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Assessment of Impact of Pit Latrine on the Physicochemical Properties of Well Water in Oke Agbo Area of Ijebu Igbo, Ogun State

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ABSTRACT
Groundwater samples from eight different sampling locations were analyzed from oke Agbo area of Ijebu Igbo, Ogun state. Physicochemical parameters analyzed include pH, Dissolved Oxygen (DO), Electrical Conductivity, Turbidity, Acidity, Alkalinity, Total Hardness, Calcium Hardness, Chloride, Nitrate and Phosphate. The parameters analyzed fell within the NAFDAC, SON maximum allowable limit and WHO desirable and maximum permissible limit for potable water. However, magnesium, total hardness and nitrate were higher than WHO desirable standards for portable water in most of the locations which may be attributed to the contamination of soil leachate from human solid and liquid waste in the it latrines.
***Keywords**: Physicochemical, Well water, Pit latrine, pollution, water standard.*

INTRODUCTION

In Nigeria, particularly many rural and urban areas, most of the population is dependent on groundwater as the only source of drinking water supply. However, groundwater can be and often has been contaminated by people's aboveground activities. Olson [1]. Water from shallow wells is usually under the influence of being contaminated from surface water via runoff and/or infiltration. NAAS [2]. The presences of pit latrines close to the water sources, lack or little environmental protection, and poor catchments management also contribute to contamination of ground water Zamxaka *et al* [3].

Water quality is therefore a critical factor affecting human health and welfare. Studies showed that approximately 3.1% of deaths (1.7 million) and 3.7% of disability-adjusted-life-years (DALYs) (54.2 million) worldwide are attributable to unsafe water, poor sanitation and hygiene WHO [4].

Ground water is often polluted because pit latrines are mostly located near water source such as shallow wells. In fact, pit latrine has been identified as a major source of contamination of wells with fecal matter Mallord et al., [5].

The pit latrine is one of the most widely used sanitation technologies. It is made out of a latrine superstructure and a pit in which anal cleansing material (water and/or solids) are disposed. Tilley et al. [6]. It is therefore very important that groundwater is protected as good as it gets. A horizontal distance of 30 m between the pit and a water source is recommended to limit exposure to chemical and biological contamination. Tilley et al [6]. The WHO (1992) advises a minimum of 15 m between a pollution source and a downstream water abstraction point. In densely populated areas with many pit latrines, the risk of a groundwater contamination remains however extremely high.

Considering the vital role of sanitation and safe water in maintaining health and the danger of groundwater contamination from pit latrine due to soil infiltration, the present study was

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therefore undertaken to assess the impact of this contamination on the physical and chemical properties of well water.

Study area

Ijebu Igbo is located at 6.98° North Latitude, 4° East Longitude and about 75 meters altitude above the sea level. Ijebu Igbo is a big town in Ogun state, Nigeria having about 109261 residents. Major source of water for the people daily need are open well water, tube well water as well as municipal water. The literature survey reveals that no water quality management studies have been made in this region so far. Hence the present study was undertaken in order to investigate whether the level of contaminants in these wells from pit latrine is sufficient enough to affect the health of inhabitants in this area.

MATERIALS AND METHODS

Preparation of water samples

Water samples were collected from eight different wells which are located at a varying distance away from pit latrine. The water samples were transferred into a plastic container and labeled W_1, W_2, W_3……..W_8. The temperature of the samples was measured immediately at the point of collection. They were later kept in the refrigerator at 4°C before the samples were transferred to the laboratory for analysis.

Physicochemical analysis

The physicochemical parameters were analyzed using standards methods described by Ademoroti [7]. The temperature was determined using a thermometer. The colour was measured by the use of a lovibond comparator while the odor and taste were determined using the sense organs.

The turbidity was carried out using the nephelometric method, the suspended solid was determined by filtration while the total solid was analyzed by evaporation to dryness also, the total dissolved solid was determined by difference between total solid and suspended solid.

pH was measured by electrolytic method using standard pH meter. The electrical conductivity was determined by a conductivity meter using a standard KCl solution. However, the acidity and alkalinity were determined using titrimetric method while the calcium, magnesium and total hardness were analyzed using titrimetric method with EDTA. The dissolved oxygen was carried out by the use of winkler's titration while the chemical oxygen demand was by reflux method, the chloride by titration using Mohr method, and the residual chlorine by iodometric method. Moreover, the nitrate, phosphate and iron were analyzed by spectrophotometric method. All analyses were carried out in triplicate and the results obtained were statistically analysed using ANOVA and Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Table 1: Physicochemical analysis of well water sample from Oke-Agbo area of Ijebu- Igbo

Parameters	Sampling Points							
	W1	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**
Distance from pit latrine (m)	4.00	7.00	10.00	12.00	14.00	17.00	19.00	24.00
PH	6.05^{b}	6.45^{c}	6.64^{d}	6.51^{c}	6.46^{c}	6.07^{b}	6.00^{b}	5.76^{a}
Dissolved Oxygen (mg/l)	5.05^{d}	5.44^{e}	5.65^{f}	4.77^{c}	4.36^{a}	4.82^{c}	4.64^{b}	4.56^{b}
Electrical Conductivity (µs/cm)	187.10^{e}	427.00^{g}	136.90^{c}	123.10^{a}	185.30^{d}	135.20^{b}	472.00^{g}	440.00^{f}
Turbidity NTU	0.51^{a}	9.03^{g}	10.80^{h}	8.82^{f}	3.32^{e}	1.50^{c}	0.88^{b}	1.94^{d}
Acidity (mg/l)	0.80^{c}	0.60^{b}	0.50^{a}	0.50^{a}	0.60^{b}	0.80^{c}	0.80^{c}	1.20^{d}
Alkalinity (mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Hardness (mg/l)	49.00^{b}	168.00^{g}	68.00^{d}	56.00^{c}	68.00^{d}	18.00^{a}	97.00^{e}	135.00^{f}
Calcium Hardness (mg/l)	37.00^{c}	102.00^{h}	38.00^{d}	28.00^{b}	41.00^{e}	11.00^{a}	42.00^{f}	61.00^{g}
Chloride (mg/l)	70.00^{d}	95.00^{f}	25.00^{a}	26.00^{b}	73.00^{e}	49.0^{c}	168.00^{h}	138.00^{g}
Nitrate (mg/l)	44.40^{f}	66.0^{g}	0.22^{a}	0.35^{b}	17.60^{d}	26.40^{e}	2.20^{c}	70.40^{h}
Phosphate (mg/l)	0.018^{a}	0.009^{a}	0.031^{a}	0.064^{b}	0.017^{a}	0.044^{a}	0.066^{b}	0.077^{b}
Iron (mg/l)	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL

DISCUSSION

Results obtained for physicochemical analysis of well water in Oke-Agbo Area of Ijebu-Igbo is as shown in Table 1 above. All the well water samples are clear with unbjectionable taste and odour. The pH value obtained for all the well water compare favourably well with SON except that of W8 located at 24m away from the pit latrine which may be due to the nature of the soil leachate. The total solid mg/l of all the well sample falls within the allowable limits of WHO, 1993. The TDS mg/l and TSD ranges between 52.1 – 205 and 31.4 – 39.7mg/l respectively. These values are within the 500mg/l maximum permissible limit set by NAFDAC, SON and WHO.

The conductivity µs/cm which signifies chemical purity of a low electoral conductance [8] ranges from 123.1 – 472.0 and it is within the EU permissible limit of 2500 os/cm for portable water. The total acidity varies from 0.5 for well water sample located at 10 and 12cm away from pit latrine and 1.2 for well located at 24m away. This indicates that organic and inorganic acidifying precursors which may emanate from organic and inorganic human waste. However, the acidity falls within the maximum allowed limits of NAFDAC, SON and WHO.

Table 2: Physicochemical characteristics of national and international portable water standards (2007)

Parameters	NAFDAC (Maximum allowed limits)	SON	WHO (Highest desirable)	WHO (Maximum permissible)
Colour	TCU	3.0 TCU	3.0 TCU	1.5 TCU
Odour	Unobjectionable	Unobjectionab	Unobjectio	
pH	6.5-8.5	6.5-8.5	7.0-8.9	6.5- 9.5
Dissolved Oxygen (mg/l)	-		5.0	
Electrical Conductivity(µs/cm)1000	1000	900	1200	
Alkalinity (mg/l)	100	100	100	100
Total Hardness (mg/l)	100	100	100	500
Calcium Hardness (mg/l)	100	75	-	-
Magnesium hardness	20	0.02	20	20
Chloride (mg/l)	100	100	200	250
Nitrate (mg/l)	10	10	10	50

The calcium (mg/l) hardness ranges between 11 – 102 with well water sample located at 17m distance having the lowest. All these values falls within the maximum permissible limit for NAFDAC, SON and WHO except well water sample located at a distance of 7m from the pit latrine while majority of the well water sample have high Mg hardness value than maximum permissible limit except not completed.

In addition, values obtained for chlorine (mg/l) range from 25 – 168 which fall below the maximum permissible limit for WHO. The higher chloride value in in well located at 19m and 24m distance away from the pit might be as a result of feacal contamination according to Haruna *et al* [9].

Fe^{2+} was not detected except in well water sample located at 10m away from pit latrine which might be as a result of the location or the nature of the soil. Most of the well water samples have higher Nitrate (mg/l) than maximum permissible limit of WHO, SON and NAFDAC except W3, W4, W5 and W7 which have 0.22, 0.35, 17.6, and 2.20 respectively. This may be caused by leachate from human liquid and solid waste deposit from nearby pit latrines [10]. The phosphate (mg/l) which may occur as a result of domestic sewage ranges from 0.009 – 0.077.

Moreover, the dissolved oxygen in most of the well water samples are slightly lower than the highest desirable limit for portable water except well water samples which are located at distance of 4m, 7m and 10m away for pit latrine. This may be as a result of organic waste decomposition by bacteria which remove oxygen from the water during breathing [11].

Conclusively, higher values of nitrate, chloride, hardness and lower dissolved oxygen encountered in some of the well water is a clear indication that improper construction of latrines and septic tanks are the most common sources for sewage contamination of well water. Hence, regular

examination of water quality for the presence of pathogenic organisms, chemicals and other physical contents is essential to provide information on the level of the safety of water.

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