COLIFORM BACTERIA CONCENTRATION IN OKPON RIVER, OBUBRA LOCAL GOVERNMENT AREA, CROSS RIVER STATE, NIGERIA

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ABSTRACT. Water pollution takes place in both rural and urban areas. Drinking water from sources like rivers, streams, lakes and ponds are polluted by organic and inorganic material from human activities. The study on coliform bacteria concentration in Okpon River, Obubra Local Government Area of Cross River State, Nigeria was conducted. The method adopted in the study were systematic sampling technique and laboratory water quality analysis. Systematic sampling technique was adopted in the collection of water samples at three locations along Okpon river for laboratory analysis. One hundred and ninety-six (196) questionnaire were distributed to the respondents. The findings showed that, typhoid had the highest frequency of prevalence with a value of 63 and 32.1 percent. A significant relationship exists between coliform concentration and water borne diseases in the study area with a Spearman's Rank correlation of 0.658. This meant that as average coliform count increases, percentage of people suffering from water borne diseases increases. This observed increase was significant at the 0.02 probability level since rs(df = 10) = 0.658, $P < 0.05$. The study showed that the risk of coliform concentration in water sources grew with increase in human population, with the current social and cultural habits. The researcher therefore recommended that residents should dispose their faecal waste properly and provide modern toilet facilities.

Key-words: Coliform, concentration, faecal waste, water borne disease and defecation.

1. INTRODUCTION

Water pollution takes place in both rural and urban areas. Drinking water from sources like rivers, streams, lakes and ponds are polluted by organic and inorganic material from human activities. Water pollution has increased over the years with the attendant increase in human population and the plethora of human activities. Water is said to be contaminated when unwanted pollutants are introduced into it and cannot support human use and its biotic communities (Pink, 2006).

The contamination of water sources with human, animal and waste pathogens causes threats to public health if the issue is not appropriately addressed (Pradipta, 2006). The deliberate and continuous deposition of contaminants into water sources reduces the quality of domestic, commercial and agricultural water, and renders it unsuitable for consumption and other uses. Faecal materials in water

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sources emanates from humans, pigs, cattles, dogs, birds, agricultural farmlands and storm runoff from household wastes materials discharge (Frenso, 2009).

Coliform bacteria in faeces are capable of causing diseases within living organisms in which they live, even though most of the faecal microorganisms are not harmful. Faecal coliform bacteria are bacteria that are found in human and animals faeces. It originates from the intestines of warm-blooded animals and humans. Coliforms are bacterial indicator of sanitary quality of water. Its presence in water sources indicates that pathogenic microorganisms are present.

Akpata and Ekundayo (1998), observed high incidence of total coliforms and E-coli when faeces were discharged into Lagos lagoons. There was a reported case of high coliform concentration load in Warri River when faecal matter from slaughter and sewage from houses were discharged directly into river (Selendy, 2011). In Obubra, Okpon River and its tributaries are the main sources of domestic and agricultural water supply of the villages along the river bank. Unfortunately, rather than protecting this means of water supply, the inhabitants in the villages along the river banks pollute the river with human faeces through direct defecation and through runoff from nearby open toilets which increased the risk of bacterial coliform concentration in the river.

The presence of faecal coliform in water indicates health risk which may eventually result in disease outbreak, such as cholera, typhoid fever, diarrhea, dysentery, malaria and other health problems, if the water samples are not investigated before there are consumed. Pampley *et al.,* (2002) posit that the indiscriminate discharge of faecal wastes in the shallow, open pit toilets, streams and river banks exposed the excrements to flies and other vectors. Most households in the riverine communities have no functional toilet systems in their homes and discharge excrements into rivers and streams. Reconnaissance survey undertaken by the researcher revealed that, the toilets available in the study area were mostly open toilets with crossbars, which are often washed into nearby streams during the rains. Some animals and birds carry faeces on their bodies to streams and ponds, as they bath, the excrements are washed-off into the streams and the river.

About 85% of faecal wastes in water sources are from domestic animals such as poultry, cattles, sheeps, and pigs (Adediji & Adetunyi, 2006). These animals harbour microorganisms that are transported through the environment by water during runoff and finally washed into surface water sources.

Based on these challenges, this study on public health implications of coliform concentration in Okpon River in Obubra Local Government Area of Cross River State is undertaken to ascertain the effect of unguarded human activities on water sources, since potable drinking water, has become a critical problem in Obubra and its environs causing wide spread incidence of diseases.

2. STUDY AREA

Okpon River is located at the Eastern flank of Obubra Local Government Area. It lies within longitudes 08^0 26'E and 08^0 15' East of the Greenwich meridian and latitudes 05^0 47' and 05^0 51' North of the Equator. It is bound to the North by Onyen-Orangha, to the South by Ekuri Owai to the West by Ogambang and to the East by Ikom Local Government Area.

Obubra is influenced by the rain bearing Southern Monsoon wind which blows from the Atlantic Ocean and the dry dust harmattan North East trade winds which come from Sahara Desert. The study area lies within the humid tropical zone and characterized by double maxima rainfall. It has an annual rainfall ranging from 2000mm to 3000mm. The annual mean maximum and minimum temperature are 30.1^0C and 22.4^0C respectively with a relative humidity of 68.1 percent (Eni, 2011).

All the streams in the study area drain into the Okpon River which eventually empties itself at the Onyen-Orangha Estuary of the Cross River and finally drained into the Bight of Bonny. The area is characterized by high run-off due to the underlying geology especially in the underlying crystalline basements (Cross River Basin Development Authority, 2002). Water table for UNICEF – RUWATSAN boreholes drilled in Obubra zone range from 2.14m to 9.15m (Peters, 1982). The Okpon River rises from the Cameroon region through Ekokori Owai down through Odonget, and empties at Onyen Orangha. The river "Okpon" is the major source of domestic and agricultural water supply in the area, in which other small streams empty themselves into this fast flowing River Okpon. Hydrologically, the area has alluvial deposits recurring along the low lying swamps and banks of the riverine area. The low lands adjacent to the river through which it meanders are often waterlogged during the rainy seasons.

3. METHOD OF DATA COLLECTION

This study adopted the survey and experimental designs for data collection. This involved direct field observation, measurement and analysis of water samples obtained from the Okpon River. Both discrete and continuous types of measurements were used for this research. The discrete measurements were those on water borne diseases caused by consumption of water from Okpon River, while the continuous measurements were on the bacterial coliform concentration of Okpon River. Data used for this study were obtained from primary and secondary sources. The primary sources involved field observation, measurements, field surveys with questionnaires, interviews and water samples collected from the study sites for laboratory analysis.

Systematic sampling technique was used to collect water samples from three sampling stations SP1, SP2 and SP3 along Okpon River for laboratory analysis with their corresponding coordinates. The samples were labeled and preserved in an ice-box at temperature of 4^0C and then transported within 24 hours to the laboratory for analysis. Samples were collected in the morning and evenings.

The membrane filter method was used and the River water was filtered through the membrane and incubated for 20 hours each. Agar plate of total and faecal coliform enumeration was supplemented with 50mg/ml of Nystatin incubated at 30^0C for 48^0 hours in the laboratory. The bacteria were then counted by the use of microscope, using features of cultural morphology, pigment and biochemical reaction with reference to Bergy's manual of determinative bacteriology (1974). The values obtained from these analyses were compared with the World Health organization (WHO, 2014) values. The sample location coordinates were obtained using a Global Positioning System (GPS) for proper geo-referencing. Samples were also collected at one control point one kilometer upstream away from the sample points for comparison. A total of one hundred and ninety six (196) copies of questionnaires were administered purposively to the residents within the communities to deduce information on the type of toilet used and water borne diseases associated with the consumption of water from Okpon River.

4. RESULTS AND DISCUSSION OF FINDINGS

Water samples were collected from three points namely Onyen Okpon (downstream), Ochon (midstream), Odonget (upstream) and control of Edondon respectively as shown in (Table I).

Table 1. Locations of sample stations and their coordinates

S/NO	Sample station	Location	Longitude (E)	Latitude (N)
1.	SP1	Onyn Okpon (downstream)	08^0 29'	05^0 57'
2.	SP2	Ochon (midstream	08^0 27'	05^0 56'
3.	SP3	Odonget (upstream)	08^0 26'	05^0 55'
4.	CP1	Edondon (control)	08^0 25'	05^0 54'

(Table II) presented data on methods of faecal waste disposal within the study area. This include; open defecation which had the highest value of 110 respondents and it represented 56.1 percent, this was followed by pit latrine with the value of 40 and 20.4 percent. Defecation at nearby bush had 38 respondents and 19.4 percent water, cistern had 8 respondents with 4.1 percent.

Lack of functional toilet system at the study area has caused the inhabitants to use various unconventional methods of faecal waste disposal. Runoff from the open defecation carry excreta from the gutters, fields and nearby surroundings and deposited directly into the surface water body. Pit latrines served as breeding grounds for flies, mosquitoes and other vectors. Once vectors come in contact with water and food it causes health problems to the residents. Ikpeme (1994) corroborated that, faeces passed at nearby bush result in offensive odour and aesthetic nuisance to the community.

Table 2: Methods of faecal waste disposal

Methods of waste disposal	Communities			Total frequency	Percentage (%)
Open defecation	60	30	20	110	56.1
Pit latrine	25	10	5	40	20.4
Water cistern	2	5	1	8	4.1
Nearby bush	20	12	6	38	19.4
Total					100

(Table III) revealed the concentration of bacterial coliform at different sampling stations. The three main sampling locations were at Onyen Okpon (downstream), Ochon (midstream) and Odonget (upstream). The fourth sampling station located at Edondon about 1km upstream away from the sampling stations which served as the control sample location. Higher values of coliform were recorded mostly during the evening hours as shown in Table 3. The Onyen Okpon (downstream) had the highest coliform concentration mean values while the Odonget upstream had the lowest coliform concentration.

Table 3. Concentration of coliform bacteria (cfu/100ml) at different sample locations

Duration	Odonget (cfu/100ml) upstream	Ochon (cfu/100ml) (midstream)	Onyen Okpon (cfu/100ml) (downstream)	Edondon (cfu/100ml) (control)
Morning hours	14	20	35	1
	13	21	36	2
	15	24	34	1
	16	18	36	2
	17	16	34	2
	16	18	32	2
	18	19	38	1
	15	20	34	2
	13	23	35	1
	14	21	40	2
Evening hours	25	29	45	3
	26	30	37	4
	25	32	42	5
	23	29	47	4
	26	30	35	5
	19	30	41	6
	28	32	34	4
	26	31	45	6
	24	28	41	7
	25	25	40	5

(Table IV) depicts health related problems caused by the consumption of water from the Okpon River. The table indicated that typhoid had the highest frequency of 63 and a percentage value of 32.1 with three recorded deaths. Dysentery and cholera had 22 and 10 with a corresponding percentage of 11.2 and 5.1 respectively and they recorded 4 and 2 deaths. Diarrhea had 48 frequency representing 24.5 percent with 3 deaths. However, 53 respondents agreed that, all of the above cases led to illnesses and deaths among the residents with a frequency of 53 and a percentage value of 27.1. The incidences of deaths recorded at the study area predisposed that the inhabitants are exposed to faecal pathogen.

Table 4. Common water borne diseases

Health problems	Communities			Total frequency	Percentage (%)
	Onyen Okpon (upstream)	Ochon (middlestream)	Odonget (downstream)		
Typhoid	30	20	63	63	32.1
Dysentery	12	6	22	22	11.2
Cholera	5	3	10	10	5.1
Diarrhea	28	10	48	48	24.5
All of the above	33	15	53	53	27.1
Total	108	54	34	196	100

The effects tend to be greater on vulnerable people like children, the aged and those experiencing chronic illness.

(Table V) Spearman's ranked correlation was used to test the hypothesis and the result was ($p<0.05$, 0.658). which means that as average coliform count increases, percentage of people suffering from water-borne diseases also increase in the study area. The correlation is significant, that is rs (d.f = 10) = 0.02. Hence the null hypothesis was rejected. It was therefore concluded that, there is a significant relationship between bacteria coliform concentration and water borne diseases in the study area.

Table 5. Correlation Analysis

	Average coliform count	Percentage of people suffering from water borne diseases
Spearman's rho average coliform correlation count coefficient. Sig. (2tailed) N	1.000 . 10	.658* .02 10
Percentage of people correlative suffering cholera coefficient Sig. (2-tailed) N	.658* .02 10	1.000 10

Finally drinking of water contaminated with faeces was the cause of a variety of diseases through oral route faecal transmission via water, food, air and soil. High coliform in water raised the concentrations of pathogens (Frenso, 2009).

5. CONCLUSION

Waste disposal into water sources is one of the environmental problems associated with urban and rural dwellers. As human population grow, consumption pattern also grows, resulting in high increase of waste generation. Faecal waste disposal on land, streams, ponds and river increases bacterial coliform concentration which eventually result in outbreak of water borne diseases such as cholera, diarrhea, dysentery, typhoid and other health problems. In Obubra Local Government Area, excrements are exposed to flies and other vectors through the use of archaic and primitive methods of faecal disposal by most rural dwellers. Most households in the riverine communities of Obubra have no functional toilet system in their houses and thus discharged excrement into the river and adjoining streams with attendant negative implication on the health of the residents and the environment.

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