Research article

PHYSICOCHEMICAL AND BACTERIOLOGICAL ANALYSIS OF WELL WATER IN KADUNA METROPOLIS, KADUNA STATE

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Abstract

The study was carried out to determine the physicochemical and bacteriological quality of well water from Kaduna metropolis. The physiochemicalquality of the water was analyzed using FAO (1997a) method and the result obtained shows that the water sample was acidic, some neutral but they all fall within the range as recommended by WHO, and NAFDAC, the water sample fall within the recommended range for Nitrite, turbidity, conductivity and chloride. The bacteriological quality of the water was also determine by most probable number technique, the total coli-form count and the differential *E. coli* count in which several tubes with diluted buffered solution to dilute the water sample and then incubated for 24 hrs, this is called the presumptive test while for the confirmation test, positive tubes from the presumptive test were inoculated into separate growth medium for total coli-form and *E. coli* and then incubated. The results obtained shows that total coli-form were observed ranging from 11.0 to 63.0 cfu/ml with Sabon Tasha (TS) having the highest counts and Nasarawa (NS) with the least counts, while

only two site Sabon Tasha (ST) and Kakuri (KK) were recorded to have feacal contaminations*E-coli* was identified suggesting that the water samples rom the two werehaving recent feacal contamination. **Copyright © AJPPS, all rights reserved.**

Keywords: Physicochemical, bacteriological, analysis and well water.

Introduction

Water is the second essential factor for life after oxygen. If this essential factor is not available, some organisms die. Human beings are not excluded from this marvelous factor. People obtain their water from different sources and water is of paramount importance especially in developing countries where water supplies still pose an issue.Natural groundwater is usually of good quality, but this can deteriorate due to inadequate source protection and poor resource management. Mechanisms of groundwater recharge and the natural attenuation capacity also depends on soil type and geomorphologic characteristics. Groundwater contamination may be due to improper dwelling of well and waste disposal (Nkuma, 2010). Microbial and chemical contaminations have been detected in groundwater (Pritchard *et al*., 2010). The source of contamination are numerous and includes, land disposal of sewage effluents, sludge and solid waste, septic tank effluents, sludge and solid waste, septic tank effluent, urban runoff and agricultural mining and industrial practices.

The use of untreated and inadequately treated ground water has been responsible for water borne diseases including gastroenteritis, cholera, hepatitis, typhoid fever, and giardiasis; the causative agents are bacterial and viral pathogens as well as protozoan parasites. In contrast to chemical hazards that may pollute groundwater, resulting in a long range influence on public health in terms of time, microbiological pollution of groundwater sources has an immediate effect on a large number of people.Chemical pollutants can cause a different type of intoxication. The effects of inorganic chemicals are better known than those of trace levels of organic chemicals detected in groundwater. The list of groundwater contaminants includes hydrocarbons, metals, cyanide, arsenic various synthetic substances, soluble form of nitrogen and phosphorus, organic matter. Nitrate is one of the most common ground water contaminants in rural areas; it can enter the system from a variety of natural and anthropogenic sources (mainly fertilizer usage) nitrate is regulated in drinking water because high levels may cause serious illness and sometimes death, it also has the potential to cause shortness of breath, methemoglobinemia or blue baby disease, an increase in starchy deposits and hemorrhage at the spleen (Pritchard *et al*., 2010).Contamination of groundwater has severe implications for public health, particularly in small communities and developing countries where groundwater is often the preferred source of drinking water.Conformation with physiochemical and bacteriological standards is of special interest because of the capacity of water to spread disease within a large population. Although the standards vary from place to place, the

objective anywhere is to reduce the possibility of spreading water borne diseases to the breast minimum in addition to being present to drink which implies that it must be wholesome and palatable in all respects (Edema *et al*, 2000).Due to the increasing number of people in Kaduna state which is as a result of an increase in industries, schools (tertiary, secondary and primary schools), and vast land space for agricultural purposes, the role well water which is a major source of water cannot be over emphasized. Provision of this basic need have not been met by social bodies and government, thus the need for an alternative and groundwater or well water have been provided by nature which is as old as man himself.The physicochemical and bacteriological quality of water is a concern to consumers, regulators and public health experts. The potential of drinking water to transmit microbial pathogens to great number of people causing subsequent illness is well reported in many countries at all levels of economic development. Therefore, it is of paramount importance to assess both physical and bacteriological standard of well water in order to improve awareness and reduce the incidence of disease transmission.

Material and Method

Study Area

The study was conducted in Kaduna metropolis, Kaduna state, Nigeria. Kaduna state lies between latitude $9^0 30'0''$N and $11^0 0'0''$N and longitude $6^0 0'00''$E and $9^0 0'0''$E and shares boundrieswith Katsina, Kano and Zamfara States to the North, Plateau and Bauchi States to the East, Nasarawa State and Federal Capital Territory to the South and Niger State to the West.(KDSG, 2008).The metropolis may be demarcated by the intersection of longitude $7^0 32$E and latitude $10^0 36$N at an altitude of about 643m. The climate is characterized by a rainy season (about 6 months), followed by a dry and dusty harmattan season lasting from November to February. The rainy season is preceded by a short hot dry spell with mean maximum daily temperature of between 35^0C and 40^0C. Annual total rainfall is about 1,272mm and rain falls mostly from May to October (KDSG, 2008). Kaduna State has a population of over 6,066,562 people according to the 2006 census figures (KDSG, 2008). Agriculture is the main stay of the economy of the State with about 80% of the people actively engaged in animal and crop farming.

Sample Collection

Water samples were collected from twelve (12) different areas located within the metropolis using a 50cl sterile plastic container. The collected samples were analyzed within 6 hours of collection time.The method employed in the collection of samples is random sampling technique. Three (3) wells were randomly selected from each of the towns that make up the local government area. A formal introduction is made to the household owners as an undergraduate with

purpose of collection explained which is basically for research. With permission granted, water sample is drawn from the well into a sterile 50cl plastic container (Isa *et al*., 2013).

Physicochemical and Bacteriological analysis

The physicochemical quality of the well water sample was analyzed for pH, turbidity, conductivity, Nitrite and chloride as described by FAO (1997a).

Bacteriological characteristics of the well water sample were determined using multiple tube fermentation method (most probable number) for enumeration of both total coli-form count and differential *Escherichia coli* count.Lauryl Tryptose Broth (LTB) along withfermentation tubes (Durham tubes) was used. A serial dilution ofthe water sample to be tested was made and inoculated into LTBgrowth media. Samples were then incubated at 35°C for 48h forthe presumptive test for total coliform count. After the positive tubeswere transferred to Brilliant green lactose bile broth (confirmationtest) and incubated for 48h at 35°C, the growth or gas productionconfirmed the presences of coliform (Isa *et al*., 2013).

Results and Discussion

The physicochemical parameters of the water samples from the twelve (12) areas within Kaduna metropolis wereanalysed. The result as shown in Table 1 indicates that the pH ranges from 6.1 to 7.3 and the lowest was recorded at Sabon Tasha (ST) and highest pH at Riga Chuku (RC) and the pH level was within the standard of both WHO and NAFDAC, even as pH has to clear health implication to human health, but it action on physiological processes cannot be overemphasized (Bello *et al*., 2013). Water sample from Malali (ML) had the highest temperature of 33.1^0C.

The turbidity of the water sample was higher with a range of 3.4 to 4.8 at BarikinLahu (BL) and Mando (MD) respectively which are very close to the standard limit by WHO and NAFDAC of 5.0 this is indicating that the well water relatively turbid this may be due to parental rock activities, Water turbidity is very important because high turbidity is often associated with higher level of disease causing microorganism, such as bacteria and other parasites (Isa*et al*., 2013).Thepresence of TDS in water may affect its taste (WHO,1996). It has been reported that drinking water withextremely low concentration of TDS may beunacceptable because of its flat insipid taste (WHO, 2006; Isa, *et al*., 2013). And conductivity ranged from 183 to 197.Also, fluoride content of all water samples fellwithin the standard limit of WHO and NAFDAC (1.5 mg/l), likewisethe copper content of all the water samples used in thisstudy which is in agreement with WHO and NAFDAC standard of 1mg/l. Although, presence of copper above the standard set by NAFDAC may cause gastrointestinal distress with ashorter term exposure, while a long term exposure mayexperience liver or kidney damage (EPA, 2012). Likewise the Iron content of the water sample with

0.0 to 0.1 which is of relative concern while chloride and nitrite both ranged from 16.5 to 45.9 and 0.1 to 0.6 respectively, The implication of this might be as reported byMiller (1997), about 4500billion liters of contaminated water seeps into the ground in the United States every day from septic tanks, oil wells, landfills, agricultural and ponds holding hazardous waste Unfortunately, very little is known about the extent of groundwater contamination(Table 1).

Table 2 shows the bacteriological analysis of water from well within Kaduna Metropolis. The total coliform count within the twelve (12) different sites range from 11.0 to 63.0cfu/ml and with water from Kakuri (KK) and Sabon Tasha (TS) having the highest counts of 63.0 and 60.0 respectively, while water from Nasarawa (NS) recorded the lowest counts of 11.0 cfu/ml. The total coliform counts of all the water samples were generally high. They exceeded the standard requirement of 10 total coliform counts per 100 ml for NAFDAC and zero total coliform count per 100 ml for WHO (Isa *et al.*, 2013). The implication of this finding is that water from these wash well may look clean to naked eye andhave no unwanted odour or taste but contains pathogenic bacteria that can cause significant illness such as gastrointestinal, urinary tract infection (UTI) tract infections, which may even become fatal in severe condition. The results of this study correlate with the report of Yakubu*et al*. (2011) who showed that the water samples from well was highly contaminated with coliform bacteria. However, with the exception of water sample from Sabon Tasha (ST) and Kakuri (KK) which had the fecal coliform count of 2.0 and 1.0 cfu/ml respectively this indicated recent faecal contamination and might be due to the close proximity of the well to commercial toilet as is seen at Sabon Tasha (TS), but all the remaining samples have zero fecal coliform count, which indicate that the water samplesare free from recent faecal contamination.

Table 1. Physicochemical analysis of well water from Kaduna metropolis.

S/N	Parameter	ST	NY	KY	B N	KK	NS	UR	ML	BD	MD	BL	RC	WHO	NAFDAC
1.	pH	6.1	6.8	6.5	7.2	6.5	7.1	7.1	6.6	7.0	6.7	7.1	7.3	6.5-8.5	6.5-8.5
2.	Temperature (^{0}C)	30.0	31.0	30.2	31.5	30.5	31.1	29.8	33.1	30.7	30.6	31.1	30.9	40.0	Ambient
3.	Turbidity (ntu)	4.7	4.6	4.6	4.3	4.1	3.8	3.7	3.9	3.8	4.8	3.4	4.1	5-25	0-5
4.	Conductivity (µs/cm)	183	188	191	191	196	197	190	188	187	190	194	191	250	1000
5.	Chloride mg /L	37.5	40.9	41.9	25.9	28.3	20.2	22.5	45.9	49.2	16.5	21.8	30.9	250	250

6.	Nitrite mg/L	0.6	0.6	0.6	0.4	0.4	0.4	0.1	0.1	0.5	0.5	0.5	0.5	5.0	4.0
7.	Iron mg/L	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.1
8.	Copper mg/L	0.44	0.34	0.50	0.33	0.45	0.40	0.60	0.60	0.58	0.29	0.30	0.69	1.0	1.0
9.	Total dissolved solid(TDS) mg/L	455	600	560	666	609	700	546	768	749	608	709	688	1500	500

Sabon Tasha- (ST)
Narayi- (NY)
Karji (KJ)
Barnawa (BN)
Kakuri (KK)
Nasarawa (NS)
UngwarRimi (UR)
Malali (ML)
Badarawa (BD)
Mando (MD)
BarkinLahu (BL)
Riga Chuku (RC)

Table 2: Bacteriological analysis of well water from Kaduna Metropolis

Sample Sites	Total coli form count	Differential *E. coli* count
Sabon Tasha (ST)	63.0	2.0
Narayi (NY)	25.0	N.D
Karji (KJ)	22.0	N.D
Barnawa (BW)	35.0	N.D
Kakuri (KK)	60.0	1.0
Nasarawa (NS)	11.0	N.D
UnguwarRimi (UR)	23.0	N.D

Malali (ML)	30.0	N.D
Badarawa (BD)	32.0	N.D
Mando (MD)	20.0	N.D
BarkinLahu (BL)	25.0	N.D
Riga Chukwu (RC)	18.0	N.D
WHO standard	0 per 100ml	0 per 100ml
NAFDAC standard	10 per 100ml	0

ND= Not detected

Conclusions

The importance of water in sustenance of life fascinating the attention of governmental and non- governmentalorganizations such asWHO and NAFDAC to establish the standard of the drinking water quality. The importance of access to good quality water cannot be overemphasized. Increase in population in Kaduna Metropolis coupled with the rise in human activity pose a great pressure onprovision of safe drinking water. This necessitates large number of people to consume water from wellswhich constitute a major health problem due to close proximity of wells to either source of contaminations. This study recorded high number of coliform counts in water samples analyzed, thus making it unsafe for drinking and require further treatment. Therefore, there is an urgent need for awareness to be created about the present situation of these wells; peoples should to enlighten the peopleon the necessity for further treatment of this water beforethey can be used for drinking and domestic purposes and wells should be drilled some meters far away from any source of contaminations.

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