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Physico-Chemical and Bacteriological Analysis of Eripa and Erin-Ijesa Waterfalls used for Drinking & Recreational Purposes in Osun State, Nigeria.

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Abstract: *Physico-chemical and bacteriological analysis of the two water falls were carried out. The results obtained were compared with EPA and WHO standards for drinking and recreational water. The water sources were within the standard set for pH, Total dissolved solids, Total solid, acidity, chloride and iron contents. For bacteriological analysis, the two samples did not comply with bacteriological standards because the total coliforms could higher than 1,300 MPN/ml, Vibrio cholerae counts and Salmonella – Shigella counts were also high. The pathogens in water for drinking and recreational purposes may pose a threat in public health and even other microorganisms that may also be present. The pathogens and other microbes are all concerned in gastro-intestinal water source diseases that usually affect man and aquatic lives at large.*
Key words*: Drinking water, Recreational, Waterfall, Pathogens.*

I. Introduction

Water is the most essential needs of the continued existence of all human lives and the equilibrium of natural life. Water sources are at every stage of human lives and they become one of the most important necessities of people [1]. It is effectively and efficiently put into use by plants, animals, microorganisms and man. In the microbial world, no single microorganisms has been discovered to be active at the extreme lack of water for the single reason that man cannot exist without water [1]. Increase in human population exert an enormous pressure on the provision of safe drinking water especially in developing countries [2]. Many infectious diseases are transmitted by water through the fecal-oral route. Diseases contacted through drinking water kill about 5million children annually and make $1/6^{th}$ of the world population risk [3]. Water related diseases continue to be one of the major health problems globally. The high prevalence of diarrheal among children and infants can be traced to the use of unsafe water and unhygienic practices [4]. Therefore, maintaining a safe drinking water remain essential to human health as transient bacterial contamination may have implication well beyond a period of acute-self limited illness [4]. Water of good drinking quality is of basic important to human physiology, although, guideline for bacteriological water differs from country to country, but they all conform to WHO recommendation [5]. The standard for drinking water are more stringent than those for recreational, constraints are the major obstacles in the provision of water of good quality in developing countries and rural areas [5]. In Nigeria, majority of the rural populace do not have access to portable water and therefore, depend on well, stream and river water for domestic use [6]. The bacterial qualities of groundwater, pipe borne water and other natural water supplies in Nigeria have been reported to be unsatisfactory, with coliforms counts for exceeding the level recommendation by WHO [6]. The research is aimed at investigating the physico-chemical parameters and bacterial counts of certain genera in both Eripa and Erin-Ijesa waterfalls respectively.

II. Materials And Methods

Water samples from the two waterfalls (Eripa and Erin-Ijesa) were randomly collected for physico-chemical bacteriological analyses in sterile bottles and taken to the laboratory aseptically.

2.1 Physico-Chemical Analysis

The physico-chemical analysis conducted are: determination of pH, colour, Odour, turbidity, total solids, total dissolved solids, conductivity, acidity, iron and chloride contents using the methods of FAO [7].

2.2 Bacteriological Analysis

Bacteriological characteristics were determined according to Bezeidenhout [8], the Most Portable Number-Multiple tube technique was used for coliform concentration. *Salmonella-Shigella* agar and Thiosulphate citrate bile salt sucrose agar were used to determine *Salmonella – Shigella* and *Vibrio cholerae* respectively. Every plate was incubated at 37^0C for 24hours. Gram staining and biochemical reactions were used

to confirm the presumptive colonies where each plate was given a positive or negative score. The isolates were determined through conventional biochemical test, Standing Committee of Analysis [9].

III. Results And Discussion

The physico-chemical analysis conducted involved the colour, Odour, total solids, total dissolved solids, turbidity, acidity, chloride and ion contents which are all presented in Table 1.

The two waterfalls are colourless and also no objectionable odour (Table 1). The pH of the water sources ranged from 6.5 and 6.9 respectively, while the turbidity of the water samples ranged between 3.5 and 3.8 NTU (Both waterfalls). The conductivity measured at (µs/cm) ranged between 465 and 580 (µs/cm). Eripa Waterfalls has the lower conductivity of 465µs/cm while Erin-Ijesa waterfall has the higher conductivity of 580(µs/cm) (Table 1).

Table 1: Physico-Chemical Analysis of the two Waterfalls

Parameters	**Eripa Waterfall**	**Erin-Ijesa Waterfall**
Colour	Colourless	Colourless
Odour	U	U
pH	6.5	6.9
Conductivity (µs/cm)	465	580
Turbidity (NTU)	3.5	3.8
Total Solids (mg/L)	410	390
Total Dissolved Solids (mg/L)	336	320
Acidity	0.1	0.1
Chloride content	210	180
Iron Content	0.1	0.2
	WHO STANDARD	**EPA STANDARD**
Colour	Colourless	Colourless
Odour	U	U
pH	6.5	6.5 – 8.5
Conductivity (µs/cm)	NS	NS
Turbidity (NTU)	6.0	0.5
Total Solids (mg/L)	500	500
Total Dissolved Solids (mg/L)	NS	NS
Acidity	0.3	0.3
Chloride content	200	250
Iron Content	0.3	0.3

U → Unobjectionable NS → No Standard

Table 2: Bacteriological Analysis of Water

Sample	Total coliform count	*Salmonella-Shigella* count	*Vibrio cholerae* count
A (Eripa waterfall)	1,300	3.6×10^4	5.6×10^4
B (Erin-Ijesa waterfall)	>1,600	5.0×10^4	4.0×10^4
WHO Standard	Zero/100ml	Zero	Zero
EPA Standard	Zero	Zero	Zero

Table 3: Microbial isolates from the two waterfalls.

Isolates	**Eripa waterfall**	**Erin-Ijesa waterfall**
Escherichia coli	+	+
Staphylococcus aureus	+	+
Shigella sp.	+	+
Vibrio cholera	+	+
Pseudomonas sp.	+	+
Klebsiella sp.	+	-
Salmonella typhosa	+	+
Proteus sp.	+	+

Total dissolved solids ranged between 320 and 336mgl while the total solids ranged between 390 and 410mg/L (Table 1). The acidity of the two waterfalls samples were the same (0.1 and 0.1 respectively) (Table 1).

The chloride content ranged from 180 to 210, while the Iron content ranged from 0.1 to 0.2 (Table 1).

The result of the bacteriological analysis of the two waterfall samples are shown in Table 2. The total viable counts for the two sample sources were very high, which ranged between 4.0 x 10^4cfu/ml to 5.0 x 10^4cfu/ml. Eripa waterfall sample has higher microbial load of 5.0 x 10^4 while Erin-Ijesa waterfall sample has lower microbial load of 4.0 x 10^4 (Table 2).

The most Probable Number (MPN) for positive total coliform count of the samples from the two sources (Eripa and Erin-Ijesa waterfalls) ranged from 1,300 to >1,600MPN per 100ml. Sample B (Erin-Ijesa waterfall sample) has the higher total coliform count greater then 1,600MPN/100ml, while the other sample (Eripa waterfall sample) has the lower total coliform counts of 1,300MPN/100ml. (Table 2).

The *Vibrio cholerae* count and the *Salmonella* and *Shigella* counts for samples A and B (Eripa and Erin-Ijesa waterfalls) ranged differently. The *Vibrio cholera* count of the two samples ranged between 4.0 x 10^4cfu/ml to 5.6 x 10^4cfu/ml in which the Eripa waterfall sample has the higher count (Table 2).

The *Salmonella* and *Shigella* counts for the two samples also ranged differently. The counts ranged between 3.6 x 10^4cfu/ml to 5.0 x 10^4cfu/ml, while the Erin-Ijesa waterfall sample has the higher count (Table 2). At the end of this investigation, both Eripa and Erin-Ijesa waterfalls have the following bacteria as being isolated from the samples analysed, they are *Escherichia coli, Staphylococcus aureus, Shigella sp., Vibrio cholerae, Pseudomonas sp., Klebsiella sp.* and *Salmonella typhosa* (Table 3). *Klebsiella sp.* was only isolated from Eripa waterfall sample and not isolated from Erin-Ijesa waterfall sample.

IV. Discussion

The total coliform count for the two samples were very high in comparable to EPA standard for coliform bacteria in drinking water which is at zero total coliform per 100ml of water [10].

The presence of coliform in the samples may be as a result of pollution (faecal) [10,11]. None of the two samples is in order with EPA standard for coli-form in water.

The bacteria isolated from the two waterfall samples, which include *Pseudomonas spp., Staphylococcus aureus*, are of public health significance because they produce toxins, especially, *Staphylococcus aureus* that produce enterotoxin [10,12]. Greater number of *Vibrio cholera, Salmonella typhosa, Shigella spp.* isolated from the two water sample sources did not agree with EPA water standard for swimming purpose and if care is not taken where they are present they are very dangerous to health of individuals swimming in such water. However, the presence of these organisms in the waterfall samples may give rise to gastrointestinal infections, typhoid fever, diarrhoea, salmellosis, shigellosis and a host of other gastrointestinal disorders [10].

The pH of the samples determined were in line with the pH assigned by EPA as the standard pH of water which ranged from 6.5-8.5 but a little bit higher than WHO standard which is 6.5. Although, one can still recommend the pH as standard with a little difference shown in this study [10)

The colour and the odour of the two water samples determined showed that samples met the standard to which wholesome water should be, because it was determined as colourless and odourless [10].

The total dissolved solids of the water samples are in agreement with the environmental protection agency standard of 500mg/L and even with WHO standard which is also at the same standard (500mg/l). The total solids and total dissolved solids of any portable water could be attributed with the natural sources, sewage urban runoff, and even chemical that have seen used in the water treatment process [10], this could be fair rather than being hazardous to health [10]. The turbidity of the samples determined showed that the Eripa water sample met the standard of WHO but higher than the EPA standard while Eripa water sample which is a little bit higher than Eripa sample also met the WHO standard but above the EPA standard. The high turbidity level may be attributed to those parasites and bacteria causing infectious inhabiting in the water environment which were brought there during surface runoff and this tends to increase the turbidity [10,12]. The high turbidity makes the water to become cloudy and this also affects aquatic lives.

The chloride content of the water samples determined showed that the Erin-Ijesa water sample agreed with the EPA standard while the Eripa water sample was above the standard of WHO but in agreement with the EPA standard [10, 14]. The chloride content recommended by EPA is 250mg/l while that of WHO is 200mg/l likewise, the iron content of the water sample was investigated and the results showed that both water samples are in agreement with EPA and WHO standard [10,12].

V. Conclusion And Recommendation

Human activities around those waterfalls, such as defaecation defection may contribute to the level of contaminants in the water fall. These materials may be transported during surface runoff. Also, people should be educated on proper way of defaecating, that is, defaecation and other negative activities should be checked.

Finally, the organisms confirmed being associated with the two waterfalls are of public health significance which could result into infections if not properly taken care of.

Refernces

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