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Physicochemical and Microbial Analysis of Water Samples from some Hand-dug Wells in Iworoko-Ekiti, Ekiti State, Nigeria

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Physicochemical and microbiological quality of water samples from some hand-dug wells in Iworoko-Ekiti, Nigeria were investigated. The coliform count ranged between 25 and 1,600 per 100mls of the original water sample. Physico-chemical values ranged; pH (6.30-8.90), conductivity (1.20-5.30), acidity (7.50-9.60mg/ml), alkalinity (27-170mg/l), chloride (0.11-3.20mg/l), free CO_2 (0.23-1.95mg/l), total solid (0.20-1.60mg/l) total suspended solids (0.10-1.20mg/l) respectively. Values for minerals ranged; Zn (0.19-0.70), Fe (0.24-0.66), Pb (0.01-0.04), Ca (3.28-32.24), Mg (1.98-15.36), Na (1.01-4.69) and K (1.077-6.715). There is no evidence on the effect of installation of concrete ring casting in wells on the quality of the water as samples from either ringed or unringed wells were almost of the same quality.

Keywords: Physico-chemical, Microbiological, Coliform count, Well, water.

Water plays a significant role which cannot be overemphasized as it is of fundamental importance to all kinds of plants and animals. The availability of water dictates the quality of life since water is the basic requirement of life. Water has been complicated of transmitting human diseases with the fact that it has a good medium for microbial growth particularly bacteria because of its tendency to accommodate useful materials that act as nutrients to the organisms[5].

Good quality water must be free of suspended solid and turbidity, taste, colour, the dissolved organic solids be of moderate qualities while organic toxic substances and pathogens must be absent[6]. Although bacteria are found in water, most of them are of sanitary significance, some are indicators of pollution but are harmless. Others which are few in number are pathogenic. Groundwater normally does not contain many bacteria since the effect of filtration, exposure to unfavourable environment and the element will eliminate most of them including those of sanitary significance[1]. Apart from bacteria, other organisms can be present in water such as algae, fungi, protozoa and viruses.

Physical, chemical and biological factors determine the growth and survival of the organisms. All natural waters more or less have dissolved mineral matter in them. Chemical elements, which are generally considered as the most abundant in ground water are Ca^{2+}, Mg^{2+}, K^{+}, and Na^{+} for cathions as well as HCO_3^{2-}, Cl^{-} and SO_4^{2-} for anions[4].

WHO in 1997, produced a global international standards for the drinking water. These standards are however, merely recommendations about minimal standards which the WHO itself recognized will not necessarily be attained

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in all countries of the world or regions due to differences in the economic and technological capabilities of various countries.

Water is very essential especially for domestic purposes and the use of well water is a common practice in most homes, both urban and rural areas, where potable water supply is a problem. Most rural villages in Nigeria have poor access to safe and clean water supply and sanitation but to meet the water standards in rural communities it will be difficult due to the absence of water treatment materials and knowledge of water quality maintenance. The presence of objectionable microorganisms and chemicals in well water apart from causing human diseases and infections could result to food spoilage, destruction of materials and equipment by corrosion[5].

This study is aimed at determining the levels of microbial, physical and chemical contaminants of water samples from hand-dug wells in Iworoko-Ekiti, Ekiti state, Nigeria.

MATERIALS AND METHODS

Collection of water samples

Raw water samples were collected from different hand-dug wells in Iworoko, Ekiti, Nigeria. The water samples were collected into 250ml sterile bottles by submerging into the concrete ringed and unringed wells. The bottles were tightly closed to prevent contamination from the air. Samples were transported to the laboratory on iceand 5ml analyzed within 4hours after collection. The water samples required for metal analysis were preserved with concentrated nitric acid (HNO_3) per litre so as to keep the metals in solution.

Estimation of Coliform bacteria

Estimation of coliform bacteria was carried out on MacConkey broth instead of Lauryl sulphate Tryptose broth. The most probable number of coliform bacteria in the original sample was estimated from the number of tubes giving positive reactions and reference was made to the standard (McCrady)table of probability.

Minerals and physico-chemical analysis

The physico-chemical analysis was carried out according to the method of AOAC (1990). Sodium and potassium were determined using a flame photometer (Model (405 Corning, UK). All other metals were determined using atomic absorption spectrophotometer (Perkin-Elmer Model 403). All determinations were done in duplicate. All chemicals used were of analytical grade (BDH, London). Earlier, the detection limits of the metals had been determined according to Techtron (1975). The optimum analytical range was 0.1 to 0.5 absorbance units with a coeficient of variation of 0.87-2.20% concentration of the minerals were reported as part-per-million (ppm).

RESULTS AND DISCUSSION

The data on coliform count of water samples using most probable number (MPN) are shown in Table 1 the coliform count ranged between 25 and 1,600 with samples A_1 and A_5 having the highest value, while sample B_5 recorded the lowest value (25) per 100ml of the original water sample.

Table 1. Coliform count of water samples using Most Probable Number (MPN)

Water samples	Coliform bacteria in 100ml of water sample
A_1	1,600
A_2	170
A_3	200
A_4	130
A_5	1,600
A_6	85
A_7	55
A_8	115
A_9	95
A_{10}	120
B_1	75
B_2	115
B_3	85
B_4	150
B_5	25
B_6	55
B_7	550
B_8	550
B_9	50
B_{10}	275

A-samples from ringed wells.
B- samples from unringed wells.

Table 2. Physico-chemical Analysis of Water Samples.

Water samples	pH	Conductivity	Acidity	Alkalinity	Cl^-	Free CO_2	TS	TSS	TDS
A_1	7.50	1.80	8.60	170	1.20	1.25	0.60	0.20	0.40
A_2	7.40	2.10	8.69	156	0.90	1.90	0.80	0.20	0.60
A_3	8.80	2.20	9.20	277	2.10	1.50	1.00	0.40	0.60
A_4	8.90	1.20	9.60	48	2.10	1.95	1.20	0.10	1.10
A_5	7.07	1.60	8.50	129	0.80	1.90	0.60	0.20	0.40
A_6	7.12	2.80	8.20	63	ND	1.85	1.00	0.30	0.70
A_7	6.30	3.10	7.80	70	0.22	1.10	0.50	0.40	0.10
A_8	7.14	3.50	7.60	49	0.35	1.05	1.20	0.40	0.80
A_9	7.36	2.00	8.30	48	0.12	1.00	0.60	0.40	0.20
A_{10}	6.82	2.30	8.10	32	ND	1.15	0.20	0.30	0.90
B1	7.02	1.20	8.30	40	2.40	0.23	1.00	0.40	0.60
B2	7.30	1.60	8.39	68	1.10	0.26	0.60	0.40	0.20
B3	6.81	1.50	7.50	53	3.00	0.24	1.40	0.20	1.20
B4	7.83	3.10	8.60	161	3.20	0.24	0.80	0.20	0.60
B5	7.02	2.90	8.10	50	1.90	0.38	1.60	0.80	0.80
B6	7.39	4.00	7.50	63	0.22	0.37	0.60	0.20	0.40
B7	7.22	5.30	7.80	52	ND	0.35	0.40	0.20	0.20
B8	6.93	2.80	8.20	32	0.14	0.32	0.40	0.20	0.20
B9	6.88	2.40	8.50	27	0.11	0.33	0.80	0.20	0.60
B10	7.39	1.80	8.30	30	0.21	0.40	1.20	0.40	0.80

A-samples from ringed wells. B- samples from unringed wells.

Table 3. Mineral composition of water

Water Samples	Metals Analyzed						
	Zn	Fe	Pb	Ca	Mg	Na	K
A_1	0.50	0.64	0.03	29.73	14.91	4.59	6.715
A_2	0.30	0.45	0.04	7.22	15.08	3.38	5.988
A_3	0.41	0.47	0.02	25.60	15.36	4.69	6.514
A_4	0.23	0.39	0.01	20.11	8.14	2.56	4.416
A_5	0.19	0.24	0.02	31.61	14.39	2.89	6.359
A_6	0.28	0.37	0.02	32.24	13.62	2.71	6.311
A_7	0.24	0.41	0.04	8.43	10.21	2.69	6.513
A_8	0.43	0.26	0.01	17.12	13.15	3.01	6.345
A_9	0.26	0.33	0.01	12.84	11.14	2.67	6.116
A_{10}	0.37	0.44	0.02	3.28	2.51	1.13	1.914
B_1	0.24	0.33	0.02	10.32	6.49	1.72	2.115
B_2	0.31	0.36	0.02	9.63	4.07	1.82	3.075
B_3	0.34	0.32	0.04	11.41	5.59	2.03	2.166
B_4	0.32	0.41	0.03	11.02	5.47	1.04	2.343
B_5	0.28	0.44	0.03	7.54	3.14	1.26	1.077
B_6	0.70	0.38	0.01	5.39	1.98	1.01	1.114
B_7	0.21	0.29	0.01	8.11	3.46	2.36	1.236
B_8	0.34	0.36	0.04	10.32	4.57	2.14	1.649
B_9	0.31	0.57	0.02	18.71	6.31	1.53	2.071
B_{10}	0.43	0.66	0.02	17.44	4.18	1.36	2.016

The results of physico-chemical analysis carried out on the samples are shown in Table 2, the values range are as follows: pH (6.30-8.90), conductivity (1.20-5.30), acidity (7.50-9.60mg/l), alkalinity (27-170mg/l), chloride (0.11-3.20mg/l), free CO_2 (0.23-1.95), total solid (0.20-1.60mg/l), total suspended solids (0.10-0.80mg/l) and total dissolved solids (0.10-1.20mg/l) respectively.

The results of the mineral analysis are shown in Table 3. the values range (in parts per million) as follows: Zn (0.19-0.70), Fe (0.24-0.66), Pb (0.01-0.04), Ca (3.28-32.24), Mg (1.98-15.36), Na (1.01-4.69) and K (1.077-6.715)

It is obvious that water samples from the hand-dug wells are not fit for drinking based on the results of microbial and physico-chemical analyses of the water samples. This is so because none of the water samples absolutely meets the limits or standard set for drinkable water by World Health Organization (WHO)[7]. Reported that a portable water must not contain coliform bacteria but is contrary to the result obtained in this study.

The presence of lead (Pb) in all the water samples at a level higher than the maximum permissible limit given by the WHO regulation/standard renders the water samples not suitable for drinking[8]. Furthermore, the results of acidity, conductivity and total hardness are not in compliance with WHO standard, but parameters like pH, total dissolved solid, alkalinity and concentration of metals such as calcium, magnesium, sodium, iron, and zinc of the water samples, conforms with the limits set by WHO. From the results, there is no evidence on the effect of installation of concrete ring casting in wells on the quality of the water, as samples from either ringed or unringed wells almost the same quality. There is the need for intensive treatment of the water from the wells to improve the quality, thus making them portable.

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