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An Investigation into the Presence of Pathogenic Organisms as Indicators of Contamination in Erelu Dam of Oyo, Oyo State.

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Abstract: *The study seeks to investigate various pathogenic organisms that may result into contamination and subsequent high human health risk in Erelu dam- a major source of water supply to Oyo and its environ. Fecal Indicator Bacteria andProtozoa were investigated.Water was sampled every morning for one week within the dam, furthest downstream and upstream.These samples were subjected to extensive microbiological analysisusing membrane filter technique. The result indicated high numbers of fecal indicator bacteria and protozoan which greatly exceeded acceptable WHO standard (0colony forming unit(cfu)/100ml)Escherichia coli indicates the presence of bacterial pathogens, while Clostridium perfringens, an obligate anaerobe, indicates the presence of parasitic protozoan and enteric viruses. This research work opined that Oyo State Water Corporation should embark on a treatment technique with high level of technological performance which public water systems must follow to ensure control of pathogens and indicators in Erelu pipe borne water.At the same time, the distribution pipe should be totally overhauled to minimize breeding of microbes which may be responsible for the high level of microbial activities observed upstream (Sabo Area).*

I. Background

Pathogens are micro organisms that can cause disease. Pathogen of particular concern include; bacteria and protozoa. Bacteria and Protozoa like other forms of life, constantly evolve to meet new environmental challenges. It is obvious that many of the pathogens that can be spread through drinking water are also spread through other means, including direct contact with people who are sick, contact with animals, contacted food, and swimming in contaminated pools.

The use of an organism that can serve as a surrogate for another is called an indicator organism.

Trying to detect disease causing bacteria, protozoan and other pathogens in water is expensive and may pose potential health hazards. Further testing for pathogens requires large volume of water and the pathogens can often be difficult to grow in the laboratory and isolate. It is suggested that the four indicators Escherichia coli, fecal enterococci, Clostridium perfringens, and Coliphage are most useful (Tyagi et al., 2006). E. coli and enterococci indicate the presence of bacteria pathogen while coliphage indicate the presence of enteric viruses and Clostridium perfringens, an obligate anaerobe, indicates the presence of parasitic protozoan and enteric virus. Alcamo, (1994) reported that water might be vehicle for transfer of broad variety of diseases transmitted by fecal contaminated water, include Hepatitis A and Gastroenteritis. Many pathogenic protozoa form cysts, which can survive for long periods in surface water causing diseases such as gastrointestinal illness, Giardiasis and Amoebic dysentery (WHO, 1999).

For routine monitoring and water quality evaluation, an indicator organism is usually used. Geldreich, (1972) found that ideally, the best indicator of the presence of pathogenic organism in water or waste water is the specific pathogenthemselves. In practice, however, this could not be a suitable approach because of the variety of pathogens involved and the fact that pathogens usually exist in low number and require selective and enriched media for their growth so that very large water samples and expensive media are needed for the detection procedure. Thus, indicator micro organisms are used to predict the presence and/or minimize the potential risk associated with pathogenic microbes (Scott et al., 2002).

Objective of the Study

Monitoring a suite of indicator organism is more likely to be predictive of the presence of certain pathogens in order to protect public health (Ahmed et al., 2008).

Accordingly, the objectives of the present study were to monitor identify and evaluate the pathogenic contamination status of surface water in Erelu dam, downstream and upstream, that is, Pretreated, Treated and Distributed water.

II. Material and Methods

Surface water samples of Erelu dam in Oyo town of Oyo State, Nigeria were collected from several sites within the stream. The collection was also done furthest downstream and upstream. This is to ascertain the microbial levels of pretreated, treated and distributed water. Water samples were collected in sets of sterile

Polyethylene bottles (500ml). Samples were stored immediately in icebox while transported to the laboratory. Sampling was carried out every morning for a period of one week. Microbiological analysis was carried out within 24 hours of sampling (APHA, 1992).

Samples Processing and Microbial Counting

Sample processing and microbial counting of indicator organisms were carried out in the laboratory of the Department of Applied Biology Ladoke Akintola University of Technology Ogbomoso, OyoState. Both physical and chemical sterilization techniques were employed to sterilize test tube syringes, needles, conical flask and inoculated plates used.

Microbiological investigation was carried out on indicator organisms such as E. coli and Clostridium perfringens spores using membranefilter technique (APHA, 1992). One hundred millimeters of each sample were aseptically filtered through sterile 0.45mm pore size membrane filters, and the filters were laid onto the appropriate media. Levine Agar, Clostridium selective Agar, Nutrient Agar, Marconckey Agar,Blood Agar and Potato Dextrose Agar (PDA) respectively.

E. coli were cultured using Levine Agar while C.perfringens were culture using Clostridium selective Agar (CSA).E. coli was incubated aerobically at 44.5^0c for 48 hours. C. perfringens spores were detected by a modified method according to Ashbolt et al., (1993), where water samples were heated at 75^0c for 10 min in water bath before filtration to kill vegetative cells and then cooled on ice. This same method was also employed using some other media such as Nutrient agar, Blood agar, PDA, Marconckey agar to detect pathogens such as Salmonella sp. Vibro cholerae and Giardia lamblia.

III. Result

The result of the study shows the presence of the following Organisms as observe on culture media.

Table 1: Growth Pattern of Pathogens on Culture Media in Pretreated Water Sample

Organism	Culture Media					
	Nutrient Agar	Levine Agar	Clostridium selective Agar	Blood Agar	Potato Dextrose Agar	Marconckey Agar
E.coli	++	+++	+	+	+	+
Clostridium Perfringens	+	+	+++	+	+	+
Enterobacter	+	_	_	+	+ +	
Entamaeba histolytica	+	_	++	+	_	+
Salmonella sp.	+ _	_	+	+	+	
Giardia lamblia	+	_	+ +	_	+	+
Vibro cholera	++	++	_	+	_	_

Key: + = indicates positive growth
- = indicates negative growth

Table 1: Shows the result obtained after microbiological analysis of pretreated water on culture media. It was observed that most of the pathogen detected grows well on almost all the media used except the two selective media (Levine agar and Clostridium selective agar) for the indicator organism (E.coli and C. perfringens). The result indicates high level of pathogenic contaminants in the pretreated water sample having E. coli(ranges from $20x10^3$colony forming unit (cfu)/100ml to $80x10^3$cfu/100ml) as the most abundant, because of its affinity to grow on varieties of culture media.

Table 2: Growth Pattern of Pathogens on Culture Media in treated Water Sample

Organism	Culture Media					
	Nutrient Agar	Levine Agar	Clostridium selective Agar	Blood Agar	Potato Dextrose Agar	Marconckey Agar
E.coli	+	+	+	+	+	+
Clostridium Perfringens	+	+	+	+	+	+
Enterobacter	+	_	_	+	_	+
Entrmoeba Hystolitica	_	_	+	_	+	_
Salmonella sp.	_	_	_	+	+	+
Giardia lamblia	+	_	+	_	+	+
Vibro cholerae	+		_	+	_	_

Table 2: Indicate some effects of water treatment at Erelu Water Works even. Only indicator organisms and very few pathogens were recorded. These include, E.coli,(ranges from $2x10^3$cfu/ml to $10x10^3$cfu/ml),C.perfringens,Entamoebahistolytica and Salmonella sp.

Table 3: Growth Pattern of Pathogens on Culture Media in distributed Water Sample

Organism	Culture Media					
	Nutrient Agar	Levine Agar	Clostridium selective Agar	Blood Agar	Potato Dextrose Agar	Marconckey Agar
E.coli	+	++	+	+	+	+
Clostridium Perfringens	+	+	++	+	+	+
Enterobacter	+	_	_	+	+	+
Entamoeba histolytica	+	_	+	+	_	_
Salmonella sp.	+	_	_	+	+	+
Giardia lamblia	+	_	++	_	+	+
Vibro cholera	+	+	_	+	_	_

However **Table 3** shows a deterioration in the quality of distributed water at Sabo area- a highly overcrowded residential area. The growth was almost equal to what was obtained in the pretreated water.

Table 4: Plate count for Indicator Pathogen in Sampled Water

Organism	Culture Media					
	Nutrient Agar	Levine Agar	Clostridium selective Agar	Blood Agar	Potato Dextrose Agar	Marconckey Agar
E.coli						
Pretreated water	$50 X10^3$	$80 X10^3$	$20 X10^3$	$40 X10^3$	$25 X10^3$	$30 X10^3$
Treated water	$8X10^3$	$10 X10^3$	$5 X10^3$	$2 X10^3$	$3 X10^3$	$4X10^3$
Distributed water	$30 X10^3$	$20 X10^3$	$15 X10^3$	$30 X10^3$	$10 X10^3$	$15 X10^3$
Clostridium perfringens						
Pretreated water	$60 X10^3$	$70 X10^3$	$75 X10^3$	$25 X10^3$	$40 X10^3$	$30 X10^3$
Treated water	$2X10^3$	$5 X10^3$	$5 X10^3$	$2 X10^3$	$3 X10^3$	$4X10^3$
Distributed water	$20 X10^3$	$15 X10^3$	$30 X10^3$	$20 X10^3$	$10 X10^3$	$25 X10^3$

Table 4 shows the growth pattern / plate count of the indicator pathogens.E.coli recorded the highest growthranging from $2x10^3$cfu)/100ml to $80x10^3$cfu/100ml,while that of C. perfringens on clostridium selective agar was from $2x10^3$cfu)/100ml to $60x10^3$cfu/100ml

IV. Discussion

Indicator organisms are not by themselves, usually a health concern for healthy individuals, but their presence in water indicate an increase risk that pathogenic (disease-causing) organisms are present. This is evident in the result obtained on **Table 1** in which varieties of pathogenic bacteria as well as protozoan parasites were isolated from the untreated water sample. E.coli(ranging from $20x10^3$(cfu)/100ml to $80x10^3$cfu/100ml) whichis considered to be the species ofColiform bacteria that is the best indicator of fecal pollution of Erelu water, is the most abundant(ranging from $20x10^3$(cfu)/100ml to $80x10^3$cfu/100ml). This is not far from various human activities around Erelu dam as well as influence of both wild and domestic animals. Various water channels that empty into the dam is another major source of contamination.

The result obtained from treated water (down stream) indicates a negligible colony of some bacteria(enterobacter, Vibro choleraeand Salmonella sp) and protozoan(Entamoeba histolytica,and Gairdia lamblia)as well as indicator organism(ranging from $2x10^3$cfu/ml to $10x10^3$cfu/ml). Comparing this with untreated water, it obvious that, Chlorination method of treatment in Erelu Water Works was able to reduce the pathogen, though the treatment did not conform with WHO standard for pure water (0cfu/100ml)

Hence,this called for treatment technique of a very high technological performance which public water systems must follow to ensure control of a contaminant.

The result obtained fromdistributed water(upstream), shows great deterioration in the treatment of Erelu water the plate count raging from $15X10^3$cfu/100ml to$30X10^3$cfu/100ml.This value is almost equal to the value obtained in untreated water (ranging from $20x10^3$(cfu)/100ml to $80x10^3$cfu/100ml).

V. Conclusion

The finding shows a high count of indicator Organisms in distributed water(upstream) which surpose not to be ordinarily.Folicorm level should decrease after the process of water treatment. Hence, there is every indication that treated water pumped from Erelu water work to consumers is being contaminated the second time probably due to faulty distribution pipes or storage tanks.Contamination with indicator pathogens and their surrogates was evident some few meters away from the utility station. WHO suggests that, if distribution pipes are intact, treated water may retain its quality about 500 meters away from the treatment station, after which contamination may occur. Since Sabo area in Oyo town is a little above 500 meters and contaminants were observed, more consumer points are liable to contaminated further along the distribution line.The finding suggests fault in pipeline and a need to improve on the method of water processing at Erelu water works. Most of this distribution pipes has being installed years back which had already rust and leaking along sewage and drainage lines.

Various results on this study indicates that the water is not of good quality, this may be due to;

- poor town planning system that can affect the water pipeline
- inadequate infrastructures for the water co-operation
- unhygienic habits of the general public
- leakages in the pipelines which may pre-disposewater to contamination.

VI. Recommendations

The distributed water by Oyo StateWater Corporation (Erelu water works) to Oyo and her environ tested positive to indicator pathogen such as E.Coli and Clostridium perfringens. This indicates the presence of both bacterial and protozoan pathogens in the water, which in turn may place human health at risk;

To produce good quality water for Oyo town and environ, as well as avoiding the pollution of the pipe borne water or water body. The following measures are suggested.

- The Government should put in place a more stringent treatment technique, measurable to the level of technological performance which water system musts follow to ensure control of regular contaminants in Erelu water. Government should provide up to date infrastructure facilities for effective for effective water treatment such as ultraviolet ray (un light)
- The establishment of mini-utility stations will decentralize the duties of the parent station and ensures effective monitoring and maintenance of distribution lines.
- In addition a clean environment established through provision of adequate infrastructures for refuse and sewage disposal will reduce the frequent level of contamination.
- The entire populace should inculcate a good hygiene in order to combat contamination of pipe borne water.
- Government should carry out routing public awareness on the danger of poor water.

- The environmental contamination should be controlled with a comprehensive sanitation program and regular monitoring to assess the success of the program.
- Educating personnel and consumers about their role in preventing contamination.

Suggestions for Further Studies

Further research work may be carried out to determine the abundance of specific pathogen isolated in the water respectively.

Likewise, the relationship between Clostridiumperfringens and protozoan parasite may be looked into.

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