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Quality Assessment of Well Water from some Private Households in Fabian Hotels Area of Ado Ekiti (Ekiti State, Nigeria) Metropolis

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Abstract

Water is indispensible and one of the most abundant renewable natural resources. Without water, biological life may not survive.This study investigated some physicochemical, microbial and elemental properties of water from hand dug, ringed and covered water wells in Ten (10) different private households at Fabian hotels area of Ado Ekiti, Ekiti State, Nigeria. The water samples were analysed for pH, water hardness, total solids, ammonia nitrogen, dissolved oxygen, total bacteria count, coliform count and some mineral elements.

pH of the well water samples ranged from 6.8-7.2 while the temperature was 25-27^{0}C. The samples odour and taste were unobjectionable while the colour was 5.0 NTU. Dissolved oxygen was 129-143 mg/l, total solids 146-216 mg/l. Total alkalinity was 07-21 mg/l and chloride content was 54– 98 mg/l. Ammoniacal nitrogen was not detected in the water samples and total acidity was 12-21 mg/l.

Results of microbial analysis indicated that there was no gas producing organism in any of the water samples, coliform bacteria was not detected, while total plate count ranged between 2-4 cfu/ml.

Elemental analysis showed that lead, chromium, cadmium, mercury, nickel, arsenic and copper were not detected in any the water samples. Zinc ranged from 0.1-1.2 ppm, calcium ranged between 68-86 ppm while magnesium was between 34- 68 ppm.

These results imply that these water samples were within WHO minimum standards for potable water, hence, they can be used for domestic or other applications.

Keywords: Quality, availability, contamination, health.

Introduction

Water is an important constituent of life. The necessity of water for drinking and its wide distribution globally has made its study to be very important for domestic and industrial applications. Water is one of the most important and abundant renewable resources, essential for sustaining all forms of life, food production, economic development and for general well-being [1; 2; 3]. About 97% water exists in oceans and may not be suitable for drinking,only 3% is fresh water, wherein 2.97% is comprised of glaciers and icecaps, while the remaining little portion of 0.3% is available as surface and ground water for human. It is impossible to substitute for most of its uses, difficult to de- pollute, expensive to transport, and it is truly a unique gift to mankind from nature. Water is also one of the most manageable natural resources as it is capable of diversion, transport, storage, and recycling. All these properties impart to water its great utility for different applications and utilization [4; 5; 6].

Safe drinking water is a basic need for good health and is also a basic right. Fresh water is already a limiting resource in many parts of the world. In the next century, it will become even more limiting due to increasing population, urbanization and climate change [1; 7]. Unfortunately, according to recent estimates, the quantity of available water in developing regions of the world is decreasing sharply while water quality is deteriorating rapidly in recent times.

Safe drinking water for human should be free from pathogens such as bacteria, viruses and protozoan parasites,it must meet the standard guidelines for taste, odour, appearance and chemical concentrations, and must be available in adequate quantities [8; 9]. However, inadequate sanitation and persistent contamination of water sources is responsible for a large percentage of people in both developed and developing countries not having access to safe drinking water and suffering from water bornediseases [10; 11]. Diarrhoea is responsible for approximately 2.5 million deaths annually in developing countries, affecting children younger than five years, especially those in areas devoid of access to potable water supply and generally poor sanitation [12; 13; 14].

Water should be free of tastes and odour that would be objectionable to the majority of consumers. In assessing the quality of drinking water, consumers rely principally upon their senses. Microbial, chemical and physical water constituents may affect the appearance, odour or taste of the water, and the consumer will evaluate the quality and acceptability of the water on the basis of these criteria. Although these substances may have no direct health effects, water that is highly turbid (highly coloured), or has an objectionable taste or odour may be regarded by consumers as unsafe and may be rejected [9; 15; 16].

In extreme cases, consumers may avoid aesthetically unacceptable but otherwise safe drinking water in favour of more pleasant but potentially unsafe sources. Changes in the normal appearance, odour or taste of a drinking water supply may signal changes in the quality of the raw water source or deficiencies in the treatment process and should be investigated.

Materials and methods

Materials and sample collection

2L glass sampling bottles were obtained from BISO Lab in Ado-Ekiti. A plastic bucket fetcher and thin trawling rope were procured from Oja Oba market in Ado Ekiti. The rope was attached to the bucket fetcher. The sampling bottles were coded, wrapped with aluminum foil with the lids and sterilized in an autoclave at 121^0C for 15 minutes. The plastic fetcher and rope was heated for 15 minutes at 100^0C in an oven and then allowed to cool.

The households were identified and visited pre-sampling. The well water samples were collected in triplicates early in the morning within 2 hours, using the same bucket fetcher. The plastic bucket fetcher with the attached ropes was washed and rinsed thoroughly with de-ionised water after each sample collection.

All the water wells in the identified households were ringed and covered, and had not been chemically treated within the last three months pre-sampling. The well water samples were collected in the month of February, well before the start of the raining season in Nigeria.

Table 1.Sample coding

Sample Code	Household name
01	Victory ville
02	Ajayi house
03	Iyaceleplace
04	Ogo-Oluwa lodge
05	Alade palace
06	Karounwi house
07	Ghettolodge
08	Boys lodge
09	Finest place
010	Praise house

Sample treatment

The water samples for elemental analyses were treated as described [17; 18; 19]. Samples were treated with 5mL concentrated nitric acid (Analar grade) per litre and 100mL aliquots of the samples were mixed with 15mL mixture of nitric and sulphuric acids (Analar grade). The mix was heated on an electric hot plate, allowed to cool and filtered using micro filters (0.45µm). The filterate was then made up to 100mL with deionised water. The digest was used for elemental analysis.

Sample analysis

Temperature and pH evaluation was done immediately on site after each sample collection. The temperature was evaluated using a field hand held thermometer while the pH was evaluated using Metroph pH meter (Model E520). Sample for microbial evaluation was evaluated within 3

hours post sample collection, while all physicochemical analysis was carried out within 5 days post well water sampling.

Colour, taste, turbidity and odour of the water samples were determined immediately on sample arrival in the laboratory using methods as described [20]. Total and dissolved solids were done using gravimetric methods as described [9; 21]. The chloride content determination was evaluated using $AgN0_3$ as the precipitant. Total alkalinity, acidity and water hardness were done using titrimetric methods as described [20; 21]. Ammonia nitrogen and dissolved oxygen content were evaluated as described [21]. Sulphate content was determined using turbidimetry method while spectrophotometric method was used in nitrates determination [19; 21].

Elemental analysis was done as described [17] using Perkin Elmer (Model 200) atomic absorption/emission spectrophotometer after digestion of the water samples.

Total viable count was determined as described by Pelczar*et al*., [22] and Adegoke [23] using total count agar, presumptive coliform test was done using macconkey broth agar while coliform count was carried out using eosin methylene blue agar [23].

Data analysis

All experimental analysis was done in triplicates. The average of the triplicate determination was taken as the representative results.

Results and discussion

Results

Physicochemical properties of well water in some private households in Fabian hotels area of Ado Ekiti, Ekiti State, Nigeria.

Table 2 shows the physicochemical properties of some well water in Fabian area of Ado Ekiti metropolis.

Table 2.Physico-chemical properties of well water from some private households in Fabian hotels area of Ado Ekiti, Ekiti State, Nigeria

Water sample										
Parameter	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**010**
pH	6.7	6.8	7.0	7.2	7.2	7.0	7.1	6.9	6.9	7.0
Colour (NTU)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Turbidity (HU)	5.0	4.0	5.0	5.0	4.0	5.0	4.0	5.0	4.0	5.0
Odour	Uo	Uo	Uo	Uo	Uo	Uo	Uo	Uo	Uo	Uo
Taste	Uo	Uo	Uo	Uo	Uo	Uo	Uo	Uo	Uo	Uo
Temperature (^{0}C)	28	25	26	28	27	27	26	27	25	25
Acidity (mg/l)	38	46	44	42	55	29	48	52	42	54
Alkalinity (mg/l)	24	32	27	28	32	36	34	36	32	32
Total Solids	166	202	208	216	208	186	170	186	174	186

(mg/l)										
T. Sus. solids (mg/l)	134	168	152	148	152	166	144	138	128	142
T. Diss. solids (mg/l)	311	379	378	366	366	329	320	332	310	334
Amm. Nit (mg/l)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Dissolved 0_2 (mg/l)	153	144	149	160	168	188	168	170	164	168
Phosphates (mg/l)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Hardness (mg/l)	28	65	44	46	55	48	36	42	48	52
Chlorides (mg/l)	64	59	68	68	68	74	70	68	62	64
Nitrates (mg/l)	0.2	0.3	0.2	0.3	0.3	0.1	0.2	0.3	0.1	0.2
Sulphates (mg/l)	0.2	0.3	0.2	0.4	0.3	0.2	0.2	0.3	0.2	0.3
Res. Chl (mg/l)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Uo-Unobjectionable

All the well water samples had unobjectionable odour and taste while the colour was 5.0 NTU. pH of all the analysed water samples ranged from 6.7-7.2. This pH range is considered adequate for drinking water. pH of water was earlier suggested to be influenced by the dissolution of acidic gasses from the atmosphere by rain, the subsequent percolation to ground water in turn, influences groundwater pH [1; 9; 16]. Water alkalinity ranges from 24-36 mg/l, below recommended limits [11]. Water alkalinity is the ability of water to neutralize acids [7; 11]. Dissolved oxygen was very high in all the samples (144-188 mg/l) indicating that the water samples are fresh and well aerated, and does not contain any oxygen depleting organisms [9; 24]. Nitrates was low (0.1-0.3 mg/l) while ammonia nitrogen were not detected in any of these samples which is indicative of the absence of decaying materials. High nitrate content of domestic water is mostly attributed to the presence of decaying plant and animal materials and may also imply sewage contamination of water [7; 10], it can also be deduced that relatively high nitrate values may be due to leaching from sewages, pit latrines and refuse dump located close to wells. Phosphates was not detected in any of the samples.

Water hardness ranged from 24-65 mg/l, hard water is known to cause scale formation, which might be a source of problems in boilers, with the attendant risks of scale formation [7; 12; 14]. Residual chlorine was not detected in any of the samples, implying that all the wells had not been previously treated with chlorine. In literature, chlorine is a common water disinfectant [3; 7; 9].

The results obtained for the physicochemical properties of these water samples were largely within the WHO standard for potable water. These results are similar to previous studies as reported by Okunade*et al* [9; 25; 26], Adesina and Akinyele[18] for packaged water, and well water supplies in private households, and for some spring water in Ado Ekiti, Ekiti State, Nigeria respectively.

Mineral elements in well water from some private households in Fabianhotels area of Ado Ekiti, Ekiti State, Nigeria

Table 3 depicts the mineral content of well water samples from Fabian hotels area, Ado Ekiti. Lead, chromium, cadmium, mercury, nickel, arsenic and copper were not detected in all the water samples. Zinc content ranged from 0.2-0.8 ppm while magnesium ranges from 58-78 ppm. Zinc is known to have gastro-intestinal effects on human at a higher concentration and can cause liver damage [11; 27]. Magnesium is known as an activator of many enzymes systems, it also assists in maintaining the electric potentials in nerves[27; 28]. Calcium ranges 72-106 ppm, below WHO limit of 200 ppm. Calcium in conjunction with other minerals (phosphorous, magnesium, manganese etc) and protein, are all involved in bone formation and is also important in blood clothing, muscle contraction and in certain enzymes metabolic processes [28]. Iron ranges from 0.02 to 0.06 ppm, while sodium ranges from 60-88 ppm. Sodium is required to maintain the osmotic balance of the body fluids, pH of the body, regulate muscle and nerves irritability and control glucose absorption [27; 28]. Sodium has the tendency of affecting the taste of water meant for consumption when its concentrations are above the threshold limits. Aluminum content was 0.02-0.06 ppm. Manganese ranges between 0.08 and 0.2 ppm in the water samples, well below the guideline value of0.50 ppm. Large quantity of manganese influence staste in water and encourages the growth of bacteria; though not hazardous but are very unpleasant[27].

Table 3.Mineral elements in well water from some private households in Fabianhotels area of Ado Ekiti, Ekiti State, Nigeria

Water sample										
Metals (Ppm)	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**010**
Pb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fe	0.04	0.06	0.03	0.02	0.02	0.04	0.02	0.03	0.02	0.04
Ar	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cr	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Al	0.06	0.04	0.04	0.06	0.02	0.04	0.02	0.04	0.04	0.02
Cu	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mg	68	71	78	64	58	64	66	68	64	68
Zn	0.2	0.4	0.6	0.8	0.6	0.4	0.2	0.4	0.4	0.6
Ca	106	94	88	90	72	87	92	88	96	98
Na	60	62	68	82	86	88	78	84	74	78
K	33	35	46	65	54	68	42	62	42	42
Mn	0.1	0.08	0.08	0.14	0.2	0.2	0.1	0.1	0.1	0.2
Cd	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ni	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND: Not detected

Generally, all the water samples had low mineral contents below WHO stipulated limits hence, these water samples may not constitute health risks to consumers and the general public.

Microbial properties of well water from private households in Fabian hotels, Ado Ekiti, Ekiti State, Nigeria

Table 4 shows the result of microbial parameters of well water samples from Fabian hotels area in Ado Ekiti town. The total plate count ranged between 3-5 Cfu/ml, which is within WHO acceptable limits (10^2cfu/ml). Presumptive test was negative in all the tested water samples, indicating that all the samples had no gas producing organisms. Coliform bacteria was not detected in any of the water samples, implying that the water samples had no faecal contamination, which is acceptable for human domestic use[11; 29].

Table 4.Microbial properties of well water from some private households in Fabianhotels area of Ado Ekiti, Ekiti State, Nigeria

Water sample										
Parameter (Cfu/ml)	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**010**
Tot. viable count	4	4	4	3	3	5	3	4	3	4
Presumptive test	-Ve	-Ve	-Ve	-Ve	-Ve	-Ve	-Ve	-Ve	-Ve	-Ve
Coliform count	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

-Ve-Negative

The total viable count in treated drinking water is a measure of its general sanitary quality whereas the indication of faecal contamination in water is measured by the presence of faecal coliforms [30]. WHO/NIS/SON limit for coliform organisnsis that none should be detected in drinking water [3; 11; 30].This clearly indicated that the well water are of good microbiological quality, and thus suitable for human consumption.

Conclusion

Globally, water bodies is increasingly being contaminated by indiscriminate dumping of waste, coupled with rapid industrialization and population growth.

The vast majority of rural communities, particularly in the underdeveloped regions of the world are poverty stricken, lack access to potable water supplies, and mostly rely on water sources such as rivers, streams, ponds, springs and boreholes for their daily water needs. Water from these sources is used directly by the inhabitants and the water sources may usually be contaminated, with resultant associated health risks and its dire implications. In most underdeveloped countries, access to potable water is getting more and more difficult, hence the need to ensure that public water is free from potential contaminants.

From the result obtained, it can be concluded that the physiochemical properties of these samples was within the minimum acceptable limits for potable water as stipulated by WHO.

However, a few of these water wells may need to be properly treated, in order to ensure safety of consumers or users. Adequate water treatment ensures that domestic water supplies are free from pathogenic organisms.

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