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AN EXAMINATION OF SELECTED WELL WATERS FOR PHYSIOCHEMICAL AND HEAVY METALS IN ZAAKPON COMMUNITY, KHANA LGA, RIVERS STATE, NIGERIA

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Abstract

Analytical methods were used to carry out the investigation of certain physiochemical parameters and heavy metals found in particular well fluids in the Zaakpon community, Khana Ogoni, Rivers State, Nigeria. Ten (10) different samples of different well locations were mapped out for investigations and the well waters collected in line with best practices. The physio-chemical characteristics revealed that the water samples' PH ranged from 2.58 to 4.30, with a mean value of 3.547 in contrast to the WHO's 6.5–8.5 guideline. It revealed that the PH was acidic. The samples' temperature (0C) ranged from 24.8 to 36.8, with a mean of 28.180C. The temperature may not be dangerous because it is just higher than the WHO's recommended range of 26 to 280 degrees Celsius. TDS (ppm) had a mean of 30.01 and a range of 5.10 to 50.20 ppm. This outcome is significantly lower than the 300–500 ppm WHO standard. This shows that the samples' conductivity ranged from 7.48 to 95.2 us/cm, with a mean of 53.24 S/cm. Salanity had a mean of 0.0029 ppm and a range of 0.00 to 0.006 ppm. These findings suggest that the water is tasty. Cu > Fe > Cr > Pb > Mn > Cd was found in the examination of the chosen heavy metal, with mean concentrations of 1.632, 0.2173, 0.0337, 0.0255, 0.0206, and 0.0021 mgl-1, respectively. The WHO's (2008) drinking water acceptable limit was exceeded by all of these elemental results. These findings could not indicate a significant short-term health risk. The WHO's (2008) drinking water acceptable limit was exceeded by all of these elemental results. These findings could not indicate a significant short-term health risk. However, as this study was conducted during the rainy season, the well water should be continuously monitored, primarily throughout the dry season. Once more, lime treatment is necessary to make these well fluids drinkable and appealing.

Keywords: Investigation, Physico-chemical, well water, heavy metal, portable.

1. INTRODUCTION

It is easy to dispose waste water; surface water is susceptible to pollution. Untreated sewage, industrial waste, nitrates from animal waste, chemicals from industry, and fertilizer are the main causes of pollution, which is becoming a major ongoing issue. It can be quite significant because urban growth and population growth are some of the reasons that lead to water contamination (Tekenah et al., 2014). However, rivers in urbanized cities are crucial for transporting industrial waste water, manure discharges, runoff from streets and agricultural practices, and river population (Abogan, 2014).

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The industries that affect our environment and mining operations are the most significant producers of heavy metals in our urbanized areas. However, the detrimental impacts of heavy metals as environmental contaminants are mostly caused by two sources. Because they are easily digested and non-biodegradable, aquatic animals and plants can bio accumulate them (Tekanam et al, 2014). A significant quantity of heavy metals from both natural and man-made activities enters aquatic environments. These could be transmitted as dissolved species in water or as a crucial component of suspended sediments when incorporated into the food chain; their possible toxicity could harm human health (Marcovecchio et al., 2007).

One of the natural resources that keep humans and other living things alive on Earth is water. Water can be found all over the planet. We have both groundwater and surface water bodies. While subterranean water bodies are primarily made up of water from beneath the earth's surface, surface water comprises streams, lakes, seas, and oceans (Babatunde and Wokoman, 2013).

An excellent source of drinking water for humans is groundwater. Its water is a significant supply of high-quality water and has more freshwater than groundwater, which is widely used. This exploitation is used for industrial, agricultural, and household purposes. The need for portable water has increased as a result of urbanization and rapid population rise.

According to Abogan (2014), ground water contamination is a slow deterioration of water quality caused by the addition of hazardous chemicals, heat, or microorganisms that pose a risk to public health and negatively impact domestic industrial and agricultural use.

Concerns have been raised about heavy metal toxicity, even at low concentrations (Marcovecchio et al., 2007). These heavy metals include arsenic (As), lead (Pb), silver (Ag), chromium (Cr), copper (Cu), iron (Fe), platinum (Pt), cadmium (Cd), and manganese (Mn). While some heavy metals are necessary for life at low amounts, they can be dangerous at high concentrations.

We shall investigate the presence of lead (Pb), chromium (Cr), cadmium (Cd), manganese (Mn), and copper (Cu) in Zaakpon Community in Khana Local Government Area of Rivers State because heavy metals are harmful due to their bioaccumulation.

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METHODS

The materials used for the analysis are as follows:

- pH
- Conductivity meter
- Thermometer
- Atomic absorption spectrophotometer
- Beakers
- Ethanol
- Distilled water
- Reagents
- Masking tape
- Well water samples

SAMPLES COLLECTION

Ten (10) well locations were selected for sample collection during the research in September 2025 in order to examine the water quality of Zaakpon Community. One-litre polystyrene bottles were used to collect the samples. Prior to this, all glassware were carefully cleaned using distilled water, ethanol, tap water, and detergent. As soon as they were brought to the laboratory, chemical parameters were determined using established procedures. To preserve the sample, preservation methods were used.

Ten (10) distinct wells, labeled A through J, were used to collect the samples in plastic cans, which are one-litre plastic containers with caps or covers.

At the time of collection, the samples' temperature and time were recorded in the field. Prior to analysis, it was stored in a laboratory refrigerator at -40°C. The common-sense organs were used to assess its color.

ANALYSIS

Analyses were carried out for various water quality parameters such as pH, total water quality parameters such as pH, total dissolved solid (TDS), total hardness TH. 100ml of all samples ranging from A-J were collected and at point of collection temperature were determined using a mercury in –glass thermometer in situ. The samples were them taken to the laboratory, while in the laboratory, the pH was determined using pH meter, which was calibrated using the conductivity meter. The total alkalinity, total hardness and total dissolved solid (TDS) were determined using gravimetric technique and finally the heavy metals were analyzed using Atomic Absorption spectroscopy (AAS) to determine the percentage concentration of heavy metals such as Pb, Cr, Cd, Fe, Mu, and Cu present in the well water samples.

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RESULTS

The results of analysis show a remarkable insight into the pollutants in the study location:

Table 1. Physico-chemical parameters of sampled well water

PARAMETERS	SAMPLES OF WELL WATER										
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**WHO LIMIT**
PH	2.58	3.86	4.19	4.10	2.98	3.06	4.10	4.30	2.80	3.50	
Temperature °C	26.8	36.3	26.3	26.5	26.0	24.8	26.2	25.7	26.4	26.8	26 – 28
TDS (ppm)	21.00	48.00	34.61	3.78	5.10	20.30	37.70	41.30	38.10	50.20	300–500
Conductivity (us/cm)	42.40	95.20	69.60	7.48	10.24	11.50	91.80	80.30	50.70	73.2	250
Salinity (ppm)	0.001	0.002	0.006	0.001	0.003	0.00	0.004	0.006	0.005	0.001	250
Lead (Pb) (Mgl^{-1})	0.0114	0.0183	0.0138	0.0127	0.042	0.051	0.040	0.011	0.023	0.031	< 0.05
Chromium Cr (mgl^{-1})	0.0142	0.0416	0.0667	0.005	0.0341	0.0276	0.0410	0.0422	0.0378	0.0266	0.05
Cadmium (Cd) mgl^{-1}	< 0.001	0.0010	0.0030	< 0.001	0.0031	0.0032	0.0029	0.0026	0.0030	ND	0.003
Manganese (Mn) mgl^{-1}	0.0092	0.010	0.032	0.0196	0.0203	0.030	0.033	0.028	0.0200	0.0034	< 0.3
Cupper (Cu) mgl^{-1}	1.350	1.410	1.280	1.390	1.750	1.920	1.850	2.010	1.940	1.420	2.0
Iron (Fe) mgl^{-1}	0.123	0.150	0.230	0.320	0.290	0.175	0.210	0.27	0.220	0.190	0.3

ND = Not Detectable.

Table 2. GPS of Zaakpon Community

1.	$ZAAKPON_1$	4.6539125 7.3794804	OPEN WELL
2.	$ZAAKPON_2$	4.66150125 7.3765846	OPEN WELL
3.	$ZAAKPON_3$	4.6583445 7.3788759	OPEN WELL
4.	$ZAAKPON_4$	4.6557468 7.3792250	OPEN WELL
5.	$ZAAKPON_5$	4.6584370 7.3793481	OPEN WELL
6.	$ZAAKPON_6$	4.6594320 7.3797786	OPEN WELL
7.	$ZAAKPON_7$	4.6612400 7.3752001	OPEN WELL
8.	$ZAAKPON_8$	4.6617068 7.3764128	OPEN WELL
9.	$ZAAKPON_9$	4.6618725 7.3750081	OPEN WELL
10.	$ZAAKPON_{10}$	4.6615463 7.3763887	OPEN WELL

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Summary of Results

Table 3. WHO, USEPA and SON permissible limit for some heavy metals on drinking water.

Heavy Metal	WHO limit Mg/l	USEPA Mg/l	SON limit Mg/l
Lead (Pb)	0.005	-	0.1
Chromium (Cr)	0.05	0.1	0.05
Cadmium (Cd)	0.005	0.005	0.003
Manganese (Mn)	0.3	0.1	<0.3

Table 4. Maximum, minimum, mean values with WHO permissible limits

PARAMETER	MIN	MAX	MEAN	WHO LIMIT
pH	2.58	4.30	3.547	6.5 – 8.5
Temp. °C	24.8	36.8	28.18	26 – 28
TDS (ppm)	5.10	50.20	30.01	300 – 500
Conductivity (μ S/cm)	7.48	95.2	53.24	250
Salinity (ppm)	0.00	0.006	0.0029	250
Lead (Pb) mgl^{-1}	0.0114	0.051	0.02548	< 0.05
Chromium (Cr) mgl^{-1}	< 0.005	0.0667	0.03368	0.05
Cadmium (Cd) mgl^{-1}	< 0.001	0.0032	0.00208	0.003
Manganese (Mn) mgl^{-1}	0.0034	0.033	0.02055	< 0.3
Cupper (Cu) mgl^{-1}	1.2810	2.010	1.632	2.0
Iron (Fe) mgl^{-1}	0.123	0.320	0.2178	0.3

ND = Not Detectable

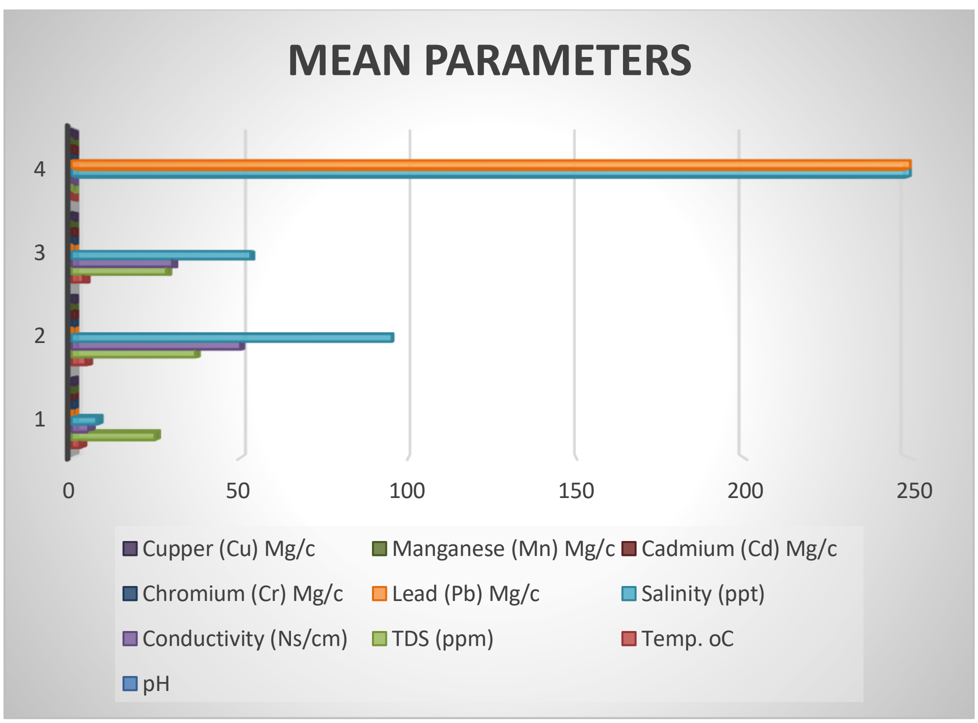

Figure 1. Comparison of mean parameters with WHO limit

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DISCUSSION

The ten (10) samples' pH values ranged from 2.58 to 4.39, with a mean of 3.547, which is strongly acidic, indicating that the well fluids at Zaakpon were acidic. The WHO acceptable range of 6.5 to 8.5 is exceeded by all of these values. Acid rain caused by atmospheric carbon dioxide and other airborne contaminants could be the cause of this. The usage of fertilizer, insecticides, herbicides, and pesticides may be to blame. Since Ogoni is an oil-producing community, the impact of oil exploration and exploitation may also be a problem. This means that the geological formation of the oil source and bearing rock may create leaks and migrate to the wells.

With the exception of samples A and B, which had temperatures of almost 300 degrees Celsius, and sample F, which had a temperature of 24.80 degrees Celsius, the well water's temperature (oC) did not present a risk; all other samples met the WHO's acceptable range of 26 to 28 degrees Celsius. The results showed that the TDS (ppm) was less than 50 ppm. This suggests that the TDS level is exceptionally low and is typically the product of extensive filtration, such as reverse osmosis (RO) or distillation, and that the water is very pure but nearly mineral-free. Its concentration ranged from 11.50 to 95.2 μS/cm, with a mean of 53.24 μS/cm, according to the conductivity result. This suggests that the quantity of dissolved minerals and salts in these well waters is quite low. Consuming such demineralized water exclusively or over an extended period of time may be harmful to one's health.

The salinity result had a mean of 0.0029 ppm and varied from 0.000 to 0.006 ppm. This finding suggests that the well water is of excellent quality for almost all uses. Lead (Pb) results indicated that, with the exception of sample "F," all other samples were below the WHO limit of 0.05. As a result, consuming these well waters won't be problematic.

The chromium concentration results revealed that all samples had values below the WHO limit of 0.05 mgl-1, which may not pose a risk to the residents' lives. Only two samples, E and F, had cadmium levels that were very slightly above the WHO limit, according to the results. The results in all other samples fell within the standard. As a result, the short-term risk of cadmium pollution cannot be substantial.

All of the manganese (Mn) results were below the WHO Limit of less than 0.3 mgl-1, which may not pose a serious health risk. The copper (Cu) test indicated that "sample H" was 0.010 mgl-1 above the WHO limit. All other samples were below the WHO standard of 2.0 mgl-1. In the short term, this might not be fatal. With the exception of "sample D," which had an iron (Fe) value of 0.320 mgl-1, all of the results were below the WHO standard. It is crucial to state that these well waters are portable because all seven (7) of the heavy metals examined were nearly within the acceptable WHO guideline for drinking water. Additionally, there is no indication of heavy metal pollution in general based on these results.

Secondly, the results of the physiochemical examination do not pose much threat to the dwellers and residents of Zaakpon community.

CONCLUSION

The concentration of the metals is Cu > Fe > Cr > Pb > Mn > Cd, with means of 1.362, 0.2173, 0.0337, 0.0255, 0.0206, and 0.0021 Mgl-1, respectively, according to the trend of the results of the investigation of some heavy metals present in some selected well water in the Zaakpon community. When compared to the WHO drinking water limit (WHO, 2008) and BIS 10500 (2012), these amounts might not indicate any significant health risks in the near future.

RECOMMENDATIONS

The following are suggested in light of the investigation's findings:

1. Additional research utilizing X-rays should be used for additional analysis to support our findings.
2. Since this study was conducted during the rainy season, well water should be continuously monitored to determine whether the acidity of these wells would decrease, particularly during the dry season.
3. Limes and other chemicals should be used to treat these acidic wells in order to lessen their acidity.
4. The inhabitants should be informed about the physiochemical and elemental properties of these waters.
5. To find out their health state, residents should be asked to visit the doctor on a regular basis.

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