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Preliminary Assessment of Flourine Level of Spring and Stream Water in South West Nigeria

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Abstract: Four water samples from each of spring and stream in some locations across South-West, Nigeria, were analyzed for their fluoride levels and some other quality parameters. The samples coded 101, 202, 303, 404 representing spring water and 505, 606, 707, 808 representing stream water were analyzed for fluoride levels using Ion Selective Electrode method (ISE) while other quality parameters such as calcium, chloride, alkalinity, hardness and pH were determined using standard methods. The results obtained showed low fluoride concentrations of 0.15 ppm and 0.03 ppm in samples 101 and 202 respectively (spring water) while other water samples contained no traces of fluoride. These values are far below World Health Organization (WHO) limits of 1.50 ppm fluoride for drinking water. The water contained low calcium and chloride contents, ranging from 20.0 mg/l to 37.5 mg/l (hardness) indicating that the water is soft. pH values of between 5.6 and 6.0 were also obtained in contrast to 6.5-8.5 as stipulated in the World Health Organization guideline (WHO) for drinking water.

Key words: Spring and stream water, fluoride, WHO, dental carrier

INTRODUCTION

Fluorine is one of the most abundant elements in earth crust and as such it is widely distributed by nature. A fluoride ion (F') is the ionic form of fluorine. Public health research results have generated much interest in the fluoride content of water. The significance of nutrition is related to its regular presence in small amount in most foods and in all tissues of the body, particularly in bones and teeth. It has been established that the ingestion of fluorine significantly reduces the prevalence of dental carries, especially in young children, less than eight years (Beaton and Earle Willard, 1967).

Recent studies have indicated that fluoride also benefits older people in reducing prevalence of osteoporosis and hardening of the arteries (Hammer, 1979). Low intake of fluoride below 1.00 pm results in excessive tooth decay and if above 1.50 ppm, can cause mottling of the tooth (dental fluorosis and in the extreme cases, skeleton fluorosis). High doses have been linked to cancer (Harrison, 2005). Drinking water is then the main source of fluoride in water as very few foods contain more than 1.0 ppm, the main exception being sea fish, tea which contains 5.00-10.00 ppm.

Traces of fluorides occurrence are widespread in all surface and underground water. Higher concentrations are often associated with ground water sources in areas where fluoride bearing minerals are common (Philips, 1998). The world health organization (WHO, 1971) sets limit of fluoride concentration in drinking water as 1.50 ppm, hence 1.00 ppm fluoride concentration in drinking water prevents dental carries (Herman and Warwick, 1972). The present study therefore aims at establishing a baseline data for fluoride from spring and stream water in south west part of Nigeria as well as relating their depletion and enrichment with the health problems in these areas.

MATERIALS AND METHODS

Collection of water samples: Four samples each of spring and stream water were collected under hygienic conditions using sterile pet bottles early in the morning at 8 different locations spread across south west, Nigeria. The samples were coded 101, 202, 303, 404 representing spring water and 505, 606, 707 808 representing stream water for easy identification and stored at ambient temperature for analysis.

Experimental description

Determination of fluoride ion using Ion Selective Electrode method (ISE): Principle: the potential of Ion Selective Electrode (ISE) measured against a suitable electrode potential is related to the logarithms of concentration of the measured ion by the Nernst equation i.e.:

$$\text{Log }(m + n)\ 2.303\ RT/F = E_0$$

Where n is the ion charge (negative for anions). The factor 2.303 RT/F has a theoretical value of 59 mv at 25°C.

0.42 g of already dried (100°C for 1 h) sodium fluoride (NaF) was accurately weighed and dissolved in 100 ml de-ionized water, made up to mark in a 100 ml volumetric flask. This solution was about 10-4F in NaF. 10.00 ml of the solution was transferred to 100 ml volumetric flask using pipette and diluted with de-ionized water, made up to the mark. This solution is about 10-2F in NaF. Then 7.55 g of KCl was dissolved in 100 ml de-ionized water. This solution was 1 K in KCl. Standard solutions were prepared by taking 1.00 ml, 2.00 ml, 5.00 ml and 10.00 ml of 10-2F in NaF and made up to the mark with de-ionized water in 100 ml volumetric flask. An unknown solution in which 1ml of the unknown solution was added with 10.00 ml of potassium chloride, made up to the mark in a 100 ml volumetric flask with de-ionized water. The potential in mv of the fluoride (ISE) was measured against the reference electrode for each of the four standards and unknown. 30.00 ml of each standard solution was poured into clean dry 100 ml beaker and the electrode was immersed in the solution to a depth of not more than 2 cm. The electrode potentials were measured.

Titrimetric determination of total hardness: 20.00 ml of the unknown sample was measured into 250 ml volumetric conical flask after which a few drops of ammonium chloride (Buffer 1 solution) and drops of Solochrome Black T was added. The contents were titrated against standard solution until there was no further colour change. The indicator changed from red to blue and the titrant was in excess. The colour of over titrated was taken as the end point.

$$\text{Total hardness (mg/l)} = \frac{\text{Vol of 0.05 M EDTA x 100}}{\text{Volume of sample}}$$

Titrimetric determination of calcium: 25 ml of buffer II solution (Potassium Hydrogen Phthalate) and a pinch of nurexide indicator were added to 10.00 ml of water sample in a 250 ml conical flask. The solution was then titrated with EDTA until the pink colour changed to purple and addition of further titrant gave no further colour change. Titration was also carried out for the blank.
Calcium (mg/l) is expressed as A-B, where
A = Titre value of sample
B = Titre value of the blank

Determination of alkalinity: A few drops of phenolphthalein indicator was added to 100 ml of water sample and titrated with 0.1 M HCL until pink colour just disappeared. The titration figure multiplied by 10 gave the phenolphthalein alkalinity expressed as $CaCo_3$. Also, a few drops of screened methyl orange indicator were added and the titration continues to a second end point, when the content changed to a neutral grey colour. The titration figure multiplies by 10 gave the methyl orange alkalinity as $CaCO_3$ in mg/litre

Determination of pH: The pH of the water samples were measured using digital pH meter (model pHs-25 pit meter) after necessary calibration with buffer solutions of 4.0 and 9.0.

Titrimetric determination of chloride using Mohr's method: 1 ml of potassium chromate was added to 100 ml of sample contained in a 250 ml conical flask after alkalinity titration. The sample was titrated with silver nitrate solution until a faint brick red colour was obtained.

$$\text{Mg/l of chloride} = \frac{\text{ml of } AgNO_3 \text{ x 3.546 x 1000}}{\text{100 ml of sample}}$$

RESULTS AND DISCUSSION

The results as revealed in the above table showed an exceptional low fluoride contents of both spring and stream water in South West, Nigeria. None of the samples analyzed had a fluoride level greater than 0.15 ppm. The values were far below World Health Organization (WHO, 1971, 1972) limits of 1.50 ppm for drinking water. Natural Fluoride in water (surface and ground water) is desired from the solvent action of water in the inter slices of mineral and rock grains. However, according to World Health Organization (WHO, 1970), most of the water contained below 1.00 mg of fluoride per litre, with drinking water typically the largest contribution of the daily fluoride intake. The pH of most raw water sources lies within the range 6.5-8.5. Chlorination tends to lower the pH, whereas water softening using the excess lime/soda as process raises the pH level. A direct relationship between human health and pH of drinking water is so closely associated with other aspect of water quality. WHO guideline (1984) recommended guideline value for pH is 6.5-8.5. Calcium as a mineral is needed for numerous functions and these includes blood clotting, the transmission of nerve impulse and the regulation of the heart rhythm. The presence of calcium in water supplies, results from

Table 1: Result of analysis showing some chemical and physical characteristics of spring and stream water in south west, Nigeria

Water source	Calcium mg/l	Alkalinity mg/l	Hardness mg/l	pH	Chloride mg/l	Flouride mg/l (ppm)
101	1.8	-	30.0	5.6	6.6	0.15
202	1.4	-	35.0	5.7	7.0	0.03
303	8.0	-	37.5	5.5	4.2	
404	2.0	-	28.5	5.6	8.5	
505	12.0	-	30.0	6.0	1.7	
606	3.0	-	28.0	6.0	1.7	
707	16.0	-	20.0	5.7	1.3	
808	8.5	-	30.0	5.7	1.3	

deposit of limestone, calcite, gypsum etc. Since calcium mineral are not readily soluble in pure water, the presence of carbon (IV) oxide (CO_2) increases their solubility. Sources of water containing up to 100 mg/l of calcium are fairly common in region having pH above 7.0. Permissible level is 75 mg/l according to WHO (1996). Also, the guideline for drinking water quality by WHO (1990) documented that there is no firm evidence that water hardness causes ill effects in man. In most cases, calcium concentration had shown the strongest correlation. Water taken from rivers, reservoir or wells after percolating through soil, rock etc containing large amount of dissolved solids, may be hard (Fair, 1996). Water with less than 50 mg/l is soft, with 100 mg/l, is hard. However, hard water causes formation of scale in pipes and fillings.

Chloride of high concentration occurs from chloride containing geological formation, pollution by sewage, industrial water, intrusion of sea water and other saline water. It is widely distributed in nature in form of NaCl, KCl and $CaCl_2$ (Calcium Chloride) salts. One table salt (NaCl) per person is essential for normal health. WHO (1984) had recommended 250 mg/l as guide value. The objective of municipal water treatment is to provide a portable supply water that is chemically and bacteriological safe for human consumption and for domestic uses. Treated water must therefore be aesthetically acceptable (Hammer, 1979).

Although, the role of fluorine in controlling tooth decay has been recognized, it has only been in the last few years that fluoride has been considered as essential nutrients. Out of 719 patients registered and treated for various dental related ailments in some general hospitals in South West, Nigeria, 526 occurred due to dental carries and 65% of them are children. However, since World Health Organization (WHO, 1971) recommended about 1.50 ppm of fluoride in water, there is need for water in this part of the country to be fluoridated at a point where all the water that are being treated passes so as to reduce mostly dental carries among children.

Conclusion: The level of fluoride detected in samples of spring and stream water investigated in South West, Nigeria is below WHO recommended standard and this has been largely responsible for the occurrence of dental related problems, hence there is need for fluoridation of this water so as to meet WHO recommended standard for drinking water.

REFERENCES

Beaton, H. and M. Earle Willard, 1967. Nutrition (Vol. 1). Published by Academic Press Inc., New York, pp: 230.

Fair, A.M., 1996. Waste water and water Engineering. Published by John Wiley and Sons inc., pp: 15.

Hammer, M.J., 1979. Water and waste water technology. Published by John Wiley and Sons inc., pp: 217-254.

Harrison, P.T.C., 2005. Fluoride in water. J. Fluoride Chem., 126: 1448-1456.

Herman, G. and J. Warwick, 1972. Effect of Fluorine. Nig. Food J., 3: 157.

Philips, G., 1998. Philips Science and Technology Encyclopedia by Philip George. Ltd. Michelin House. UK.

World Health Organization, 1970, 1971, 1972, 1984, 1990, 1996. International Standard for Drinking Water.