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Assessment of the Impact of Abattoir Waste on Ikpoba River Water Quality, Benin City Nigeria

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ABSTRACT

The presence of anthropogenic inputs has seriously affected the quality of available water in the environment. In this view, the effect of the discharge of abattoir waste on water quality of the Ikpoba River was investigated. Surface water samples were collected from ten (10) designated locations on the River and analyzed for Physico-chemical and bacteriological parameters. Using standard procedures. The results of physicochemical parameters obtained were ranges as follow: pH (5.4 to 6.3), Electrical Conductivity (10-90µS/cm), Total Dissolved Solids (50.3-88.3mg/l), Total Suspended Solids (10-39mg/l), Chemical Oxygen Demand (6.01-14.04mg/l), Dissolved Oxygen (2.07-4.29mg/l), Biochemical Oxygen Demand (4.02-6.17mg/l), Sulphate (0.10-0.51mg/l), Chloride (10.06-18.24mg/l), Calcium (0.80-22.64mg/l), Magnesium (0.49-3.4mg/l), Phosphate (0.16-0.45mg/l), Nitrate (3.12-5.78mg/l), Ammonia (0.86-1.59mg/l), Iron (0.34-0.85mg/l), Copper (0.07-0.51mg/l) and Zinc (0.07-1.41mg/l). The total microbial count ranged from 2×10^3 to 21×10^3CFU/ml and 1×10^3CFU/ml to 12×10^3CFU/ml for the bacterial and fungal isolates respectively. Total coliform counts spans from 3×10^3 to 16×10^3MPN/100ml.The microorganisms isolated were Pseudomonas aeruginosa, Staphylococcus aureus, Staphylococcus epididymis, Klebsiella mirabilis, Proteus vulgaris, Enterobacter aerogenes, Micrococcus luteus, Aspergillus niger, Aspergillus flavus, Penicilliumnotatum, Mucormucedo, and Saccharomyces cerevisiae. The statistics show that there was no significant difference in the physicochemical parameters of various stations of the river water samples when compared ($P>0.05$). There was a significant difference in the bacteriological parameters of various stations of the river water samples ($P<0.05$). Hence the water quality of Ikpoba river water poses serious health to human health. It is recommended that abattoir be monitored for compliance with hygienic requirements and sanitary regulations governing the operations of the abattoir.

KEYWORDS

Physico-chemical parameter, bacteriological load, abattoir effluent, water quality, experimental, Nigeria

INTRODUCTION

Over the last century, the quality of drinking water has been a focal point for disease prevention and control of water-borne diseases (WHO, 2017, Ekanem *et al.,* 2016). Water quality is a prerequisite in evaluating the health status of any community, therefore vital for preventing diseases (WHO, 2017). Water is used for different purposes, thus making it a reservoir for the spread of many communicable diseases such as typhoid, dysentery and cholera in the human population (Falodun & Rabiu, 2017). Consequently, the World Health Organization recommended that water resources should remain within specific standard limits (WHO, 2017).

In Nigeria, the establishment of abattoirs/ slaughter houses and the management of the wastes generated from these facilities are collectively seen by the government at levels both at the federal, state and local governments as social services. However, for decades, the government has been unconcerned about their responsibilities and functions to abattoirs/slaughter houses, which eventually has culminated in the deterioration of abattoirs/slaughter houses, poor environmental hygiene, improper meat inspection and waste management (Falodun & Rabiu, 2017).

Due to the attendant environmental impacts arising from abattoir operations as a result of the failure of abattoir operators to adhere to environmentally friendly and good hygiene practices, abattoir or slaughter-house wastes has become a major cause for worry in Nigeria (Falodun and Rabiu, 2017). The indiscriminate activities of these abattoirs pose a significant challenge to proper management of the environment, particularly in the areas where they are located. Furthermore, they encourage the transfer of infectious agents which can be pathogenic to humans (Solomon, Wudu, Biruk, Tesfay & Aklilu, 2016; Onuoha, Eluu & Okata, 2016). Aquatic food chain has been affected by the discharge of abattoir wastes into rivers and/or streams, especially in urban areas (Falodun & Rabiu, 2017). The illicit discharge of abattoir effluents into streams may lead to a reduction of dissolved oxygen as well as nutrients in the receiving water bodies (Akatah, *et al.,* 2018).

Abattoir waste is raising public health concerns emerging from the poor environmental management practices. Most of the abattoirs dispose their waste without any form of treatment or approved environmental guidelines to mitigate the possible environmental impacts of the wastes in the River (Kwadzah & Iorhemen, 2015). The indiscriminate disposal of abattoir wastewater and the solid wastes from abattoir operations into Ikpoba River by abattoir operators in the area is a viable source of pollution of the river. It has resulted to poor water quality over the years as well as the outbreak of waterborne diseases in the area (Olaiya *et al.,* 2016).

According to the United Nations, water is a significant factor in achieving sustainable development goals, healthy ecosystems and a critical component for socio-economic development. Notwithstanding, the practice of direct discharge of abattoir waste into Ikpoba River has continued relentlessly, resulting in the introduction of pathogenic microbial organisms, which can result in severe water borne diseases like dysentery, cholera, diarrhea (Solomn, *et al.,* 2016; Olaiya *et al.,* 2016). It is against the stated problem that this study aims to examine the physico-chemical and microbial properties of Ikpoba River. This help will help to determine the safety of the river for human and domestic usage.

Reports from previous authors show that abattoirs generate waste comprised of animal parts and wastewater as a direct result of its operations. According to Atuanya, *et al.,* (2015), wastewater from abattoir is characterized by high amount of blood and other solid products from slaughtered animals. Atuanya, *et al.,* (2015), in analyzing the effluents from abattoirs in Benin City, observed that the mean heterotrophic bacterial counts of abattoir effluent was 5.76 while for private abattoirs, the mean heterotrophic bacterial counts was 6.3 x 105 CFU/ml. Mulu & Ayenew (2015) observed that raw wastewater of from Kera and Luna abattoirs in Central Ethiopia were characterized by extremely high turbidity, color, TS, TSS, BOD, COD, NH_3, NO_2, NO_3, SO_4^{-2}, &PO_4^{-3}.

Ogbomida, *et al.,* (2016) evaluated the bacterial profile and biodegradation potential of abattoir wastewater from Ikpoba Hill and Eyean abattoirs. The most dominant and least dominant bacteria in the wastewater from both abattoirs were *Escherichia* sp. and *Streptococcus* sp. respectively. Chukwu *et al.,* (2011) also noted that the microbial load in the abattoir effluent was high; while the analysis of the physico-chemical parameters of the samples taken from the rivers that directly received effluents from abattoirs were above the WHO permissible limit for drinking water.

Adesina, *et al*., (2018) in their study reported that most of the chemical parameters exceeded the accepted standard; phosphate was seen to range between 0.34-109mg/l with a mean value of 27.62mg/l. Akatah, *et al.,* (2018) reported that other parameters such as temperature, DO, TDS, COD, BOD, phosphate and Iron of the samples were within WHO standard for surface water. Statistical analysis of the physico-chemical parameters of the three stations showed no significant difference (P> 0.05).Similarly, Elemile, *et al*., (2019) in Omu-Aran Nigeria observed that the mean values for DO ranged from 5.80±0.20 to 7.23±0.55 mg/l, BOD ranged from 12.0±1.0 to 26.0±2.0 mg/l, lead ranged from 0.06±0.02 to 0.16±0.02 mg/l and total coliforms ranged from 208.0±24.25 to 254.67±12.22 cfu/ml. Statistical analysis indicated significant difference in the water quality. The quality of the groundwater improved with increasing distance from the abattoir.

Falodun & Rabiu, (2017) observed that the physico-chemical parameters of the wastewater showed total dissolved solids of 4,150 mg/l and 2300 mg/l for slaughter slab and drainage respectively while biochemical oxygen demand was 867.2 mg/l and 698.5 mg/l. Dissolved oxygen was between 0.01 mg/l and 0.02 mg/l; the mean value of TBC and TCC ranged between 4.24x 10^7- 4.78x10^7CFU/ml and 3.03x10^7- 3.51x10^7CFU/ml respectively. Salmonella species isolated were 48 and were all resistant to ampicillin and ceftriaxone.

Deborah, *et al*., (2017) observed that hhe biological and chemical parameters ranged between 2 -18mg/l DO and 10 -45mg/l BOD 598 -789mg/l CL, 29.8 -855mg/l SO_4, 3.50 -19mg/l PO_4 for different sampling point in the study area and were above the WHO Standard for effluent discharge from industries. The rise and fall pattern of DO and BOD confirms the process of self-purification of the receiving stream with distance. Similarly, Abdullahi, *et al*., (2017) observed that abattoir wastewater exhibited significantly higher levels of total dissolved solids (1385.5+23.12mg/l*)*, phosphate (PO_4^{3-}) (241.03+6.18mg/l*)*, nitrate (NO^{3-}) (4.16±0.46 mg/l*)*, nitrite (NO^{2-}) (1.63±0.49mg/l 0, ammonia nitrogen (63.58+1.51mg/l*)* and chemical oxygen demand (COD) (12559±2019mg/l*)* compared to both upstream as well as downstream regions along Nsooba Channel. Similarly, Mulu *et al.,* (2013) in their study reported that all parameters with the exemption temperature and pH did not comply with Ethiopian environmental standard.

The summary of the literature review revealed that the direct discharge of abattoir waste is a potential environmental pollutant and could affect the quality of available waters in the river. This possess threat to threat to the health of public who uses the water for drinking and other domestic purposes without treatment. Hence the need for continuous water quality monitoring in such environment.

MATERIALS AND METHODS

The study was carried out at Ikpoba River in Benin City Edo State Nigeria. Ikpoba River flows from north to south through Benin City, Edo State, Nigeria (6.5°N, 5.8°E). The river is located in Ikpoba Okha Local Government Area of Edo State. Ikpoba River traverse Benin City, draining the whole eastern part of the City.

The study adopted field work measurement and experimental design to generate data on the physicochemical and microbial quality of the water. Purposive and simple random sampling was used in the process of data collection. Data collection was done on a single day in the morning between 9 and 11 am.

The collection of the surface water samples was done in ten established sampling stations comprising of three (3) control stations located before the abattoir effluent discharge point and seven (7) stations after the discharge point.

Surface water samples for dissolved oxygen was collected by immersing 250ml glass stopper reagent bottle into the water body and filled to the brim. The bottles were carefully covered tightly under water to avoid the inclusion of air bubbles and 1.5ml of Winkler's solution was added to each of the samples after the bottles were lifted out of water and the stopper were carefully replaced. The plastic kegs were distinctively labeled and taken to the laboratory to be analyzed immediately. Those not immediately analyzed were stored at 4°C for subsequent analyses. Water samples were analyzed in the laboratory (Benin Owena Basin Environmental Laboratory, University of Benin)

In-situ measurements of water and air temperature which was done using mercury in glass thermometer immersed into water (0 -20cm) for between 3 and 5 minutes and read while still in the water. The air temperature was taken by holding the end of the thermometer and keeping it in place in the air for between 3 and 5 minutes after which the reading was taken

Data Analysis was done using SPSS version 15. Percentages, mean, standard deviation, graphs and tables were used to present the results while Analysis of Variance (ANOVA) was used in the test of the various hypotheses.

RESULTS AND DISCUSSION

The data on Physico-chemical parameters and microbial load of surface water samples from Ikpoba River.

Table 1: Physico-chemical analyses of water samples at various source points and WHO standard limits

Parameters	Units	C1	C2	C3	SP1	SP2	SP3	SP4	SP5	SP6	SP7	WHO Std.
Temperature	(°C)	22.45	22.60	23.05	25.40*	24.50	25.25*	25.40*	25.50*	26.15*	26.35*	25
pH	-	5.9	6.4	5.4	6.9	6.6	6.2	6.0	6.1	5.8	5.7	6.5-8.5
Conductivity	µS/cm	20.01	28.75	41.54	69.10	63.13	51.19	48.16	30.54	22.43	32.20	400
T.D.S	mg/l	16.32	18.32	22.44	56.14	48.01	37.64	32.40	27.22	19.32	26.10	500
T.S.S	mg/l	16	12	30*	39*	12	14	12	15	10	14	30
Turbidity	NTU	18*	17*	16*	15*	14*	15*	19*	18*	18*	17*	5
Sulphate	mg/l	0.29	0.29	0.28	0.51	0.28	0.14	0.10	0.37	0.26	0.37	250
Chloride	mg/l	11.18	14.12	14.12	18.24	14.12	21.18	11.18	11.18	10.06	11.18	250
Calcium	mg/l	8.75	9.80	12.41	22.64	16.10	15.65	11.06	12.08	11.05	7.28	150
Magnesium	mg/l	0.44*	0.49*	0.62*	2.76*	1.99*	1.98*	1.94*	1.92*	2.76*	3.12*	0.2
Phosphate	mg/l	0.29	0.33	0.25	0.45*	0.16	0.33*	0.16	0.17	0.23	0.42*	0.3
Nitrate	mg/l	4.13	4.07	4.10	5.22	5.01	4.29	5.25	5.78	3.46	3.12	10
Ammonia	mg/l	1.47	1.38	1.44	1.59*	1.46	1.40	1.05	0.87	0.95	0.86	1.5
Iron	mg/l	0.35*	0.34*	0.36*	0.83*	0.72*	0.82*	0.82*	0.81*	0.85*	0.65*	0.3
Copper	mg/l	0.13	0.11	0.07	0.47	0.34	0.41	0.51	0.29	0.28	0.14	1
Zinc	mg/l	0.11	0.14	0.08	0.56	0.50	1.41	0.85	1.28	1.28	1.36	3
COD	mg/l	7.02	6.01	8.02	7.05	11.06	12.08	11.05	12.72	14.04	13.09	80
DO	mg/l	2.07	2.33	3.39	2.22	2.09	3.10	3.50	4.21	3.72	4.29	14
BOD	mg/l	4.02*	5.01*	4.54*	5.23*	5.07*	6.11*	5.18*	5.56*	6.14*	6.17*	4.0

* Values Exceeded WHO Standard
Note: Unit of measurement = milligram per litre (mg/l); micro Siemens per centimeter (µS/c

Physico-Chemical Parameters of Water Samples Collected From Ikpoba River at Different Sampling Points

Table 1 shows the distribution of physico-chemical parameters at the various sampling points of Ikpoba River. This was presented against the WHO standard limits. The values for pH ranged from 5.4 to 6.3. The values for pH were below the WHO permissible limits of 6.5-8.5. The acidity of the water suggested a serious degradation in water quality in the area. Sampling point 1(SP1) recorded the highest pH at point of discharge which could be due to presence of abattoir effluent. EC ranged from 20.01μS/cm to 69.10μS/cm. The range of electrical conductivity recorded at all stations where within WHO permissible limit. TDS ranged from 16.32mg/l to 56.14mg/l. The values for TSS ranged from 10mg/l to 39mg/l. All values recorded for TSS were within WHO limits except control point 3 (C3) and SP1. The values for turbidity ranged from 14NTU to 19NTU. Sulphate concentration ranged from 0.10mg/l to 0.51mg/l. The values for chloride ranged from 10.06mg/l to 18.24mg/l. The values for calcium ranged from 0.80mg/l to 22.64mg/l. Magnesium concentration ranged from 0.49mg/l to 3.4mg/l. The concentration of magnesium recorded at all stations was higher than the WHO permissible limit. Values for phosphate ranged from 0.16mg/l to 0.45mg/l. The nitrate concentration ranged from 3.12mg/l to 5.78mg/l. The ammonia concentration ranged from 0.86mg/l to 1.59mg/l. The values for iron ranged from 0.34mg/l to 0.85mg/l. The value for copper ranged from 0.07mg/l to 0.51mg/l. The concentration of zinc recorded at the various stations ranged from 0.07mg/l to 1.41mg/l. The COD values ranged from 7.02mg/l to 14.04mg/l. The concentration of dissolved oxygen in the samples ranged from 2.07mg/l to 4.29mg/l. The values for BOD ranged from 4.02mg/l to 6.17mg/l.

The mean pH range of Ikpoba River is between 5.4 and 6.0. The observed pH range is lower than that earlier observed by Akatah, *et al.,* (2018) in the same river (6.0-6.6), where all the samples were slightly acidic. PH is vital in assessing biodiversity in water bodies and these organisms by producing acidic or alkali waste products may alter the pH of their own habitats. The values of electrical conductivity were within the range of 20.01-69.110 μS/cm with SP1 having the highest value. This value is comparable to and reaffirms the findings of Akatah, *et al.,* (2018) who in their study recorded an electrical conductivity range of 10-90μS/cm. Similarly, the values for TDS were within the range of 16.32-56.14mg/l, with the highest value recorded at the point of discharge (SP1).

The total suspended solid (TSS) values of all samples analyzed ranged from 10-39mg/l. Akatah, *et al.* (2018) in an earlier study in the same study area reported similar values in the same river. In contrast to the values recorded in this study, Adesina, *et al*. (2018) recorded much higher values (up to 6,650mg/l for TSS) in a river contaminated with abattoir waste in Ogun River Basin in Southern part of Nigeria. The highest values (30-39mg/l for TSS) was recorded at C3 and SP1 respectively. The higher TSS values recorded at these points may be due to the continuous discharge of effluents from the abattoir which carries many materials from the upper land into the river.

The values for chemical oxygen demand (COD) recorded in the current study ranged from 6.01mg/l to 14.04mg/l. These finding is higher than 8-14mg/l reported in an earlier study in the study area by Atuanya, *et al.,* (2015). Similarly, Akatah, *et al.,* (2018) also reported lower COD levels of 5.25-5.9mg./L in same study area. A high COD is indicative of the presence of oxidative chemicals and vice versa. The survival of aquatic life depends on the relative measure of the amount of oxygen (O2) dissolved in water (Ojekunle and Lateef, 2017). The values for DO in this study ranged from 2.07mg/l to 4.29mg/l. The DO values recorded in this study was consistent with the findings of Akatah, *et al.,* (2018). Conversely, aerobic biological organisms need dissolved oxygen to break down organic matter at certain temperature over a specific time period this is known as biochemical oxygen demand (Akatah, *et al.,* 2018). The BOD of these water samples ranged from 4.02mg/l to 6.17mg/l. This was higher than the findings reported by Akatah, *et al.,* (2018) who reported BOD values ranging from 1.0 to 1.6mg/l. This is above the accepted WHO permissible limits; moreover, high Biochemical Oxygen Demand values at the discharge point could be attributed to the low Dissolved Oxygen level, since low Dissolved Oxygen will result in high Biochemical Oxygen Demand and this is a strong indication of pollution (Tekenah, *et al*., 2014).

The chloride values ranged from 10.06mg/l to 21.18mg/l. The sources of chloride could be from sodium chloride and/ or potassium chloride. The chloride values were higher than 14.1mg/l reported by Akatah, *et al.,* (2018). Similarly, the concentration of nitrate in the current study ranged from 3.12-5.78mg/l, which was within the WHO standard limits of 10mg/l. This finding however, disagrees with the findings of Mulu, *et al.,* (2015). Other parameters such as zinc and copper obtained in this study where within the WHO recommended standard limits.

Table 2: Biochemical characterization and possible identification of bacterial isolates in samples

Isolate	Gram Stain	Morphology	Oxidase	Indole	Catalase	Coagulase	Citrate	Urease	Methyl red	Motility	Lactose	Glucose	Probable Identification
A	-	Rod	+	-	+	-	+	-	-	+	-	-	*Pseudomonas aeroginosa*
B	+	Cocci	+	-	+	+	+	-	-	-	-	-	*Staphylococcus aureus*
C	+	Cocci	+	-	+	-	+	-	-	-	-	-	*Staphylococcus epididymis*
D	-	Rod	-	-	-	-	+	+	-	-	+	+	*Klebsiella mirabilis*
E	-	Rod	-	+	-	-	-	+	-	+	-	+	*Proteus vulgaris*
F	-	Rod	-	-	-	-	+	+	-	+	+	+	*Enterobacter aerogenes*
G	+	Cocci	+	-	+	-	+	-	-	-	-	-	*micrococcus luteus*

N/B: + = positive for the test; – = negative for the test)

Bacteriological Load of Ikpoba River Water Sample Ikpoba River at Different Sampling Points

Table 2 shows that a total of seven bacterial isolates were consistently isolated from Ikpoba River water. These includes, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Staphylococcus epididymis*, *Klebsiella mirabilis*, *Proteus vulgaris*, *Enterobacter aerogenes* and *Micrococcus luteus*. The presence of these bacteria in Ikpoba River water samples is an indication that that the pollution of river water could be due to effluent discharges from abattoirs and other human activities. These organisms may be potentially pathogenic to potential consumers. The most common fungi isolates in the current study was the genus *Aspergillus.* This reaffirms the findings of an earlier study in the same study area (Akatah, *et al.,* 2018). The *Aspergillus spp.* isolated in this study were *Aspergillus niger* and *Aspergillus flavus*.

Table 3: Profile of total bacteria, total coliform and total heterotrophic fungi (THF) counts obtained from samples.

Parameters	C1	C2	C3	SP1	SP2	SP3	SP4	SP5	SP6	SP7	WHO Std.
Total bacteria × 10^3CFU/ml	2	3	7	21	13	11	8	9	6	7	0
Total coliform MPN/100ml	3	4	13	16	14	12	7	5	6	5	10
THF× 10^3CFU/ml	2	5	8	12	3	2	5	2	1	2	0

Table 3 reveals that the total bacteria count ranged from 2×10^3CFU/ml (C1) to 21×10^3CFU/ml (SP4). The total coliform ranged from 3×10^3 to 16×10^3MPN/100ml. However, the coliform count decreased down the river. The total heterotrophic fungi (THF) ranged from 1×10^3CFU/ml to 12×10^3CFU/ml. A total of four (4) gram negative rods were isolated while three (3) gram positive cocci were also isolated. Additionally, three (3) of the gram negative rods shaped bacteria fermented glucose. Citrate was utilized by six (6) isolates.

Table 4: Distribution of occurrence of bacteria isolates in samples

Bacterial Isolates	Samples										
	C1	C2	C3	SP1	SP2	SP3	SP4	SP5	SP6	SP7	%
Pseudomonas aeruginosa	1	1	2	0	1	0	1	3	2	0	12.3
Staphylococcus aureus	2	2	4	2	0	2	0	1	4	1	21.3
Staphylococcus epididymis	2	3	2	1	0	1	0	2	3	1	16.9
Klebsiella mirabilis	1	2	0	3	1	2	1	0	1	0	12.4
Proteus vulgaris	1	2	1	1	0	1	2	2	2	1	15
Enterobacter aerogenes	2	2	1	1	0	1	1	3	3	0	16
Micrococcus luteus	1	2	1	0	0	0	1	1	0	0	7
Escherichia coli	0	0	0	0	0	0	0	0	0	0	0
Feacal streptococcus	0	0	0	0	0	0	0	0	0	0	0
	TOTAL = 89										

Table 4 shows the distribution of occurrence of bacteria isolates in the samples. *Staphylococcus aureus* (21.3%), *Staphylococcus epididymis* (16.9%), *Enterobacter aerogenes* (16%), *Proteus vulgaris* (15%), *Klebsiellamirabilis* (12.4%), *Pseudomonas aeruginosa* (12.3%), and *Micrococcus luteus* (7%). Nil *E. coli* and *Fecal streptococcus* were isolated from the samples.

Table 5: Distribution of occurrence of fungi isolates in samples

Bacterial Isolates	Samples										
	C1	C2	C3	SP1	SP2	SP3	SP4	SP5	SP6	SP7	%
Aspergillus niger	0	1	1	1	0	0	1	0	0	1	13
Aspergillus flavus	0	1	0	1	1	1	1	1	1	0	18.4
Penicilliumnotatum	0	1	0	1	1	1	1	1	1	0	18.4
Mucormucedo	1	1	1	1	2	1	1	1	1	1	29
Saccharomyces cerevisiae	3	1	0	1	0	1	2	0	0	0	18.4
	TOTAL = 89										

Table 5 reveals the distribution of occurrence of fungi isolates in the samples. Of the eighty-nine (89) isolates, *Mucormucedo* (29%), *Aspergillus flavus* (18.4%), *Penicilliumnotatum* (18.4%), *Saccharomyces cerevisiae* (18.4%), and *Aspergillus niger* (13%) in the water samples from all stations The study showed the occurrence of bacteria, staphylococcus aureus, coliform, and heterotrophic fungi in the water samples analyzed. Presence of coliform bacteria in water will not likely cause illness, however, it is indicative of the presence of other disease-causing organism in the water body (Atuanya, *et al.,* 2015). Results in the current study, indicates variations in coliform counts by most probable number (MPN) which could be indicative of the effect of abattoir effluent into Ikpoba River.

Table 6: Antibiotic sensitivity of bacteria isolated from water sample.

Antibiotics	CPX	PEF	AU	CH	SXT	GN/CN
Potency	30µg	10µg	30µg	30µg	10µg	30µg
Staphylococcus aureus	+	+	+	-	-	+
Pseudomonas aeruginosa	+	+	-	-	-	+
Staphylococcus epididymis	-	+	-	+	-	+
Proteus vulgaris	+	-	+	-	+	-
Klebsiella mirabilis	+	-	+	-	-	+
Micrococcus luteus	+	+	-	-	-	-
Enterobacter aerogenes	-	-	+	-	-	+

Where: - = represents resistance, + = sensitive, CPX = ciprofloxacin, PEF = pefloxacin, AU = augmentin, CH = chloramphenicol, SXT = septrin, GN/CN = gentamycin.

Results of antibiotic sensitivity analysis as presented in Table 6 revealed that multiple antimicrobial resistance was observed among the analyzed isolates. Resistance to septrin, augumentin and chloramphenicol was observed among gram negative bacteria, while susceptibility to Quinolones (Pefloxacin and Ciprofloxacin) was observed among the gram positive bacteria. The multiple antimicrobial resistance showed that majority were gram negative bacteria.

Conversely, similar studies have showed that water bodies could be a reservoir for microorganisms and genes that are resistant to antibiotics (Akata, *et al.,* 2018). In the study, many of the microbes isolated showed resistance to chloramphenicol, septrin, augumentin and quinolones (Pefloxacin and Ciprofloxacin). The resistance of these isolates as observed in this study can be attributed to the contamination from abattoir effluents.

Comparison of the physico-chemical parameters and bacteriological load of Ikpoba River with World Health Organization (WHO) standard for drinking water.

The pH range of Ikpoba River was slightly acidic with pH values ranging between 5.4 and 6.3, hence the mean pH value of 6.1±0.45 obtained for the river body is below World Health Organization (WHO)pH tolerance level of (6.5-8.5) of drinking water standards (WHO, 2017). Lower pH can be acidic, naturally soft and corrosive, conversely, this can put humans at risk of so many health problems. The values for the total dissolved solids (TDS), electrical conductivity (EC), total suspended solids (TSS), chemical oxygen demand (COD), dissolved oxygen (DO) and biological oxygen demand (BOD) were within the WHO permissible standard limits.

Similarly, the mean values of Chloride, Calcium, Magnesium, Phosphate, Nitrate, Ammonia, Copper and Zinc respectively were all within WHO standard limits for drinking water. However, the values of biological oxygen demand (BOD), turbidity and iron concentration in the collected samples were above the WHO guideline of 0.3mg/l this could be attributed to the presence of corrosive materials.

CONCLUSION

Abattoir effluents is significant anthropogenic pollutant in Ikpoba River. The practice of channeling untreated abattoir effluent into Ikpoba River makes the water unwholesome for certain usage despite its importance in solving issues in water supply in Benin City, Nigeria.

Although some of physico-chemical parameters such as TDS, conductivity, COD, DO, BOD were within WHO standard limits, the presence of some pathogenic microrganisms could be a source of antimicrobial resistant bacteria in the area. Hence, the river water could pose serious health threat to people who use the water for drinking and other domestic usage.

RECOMMENDATIONS

Therefore it is necessary for the river water to undergo treatment processes before public usage. Furthermore, the State Environmental Protection Agency should monitor the activities of abattoirs so as to ensure compliance with regulations governing the operations of abattoirs. Similarly, serious Steps should be taken to put machinery in place to ensure the treatment of abattoir waste before disposal.

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