SPECTROPHOTOMETRIC QUANTIFICATION OF FLUORIDE IN DRINKING WATER OF SOME SELECTED AREA IN HONG LOCAL GOVERNMENT AREA ADAMAWA STATE, NIGERIA

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Abstract
Three water types (borehole water, sachet water and well water) in Hong Local Government Area of Adamawa State Nigeria were randomly collected from different villages and subjected to laboratory analysis for fluoride contamination using Lamotte Smart Water Spectrophotometer MODEL 2000. Highest fluoride concentration in Borehole was recorded in Fadaman Reke and Gashaka as 1.56±mg/L, while the lowest was obtained in Mararraba as 0.31±mg/L. In well water, the highest value was obtained in Hong town 1.48mg/L while the least value was obtained in Mararraba 0.14mg/L. In sachet water, higher (0.75mg/L) fluoride concentration was obtained in Hong town while lowest (0.11mg/L) was at Mararraba. Generally, more than 50% of water sources from borehole and well water had higher fluoride concentration above WHO recommendation limit of 0.5-1.0mg/L while less than 50% obtained were within the accepted level of fluoride concentration of the WHO. Sachet water however, happens to be within the accepted level of fluoride for human and animal consumption. Water sources in Hong therefore need to be treated for fluoride contamination in other to prevent dental fluorosis, which is very common in the area.

Key words: Drinking Water, Fluoride, Dental Fluorosis, Hong

INTRODUCTION

Fluoride is one of the chemical contaminants of water, though it was believed to be an essential element for living organisms. It was well known that fluoride helps to prevent and even reverse the early stage of dental decay (caries). The World Health Organization through extensive studies has identified dental cavities as a world wide epidemic. In her effort to reduce this menace, she advised that fluoride should be added to drinking water where naturally occurring level of fluoride is below 0.5 to 1.0mg/L optimal level (WHO, 1994).

Water fluoridation in low fluoride containing water supplies helps to maintain optimal dental tissue development and dental enamel resistance against caries attack for life (Brunel and Carlos, 1990). Recently, the consumption of naturally occurring fluoridated water and artificially fluoridated drinking water has generated both strong support and opposition within communities and regulatory bodies world wide. The issue is controversial because fluoride has been known to have beneficial effect at low concentration. However, at higher concentration it is found to have toxic effect, (Wikipedia Encyclopedia, 2009).

This has prompted so many researchers to study the adverse health effect associated with exposure to higher level of fluoride in drinking water and also necessitated this work since people of the selected study area have degradated coloured teeth suspected to be caries or fluorosis.

Fluorides adverse effects depend on the total daily intake of fluoride from all sources. Drinking water is typically the largest source (Fawell *et al*, 2006). One of the long term effects of prolonged ingestion of fluoride in drinking water is dental fluorosis which is the first adverse effect of fluoride in drinking water, (Wikipedia Encyclopedia, 2009).

Any use of fluorides, whether systematic or topical in caries prevention and treatment in children result in ingestion and absorption of fluoride into the blood circulation. The mineralization of teeth under formation may be affected so that dental fluorosis may occur. Dental fluorosis reflects an increasing porosity of the surface and subsurface enamel causing the enamel to appear opaque. The clinical features represents a continuum of changes ranging from fine white opaque line running across the tooth on all parts of the enamel to entirely chalky white teeth. In the later case, the enamel may be so porous or hypo mineralized that the outer enamel breaks apart posteruptively and the exposed porous subsurface enamel become discoloured, (Fejerskov, 1990).

While dental professionals claims that dental fluorosis is solely a cosmetic effect and not a health effect, this statement is an assumption and not a fact, dental fluorosis represent a toxic effect on tooth cells. The question is whether tooth cells are the only cells in the body that are impacted, as noted by former proponent of fluoridation, (Colquhoun, 1997). Common sense should tell one that if a poison circulating in a child's body, can damage the tooth forming cells, then other harm is also likely to occur. Like bones, a child's teeth are alive and growing. Fluorosis is the result of fluoride rearranging the crystalline structure of a tooth's enamel as it is still growing; it is evidence of fluoride potency and ability to cause physiologic changes within the body and raises concerns about similar damage that may be occurring in the bones, (Environmental working group, 2006).

Dental fluorosis is not the only risk from early-life exposure to fluoride. A recent review in the Lancet described fluoride as "an emerging neurotoxic substance" that may damage the developing brain. The National Research Council has identified fluoride as an "endocrine disrupter" that may empire thyroid function, while recent research from Harvard University has found a possible connection between fluoride and borne cancer, (www.fluorideACTION.net, 2010).

Because of the risk for dental fluorosis and the lack of demonstratable benefit of ingesting fluoride before teeth erupt, the American Dental Association (ADA) and a group number of dental researchers recommended that children under twelve months of age should not consume fluoridated water while babies under six months of age should not receive any fluoride drugs or pills, (ADA, 2006).

Fluoride is now introduced at a much earlier stage of human development than ever before (reconstitution of infant formula with fluoridated water) and consequently alters the normal fluoride pharmacokinetics in infants, (Luke, 1997). More than fifty percent of infants are currently formula fed by one month of age and these infants are likely to be continuously exposed to high intakes of

fluoride for nine to ten months a circumstances quite rear in the early 1960s and early 1970s, (Ekstand, 1999). Infant formula reconstituted with high fluoride water can produce 100 to 200 times more fluoride than breast milk. A study conducted in Sweden of 12 and 13 year old children who had lived since birth in a community with 1.2ppm of fluoride in the drinking water demonstrated that dental fluorosis was less common in those who have been breast fed than those who have been fed powdered formulas reconstituted with tap water, (Forsman, 2003). A somewhat similar study in the United States demonstrated that among 7 to 13 year old children (most of them living in a community with fluoride concentration of the drinking water 1mg/L), the prevalence of mild enamel fluorosis was significantly greater in those who had been fed concentrate liquid formula diluted with tap water during the first three months of life than in those who had been breast fed during this time, (Walton and Messer, 2004). It seem reasonable to conclude that the lower prevalence of fluorosis of the permanent teeth of individuals who were breast-fed during the early months of life is related to the low fluoride concentration of human milk – concentration less than 7µg/L regardless of the concentration of fluoride in the woman's drinking water.

AIM AND OBJECTIVES

The aim will be achieved through the following specific objectives.

i. To investigate the cause of the brown coloration of the teeth observed among people of Hong Local Government, Adamawa State.
ii. To provide information on the quantity of fluoride in water consumed by the people of Hong Local Government Area.
iii. To suggests possible way(s) of avoiding the chronic carrier threatening teeth damage observed among the beautiful people of Hong, Adamawa State.

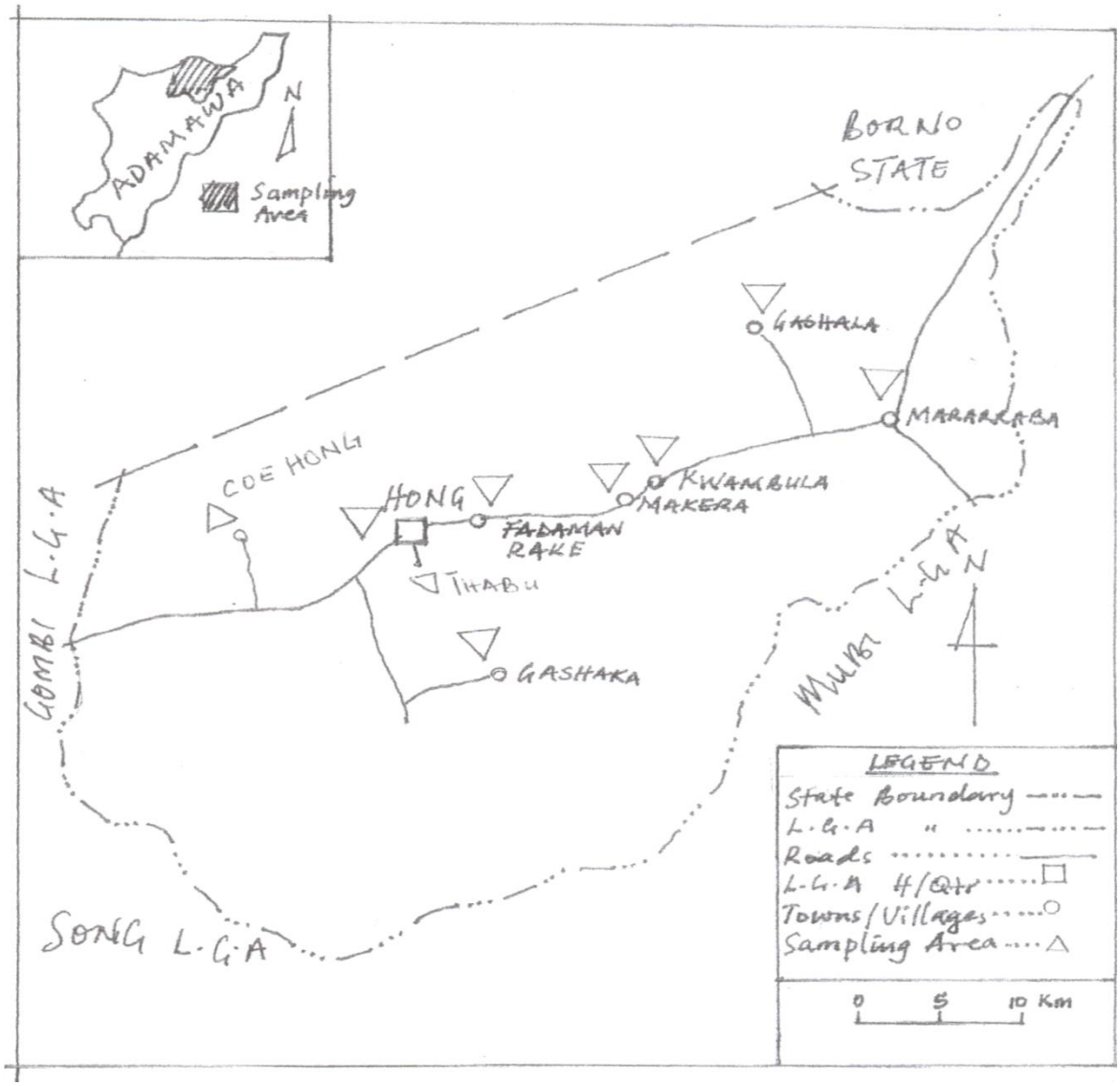

FIG.1: The Sampling Area

http://www.travelsjournals.net/explore/nigeria/map/m2797359/hong.html

MATERIALS AND METHODS

Description of the Study Area: Hong with a latitude of 10.23(10^o 13 60N) and a longitude of 12.93 (12^o 55 60E), is a populated place located in the area /state of Adamawa in Nigeria that is a part of Africa. The location is situated 541Km East (87^o) of the approximate center of Nigeria and 606Km East (77^o) of the capital Abuja.

A 100 Square Km Area around Hong has an approximate population of 266168 (0.000027 persons per square meter) and an average elevation of 629 meters above sea levels.

Sampling Site and Procedures: Three water samples (sachet water, well water and borehole water) were collected randomly from the following areas; College of Education (campus), Fadama Reke, Gashaka, Hong, Kombla, Makera, Mararraba and Thabu in Hong Local Government, Adamawa State. All the samples were collected in a well washed and dried one liter plastic container as described by Bartram and Balance (1996). For well water, a reasonable length of weighted string was tied to the sample bottle and then lowered slowly

into the well without touching the sides or walls of the well. The bottle was immersed completely inside the well water to a depth of about 20cm without touching the bottom of the well or disturbing the sediment.

Preparation of Reagent Blank

Reagent Blank was prepared in a clean tube (0290) with clear colorless, fluoride free water (Distilled Water).

The tube was rinsed with distilled water and filled to the 10mL line with the distilled water.

0.5mL Sodium Arsenite Solution was added to the distilled water (using 0.5mL pipet) in the tube, the tube was then caped and shook to mix.

2mL of Acid Zirconyl SPADNS Reagent was also added (using 1.0mL pipet) the tube was then caped and mixed thoroughly. This served as the Reagent blank.

Sample Analysis

The Spectrophotometer was first calibrated with a prepared reagent Blank. The tube was then washed and rinsed with Sample water. The tube was filled with the sample water to 10mL line. 0.5mL Sodium Arsenite Solution was added to the sample water (using 0.5mL pipette) in the tube. The tube was capped and shook to mix. 2mL of Acid Zirconyl-SPADNS Reagent was also added (using 1.0mL pipette) the tube was then capped and mixed thoroughly. This was then inserted into the chamber and SCAN SAMPLE was selected on the Spectrophotometer.

The result was then recorded and the procedure was repeated for all the samples.

Data Analysis

The data collected fluoride concentration in different water sources were subjected to simple measure of Arithmetic mean in relation to the WHO recommendation. Three samples were collected per sample area in all the locations.

RESULTS

Table 1. Fluoride Concentration in Drinking Water

S/N	LOCATION OF SAMPLE	Borehole Water (mg/L)	Well Water (mg/L)	Sachet Water(mg/L)
1	C. O. E Hong	1.41± 0.04	1.40±0.07	
2	Fadama Reke	1.56± 0.04	1.41±0.07	
3	Gashaka	1.56± 0.04	1.42±0.07	
4	Gashala	0.61± 0.04	0.60±0.07	
5	Hong	1.51± 0.04	1.48±0.07	0.75±0.57
6	Kwambla	0.62± 0.04	0.60±0.07	
7	Makera	0.32± 0.04	0.19±0.07	
8	Mararraba	0.31± 0.04	0.14±0.07	0.11±0.57
9	Thlabu	1.46± 0.04	1.14±0.07	

WHO Standard, 0.5 – 1.0mg/L optimal level of fluoride concentration depending on air temperature (WHO 1994).

Fluoride Concentration In Drinking Water.

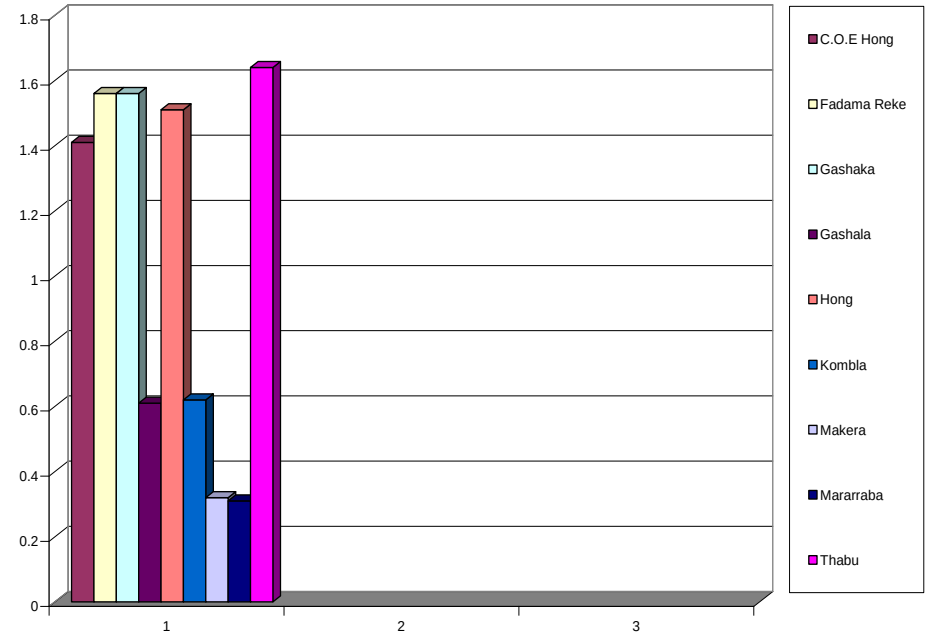

Fig 1: Fluoride Concentration in Borehole Water

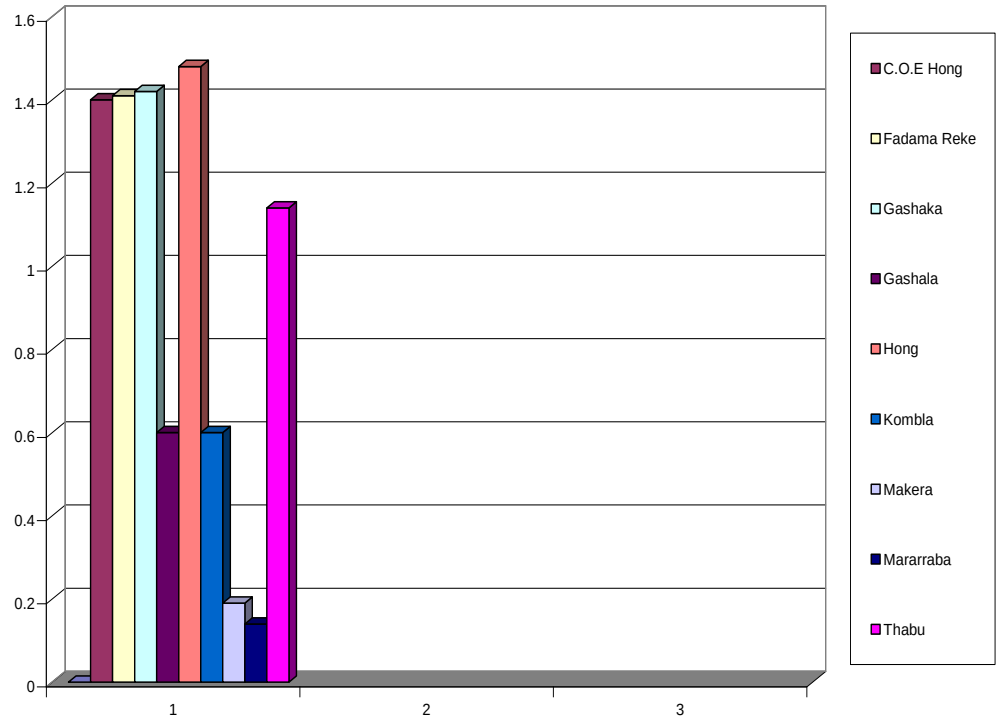

Fig 2: Fluoride Concentration in Well Water

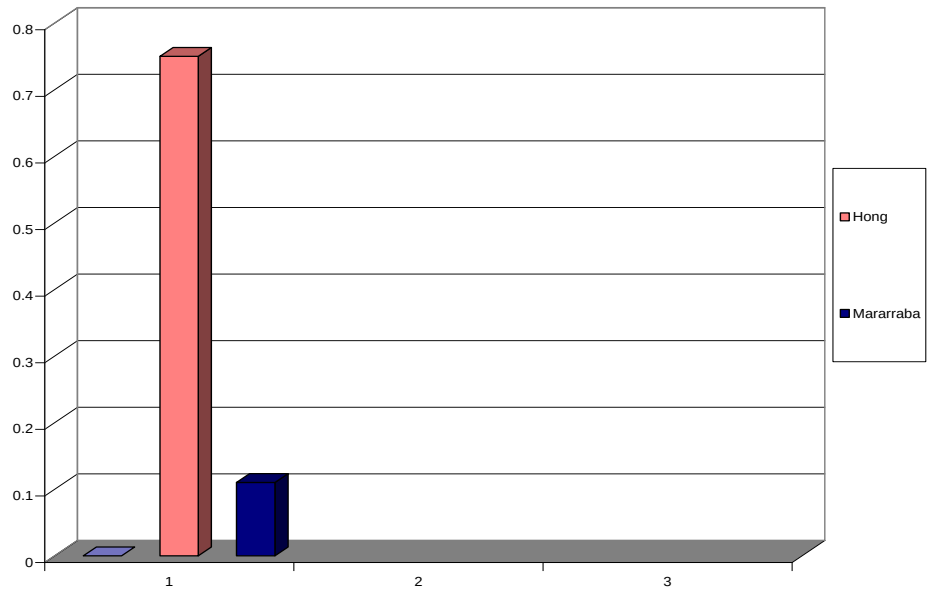

Fig 3: Fluoride Concentration in Sachet Water

Standard Permitted Levels of Fluoride in Drinking Water

The World Health Organization expert committee recommended 0.5 - 1mg/L optimal level depending on air temperature, (WHO, 1994). The US specifies the optimal level of fluoride to range from 0.5 – 1.2mg/L depending on average maximum daily air temperature, (Bailey *et al*., 2008).

1.5mg/L limit is permitted by Mexican regulations, (Trejo-Vazguez *et al*., 1997). Nigerian Standards for Drinking Water through Standard Organization of Nigeria (SON) approved 1.5mg/L as the optimal level of fluoride in drinking water, (NIS, 2007). Australian systematic review recommended a range of fluoride concentration from 0.6 – 1.1mg/L, (NHMRC, 2007).

DISCUSSION

From the result obtained, it can be observed that water from boreholes and wells in C.O.E Hong, Gashaka, Hong, Fadadman Reke, Makera, and Thabu have exceeded the 0.5-1.0mg/L recommended permissible level of fluoride in consumable water. Such water is capable of causing dental fluorosis. (WHO, 1994). The result also shows that higher concentration of fluoride were found in College of Education (C.O.E.) Hong, Fadaman Reke, Gashka, Hong, and Thabu among others. This is consistent with other findings which state that "higher concentration of fluoride can be found in ground water particularly in volcanic and mountainous area (Fewel, *et al*., 2000). The result indicated that inhabitants of mountainous area are at higher risk of having high amount of fluoride in ground water compared to people residing far away from the foot of the mountains.

C.O.E. Hong, Fadaman Reke, Gashka, Hong, and Thabu had fluoride concentrations of ±1.41, ±1.56, ±1.56, ±1.51 and ±1.46mg/L in borehole water and ±1.40, ±1.41, ±1.42, ±1.48 and ±1.14mg/L in well water. These areas are at higher risk of having dental fluorosis compared to those with fluoride concentrations ranging from ±0.14 – ±0.62mg/L in both borehole and well water from Mararraba. This is true as observed among people of the study area. However, Fluoride concentration in sachet water from Hong (±0.75mg/L) and Mararraba (±0.11mg/L) happens to fall within the permitted level by WHO, (1994).

Result from similar studies in Sam Lius Potosi (SLP Mexico) showed that in areas where fluoride concentration ranges from 6.44 – 7.30mg/L, the entire population surveyed had some degree of dental damage and 35% of them are at risk of losing their teeth at early stage because of the severe dental fluorosis, (Grimaldo and Teresa, 2001). The same authors reported that in the USA, 83% of people surveyed in areas where fluoride concentration ranges from 3.70 – 4.00mg/L have varying degree of dental fluorosis and this is in accordance with the result of this research work.

Conclusion

In conclusion, dental degradation observed among the people of Hong Local Government Area is as a result of high level of fluoride content in drinking water and the degradation can be said to be fluorosis.

Acknowledgement

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