Bacteriological Quality of Selected Sachet Water in Iree Community, Osun State, Nigeria

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ABSTRACT
Water is an unaffordable resource and vital for human life. Potable drinking water is a basic need for human's good health. The aim of the study was to examine the qualities of available sachet drinking water in Iree community bacteriologically. Ten different brands if sachet water were selected and were all purchased within Iree community. The selected samples were examined for Total Heterotrophic Bacterial Count (THBC), Total Coliform Counts (TCC) and Total Thermotolerant (Faecal) Count (TTC) using standard microbiological methods. The THBC values obtained ranged from ($1.10 \times 10^2 - 1.30 \times 10^3$) cfu/ml, and were all higher than WHO limit of 1.0×10^2 cfu/ml. The total coliform counts obtained ranged from 17-98 MPN/100ml while the total thermotolerant coliform values obtained ranged from 7-15 MPN/100ml all these values are above WHO limits of 10MPN/1000ml and 0 MPN/100ml respectively. A total of eight bacteria were isolated from all the examined number if samples and were identified to include; Staphylococcus species, Erysipelothrix species, Bacillus species, Salmonella species, Escherichia coli, Pseudomonas species, Enterobacter species and Shigella dysenteriae. The study concluded that, the qualities of all examined sachet water for drinking in Iree community is poor and unsafe for drinking, it is then recommended from the study that the manufacturer of all these water should adopt an effective purification processes otherwise may result into outbreak of water borne illness in people consuming these sachet water brands in this community.

INTRODUCTION AND LITERATURE REVIEW

Water is vital for human life, directly as drinking or domestic purposes and indirectly as food constituent. Is one of the basic needs of all forms of life. The physiological activities of all living things cannot hold without water. Presently, many cities in the world are facing shortage of water because of increase in human's population. The various ways of water usage such as human's agricultural food supply that grown through irrigation, industrial and domestic uses, all in turns pollute the water sources. Pollution of water is a great problem in many developing countries and results into scarcity of potable water in almost people in the rural dwellers.

The sachet water gained popularity because of unavailability of potable water. Its industry started in 1990s (Rachel & Williams, 2023), is one of the fastest growing industries in Nigeria because of its simplest way of production and packaging. Potable water is the one that is safe and aesthetically acceptable and is giving priority by both national and international

organizations such as Standard Organization of Nigeria (SON), National Agency for Food and Drug Administration and Control (NAFDAC) and World Health Organization (WHO) and the likes.

Also, water that is fit for human consumption must meet the qualities set by these organizations and must free from physical, chemical and microbiological contaminant in an amount hazardous to human's health (Augustine, *et al* 2019). It is very certain that no simple purification method can remove completely the contaminant from used water. Although by all means, the water that must meet the drinking standard must be within the acceptable limits (Denolye, 2004) sets by most organizational bodies. People did not have knowledge about the potential health risks associated with pollutant of water that can leads to water borne or water related diseases such as diarrhea, typhoid dysentery (Augustine, *et al.*, 2019). Sachet water can be referred to as potable water because it had been assumed to undergone some treatments to meet drinking standard (Aroh, *et al.*, 2013). The National Agency for Food and Drug Administration and Control (NAFDAC) between 2004-2005 was established and were saddled with responsibility among others, to regulate the packaged water and ensuring quality in the production and packaging of it (Solomon, *et al.*, 2018). It was noted, that most of sachet water producer were not care about their production processes, their hygienic practices, they even packaged untreated water, we even have among them producing illegally without the approval of their premises. The producers were just after their profit that they we make from it, not even mindful of health effect on their consumers.

Drinking water quality describes a wide spectrum of items related to how to identify water problems and how to collectively address the issues. Most widely used description of water quality is the chemical, physical and biological characteristics in respect to its suitability for drinking (USEPA, 2006).

Monitoring of drinking water quality can be conducted at regular intervals so as to gather actual information about water characteristics in order to provide data that can be used to present conditions to establish what is likely to be the expected nature of drinking water. In monitoring drinking water biologically, we check for the presence of indicator organisms especially the coliform group, to assess the potential presence of water-borne pathogens has been paramount to protecting public health (USEPA, 2002).

Indicator organisms are used to assess the microbiological quality of water. Coliform have been use in Britain since 1901 (WHO, 2006) as the standard indicator of faecal contamination in water. Bacteriological assessment of drinking water was aimed to determine how safe the water is for consumption to avoid public health hazards. Organism index in water gives a measure of the level of faecal pollution in the water sources. Indicator parameter as observed by Kolawole, *et al.*, (2011) can be used to give information on the effectiveness of the removal or inactivation of a specific group of microorganisms by the treatment processes, with the presence of indicator after treatment indicating that pathogen may still be present (Wohlsen, *et al.*, 2006). The absence of this group of bacteria does not necessarily assured the absence of pathogens (Krewski, *et al.*, 2004) because many pathogens such as viruses and protozoan parasites, reliable indicators are not available for their presence, and if there is no absolute correlation between the number of indicator organisms and the actual numbers of enteric pathogens and the risk of illness occurring (USEPA, 2002),

Statement of Problem

Water has unique properties that make it very important to life, among which is been a good solvent that dissolves many substances, and serves as habitat for some creatures. Based on these properties of water, pure water does not exist. We only referred to water that is safe for drinking as pure water. As a result, water can be polluted physically, chemically and

microbiologically, which when consumed can result in human health issues that will be of public health concern.

Justification of the Study

The pressure of increasing population, industrial growth and other human's developmental activities causes pollution of water. The use of surface water for drinking are harmful for human and animal's health (WHO, 2013) because of pollutant in them. To remove this pollutant of water to make them safe for drinking, surface water is subjected to a lots of purification or treatment processes. In order to avoid public health effects resulting from pollutant in water, the treatment water for drinking purpose needs to be assessed bacteriologically. Bacteria are the major cause of diarrhea and its related water borne illnesses from unsafe treated drinking water. DesselBerger and Gray, (2013) reported that most common human diseases like inflammation of intestine and stomach are said to cause by enteric bacteria where their basic sources is through faeces of infected individuals. Therefore, there is need to assess the quality of sachet drinking water consumed in Iree community of Boripe Local Government Area of Osun State, Nigeria.

Aim and Objectives

The aim of the research was to examine the bacteriological quality of some selected sachet water in Iree community while the objectives are

i. To enumerate the total heterotrophic bacterial count,
ii. To enumerate the total coliform count and
iii. To enumerate the faecal coliform count of those selected sachet water for drinking in that community.

METHODOLOGY

Sample Collection

A total of ten (10) sachet water samples of different brands were bought from the vendors in Iree town of Boripe Local Government, Osun State. The collected samples were designated Sw1-Sw10. The collected samples were very commons and well accepted among the drinking sachet water in the said community. The samples were carefully labelled with their designations and were all taken to the microbiology laboratory of Osun State Polytechnic, Iree (Fawole and Oso, 2004).

Bacteriological Analysis

Total Heterotrophic bacterial count methods used to enumerate bacteria from collected water samples was standard plate count as described by (APHA 2005) using spread plate method. The plates were then incubated at 37^{o}C for 24-48 hours and were examined, the numbers of discrete colonies observed on the plate were counted and recorded in cfu/ml.

Enumeration of Total Coliform Count Using (MPN) Technique

In this technique, series of tubes containing MaConkey broth was used and cultured medium was inoculated with the water samples. Three regimen tubes method was used. Three boiling tubes containing 10ml double strength MaConkey broth were used and these were inoculated with 10ml samples each. Another two sets of 3 test tubes containing 10ml single strength broth were also inoculated with 1ml and 0.1ml of test water samples respectively. All the inoculated tubes were incubated for 24-48 hours for acid and gas production (APHA, 2002; Fawole and Oso 2004), this indicates possible presence of coliform. Bacteria concentration in the sample was estimated using MacCrady statistical table in MPN/100ml.

Enumeration of Total Faecal (Thermotolerant) Coliform Counts

This was done following method used for total coliform count (APHA, 2005). The incubation temperature here was 44.5^{o}C for 18-24 hours instead of 37^{o}C for total coliform. This is basically because only thermotolerant coliform (*E. coli*) can tolerate this higher temperature (44.5^{o}C). After incubation for positive test, bacterial concentration was also estimated using MacCrady statistical tables in MPN/100ml.

Characterization and Identification of Bacteria Isolates

Bacterial characterization was done by the determination of their colonial and cellular morphology and biochemical characteristics pure colonies were observed for characters such as size, shape, optical, consistency and elevation. Various biochemical test was also carried out on the isolates to complement cellular morphology, the tentative identification of the isolates was obtained through Buchanan and Gibbons, 2004.

RESULT AND DISCUSSION

Table1: Bacteriological Analyses

Samples	TVBC (cfu/ml)	TCC (MPN/100ml)	TTC (MPN/100ml)
Sw_1	1.30 x 10^3	86	15
Sw_2	1.10 x 10^3	36	11
Sw_3	1.10 x 10^2	17	15
Sw_4	1.30 x 10^3	72	15
Sw_5	0.40 x 10^3	53	7
Sw_6	0.30 x 10^3	53	11
Sw_7	0.35 x 10^3	17	11
Sw_8	0.38 x 10^3	53	15
Sw_9	1.30 x 10^2	21	11
Sw_{10}	1.30 x 10^2	17	11

Key:

TVBC: Total Viable Bacterial Count
TCC: Total Coliform Count
TTC: Total Thermotolerant (faecal) Count
Sw_{10}: Designation given to ten (10) Sachet Water Selected

Total Heterotrophic Bacterial Count (THBC)

The values obtained for THBC ranged for (1.10 x10^2 – 1.30 x 10^3) cfu/ml. The highest was obtained in Sw_1 sample while the least was obtained in sample Sw_3. Generally, the values obtained in all the examined sachet water exceeded the standard of 1.00 x 10^2 given by (WHO 2006).

Total Coliform Counts (TCC)

The total coliform counts of the examined sachet drinking water in Iree community ranged from (17 – 86) MPN/100ml, the least was obtained in samples Sw_3, Sw_7 and Sw_{10} while the highest was obtained in Sw_1 (as shown in Result Table 1). Generally, all the result obtained exceeded the WHO (2006) standard of 1MPN/100ml.

Total Thermotolerant (faecal) Count (TTC)

The values obtained for TTC in all the examined sachet drinking water ranged between (07 – 15) MPN/100ml. The highest was gotten from the samples Sw_1, Sw_3, Sw_4 and Sw_8

respectively, while the least was obtained in Sw_5. Sincerely speaking all the values obtained from all the samples exceeded the WHO standard of zero (0) MPN/100ml.

The conventionally identified bacteria in all the samples are: *Erysipelothrix* sp, *Staphylococcus* sp, *Bacillus* sp, *Salmonella* sp, *Escherichia coli*, *Pseudomonas* sp, *Enterobacter* sp, and *Shigella dysenteriae*.

Table 2: Bacterial Distribution in Water Samples

Samples	Identified Bacteria
Sw_1	*Shigella dysenteriae, Pseudomonas sp., E.coli* and *Salmonella sp.*
Sw_2	*E. coli and Staphylococcus sp., Bacillus sp.,* and *Shigella dysenteriae*
Sw_3	*Pseudomonas sp., E. coli, Enterobacter sp.,* and *Salomonella sp.*
Sw_4	*Salomonella sp., E. coli, Shigella sp.,* and *Erysipelothrit sp.*
Sw_5	*E. coli, Staphylococcus sp.,* and *Pseudomonas sp.*
Sw_6	*Salomonella sp., E. coli, Pseudomonas sp.*
Sw_7	*Shigella dysenteriae, Staphylococcus sp.* and *Bacillus sp.*
Sw_8	*Salomonella sp., Pseudomonas sp.* and *Enterobacter sp.*
Sw_9	*Staphylococcus sp., Salomonella sp., Escherichia coli.*
Sw_{10}	*Salomonella sp., E. coli, Shigella dysenteriae,* and *Staphylococcus sp.*

The presence of Pathogenic bacteria in this examined water will make all the sachet was serve as a vehicle of disease transfer indicating that the method of treatment used by all the producers of the water is not effective at all. The identified bacteria in those water examined were classified according to Cabral, (2010) to sewage origin. Coliform serve as bacteria indicators of faecal pollution in water because they are universally present in large numbers in the human faeces and other war-blooded animals. Among the bacteria isolated from all the sachet water examined include: *Salmonella sp.*, *Escherichia coli*, *Enterobacter sp.* and *Shigella dysenteriae.* All these belong to the coliform genera that present in water environment that are of public health concerned (EPA, 2002). The *Enterobacter* sp. can occur in drinking water as a result of re-growth but poses no health risk (EPA, 2002).

Species of *Klebsiella* are known to cause infection in patient undergoing hospital treatment that has weak immune system, and the primary route of infection is by person-to-person contact or through food rather than water-borne *Klebsiella* genera is not exclusively present in intestinal tract of humans, its widespread in the environment and in natural waters, soils, and in plant materials, hence it isolation in those samples many not be of health importance (EPA, 2002).

The presence of Erysipelothrix in the water sample is as a result of inefficient treatment process (Mclauchlin and Riegel, 2012). The bacteria cause economically important disease in domestic animals, but its human infections are rare, if it occurred, it present as a localized cutaneous infection (Erysipeloid), which occasionally becomes diffuse and may lead to speticaemia and endocarditis. It presence in treated drinking water is as a result of faulty treatment processes.

Staphylococcus sp. isolated may be contaminant during isolation process because it was not found to correlate with the presence of coliform bacteria (Lechevallier and Seidles 1980).

Contaminated drinking water poses a potential health risks, because the presence of total coliform bacteria, faecal coliform most especially *E. coli*, when present in drinking water indicated that the water may be contaminated with human or animal wastes and these may not contain only pathogenic bacteria alone but also pathogenic viruses and protozoan cysts. These

may cause short term effects, such as diarrhea, cramps, nausea, heartaches or other symptoms. These may pose a special health risk for infants, young children, elderly and even most people with severely compromised immune systems (Neb Guide, 2023).

CONCLUSION

All the sachet drinking water examined in Iree community had higher values if total heterotrophic bacterial count, total coliform count and total thermotolerant (feacal) count exceeded the recommended values by WHO which make them unsafe for drinking.

RECOMMENDATION

To avoid production and marketing unsafe drinking water by private water supply, that will be of public health concerned, Government must:

i. Provide quality and safe water to every citizen from Local, State to Federal level.
ii. Must establish very workable and functioning team that will be testing all the available private water marketed on routine basis.
iii. Must establish very strict legislation and inert law for those that will be selling unsafe drinking water.

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