PHYSICOCHEMICAL AND BACTERIOLOGICAL ANALYSIS OF WELL WATER IN ZANGO – ABATTOIR KADUNA – NIGERIA.

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ABSTRACT
Physiochemical and bacteriological quality of hand-dug well water in Zango – Abattoir Kaduna Metropolis was determined. A total of 12 samples were collected from 3 opens wells. The mean pH, electrical conductivity, turbidity, dissolved oxygen (DO) and Biochemical Oxygen Demand (BOD) were 5.98, 22.8µs/cm, 18.1NTU, 0.4mg/L and 0.23mg/L respectively. The results indicated very high concentration of sodium and potassium, with a range of 425 to 2,817mg/L for sodium and 132.5 to 222.5mg/L for Potassium. The concentration of lead and cadmium were also significant ranging from 0.3972 to 0.652mg/L and 0.0062 to 0.0193mg/L respectively. The bacterial analysis also revealed that 9 of the samples had total coliform bacteria and 4 had fecalbacteria. Though the overall physicochemical and bacteriological quality of the water samples lies within the maximum permissible limits of established standards, the high metal concentration makes the water unsuitable for drinking.

INTRODUCTION
Groundwater is any fresh water that lies beneath the earth's surface in soil pore spaces and in the fractures of rock formations[1] Groundwater is usually regarded as great sources of water because it looks clear and clean. This is because it runs through so many layers of rocks and sediments which serve as a sort of natural filtration system. The quality of groundwater can however deteriorate due to inadequate source protection and poor resource management resulting in groundwater contamination[3].
Groundwater contamination is nearly always the result of human activity. In areas where population density is high and human activity is intensive, groundwater is vulnerable to pollution intentional or accidentally[1]. Chemicals, micro-organisms, fertilizers, fuel mineral and metals etc. can all cause groundwater contamination.

The use of contaminated groundwater has been responsible for water borne diseases including gastroenteritis, cholera, typhoid, giardiasis, stomach cramps and aches, vomiting, (caused by bacterial and viral pathogens and also protozoan parasites[3] respiratory infections, liver damage and even cancer (due to DNA damage) caused by a series of chemical such as CFCs, MTBE etc[2].
In contracts to chemical pollution that results in a long range pollution of groundwater over time, micro-biological pollution of groundwater source has an immediate effect on large number of people[3]. Nonetheless chemical pollution can be equally detrimental to health and wellbeing of both plants and animals.

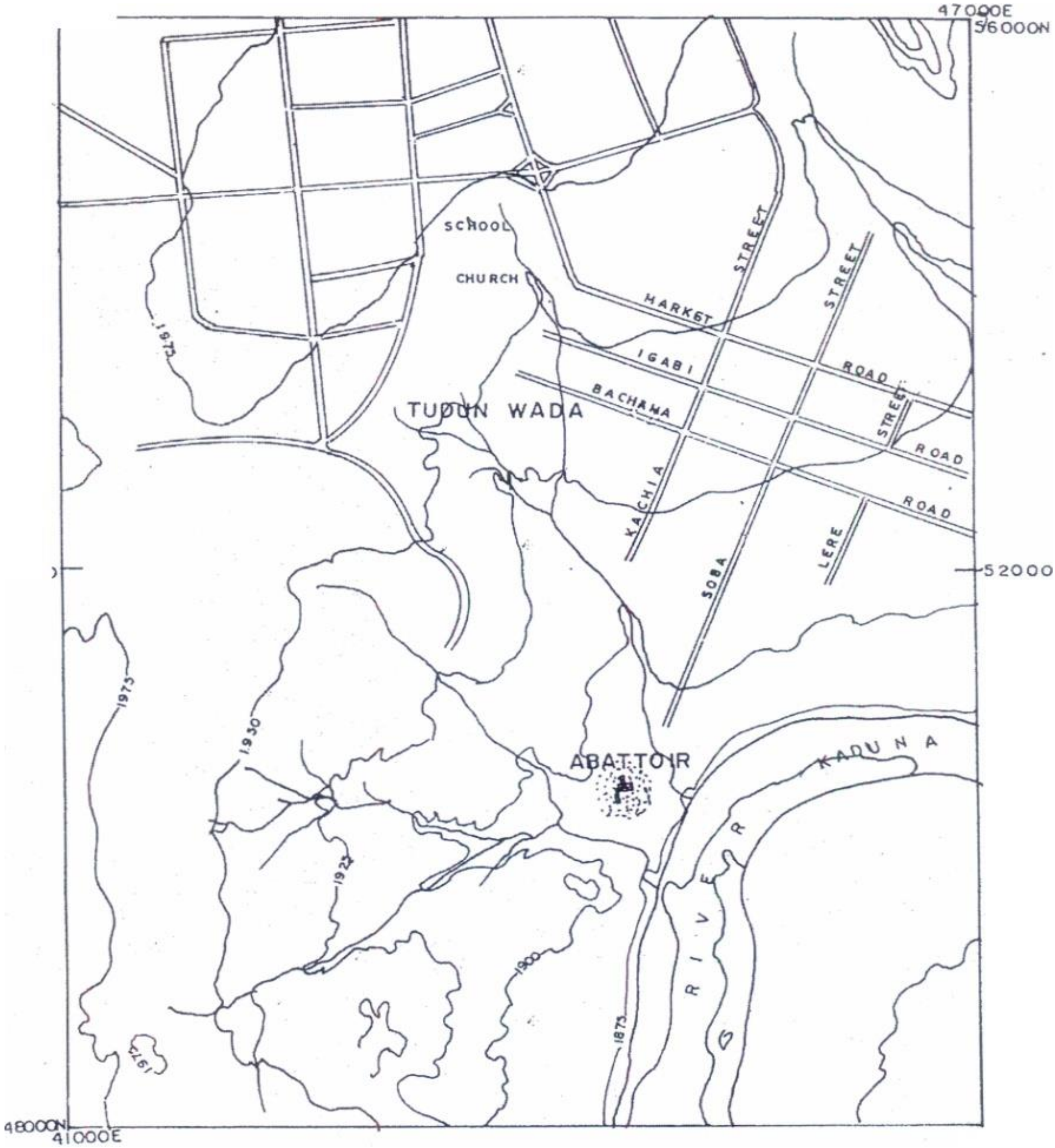

Figure 1: Showing the map of sampling site(Abattoir)

Because coliform bacteria are most commonly associated with sewage, or surface and groundwater they are used as indicator group to determine the sanitary quality of drinking water[5].

Though most Coliform bacteria do not cause illness, their presence in a water system is a public health concern because it suggests that other disease causing organisms may exist in the water[6]. Coliform bacteria are commonly found in the soil, on vegetation and in water. They are also found in the intestine of warm blooded animals[7,8]. Coliform from animals wastes can enter directly into water supplies and contaminate the groundwater source thereby rendering it defective.

Zango-Abattoir is a suburb in Tudun wada, Kaduna, where a lot of animals including goats, sheep and cattle are slaughtered and processed before they are transported to various markets and cold store for onward sell to consumers.

Though, the abattoir is provided with a tap water system, there are also a number of hand-drug wells that were provided to augment the water supply. These wells are however mainly used by the animal rearers to water animals and to perform ablution.

These hand-dug wells are open and exposed to intensive human activity, leading to the likelihood of being contaminated.

The contamination of the wells can be caused by both point-source e.g. accidental spills, washings, leakages, dumping of animal wastes etc. and nonpoint-source e.g. runoff from roads, chemicals used in agriculture such as fertilizers, pesticides and herbicides. These sources of pollution may also contribute to the total and fecal coliform contamination thereby raising concerns about its safety; especially concerns about its potential for disease transmission.

In order to assess the risk of using water from these wells, information about the quality of the water is needed. Therefore, the objectives of this study are to measure:

i. the physicochemical and bacteriological quality of the well water.

ii. the levels of sodium, potassium, lead and cadmium of the well water.

MATERIALS AND METHODS

Sample collection, Preservation and Storage

Water samples were collected in clean polypropylene sample bottles with leak proof lids from 23/03/09 through 12/09/09.

A total of 12 composite samples were collected, 4 samples per well. A sample is however a composite of 3 samples collected at different times of the day. The sample collected were kept on ice at a temperature of 1- 4^0C[1] and then transported to the central laboratory of the Kaduna State Water Board Barnawa in Kaduna, Nigeria, where bacterial analysis was carried within 6 hours of collection. The physicochemical parameters were measured before the bacteria analysis began.

The concentrations of lead and cadmium were also found to be above the limits set by WHO and NSDWQ in all the water samples. Likely sources of lead and cadmium pollution could be from municipal wastes around the area, dumped lead batteries, exhaust fumes from vehicle and zinc materials (for cadmium pollution).

Sample analysis

Physicochemical parameters such as pH, electrical conductivity (EC), turbidity, dissolved (DO) and biochemical oxygen demand (BOD_5) were measured at the central laboratory of Kaduna state water board, Barnawa, using standard methods.

Sodium and potassium were determined using flame emission spectroscopy (FES) while lead and cadmium were determine by atomic absorption on a bulk scientific model AA 6800 Shimadzu atomic absorption spectrophotometer, at the National Research Institute for Chemical Technology (NARICT) Zaria, Nigeria. Total and Fecal coliform were measured using EPA method 1604 membrane filtration technology.

RESULT AND DISCUSSION

The result of physicochemical analysis and metal analysis of the water samples (Table 1) showed variation in the parameters determine. Turbidity was found to be above the limits set by WHO[10] and NSUWQ[11] in most of the samples analyzed except sample S – 1 and S – 4. Electrical conductivity was also found to be above the limit set by WHO in all the samples analyzed, while the other parameters fell within the permissible limits of WHO and NSDWQ.

The concentrations of sodium and potassium in all the samples were found to be above the maximum, permissible limit set by WHO and NSDWQ. Likely sources of sodium and potassium pollution could be from animal dung, animal blood, urea, municipal waste and local potash used in the animals.

Table 2 showed that total coliforms were present in 9 well water samples i.e. S-2, S-3 S-4, S-5, S-6, S-8, S-9, S-11 ad S-12, while fecal coliforms were found in only 4 samples i.e. S-2, S-5, S-8 and S-11. The fecal coliforms indicate fecal contaminations of the water. But just how contaminated are these water samples? Not very much! Because the samples all fell within the maximum permissible limit set by NSDWQ for total coliform bacterial but were a little above the limit set for fecal coliform bacteria. The number of both total and fecal coliform bacterial were found to be similar to that found by Magami, *et al*; [12] but were however in contrast when compared to the study by Casanova *et al*., [5]. who carried out a study on the chemical and microbial characterization of house hold Graywater; where the total coliforms averaged 8.03 x 10^7 CFU/100mL and fecal coliform averaged 5.63 x 10^5 CFU/100mL.

A comparison of turbidity and total Coliform bacterial of the well water samples was conducted the study proved a strong positive correlation with R value for turbidity as 0.9740. This direct correlation between turbidity and total Coliform indicates that as turbidity increase, so does total coliform bacterial.

This result is significant and is in agreement with those reported by Busse *et al*.,(2007) [9].

Table 1: Physical and chemical parameters of well water samples

	SAMPLES													
Parameter	1	2	3	4	5	6	7	8	9	10	11	12	WHO	NSDWQ
pH	6.0	7.9	6.2	6.1	6.0	5.7	5.9	8.0	5.7	5.9	7.8	6.5	6.5-8.5	6.5-8.5
Conductivity (μS/cm)	25.50	6.38	30.00	24.00	20.3	34.6	30.70	6.50	34.0	31.00	6.45	24.2	1.00	1000
Turbidity (NTU)	4.20	36.7	15.0	4.7	25.5	7.85	5.70	49.0	8.00	6.55	43.3	11.4	5.0	5.0
Dissolved Oxygen Mg/L	0.2	0.6	0.3	0.3	0.4	0.2	0.2	0.8	0.3	0.3	0.8	0.3	NAD	NAD
Biochemical Oxygen demand Mg/L	0.1	0.4	0.2	0.2	0.3	0.1	0.1	0.4	0.2	0.20.4	0.4	0.1	NAD	NAD
Sodium Mg/L	1,125.5	460	1,980	1,570	1,090	2,817	2,005	587	2,805	2,250	424	1,460	200	200
Potassium Mg/L	189.0	132.5	195.0	175.5	140.0	210.0	194.5	137.0	222.5	203.0	135.0	180.0	NAD	NAD
Lead Mg/L	0.5120	0.3972	0.5324	0.4890	0.4230	0.6050	0.5850	0.4001	0.6526	0.6025	0.3990	0.5010	0.01	0.01
Cadmium Mg/L	0.0105	0.0062	0.1454	0.1055	0.0080	0.1800	0.1390	0.0071	0.1937	0.1405	0.0065	0.0090	0.003	0.003

NAD = No Available Data

Table 2: Total and Fecal coliform counts of well water samples

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	WHO	NSDWQ
Total coliform CFU/100mL	0	5	2	1	3	1	0	9	1	1	6	1	0	10
Fecal coliform or E.coli count CFU/100mL	0	1	0	0	1	0	0	2	0	0	1	0	0	0

CONCLUSION

The levels of total coliforms among the three well water samples was varied. This indicate that the levels of pollution are also varied. The results also indicated that the well from which samples S-2, S-5, S-8 and S-1 are collected was more polluted than the other two wells.

The study also indicated that though the well water sample contains significant amount of sodium, potassium, lead and cadmium, the overall physicochemical and microbial quality of the water samples lies within maximum permissible limits of established standard.

The danger posed by using water from these wells will therefore come from the metals, especially lead and cadmium that are toxic and have serious health implications among which are cancer, poor mental development in infants, toxicity to the central1 and peripheral nervous system, toxicity to the kidney, interference with vitamin D metabolism etc.

RECOMMENDATION

The polluted water is not fit for drinking.

The well water should be effectively treated by disinfection or distillation so that bacteria and other harmful disease causing microorganism can be reduced or even completely eliminated.

The wells should be covered and the wells casing should be water tight and extend 6 inches above the ground. The wells should also have proper vermin proof cap.

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