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Analysis of Water Sources in Ikwo Local Government Area of Ebonyi State, Nigeria

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ABSTRACT

Water samples from various sources in Ikwo Local Government Area of Ebonyi State Nigeria were analyzed using standard methods during the dry season. These sources are used for agricultural, domestic and commercial purposes and were analyzed for physicochemical properties as well as some heavy metals contents. The pH of all the water samples were within the normal range except for Ogbara Ebonyi stream, Igboji and Eduku bore-holes which were alkaline. The samples were low in conductivity but Idumowo well was very high in conductivity indicative of high level of dissolved minerals and electrolytes. The total suspended solids were generally lower than 350ppm while the total dissolved solids were generally less than 100ppm. The analysis of mineral concentrations revealed that iron was highest 0.211µg/ml in Ekpor Omaka well and lowest 0.094 µg/ml in Igboji bore-hole. The level of sulphates was significantly high ($p<0.05$) in Idumowo well compared to the rest of the sources while the concentration of copper ranged from 0.125µg/ml in Igboji bore-hole to 0.297µg/ml in Ogbara Ebonyi stream. The highest concentration of magnesium was found in Ekpor Omaka well. However, there was no significant difference ($p>0.05$) in the level of copper and magnesium when compared with each other. Lead and arsenic were found at various concentrations in the water samples. The results of the physicochemical properties were within the recommended levels for safe drinking or portable water except for nitrates and heavy metals. The water sources were not good for domestic and portable water, especially for children. This could be the cause of poor intelligent quotient and certain abnormal symptoms in the area that are attributed to evil medicine. They are good sources of water for agricultural purpose.

Keywords: Water, Ikwo, minerals, heavy metals.

INTRODUCTION

Water is a good solvent and picks up impurities easily. Pure water is tasteless, colorless, and odorless. As water moves through soil and rock, it dissolves very small amounts of minerals and holds them in solution. Calcium and magnesium dissolved in water are the two most common minerals that make water "hard." The degree of hardness becomes greater as the calcium and magnesium content increases and is related to the concentration of multivalent cations dissolved in the water [1].

Clean drinking water is essential to human and other life forms. Access to safe drinking water has not improved in the developing countries substantially over the last decades. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability [2]. All the major components in cells (proteins, DNA and polysaccharides) are also dissolved in water. Pure water has a low electrical conductivity, but this increases significantly with the dissolution of a small amount of ionic materials. Thus, the low electrical conductivity of water increases significantly upon solvation of a small amount of ionic material, such as hydrogen and

sodium chloride or any salt. Thus the risks of electrocution are much greater in water with impurities [1].

Water fit for human consumption is called drinking water or potable water [3]. To function properly, the body requires between one and seven liters of water per day to avoid dehydration; the precise amount depends on the level of activity, temperature, humidity, and other factors. Most of this is ingested through foods or beverages other than drinking straight water. It is not clear how much water intake is needed by healthy people, though most advocates agree that 6–7 glasses of water (approximately 2 liters) daily is the minimum to maintain proper hydration [4]. The dietary reference intake report by the United States National Research Council in general recommended (including food sources): 2.7 liters of water total for women and 3.7 liters for men [5].

MATERIALS AND METHODS

The water samples were collected randomly in various parts of Ikwo L. G. A. of Ebonyi state with washed, clean and dry water bottles. They were labeled and taken to the laboratory immediately for analysis. The water samples were collected in November during the dry season, the period these poits are exploited as sources of water for domestic and farm use.

Ikwo is one of the Local Government Areas in Ebonyi State Nigeria. The villages do not have access to portable water and depend primarily on in-land water bodies for domestic, recreational and agricultural purposes. The major sources of water include streams, wells and bore-holes. Some of the bore-holes were sunk by donor agencies and the state government to help alleviate the sufferings of the people while the average farmers dig wells to provide water for their compound and extended families. This work is aimed at providing results of preliminary investigation into the water sources randomly picked to know how safe and portable the sources are. It is hoped that it will provide information necessary in the planning the best treatment procedure to make the water safe and portable, especially as the source of portable water is very far from the reach of the villagers.

BACKGROUND OF WATER SOURCES

Ikpor Amaka Well is a seasonal water source for a section of the village and it is do not use for drinking or washing but for a sole purpose of boiling raw harvested rice. Ebonyi River is diverted because of the road construction in this zone, so oil and other particulate organic matter with metals scrabs have polluted the water. Idumowo well is not used for cooking, drinking or washing of household purpose. This is because when yam for instance is boiled with it, the yam turns red in colour. Water from this well is used mainly for processing and boiling raw rice. Ogbara Ebonyi Stream is located close to Ebonyi River. Though the source of the water is not very clear, it is used for washing but not as protable water because it is not always very clean. Igboji Borehole is located in a hospital premises. It was meant to serves the patients, medical personnels and the host village. Eduku Borehole water is hard and tastes salty.

METHODS: the methods of [1] and [6] were used in the analysis of the water samples. The pH meter was used for the determination of the pH. The conductivity was determined using the conductivity electronic meter.

RESULTS

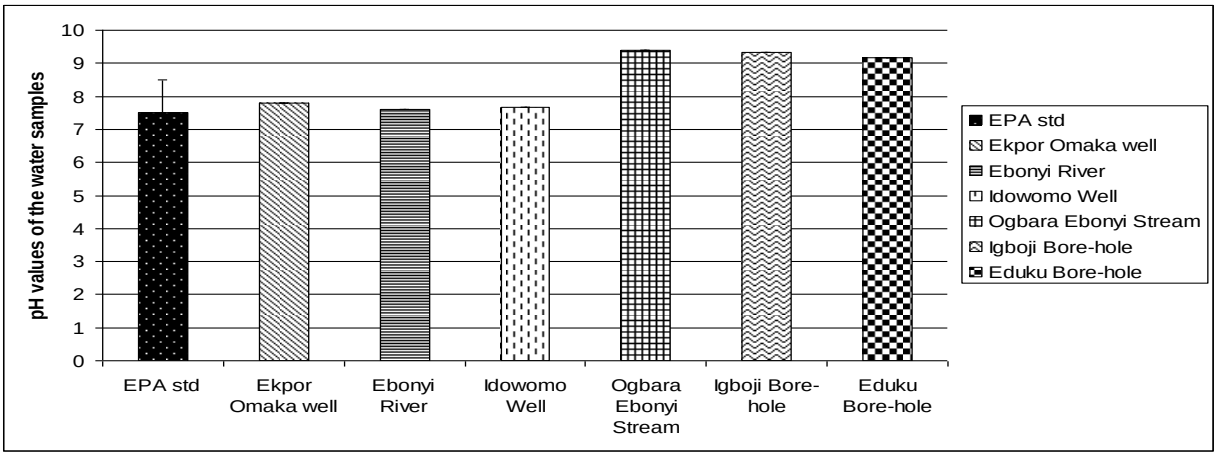

Figure 1: pH values of the various sources of water in Ikwo Local Government Area of Ebonyi State Nigeria.

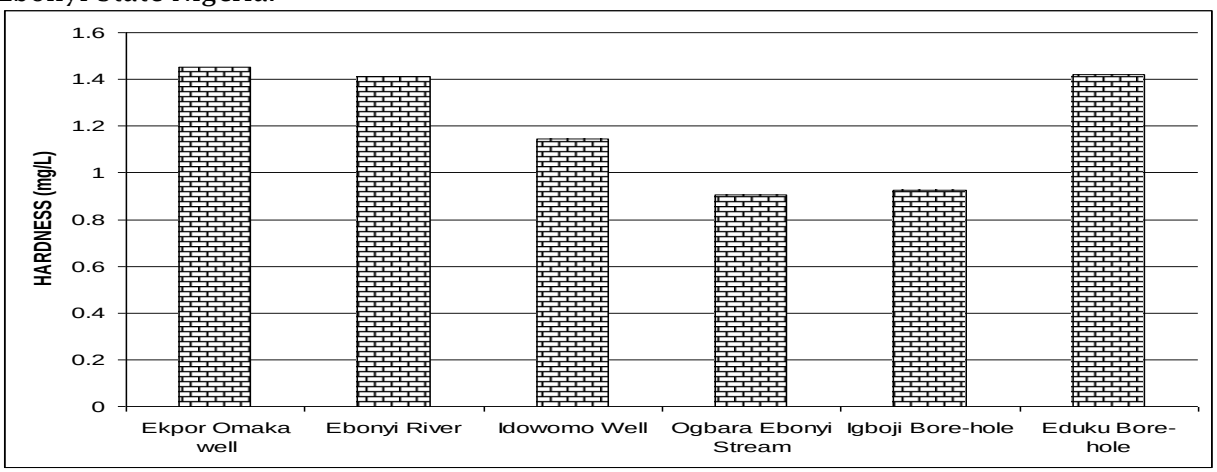

Figure 2: Hardness of the water samples in mg/L.

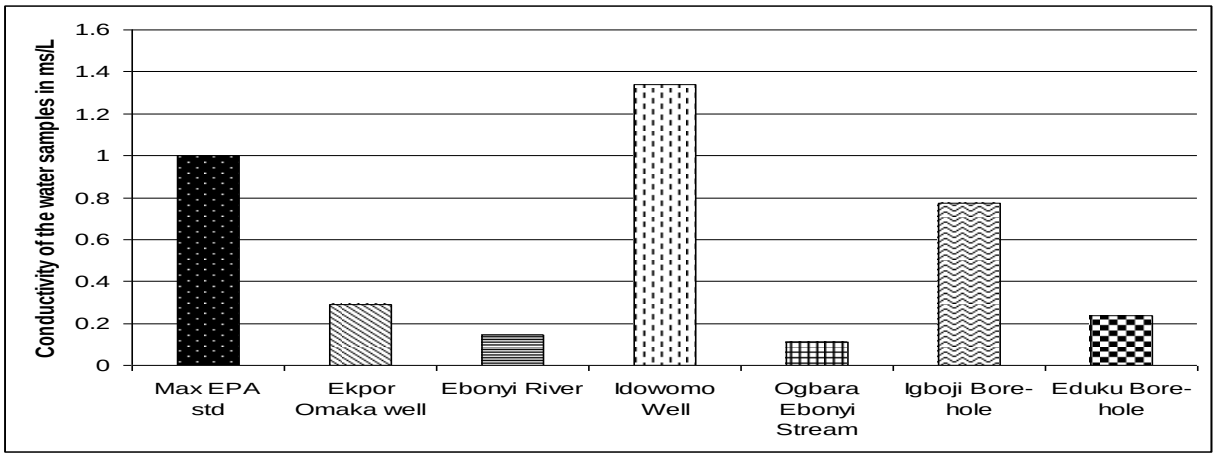

Figure 3: Conductivity in ms/L.

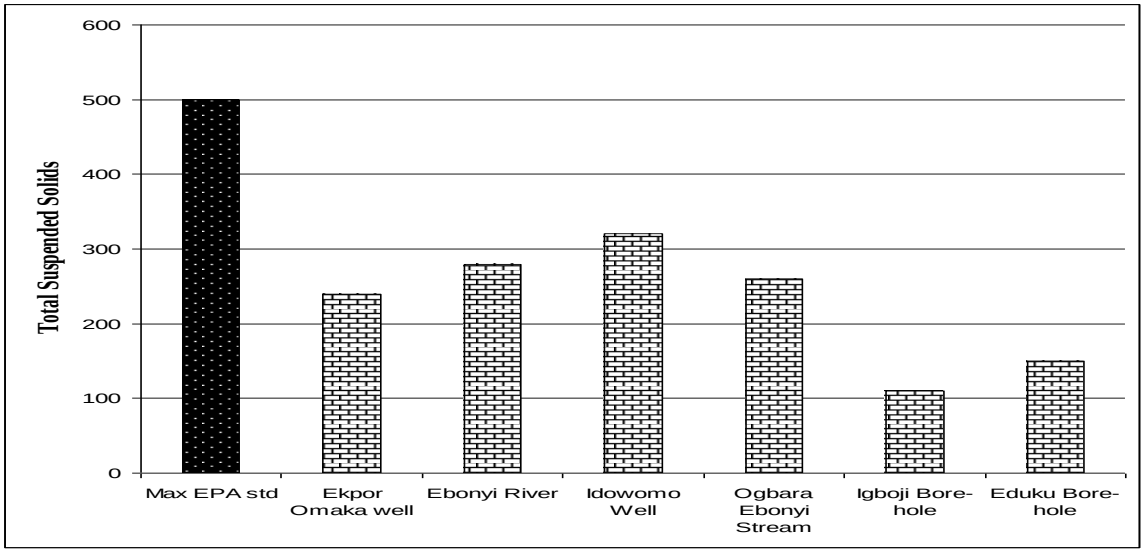

Figure 4: Total Suspended Solids in parts per million (ppm)

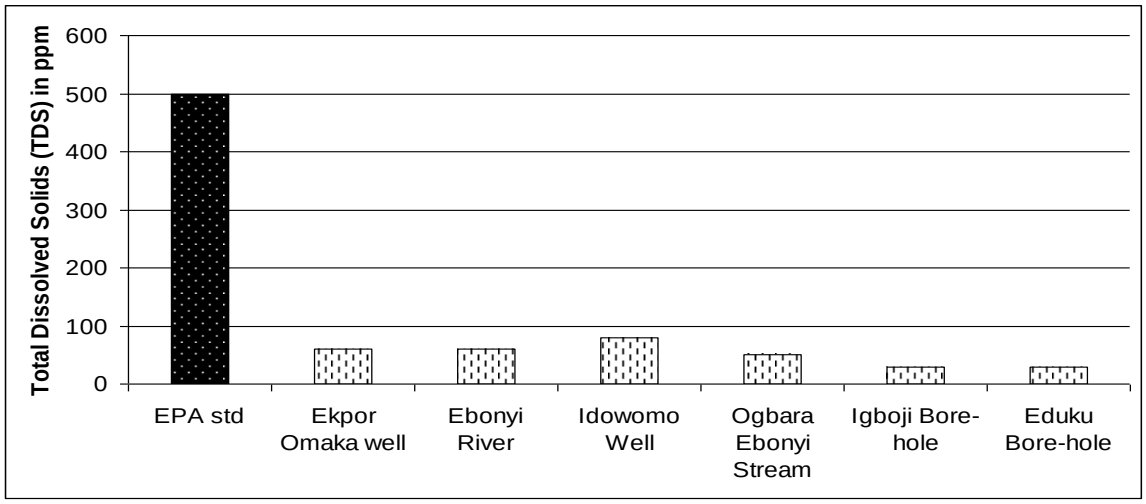

Figure 5: Total Dissolved Solids in parts per million (ppm).

Table 1: Mineral Components of the Water Sources in Ikwo, Ebonyi State Nigeria in µG/100ml.

	Location	*Iron (Fe) in µg/ml*	*SO_4^{2-} in µg/100 ml*	*Nitrate in µg*	*Cu in µg/ml.*	*Mg in µg/ml.*	*Lead (Pb) in µg/100 ml.*	*Arsenic in µg/100 ml.*
1	Ekpor Omaka well (15ft)	0.211±0.001	3.685±0.010	229.00±0.820	0.143±0.000	0.274±0.002	0.026±0.000	0.025±0.001
2	Ebonyi River	0.164±0.012	2.463±0.002	204.00±1.021	0.174±0.001	0.232±0.011	0.011±0.000	Nil
3	Idowomo Well (17ft).	0.133±0.002	92.960±0.204	283.00±1.21	0.229±0.002	0.223±0.154	0.011±0.000	Nil
4	Ogbara Ebonyi Stream	0.141±0.001	2.222±0.052	248.00±0.984	0.297±0.001	0.211±0.001	NIL	0.025±0.001
5	Igboji Bore-hole	0.094±0.000	2.278±0.001	235.000±1.221	0.125±0.001	0.171±0.003	0.016±0.001	0.025±0.001
6	Eduku Bore-hole	0.203±0.001	2.315±0.001	216.000±0.998	0.281±0.001	0.158±0.017	0.005±0.000	Nil

The pH of Ikpor Amaka Well was good and the water was found to be soft hard water [7] with moderate TDS and TSS and low conductivity. The levels of iron, sulphate and magnesium were within acceptable range. The levels of nitrate, copper, lead and arsenic were higher than the upper limit of the recommended standard levels for safe drinking water, thereby rendering the source unsafe.

Ebonyi River has normal pH, water hardness was soft, with relatively high TDS and TSS, low and normal levels of iron, sulphate, copper and magnesium. Arsenic was not present. The water was not safe for drinking especially by children due to high nitrate level and presence of lead.

Idumowo Well had pH within a normal range. The water hardness was soft. The conductivity was high (high in electrolytes), with a relatively high level of TDS and TSS. The iron level, copper and magnesium were normal but sulphate level was relatively high. The nitrate level was very high and lead was also present, while arsenic was not present. The water is not a good source of water for domestic purposes.

Ogbara Ebonyi Stream had a high pH indicative of high alkalinity, with a high level of electrolytes (conductivity). The levels of the TDS and TSS were within acceptable range of standards [7] but relatively high while the levels of iron, sulphate, copper and magnesium were normal. The level of nitrate was very high and arsenic was also present, though lead was totally absent.

Igboji Borehole water was hard and salty. The water was very alkaline with a high pH, hardness was soft and conductivity was low. There was normal level of TDS and TSS which was relatively low when compared with the river and well sources. The levels of iron, sulphate copper, and magnesium were low and normal. The water was high in nitrate, lead and arsenic which will render it unsafe for drinking and domestic purposes. Eduku Borehole water was very alkaline, soft hard, low in electrolyte, low but normal levels of TDS and TSS, normal levels of iron, sulphate, copper and magnesium. Nitrate was very high as well as lead but there was no trace of arsenic.

DISCUSSION

The water from *Ekpor Omaka* well, *Ebonyi* River and *Idomowo* well had good pH but the water in *Ogbara* Ebonyi Stream, *Igboji* borehole and *Eduku* borehole had high range of pH, indicating that the water samples in the area were alkaline. The normal range of pH acceptable for safe and portable water is between 6.5 – 8.5 [7]. This high pH can lead to formation of a "scale" or precipitate on piping and fixtures causing water pressures and interior diameter of piping to decrease; causes an alkali taste in the water and can make coffee taste bitter; formation of a scale or deposit on dishes, utensils, and laundry basins; difficulty in getting soaps and detergents to foam and formation of insoluble precipitates on clothing, etc.; and decreases efficiency of electric water heaters. It also showed that there were high levels of dissolved substances in the water. The total suspended and dissolved solids were found to be lower than acceptable range of standards of 500mg/L by [7]. An elevated total dissolved solids (TDS) concentration is not a health hazard. The TDS concentration is a secondary drinking water standard and therefore is regulated because it is more of an aesthetic rather than a health hazard. An elevated TDS indicates the following: The concentration of the dissolved ions may cause the water to be corrosive, have salty or brackish taste, result in scale formation, and interfere and decrease efficiency of hot water heaters; and many contain elevated levels of ions that are above the Primary or Secondary Drinking Water Standards, such as: an elevated level of nitrate, arsenic, aluminum, copper, lead, etc.

Generally, the level of nitrate was very high, though highest in *Idomowo* well. The EPA standard for nitrogen is 10mg/L [7]. Nitrogen is usually present in the form of ammonia (NH_3), nitrite (NO_2), and nitrate (NO_3), Infants drinking baby formula or water that contains an elevated level of nitrate or nitrite the baby could die from the disease "methemoglobinema". Nitrite is absorbed into the body when in excess and reacts with the blood (hemoglobin) to form methemoglobin. Since hemoglobin carries the oxygen throughout the body and methemoglobin can not carry oxygen, the infant can suffocate due to lack of oxygen" [8]. This is why this is sometimes known as "Blue Baby Syndrome". High level of nitrate in water has been related to cancer, so it is adviseable to reduce exposure to sources of nitrates. Nitrate contamination is typically a problem in agricultural areas, but other rural non-agricultural communities are also at risk. Sources of nitrates include animal waste, fertilizers, natural deposits, septic tanks and sewage while the clinical manifestation shows as methemoglobinemia. The only ways to prevent nitrate contamination of a water supply include: proper siting of water system, proper management of fertilizers and manure, proper well construction (sanitary wells), and install point-of-use water treatment devices. The primary water treatment devices for nitrate removal include: ion exchange resins, distillation, and reverse osmosis. However, adults are tolerable to the high nitrate contents of the samples. Meanwhile, the high nitrate content will be beneficial to agriculturists since it is a source of the organic nitrogen content of plant proteins [9]. Iron is a component of hemoglobin and cytochromes while magnesium is needed as a component of chlorophyll [10].

Copper was high in *Ekpor Omaka* well. The EPA standard for copper in drinking water is 1.30mg/L [7]. *Idomowo* was found to be high in conductivity, indicating a high level of electrolytes and dissolved minerals. Excess electrolytes might cause imbalance in electrolyte profile which can lead to clinical problems ranging from malabsorption to toxicity. The safe level of the conductivity is 1ms/L. The value of the sulphate level was also relatively high, though still below 250mg/L safe range for portable water. Lead was present was present in all the samples except *Ogbara Ebonyi.* Like nitrate, it is difficult to understand why lead in drinking water is a potential health hazard or even a concern. The result obtained from this study is comparable to the data obtained for water sources in Ohaozara Local Government Area of same state in Nigeria [9].

Lead is a toxic metal that is harmful to human health; there is no safe level for lead exposure. The degree of exposure depends on the concentration of lead, route of exposure (air, water, food), current medical condition, and age. It has been estimated that up to 20 % of the total lead exposure in children can be attributed to a waterborne

route, i.e., consuming contaminated water. In addition, infants, fetuses, and young children are particularly vulnerable to lead poisoning. This is because they usually consume more water and their bodies are actively developing, which facilitates the bioaccumulation of lead. High levels of lead contamination in a child can result in convulsions, major neurological damage, organ failure, coma, and ultimately death. Moderate to low levels of exposure may result in hearing loss, inhibit growth, and cause learning disabilities. There may be no signs of lead poisoning or the signs could mimic a flu or other gastrointestinal disease. The symptoms may include: cramps, irritability, fatigue, vomiting, constipation, sleep disorder, poor appetite, and trouble sleeping. Unlike other contaminants, lead will accumulate within the body over time, i.e., bioaccumulate. Lead will tend to be stored in the brain, bones, kidneys and other major organs. It can be stored in child's blood for months and bones for many decades. Some of the effects of lead poisoning can not be cured, but it is possible to reduce exposure to lead. In the kidneys, lead decreases the ability of the kidneys to excrete uric acid [10]. Arsenic was also present in the samples except in Ebonyi River, Idumowo well and Eduku borehole. This heavy metal has similar effect with lead and the safe limit as approved for drinking water is 0.05mg/L[11].

CONCLUSION

The water sources were found to be high in nitrates and lead and/or arsenic were present in all the water samples. Contaminated water sources could result to poor brain development, delayed immune response, impaired tissue function and malformation and low intelligent quotient among the people. This was probably the reason why the area was considered as an educationally backward community because of poor performance of the people academically.

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