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ASSESSMENT OF PHYSICOCHEMICAL AND HEAVY METAL CONCENTRATION LEVELS OF SOGIDI LAKE WATER SUITABILITY FOR DRINKING

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Abstract
Sogidi Lake in Awe, Afijio Local Government of Oyo State is considered sacrilegious for the mystery of its healing power and mythical fishes that inhabit the water. People from home and abroad drink the raw water without any form of pretreatment believing the water is safe for drinking. This study attempted to assess the suitability of the water for drinking by a way of providing an empirical and scientific base. Heavy metal concentrations were determined by using atomic absorption spectrophotometer and physicochemical parameters were determined using standard methods. The result obtained from the analysis showed the order of concentration of the heavy metals detected in the water samples analyzed to be in the sequence of Zn > Ni > Cr > Pb > Cd > Ag > Hg and physicochemical parameters COD > BOD > Sulphate > TS > TSS > Chlorine > TDS > DO. It was observed that, the mean value of heavy metals in the water samples analyzed showed abnormal higher concentration than recommended values for drinking water except, Lead (Pb). Physicochemical parameters Sulphate, Chloride, TDS, and DO had concentrations within the acceptable limit set by World Health Organisation (W.H.O. 2011).

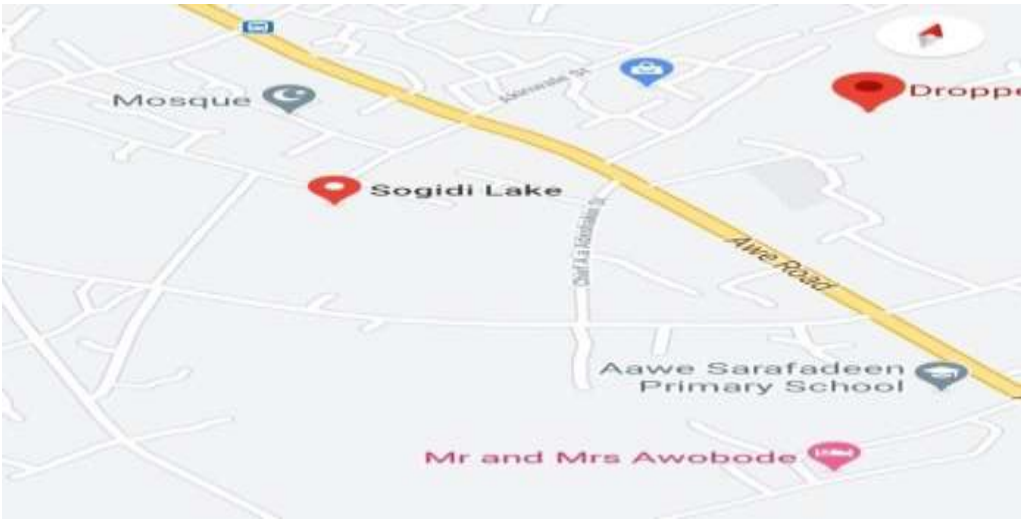
Keywords: Sogidi Lake, Mythical fishes, heavy metal, physicochemical parameters

Introduction

Water is one of the essential life supporting natural resources on which man and other living organisms depend for existence. Water can be broadly grouped into surface water and groundwater. Surface water bodies include: stream, lakes, sea and oceans, while groundwater water refers to water formed beneath the earth sub surface such as well water, borehole etc.

Sogidi Lake was discovered in 1750 in Awe. Awe is located on **Latitude:** 7.8200° N

Longitude: 3.9657° E covering RXC8+278, 211106 Area. Awe is a town very close to Oyo in Afijio Local Government Area of Oyo State, Nigeria. People believe Sogidi lake has healing power against barrenness, that they usually come to the lake to say special prayers and drink the water.



Map of Aawe showing Sogidi Lake
Source: (Google Maps)

According to Custodian, Sogidi water could appear rough but it is clean, odourless, healthy and good for drinking as well as being highly medicinal. Also claimed the water tastes like any of the well treated and there has never been any record of cholera breakout in the town as a result of drinking the water.

Water pollution has become one of the greatest challenges to Nigeria especially in rural areas with low income (Muta aHellandendu, 2012).

Though Sogidi lake environment is dead quiet and serene, Awe been an industrialized home of a big pharmaceutical company and a farm, Bond Chemical and Amo Byne respectively, like any other industrial area is prone to pollution by industrial effluents. In Nigeria, most portable water sources get contaminated through anthropogenic activities (Izah, Chakrabarty & Srivastav, 2016).

According to Izah and Ineyougha (2015) and Kolo and Waziri (2012), portable water for human consumption must be free from any kind of chemical and microbial contaminants. Miller et al (2004) opined that effluents from manufacturing industries such as mining contaminate the water. Other industries like textile, metal, dying chemicals, fertilizers, pesticides, cement, petrochemical, energy and power, leather, sugar processing, construction, steel, engineering, food processing etc typically contain several types of toxic elements.

Heavy metals are natural elements characterized by their rather high atomic mass and their high density. Specifically, metals which have ≥ 5cm^3 specific gravity are known as heavy metals (Idris et al., 2013) and Oladejo and Ayankoso (2022). These metals include lead (Pb), cadmium (Cd), zinc (Zn), mercury (Hg), arsenic (As), silver (Ag), chromium (Cr), copper (Cu), iron (Fe), platinum (Pt) and manganese (Mn). These heavy metals in water are toxic even at very low concentration and can accumulate in human body depending on the type (Elinge et al., 2011). Heavy metals particularly are of great concern, due to their toxicity even at low concentrations (Marcovecchio, et al, 2007). Heavy metals are dangerous because they tend to bio- accumulate resulting in heavy metals poisoning. When humans are exposed to heavy metals above the permissible limits, disease conditions may occur (Izah, Chakrabarty & Srivastav, 2016).

It is imperative to assess the suitability of Sogidi lake water for drinking in respect of the heavy metal concentration and physicochemical properties as against acceptable standards for drinking water.

Water Sampling and Sample preservation

Water sample was collected from the study area in a five litre plastic keg and acidified immediately with 2mL of HNO_3 and kept in ice chest to reducing the temperature, the microbial activity and prevent evaporative

loss of the ILRs (Ignitable Liquid Residue). Prior the sampling, the plastic keg was rinsed three times with the water to be examined. After Sampling, the odour and colour of the water sample were determined on site using Qualitative Human Receptor .The sample was transported to the laboratory within 2hrs for analysis of heavy metals and physicochemical parameters.

Sample Analysis

Heavy metals contents were analyzed in the water sample using atomic absorption spectrophotometer (AAS) according to the standard methods of APHA. The metals analyzed include; Cd, Cu, Pb, Cr, Ni, Hg, Ag and Zn. Sawyer et al (1994) method was adopted for the physicochemical parameters (BOD, COD, DO, Sulphate, Chloride, TS, TSS, and TDS). Except for Chloride, TS, TSS, and TDS, that was analyzed using Argentometric Titration, Gravimetric,
Gravimetric after Filtration and Calculation from TS And TSS respectively.

Results and Discussions

The results of the analysis are presented in Tables 1 and 3 below. Table 1 showed the heavy metal concentration and some physicochemical parameters, Table 2 presented different guideline for permissible limits of heavy metals in quality drinking water, while Table 3 contained the result for the organoleptic tests. The World Health Organization Permissible limits are also included in the Table 1 for easy referencing and comparison with the determined values. The concentration of some heavy metals such as Cd, Cr, Ni, Hg and Zn and physicochemical parameters such as BOD and COD were found to be above the permissible values, while the concentration of heavy metals Ag and Pb and physicochemical parameters TSS, TS, TDS, CHLORIDE, DO AND Sulphate were found to be below the permissible value. All parameters were reported in mean value of the data (Table 1).

Table 1: Heavy metal and physicochemical concentration level of Sogidi lake water

SAMPLE PARAMETER	WATER VALUE 1	WATER VALUE 2	WATER MEAN	PERMISSIBLE LIMIT(mg/l) WHO (2008)
Pb(mg/l)	0.185	0.183	0.184	0.01
Cd(mg/l)	0.072	0.071	0.0715	0.003
Zn(mg/l)	55.80	54.88	54.84	3.00
Cr(mg/l)	33.65	33.09	33.37	0.05
Ni(mg/l)	48.79	48.77D	48.78	0.02
Hg(my/l)	0.029	0.027	0.028	0.001
Ag(mg/l)	0.067	0.070	0.0635	0.10
BOD(mg/l)	187.16	187.14	187.15	6.90
COD(mg/l)	329.74	329.77	329.755	10.00
SO4(mg/l)	167.59	167.62	167.605	250
DO(mg/l)	3.38	3.35	3.365	7.50
Total Dissolved Solid(mg/l)	10.00	10.20	10.00	259.500
TSS(mg/l)	20.20	20.00	20.00	-
TS(mg/l)	30.00	30.20	30.00	-
Chloride(g/l)	12.63	12.61	12.62	200

Table 2: Guideline for drinking water quality

Guideline for drinking water quality											
Limits	Fe	Zn	Cd	Cr	Pb	Hg	Cu	Co	Ni	Mn	Reference
SON	0.3	3	0.003	0.05	0.01	0.001	1	__	0.02	0.2	SON (2007)
WHO	__	__	0.003	0.05	0.01	0.006	2	__	0.07	__	WHO (2011)
WHO	0.3	3	0.003	0.05	0.01	0.001	2	__	0.02	0.5	Azizullah et al. (2011)
EU	0.2	0.02	0.005	0.05	0.01	0.001	2	__	0.02	0.05	Lenntech (2014)

Adapted from Izah, Chakrabarty & Srivastav (2016).

Lead (Pb)

The sampled water was determined to have 0.184mg/l lead concentration as against the allowed limit 0.01mg/l for drinking water recommended by WHO (2011), SON (2007) and EU
(Lenntec, 2014). The obtained value is about 20 times higher than the permissible limit. The raw
Sogidi water may not be safe for drinking. In human generally, exposure to high lead levels can severely damage the brain and kidneys and ultimately cause death. Specifically in pregnant women, high exposure to lead may cause miscarriage while in men it may damage sperm production organs (Martin & Griswold, 2009)

Cadmium (Cd)

Cadmium is classified as a very toxic metal. It is assigned a lower permissible limit 0.003ppm or m/l than even lead 0.01ppm or m/l, coming closely after the most toxic and intolerable heavy metal mercury (Hg) with 0.001ppm or m/l permissible limit. Cadmium and cadmium compounds are carcinogens to man and can bioaccumulate over a long term on low level exposure to cause kidney and lung damage. As against the allowed value, the concentration level of cadmium in the sampled water 0.0715ppm was higher than water permitted for drinking water, (Table 1).

Zinc (Zn)

Zinc (Zn) is a 'masculine' element that balances copper in the body, and is essential for male reproductive activity (Nolan, 2003). The water sample ad 54.84ppm Zn as against the permitted recommended 3.00ppm value WHO (2011), SON (2007) and EU (Lenntec, 2014). The high zinc intake may increase men sexual activity, libido and fecundity. This may serve as a source of high intake of zinc which may be advantageous for procreation, but it does not take away the threat of other toxic metals present in the water

Chromium (Cr)

Long term exposure to chromium portends serious damage to important organs like liver and kidney, likewise the nervous and circulatory system. Though Chromium (III) is consider benign, unlike Chromium (V) which is a toxic carcinogen. According to World Health Organization, the permissible limit of Chromium is 0.05mg/l. The sampled Sogidi lake water had 33.37mg/l concentration of chromium. This may pose a serious health challenge to those who rely on the water for drinking.

Mercury (Hg)

Mercury in soil and water is converted by microorganisms to methlymercury, a bioaccumulating toxin. Exposure to high levels of mercury can permanently damage the brain, kidneys and developing fetuses. Standard Organization of Nigeria permissible limit for mercury in drinking water is 0.001mg/l (SON, 2007). The concentration level of mercury determined as 0.028 mg/l in the Sogidi water is worrisome and may pose health challenges to consumer, as it can bioaccumulate to a lethal dose in human over time.

Table 3: Organoleptic assessment of Sogidi lake water

TEST	OBSERVATION
COLOUR	COLOURLESS
ODOUR	ODOUR FREE
TASTE	TASTELESS

Recommendation

The results of the research indicate that the physical and eavy metals analyzed from the sampled water from Sogidi Lake are above the permissible level recommended for drinking water by WHO and other reputable bodies. The research recommended that the water should be treated to remove toxic heavy metal contaminant before the water from lake could be used for drinking under any disguise, to forestall outbreak of water related diseases and bioaccumulation of heavy metals in the body.

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