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Analysis of floride content and some heavy metals in university of Maiduguri drinking water

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ABSTRACT

Atomic Absorption Spectrophotometry was employed to determine the concentration of Aluminium, Iron, Zinc, Lead, Cobalt, Nickel and Chloride in the various samples of water obtained from different locations obtained within the University community. Where it was found out that concentrations of the element "fluoride" were 0.38mg/L, 0.45mg/L, 0.42mg/L, 0.79mg/L, 0.60mg/L, 0.77mg/L, 0.49mg/L, 0.77mg/L, 0.62mg/L, 0.62mg/L, 0.78mg/L, 0.77mg/L, 0.79mg/L, 0.62mg/L and 0.39mg/L for Engineering Mosque, Faculty of Engineering, Central Mosque, SMS, Quarters, B block, Murtala Hall, Gate 5, Ado Bayero Hall, Bursary, Aisha hall, Fire Service, Sardauna Hall, Tafawa Balewa, and Ramat Library respectively. From the results obtained, it can be concluded that majority of the samples (9 out of 15) show concentrations that are above the WHO stipulation.

Keywords: water, atomic absorbtion spectroscopy, flouride and heavy metals

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INTRODUCION

Water may be defined as a liquid which forms the seas, lakes, rivers and rain in the basis of fluids of living organisms, which has the chemical formula H_2O. Therefore water can be referred to as a colourless and transparent compound of hydrogen and oxygen having no taste or smell which turns to steam when boiled and to ice when frozen.

$$\underset{(g)}{2H_2} + \underset{(g)}{O_2} \longrightarrow \underset{(l)}{2H_2O}$$

Drinking water may be regarded as water of sufficiently high quality that can be used or consumed without any risk of immediate or long terms harm [1]

The high need and inevitable dependency for water cannot be over emphasized as it has been established that humans can only survive a maximum of five days without water [2]

The fact that water is prone to contamination by both natural and man made process, the world health organization recommended that water intended for drinking should be treated if it is not of drinking water standard. [1]

Contaminant may exist in water in various forms they may include the microbiological and chemical contaminants. Microbiological contaminants include salmonella, and *Escherichia coli* whereas the chemical contaminants may include the sulphur compounds manganese, lead and iron.

The quality of grand water may be affected by the nature of the soil as well as the medium of transport and the storage facilities. These also has a great influence on the purity and the portability of safe water for drinking purpose. As a standard the drinking water should be odourless several measures can be used to analyse the water for drinking. This can include the chemical method of the analysis of drinking water which can be carried out using gravimetric, volume tric and colorimetric technique or by using sensing electrodes and specialized instrumental methods [2].

OCCURENCE OF WATER

Water occurs as ice, liquid water, pure water and water vapor. It is found almost everywhere on the earth. About two third or seven-tenth of the earth surface is covered by water. Water is so much abundant that it is also present in the atmosphere in the form of vapor.

Despite the abundance of water, pure form of water is rare and difficult to find. This is largely because almost all substances are soluble in water to a certain extent; thus water is regarded as a universal solvent [3].

SOURCES AND CLASSIFICATION OF WATER

Water is generally classified based on three groups or classes:

1. Surface water: It that water obtained from steams, natural ponds, lakes and rivers of significant sizes. Surface water can be flowing water (i.e. stream water) or standing water (i.e. lake, pond etc). surface water can suitably be obtained from stream with adequate flow (by intermittent seasonal or selective draft of clean stream water and their storage in reservoirs adjacent to the streams or otherwise readily recovered from them). Surface water is usually not high in mineral content and is also referred to as “soft water”. Nevertheless, surface water is usually exposed to contaminants.

2. Ground water: As a name implies, is trapped beneath the ground. Surfaces of water that replenish the ground water include rain that soaks “into the ground, rivers that disappear beneath the ground and melting snow [2].

Natural springs and wells can also serve as sources that recharge ground water. Ground water may further be classified into deep well and shallow well, otherwise known as low water table and high water table respectively.

Because ground water can absorb dissolved minerals during its stay underground, in addition to that which surface water is exposed, it is regarded as hard water.

3. Rain water: although sometimes not regarded as a class of water but as a source of water both surface and the ground water, rain water may possess characteristics that are different from those of surface and ground water.

CHARACTERISTICS OF WATER

Like all other compounds water has its own characteristics which largely depend on the level and concentration of organic and inorganic substances that could be suspended therein from the surrounding environment. The characteristics of water can be broadly divided into physical, chemical and biological characteristics.

Physical characteristics: these characteristics of water are described by the measure of certain parameters and in most cases are observable even to the layman. Parameters describing the physical characteristics of water include:

1. Taste: ideally water should be tasteless, however a characteristics taste may be imparted to it as a result of dissolved impurities often organic in nature such as phenols and chlorophenols. Taste is a subjective property and often difficult to measure.

2. Odor: Just like the taste, natural water has no odor of its own, but certain odor may be imparted to it by suspended or dissolved impurities.

3. Color: Even pure water is not colorless. It has a pale green-blue tint when in large volume. It is therefore particularly important to differentiate between true color due to material suspended in solution and apparent color due to suspended matter.

4. Turbidity: The presence of colloidal solids givens clear liquids a cloudy appearance which is aesthetically unreactive and may be harmful upon consumption. Turbidity in water may be due to particles discharged form sewage or industrial waste or due to presence of large amounts of micro-organisms [4].

BIOLOGICAL CHARACTERISTICS

Many microorganisms particularly bacteria are found in water, most of which are of no sanitary significance. Some are indicators of pollution but are harmless, while other such as the bacterial salmonella re pathogenic, capable of causing typhoid and paratyphoid fever.

Ground water is believed to be less prone to biological contamination because of effect of infiltration, exposure to unfavorable environmental conditions and time which eliminates most of microorganisms including those of sanitary significance surface water on the other hand is more likely to be biologically contaminated because of exposure to atmospheric, human and animal activities [5].

SOME HEAVY METALS IN WATER

A heavy metal is a number of a loosely-defined subset of elements that exhibit metallic properties. It mainly include the transition metals some metalloids, lanthanides and actinides. Many different definition have been proposed, some based on density, some on atomic number or atomic weight and some on chemical properties or toxicity. The term heavy metal has been called a “misinterpretation’ in an IUPAC technical report due to the contradictory definitions and its lack of a “coherent scientific basis”.

There is an alternative term toxic metal, for which no consensus of exact definition exist either. As discussed below depending on context, heavy metal can include elements higher than carbon and can exclude some of the heaviest metals.

Heavy metals occur naturally in the ecosystem with large vaccinations in concentration. In modern times, anthropogenic sources of heavy metals i.e. pollution, have been introduced to the ecosystem. Waste-derived fuels are especially prone to contain heavy metals.

Water fluoridation

Water fluoridation is the controlled addition of fluoride to water supply to reduce tooth decay. Fluoridated water has fluoride at a level that is effective for preventing cavities. Defluoridation is needed when the naturally occurring fluoride level exceeds recommended limits. A 1994 world health organization expert committee suggested a level of fluoride from 0.5 to 1.0mg/h (milligrams per litre) depending on climate. Bottled water typically has unknown fluoride levels, some domestic water are filtered to remove some or all fluoride.

Although water fluoridation can cause dental fluorosis which can alter the appearance of developing teeth, most of this mild and usually not considered to be aesthetic or public health concern.

Implementation

Fluoridation does not affect the appearance, taste or smell of drinking water. It is normally accomplished by adding one of three compounds to the water: sodium fluoride, fluorosilicic acid, or sodium flurosilicate. Sodium fluoride (NaF) was the first to be used and is the reference standard. It is a white odourless powder or crystal, but the crystalline form is preferred.

Fluorosilicic acid (H_2SiFe_6) is an expensive liquid by product of phosphate fertilizer manufacturer. It comes in varying strength typically 23-25%; because it contains so much water, shipping can be expensive. It is also known as hexafluorosilicic, hexafluosilicic, hydrofluosilicic, and silicofluroric acid.

The centers for disease control and prevention has developed recommendation for water fluoridation that specify requirement for personnel, reporting, training, inspecting, monitoring, surveillance, and actions in case of overfeed, long with technical requirement for each major compound used.

Although fluoride was once considered an essential nutrient, the U.S national research council has since removed this designation due to the lack of studies showing it is essential for human growth, though still considering fluoride a “beneficial element” due to its positive impact on oral health. The U.S specifies the optimal level of fluoride to range from 0.7 to 1.2mg/h (milligram per liter, equivalent to parts per million) depending on the average maximum daily air temperature; the optimal level is lower in wormer climates, where people drink more water is higher in cooler climates. The U.S standard, adopted in 1962, is not appropriate for all parts of the world and is based on assumptions that have become absolute with the rise of air conditioning and increase used of soft drinks, processed

food, and other sources of fluorides. In 1994, a world health organization expert committee on fluoride use stated that 1.0mg/h should be an absolute upper bound, even in cold climates and that 0.5mg/h may be an appropriate lower limit.

A 2007 Australian systematic review recommended in range from0.6 to 1.1mg/L (ASR, 2007) decay.

EXPERIMENTAL SECTION

MATERIAL

- Materials used during sample collections
- 12 pieces of 1.5 litres of empty polyethylene water bottles
- Labeling materials (pen and gum)

MATERIALS USED DURING ANALYSIS

- Atomic absorption spectrophotometer
- Computer set
- Sampling tube (pieces of test tube)

SAMPLE COLLECTIONS

12 Sample were collected separately, each from various point of drinking water source within University of Maiduguri, the samples were collected at different times in a 1.5 litre of plastic water bottles

SAMPLING AREAS

1. Central mosques
2. Gate 5
3. Ado Beyero Hall
4. Sardauna Hall
5. Aisha Hall.
6. Tafawa Belewa Hall
7. Murtala Hall
8. Ibrahim Imam Hall
9. Bursary Department
10. Faculty of Engineering
11. Clinic (English Mosque)
12. Quarters
13. Library
14. Fire Services Area

Procedure for the collection of the water sample used in this project

The water sample was collected directly from the up and under ground reserviour in the various water reservoir in the various water locations within the University of Maiduguri

Collection of water from the tap

The polyethylene bottle was thogroughly clean and properly rinse with water and allow to drain upside dawn before the water was collected from the tap by filling the bottle under the tap and rash the water to the bottle the cover of the bottle was then quickly secrew to close the cap to prevent contamination by ways the bottle were lebel

Atomic absorption spectrophotometer

Is an analytical procedure for the qualitative and quantitative determination of chemical elements employing the absorption of optical radiation (light) by free atoms n the gaseous state. In analytical chemistry the technique is used for determining the concentration of particular element (the analyses) in a sample to be analyzed. As can be used to determine over 70 different elements in solution or directly in solid samples. Atomic absorption espctrometry was first use as an analytical techniques. The principle were established in of the 19^{th} century by Robert Wither Bunsen by Robert Krich Hoof, both Professors at the University of Heidelberg,

PRACTICAL PROCEDURES

The samples collected were taken immediately to Nationa Agency forbFood Drug Adminstration and Control for the analysis,

Samples in the polyethylene water bottle were transferred into sampling tube. The tubes were lebel appropriately and care was taken to ensure that each sample was analyzed. The tubes were then inserted separately into the sampling chamber of the AAS.

The connected computer displays the result of the analysis on the screen that is the monitor and the result was recorded.

RESULTS

The concentration of fluoride and some other heavy metals such as zinc, lead, Aluminum, cobalt, nickel, iron, chloride in University of Maiduguri's drinking water.

Table: 1 TABLE SHOWING CONCENTRATIONS OF FLUORIDE, ALUMINUM, IRON, ZINC, LEAD, COBALT, NICKEL, AND CHLORIDE IN UNIVERSITY OF MAIDUGURI DRINKING WATER SAMPLE

Water sample Source	Aluminum (Al^-)	Chloride (Cl)	Iron (Fe)	Zinc (Zn)	Lead (Pb)	Cobalt (Co)	Nickel (Ni)	Fluoride (F^-)
ENGENEERING . MOSQUE	0.16mg/L	15mg/L	0.3mg/L	0.23mg/L	-0.10mg/L	ND	ND	0.38mg/L
FACULTY. OF ENGENEERING	0.17mg/L	15mg/L	0.3g/L	0.24mg/L	ND	ND	ND	0.45mg/L
C BLOCK.MOSQUE	0.21mg/L	13mg/L	0.2mg/L	0.26mg/L	ND	0.01mg/L	ND	0.42mg/L
SMS	0.17mg/L	18mg/L	0.30mg/L	0.25mg/L	ND	0.03mg/L	ND	0.79mg/L
QUARTERS	0.19mg/L	19mg/L	0.2mg/L	0.29mg/L	ND	0.16mg/L	ND	0.60mg/L
B.BLOCK	0.24mg/L	19mg/L	0.20mg/L	0.29mg/L	ND	ND	ND	0.77mg/L
MURTALA HALL	0.18mg/L	18mg/L	0.30mg/L	0.28mg/L	ND	ND	ND	0.49mg/L
GATE **5**	0.20mg/L	16mg/L	0.30mg/L	0.26mg/L	ND	ND	ND	0.77mg/L
ADO BAYERO HALL	0.18mg/L	19mg/L	0.30mg/L	0.29mg/L	ND	ND	ND	0.62mg/L
BURSARY DEPT. MOSQUE.	0.19mg/L	18mg/L	0.30mg/L	0.27mg/L	ND	ND	ND	0.62mg/L
AIHSA HALL	0.16mg/L	16mg/L	0.20mg/L	0.26mg/L	ND	ND	ND	0.78mg/L
FIRE SERVICE	0.15mg/L	18mg/L	0.25mg/L	0.25mg/L	ND	ND	ND	0.77mg/L
SARDAUNA HALL	0.19mg/L	19mg/L	0.30mg/L	0.25mg/L	ND	ND	ND	0.79mg/L
TAFAWA BALEWA HALL	0.22mg/L	15mg/L	0.20mg/L	0.28mg/L	ND	ND	ND	0.62mg/L
RAMAT LIBRARY	0.19mg/L	19mg/L	0.24mg/L	0.29mg/L	ND	ND	ND	0.39mg/L

ND: Not Detected

DISCUSSION

This research analysis was performed using Atomic Absorption Spectrophotometry to determine the concentration of Aluminium, Iron, Zinc, Lead, Cobalt, Nickel and Chloride in the various samples of water obtained from different locations obtained within the University community.

For the element fluoride, the concentrations obtained for the 16 samples are 0.38mg/L, 0.45mg/L, 0.42mg/L, 0.79mg/L, 0.60mg/L, 0.77mg/L, 0.49mg/L, 0.77mg/L, 0.62mg/L, 0.62mg/L, 0.78mg/L, 0.77mg/L, 0.79mg/L, 0.62mg/L and 0.39mg/L for Engineering Mosque, Faculty of Engineering, Central Mosque, SMS, Quarters, B block, Murtala Hall, Gate 5, Ado Bayero Hall, Bursary, Aisha hall, Fire Service, Sardauna Hall, Tafawa Balewa, and Ramat Library respectively.

As we have seen earlier, the WHO[6] has stipulated a recommended fluoride concentration of 0.70-0.10mg/L as the safety standard. This could be because of health and aesthetics problems associated with deficiency as excess. Water samples with fluoride concentrations that are significantly below (as is often the case) or above (in rare cases) the normal concentration will therefore require adjustment by fluoridation or defluoridation as the case may require. We will now take a look at various samples and compare them to the WHO standards.

Of the 15 samples used for the purpose of this work, only 6 were within the WHO stipulated recommended concentrations. These are samples obtained from SMS, B. Block, gate 5, Aisha Hall, Fire Service and Sardauna Hall. The other 9 samples show concentrations that are below the WHO recommendation. These are samples obtained from Engineering Mosque, Faculty of Engineering, Central Mosque, Quarters, Murtala Hall, Ado Bayero Hall, Bursary, Tafawa Balewa Hall And Ramat Library. It can therefore be stated that majority of the samples obtained within the University of Maiduguri campus will require fluoridation

CONCLUSION

From the results obtained, it can be concluded that majority of the samples (9 out of 15) show concentrations that are above the WHO stipulation. It will therefore be of significance for the University management to consider treating water (at least that intended for drinking purpose) by any suitable fluoridation method.

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