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Quality of Well Water in Ede Area, Southwestern Nigeria

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ABSTRACT This study examined the chemical composition /quality of Well water in Ede Area of Southwestern Nigeria with a view to determine their suitability for human consumption. The pH, total dissolved solids (TDS) and cations concentration such as calcium (Ca^{2t}), sodium (Na^{+}), magnesium (Mg^{2+}) and potassium (K^{+}) of 21 well water samples were determined using pH meter, Electronic Conducting (EC) meter and Atomic Absorption Spectrometer respectively. The results of this study shows that potassium (K^{+}) was the most abundant dissolved cation in the well water sampled in the area. All the dissolved cations such as Ca^{2t}, mg^{2+} Na^{+} K^{+} and generally conformed with the recommendation of W.H.O maximum limits. However, since most of the inhabitants of the area depend on well water supply for drinking, the authors of this study recommended that waste disposal facilities should be sited in the outskirts of the towns.In this regard, the site of the well should be at least thirty meters away from any source of contamination.

INTRODUCTION

Water is essential for growing food., for household water uses including drinking, cooling, sanitation., as a critical input into industry, for tourism and cultural purposes., and for its role in sustaining the earth's ecosystem (Mark et al., 2002). In addition to water value for direct human consumption, it is integrally linked to the provision and quality of ecosystems service. Domestic water is used for drinking, cooking, bathing and cleaning,

However, access to safe drinking and sanitation is critical in terms of health especially for children. For instance, unsafe drinking water contributed to numerous health problems in developing countries such as the one billion or more incidents of diarrhea that occur annually (Mark et al., 2002)

Several studies exist on the relationship between ground (well) water quality and rock types in many parts of the world (e.g Kawamura, et al., 1942; Davis and De Wiest, 1961; Aseez, 1971; Handa, 1975; Johnson, 1975., Freeze and Cherry, 1979; Okufarasin, 1984 and Adediji, 1990). But, however, there is little work on the suitability of well water for human consumption in this part of the world. In fact, due to inadequate supply of pipe –borne water in towns and cities in Nigeria, many people have been sourcing their daily water need from wells. Thus, the main objective of this is to determine the suitability or otherwise of the quality of well water in Ede Area of southwestern Nigeria by comparing the chemistry of the water with WHO drinking water standards.

STUDY AREA

Ede and some of its suburb towns such as Irageri, Awo and Iwoye constitute the study area. The study area lies between Lat 7°42'N and 7° 47'N and Long.4°21 and 4°27' East of Greenwich Meridian (see Fig.1)

The study area is underlined by six rock types (see Geological Map of Iwo on a scale 1:250000, 1966). These rocks types include pegmatite (P) and Schist, Pegmatised (Sp) at Ede, Gneiss and Migmatite, undifferentiated (M) and Porhyroblastic gneiss (OPg) at Iragberi, Charnockitic metal intrusive (CL/M) at Awo and Quartzite and quartz-schist (Q) at Iwoye.

Based on 1991 Population Census, the population of the area was put at 386250. Most of the inhabitants of the area engaged in subsistence farming and trading.

STUDY METHOD

Before the reconnaissance survey of the study area was carried out, we decided to select five hand-dug wells from each of six rock types in Ede area. But , when the pilot survey of the area was carried out, it was found out that only a well was available on quartzite and quartz schist at Iwoye and /non was available on charmockite metal intrusive at Awo,

In this regard, a total of twenty-one hand-

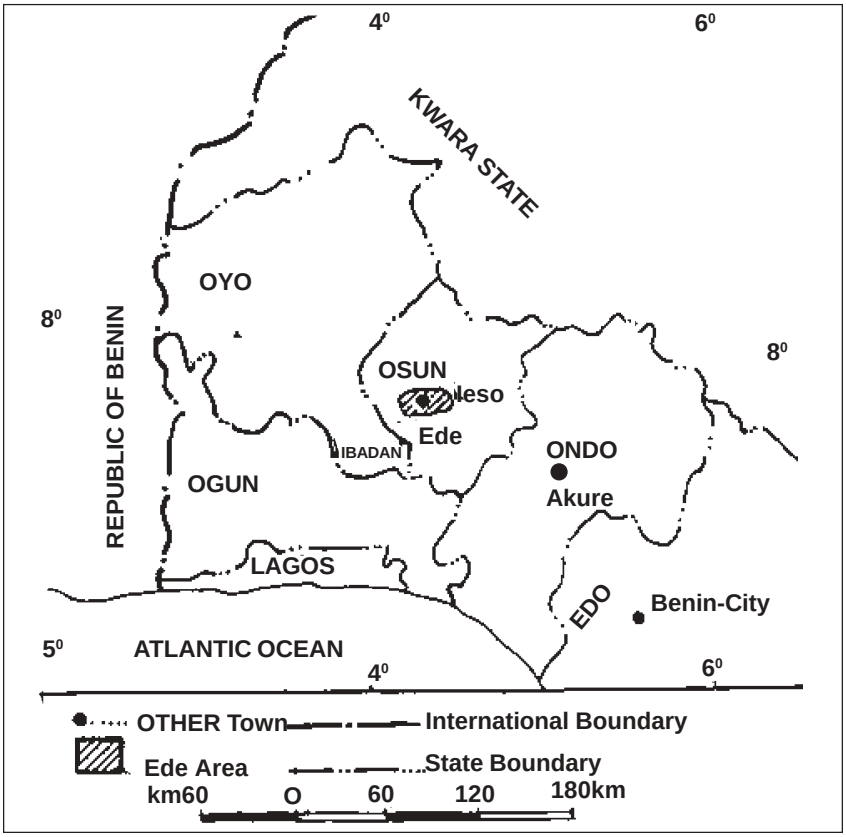

Fig. 1. Location of Ede Area

dug wells were selected for this study. In other word, 5 wells were sampled from each of the four rock types at Iragberi and Ede and only one available at Iwoye was also studied. The choice of a well depends on its distance from a previously chosen well in the locality, the wish of the owner to make the well available for study. The environment conditions around the well which are likely to affect water quality composition were also noted (see Table 1). The samples were taken from the outskirt down to the centre of the towns in the study area.

The details of the sampling procedures were documented elsewhere (Adediji. 1990). , In the study, chemical quality of the well water in Ede area was investigated. The selected chemical properties examined are pH, electrolytic conductivity (total dissolved) (TDS) and cations concentration such as calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^{+}) and potassium (k^{+}). The pH and total dissolved solids (TDS) of water samples were determined using pH and conductivity meter, respectively. The cations concentrations were determined in the Department of Chemistry Laboratory Obafemi Awolowo University, Ile-Ife, using Atomic Absorption Spectrometer (Perkin lmer 306) with wave length λ of 285. The values obtained are reported in ppm (part per million). The detail of the procedures involved are documented elsewhere (Adediji, 1990).

The wells studied are hand-dug and uncased but enjoyed the support of the firm soil. There depths vary from 2.2 to 12.4 metres and depend on the topographical levels. For instance, most of the wells have concrete rims and are covered with painted metal plates and plywood plate but a few are left open. The environmental conditions around each well vary widely (see Table 1).

RESULTS AND DISCUSSION

The pH and total dissolved solids (TDS) in

Table 1: Information about the well water sampled

Town	*Rock type*	*Sample no.*	*Location*	*Date of sampling*	*Depth to surface (M)*	*Depth of water in the well (M)*	*Remarks*
Iragberi	Gneiss and Migmatite	1	No 3, Ara road, Iragberi	16|9|89	7.00	1.04	Well covered with painted metal plates, clean surrounding
Undifferentiated		2	No 11, Daodu's compound	16|9|89	8.44	2.83	Well covered with pank-wood plate, pit latrine located nearby
		3	No 23, Isale-ola, Ejigbo road	16|9|89	6.90	3.15	Well has cover but surface run off can keep through the face of rim in to the well.
		4	No 10, Oba's compound	16|9|89	7.15	1.87	Uncovered well surrounded by bushy growth
		5	No 26. Isale Ola, Ejigbo road Iragberi	16|9|89	8.50	2.11	Well covered with rooted irin sheet. surrounding area is neat
Porphyroblastic		6	No 7, Oba's compound, Iragberi	16|9|89	9.45	2.83	Well covered with plank wood. Small refuse dumped about 3m away
Gneiss		7	No 5, Oba's compound	16|9|89	7.20	2.20	Well was not covered. Surrounding soil is water logged
		8	In front of Oba's palace	16|9|89	12,14	3.74	Well cover with rotted iron sheet. Surrounding area is clean.
		9	no 12 0ke Odo compound	16|9|89	7.46	4.62	Well is not covered. surrounding is full of litter and leaves
		10	No 42, Ede road	16|9|89	6.10	4.00	Well covered with metal plates. about 2m to Ede road
Iwoye	Quartzite and quartz scist	11	Balogun's compound, Iwoye	16|9|89	5.10	1	Well is not covered and see page into the well is possible from the surface. it is about 3,50m to Iwo road
Awo	Gneiss and migmatite undifferentiated with charnokitic metal intrusives	-					
Ede	Pegmatite	12	No 6, Sabo street, Ede	17|9-89	2.04	1.31	Well covered with rusted iron sheet. Surrounding area is clean. Well is not covered it is about 3m to Olubonku stream
							Well is not covered sited at the backyard of the house
			No 10 Opalado's compound	17-9-89	1.59	1.13	Well covered with plankwood plate. surrounding area is marshely Well covered with plated metal plate. surrounding area is clean
		13	No 12, Asalu compound				
		14	No 13, Isale Oun compound	17-9-89	2.83	0.69	
		15	No 28, Sabo street	17-9-89	1.48	0.33	

Table 1: Contd...

Town	*Rock type*	*Sample no.*	*Location*	*Date of sampling*	*Depth to surface (M)*	*Depth of water in the well (M)*	*Remarks*
		16		17-9-89	2.43	0.91	
	Schist pegmatitesed	17	No 1, Islamic street, Ede	17-9-89		1.24	Well is not covered. surrounding area is marshy bounded by cultivated garden. Well covered with plankwood plate surrounding area is clean
			No 28 Agbangudu compound				Well covered with metal plate. Surrounding area is plastered with concrete.
		18		17-9-89	3.14	3,23	Well covered with plank wood plate. Surrounding area is clean
			No 3 Agbinpa compound				
		19		17-9-89	5.16	1.29	
			Bisikus compound Ede				
		20	No. 9, Osogbo road	17-9-89	2.81	1.46	
		21		17-9-89	2.16 3.85	3.04	

ppm of well water sampled are shown in Table 2. As shown in Table 2, based on the general classification of water according to pH as recommended by Taylor (1958), about 14% of the samples tested fall within the acidic range while the rest of the samples (about 86%) fall within the neutral range. Based on Taylor's interpretation, one can say that all the samples tested are free from inorganic or organic acids and that non of the samples are saturated with carbondioxide. However, about 52% of the samples contain some amount of free carbondioxide.

Also, as shown in Table 2, the total dissolved solids (TDS) of about 95% of the samples fall within the class of freshwater while the rest (5%) fall within a class of brackish water based on Freeze and Cherry (1979)'s classification of ground water. In this regard, non of the water samples are saline or brine. Total dissolved solids is rough estimate of the chemical quality of water sample such that the lower conductance indicates the abundant of Ca^{2+} while higher conductance indicate abundant of sodium and potassium salts. With exception of sample Number 6, other water samples are good for domestic and industrial uses. But, the sample Number 6 with total dissolved solids of 1040 which is below 3000 ppm is mostly good for agricultural purpose.

The concentration of the selected cations (positively charged ions) are shows in Table 3. From the table, one can observed that concentrations of calcium (Ca^{2+}) ranged from 0.00 to 49.00 ppm which fall within the range for the normal potable groundwater (10-100ppm). Calcium in these concentrations have no known effect on the health of human beings. Also, the

Table 2: pH and Electrolytic Conductivity (E.C) of the sampled wells

Sample No	*pH*	*Electrolytic conductivity (total dispatched solids) (ppm)*
1	5.8	330
2	6.3	530
3	6.2	600
4	6.5	650
5	6.9	775
6	7.0	1040
7	7.1	325
8	7.2	800
9	6.2	950
10	5.4	290
11	7.0	675
12	6.8	440
13	7.0	500
14	7.1	775
15	7.2	560
16	7.3	625
17	7.2	590
18	6.3	625
20	6.8	850
21	5.6	240

Source: Laboratory Analysis 1990.

magnesium concentrations from all the samples ranged from 3.63 to 7.42 ppm fall within the common concentrations of magnesium range (1 to 40 ppm) for potable groundwater. These low values of magnesium also indicated that water have undergone natural softening by cation exchange.

As shown in Table 3, the measurable amount of sodium (Na^+) in all the samples ranged from 11.60 to 38.40ppm which is more than the value of about 0.20ppm in rain and snow and les than the value of 100,000 ppm in brine and salt water. These values of sodium concentration also indicated that sodium salts in the wells sampled are soluble. The potassium (K^+) concentrations in all the samples analysed ranged from 4.80 to 100.80ppm with sample 1 and 6 having the least (4.80ppm) and highest (100.80ppm) concentrations, respectively. Normally, the concentration of potassium should be one-tenth of sodium concentration and less than 10ppm for potable groundwater. But, in all the samples analysed, the concentration of potassium is about two fold of the sodium concentration. From the table, one can see that only two samples with concen-tration amount of 4.80 ppm (sample 1) and 6.00ppm (sample 21) fall within the range for most potable water. The abundance of k^+ in all the samples can be attributed to the high concentration of the total dissolved solids in all wells studied.

Table 3: Concentrations of Cations (Na^+, Mg^{2+}, Ca^{2+} and K^+) of Well Water sampled in ppm (part per million)

Sample No.	*Ca^{2+}*	*Mg^{2+}*	*(Na^+*	*K^+*
1	26.00	5.53	11.60	4.80
2	27.00	6.00	36.00	40.80
3	14.00	7.26	28.80	36.00
4.	36.00	6.79	36.00	45.60
5.	49.00	7.11	24.00	45.60
6.	47.00	7.42	14.40	100.80
7	6.00	3.63	38.40	45.60
8	37.00	6.95	38.40	93.60
9	29.00	7.42	12.00	84.00
10	3.00	6.47	14.80	10.40
11	30.00	6.79	18.00	38.00
12	13.00	6.47	28.00	30.40
13	18.00	7.11	31.20	48.00
14	25.00	6.63	38.40	60.00
15	20.00	6.79	26.00	27.60
16	22.00	6.79	19.20	40.80
17	11.00	6.00	31.20	48.00
18	13.00	6.42	31.20	38.40
19	18.00	6.79	33.60	91.20
20	23.00	7.42	28.80	64.80
21	0.00	4.58	20.00	6.00

Source: Laboratory Analysis 1990.

Suitability of Well Water for Community Uses: Water authorities all over the world, especially those concerned with drinking water supply and also many researchers have made efforts toward working out the safety limits of wholesome water constituents. For instance, Taylor (1958) defines the wholesome water as one not necessarily pure but should not endanger heath. Desirable limits for water constituents have therefore been worked out by many researchers and research bodies on the basis of known Toxicological data. These limits are usually regarded as tentative since they are subject to review with new discoveries. The limits given are usually considered as recommendations and mainly to provide acceptable aesthetic and taste characteristics. In this regard, based on the recommendations made by the U.S. Public Health Service Drinking Water standards (1962), the results of chemical analysis especially with regard to magnesium concentration which ranged from 3.63 to 7.42 ppm fall below the concentration limit.

Further, the based recommended safety limits of chemical constituents shown in Table 4, the concentration of Ca^{2+}, mg^{2+} and Ng^{2+} in all the samples analysed fall within the safety limit of good water. For general household use.

Also, the World Health Organisation (W.H.O) has recommended a worldwide standards for drinking water in 1971 (see Table 5).

Based on the WHO's standard, the results of the analysis compared favourably with W.H.O. International Standards for Drinking water as follows:

Firstly, in all the samples analysed, pH of

Table 4: Davis and De Wust (1966) recommended safety limits

Constituents	*Drinking*	*General household good*	*Use poor*
Bicarbonate	500	150	500
Calcium	200	40	100
Chloride	250	-	-
Iron	1.0	0.2	0.5
Magnesium	125	20	100
Manganese	0.05	0.05	0.30
Nitrate	20	-	-
Silica	-	10	50
Sodium	200	100	300
Sulphate	250	100	300

Table 5 : W.H.O International Standards for Drinking Water (1971)

Substance	*Undesirable that may be produced*	*Highest desirable level*	*Maximum Permissible level*
Substances Causing Odours	Odours	Unobjectionable	Unobjectionable
Substances Causing Tastes	Tastes	Unobjectionable	Unobjectionable
PH range	Taste, corrosion	7.0-8.5	65.-9.2
Total Hardness	Excessive scale formation	100mg/l $CaCo_3$	500mg/l$CaCo_3$
Calcium	Excessive scale formation	75mg/l	200mg/l
Chloride	Tastes	200mg/l	600mg/l
Iron	Taste, discoloration, deposits turbidity	0.1mg/l	1.0mg/l
Magnesium	Irritation in the presence of sulphate	250mg/l	50mg/l acceptable
Manganese	Taste, discoloration, deposits, turbidity	0.05mg/l	0.5mg/l
Sulphate	Gastor intestinal irritation when magnesium or sodium ions are present	200mg/l	400mg/l
Nitrate	Methaemoglobanenia in infants	45mg/l	50mg/l

about 43% and 62% fall within the highest desirable level and maximum permissible level, respectively.

Secondly, the concentration of calcium in all the samples which ranged from 0.00 to 49ppm fall below the highest desirable level of 75mg/l as recommended by W.H.O (1971). Non of the sample studied have Ca^{2+} concentration that reach maximum permissible level.

Lastly, the concentration of magnesium in all the wells studied varied from 3.63 to 7.42 which are below the highest desirable level of 30mg/l.

CONCLUSION

The well water is Ede area contains free carbondioxide but no free acids as indicated by the pH value of all samples analysed. Potassium is the most abundant dissolved cations in the water which has been attributed to the abundant of total dissolved solids (TDS) in the samples analysed. All the dissolved cations such as calcium, magnesium, sodium and potassium of the well water studied conformed with the recommended maximum limits. Also, one can conclude that hydrogen ions calcium and magnesium ions concentration exist at level suitable for drinking. However to avoid pollution of groundwater, the study recommended that the site of well to be dug should be at least 30m away from any source of contamination such as cesspool or manure heap.

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