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Evaluation of Hydrochemical and Microbiological Contaminants isolated from Brass River in Niger-Delta Ecological Zone

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Abstract: The health status of Brass River, a major Rivers in fragile Niger-Delta ecological was investigated. The total viable bacterial counts and hydro-chemical characteristics were measured using internationally approved methods for the assessment of water. The total viable bacterial counts observed were; total heterotrophic bacteria (2.1×10^4) cfu/ml, total coliform count (13 MPN/100 ml) and total feacal coliform (8 MPN/100 ml). The species isolated from the Rivers are *Bacillus* species, *Staphylococcus aureus*, *Pseudomonas* species, *Escherichia coli, Enterobacteria* species, *Salmonella* species and *Shigellas* species. The high viable bacteria count was an indication of the contamination of the river, and the observed hydro-chemical values exceeded the permissible limits set by Nigeria Environment Standards Regulation Enforcement Agency (NESREA). This call for sensitization and regular monitoring of the Niger-Delta aquatic environment in order to reduce the hazardous effects on people in this region that rely on the water from the rivers for home usages. Possibility of outbreak of epidemic is envisaged, if drastic steps are not taken.

Keywords: Waste water, *Bacillus* species, Hydro-chemical parameter, Niger-Delta, *Salmonella* species

1. INTRODUCTION

Aquatic environments are exposed to various environment factors that may likely alter their quality. Examine the river water samples for changes in physicochemical parameters and indicator's bacteria such as *Bacillus* species, *S. aureus*, *Pseudomonas* species, *E.coli*, *Enterobacteria* species, *Salmonella* species, *Shigellas* species become inevitable [1]. These microrganisms of concern, especially the bacteria, viruses and protozoa, cause from mild gastroenteritis to severe and sometimes fatal diarrhea, dysentery, hepatitis, cholera, typhoid fever and campylo-bacteriosis [2].

In most towns in developing countries such as Nigeria with rivers passing through them, such rivers are littered with waste that are likely consequential to the health of the users. In spite the poor sanitation culture exhibited by Africa populace, the contaminated land and streams line may contribute to the deterioration of environmental quality of Nigeria [3].

Pathogens organisms found in aquatic environment are from both point and diffuse sources and their quantities vary with time. Point sources for contaminants include wastewater from municipals, which are highly loaded with pathogenic microorganisms. Diffuse sources include the common urban and agricultural and sometimes forestry runoffs. Besides, the microbial load to the untreated water within an area is influenced by normal factors, especially climatologically parameters [4].

In Nigeria, one of the problems the environmental managers, hydrologists, and water resource analysts has been the problem of surface water effluence [5]. Microbial water quality models to analyzed water quality become inevitable as it helps in predicting the distributions level and risks of microbial pollutants in a given area of the water body [6].

The wide variety of waterborne pathogens that contaminate water and the lack of quantitative data concerning their origin and distribution within drinking water catchments have made the development of predictive models of pathogen loads from catchments difficult [7]. Having a good idea about water quality required known the insight in and out of the aquatic environment, including weather conditions and influence of xenobiotics [8].

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According to Tahri *et al*. [9], the importance of the provision of potable water supply in any nation cannot be over emphasized. With increasing population, wealth and economic activities generally, there is a corresponding increase in the demand for water supply globally [10]. In the last few decades, there has been a tremendous increase in the demand for water due to rapid growth of population and the accelerated pace of industrialization [3]. However, where such necessities are not available and water is indispensable people retort to use available alternative. Similarly, Africa, since the time immemorial has relied on rivers and rain for source of water. Thus, rivers water quality monitoring is indispensable in developing countries, especially for rivers affected by urban effluents of which Brass River not exceptional.

Brass River is one the major rivers in Nigeria. It serves many purposes, commercially for transportation or self-help by the individual paddling canoe through it to their farms. Peasant fish farmers catch fishes from the river regularly, dredging activities and sewage deposit not left out. It is a very disturb river, and therefore it becomes necessary to monitor the water quality of the River holistically. Hence, the objective of this investigation is to assess the health status of Brass River at Onuebu town by characterizing the condition of the hydro-chemical and microbiological intensity at three pollution routes.

2. MATERIALS AND METHODS

Sites Selection: Three sites (stations) were chosen and were within Onuebu town along the Brass Rivers for this investigation. The stations are Sewage site, including urban run-off (station 1), refuse dump site (station 2) and dredging site (station 3). These sites empty a lot of pollutants into the water ways.

Water Samples Collection: Collection of water samples was done in triplicates from the three sites at Onuebu town (Fig.1). Sampling was done between and April, 2016 to March, 2017, with the sites visited first Saturday of every month. Sterilized plastic sample bottles were used to collect samples from different points at a considerable distant apart to ensure homogeneity and proper depiction of the water. For hydro-chemical analyses, samples were taken at the top of the river at depths 15–20 cm directly into a clean bottle. Temperature and pH were measured in situ, using a temperature probe (J Thermocouple Bead Probe, USA) and portable pH meter (Cyberscan pH 300 series, USA) respectively. The collected samples were homogenized, sealed with sterilized closures and transported to the Microbiology -laboratory of Federal University Otuoke, Bayelsa in an icebox at 4°C for analyses [12].

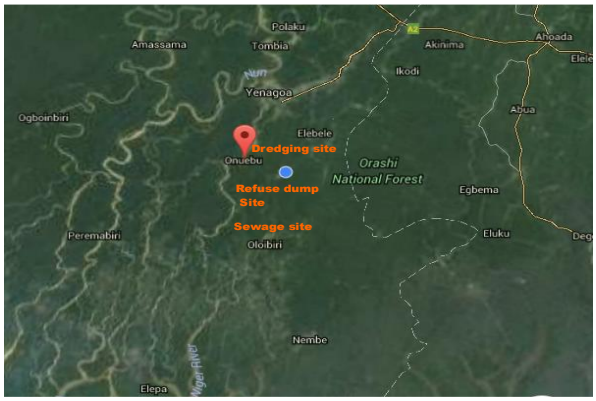

Fig. 1 The Brass River showing the sampling stations at Onuebu town.

Sample Analysis

Hydro-chemical and Bacteriological analysis

The hydro-chemical parameters were determined according to procedures outlined in the standard methods for the examination of water and wastewater [13]. For the total heterotrophic bacteria the spread plate method was used to depict their present. 10-1 to 10-4 of the samples were diluted in 0.1% buffered peptone water and 0.1 ml aliquots of each dilution was inoculated onto the surface of dried nutrient agar plate and incubated at 37ºC for 24 hours. Petri-dishes from dilutions containing between 30 and 300 distinct colonies were counted up and the outcome expressed as colony forming unit per milliliter [14].

Total and Feacal coliform Examination

Presumptive test: Enumeration of total coliform and faecal coliform were done by multiple tube fermentation tests [15].

Confirmed test: This test was done by transferring a loopful of culture from a positive tube from presumptive test into a tube of Brilliant Green Lactose Bile broth with Durham tubes. The tubes which were incubated at 36ºC for 37 hours for total coliform and 44.5ºC for faecal coliforms were observed for gas production.

Completed test: This test was carried out by streaking a loopful of broth from a positive tube onto Eosine Methylene Blue agar plate for pure colonies. The plates that were incubated at 37ºC for 30 hours developed colonies on EMB agar.

Isolation of Salmonella/Shigella species: They were isolated using Salmonella/Shigella agar (SSA). The media was prepared following the manufacturer's instruction as described by [16].

Isolates Identification: The isolates in a pure culture were determined as per the procedures described in Bergey`s manual [14].

Statistical analysis: The data were summarized for each bacteria count using description statistics. Statistical differences between the stations were analyzed using one-way analysis of variance with confidence range of $p < 0.05$ with SPSS (16.0 version), SPSS Inc, USA.

3. RESULTS

Hydro-chemical parameters: The hydro-chemical parameters of the water samples of Brass River at Onuebu are shown in Table 1. There was fluctuation in the temperature as the month progresses. Meanwhile, highest temperature of (36.10 ± 0.1)°C was observed in February and the lowest (25.10 ± 1.3)°C was recorded in May, which corresponds with the peak wet season.

Meanwhile, the hydrogen ion concentration (pH) ranged between 8.00-5.90, turbidity ranged between 14.20-5.10 and the dissolve oxygen ranged between 5.20-12.06 were also observed. Total dissolve solid (TDS) decreases as the year progresses, and ranged between 216–330. It was highest in sewage site and least in the dredging site. Conductivity and salinity followed similar pattern as the TDS in spatial distribution. Highest conductivity of 15.20 ± 0.3 µs/cm was observed in March, while the least 4.70 ± 0.1 µs/cm was observed in July (Table 1). The salt content was high in the early period of the year. Highest concentration of 5.60 ± 0.20 ppm was recorded in the month of March at station 3, while the least salinity (0.47 ± 0.70) ppm was observed in the month of August. All the parameters varies significantly between the three stations ($p < 0.05$).

Bacteriological Quality: Results of the bacteriological contaminants of Brass River at Onuebu showed that ; the total heterotrophic bacteria ranged between (3.4×10^4) cfu/ml – (1.0×10^4) cfu/ml, total coliform count (25 MPN/100 ml) – (6 MPN/100 ml),while total feacal coliform ranged between (15 MPN/100 ml) – (1 MPN/100 ml) (Table 2).

The highest THB count (3.4×10^4) cfu/ml was observed at station1in the month of March, when the water level had decreased and human activities around the water were at its peak. The finding also revealed striking occurrence of total coliform in all the sampling stations and months, with the highest of 21 MPN/100 ml observed in August. Similarly, faecal coliform (15 MPN/100 ml) was also reported in March and the least (1 MPN/100 ml) in mid-wet season.

The bacteriological analysis showed that a total of 67 strains were isolated from the river. Isolated bacteria species were; *Bacillus* species (33.30%) *S. aureus* (22.80%), *Pseudomonas* species (19.30%), *E.coli* (17.54), *Enterobacteria* species (12.28%), *Salmonella* species (8.7%) *and Shigellas* species (3.5%) (Table3). *Bacillus* species had the highest of occurrence, while *Shigellas* species had the least. The *Bacillus* species varies significantly among the three stations ($p < 0.05$), and there was no significant variation ($p > 0.05$) between sewage site and the refuse dump site in number of *Saureus* isolated. However, there was variation ($p < 0.05$) between the two sites and the dredging site (Table 3). *Pseudomonas* species significantly varies ($p <$

0.05) between station 1 and the two other stations (station 2 and 3) but no significant different between station 2 and station 3. The same significances were observed in *Enterobacteria* species and *Salmonella* species. No significant different ($p > 0.05$) in the occurrence of *Shigellas* species among the three sites.

4.0 DISCUSSION

Physicochemical parameter

Man activities have critically altered the Earth's natural composition. For instance temperature changes alter physiological and biochemical functions in organisms [16]. In this study, the temperature of Onuebu River, which ranges between 36°C –24°C is far above the temperature range in water bodies in the tropical forest areas [17]. Sewage site had the highest temperature, followed by the refuse dump and the dredging sites. High temperature observed in the sewage site could be attributed to conspicuous human activities. Open defecation and sludge that flows from home were emptied into the water at this site. Whenever, the water temperature is increased, community biodiversity are affected, especially, freshwater organisms. For instance, freshwater fish are very sensitive to temperature changes being ectothermic organism: their rate of metabolism, responses, development and growth are affected by temperature [19].

pH of a solvent/liquid is determine using the pH meter only, it cannot be estimated like other parameters as concentrations or in quantity. There were fluctuation in pH of surface water in this study with the highest (8.10) observed in the month of April, recorded at the sewage site. Changes in pH are usually caused by pollution and most of which are as a result of human activities. Discharge of pollutants cause fluctuation in the pH level and it depends on the chemical involved [22]. The least pH (5.80) was observed at the dredging site and was observed in the month of August. Though, the pH range observed in this study were within the range for the survival of aquatic organism [23], it still boil than to the fact if pollution of the aquatic ecosystem is not abated, it can create imbalance in the environment and few organism can survive in water with pH levels outside the range observed in this investigation

In this study, the turbidity of the River at Onuebu town showed that the dredging site was highly turbid and least in the sewage site. The level of turbidity in station 3 could be in consequence of the disruption of the water column by the dredging activities which made the water appear cloudy, murky and colored, which affect the physical look of the water. Turbidity can easily impair fish and other aquatic life by reducing food supplies, degrading spawning beds, and affecting gill activities [24]. High turbidity (41NTU) reported in this investigation was far higher than the limits set up for drinking water and aquatic life especially fishes. Drinking water (10NTU) cold water fishery (25 NTU) and for indigenous fish (25NTU) [25].

Dissolved Oxygen is found as microscopic bubbles of oxygen that are mixed in the water and occur between water molecules. DO is an essential indicator of a water body's health in reference to its ability to support aquatic [18]. The order of dissolve oxygen in the investigated river is dredging site > sewage > refuse site and the oxygen level was low during the peak dry season and maximum during the wet season. The disparity in dissolve oxygen could be as a result of seasonal variation. During dry seasons, water levels decrease and the flow rate of a river slows down [26]. As the water moves slower, it mixes less with the air, and the DO concentration decreases. During rainy seasons, oxygen concentrations tend to be higher because the rain interacts with oxygen in the air as it falls [26]. The range of DO was within the limit for the survival of aquatic organisms [27, 28].

Total dissolved solids (TDS) is the sum of all ion particles that are smaller than 2 microns (0.0002 cm) [29]. Depending on the water bodies, the TDS can also include organic solutes such as hydrocarbons and urea in addition to the salt ions. In this study, the TDS in the river revealed that refuse dump site had the highest (326 mg/L), and it was observed in March when the water level had dropped significantly. The least TDS (201 mg/L) was recorded in August, which coincides with period of maximum wet

season. The concentrations of TDS reported in this study were far below the level that will be detrimental to the aquatic organisms. For instance, Ponce [30] has reported that concentration of TDS less than 750 mg/L does not significantly affect fertilization and hatching rates in Coho and Chum salmon. Similarly, TS [31] reported that aquatic invertebrate growth and survival is affected by concentrations of TDS greater than 1500 mg/L and that the concentrations of TDS showing adverse effects were normally from 1692 mg/L to > 2430 mg/L.

The level of concentration of chemicals in the studied river was more pronounced in March (16.10 µs/cm) than any other periods, which was observed in the refuse dump site. The least (4.70 µs/cm) was recorded in the month of July at the sewage site. The concentrations observed in the month of March could be attributed to the season [23]. The refuse dump site had the highest concentrations, which may be due to the fact that the dump composition contain different chemicals, that may invariably increase the concentration of ion that may likely originated from the inorganic matters especially household items. Ions are present in the water that are involve in conducting electrical current e.g. sodium, chloride, calcium and magnesium. The conductivity reported in this study was quite high compared with standard. Conductivity of rivers in the United States generally ranges from 0.50 to 1.50 µs/cm [23]. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 1.50 and 5.00 µs/cm [32]. Conductivity outside this range could indicate that the water is not suitable for certain species of fish or macro-invertebrates.

Salinity is pretentiousness a threat to the coastal water systems, as organisms thriving in such environment are limited to ranges of water salinity. When the salinity is high, the taste of water is affected. For instance, when ion such as chloride is above the threshold in the water, low taste is observed. Similarly, ion such as sodium and magnesium sulfate in drinking water causes a laxative and decrease the quality of water. In this study, the salinity of was within the normal range for fresh water. The highest salt concentrations observed was 15.60 ppm, which is far below the limit recommended limit [33]. Factors such as irrigation, mining activity and de-icing usage of salt for roads, are mentioned as reasons for the human-induced rise in salt levels in coastal water [33]. High levels of salinity are affect freshwater invertebrates especially mayflies, stoneflies and caddis flies [31]. These organisms play a major role in recycling the terrestrial vegetation like leaves that fall into streams and providing food for aquatic vertebrates and birds.

The present of number of bacteria in a river's water provides dependable information on the microbiological and health status of the river. In a serene condition, this number depends on the autochthonic matter, comprises phyto- and zooplankton excretions and allochtonic matter that gets into water in spring surface run-off and atmospheric precipitation [34]. However, in a polluted environment, it depends on the nature of the pollutants. Investigation on Brass River at Onuebu town revealed that the maximum number of bacteria occurs in station 1, where the water received faecal contamination, followed by the sewage site and least in dredging site. The two sites with maximum bacteria are domestic and industrial waste discharge points confirmed that the highest number of bacteria occurs in places where allochtonic matter enters the river, thus polluting the water in the river.

Heterotrophic bacteria (HB) make up one of the leading collections of microorganisms that involve in matter and energy circulation in the water environment. The organic matters they decompose are used as a basis of energy that is responsible for essential processes [35]. In aquatic environment they are involve in the decomposition of organic matter, both of autochthonic and allochtonic origin, making up an significant linkage in the microbial sphere, and thus take a dynamic component in the self-purification of waters [36]. In this investigation, the total highest number of bacteria was observed in March and February than any other month (3.4 and 2.91×10^4 cfu/ml, respectively), and the lowest in August and September (1.0 and 1.2×10^4 cfu/ml respectively). Similar observation was reported in a research carried out by Figueras and Borrego [37], where the number of planktonic bacteria in Chełmżyńskie lake were more in the summer than in the autumn (37).

When total coliform is found in water it indicates the water is unsafe, but does not indicate that there is present of disease causing organism. In this investigation, there was striking occurrence of total coliform in all samples, especially in the sewage and refuse dumping sites. The frequent occurrence in the sewage and dump sites indicates a possible contamination by sewage or animal wastes. Normally, faecal coliform are non-pathogenic, but are good biological indicators. However, there are strains of *E.coli*, which are coliform that are responsible for intestinal illness. For instance, *E. coli* O157: H7 that live in alimentary tract of cattle. This study indicated that the Brass River at Onuebu town is highly polluted. The order of the occurrence of the faecal coliform is sewage site > refuse dump site > dredging site.

The predominant of *Bacillus* species in this study could be attributed to their ability to survive as aerobic or facultatively anerobic microbes. This is because under stressful environmental conditions, they produce oval endospore that can stay dominant for extended periods [38]. The fact that *Enterobacter* species, *S. aureus*, *Pseudomonas* species, *E.coli*, *Salmonella* species and *Shigellas* species amongst others, were detected at the Sites, is an indication of faecal contamination of Brass river at Onuebu town. Though, the isolates are bio-indicators of coliform group of bacteria, most are harmless, but there occurrence in aquatic system call for major concern as it indicates the presence of disease causing strain of bacteria (39). Similar report were given in sewage and refuse polluted Berg Rivers in the Western Cape, South Africa.

5.0 CONCLUSION

Onuebu is a small town in Ogbia district of Bayelsa State, Nigeria. The inhabitants use the water for bathing and other domestic purposes. As a result of poor sanitary system, the River is litered with wastes that are likely consequential to the health of the users. Similarly, hysterical dredging activities in this district, which allows heavy trunks to access the dump sites, thereby creating routes through which rain water drained from agricultural lands and homes into the river. This finding showed that there should be proper sensitization and regular monitoring of Brass river, being a major river in this region and most of the settlements were at its banks. There is possibility of outbreak of epidemic if drastic steps are not taken.

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Table 1: Hydrochemical parameters of Brass Rivers, at Onuebu Bayelsa state Nigeria

Months	Stations	Temperature(o°c)	pH	Turbidity (NTU)	D.O(mg/l)	TDS	Conductivity(µs/cm)	Salinity (ppm)
	Station 1	27.20 ±0.2	5.10 ± 1.1	17.20 ± 2.1	5.30± 0.5	216± 3.4	8.30 ± 1.8	11.30± 0.2
April	Station 2	28.05 ±0.7	6.30 ± 0.4	19.50 ± 1.4	5.20± 1.3	245± 1.1	9.10 ± 0.4	11.70± 0. 6
	Station 3	27.60 ±0.4	7.10 ± 0.1	28.20 ± 2.2	6.00± 0.4	212± 0.3	8.60 ± 0.3	1 1.83± 0. 4
	Station 1	25.10 ±1.3	5.80 ± 0.4	16.20 ± 1.1	4.46± 0.2	210± 1.4	6.10 ± 1.2	11.67± 0.40
May	Station 2	28.00 ±0.6	5.90 ± 0.1	17.00 ± 0.3	5.20± 1.3	219± 0.3	7.50 ± 0.2	11.97± 0.10
	Station 3	26.80 ±0.6	6.10 ± 0.2	23.60 ± 0.3	6.00± 0.6	209± 2.1	7.90 ± 0.1	12.12± 0.40
	Station 1	26.00 ±0.3	7.80 ± 0.4	15.20 ± 0.2	5.16± 1.1	206± 0.6	5.50 ± 0.2	11.77± 0.20
June	Station 2	26 .10 ±0.1	7.40 ± 0.2	19.60 ± 1.3	6.02± 0.4	230± 0.2	6.70 ± 1.2	11.72± 0.10
	Station 3	24 .70 ±2.1	7.90 ± 0.1	26.20 ± 1.3	6.56± 2.3	204± 4.2	6.20 ± 1.7	12.02± 0.02
	Station 1	29.20 ±1.1	7.20 ± 0.1	15.10 ± 0.2	5.16± 1.1	216± 0.2	4.70 ± 0.1	1 0.65± 0.30
July	Station 2	25.30±0.2	7.70 ± 0.2	25.70 ± 0.1	4.10± 0.5	230± 0.2	6.50 ± 0.2	10.62± 0.20
	Station 3	24.00±0.5	7.20 ± 0.4	35.10 ± 0.2	8.20± 0.2	204± 0.1	6.20 ± 0.6	10.73± 0.10
	Station 1	28.30±0.2	7.50 ± 0.6	15.20 ± 0.4	7.10± 0.2	210± 0.2	5.20 ± 0.3	10.70± 0.10
August	Station 2	28.10±0.5	7.00 ± 0.1	26.30 ± 0.1	7.00± 0.3	228± 0.4	7.80 ± 0.1	10.50± 0.30
	Station 3	26.70±0.1	8.10 ± 0.2	32.10 ± 0.4	8.80± 0.2	201± 0.1	6.90 ± 0.3	10.47± 0.70
	Station 1	25.30±0.2	7.50 ± 0.1	19.20 ± 0.2	6.20± 0.7	210± 2.4	7.20 ± 0.1	11.70± 0.50
Sept.	Station 2	27.20±0.5	7.20 ± 0.2	31.60 ± 0.2	5.90± 0.2	224± 5.2	8.00 ± 0.3	11.40± 0.10
	Station 3	27.20±0.5	7.20 ± 0.2	39.60 ± 0.2	7.10± 0.1	208± 5.2	8.00 ± 0.3	11.40± 0.10
	Station 1	26.10±0.3	7.00 ± 0.3	20.40 ± 0.5	4.10± 0.3	202± 1.3	9.10 ± 0.3	12.10± 0.20
Oct.	Station 2	26.50±0.2	7.40 ± 0.1	31.20 ± 0.4	6.30± 0.1	219± 1.1	11.10 ± 0.2	12.00± 0.30
	Station 3	26.40±0.4	7.00 ± 0.1	41.10 ± 0.1	7.20± 0.1	200± 1.3	9.40 ± 0.1	12.00± 0.50
	Station 1	26.90±0.2	6.90 ± 0.5	22.40 ± 0.1	4.00± 0.3	243± 0.2	8.40 ± 0.2	13.20± 0.10
Nov.	Station 2	27.10±0.1	7.00 ± 0.2	24.20 ± 0.2	6.80± 0.2	251± 0.5	13.20 ± 0.3	13.00± 0.90
	Station 3	27.40±0.2	7.00 ± 0.7	32.10 ± 0.2	7.50± 0.2	206± 0.2	10.20 ± 0.5	13.00± 0.40
	Station 1	29.20±0.2	7.10 ± 0.2	21.40 ± 0.2	4.60± 0.1	251± 0.1	10.20 ± 0.1	13.80± 0.20
Dec.	Station 2	31.30±0.3	7.50 ± 0.1	30.20 ± 0.3	6.20± 0.3	260± 0.3	15.10 ± 0.2	13.10± 0.10
	Station 3	30.10±0.3	7.70 ± 0.4	38.10 ± 0.1	8.80± 0.1	201± 0.1	10.10 ± 0.4	13.60± 0.80
	Station 1	33.10±0.1	7.00 ± 0.1	20.20 ± 0.3	5.50± 0.2	248± 0.5	12.40 ± 0.2	13.10± 0.40
Jan.	Station 2	32.10±0.4	6.80 ± 0.2	30.10 ± 0.5	4.10± 0.1	272± 0.5	19.20 ± 0.3	13.30± 0.20
	Station 3	33.40±0.7	6.60 ± 0.2	39.30 ± 0.1	6.60± 0.4	215± 0.9	17.30 ± 0.5	13.70± 0.30
	Station 1	35.70±0.2	6.20 ± 0.3	22.70 ± 0.2	5.20± 0.7	252± 0.2	10.10 ± 0.1	13.50± 0.10
Feb.	Station 2	35.20±0.1	6.10 ± 0.1	28.30 ± 0.1	4.60± 0.4	316± 0.1	15.10 ± 0.2	13.70± 0.30
	Station 3	36.10±0.1	6.00 ± 0.5	32.10 ± 0.2	6.00± 0.1	311± 0.2	11.50 ± 0.1	13.60± 0.10
	Station 1	34.50±0.4	6.40 ± 0.1	18.20 ± 0.4	5.40± 0.1	310± 0.4	11.20 ± 0.4	13.60± 0.10
March.	Station 2	34.10±0.2	6.60 ± 0.3	24.60 ± 0.3	3.70± 0.2	326± 0.6	16.10 ± 0.3	14.20± 0.30
	Station 3	32.30±0.5	6.30 ± 0.1	29.80 ± 0.6	7.20± 0.2	232± 0.1	12.20 ± 0.3	15.60± 0.20

Table 2: Total heterotrophic bacteria (THB), total coliform and faecal coliform counts obtained from the water samples at Onuebu, Brass Rivers Bayelsa state Nigeria.

Months	Sampling stations	THB (cfu/ml)	Total coliform (MPN/100ml)	Faecal coliform (MPN/100ml)
	Station 1	$2.6x10^4$	16	8
April	Station 2	$2.2x10^4$	14	6
	Station 3	$2.3x10^4$	12	2
	Station 1	$2.0x10^4$	13	5
May	Station 2	$1.6x10^4$	11	5
	Station 3	$2.1x10^4$	12	5
	Station 1	$2.0x10^4$	10	6
June	Station 2	$1.2x10^4$	08	2
	Station 3	$1.6x10^4$	10	4
	Station 1	$1.0x10^4$	13	2
July	Station 2	$1.1x10^4$	14	1
	Station 3	$1.3x10^4$	16	3
	Station 1	$1.2x10^4$	21	6
August	Station 2	$1.0x10^4$	18	3
	Station 3	$1.2x10^4$	16	3
	Station 1	$1.1x10^4$	19	6
Sept.	Station 2	$1.0x10^4$	14	2
	Station 3	$1.0x10^4$	14	3
	Station 1	$1.0x10^4$	09	4
Oct.	Station 2	$1.0x10^4$	09	2
	Station 3	$1.0x10^4$	08	2
	Station 1	$2.7x10^4$	12	5
Nov.	Station 2	$2.1x10^4$	09	3
	Station 3	$2.4x10^4$	01	3
	Station 1	$2.3x10^4$	11	8
Dec.	Station 2	$2.7x10^4$	09	4
	Station 3	$2.5x10^4$	08	6
	Station 1	$2.7x10^4$	10	10
Jan.	Station 2	$2.4x10^4$	07	8
	Station 3	$2.2x10^4$	05	10
	Station 1	$3.0x10^4$	10	10
Feb.	Station 2	$2.1x10^4$	05	8
	Station 2	$2.5x10^4$	03	10
	Station 1	$3.4x10^4$	12	15
March.	Station 2	$2.7x10^4$	06	12
	Station 2	$2.9x10^4$	02	13

Table 3: The isolate from the Brass River from the water samples at Onuebu Bayelsa state Nigeria.

Isolates (n = 67)	Occurrence			Frequency of occurrence (%)
	Station 1	Station 2	Station 3	
Bacillus species	10^{a}	6^{b}	3^{c}	33.30
S.aureus	7^{a}	5^{a}	1^{b}	22.80
Pseudomonas species	6^{a}	3^{b}	2^{b}	19.30
E.coli	6^{a}	3^{b}	1^{b}	17.54
Enterobacteria species	4^{a}	2^{b}	1^{b}	12.28
Salmonella species	4^{a}	1^{b}	0^{b}	8.70
Shigellas species	1^{a}	1^{a}	0^{a}	3.50

Mean with different superscript varies significantly ($p < 0.05$)