

CORRELATIONS BETWEEN HYDROCHEMICAL AND FAECAL BACTERIA COUNTS IN URBAN GROUNDWATER UNDERLYING AGO-IWOYE, SOUTHWESTERN NIGERIA



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Background / Rationale.

* To provide detailed and technical information that could checkmate the causes of illness breakout in the study area through analysis of biological and physico-chemical properties of water sources and impacts of minerals on bacterial growth.
 * The information gotten from the study will be made relevant to other communities in Nigeria with similar problems as it is common in West Africa, upon which the government of Nigeria might pay more attention to implementing the appropriate policy in rural areas of the country.

Objectives / Hypotheses to test

* Nigeria, though with a population of 130 million people has about 70 % of this population residing in rural areas with the government committed to playing active role in reaching the Millennium Development Goals (MDG) through the Presidential Water Initiative Programmes.
 * This programme has a target of 100 % coverage in all state capitals, 75 % in small towns, and 67 % in rural communities (for example the study area) by 2007
 * In this respect, a national body meant to formulate national policy among other things were to address the issue of water. This led to the promulgation of the hazardous waste decree with the intention of discouraging reckless and illegal dumping of hazardous and harmful wastes on land and into water courses (FGN, 1988b).
 * Ground/well water is the major source of water for the purpose of human activities (consumption inclusive), and agricultural sector in Nigeria, especially in the densely populated university town Ago-Iwoye.
 * Ago-Iwoye (Fig. 1) is geographically located on longitudes 3° 50' and 3° 56' E, and latitudes 6° 55' and 7° N.
 * Geologically, it is within the basement complex of the Southwestern Nigeria, comprising the migmatites and porphyroblastic gneiss.
 * Records from the health care unit of the university in this study area showed that from year 2003 till 2005, there has been a great increase in reported cases of water borne diseases especially diarrhoea.
 * Some of the microbes discovered by Quinlan, 1990 to cause diseases and other various forms were considered in this study.
 * However, previous studies of microbial contaminations in southern Nigeria (Oyemade, 1998) and in neighbouring Ghana (Beneh et al., 1993) showed very high levels of contaminations in drinking water.



Diseases and their agents which might spread by faecally contaminated groundwater

Viral Disease	Pathogen
Infectious hepatitis	Hepatitis A virus
Polioomyelitis	Poliovirus
Diarrhoeal diseases	Rotavirus, Norwalk agent, other viruses
Varied symptoms and diseases	Echoviruses and Coxsackievirus
Bacterial Diseases	Pathogen
Cholera	<i>Vibrio cholerae</i>
Typhoid fever	<i>Salmonella typhi</i>
Paratyphoid fever	<i>Salmonella paratyphi</i>
Bacillary dysentery	<i>Shigella</i> spp
Diarrhoeal diseases	Enterotoxigenic <i>E. coli</i>
	Enteroinvasive <i>E. coli</i>
	Enteropathogenic <i>E. coli</i>
	<i>Salmonella</i> spp
	<i>Campylobacter jejuni</i> spp <i>jejuni</i>

Methodology.

* Well water samples were collected at ten sites across the study area into one-litre bottles from 5 cm depth. The physical and chemical measurements were performed according to accepted procedures (Tymczynska et al., 2000, Akinyele, 1999).
 * The Na & K concentrations were determined by the flame photometric method.
 * The biological procedures recommended by the Water Aid Nigeria using the Delagua Portable Water testing kit, developed by the Robens Institute and lately by the Centre for Environmental Health Engineering, Surrey University were adopted for the analyses of microbes in this study.

Results.

Table 1: Results from the chemical properties observations

Well Nos	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 8	Well 9	Well 10
pH	6.70	6.50	6.80	6.50	6.70	6.50	6.70	6.90	6.80	6.50
Na mg/l	44.00	34.00	55.00	46.00	44.00	59.00	69.00	58.00	64.00	47.00
K mg/l	73.00	90.00	10.00	39.00	11.00	7.00	41.00	8.00	24.00	13.00
Mg mg/l	1.05	1.88	1.65	1.92	1.52	1.97	0.87	2.01	0.80	0.64
Zn mg/l	0.18	0.24	0.73	0.98	1.59	0.49	0.84	0.96	0.98	0.74
Pb mg/l	0.09*	0.08*	0.06*	N/L	0.09*	0.01	N/L	0.04*	0.02*	0.09*
Cu mg/l	88.78	39.50	53.25	71.00	88.78	53.25	82.56	71.51	64.20	75.06
Ca mg/l	1.80	1.77	2.09*	0.10	0.78	0.12	2.09*	0.50	0.43	0.12
Fe mg/l	N/L	1.28	N/L	1.98	N/L	N/L	0.80	1.10	N/L	N/L
Mn ₂ mg/l	1.99	2.96	1.64	0.94	1.02	1.87	0.59	0.66	1.01	1.15
Cl ₂ mg/l	9.40	6.90	4.31	2.71	1.34	2.08	3.78	1.49	2.18	2.11
SO ₄ ²⁻ mg/l	1.80	1.30	3.20	1.80	2.40	4.80	2.00	0.93	0.97	1.05

Table 2: Results of the physical properties observations

Well Nos	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 8	Well 9	Well 10
Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
Turbidity	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
TDS (mg/l)	14.00	13.00	18.00	16.05	20.15	17.04	10.71	11.89	15.20	9.45
T.H. (mg/l)	32.00	38.00	42.00	35.00	47.00	51.00	32.00	49.00	37.00	23.00

Table 3: Results from the microbial observations

Well Nos	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7	Well 8	Well 9	Well 10
Total plate count (cfu/100ml)	0.05	0.08*	0.04	0.01	0.01	0.01	0.02	0.04	0.01	0.01
Coliform count (cfu/100ml)	0.01*	0.01*	0.00	0.01*	0.00	0.00	0.00	0.02*	0.00	0.00
Salmonella count (cfu/100ml)	N/L	0.01*	N/L	N/L	N/L	N/L	N/L	N/L	N/L	N/L

Discussion.

* This study made use of the laid down maximum and minimum values/tolerant limit for the microbes and the physico-chemical properties of good quality water by WHO, 2003.
 * Though there are other effects by contaminations in water, rather we'll be concerned with the health effects since it was the health problem of the study area that necessitates the study.
 * From the chemical analysis carried out (Table 1), some of the toxic chemicals identified by W.H.O to be dangerous to health are unfortunately the defaults of this analysis.
 * Well water are contaminated by the excess concentration of mineral elements Lead (Pb) in wells 1, 2, 3, 5, 8, 9 & 10 with values exceeding the tolerant level of 0.01mg/l hence, require attention.
 * While Iron (Fe) mineral values observed in wells 2, 4, 7 and 8 (exceeding the tolerant level of 0.2mg/l) could cause the water to have taste, discoloration and bacteria growth.
 * Wells 3 and 7 have excess concentration of copper (Cu) (exceeding the tolerant level of 2mg/l) mineral which could cause a stringent taste and pipe corrosion.
 * Other physical and chemical properties agree and exist within the tolerant limit.
 * From Tables 3, it can be observed that well 2 was located very close to a soak-away by the presence of *salmonella* bacteria and further buttressed by the highest value of 0.08 cfu/100 ml for standard plate count among other samples which is an identification of bacteria.
 * Wells 1, 2, 4 & 8 from Table 3 have coliform count value of 0.01, 0.01, 0.01 & 0.02 cfu/ml respectively this in itself is not an indication of danger but of the presence of coliform bacteria but the recommendations of WHO/EPA is zero level of bacteria. This if not treated could aid the thriving of other forms of bacteria which could be dangerous to health.
 * Hence, the study demonstrates the importance of education for the consumers who use individual supplies for their drinking water.
 * Efforts need to be put in place to increase awareness of the hazard of drinking contaminated water and of ways to prevent contamination. Improper placement of wells, lack of sanitary seals, proximity of grazing animals to the well, and lack of knowledge of the significance of contaminated water were all found to be factors contributing to the poor-quality water supply in this study area

Conclusions

Physico-chemical and biological properties studies indicate that drinking water contaminants are implicated in causing health-related problems. Well 2, 4, 7 & 8 particularly has been able to support the published fact that some compound such iron might actually support bacteria growth (Lechevallier et al., 1991) i.e. the presence of some mineral in excess implies presence of bacteria and also aid bacteria growth thus, this study has been able to confirm the fact that metals in the environment, human and animal faecal are sources of contamination which could cause illnesses and diseases in human body (Water Quality Policy, Water Aid Nigeria, Oct. 2004). These observations reflect leaching of these minerals probably via rainfall or excessive irrigation which may eventually reach groundwater. Hence, most of the epidemics breakout in the study area which falls under water-borne diseases category could actually be traced to the observations made about the utilized well waters by the inhabitants.
 Most frequent monitoring will be helpful in detecting contaminated water particularly during and after rainfall periods.
 This study therefore recommends:
 That the gap between the Federal Ministry for Water Resources and Rural Water Sanitation Agencies as well as Local Governments for full implementation of Nigerian laid down policy on Environmental Protection issues be bridged by adopting promptly the National Standards and guidelines that most suit our climate.
 Then calls for enforcement and monitoring of the relevant policies in the rural areas concerning well digging/borehole drilling with its maintenance.
 That the public be kept informed about water quality objectives that have been established and measures taken to attain these objectives (UNESCO/WHO, 1978; UNECE, 1993, 1995).

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