Fluoride Content in Table Salt Distributed in Mexico City, Mexico

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Abstract

Objective: The aim of this study was to analyze table salt available in Mexico City's market to identify the fluoride concentrations and to compare these with the Mexican regulations. **Methods:** We analyzed 44 different brands of table salt. All samples were purchased at random in different stores, supermarkets, and groceries from Mexico City's metropolitan area and analyzed in triplicate in three different laboratories (nine determinations per sample) with an Orion 720 A potentiometer and an Orion 9609 BN ion-specific electrode. **Results:** Fluoride concentration in the samples varied from 0 ppm to 485 ppm. It was found that fluoride concentration varied widely among the analyzed brands. Also, we found that fluoride concentration in 92 percent of the analyzed samples contained fluoride concentrations that meet Mexican and WHO regulations. **Conclusions:** The broad variation in the analyzed samples suggests that Mexican Public Health authorities must implement more stringent regulation guidelines and procedures for controlling the distribution of salt and its fluoride concentration for human consumption.

Key Words: salt, salt fluoridation, dental fluorosis, fluoride

Introduction

It is well known that fluoride is a useful tool for dental caries prevention (1). Countering the dental caries prevention, dental fluorosis is clinically seen as discoloration areas in the dental enamel surface and it is related to a cumulating phenomenon mainly due to the ingestion of fluoridated water (1). Also, it has been recognized that the "halo effect" for dental fluorosis is associated with consumption of fluoridated products of unknown unreported fluoride content or (2-4).

Mexico has diverse dental fluorosis endemic zones comprising wide areas in several states (Aguascalientes, Chihuahua, Durango, Jalisco, Tamaulipas, Baja California, Hidalgo, San Luís Potosí, Campeche, and Zacatecas), and it has been reported that in these states, water for human consumption contains more than 1.5 ppm fluoride (5). In Mexico City, because of its geographic location and the special design of its water supply system, natural fluoride concentration in water for human consumption varies from 0.26 to 1.38 ppm (5).

Since 1998, epidemiological data on the incidence of dental fluorosis in children living in different zones of Mexico City (a non-endemic zone for dental fluorosis) have been reported, suggesting that dental fluorosis lesions are increasing in this child population (6). These results suggest that certain products consumed by the Mexican population on a daily basis might be involved in this public health problem.

In 1981, the Mexican Public Health authorities established the salt fluoridation program as an alternative measure for dental caries prevention (2). In Mexico, the Ministry of Health is in charge to dictate the regulations and to enforce and monitor the fulfillment of the norms, together with a subsidiary (the Dental Health Department). There are studies on the fluoride concentration in table salt in other countries (7), but no studies on fluoride concentration in table salt sold in the Mexican market are available to date. For this reason, the aim of this study was to determine the fluoride concentration in different brands of table salt available in a dental fluorosis non-endemic zone (Mexico City) and to ascertain if these concentrations agree with the Mexican (NOM-040-SSA1-1993), regulations

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Table 1Fluoride Concentration in the Analyzed Samples

which establishes that table salt should contain from 200 to 250 ppm F/kg (8).

Methods

The fluoride content in 44 brands of table salt was determined. Table salt packages were purchased at random from various stores, supermarkets, and groceries in different areas of the Mexico City Metropolitan Market (MCMM). The name of the product, country of origin, source (marine or earth), and total fluoride content (if it appeared on the package) were recorded.

In order to obtain higher accuracy, all samples were analyzed in triplicate in three different laboratories of the Universidad Nacional Autónoma de México (nine determinations per sample). A fluoride ionspecific electrode (Model 9609 BN, Orion, Cambridge, MA, USA) and a potentiometer (Model 720 A, Orion, Cambridge, MA, USA) were used for fluoride measurements. A calibration curve was built using solutions from 1 to 500 ppm F. A 2 g sample of salt was diluted in 25 ml of deionized water, mixed with 25 ml of TISSAB and constantly stirred during measurements. The readings in mV were converted to ppm F according to the calibration curve. Results were recorded in the SPSS 11.0 program and central tendency, dispersion test, and Pearson's correlation test were applied. Results were compared with the official Mexican norm (8).

Results

Individualized data obtained from the 44 analyzed samples are presented in Table 1. Fluoride concentration was printed on the package of 39 samples (88 percent). The labels of 22 samples (50 percent) indicate that fluoride concentration was in agreement with the Mexican norm (8); 17 (38 percent) indicated a higher content, and five product labels indicated no fluoride. There were 15 products of marine origin, 11 from the earth, and the other 18 did not indicate their source.

The fluoride concentration found in the analyzed samples ranged from 0 to 485 ppm F (129.8 ± 144.9 ppm F). In 12 products (27.3 percent) fluoride was not detected; in the other 12 samples (27.3%), we found that fluoride concentration was from 1 to 124 ppm; eight samples (18.2 percent) contained 125-199 ppm F; in three (6.8 percent) it was 200-250 ppm F; and in nine samples (20.4 percent) fluoride concentration was between 251-485 ppm F (Table 1).

Comparing our results with the Mexican norm (8), which states that fluoride content for human consumption should be within 200-250 ppm F, we found that only three samples (6.8 percent) contained the fluoride concentration established in this regulation; 33 (75 percent) were below the norm; and eight (18.2 percent) showed fluoride

concentrations above the Mexican guidelines (2, 8).

Salt products from marine origin had a fluoride concentration of 145.46 ± 168.81 ppm; and in the samples from earth, fluoride concentration was 136.82 ± 156.43 ppm. When we compared the fluoride concentration values from earth and marine derived salts. Pearson's correlation showed no statistically significant correlation (P=0.617). Additionally, the fluoride concentration in national salt was 142.8 ± 145.74 ppm, and none of the four imported salt samples contained fluoride. Comparing the fluoride concentration printed on the package and that found in this study (Table 1), we found that the fluoride content was incorrectly labeled in 92 percent of the studied samples.

Discussion

A recent report showed that fluoride concentration of water in different Mexico City areas varied from 0.26 to 1.38 ppm. These concentrations varied with the analyzed geographical zone, the water supply system examined (Mexico City has two different water supply systems), and the season of the year (5). Despite Mexico City's population being at low risk for dental fluorosis, this low risk could increase because of the unrestrained ingestion of additional fluoride products (2-4, 9). For example, a recent study analyzed 65 brands of toothpastes sold in the MCMM and found that their fluoride concentration was 879 ± 599.2 ppm (4). Also, the presence of additional fluoride sources has been identified in different products: bottled waters (0.08-0.37 ppm), juices (0.08 -0.92 ppm), nectars (0.07-1.31 ppm), and carbonated soft drinks (0.09-1.70 ppm) (2). These results suggest that consumption of the above mentioned products by the Mexican population might support any observed increase of dental fluorosis (6, 9).

Mexican law (NOM-040-SSA1-1993) establishes that table salt should contain 200-250 ppm F/kg (8). Results of this study disclose that 18.2 percent of the analyzed samples go above the amount indicated by this norm, and only 6.8 percent of the sample was within the Mexican guidelines. Also, these results showed that fluoride content in the analyzed samples is widely variable (from 0 to 485 ppm F). It is important to note that for 88.6 percent of the analyzed products the information on the packages was not accurate. This figure indicates that customers have no reliable information about the quantity of fluoride they are consuming. This may be one reason that people are unaware of the risk for developing dental fluorosis.

Fluoride has been demonstrated to be an important factor in dental caries prevention. It has been reported that a reduced caries index after implementing salt fluoridation programs occurred (7). Data obtained from a Mexican population living in a non-endemic fluorosis zone (Estado de México state) indicated that since implementation of the salt fluoridation program, dental caries declined 43 percent (the mean DMFT index was 4.39 in 1988 and 2.47 in 1997) in 12-year-old children (10). The above mentioned figures support the concept that fluoride reduces dental caries in the population. Nevertheless, the results of studies showing consumption of fluoridated water with fluoride concentrations above the Mexican and WHO recommendations in addition to fluoride-containing products (1, 3-5, 7, 9), seem to demonstrate an increased development of dental fluorosis lesions, even in people living in regions considered as nonendemic zones.

Results from our previous studies (6, 10) demonstrated that in areas where fluoride content in water is low, frequency of dental fluorosis is increasing. This could be related to the unrestricted use of fluoride-containing products and to the consumption of foods and beverages with unknown fluoride concentrations. It should be pointed out that the unregulated introduction of fluoride-ridated salt in endemic and non-endemic zones might aggravate this

public health problem. Also, the uncontrolled distribution and the unreliable and unrestricted supply of fluoridated products for dental caries prevention in endemic and nonendemic dental fluorosis areas might be associated with the increase in the frequency of this disease found in previous studies made by our study group (3-6, 9).

All the previously mentioned results should alert the Mexican Public Health Authorities to enforce existing or to implement additional regulations for appropriate and adequate distribution of all fluoridecontaining products for human consumption. Our results, showing that only 6.8 percent of the analyzed products were within the Mexican rules for fluoride content in table salt, is supportive of an intervention.

The results regarding printed fluoride concentration on the packages of the analyzed products deserve a special consideration. Our results showed both incorrect and inappropriate information, whether it was the recommended amount or not. This finding suggests that perhaps manufacturers are not informed on the regulations implemented since 1981 by the Mexican Health Ministry (2, 8) or that table salt manufacturers have inadequate measuring procedures to monitor fluoride concentration in their products.

According to our results, we can conclude that: a) Fluoride concentration of the analyzed table salts varied widely; b) distribution of table salt in the Mexican market does not follow the Mexican guidelines; c) only 6.8 percent of the samples analyzed in this study were within the Mexican regulations; d) fluoride concentrations of 92 percent of the analyzed samples of table salt did not match with the fluoride concentration printed on the label; e) Mexican Public Health authorities should implement more stringent regulations for the fluoride content of table salt for human consumption and for distribution in the Mexican market; f) the Mexican population is left unaware of the risk for developing dental fluorosis since products are purchased with variable, sometimes unknown and frequently wrong information on fluoride concentration; g) consumers in Mexico City are unable to make educated purchasing decisions with respect to fluoride content of table salt, given the misleading information currently on labels; and h) table salt manufacturers must follow the Mexican guidelines and improve their procedures for monitoring fluoride concentrations in their products and printing the correct fluoride content on the labels.

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