counted and expressed as colony forming units (cfu)/ml of the samples.

3. Results and discussion

3.1. Microbiological Quality Analysis of Unwana (Akpghara) River and Iyioka stream Waters

According to [22], drinking water must be free from disease causing organisms, poisonous substances, excessive amount of minerals and organic matter. Water level fluctuations are an inherent feature of water ecosystems and have been regarded as a pervasive pressure on ecosystem globally due to anthropogenic activities and climate change. However, the impact of water level fluctuation on microbial quality is of significant important to the aquatic habitat [16]. The microbiological quality of two prominent water bodies (Unwana River and Iyioka stream) located at Ebonyi state, Nigeria at different locations and seasons are shown in table 1 and 2. The water samples collected from the middle and terminal point of Unwana river during the dry season showed non-significant ($P > 0.05$) reduction in microbial load compared to the samples collected from the source. The result was different for the wet season where significant ($P < 0.05$) increase was observed in the microbial quality of water sample collected from the terminal point ($21.4 \times 10^8 \pm 2.25 \times 10^8$Cfu/ml) compared with the source but non-significant ($P > 0.05$) reduction was observed in middle point water sample ($15.67 \times 10^8 \pm 3.21 \times 10^8$ Cfu/ml) compared with the source water sample ($17.27 \times 10^8 \pm 4.73 \times 10^8$ Cfu/ml). Overall, the microbial quality observed from the three water samples (source, middle and terminal point) were higher during the wet season compared with the dry season (Table 1).

Table 1 Microbiological Quality Analysis of Unwana (Akpghara) River.

Name of Sample	Serial Dilution Factor	Total Microbial (cfu/ml)
During dry season		
Unwana River (Source)	10^{-7}	$8.73 \times 10^8 \pm 2.46 \times 10^8$
Unwana River (Middle Point)	10^{-7}	$8.17 \times 10^8 \pm 1.89 \times 10^8$
Unwana River (Terminal Point)	10^{-7}	$7.73 \times 10^8 \pm 5.74 \times 10^8$
During wet season		
Unwana River (Source)	10^{-7}	$17.27 \times 10^8 \pm 4.73 \times 10^8$
Unwana River (Middle Point)	10^{-7}	$15.67 \times 10^8 \pm 3.21 \times 10^8$
Unwana River (Terminal Point)	10^{-7}	$21.4 \times 10^8 \pm 2.25 \times 10^{8a}$

Values are mean ±SEM, n = 3^a($P < 0.05$) significant compared to source

Table 2 Microbiological Quality Analysis of Iyioka Stream Waters.

Name of Sample	Serial Dilution Factor	Total Microbial Count (cfu/ml)
During dry season		
Iyi Oka Stream (Source)	10^{-7}	$5.73 \times 10^8 \pm 4.05 \times 10^8$
Iyi Oka Stream (Middle Point)	10^{-7}	$5.83 \times 10^8 \pm 3.33 \times 10^8$
Iyi Oka Stream (Terminal Point)	10^{-7}	$5.83 \times 10^8 \pm 4.01 \times 10^8$
Waters during wet season		
Iyi Oka Stream (Source)	10^{-7}	$16.1 \times 10^8 \pm 14.91 \times 10^8$
Iyi Oka Stream (Middle Point)	10^{-7}	$1.67 \times 10^8 \pm 5.86 \times 10^{8a}$
Iyi Oka Stream (Terminal Point)	10^{-7}	$9.83 \times 10^8 \pm 5.53 \times 10^{8a}$

Values are mean ±SEM, n = 3^a($P < 0.05$) significant compared to source

The results in table 2 revealed that, the difference between the microbial quality of water samples from the three location (source, middle and terminal point) in Iyioka stream was not significant during the dry season but significant ($P < 0.05$) reduction in microbial load was observed in water samples collected from the middle and terminal points of Iyioka stream compared with the sample collected from the source of the stream during the wet season. The microbial load of water sample from source and terminal points of Iyioka during the wet season were observed to be significantly ($P < 0.05$) higher compared to the same points but collected during the dry season (Table 2). From Fig 1, the microbial load of water samples from the three point of Unwana (Akpghara) were observed to be significantly ($P < 0.05$) higher compared to the microbial load of water samples from these points in Iyioka stream. Generally, microbial load should be highly abundant during the wet season than during the dry season because the higher water temperature during the wet season is more favourable to microbial growth. The results obtained were consistent with the findings of [3] who reported that higher bacterial growth in three Gorges Reservoir during wet season compared to dry season. The increase in microbial load during the wet season compared to the dry season might also result from the flow of nutrients with flood from the surrounding lands into the water bodies. This may increase the available carbon source for the microbial growth. This observation was also confirmed by the results of [13, 18].

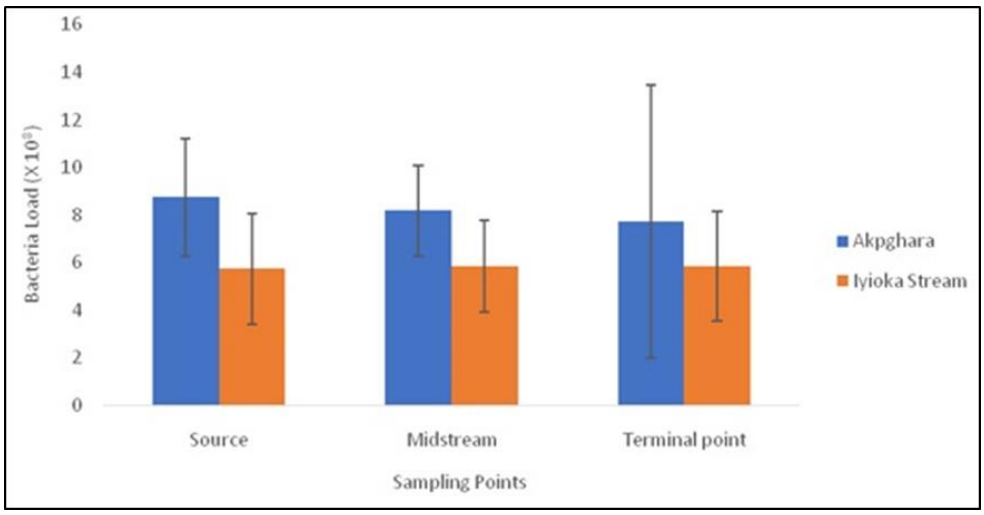

Figure 1 Total Bacteria load in the three sampling points in both Unwana (Akpghara) river and Iyioka stream water

3.2. Physicochemical Analysis of Unwana (Akpghara) River and Iyioka stream Waters

The results obtained for the monitoring of physicochemical parameters of Unwana (Akpghara) river and Iyioka stream during the wet and dry seasons are summarized in table 3. Several physicochemical parameters i.e. pH, temperature, total dissolve solid, total suspended solids, electrical conductivity, turbidity, nitrates, dissolved oxygen and biochemical oxygen demands of the water samples at various points were compared with the world health organization (WHO) and structural organization of Nigeria (SON) standard limit.

The pH value of water samples collected from the source of Unwana (Akpghara) river during the dry and wet season were observed to be lower than the samples collected from middle and terminal points of the river. pH of water samples from the source were also observed to be below the WHO and Son standard limit while the pH of water samples from the middle and terminal points during the two seasons were within the WHO and SON limit. The pH is the standard measure of acidic and alkaline of a solution [1]. It is measured on a scale of 0-14. pH 7 is neutral, pH less than 7 is acidic and pH greater than 7 is basic. The pH of the water samples from all the location of Unwana River and Iyioka stream during the wet and dry seasons tends towards acidity with ranges between 3.90 to 6.79. The slight acidity observed in these water samples could be due to the high carbon (iv) oxide (CO_2) and sulphur (iv)oxide (SO_2) released by microbial activity. The results obtained are consistent with the findings of [14] who reported that, low pH values in water might be due to the high levels of CO_2 which may consequently affect the bacterial counts.

Table 3 Results of the Physicochemical Analysis

Samples	Location	pH	T°c	TDS	TSS	TBD	E/C	DO	NO_3	BOD
Unwana (Akpghara) River Dry Season	Source	3.90 ± 0.61	31.33 ± 0.57	30.00 ± 0.00	157.33 ± 7.51	4.10 ± 0.10	122.2 ± 5.51	6.23 ± 0.06	22.3 ± 2.50	41.0 ± 1.00
	Middle Pt	6.60 ± 0.20	30.0 0 ± 0.00	30.33 ± 0.58	169.00 ± 1.00	6.03 ± 1.25	169.3 ± 13.5	6.6 ± 0.1	20.3 ± 0.58	43.3 ± 1.53
	Terminal Pt	6.10 ± 0.10	30.00 ± 0.00	31.33 ± 0.72	146.33 ± 1.53	7.10 ± 0.40	220.3 ± 20.5	6.63 ± 0.35	21.3 ± 0.58	44.3 ± 1.53
Unwana (Akpghara) River Wet Season	Source	5.67 ± 0.64	32.20 ± 1.85	32.00 ± 1.00	155.33 ± 5.51	4.27 ± 0.40	138.33 ± 5.51	6.33 ± 0.15	25.67 ± 2.08	45.67 ± 1.53
	Middle Pt	6.79 ± 0.20	31.67 ± 0.58	33.00 ± 1.73	159.00 ± 7.94	6.30 ± 1.23	185.33 ± 13.50	6.80 ± 0.10	25.00 ± 2.65	51.33 ± 4.16
	Terminal Pt	6.25 ± 0.10	32.33 ± 1.53	32.67 ± 1.26	140.67 ± 10.12	7.07 ± 0.30	251.00 ± 32.42	6.80 ± 0.36	25.00 ± 1.00	48.56 ± 1.15
Iyioka Stream Dry Season	Source	4.20 ± 2.25	30.33 ± 0.58	44.00 ± 1.00	141.00 ± 1.00	7.53 ± 0.06	116.33 ± 0.58	5.80 ± 0.10	18.00 ± 1.00	53.33 ± 0.58
	Middle Pt	5.33 ± 0.06	31.33 ± 0.58	42.67 ± 0.58	147.00 ± 1.00	7.77 ± 0.06	118.0 ± 1.00	5.53 ± 0.06	17. 0 ± 1.00	56.33 ± 0.58
	Terminal Pt	5.33 ± 0.15	30.33 ± 0.58	43.00 ± 1.00	144.00 ± 1.00	7.63 ± 0.06	117.67 ± 0.58	5.60 ± 0.10	17.00 ± 1.00	54.33 ± 0.58
Iyioka Stream Wet Season	Source	5.87 ± 0.25	31.00 ± 1.00	49.00 ± 1.00	147.67 ± 2.52	7.97 ± 0.15	12.00 ± 0.10	6.37 ± 0.37	19.00 ± 1.00	56.33 ± 1.53
	Middle Pt	6.37 ± 0.83	31.67 ± 1.053	49.33 ± 2.08	150.00 ± 1.00	8.20 ± 0.10	12.23 ± 0.29	5.93 ± 0.06	18.33 ± 0.57	60.33 ± 1.53
	Terminal Pt	5.70 ± 0.10	31.00 ± 1.00	47.00 ± 1.00	148.78 ± 2.51	7.93 ± 0.15	12.57 ± 0.21	5.97 ± 0.06	18.00 ± 1.00	57.67 ± 1.25
	WHO Limit SON Limit	6.5-8.5 6.5-8.5	20-30 30	250 – 500 _	50 -	5 0-5	100 -	10 50	- -	10 6

T°C= Temperature, TDS = Total Dissolved solid, TSS = Total Suspended Solid, E/C = Electrical conductivity, TBD = Turbidity, NO3 = Nitrates, PO4 = Phosphates, CaCO3 = Calcium Trioxocarbonate, DO = Dissolved Oxygen, BOD = Biochemical Oxygen Demand, WHO: World health organization; Pt: Point; SON: Standard organization of Nigeria

The temperature range of water samples from Unwana River and Iyioka stream during the wet and dry seasons was between 30°c to 32°c which were observed to be within the WHO and SON standard limit. The observed temperature of the water samples could be influenced by the intensity of sunlight which might be affected by shades provided by many trees [1, 6].

The total solid (TS) refers to the material residues left after evaporation of a sample and its subsequent drying in an oven at a defined temperature. The TS include total dissolved solid (TDS) and total suspended solid (TSS) [1]. The TDS is the portion that passes through the filter while TSS is the portion of total solids retained by the filter [24]. The TDS recorded in this study for water samples obtained from various points in Unwana River and Iyioka stream during wet and dry seasons range from 30.00 to 49.00. These values were observed to be below the WHO standard limit. The TSS values from all the water samples collected during the two seasons was observed to be above the WHO standard limit. Hence, high level of TSS could be toxic to aquatic life and can reduce habitat. This finding is consistent with the report of [8] who reported high TSS values from Iyienu River of Abia State, Nigeria. Conductivity is an indirect measure of the ion concentration on water samples, which is often used as a surrogate for TDS. Therefore, it is use as indicator of the taste and salinity of water samples [7]. The electrical conductivity of Unwana River collected during wet and dry seasons and Iyioka stream (dry season) were observed to be higher than the WHO permissible limits while the conductivity values of Iyioka stream water collected during wet season showed reduction compared with WHO limit.

Water clarity is the measure of water turbidity which result from suspended particles or colloidal matter that obstructs light transmission through water [1, 22]. The turbidity of water samples collected from source of Unwana River during wet and dry seasons were below the WHO limit and lower compared with the water samples from middle and terminal points. Dissolved oxygen (DO) is an essential measure of the extent of pollution in water samples [17]. The values of dissolved oxygen observed in this study was lower in Unwana River and Iyioka stream during dry and wet seasons compared with the WHO limit. This is an indicator that water samples from both sources could contain high levels of pollutants, since lower level of DO values depicts high pollution rate and vice versa [9]. Biochemical oxygen demand (BOD) refers to the amount of oxygen that would be consumed if all the organics in one liter of water were oxidized by bacteria and protozoa. The BOD values observed from this study ranged from 41.00 to 60.33; these values were higher than the WHO permissible limit of 10.00 and SON limit of 6.00. Water samples with BOD less than 4.0 are considered clean water [15]; hence water samples from Unwana River and Iyioka stream collected during dry and wet seasons could be reported unclean.

3.3. Results of metallic Ions and total hardness of Unwana (Akpghara) River and Iyioka stream

The harmful implications of high levels of heavy metals in water consumed by humans and aquatic organisms cannot be overemphasized [12]. These metals constitute the hardness of water; hence total hardness is defined as the sum of calcium and magnesium concentration in water as calcium carbonate equivalent in milligrams per liter [1]. The calcium and magnesium ion concentrations observed in Unwana River samples collected during the dry season from source, middle and terminal points were observed to be lower than the water samples collected during the wet season. Water samples from Iyioka stream showed no significant difference between the water samples collected during the wet and dry seasons (Table 4). The ca^{2+} and Mg^{2+} concentrations from the water samples from Unwana River and Iyioka streams during these seasons were revealed from Table 4 to be below the WHO standard limit. Remarkably, the calcium carbonate concentration showed the same trends for both water samples and seasons. The total hardness values i.e. calcium carbonate concentration in the studied water samples and seasons ranged from 132.30 to 152.67 Mg/l, these results were found to be close to the 150 Mg/l maximum permissible limit of standard organization of Nigeria [20]. These results show that the water samples are suitable for domestic uses. The iron (Fe) concentration of Unwana River collected from source during the wet and dry seasons was higher than that of middle and terminal points. The Fe concentration of water samples from Unwana River collected during the dry and wet season were also lower than the Fe concentration observed in Iyioka stream. Although, the mean Fe concentration of water samples from both water bodies and seasons were found to be above the SON and WHO acceptable limit (0.3 Mg/l). High Fe concentration in water promotes the growth of iron bacteria and makes the water tasteless [17, 21]. The consumption of water containing high Fe poses health risk as overload of Fe is associated with polycythemia [17]. The mean concentration of lead (Pb) from the three water collection points (source, middle and terminal) of Unwana river and Iyioka stream during the dry season was found to be lower than the Pb values of water samples collected during the wet season (Table 4). This could result from leach ate of this heavy metal from the environment into the water bodies through flood. Overall, the mean concentration of Pb found in the water samples from Unwana River and Iyioka stream during the dry and wet seasons from this study are higher than the SON and WHO acceptable limits (0.01 Mg/l). The high concentration of Pb observed in this study especially the water collected from Iyioka stream might resulted from direct disposal of wastes containing Pb at the riverbank through human activities. The result from this study is also in agreement with the findings of [17] who reported high Pb level in Rivers from Keffi central, Nigeria. Excess intake of Pb has been reported

in the pathogenesis of microcytic anemia, δ-amino levulinate synthase inhibition [5] and brain damage in children. The water from Unwana River and Iyioka stream therefore required treatment so that the Pb level is reduced to acceptable limit before use for domestic purposes.

Table 4 Determination of Metallic Ions and total hardness of Unwana (Akpghara) River and Iyioka stream Waters

Samples	Location	Ca2+ (Mg/l)	Mg2+ (Mg/l)	CaCO3 (Mg/l)	Fe (Mg/l)	Pb (Mg/l)
Unwana (Akpghara) River Dry Season	Source	31.95 ± 0.15	25.9 ± 0.10	132.3 ± 2.50	6.15 ± 0.15	1.73 ± 0.42
	Middle Pt	28.80 ± 0.20	24.43 ± 0.15	136.3 ± 1.5	4.30 ± 0.10	1.73 ± 0.25
	Terminal Pt	27.60 ± 0.40	22.73 ± 0.25	142.7 ± 2.5	4.03 ± 0.06	1.70 ± 0.28
Unwana (Akpghara) River Wet Season	Source	52.67 ± 3.78	30.67 ± 0.58	139.00 ± 2.65	5.83 ± 0.15	3.10 ± 0.43
	Middle Pt	50.00 ± 1.00	29.33 ± 0.58	139.67 ± 1.53	3.27 ± 0.65	3.47 ± 0.25
	Terminal Pt	47.33 ± 1.15	27.00 ± 2.64	152.67 ± 4.04	4.13 ± 0.76	3.17 ± 0.60
Iyioka Stream Dry Season	Source	33.13 ± 0.06	29.07 ± 0.06	146.33 ± 0.58	8.63± 0.06	4.37 ± 0.06
	Middle Pt	32.53 ± 0.45	28.73 ± 0.06	145.33 ± 0.58	8.53 ± 0.06	4.53 ± 0.06
	Terminal Pt	32.60 ± 0.50	28.8 ± 0.06	145.67 ± 0.58	8.63 ± 0.06	4.33 ± 0.06
Iyioka Stream Wet Season	Source	33.93 ± 0.11	31.40 ± 0.00	149.33 ± 0.58	8.90 ± 0.00	4.90 ± 0.20
	Middle Pt	33.27 ± 0.38	29.43 ± 0.29	148.33 ± 0.58	8.70 ± 0.17	5.00 ± 0.10
	Terminal Pt	32.87 ± 0.23	29.00 ± 0.00	147.33 ± 0.58	8.93 ± 0.06	4.80 ± 0.00
	WHO Limit	75-200	30-150	-	0.3	0.01
	SON Limit	-	-	150	0.3	0.01

SON: Standard organization of Nigeria; WHO: World health organization

4. Conclusion

This present investigation revealed that the water samples from Unwana River and Iyioka stream were found to be grossly contaminated as a result of microbial growth due to waste disposal through human activities. In the foregoing, regulatory agencies should ensure that companies and households surrounding these water bodies desist from channeling sewage, effluent, refuse, and human wastes into the water without prior treatment. As a matter of urgency, I have arranged for an environmental awareness campaign to organized and educate members of the community on the proper disposal of waste, management and protection of their water resources through the sponsorship of TETFund for this research work. These would drastically reduce acute problem of water related diseases, which are endemic to the health of man.

I recommend that more research works should be carried out in the study areas as different kinds of microorganisms erupt every day, contaminating our water bodies making it unsafe for consumption and resistant to known drugs in use for treatment of various water diseases.

Compliance with ethical standards

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Disclosure of conflict of interest

The author declares that there is no conflict of interest.

References

[1] Anake WU, Ehi-Eromosele CO,Siyanbola TO, Edobor-Osoh A, Adeniyi IO. Taiwo OS. Physicochemical and microbial assessment of different water sources in Ota, Ogun State, Nigeria. *International Journal of Current Research.*2013; 5(7): 1797-1801.

[2] Ayandiran TA, Ayandele AA, Dahunsi SO. Ajala OO. Microbial assessment and prevalence of antibiotic resistance in polluted Oluwa River, Nigeria. *Egyptian Journal of Aquatic Research*, 2014; 40: 291–299.

[3] Chen Z, Zhou Z,Peng X, Xiang H, Xiang S. Jiang Z. Effects of wet and dry seasons on the aquatic bacterial community structure of the Three Gorges Reservoir. *World J MicrobiolBiotechnol*.2013; 29:841–853.

[4] Dahunsi SO, Owamah HI, Ayandiran TA Oranusi US. Drinking water quality and public health of selected communities in South Western Nigeria *Water Quality and Experimental Health*,2014; 6: 143–153.

[5] Diouf A, Garcon G, Diop Y, Ndiaye B. Environmental lead exposure and its relationship to traffic density among Senegalese children: A cross sectional study. *Hum. Exp.Toxicol.*2006; 25:637-644.

[6] Eze SO. Madumere, IC. Physicochemical and microbiological analysis of Water bodies in Uturu, AbiaState-Nigeria. *Asian Journal of Natural &Applied Sciences.*2012; 1(4): 58 – 65

[7] Ince M, Bashir D, Oni OOO, Awe EO, Ogbechie V, Korve K, Adeyinka MA, Olufolabo AA, Ofordu F, Kehinde M. 2010. Rapid assessment of drinking-water quality in the Federal Republic of Nigeria: country report of the pilot project implementation in 2004-2005.

[8] Ken-Ikwuagwu CB, Akubugwu EI. Chinyere GC. Physicochemical and Bacteriological Studies of Iyienu River and Physicochemical Parameters of Soil from Its Banks. *Intra specific Journal of Biodiversity and Environmental Sciences*.2015; 2(2): 1-7

[9] Mgbemena NM. Okwunodulu FU. Physicochemical and microbiological assessment of borehole waters in Umudike, Ikwuano L. G. A., Abia State, Nigeria. *AdvApplSci Res*. 2015; 6(4): 210 - 214.

[10] Mulamattathil SG, Bezuidenhout C, Mbewe M & Ateba CN. Isolation of Environmental Bacteria from Surface and Drinking Water in Mafikeng, South Africa, and Characterization Using Their Antibiotic Resistance Profiles *Journal of Pathogens*, 2014; 11: 1-11.

[11] Mulusky DS. *Ecology of Estuaries*. London: Heinemain Educational Books, 1974; pp.5-103.

[12] Nwanebu FC. Nwabueze FC. Regime in occurrence of bacteria of public health significance of some natural water bodies in Imo State, Nigeria. *Inter. Res. J. Eng. Sc. Tech.*2004; 1(1): 23-31.

[13] Obi CL, Potgieter N, Bessong PO. Matsaung G. Assessment of the microbial quality of river water sources in rural Venda communities in South Africa. *Water SA*, 2002; 28(3): 287 - 292.

[14] Pavendan P, Anbu S S and Sebastian RC. Physico-Chemical and microbial assessment of drinking water from different water sources of Tiruchirappalli District, South India. *Eur. J. of Exp. Bio.*2011; 1(1): 183-189.

[15] Rajini K, Roland P, John C. Vincent R.Microbiological and physicochemical analysis of drinking water in George town. *Nature and Sci*.2010; 8(8):261-265.

[16] Ren Z,Qu X, Zhang M, Yu Y. Peng W. Distinct Bacterial Communities in Wet and Dry Seasons During a Seasonal Water Level Fluctuation in the Largest Freshwater Lake (Poyang Lake) in China. *Frontiers in Microbiology*.2019; 10: 1-13

[17] Reuben RC, Gyar SD. Aliyu Y.Physicochemical and Microbiological Parameters of Water from Rivers in Keffi, Central Nigeria. *Microbiology Research Journal International*.2018; 24(3): 1-12

[18] Sekiguchi H, Watanabe M, Nakahara T, Xu B, Uchiyama H Succession of bacterial community structure along the Changjiang River determined by denaturing gradient gel electrophoresis and clone library analysis. *Appl Environ Microbiol*. 2002; 68:5142–5150.

[19] Sharma A, Dubey N. Sharan B. Characterization of aeromonads isolated from the river Narmada, India. *International Journal of Hygiene and Environmental Health*, 2005; 208(5): 425 - 433.

[20] SON.Standard Organization of Nigeria, Nigerian Standard for drinking water quality,2007; pp. 15-16.

[21] V'olker S, Schreiber C. Kistemann T. Drinking water quality in household supply infrastructure—a survey of the current situation in Germany *International Journal of Hygiene and Environmental Health*, 2010; 213(3): 204 – 209.

[22] World Health Organization (WHO).Guidelines for drinking water quality (4thEd.), Acceptability aspects: Taste, odour and appearance. Geneva. 2011;1-294.

[23] Yagoub AEA. Ahmed TA. Microbiological evaluation of the quality of tap water distributed at Khartoum State. *Res J Microbiol*2009;.4(10):355-360.

[24] Zang J. Increasing antarctic sea ice under warming atmospheric and oceanic conditions. *Journal of Climate*.2007; 20:2515-2529.