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Recent biophysical characteristics of domestic water sources in Owerri Metropolis, Nigeria.

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ABSTRACT:

The recent biophysical characteristics of domestic water sources in Owerri metropolis, Nigeria was studied for quality. The selected water sources were borehole, Otamiri River, Nworie Rivers, tap water and rain water. Results of bio-load study of the water sources revealed borehole water to have the least colony forming units per milliliter of total heterotrophic bacterial count (THBC), total coliform count (TCC), total *Salmonella-Shigella* count (TSSC), and total fungal count (TFC), as against the Otamiri River with the highest values. Physicochemical characteristics of water sources studied were within permissible limit of World Health Organization (WHO) standards for domestic use. The high percentage occurrence of *Salmonella species* among other bacterial genera in the studied water sources raises a health concern. These could be behind the high incidence of diarrhoea and typhoid infections, routinely reported in the clinics within the metropolis. With these findings, there is need for public water supply authority within Owerri metropolis to improve in quality of water distributed. The present study has shown the recent biophysical characteristics of domestic water sources in Owerri metropolis, Nigeria.

Keywords:
Bio-load, biophysical characteristics, infections, water sources, Owerri metropolis.

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INTRODUCTION

Water of good quality is very important to health and man's continued existence. The potable water provision to rural and urban population prevents health hazards (Lemo, 2002). Hence the principal objectives of municipal water are the production and distribution of safe water that is fit for human consumption (USEPA, 2001). Therefore before describing water as potable, it has to be confirmed with certain physical, chemical and microbiological standards which ensure that the water is potable and safe for drinking purposes (Tebutt, 1983). However, potable water have to be free from disease producing microorganisms and chemical substances deleterious to health (Ihekoronye and Ngoddy, 1985).

Water can be obtained from a number of sources such as streams, lakes, rivers, ponds, rain, springs and wells (Chukwura, 2001). Raymond 1992 says, "Clean, pure and safe water only exist briefly in nature and is immediately polluted by prevailing environmental factors and human activities. Water from most sources is therefore unfit for immediate consumption without treatment". The consequences of water borne bacterial and viral infections have been well established along with chemical contamination, which is known to cause some deadly effect (Edema *et al*., 2001; Fapetu, 2000).

It is essential that water for domestic use be examined frequently as contamination may be intermittent. And considering the global data, morbidity of diarrhoea disease is greater than 1.5 million and mortality is 4 million with more than 2 billion people being at risk. The WHO (2003) and UNICEF (2004) have reported that 80% of sickness and death among children in the world are caused by unsafe drinking water. Although municipal water is distributed to large population through closed network, but very often, consumers are exposed to risk of water borne diseases due to inadequate treatment of water (Antonine and Dante, 2008; Fapetu, 2000). This study therefore is aimed at providing recent information on the microbiological and physiochemical characteristics of domestic water sources in Owerri metropolis Nigeria. This will reveal the water source or sources that could be certified suitable for domestic usages.

MATERIALS AND METHODS

Water collection

Water samples from different sources which include borehole, Otamiri and Nworie rivers, tap water and rainwater were collected within Owerri metropolis and analyzed. The samples were randomly collected from highly dependable points where residents usually would collect their water for domestic use. Samples were collected aseptically using sterilized 500 ml glass bottles following the guideline of APHA (1998) and WHO (1984) for sampling various water sources. However, the river water sample was collected using the method of Onyeagba *et al.,* (2004). The collected samples were labeled appropriately and transported to the laboratory in an ice cool pack for analysis within 24 hours.

Bio-load study

The standard methods for the isolation and identification of microorganisms as described by Cappucino *et al.,* (1992) and Onyeagba *et al.,* (2004) were adopted in the analyses. All the samples were ten-fold serially diluted before being plated out using the spread plate technique in triplicates for total heterotrophic bacteria, count (THBC) using nutrient agar, total coliform count (TCC) using MacConkey agar, total *Vibrio* count (TVC) using thiosulphate citrate bile salt agar, total *Salmonella-Shigella* count (TSSC) using *Salmonella-Shigella* agar, and total fungal count (TFC) using Sabouraud dextrose agar. All the plates were incubated for 18 to 24 hours at 37^{o}C except for fungal count that was incubated for 3 to 5 days at room temperature (about 26 to 32^{o}C). Representative colonies were streaked, purified, and identified through biochemical, microscopic and macroscopic

observations according to Gehardt (1994) and identification based on Holt *et al*., (1994).

Determination of physiochemical characteristics

Physical and chemical indices of the water sources include colour, taste, odour, pH. Iron, total alkalinity, chloride, biological oxygen demand (BOD), chemical oxygen demand (COD), nitrate, conductivity, total dissolved solids (TDS) and turbidity were determined according to standard methods described by APHA (1998).

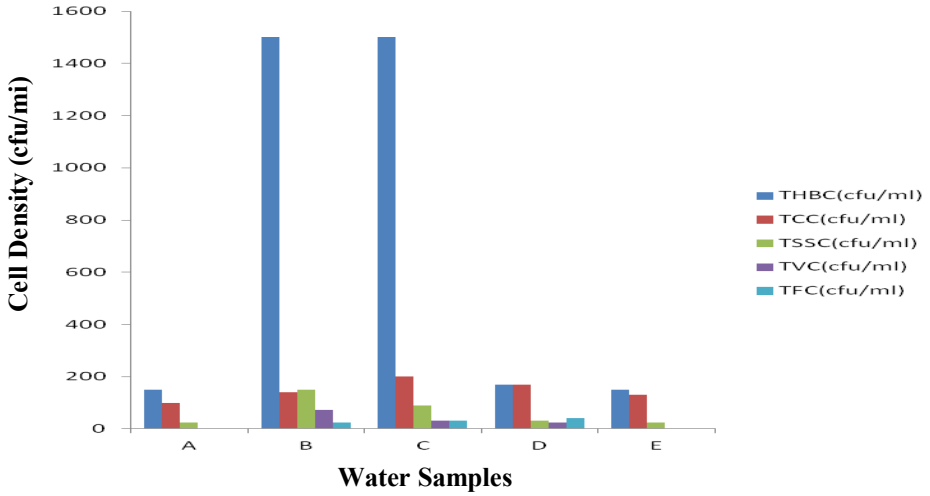
RESULTS

Result of the bio-load of water sources analyzed is shown in figure 1. The result revealed that the total heterotrophic bacteria count (THBC) ranged between $1.5x10^2$ to $1.5x10^3$ cfu/ml. The total coliform count (TCC) was in the range 1.0 to $2.0x10^2$ cfu/ml, the total *Samonella/ Shigella* count (TSSC) ranged from 1.5 to $2.5x10^2$ cfu/ml, the total *Vibrio* count (TVC) ranged from 2.5 to $7.2x10^2$ cfu/ml, and total fungal count (TFC) ranged from 2.5 to 4.0x10 cfu/ml. The findings as shown in figure 1, make borehole water the best among the studied water sources with no *Vibrio* and fungal growth; and lowest in terms of bio-load. Otamiri River had the highest bio-load in the present study. This makes it the most microbiological polluted among the water sources analyzed. Nworie River was the highest in total coliform while tap water produced the highest value of total fungal count. Rain water was next to borehole water in terms of bio-load.

Statistical analysis revealed that there was significant difference at ≤0.05 in the load of different microbial groups from the different water sources analyzed.

The overall percentage occurrence of the different genera of bacteria and fungi isolated from the water sources are presented in figures 2 and 3, respectively. The bacterial percentage occurrence revealed *Salmonella* (21.7%) to be highest in occurrence as compared to the ties of *Micrococcus* (4.35%), *Klebsiella* (4.35%) and *Enterobacter* (4.35%) as isolated and analyzed. The percentage occurrence of fungi genera isolated revealed that *Aspergillus* (42.85%) as the highest and the ties of *Cryptococcus* (14.28%) and *Saccharomyces* (14.28%) as lowest.

Statistical analysis revealed a significant difference at ≤0.05 in the percentage occurrence of bacterial and fungal isolates analyzed from the water sources.



*A-borehole, B-Otamiri river, C-Nworie river, D-tap water, E-rainwater

Figure 1. Bio-load of different water sources analyzed recently in Owerri metropolis, Nigeria.

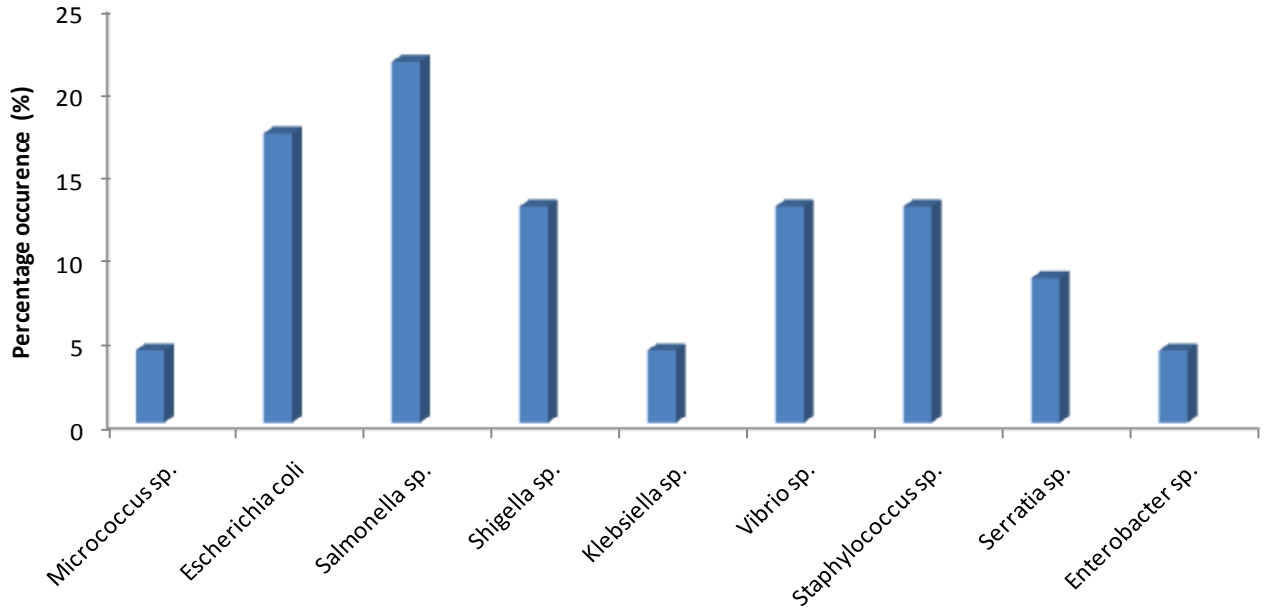


Figure 2. Overall percentage occurrence of different bacterial genera isolated from water sources in Owerri metropolis, Nigeria.

The physicochemical characteristics analyzed are shown in table 1. The water sources had pH near neutrality in the range of 6.70 to 6.92. The borehole, Otamiri, tap water and rainwater water sources were all colourless. The colour and taste of borehole, Otamiri, tap water and rainwater water sources were not objectionable, while that of Nworie was objectionable. The overall result showed that values for most physicochemical indices considered in this study were within the permissible limit as stipulated by WHO.

Table 1. Physicochemical characteristics of water sources in Owerri metropolis

Parameters	Water sources					Tolerance
	A	B	C	D	E	WHO
Colour (TCU) (Units)	colour less	colour less	dull	colour less	colour less	500
Odour	no	no	ob	ob	no	no
Taste	no	ob	ob	ob	No	no
pH	6.7	6.92	6.86	6.92	6.82	7.0 - 8.50
Conductivity (µs/cm)	146.2	23.6	45.5	28.4	3.4	500
Turbidity (NTU)	1.0	20.37	7.77	00.0	1.5	50
Alkalinity (mg/ l)	0.0	2.00	5.00	04.0	1.0	600
Chlorine (mg/l)	0.0	0.00	0.00	00.0	0.0	200
Total Iron (mg/ l)	≤0.1	≤0.1	≤0.1	≤0.1	≤0.1	0.1
BOD (mg/l)	1.3	1.38	1.48	01.2	1.3	2.0
COD (mg/l)	121.45	137.18	137.18	120.2	117.58	196
TDS (mg/l)	0.2	11.7	11.7	0.1	0.1	-

TCU-true colour unit, no-not objectionable, ob-objectionable, NTU-nephlometric turbidity units.
A-borehole, B-Otamiri, C-Nworie, D-tap water, E-rainwater

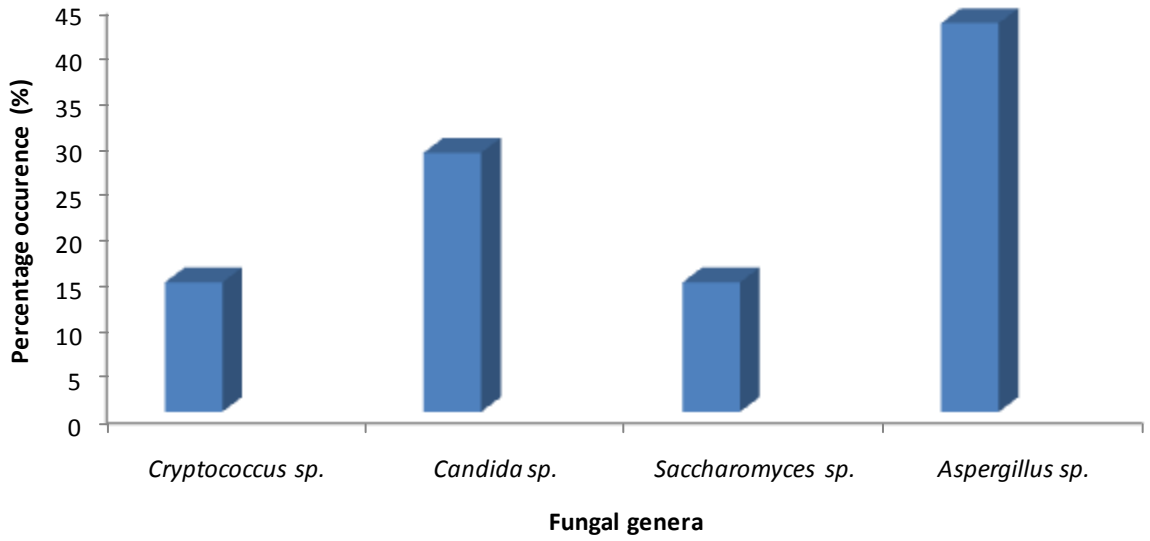


Figure 3. Overall percentage occurrence of different fungal genera isolated from water sources in Owerri metropolis, Nigeria.

DISCUSSION

The water sources in Owerri metropolis as analyzed have shown a best option in recent times for domestic usage. The borehole water source has the least bio-load and chemical components thereby making it the best source of water for domestic use among the water sources studied. This observation could be behind the high rate of sinking of borehole wells within Owerri metropolis in recent times. Its low bio-load could be attributed to the fact that it is a ground water and there is low infiltration of pollutants from the top soil downwards through capillary action (Chukwura, 2001; Edema *et al*., 2001). Rain water which is supposed to be the cleanest source of water by nature was the second best in the present study. The observed low bio-load of rain water could be due to the purification process that takes place during condensation while its relegation to second best could be due to incessant and reckless air pollution from diverse sources (Nwachukwu and otukunefor, 2006; Fapetu, 2000).

The WHO standard for domestic water supplies which recommends a 100 cfu/ml or less for total heterotrophic bacterial count and a zero coliform per 100ml of water was compared to results of this study (WHO, 2003). From the observed results, only borehole water source was acceptable while Otamiri River, Nworie Rivers, tap water and rain water sources were unacceptable for domestic and drinking purposes. This study affirms a previous study, which revealed that borehole water source has a good water acceptable quality, microbiologically (Nwachukwu and Otokunefor, 2006).

The high percentage occurrence of *Salmonella* species among other bacterial genera is a strong causal agent. The observed high percentage occurrence of *Salmonella* species in the studied water sources could be associated to high diarrhoea and typhoid infections that are routinely reported in the clinics within Owerri metropolis.

CONCLUSION

Physicochemical characteristics of the water sources in this study fall within WHO standards for domestic use whereas the observed bio-load of the water sources followed the order Otamiri River > Nworie River > tap water > rain water > borehole. Borehole was the best among the studied water sources. As inhabitants of Owerri metropolis glamour for improvement in public

water supply by public water supply authority, the findings of the present study have also shown that the improvement should as well include the quality of water distributed. Efficient distribution of portable water by public water supply authority used to be the pride of the metropolis in the past.

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