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Determination of Lead Concentrations in Different Water Sources Collected From Sokoto Metropolis, Nigeria

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Abstract: *Lead is a common industrial metal that has become widespread in air, water, food and soil. Determination of heavy metals such as lead is very important because it shows toxic effect. Thirty nine samples of different sources of water were collected from different areas within Sokoto metropolis for the determination of lead, the measurement was done by Atomic Absorption Spectrophotometer (AAS). The lead concentration in all the water samples were less than the maximum limit of 50.0µg/l recommended for drinking water except only one well water sample i.e. Gidan Hamma with concentration of 52.0±2.9µg/l which is a little above world health organization tolerant limit of 50.0µg/l. The lead concentration of water from sources such as tap, well, river, bore hole and reservoir in Sokoto metropolis have normal lead level. Therefore, there is little risk to lead toxicity as a result of the water usage.*

Keywords: *AAS, Lead metal, Water, WHO, Sokoto Metropolis.*

I. Introduction

The importance of water to human and other living organisms cannot be over emphasised, there are experimental evidences that shortage of water can lead to sudden death of any living organism [1,2]. Since water is a good solvent, it will dissolve a large variety of substances than any other liquid due to it high solvation and auto protonation properties [3]. More than one billion people don't have access to recommended daily safe freshwater globally [4].Human beings have been exposed to heavy metals toxins for an immeasurable amount of time. Industrial waste are the major sources of various kinds of toxic metals which have non biodegradable and persistence properties resulted in a number of public health problems [5]. Due to accumulative toxicity to the human body, lead is one of the most toxic metals to man, because of their stability in contaminated sites and the complexity of mechanism for biological toxicity [6] Lead is a cumulative poison that enters the body from lead water pipes, lead based paints and leaded petrol. Heavy metals, like lead are those having densities greater than 5g/cm^3 [7]. They are stable bioaccumulative and can be toxic [8].Toxic metals are considered harmful to some people in some places [9]. While the toxic effects of these are widespread concern in the modern context, man has succeeded in poisoning himself with them throughout history [10]. Lead, even at low concentration is toxic to animals and humans [11]. Lead is easily absorbed through gastrointestinal tract. Around 70 – 90% of lead assimilated goes into the bones, kidney and liver [12] and affects the brain cells and liver membrane permeability, reducing some of these organs functions [13]. Lead interferes in metabolism of calcium and vitamin D and adversely affects haemoglobin formation and causes anemia it also adversely affects nervous system and causes behavioural abnormalities, retarding intelligence and mental development [14]. It can accumulate in the body and promote disturbances such as nausea, vomiting, diarrhoea, sweating and in some cases coma and death [15].

Atomic Absorption Spectrometry (AAS) is a widely used technique for quantification of metal species, has proved to be a powerful tool for trace element determination in a variety of materials in terms of the enhanced sensitivity, efficient matrix removal, high sampling frequency and low cost of equipment [16]. The present study reports a determination of mean lead concentration in drinking water from Sokoto metropolis, Nigeria, with the aim to ascertain whether the levels of lead contamination in the drinking water is sufficient to cause health hazards to living systems

II. Materials And Methods

2.1 Sample Collection

Samples of water were collected in clean 10 litres capacity plastic containers from different locations of Sokoto metropolis and labeled. The taps were allowed to run for at least two minutes before filling the container which has been rinsed severally with the water to be collected. Each sample was collected three times at an interval of about 5 hours to form a representative of the whole water for that particular area or zone [17].

2.2 Sample Treatment For Metals Determination

Each of the 5.0 liters samples was evaporated to dryness using Pyrex beaker and hot plate. The residues were digested with 50cm^3 of 0.25moldm^{-3}nitric acid and transferred into 120cm^3 plastic containers and then analyzed using atomic absorption spectrometry (AAS) [17].

World Health Organisation Maximum Tolerance Limit for lead (Pb) is 50µg/l

Table 1.0: Concentration of Lead in Tap Water

S/NO	Location	Pb (µg/l)
1	Faculty of Science UDUs P/site	29.0±3.5
2	Minnanata Opposite Rigiya Shehu	26.0±2.3
3	Mabera Magaji, Alh. Dan Ige	26.0±2.3
4	J. Aliex Down Town	22.0±2.9
5	Anguwar Rogo,Alh. Musa	26.0±2.3
6	Sokoto Stata water Board Deport	22.0±2.9
7	Mna Babba D/Hako	21.0±2.3

Results are mean ± standard error of mean of three replicates

Table 2.0: Concentration of Lead in River Water

S/NO	River	Pb (µg/l)
1	River Sokoto	26.0±2.3
2	River Zamfara	30.0±2.3

Results are mean ± standard error of mean of three replicates

Table 3.0: Concentration of Lead in Bore-hole and Reservoir Water

Location of bore hole water	**Pbµg/l**	**Location of reservoir water**	**Pb µg/l**
Kwalkwalawa,Gidan Kifi	**17.0±2.9**	**Dandima Opposite Gidan Wanka**	**31.0±1.2**
Gidan Alh. Bello Polo Club	34.0±2.9	PHCN/RSQ/98/005 Federal Housing	30.0±2.3
Alh. Abubakar Estate University	30.0±2.3	RSQ/45/192 Bye pass Road	27.0±3.5
Danko Road no.8	26.0±2.3	Gidan Igu'a Alh Shehu Roro	13.0±2.3

Results are mean ± standard error of mean of three replicates

Table 4.0: Concentration of Lead in Well Water

Location of well water	Pb µg/l	Location of well water	Pb µg/l
Gwiwa Low Cost Hausawa Road	19.0±4.0	Mabera G/dahala Malam Ali	26.0±2.3
Gidan Jariri Mabera Iddi	17.0±2.9	Mabera Iddi, Gidan Sarkin Baki	30.0±2.3
Minnanata Gidan Alh. Usman Yau	17.0±2.9	Polo Club, Gidan Mugitaba	13.0±2.3
Minnanata Rijiya Shehu	13.0±2.3	Gidan Hamma behind Mutipurpose Hall	52.0±2.9
Jacksons Downtown	26.0±2.3	Mana Karama Gidan Mai Anguwa	34.0±2.9
Dandutse behind Energy Research	26.0±2.3	Ringi Sambo Gidan Muazu Sulaiman	30.0±2.3
Gidan Marayu behind Multipurpose	27.0±3.5	Ringi Sambo near Primary School	33.0±4.0
Rijiya Magaji in UDUs	16.0±1.2	Mabera Iddi behind Nurul Hudu	36.0±1.7
Gidan Gabas in UDUs	22.0±2.9	Topau Kwalkwalawa	22.0±2.9
Raulah, near Argungu Road Takalmawa near D.V Hostel	22.0±2.9 16.0±1.2	Gidan Igu'a	23.0±1.2

Results are mean ± standard error of mean of three replicates

III. Result And Discussion

Water contamination has increased enormously as a result of intentional and unintentional activities of human beings. Pollution of our soil, air, water and food resources has reached alarming proportions. Several reports have appeared in the press and technical literature showing the gravity of man-made environment related problems. The toxic heavy metals especially Pb and Cd have damaging effect on vital body organs and related biological processes, in view of the heightened concern of lead poisoning occasioned by an outbreak in neighboring states like Zamfara in northwest Nigeria; it was desired essentially to determine the levels of lead in water sources used for drinking in Sokoto metropolis. In the present study, concentrations of lead were determined in various drinking water sources of the metropolis in order to evaluate its quality. The results are presented in the form of tables. Their mean concentrations and standard error were used to assess their levels in the samples of water.

Table 1.0 - 4.0 shows the results for all the water samples analyzed showing the mean and standard error of mean of three replicates in (µg/l). All the values showed good agreement with world health organization maximum tolerance limit of 50µg/l, except one well water sample (Gidan Hamma behind multipurpose) with lead concentration of 52.0±2.9µg/l.

From table 1.0, it can be seen that, all the tap water collected from seven different areas within Sokoto metropolis have lead concentration in range of 21.0±2.3 to 29.0±3.5µg/l which are far below World Health Organization[18WHO] recommended guideline for drinking water (50µg/l). Faculty of Science Usmanu Dan Fodio University, Sokoto (UDU) permanent site has highest concentration of 29.0±3.5µg/l within the tap water. It high value may be because this water is a reservoir and it also flow through lead pipe, these two conditions might have accounted for its high level above the other tap water. Low level of lead concentration in Zamfara tap waters have been reported by [19].

Table 2.0 presents the concentration of lead in river water; the two rivers (river Sokoto and river Zamfara) with concentration of 26.0±2.3µg/l and 30.0±2.3µg/l respectively were less than the upper limit of 50.0µg/l recommended for drinking water. River Zamfara has a concentration higher than that of river Sokoto, it was observed that river Zamfara show a significant difference in lead concentration based on the site of collection of the water, as reported by[19] that lead concentration of Zamfara river water collected at Zamfara State was 48.0±2.9µg/l which is closer to the recommended maximum limit of 50.0µg/l, this concentration is greater than that of 30.0±2.3µg/l of the same river water collected at Sokoto State, the variation of the lead level of the Zamfara river water may be due to the fact that river water at Zamfara State flow through agricultural area unlike that of Sokoto State which pass through a less agricultural area.

Table 3.0 shows the concentration of lead in bore hole and reservoir water, all the bore hole water have lead concentration lower than the upper limit of 50.0µg/l recommended for drinking water. Kwalkwalawa gidan kifi has the lowest concentration of 17.0±2.9µg/l, far less than the tolerant limit and also significant below the other bore hole water. This significant lower concentration may be due to the soil type and hygienic nature of the bore hole. The variation in lead concentration of the bore hole samples may be due to the soil type, the bore hole processing method, deepness of the borehole (usually more than 100m deep) and hygienic nature of the environment. The lead concentrations in all the four reservoir water were below World Health Organization tolerant limit of 50.0µg/l. Gidan Igu'a Alh. Shehu roro has a concentration of 13.0±2.3µg/l which is far below the tolerant limit of 50.0µg/l and significant below the other three reservoir water clean uncontaminated container that is used in fetching the water may account for its low lead level. Dandima opposite gidan wanka has the highest concentration of 31.0±1.2µg/l. The high level of lead concentration of Dandima opposite gidan wanka above the other three reservoir water might be because of the unhygienic nature of the reservoir, the use of various containers of varying lead sources to take water and probably because of the activities of people around the place such as car wash, laundry services and so on. Poor handling of the containers used for fetching water from the reservoir can directly introduce pollutant into it as the workers around the place do not encourage good hygienic practices.

Lead analysis of reservoir water of Zamfara State indicated normal concentration [19]. Of the twenty one well water samples, only one has lead concentration greater than the recommended guideline for drinking water, all the other have concentration less than the recommended maximum limit of 50.0µg/l. Gidan Hamma has the highest concentration of 52.0±2.9µg/l above the WHO tolerant limit of 50.0µg/l, its high concentration may be due to deepness of the well (usually more than 20m,but less than 100m),soil type and unhygienic nature of the people in the area where the sample is collected. The well is not located around an industry, agricultural practice and automobile work shop area that might have accounted for its high concentration. Most of the well water studied have lead concentrations lower than that of the tap water, there is no much difference between the lead concentration in tap water and the two rivers ; River Sokoto and River Zamfara have lead concentration of 26.0±2.3µg/l and 30.0±2.3µg/l respectively which are below WHO tolerance limit, these two rivers are treated to produce tap water by the state water board but, there is no much difference between the treated tap water and the untreated river water in terms of the lead level, this might be due to the fact that tap water passes through various lead pipes which can serve as a source for lead contamination. Earlier reports on analysis of lead concentration in well waters [20] around automobile workshop in Ado Ekiti Metropolis showed high concentration beyond the upper limit of World Health Organisation Tolerance limit of 50µg/l.

IV. Conclusion

The goal of this study was to gather information about the quality of water from various sources in Sokoto metropolis, Sokoto state by determining their lead concentration.The lead concentration of water samples from sources such as well, tap, river, reservoir and borehole in Sokoto metropolis had normal lead level with the exception of Gidan Hamma with high lead concentration slightly beyond WHO acceptable levels. It was observed that some of the wells were open and uncovered and should be cased and covered which might prevent airborne lead. Based on lead concentration, Sokoto water is recommended for drinking. However, in

order to avoid complacency, the data from this study would be disseminated to the appropriate agency saddled with the responsibility of monitoring drinking water of the general populace. Analysis of the quality of the water sources should be conducted periodically and further research is recommended to investigate other parameters.

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