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Bacteriological and Physicochemical Studies on Three Major Dams in Ekiti State, Nigeria

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Abstract

The bacteriological and physicochemical properties of public water supply system in Ekiti State, Nigeria were analyzed, using treated and untreated water samples from selected dams. The antibiotic sensitivity of 140 *E.coli* (as water indicator) isolated was evaluated using microbiological standard methods. The plasmid profile of 20 selected resistant isolates was done using agarose gel electrophoresis method. The coliform and *E. coli* count were apparently high with average range of $28.6x10^2$ to $39.8x10^3$CFU/ml and $13.0x10^2$ to $8.4x10^3$CFU/ml respectively. Though less than 3% of the isolated *E. coli* was sensitive to ofloxacin, nalixidic acid and nitrofurantoin, only 24(17.1%) was resistant to amoxicillin. Among the multidrug resistant isolates about 92.9% were resistant to at least four antibiotics while 7.0% were resistant to all the eight antibiotics used. Out of 20 MDR isolates selected, only one (1) showed absence of plasmid as other harbored plasmids ranging from 1 to 4. The size of the plasmids in kilobase pair ranged between 2.03 and 3.13. The physicochemical properties and mineral content of the water samples were all within WHO permissible limits with pH range of (7.40-7.80) and temperature range of (27.5-28.0) ^{0}C. The occurrence of plasmid-mediated multidrug resistant *E. coli* in a public water supply system in rural community heightens public health concern as discussed in this work.
Keywords: Ureje, Ero, Egbe, multidrug resistance, plasmid mediated, physicochemical

1. INTRODUCTION

In many developing countries like Nigeria, unavailability of treated water for drinking and domestic usage has become a critical problem and a matter of great concern to communities that depend on public water supply system. Furthermore, the conformation of this public water supply system with international defined microbiological standards is of special interest because of the tendency of treated water from government municipalities to spread diseases within a large population (Okonko *et al*., 2008). The call for increased surveillance and more studies that aim at identifying opportunities for improvement is thus a necessity. Quality standards for treated drinking water vary from place to place. The objective of most treatment schemes is largely to reduce the possibility of the spread of water borne diseases to the barest minimum in addition to considerations for its wholesomeness and palatability (Oluyege *et al*., 2010). It is much undoubted that for any water treatment program, treatment program, multiple barriers are essential to ensure the quality of drinking water; a single barrier cannot always be relied upon, as there might be technical or operational breakdowns. Expert recommendations suggest that using this approach, safe drinking water quality could be achieved even before the final treatment step, so that failure of any one process will not result in waterborne diseases. Sanitation, source protection, water treatment and monitoring of distribution and storage units are vital to making this a reality (Odeyemi *et al*., 2012).

Ekiti state in Nigeria possess a well-known history of different water bodies which include Ureje, Ose, Ayetoro, Igogo and Eda-Oniyo rivers; to mention but few. Many of these water bodies are passed through particular water treatment plant (dam) in the state, serving as a treatment schemes before discharging them through the public water supply system, aimed to serving as a source of portable water for people within the communities. Realizing the tendency of these water to mediate the spread of different diseases; as they are use for several purposes such as cooking, washing, bathing and other domestic uses, has really attracted special interest and monitoring. Among possible issues identified in available literature as to be responsible for this, is inadequacy in the treatment and distribution processes (Odeyemi *et al*., 2012). Although absolutely pure water is not found in nature because natural water from all sources are associated with some kind of contaminants, their nature and amount however vary with the sources of the water, this further emphasizes the need for subjecting raw source waters to adequate treatment to ensure availability of good quality water; an indispensable feature for preventing diseases and improving quality of life (Oluduro & Adewole, 2007).

Although contaminants in water are divided roughly into three categories: physical, chemical and biological, but environmental risk assessment today reveals that the exposure to biological contaminants especially water-borne microbial pathogens needs to be given higher priority in treatment and regulatory programs for domestic water supplies (Okonko *et al*., 2008). The leading measure for assessing the likelihood of biological water pollution is

the detection of bacteria of faecal origin known as coliforms; family of *Enterobacteriaceae* including *Salmonella*, *Shigella*, *Klebsiella*, *Escherichia coli* and more. These have been documented to pose significant treat to human health as they serve as the causative agent of several gastrointestinal disturbance like vomiting, nausea and diarrhea and even more chronic disease like kidney damage, to susceptible or immunocompromised individual (Anonymous, 2006). Moreover, water is not a natural medium for coliform; hence their presence must at least be regarded as indicative of pollution in its widest sense (WHO, 1998). *Escherichia coli* is widely use to surrogate for potentially pathogenic bacteria including member of *Enterobacteriaceae*; as indicator organism because they generally live longer with greater number and are less risky to culture (EPA, 2002).
Aiming to highlight the necessity of improvement in the current treatment system adopted in the water treatment plants available for rural residents in the south-western Nigeria and/or developing adequate approaches in ensuring portability of the water supply for the populace, the present study is focused at the bacteriological and physicochemical quality assessment of treated and untreated water samples obtained from three major dams in Ekiti State. It also reveals the profile of plasmid carried by resistant *E.coli* isolated from these water samples.

2. MATERIALS AND METHODS

2.1 Study site and samples collection

Samples of treated and untreated water were collected at three categorical points (raw, treatment and consumer points) from three different dams (Ureje, Ero and Egbe) located in Ado-Ekiti, Ikun-Ekiti and Egbe-Ekiti respectively. Using 250ml sterile sampling bottles raw water samples were collected from the dams; samples for the treatment point were collected from the reservoir while the treated samples were collected from three different tap water sources around the dams. The water samples were analyzed three times weekly for a period of eight weeks, meanwhile each batch of the samples were transported in ice to the laboratory for microbiological and physicochemical analyses within 4h of collection. The allotted samples for mineral analysis were chemically preserved by the addition of 5ml concentrated HNO_3 per litre of the water samples.

2.2 Enumeration of total coliform and *E.coli* counts

Membrane filtration technique was applied to determine total coliforms and *Escherichia coli* count by filtering 100ml of water samples through a membrane filter (Olutiola *et al*., 2000). This was inoculated on freshly prepared sterile MacConkey agar and Eosin methylene blue agar, and then inoculated at 37 ^{0}C for 24hours invertedly. After incubation, membrane filter was transferred to an absorbent pad saturated with methylene blue solution (0.01%) and allowed to stain for 1minute. Subsequently, membrane filter was saturated with sterile distilled water so as to remove excess stain. Colonies are counted on membrane filter and used to calculate the number of coliforms per ml of the original sample recorded in colony forming unit per milliliter. With reference to Bergey's manual of determinative bacteriology, pure cultures of bacteria isolated were characterized and identified (Buchanaan & Gibbons, 1974).

2.3 Antibiotics susceptibility and plasmid profiling

The antibiotics susceptibility of the isolates was determined using disk diffusion method on Mueller-Hilton agar according to CLSI guidelines for antimicrobial susceptibility testing (CLSI, 2005). The *E.coli* isolates were tested against ABTEK disc antibiotics which comprised of ofloxacin (OFL 30µg), augmentin (AUG 30µg), gentamycin (GEN 10µg), tetracycline (TET 30µg), cotrimazole (COT 25µg), amoxicillin (AMX 25µg), nalicidic acid (NAL 30µg) and nitrofurantoin (NIT 30µg). The inoculum was standardized by adjusting its density to equal the turbidity of a Barium sulphate ($BaSO_4$) (0.5 McFarland turbidity standard), and incubated at 35 ^{0}C for 18 h. The diameter of the zone of clearance was measured to the nearest whole millimeter and interpreted on the basis of CLSI guidelines for antimicrobial susceptibility testing (CLSI, 2005).
Plasmid DNA of the resistant strains was extracted using the high pure plasmid isolation Kit (Roche, Germany), according to the manufacturer's instructions. Electrophoresis of the extracted DNA was done on 0.8% agarose gel, stained with ethidium bromide and visualized by UV-transillumination (Robins-Browne *et al*., 2004).

2.4 Physicochemical Analyses

The temperatures of the water samples were obtained at the site of collection using a thermometer (Edema *et al*., 2001; Ademoroti, 1996); electrical conductivity was measured with a CDM 83 Conductivity meter (Radio Meter A/S Copenhagen, Denmark). Turbidity and pH were determined at site using Water Proof Scan 3+ Double Junction (Wagtech International, UK) and HI 98311-HI 98312 (Hanna). The water samples were then stored in the deep freezer until analyzed. Other physicochemical properties determined were; total hardness, determined by titrimetry; total dissolved solid and total suspended solid as determined using gravimetric method; acidity,

alkalinity and sulphate were also determined by titrimetry. Both nitrate and phosphate were determined colorimetrically using Spectronic-20 (Gallenkamp, UK) as described by Association of Official Analytical Chemists (Anonymous, 1990). Manganese was determined using atomic absorption spectrophotometer (Perkin-Elmer Model 403).

3. RESULTS AND DISCUSSION

The mean coliform and *E.coli* counts of water samples of the sampling sites at the different sampling sources are shown in Table 1. The result obtained showed the mean total coliform count of the water samples from Ero sampling site for the ranged from $34.5x10^2$ to $37.0x10^3$ CFU/ml and the mean total *E.coli* count ranged from 17.8 x 10^2 to 8.5 x 10^3 CFU/ml. The mean total coliform and *E.coli* counts for water samples from Egbe sampling site ranged from 28.5 x 10^2 to 46.0 x 10^3 CFU/ml and $14x10^2$ to $9.5x10^3$ CFU/ml respectively, while bacterial count of water samples for Ureje sampling site ranged from 22.8 x 10^2 to 36.3 x 10^3 CFU/ml and 7.2 x 10^2 to 7.2 x 10^3 CFU/ml for the mean total coliform and *E.coli* counts respectively.

The isolation of coliforms from water is of great importance in different fields of microbiology as is used as a continuous standard when water is under study. Coliform bacteria are an important indicator of water quality and along with other organisms; they make up an important part of water standards. In this study, the isolation of *E.coli* and coliforms from the water dams is in correlation with past study as *E.coli* and other coliforms are known to be ever-present in different water sources be it rivers, streams, rainwater, well water, underground water and even pipe-borne water (EPA, 2002). The range of coliform count obtained generally in this study correlate with that obtained by Oluyege *et al*. (2010), having worked on the treated and untreated water samples from Ero dam in Ekiti State, recorded coliform count range of 8.0 x 10^1 to 4.7 x 10^2 CFU/ml. However, bush around these dams remarkably serve as hide-out for mammals that frequently visit these water bodies to drink and subsequently pass their faeces (Banwo, 2006). It could be deducted from the results of this study that the high number of *E.coli* isolates (140) suggests that it is a common part (normal flora) of the water dams and can be isolated from any water body as earlier reported (Zamxaka *et al*., 2004). The report attributed the main cause of water-borne diseases to the presence of *E.coli* and other faecal coliforms. *E.coli* has also been described by two different authors who both reported the implication of the organism in water and food related pathogenic infections (Wasteson *et al*., 2001; Kaper *et al*., 2004). Although, the number (140) of *E.coli* isolated from the dams was lower to the result of a study of a researcher who investigated and found about 237 *E.coli* isolates from different water bodies within provinces in South Africa (Wose-Kinge *et al*., 2010).

A total of 140 *Escherichia coli* isolates were obtained from the water samples collected from these selected dams in Ekiti State. Table 2 shows the antimicrobial susceptibility pattern of the 140 *E.coli* isolated from the water samples using eight antibiotics. The table revealed that amoxicillin was the most active as only 24(17.1%) of the *E.coli* isolates were resistant, while all the 140 isolates were resistant to ofloxacin and 98.6% and 97.1% of the isolates were resistant to nalixidic acid and nitrofurantoin respectively; signifying that both were the least active. Many other isolates showed varying degrees of sensitivity/intermediate against the eight antibiotics used.

Table 3 revealed the multidrug resistance (MDR) patterns of the 140 *Escherichia coli* isolates. The highest levels of multidrug resistant were observed in 7.9% (11) of the isolates which were resistant to all the eight antibiotics; 20(14.3%) of the isolates showed resistant to seven of the antibiotics followed by 38(25.7%) of the isolates that were resistant to six antibiotics. High number 42(30%) of the 140 *E.coli* were resistant to five of the drugs and only 13.6% were resistant to four of the eight antibiotics used.

Twenty (20) multidrug-resistant *E.coli* isolates were selected and screened for presence of extra-chromosomal DNA (plasmids) as shown in Table 4; which revealed that only one of the twenty isolates showed absence of plasmids, others showed varying number of plasmids ranging from (1-3), while only one isolate was confirmed to be carrying four different plasmids. These plasmids showed a varying molecular weight ranging from 2.32 to 23.1 (figure 1). The plasmids found on all the isolates showed molecular weights ranging from 2.03 to 3.13 kilobase pair (Kbp) with different multiple resistance patterns.

The high rate of antibiotic resistance by the *E.coli* isolates in this study correlates with the work of Bass *et al*. (1999) which reported the resistance of *E.coli* to about seven of the eight antibiotics used. The multiple resistance pattern of the *E.coli* isolates as shown in the antibiotic testing also agrees with the findings of Heike & Reinhard (2005); Walsh *et al*. (2005), which also reported the growing discoveries of antibiotic resistant strains and attributed this to use of antibiotics in animal husbandry which has caused genotypic change due to chromosomal mutation. The *E.coli* isolates in this study showed multiple resistance to about seven of the eight antibiotics used which is also in agreement with the study done earlier where out of the 237 isolates of *E.coli*,

multiple resistance was noticed for erythromycin, tetracycline, chloramphenicol and ofloxacin and a high resistance rate of about 70% was realized (Wose-Kinge *et al.*, 2010). The plasmid profile obtained from the *E.coli* isolates in this study is also in accordance with those conducted by other authors who reported that *Enterobacteriaceae* family has been linked to well-known antibiotic-resistant gene pools which are transferred into the normal flora of humans and animals (Lin & Biyela, 2005). They exert a strong selective pressure for the emergence and spread of resistance in both pathogenic and commensal bacteria. Eventually they find their way into the environment via water, manure and sewage sludge (Dancer, 2004). The transmissibility of resistance (R)-genes and plasmids poses public health risk, considering the vast potential of hosts presented by microbial populations in the gut and water environment. This risk could be heightened if R-genes are disseminated across geographic borders by travelers or by a river continuum (Vincent *et al*., 2000). However, the presence of *E.coli* in the three dams studied along with their antibiotic resistance patterns and their plasmid profiling shows that the notorious ability of *E.coli* to show multiple resistance to antibiotics is worthy of study because authors have reports describing *E.coli* from water as an organism with diverse ability to resist different antibiotics due to the gene pool that it has developed over the years(Bass *et al*.,1999; Noble *et al*., 2003; Levy, 1992).

Results obtained for the determination of some selected physicochemical parameters of the three dams' water samples (Ureje, Ero and Egbe dam) are shown in Table 4. The conductivity of the three dams ranged (175-207) µS/cm, pH ranged (7.40-7.80), Alkalinity ranged (190-270) mg/L. The hardness of the three dam water also ranges from (68-104) mg/L, turbidity (0.06-0.11) NTU, total dissolved solid ranged (4.20-9.39) mg/L, dissolved oxygen ranges from (7.60-8.10) mg/L, total suspended ranged (1.94-2.10) mg/L. Acidity mole (0.0009-0.0019) mg/L and Temperate ranged (27.5-28.0) ^{o}C. The mineral contents of the water samples include Sulphate (0.54-0.89) mg/L. Nitrates, (0.46-0.65) mg/L, Phosphate (2.05-4.19) mg/L, Magnesium (3.05-6.4) mg/L and Calcium (1.01-1.36) mg/L. All the water sources were colourless and odourless. Generally the result showed that the dams were related with respect to the physiochemical parameters revealing Ureje dam being the hardest, most turbid and most alkaline of the three dams. While the mineral content varied as they showed little or no difference in values.

The physicochemical properties recorded for the water samples obtained from each of the selected dams in the state could all be considered to be within the range for natural waters according to the standard as supported by Ademoroti (1996). The pH value of the water samples are partially in accordance with Medema, Allens & Meinear, (1982) who reported the pH of most natural waters to range from 6.5 to 8.5. This also receives support from the report that stated that the deviation of pH level of natural water from the neutral is as a result of the CO_2/carbonate/bicarbonate equilibrium (Ademoroti, 1996). The high temperature range of (27.5 and 28 ^{o}C) obtained is believed to have been influenced by the intensity of the sunlight on relatively hot days (Banwo, 2006). The turbidity measured were still in a close range to the EPA standard, which also signified low value obtained for total suspended solid (TSS). Turbidity was related as the cloudiness of a liquid as a result of particulate matter being suspended within it, and also highlighted that suspended solids helps to shield bacteria (Asano, 2007). The sulphate, nitrate, phosphate, magnesium and calcium content of these water samples are within permissible limit (EPA, 2002).

Table 1: Microbial count (CFU/ml) of water samples from three dams in Ekiti State

Sample sources	*Period of collection	Ero Dam				Egbe Dam				Ureje Dam			
		TCC		TECC		TCC		TECC		TCC		TECC	
		10^2	10^3	10^2	10^3	10^2	10^3	10^2	10^3	10^2	10^3	10^2	10^3
Fresh water	1	78	52	32	13	97	61	26	15	86	49	21	13
	2	51	39	27	12	69	48	21	13	63	41	20	11
	3	49	37	25	10	67	46	19	11	61	39	18	9
	4	47	35	24	8	66	44	17	9	60	37	16	7
	5	45	33	23	7	64	43	16	8	58	35	15	6
	6	43	33	22	7	63	42	14	7	57	33	13	5
	7	42	31	20	5	60	40	12	6	55	30	10	3
	8	48	37	25	6	66	44	15	7	60	35	12	4
	Mean	50.3	37	24.7	8.5	69	46	17.5	9.5	62.5	36.3	15.6	7.2
Reservoir water	1	67	46	27	10	71	49	21	11	58	38	17	10
	2	48	36	24	6	35	27	19	5	30	31	15	5
	3	46	35	22	6	33	35	17	3	29	30	13	4
	4	45	33	20	3	31	34	16	2	28	28	12	2
	5	43	30	19	2	29	32	15	2	27	26	10	1
	6	43	29	17	2	28	31	14	2	26	24	8	2
	7	40	26	13	10	25	28	11	8	23	21	4	2
	8	44	27	15	10	27	29	12	7	25	23	5	3
	Mean	47	32.7	19.6	5.8	34.8	33	15.6	5	30.7	27.6	10.5	3.6
Tap water1	1	62	40	25	9	64	38	22	9	45	32	14	8
	2	42	31	21	6	30	32	17	6	25	26	13	6
	3	40	29	20	4	29	30	15	5	23	25	11	4
	4	37	27	19	3	28	28	14	3	22	24	10	3
	5	34	25	17	2	25	25	12	2	19	21	8	3
	6	33	24	16	2	24	24	12	3	17	20	9	3
	7	30	22	13	11	20	19	9	7	15	12	7	5
	8	31	23	15	12	22	20	11	8	17	14	8	7
	Mean	38.6	27.6	18.3	6.1	30.2	27	14	5.3	22.8	21.7	10	4.8
Tap water2	1	60	42	23	9	61	39	20	10	43	32	13	9
	2	43	32	23	8	33	34	21	9	28	28	12	9
	3	41	30	21	6	31	33	19	7	26	27	11	8
	4	39	28	19	5	26	32	17	6	24	25	9	6
	5	36	27	17	4	23	30	15	4	21	24	8	5
	6	37	26	16	4	23	29	15	3	28	21	7	2
	7	35	23	14	3	29	27	13	3	20	16	7	3
	8	37	25	15	3	22	19	12	3	20	23	7	4
	Mean	41	29	18.5	5.3	31	30	16.5	5.6	26.3	24.5	9.3	5.7
Tap water3	1	61	43	21	10	63	38	21	9	42	33	14	9
	2	37	29	21	8	28	29	21	8	26	26	10	9
	3	35	28	20	7	27	27	19	8	25	24	9	8
	4	32	26	19	6	26	25	17	6	23	23	8	7
	5	30	25	17	5	24	23	15	5	21	22	7	5
	6	29	23	17	4	22	20	13	5	20	21	5	4
	7	27	20	15	3	20	18	10	3	18	18	3	3
	8	25	23	13	2	18	16	8	2	15	13	2	3
	Mean	34.5	27	17.8	5.6	28.5	24.5	15.5	5.7	23	22	7.2	6

Key: *TCC- Total coliform count and TECC- Total Escherichia coli count.*
**weekly*

Table 2: Antimicrobial susceptibility pattern of *E.coli* isolated from selected dam in Ekiti State.

S/N	Antibiotics	Disc Content (µg)	Susceptibility (n=140)		
			Sensitive No (%)	Intermediate No (%)	Resistant No (%)
1	OFL	30	0(0.0)	0(0.0)	140(100)
2	AUG	30	25(17.9)	45(32.1)	70(50)
3	GEN	10	16(11.4)	43(30.7)	81(57.9)
4	TET	30	2(1.4)	22(15.7)	116(82.9)
5	COT	25	20(14.3)	53(37.9)	67(47.9)
6	AMX	25	96(68.6)	20(14.3)	24(17.1)
7	NAL	30	1(0.7)	1(0.7)	138(98.6)
8	NIT	30	0(0.0)	4(2.9)	136(97.1)

Table 3: Phenotypic pattern of multiple antibiotics resistance of isolated *E.coli*

Number of Antibiotics	Combination of antibiotics	Number of occurence No (%)
4	AMX-OFL-AUG-TET	1
	AMX-GEN-NAL-AUG	1
	AMX-NIT-GEN-AUG	2
	AMX-COT-AUG-TET	2
	AMX-NIT-AUG-TET	2
	AMX-GEN-AUG-TET	11
	Total	19(13.6)
5	AMX-GEN-OFL-AUG-TET	1
	AMX-NAL-OFL-AUG-TET	1
	AMX-COT-NIT-AUG-TET	2
	AMX-COT-NAL-AUG-TET	2
	AMX-NIT-NAL-AUG-TET	3
	AMX-COT-GEN-AUG-TET	9
	AMX-GEN-NAL-AUG-TET	12
	AMX-NIT-GEN-AUG-TET	12
	Total	42(30)
6	AMX-NIT-GEN-NAL-OFL-TET	1
	AMX-COT-NIT-GEN-NAL-AUG	1
	AMX-COT-NIT-NAL-AUG-TET	1
	AMX-NIT-GEN-OFL-AUG-TET	3
	AMX-NIT-GEN-NAL-AUG-TET	7
	AMX-COT-GEN-NAL-AUG-TET	7
	AMX-COT-NIT-GEN-AUG-TET	18
	Total	38(25.7)
7	AMX-COT-NIT-GEN-OFL-AUG-TET	1
	AMX-COT-NIT-NAL-OFL-AUG-TET	1
	AMX-COT-GEN-NAL-OFL-AUG-TET	2
	AMX-NIT-GEN-NAL-OFL-AUG-TET	4
	AMX-COT-NIT-GEN-NAL-AUG-TET	12
	Total	20(14.3)
8	AMX-COT-NIT-GEN-NAL-OFL-AUG-TET	11
	Total	11(7.9)

Key: *AMX-Amoxycillin, COT-Cotrimaxole, NIT-Nitrofurantoin, GEN-Gentamycin, NAL-Nalicidic acid, OFL-Ofloxacin, AUG-Augmentin and TET-Tetracycline.*

Table 4: Plasmid profile and multidrug resistance patterns of selected plasmid-containing *E.coli* isolates

E.coli isolates	Number of plasmids	Molecular weight (Kbp)	Antibiotics to which isolates were resistant	
			Number	Combinations
1	0	0	5	AMX,NIT,GEN,AUG,TET
2	1	23.13	5	AMX,COT,GEN,AUG,TET
3	1	23.13	5	AMX,GEN,NAL,AUG,TET
4	2	23.13, 6.56	5	AMX,GEN,NAL,AUG,TET
5	4	23.13,6.56,4.36,2.32	5	AMX,NIT,GEN,AUG,TET
6	1	23.13	6	AMX, COT,NIT,GEN,AUG,TET
7	2	23.13,6.56	6	AMX,NIT,GEN,OFL,AUG,TET
8	2	23.13,2.03	6	AMX,COT,GEN,NAL,AUG,TET
9	3	23.13,4.36,2.32	6	AMX,COT,NIT,GEN,AUG,TET
10	1	23.13	7	AMX,COT,NIT,GEN,NAL,AUG,TET
11	1	23.13	7	AMX,COT,GEN,NIT,NAC,AUG,TET
12	1	23.13	7	AMX,NIT,GEN,NAC,OFC,AUG,TET
13	2	23.13,6.56	7	AMX,COT,NIT,GEN,NAL,AUG,TET
14	3	23.13,6.56,4.36	7	AMX,COT,NIT,GEN,NAL,AUG,TET
15	3	23.13,6.56,4.36	7	AMX,COT,GEN,NAL,OFL,AUG,TET
16	1	23.13	8	AMX,COT,NIT,GEN,NAL,OFL,AUG,TET
17	1	32.13	8	AMX,COT,NIT,GEN,NAL,OFL,AUG,TET
18	1	23.13	8	AMX,COT,NIT,GEN,NAL,OFL,AUG,TET
19	2	23.13,6.56	8	AMX,COT,NIT,GEN,NAL,OFL,AUG,TET
20	2	23.13,2.25	8	AMX,COT,NIT,GEN,NAL,OFL,AUG,TET

Key: *AMX-Amoxycillin, COT-Cotrimaxole, NIT-Nitrofurantoin, GEN-Gentamycin, NAL-Nalicidic acid, OFL-Ofloxacin, AUG-Augmentin and TET-Tetracycline.*

Table 5: Physicochemical properties and Mineral content of water samples from selected dams in Ekiti State

Physicochemical parameters	Ureje dam	Egbe dam	Ero dam
Clarity	Clear Liquid	Clear Liquid	Clear Liquid
Odour	Odourless	Odourless	Odourless
Colour	Colourless	Colourless	Colourless
Conductivity (µS/cm)	194	207	175
pH	7.80	7.60	7.40
Alkalinity (mg/L)	270	250	190
Hardness (mg/L)	104	68	70
Turbidity (NTU)	0.11	0.06	0.08
Total dissolved solid (mg/L)	6.42	9.39	4.20
Dissolved oxygen (mg/L)	7.60	8.10	7.60
Total suspended solid (mg/L)	2.06	2.10	1.94
Acidity (mg/L)	0.0019	0.0011	0.0009
Temperature (C)	28	27.5	28
Mineral parameters			
Sulphate (mg/L)	0.89	0.66	0.54
Nitrate (mg/L)	0.65	0.46	0.51
Phosphate (mg/L)	4.19	2.63	2.05
Magnesium (mg/L)	6.4	4.51	3.05
Calcium (mg/L)	1.35	1.01	1.36

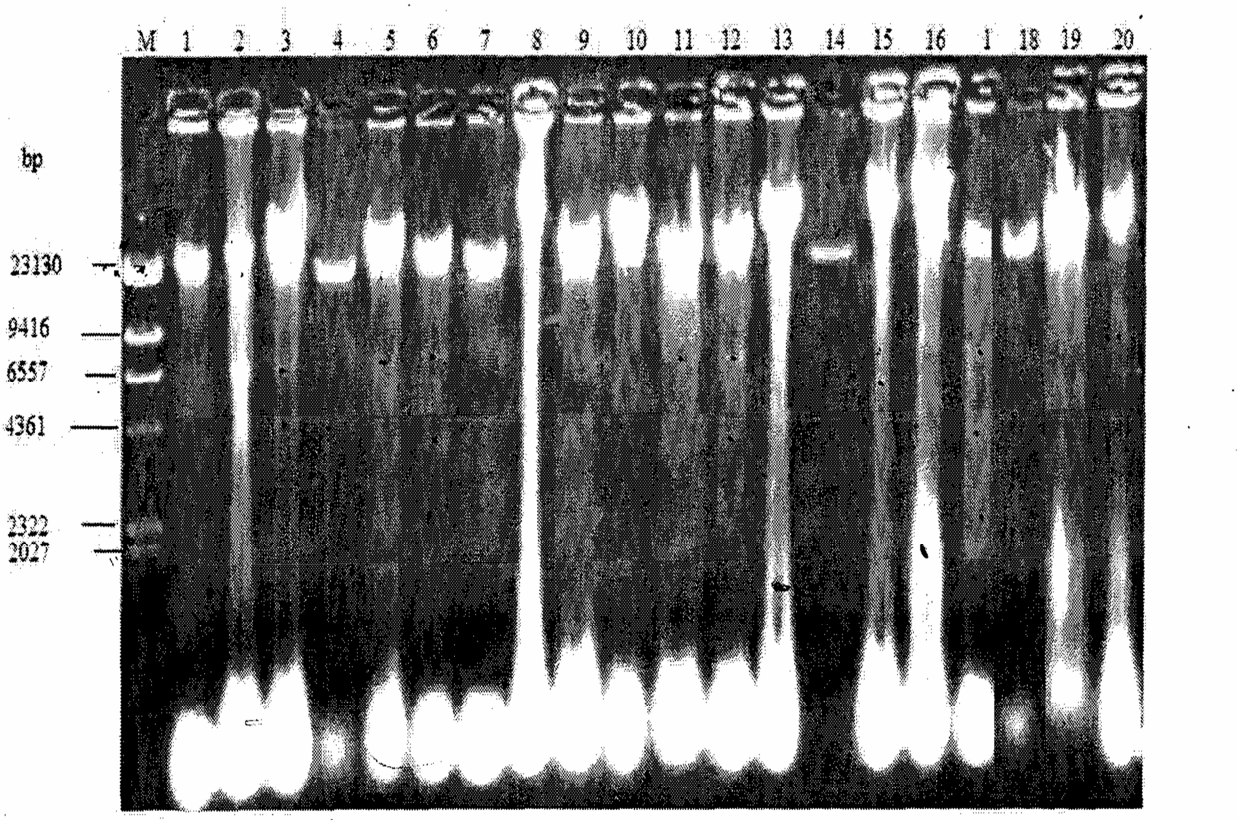

Figure 1: Plasmid profile of isolated resistant bacteria

4. CONCLUSION

In conclusion, the result of this research work has given a snap of the extent to which the public water supply system in the state is contaminated by faecal coliforms. Thus disclaiming the usability/portability of these water samples for consumption and other domestic purposes. Since the dams supply water to communities around their locations, there is however high tendency of disease outbreak which will be as a result of *E.coli* resistance to common antibiotics. Water in these three dams and other public water supply in the rural settings, should therefore be screened and subjected to efficient purification, protective distribution network to prevent the alerting risk of water-borne disease outbreak.

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