THE QUALITY OF DRINKING WELL WATERS IN JOS METROPOLIS, NORTH CENTRAL NIGERIA.

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Abstract:

Background: *Water quality is a term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose. Water is said to be polluted if there is an excess, whatsoever, in the values (concentration levels) of the physical, chemical, biological or radioactive properties that have a negative effect on human health.*

Methodology*: Twenty different Areas within Jos Metropolis were selected by simple random sampling for the research, Samples of water were drawn from wells in these areas in duplicate through simple random sampling selection of the wells giving a total of forty different sampled waters and the physical, chemical and biological analysis of the water was done using standard methods.*

Result*: All the wells had turbidity greater than the acceptable value of not more than 5.0 NTU with 19(47.5%) wells having values as high as 20-29 NTU and 2(5%) wells with values of 40-49 NTU. The PH level for all the wells were within the normal range but the nitrite above the normal range in most (82.5%) of the wells except in 7(17.5%) wells that had values between 0.01-0.02mg/L. The coliform count was found to be high in all the sampled water with 33(82.5%) wells having values as high as 5-9 coliform count per 100mls of water.*

Conclusion*: Water-related diseases continue to be one of the major health problems globally. Drinking water quality must be within tolerable use-limits for human consumption. In the study conducted, it was obvious that all the wells did not meet the standard requirement for quality drinking water since all the wells had coliform count above the recommended value for Standard Organization of Nigeria(SON), National agency for food drug administration and control(NAFDAC) and World Health Organization(WHO).*

Introduction

In addition to natural contaminants, ground water is often polluted by human activities such as Improper use of fertilizers, animal manures, herbicides, insecticides, and pesticides Improperly built or poorly located and/or maintained septic systems for household waste water, leaking or abandoned underground storage tanks and piping, Storm-water drains that discharge chemicals to ground water, improper disposal or storage of wastes Chemical spills at local industrial site.[1,]

In general, water quality issues are chronic, which means they have existed over a long period of time or reoccur seasonally, and are likely to continue if nothing is done to correct them[.2]

Water-related diseases continue to be one of the major health problems globally. An estimated 4 billion cases of diarrhea annually represented 5.7% of the global disease burden in the year 2000[-3]

Chemicals pollute water supply through industrial process and agrochemical applications while physical contaminants result from erosion and disposal of solid wastes[.4,5]

These sources contribute to degradation of quality and standard of drinking water thereby degenerating into prohibitive water pollution situations, consequently water borne diseases such as typhoid; cholera, diarrhea and dysentery become potentially communicable. Quality of drinking water must be within tolerable use-limits for human consumption. Water taste, color, odour, SAR, pH and salinity (EC) status must satisfy recommended drinking water standards[.6,7]

The sources of drinking water in Jos metropolis are mainly pipe born water and well water but with the erratic supply of pipe born water, well water has been the major source of water for most homes within the metropolis.

The study aimed to determine the quality of drinking water from the wells in Jos metropolis.

Methodology:

Study Area:
The study was carried out in Jos metropolis which comprises of Jos the capital city and its environs. Plateau state is located between latitude 80°24'N and longitude 80°32' and 100°38' east. The altitude ranges from around 1,200 meters (about 4000 feet) to a peak of 1,829 metres above sea level in the Shere Hills range near Jos. With a higher altitude than most of the other parts of the country, Plateau State has a near temperate climate with an average temperature of between 18 and 22°C. Harmattan winds cause the coldest weather between December and February. The warmest temperatures usually occur in the dry season months of March and April. The mean annual rainfall varies from 131.75 cm in the southern part to 146 cm on the Plateau. The highest rainfall is recorded during the wet season months of July and August. Plateau State is subdivided into seventeen Local Government Areas (LGAs). The state has over forty ethno-linguistic groups. Each ethnic group has its own distinct language, but as with the rest of the country, English is the official language in Plateau State; Hausa has gained acceptability as a medium of communication. Most are civil servants or farmers, other professions include petty trading, students and housewives. There are some few industries and factories in the state. The citizens of the State are between middle and low income earners.[8]

Data collection:
Twenty different Areas within the Metropolis were selected by simple random sampling for the research, they are Aba Nashehu, Ahowl, Alikazaure, Angwan Rogo, Ibrahim Katsina, Jenta Adamu, Gangere, Garba Daho, Jenta Apata, Jos Jarawa, Kabong, Lamigo, Mazah, Naraguta A, Naraguta B, Sarkin Arab, Targwangl Rigiza, Tudun Wada, Tafawa Belewa and Vanda piye.

Samples of water were drawn from wells in these areas in duplicate through simple random sample selection of the wells giving a total of forty different samples of water and the water was analyzed. Additional information was collected through an interviewer administered questionnaire.

Data Analysis:
The physical properties such as colour was determined by APHA platinum-cobalt standards, water turbidity was determined by Nephelometric method, water PH was determined using the Electrode method, while the chemical properties like Nitrate was determined by cadmium Reduction method, Nitrogen Nitrite by the diazolization method, Sulphate by Turbidimetric method, dissolved oxygen by modified Azide- Winkler method, Phosphate by Ascorbic Acid method and Chlorine by DPD method. The biological properties such as the coliform count were determined using the most probable number method. The results were presented using frequency tables.

Result: The results are presented in tables below based on the physical, chemical and biological properties of the water samples collected in different parts of the metropolis.

All the wells had turbidity greater than the acceptable value of not more 5.0 NTU with 18(45%) wells having values of 10-19 NTU, 19(47.5%) wells having values as high as 20-29 NTU,1(2.5%) well had a value of 30-39 NTU and 2(5%) wells with values of 40-49 NTU. The water samples from all the wells had colours within the normal range, 12(30%) wells had colour range of 0.01-0.1 TCU while 1(2.5%) wells had colour ranging from 0.5-0.6 TCU. The PH level for all the wells were within the normal range.

The nitrite level was found to be above the normal range in most (82.5%) of the wells except in 7(17.5%) wells that had values between 0.01-0.02mg/L. The sulphate level in all the sampled water from all the wells were within the normal range, 5(12.5%) well had sulphate level of 10-19mg/L and 35(87.5%) had range of 20-39mg/L.

The coliform count was found to be high in all the sampled water with 7(17.5%) well having a coliform count of 1-4 coliform per 100mls of water and 33(82.5%) wells having values as high as 5-9 coliform count per 100mls of water as against the zero recommended level.

Tables showing the results of the physical, chemical and biological properties of the well water samples from the different areas in metropolis Jos.

Table 1: Physical Properties of the well water samples

TURBIDITY	RANGE (NTU)	NUMBER OF WELLS
	10-19	18(45%)
	20-29	19(47.5%)
	30-39	1(2.5%)
	40-49	2(5%)
COLOUR	**RANGE (TCU)**	**NUMBER OF WELLS**
	0.01-0.1	12(30%)
	0.11-0.2	9(22.5%)
	0.21-0.3	8(20%)
	0.31-0.4	6(15%)
	0.41-0.5	4(10%)
	0.51-0.6	1(2.5%)

PH	RANGE	NUMBER OF WELLS
	5.0-5.4	4(10%)
	5.5-5.9	4(10%)
	6.0-6.4	11(27.5%)
	6.5-6.9	18(45%)
	7.0-7.4	3(7.5%)

TABLE 2: ChemicalProperties of the well water samples

NITRATE	RANGE(mg/L)	NUMBER OF WELLS
	4.0-4.9	1(2.5%)
	5.0-5.9	6(15%)
	6.0-6.9	33(82.5%)
NITRITE	0.01-0.02	7(17.5%)
	0.03-0.04	25(62.5%)
	0.05-0.06	7(17.5%)
	0.07-0.08	1(2.5%)
SULPHATE	RANGE(mg/L)	NUMBER OF WELLS
	10-19	**5(12.5%)**
	20-39	**35(87.5%)**
DISSOLVED OXYGEN	RANGE	NUMBER OF WELLS
	5-9	15(37.5%)
	10-14	25(62.5%)
PHOSPHATE	RANGE(mg/L)	NUMBER OF WELLS
	0.5-0.9	33(82.5%)
	1.0-1.4	5(12.5%)
	1.5-2.0	2(5%)
CHLORINE	RANGE(mg/L)	NUMBER OF WELLS
	0.1-0.4	27(67.5%)
	0.5-0.9	13(32.5%)

TABLE 3: Biological Properties

CALIFORM COUNT	RANGE (MPN/100ml)	NUMBER OF WELLS
	1-4	7(17.5%)
	5-9	33(82.5%)

Discussion:

The great majority of evident water-related health problems are the result of microbial (bacteriological, viral, protozoan or other biological) contamination. Nevertheless, an appreciable number of serious health concerns may occur as a result of the chemical contamination of drinking-water[5,9]

Turbidity: The result showed that the turbidity for all the sampled waters was on the high side ranging between 10 to 49 NTU as against the acceptable level of not more than 5.0 NTU. Turbidity in drinking-water is caused by particulate matter that may be present from source water as a consequence of inadequate filtration or from re-suspension of sediment in the distribution system. It may also be due to the presence of inorganic particulate matter in some ground waters or sloughing of bio-film within the distribution system. Particulates can protect microorganisms from the effects of disinfection and can stimulate bacterial growth. In all cases where water is disinfected, the turbidity must be low so that disinfection can be effective[5,9,10]

Colour

The result which was in the range of 0.01to 0.6 TCU showed that it was within the normal range of 0 to 15 TCU by WHO standard. Drinking-water should ideally have no visible colour. Colour in drinking-water is usually due to the presence of coloured organic matter (primarily humic and fulvic acids) associated with the humus fraction of soil. Colour is also strongly influenced by the presence of iron and other metals, either as natural impurities or as corrosion products. It may also result from the contamination of the water source with industrial effluents and may be the first indication of a hazardous situation[4,5,10]

Ph

From the result, 19 wells had values below the WHO and SON with values ranging from 6.50 to 8.5 and 6.50 to 9.50 respectively. Although pH usually has no direct impact on consumers, it is one of the most important operational water quality parameters. It is usually in the range 6.58. For effective disinfection with chlorine, the pH should preferably be less than 8; however, lower-pH water is likely to be corrosive[5,10]

Chemical Properties

The health concerns associated with chemical constituents of drinking-water differ from those associated with microbial contamination and arise primarily from the ability of chemical constituents to cause adverse health effects after prolonged periods of exposure.

Nitrate/Nitrite

Nitrate concentration above the recommended value of 10 mg/L is dangerous to pregnant women and poses a serious health threat to infants less than three to six months of age because of its ability to cause methaemoglobinaemia or blue baby syndrome in which blood looses its ability to carry sufficient oxygen [11,12] while Nitrite according to NAFDAC and SON standard should not exceed 0.002mg/L. Results from this study shows a nitrite level above the recommended by NAFDAC and SON in 33 wells and above 0.006 in one well.

Sulphate

The result showed that sulphate was within the range set by NAFDAC, SON, and WHO which are 100mg/L, 100mg/l and 250mg/L respectively[10]

The presence of sulphate in drinking-water can cause noticeable taste, and very high levels might

cause a laxative effect in unaccustomed consumers. Taste impairment varies with the nature of the associated cation; taste thresholds have been found to range from 250mg/litre for sodium sulphate to 1000 mg/litre for calcium sulphate. It is generally considered that taste impairment is minimal at levels below 250 mg/litre. No health-based guideline value has been derived for sulphate.[4,5]

Dissolved Oxygen

Threshold for DO is 5.0 mg/L for drinking water and should be more than 5 mg/L for agricultural purposes. Very low DO may result in anaerobic conditions that cause bad odors. The result shows a DO level that is normal and acceptable for drinking.[10,13]

Phosphate

The findings indicated that the level was within the normal acceptable limit of 0-3mg/L.

Health hazards from algal toxins are primarily associated with overgrowth (bloom) events. Algal blooms may develop rapidly and be of short duration; they are generally seasonal and are frequently associated with the presence of nutrients, particularly phosphate. Groundwater may contain high concentrations of radon and its daughters in areas where bedrock naturally contains high levels of radioactivity. This includes areas with granitic rocks, and sediments with phosphate nodules or heavy mineral sand deposits.[5,10]

Microbial Properties

The analysis of the sampled water showed that all the sampled well waters had microbiological parameters above the standard of WHO as they all had values above 0 in 100ml of water.

The most common and widespread health risk associated with drinking-water is microbial contamination, the consequences of which mean that its control must always be of paramount importance. Priority needs to be given to improving and developing the drinking water supplies that represent the greatest public health risk. Microbial contamination of major urban systems has the potential to cause large outbreaks of waterborne disease. Ensuring quality in such systems is therefore a priority.[5,9,10]

Infectious diseases caused by pathogenic bacteria, viruses and parasites (e.g., protozoa and helminths) are the most common and widespread health risk associated with drinking-water. The public health burden is determined by the severity of the illness (es) associated with pathogens, their infectivity and the population exposed.[5,9]

High coliform counts appear to be characteristic of rural ground water quality in Nigeria, which is consistent with the findings of others on bacteriological and chemical characteristics of rural water supplies in other parts of the country.[12,14,15]

Conclusion

Water is essential for life and at the same time a lot of diseases that affect man can be prevented by about 70% if potable water is provided. Water that does not meet the standard for quality water is most likely to pose a health problem to the population. From the study done, it can be said that the well water in Jos metropolis does not have the quality of a portable drinking water and can therefore constitute a health hazard to the population.

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