Well Waters Fluoride in Enugu, Nigeria

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Abstract

Abnormal fluoride levels in drinking water have been associated with adverse health effects. To determine the fluoride content of well waters in Enugu, southeastern Nigeria, water samples from 50 artisan wells chosen by multistage sampling procedure from the 5 zones of Enugu municipality were analyzed in duplicates for their fluoride content. The zonal mean values were 0.60, 0.70, 0.62, 0.62, and 0.63 mg/L for Abakpa Nike, Achara Layout, Obiagu/Ogui, Trans Ekulu and Uwani, respectively (p<0.05). The mean value for the whole city was 0.63 mg/L. Although, the mean level of fluoride recorded in this study is currently within safe limits (1.5 mg/L, WHO 2011), it is important to monitor continuously the fluoride content of well waters in the municipality in view of the increasing industrial activities going on in the city and heavy reliance on well water for domestic purposes and the widespread use of consumer products containing fluoride.

Keywords: Fluorides; Drinking water; Water wells; Nigeria

Introduction

Both organofluorine compounds and inorganic fluorine containing compounds are called fluorides.¹ Fluoride is found naturally in low concentrations in drinking water and foods. Waters from underground sources are more likely to have higher levels of fluoride—the concentration in seawater averages 1.3 parts per million (ppm); fresh water supplies generally contain 0.01–0.3 ppm of fluoride. High or low levels of fluoride in drinking water have been shown to cause adverse health effects.²⁻⁴ For instance, excessive intake of fluoride (>4 mg/L) results in skeletal fluorosis and tooth mottling.⁵,⁶ Considering the ubiquity of fluoride in the environment and the possibility that it would contaminate well waters—commonly and copiously used for domestic purposes in Enugu—this study was conducted to determine the fluoride content of well waters in Enugu municipality.

Materials and Methods

Enugu, southeastern Nigeria has a population of 722,664 mainly of the Igbo ethnic group. It is bounded by latitudes 6° 24' and 6° 30' and longitudes 7° 26' and 7° 30'. Enugu is located in the Cross River basin and the Benue trough at an elevation of 1000 m. Highlands surrounding Enugu for the most part are underlain by sandstone, while lowlands are underlain by shale. The Ekulu, Asata, Ogbete, Idaw, and Nyaba rivers are the six largest rivers located in the city. The Ekulu River is the largest body of water in Enugu urban and its reservoir contributes to part of the city's domestic water supply. Enugu is located in a tropical rain forest zone with a derived savannah with humid climate that peaks between March and No-
November. The mean daily temperature is 26.7 °C and the average annual rainfall is around 2000 mm.

A total of 50 artisan wells were chosen by a multistage sampling procedure from five zones that make up Enugu municipality—Abakpa Nike, Achara Layout, Obiagu/Ogui, Trans Ekulu and Uwani. The zones were divided into 10 areas each using the existing streets and a well was randomly located and marked out from each of the areas for sampling. A chemically cleaned plastic cup was used to collect water from the wells. The sample was stored at 4–8 °C and analyzed within 48 hours of sampling. The Sumeet Water Testing kit was used according to the manufacturer’s instruction for the analysis of the samples.

**Results**

The mean fluoride concentration of water collected from the five zones were 0.60 mg/L in Abakpa Nike, 0.70 in Achara Layout, 0.62 in Obiagu/Ogui, 0.62 in Trans Ekulu, and 0.63 mg/L in Uwani (p<0.05)—an overall mean concentration of 0.63 mg/L in the whole city.

**Discussions**

Both the highest and overall mean concentrations of fluoride recorded in this study were lower than the permissible limit of WHO. The values were however higher than the value reported in Turkey (0.17 mg/L) and Saudi Arabia (0.60 mg/L). In Nigeria, low fluoride levels have been reported in most parts of the country, being ≤0.3 ppm in 62% of the local government areas, with fluoride concentrations generally higher in North Central zones (p<0.05). However, in a few drinking water sources studied, fluoride concentrations were >1.5 ppm. The variation in fluoride content of drinking water may be a result of dissimilarity in rock composition in different zones. Water fluoride content is also dependent on climatic condition. Galagan has suggested a formula for calculating the appropriate fluoride level in drinking water based on different climatic conditions. Based on this equation, 0.6–0.7 ppm of fluoride has often been recommended as appropriate for tropical countries with mean maximum ambient temperature higher than 27 °C. Although we did not take into account the depth of the wells sampled, high fluoride levels have been observed in deep and shallow wells in the mountainous areas (altitude of almost 300 m) of the North Central and South West geopolitical zones, as well as the geographically separate lowlands (altitude <100 m) of South-South geopolitical zone of Nigeria. These observations led the authors to suggest that there was no statistically significant relationship between altitude or depth of drinking water source and fluoride content.

**TAKE-HOME MESSAGE**

- Abnormal levels (high or low) of fluoride in drinking water are associated with adverse health effects.
- Although mean fluoride level in Enugu well waters is within safe limits and gives no cause for concern, epidemiological study to correlate fluoride content of well water and incidence of adverse effects in the metropolis is highly desirable.
- Screening for fluoride among the population, particularly in children may be advisable in view of increasing industrial activities going on in the city and heavy reliance on well water in the face of chronic shortage of potable water and use of consumer products containing fluoride.
There is no consensus on the permissible limit of fluoride in water used for domestic purposes. WHO and the European Economic Commission (EEC) set the maximum permissible limit of fluoride in drinking water at 1.5 mg/L, while the United States Environmental Protection Agency (USEPA) sets the limit at 2–4 mg/L. Too low fluoride content of water may result in adverse health effects. Then, supplemental fluoridation to optimum level may be necessary. On the other hand, concentrations >2 mg/L, may cause the danger of fluorosis; water with fluoride concentration >2.4 mg/L is unfit for use by children ≤4 years of age.

Although mean fluoride level in Enugu well waters is currently within safe limits and gives no cause for concern, epidemiological study to correlate fluoride content of well water and incidence of adverse effects in the metropolis is highly desirable. This is particularly important in view of increasing industrial activities going on in the city and heavy reliance on well water in the face of chronic shortage of potable water and use of consumer products containing fluoride.

Conflicts of Interest: None declared.

References


