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BACTERIOLOGICAL QUALITY OF WATER FROM RIVER NUN AT AMASSOMA AXISES, NIGER DELTA, NIGERIA

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ABSTRACT

This study investigated the bacteriological quality of river nun at Amassoma section, Bayelsa state. Nine water samples were obtained from three location (upstream, midstream and downstream) i.e. three from each location. Standard bacteriological procedures were employed for the analysis. Results showed that Total heterotrophic bacteria, total coliform, fecal coliform and Salmonella-Shigella counts ranged from 1.78 to 9.30 x 10^6 cfu/ml, 23.00 – 28.00 MPN/100ml, 13.67 to 18.33 MPN/100ml and 0.00 – 3.23 x 10^2 cfu/ml respectively. Analysis of variance showed that there were no significance differences ($P>0.05$) among the various location beside total heterotrophic bacteria that showed significance difference ($P<0.05$). The bacteria population exceeded World Health Organization/Food and Agricultural Organization allowable limit of 1.0 x 10^2 cfu/ml for potable water and Standard Organization of Nigeria maximum permissible level of 10cfu/ml for total coliform. The bacteria tentatively isolated were *Staphylococcus aureus, E. coli, Pseudomonas, Enterobacter, Corynebacterium, Bacillus, Micrococcus, Proteus, Salmonella, Shigella* species. Based on the density and isolates the water is unfit for human consumption. Hence it can be suggested that the water from River nun at Amassoma section is not potable based on bacteriological quality except when treated using suitable treatment technology such as chlorination and boiling.

Keywords: Amassoma, Microorganisms, River Nun, Water quality.

1. INTRODUCTION

Water is a vital resource that is needed by human and other living things [1-9]. Water resources are classified based on forms including solid (ice), gaseous (vapour) and liquid. Water also exist was surface water, ground water and rain water [2,4]. Surface water resources could be classified according to their sources including fresh water, salt (marine) and brackish/estuarine (salt and fresh water interphase). Surface water especially fresh water also classified based on their size viz: creek, creeklet, pond, lake, stream, river, rivulets etc.

Freshwater is the most utilized water resource apart from transportation. Freshwater is mostly used for potable water and other domestic purposes including washing, cooking, bathing etc [10]. Other economic activities carried out on surface water include fishing [11,12], dredging etc. Fishing activities is common in communities aligning surface water in the Niger Delta especially in Bayelsa state. Typically, Bayelsa state is located in the sedimentary basin and fishing is a major occupation in the area.

The quality of water is basically assessed based on the physico-chemical (heavy metal such iron, cadmium, chromium, zinc, copper, arsenic, manganese; oxygen related parameters dissolved oxygen, biological and chemical oxygen demand; hydrogeochemical and hydrochemical, nutrients) and biological (microbial) parameters.

Surface water abounds in Bayelsa state. The physicochemical parameters of surface water and its associated sediment (creek, river, pond, lake, stream) have been widely reported in literature including river nun [1, 5], Kolo creek [6, 13], Sagbama creek [14,15], Epie creek [16, 17], Ikoli creek [7, 18]. But information about the microbial quality is scanty in literature from the study area.

Microorganisms are ubiquitous in nature. They are also known to cause different diseases. Few other have beneficial role in several industries. Microorganisms such as bacteria are found in water and could cause disease condition in human when such water is consumed. As such poor quality water is one of the medium through which pathogenic microbes including bacteria, viruses, etc can be transmitted [19]. Several diseases have been attributed to poor water with notable symptoms being enteric fever and diarrhoea. Therefore, this present study is designed to assess the bacteriological quality of river Nun at Amassoma axises, Niger Delta, Nigeria.

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2. MATERIALS AND METHODS

2.1. Study Area

Amassoma is the Host community of Niger Delta University. Amassoma is approximately 30 kilometers from Bayelsa State capital (Yenagoa). The community located between latitude 4°57'- 4°58'N and longitude 6°9'-6°10'E [20]. The climatic condition is similar to other regions in the Niger Delta. Previous studies have described the climatic condition of several surface water in Bayelsa state [1, 5-7, 14, 15, 17, 18, 21 – 25]. Several economic activities are carried out in the area probably due to the influence of higher institution. The Amassoma community typically aligns a tributary River nun.

Several wastes generated by the resident close to the water body are deposited into the river. A typical pier toilet system is also built on the river. As such sewage is also deposited in the water body.

2.2. Sampling Techniques

Nine (9) samples were collected from different sampling stations. The sampling stations were about 2km from upstream (College of Health Science waterside) and downstream (Ending pele water side) of Amassoma. Midstream samples were collected at the Alamieseigha jetty in Amassoma town (middle zone). At each sampling stations, three samples were collected using sterile container; at the town side banks, the middle of the river and in the opposite bank of the river. All the samples were labeled according to each sampling point. The water samples collected were taken to the laboratory for analysis.

2.3. Microbial density examination of the water samples

2.3.1 Examination of total and feacal coliform:

The total and fecal coliform test (presumptive, confirmatory and completed test) of the water was carried out using three tubes most probable number previously described by Pepper and Gerba [26], Benson [27] Akubunenyi *et al*. [28]. The result based on gas production and color change was compared with table presented by Pepper and Gerba [26].

2.3.2 Enumeration of Total Heterotrophic Bacteria Counts

Two media was used to enumerate the bacteria population. Nutrient Agar was used for total heterotrophic bacteria count and Salmonella-Shigella Agar was used for Salmonella-Shigella counts). Both media were prepared and used according to the manufacturers' instruction following pour plate method previously described by Pepper and Gerba [26] and Benson [27]. 1.0 ml of serially diluted sample was aseptically plates in both media and incubated inverted at 37ºC for 24- 48 hours. The resultant colonies were counted and expressed as colony forming units per the water sample. The different colonies were isolated into nutrient Agar.

2.3.3 Tentative identification of the microbial isolates

The different isolates found in the water samples were subjected to biochemical tests following the scheme of Cheesbrough [29] and Benson [27]. Thereafter, the resultant appearances were compared with those of known taxa using scheme of Cheesbrough [29] and Bergey's Manual of Determinative Bacteriology by Holt *et al*. [30] Based on gram reaction, the gram positive organisms were streaked in Mannitol Salt Agar plate and incubated inverted at 37°C for 24 hours. The presence of yellowish pigments in Mannitol Salt Agar indicates *Staphylococcus aureus* [10]. Tubes with color change and gas production were shaked and streaked in Levine's eosin Methylene Blue (EMB) Agar and incubated at 37º C for 24 hours. The presence of small nucleated colonies with greenish metallic sheen indicates *E. coli* [26, 27]. The colonies were streaked in blood agar, the presence of swarming growth and haemolytic properties on medium after incubation indicates *Proteus* species and *Streptococcus* species respectively [10]. The presence of black and pink colonies in Salmonella-Shigella agar suggests the Salmonella and Shigella species respectively [31]. A Triple Sugar Iron Agar was prepared into slants and the colonies were aseptically transferred into the slants [32]. A positive tube was confirmed by presence of cracks and blackening of the medium [32].

3.4 Statistical analysis

SPSS software version 20 was used to carry out the statistical analysis of the bacteria density. One-way analysis of variance was carried out at P = 0.05, and Tukey Honestly Significance Difference (HSD) was used to determine source of the observed differences were n=3.

3. RESULTS

The bacteria population of water samples from River Nun at Amassoma section, Bayelsa state is presented in Table 1. Total heterotrophic bacteria counts ranged from 1.78 to 9.30 x 10^6 cfu/ml. There was significance different among the various locations. The total coliform, fecal coliform and Salmonella-Shigella counts ranged from 23.00 – 28.00 MPN/100ml, 13.67 to 18.33 MPN/100ml and 0.00 – 3.23 x 10^2 cfu/ml respectively. Basically, there was no significance difference (P>0.05) among the various locations for each of the parameters.

Table 1: Bacteriological density of river nun at Amassoma section

Location	Total heterotrophic bacteria (10^6), cfu/ml	Total coliform, MPN/100ml	Fecal coliform, MPN/100ml	Salmonella-Shigella counts, x 10^2 cfu/ml
Upstream	1.78±0.11a	24.33±2.60a	13.67±1.33a	1.20±1.20a
Midstream	5.57±0.48b	23.00±5.69a	14.70±3.15a	0.00±0.00a
Downstream	9.30±0.35c	28.00±4.04a	18.33±1.67a	3.23±1.63a

Data is expressed as mean ± Standard Error; Different alphabets (a, b, c, …) along the column indicate significance difference (P<0.05) according to Tukey Honestly Significance Difference statistics.

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Variation in the total heterotrophic bacteria count could be due to difference in the anthropogenic activities in the water prior to sampling. However, lack of significant difference for coliforms and salmonella counts could be due to similarity in activities leading to their presence in the water at various sections i.e upstream, midstream and downstream. However, the occurrence of coliforms (total and fecal coliform) could be due to the fact that wastes (municipal and sewage) are discharge into the water directly. Authors have variously reported sewage is discharge into most surface water by communities aligning rivers [1, 5, 11, 12].

The bacteria population exceeded World Health Organization/Food and Agricultural Organization allowable limit of 1.0 x 10^2cfu/ml [3, 33-36]. While the total coliform and fecal coliform often exceeded the limit of 10cfu/ml and 0 cfu/100ml for total coliforms and Thermo tolerant Coliform/E. Coli/ faecal streptococcus respectively as specified by Standard Organization of Nigeria [3, 36, 37].

The bacteria population recorded in this study had some similarity with the ones previously reported in surface water in Bayelsa state. The microbial density observed in this study is similar to the values previously reported in some surface water in Bayelsa state. Agedah *et al*. [1] reported total heterotrophic bacteria in the range of 6.389 – 6.434Log cfu/ml from surface water around Wilberforce Island. Angaye and Mieyepa [38] reported total heterotrophic bacteria, total and feacal coliforms in the range of 0.44 - 1.159 X 10^6 cfu/ml, 76.72 - 260.23 MPN/100 ml and 53.67-157.02 MPN/100 ml respectively from Efi lake.

The findings of this study were comparable to the work of other authors from different locations in the Niger Delta including Imo River Estuary of the Niger Delta Mangrove Ecosystem [39], Orashi River at Ebocha Well 8 Location, Brass River at Brass Terminal jetty, New Calabar River at Wilbros Nig. Ltd., Apoi Creek at Ogbainbiri Flow Station, Dodo Creek at Clough Creek Flow Station, Sangana River at Igbomatoru Community, Nun River at Tebidaba Flow Station, Forcados River at Beniboye Flow Station, Niger River at Independent Power Plant (IPP), and Olagoga Creek at Obama Flow Station [40] and lower than other works including some surface water (Uwanse, Anatigha, Idim-Ita and Edibe-Edibe streams) in Calabar Metropolis Cross River state [28], some stream water used for consumption in Opuraja community of Delta State [41]. Microbes in the surface water could also stem from runoff after rain fall and anthropogenic activities carried out in such surface water.

The bacteria isolates from the water samples from river nun at Amassoma section is presented Table 2. The tentative bacteria isolates identified include *Staphylococcus aureus, E. coli, Pseudomonas, Enterobacter, Corynebacterium, Bacillus, Micrococcus, Proteus, Salmonella, Shigella* species.

Table 2: Bacteria isolates from river Nun at Amassoma section

Microbes	Up stream	Midstream	Downstream
Pseudomonas sp	+	+	+
Enterobacter sp	+	+	+
Bacillus sp	+	-	+
Staphylococcus aureus	+	+	+
Corynebacterium sp	-	-	+
Micrococcus sp	+	-	+
E. coli	+	+	+
Proteus species	+	-	+
Salmonella sp	+	-	+
Shigella sp	-	-	+

Some of the isolates were only found in one of the three replicates sample

+=present and - = absent

Various bacteria species tentatively isolated have been reported from potable water sources (surface water i.e. fresh water, groundwater i.e. borehole and rainwater) in Nigeria. In a recent review study, Izah and Ineyougha [3] reported *Staphylococcus aureus, E. coli, Pseudomonas, Enterobacter, Yersia, Shigella, Bacillus, Micrococcus, Serratia, Proteus, Salmonella, Klesbsiella, Streptococcus* species as bacteria isolates frequently found in potable water sources. These bacterial are microbes of public health importance. Some of the isolates have been linked to several disease conditions such as diarrhea (*E. coli, Enterobacter, Salmonella* species etc). Other bacteria are also associated with infectious diseases including gastroenteritis, typhoid fever, dysentery, cholera [42], and urinary tract infections etc. The presence of these bacteria isolates is an indication that such water sources are not potable [28].

4. CONCLUSION

Water is a valuable resources need by humans and other living things. Water exists in three forms including solid (ice), gaseous (vapour) and liquid. Water resources are also classified into surface water (river, stream, pond, lake,

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creek, creeklets etc), groundwater (borehole) and rain water. Surface water also exist in three form including marine (salt water), brackish or estuaries (salt and freshwater interphase) and freshwater. Fresh water is the most widely used water sources apart from transportation purposes. Freshwater is used for drinking, washing, cooking, bathing and other domestic uses. This study assessed the bacteriological quality of river nun at Amassoma section. The study found that the bacteria counts exceeded 10^2 cfu/ml allowable limits recommended by World Health Organization/Food and Agricultural Organization. While the total coliform and fecal coliform often exceeded the limit of 10cfu/ml for total coliforms specified by Standard Organization of Nigeria. As such the water is unfit for human consumption based on bacteriological quality. Hence we recommend that the water be treated according via chlorination and boiling prior to consumption.

REFERENCES

[1] E.C. Agedah, E.R. Ineyougha, S.C. Izah, L.A. Orutugu, Enumeration of total heterotrophic bacteria and some physico-chemical characteristics of surface water used for drinking sources in Wilberforce Island, Nigeria. Journal of Environmental Treatment Techniques, 2015, 3(1), 28 – 34.

[2] S.C. Izah, N. Chakrabarty, A.L. Srivastav, A Review on Heavy Metal Concentration in Potable Water Sources in Nigeria: Human Health Effects and Mitigating Measures. Exposure and Health, 2016, 8, 285–304.

[3] S.C. Izah, E.R. Ineyougha, A review of the microbial quality of potable water sources in Nigeria. Journal of Advances in Biological and Basic Research,2015, 1(1),. 12 – 19.

[4] S.C. Izah, A.L. Srivastav, Level of arsenic in potable water sources in Nigeria and their potential health impacts: A review. Journal of Environmental Treatment Techniques, 2015, 3(1), 15 – 24.

[5] E.N. Ogamba, S.C. Izah, T. Oribu, Water quality and proximate analysis of *Eichhornia crassipes* from River Nun, Amassoma Axis, Nigeria. Research Journal of Phytomedicine, 2015, 1(1), 43 – 48.

[6] E.N. Ogamba, E.I. Seiyaboh, S.C. Izah, I. Ogbugo, F.K. Demedongha, Water quality, phytochemistry and proximate constituents of *Eichhornia crassipes* from Kolo creek, Niger Delta, Nigeria. International Journal of Applied Research and Technology, 2015, 4(9), 77 – 84.

[7] E.N. Ogamba, S.C. Izah, B.P. Toikumo, Water quality and levels of lead and mercury in *Eichhornia crassipes* from a tidal creek receiving abattoir effluent, in the Niger Delta, Nigeria. Continental Journal of Environmental Science, 2015, 9(1), 13 – 25.

[8] O. Eleyowo, O.D. Amusa, U.U. Akpan. Prevalent Microbes in Domestic Waters of Iwochang Community, Akwa Ibom, Nigeria. Academic Journal of Life Sciences, 2016, 2(4),23-28.

[9] T.S.K. Tya, A.B. Umaru, B.R. Barmamu. Bacteriological Analysis Of Hand-Dug Well Water In Demsa Local Government Area, Nigeria. International Refereed Journal of Engineering and Science, 2012, 1(4), 28 – 31.

[10] L.T. Kigigha, D.G. Baraseibai. Bacteriological quality assessment of well water from Amassoma, Bayelsa state, Nigeria. *ASIO Journal of Microbiology, Food Science and Biotechnological Innovations*, 2017, 3(1), 9 -16.

[11] S.C. Izah, T.C.N. Angaye. Ecology of Human Schistosomiasis intermediate host and Plant Molluscicides used for control: A review. Sky Journal of Biochemistry Research, 2016, 5(6), 075-082

[12] S.C. Izah, T.C.N. Angaye. Heavy metal concentration in fishes from surface water in Nigeria: Potential sources of pollutants and mitigation measures. Sky Journal of Biochemistry Research, 2016, 5(4), 31-47.

[13] E.N. Ogamba, N. Ebere N. Assessment of Physicochemical quality of sediment from Kolo creek, Niger Delta. Greener Journal of Biological Sciences, 2017, 7 (2), 020-024.

[14] E.I. Seiyaboh, S.C. Izah, S. Oweibi, Assessment of Water quality from Sagbama Creek, Niger Delta, Nigeria. Biotechnological Research, 2017, 3(1), 20-24.

[15] E.I. Seiyaboh, S.C. Izah, S. Oweibi, Physico-chemical Characteristics of Sediment from Sagbama Creek, Nigeria. Biotechnological Research, 2017, 3(1), 25-28.

[16] L.W.A. Izonfuo, A.P. Bariweni, The effect of urban runoff water and human activities on some physico-chemical parameters of the Epie Creek in the Niger Delta. Journal of Applied Sciences and Environmental Management, 2001, 5(1), 47-55.

[17] E.I. Seiyaboh, I.R. Inyang, S.C. Izah, Spatial Variation in Physico-chemical Characteristics of Sediment from Epie Creek, Bayelsa State, Nigeria. Greener Journal of Environment Management and Public Safety, 2016, 5(5), 100 – 105.

[18] E.I. Seiyaboh, I.R. Inyang, S.C. Izah, Seasonal Variation of Physico-Chemical Quality of Sediment from Ikoli Creek, Niger Delta. International Journal of Innovative Environmental Studies Research, 2016. 4(4), 29-34.

[19] O.E. Olabisi, A.J. Awonusi, O.J. Adebayo, Assessment of bacteria pollution of shallow well water in Abeokuta, Southwestern Nigeria. Life Science Journal, 2008, 5(1), 68 – 72,

[20] P.I. Agi, A. Ebenezer, Observations on Filarial Infection in Amassoma Community in the Niger Delta, Nigeria. J. Appl. Sci. Environ. Manage., 2009, 13(1), 15 – 19.

[21] E.N. Ogamba, S.C. Izah, A.S. Ofoni-Ofoni, Bioaccumulation of Chromium, Lead and Cadmium in the bones and tissues of Oreochromis niloticus and Clarias camerunensis from Ikoli creek, Niger Delta, Nigeria. Advanced Science Journal of Zoology, 2016, 1(1): 13 – 16.

[22] E.N. Ogamba, S.C. Izah, F. Isimayemiema, Bioaccumulation of heavy metals in the gill and liver of a common Niger Delta wetland fish, *Clarias garepinus*. British Journal of Applied Research, 2016, 1(1), 17 – 20.

[23] E.N. Ogamba, N. Ebere, S.C. Izah, Heavy metal concentration in water, sediment and tissues of

Doi: 10.2016-53692176; DOI Link:: http://doi-ds.org/doilink/05.2017-91868182/

Eichhornia crassipes from Kolo creek, Niger Delta. Greener Journal of Environmental Management and Public Safety, 2017, 6 (1): 001-005.

[24] E.I. Seiyaboh, G.A. Harry, S.C. Izah, Length-Weight Relationship and Condition Factor of Five Fish Species from River Brass, Niger Delta. Biotechnological Research, 2016, 2(4), 187-192.

[25] E.I. Seiyaboh, S.C. Izah, A.H. Gijo, Length-Weight Relationship and Condition Factor of some Important Fish Species from Sangana River, Niger Delta. International Journal of Innovative Agriculture an Biology Research, 2016, 4(4), 37-44.

[26] I.L. Pepper, C.P. Gerba, Environmental microbiology. A laboratory manual. Second edition. Elsevier academic press, ISBN: 0-12-550656-2, 2005, 209pp.

[27] H.J. Benson, *Microbiological Applications:* Laboratory Manual in General Microbiology. Complete version, 5th edition. McGraw-Hill, New York, ISBN: 0-07-231888-0, 2002, 478pp.

[28] F.C. Akubuenyi, E.C. Uttah, K.H. Enyi-Idoh, Microbiological and physicochemical assessment of major sources of water for domestic uses in Calabar Metropolis Cross River state, Nigeria. Transnational Journal of Science and Technology, 2013, 3(2), 31 – 44.

[29] M. Cheesbrough, *District Laboratory Practice in Tropical Countries.* Low price Edition part 2. Cambridge press, England, 2006, 434pp.

[30] J.G. Holt, N.R. Kneg, P.H.A. Sneath, J.T. Stanley, S.T. Williams, *Bergey's Manual of Determinative Bacteriology*. William and Wilkins Publisher, Maryland. New York, 1994.

[31] N.N. Odu, A.O. Adeniji, Microbiological analysis of some packed fruit juices sold in Port Harcourt Metropolis, Nigeria. Nature and Science, 2013, 11(4), 30 –40.

[32] S.C. Izah, E.R. Aseiba, L.A. Orutugu, Microbial quality of polythene packaged sliced fruits sold in major markets of Yenagoa Metropolis, Nigeria. Point Journal of Botany and Microbiology Research, 2015, 1(3), 30 – 36.

[33] J.J. Sunday, N.C.O. Spencer, O. Kingsley, A.O. Edet, D.D. Amaka, Physico-chemical and microbiological properties of water samples used for domestic purposes in Okada town, Edo state, Nigeria. International Journal of Current Microbiology Applied Science, 2014, 3(6), 886-894.

[34] S.O. Eze, I.C. Madumere, Physicochemical and microbiological analysis of Water bodies in Uturu, Abia state-Nigeria. Asian Journal of Natural and Applied Sciences, 2012, 1(4), 58 – 65.

[35] A. Oludare, S. Sikiru, Microbiological, physicochemical and mineral quality of borehole water in Ijebu land, Ogun state, Nigeria. International Journal of Science and Advanced Technology, 2012, 2(1), 23 – 30.

[36] T.C.N. Angaye, S.C. Izah, M.E. Cosboy, B. Yougha,. Microbial density of Groundwater in Kolokuma/Opokuma Local Government Area of Bayelsa State, Nigeria. FUNAI Journal of Science and Technology, 2015, 1(1),1 -9.

[37] Standard organization of Nigeria (SON), Nigerian Standard for Drinking Water Quality. Nigerian industrial standard, Nigeria. 2007. https://www.unicef.org/nigeria/ng_publications_Nigerian_Standard_for_Drinking_Water_Quality.pdf.

[38] T.C.N. Angaye, C.E. Mieyepa, Assessment of Elemental and Microbial Quality of Lake Efi In Bayelsa State, Central Niger Delta, Nigeria. Journal of Environmental Treatment Techniques, 2015, 3(2), 71 - 75.

[39] S.P. Antai, A.A. Unimke, R.B. Agbor, Assessment of the Heterotrophic and Crude Oil Utilizing Microorganisms of Imo River Estuary of the Niger Delta Mangrove Ecosystem. American International Journal of Biology, 2014, 2(1), 29-42.

[40] Y.T. Puyate, A. Rim-Rukeh, Some physico-chemical and biological characteristics of soil and water samples of part of the Niger Delta area, Nigeria. Journal of Applied Science and Environmental Management, 2008, 12(2), 135 – 141.

[41] A.A. Ibiene, E.V. Agbeyi, I.O. Okonko, Bacteriological Assessment of Drinking Water Sources In Opuraja Community of Delta State, Nigeria. Nature and Science, 2012, 10(1), 36-41.

[42] L.L. Nwidu, B. Oveh, T. Okoriye, N.A. Vaikosen, Assessment of the water quality and prevalence of water borne diseases in Amassoma, Niger Delta, Nigeria. African Journal of Biotechnology, 2008, 7 (17), 2993 - 2997.

Doi: 10.2016-53692176; DOI Link:: http://doi-ds.org/doilink/05.2017-91868182/