

FLUORIDE LEVELS OF BOTTLED AND TAP WATER SOURCES IN AGRA CITY, INDIA

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SUMMARY: This paper presents a comparison of the fluoride content of fifteen bottled water and two tap water samples in Agra, a major tourist city in Uttar Pradesh, India. The source of the bottled and tap water is groundwater pumped from bore wells. The fifteen brands of bottled water purchased from shops in the city had fluoride levels ranging from 0.45 to 0.86 mg/L. The two tap water samples from north and south locations had fluoride levels of 1.6 and 1.7 mg/L.

Keywords: Agra City, India; Bottled water fluoride; Groundwater source; Tap water fluoride.

INTRODUCTION

One of the most common trends among consumers in recent years in various countries, including India, is the replacement of their daily water intake with bottled water, possibly due to apprehension about contaminants in natural water supplies.¹⁻³ By the late 1990s, the bottled water market was growing three times faster than soft drinks, and by year 2000, 1,390 million liters of bottled water were being consumed in UK alone.⁴

Even though bottled water is disinfected, microbes, pesticides, solvents, and arsenic can still be found in bottled water.^{5,6} Agra City was selected for the study because of its inadequate water supply, declining groundwater level, and poor water quality. The major source of drinking water in the city is groundwater with most of the drinking water supply depending on it. The Agra city is situated on the bank of the Yamuna River in western Uttar Pradesh between 27°11' N latitude and 78°0' to 78°2' E longitude at 169 m above sea level. In this study the fluoride (F) concentration was determined in samples of tap and bottled water in Agra City.

MATERIALS AND METHODS

Two tap water samples from groundwater, one from north Agra (G1) and other from south Agra (G2), were collected along with three samples each of fifteen (15) brands of bottled water purchased from various shops in Agra City. Each of the three samples of the bottled waters had a different batch number and date of bottling. Groundwater is the source of the bottled water, and reverse osmosis (RO), along with ultraviolet irradiation is used for purification. All bottles were stored in a dark place in their original sealed plastic containers at room temperature until the F analysis was done. After shaking the bottle of water, a 50-mL sample was taken and kept in container, then coded so the type and the brands were unknown to the technician testing the water. Water samples were diluted with equal quantities of TISAB (Total Ionic Strength Adjustment Buffer), and the F ion concentration was determined using a combination F-ion-selective electrode. The calibration of electrode and determination of F was carried out as per standard methods.⁷ To assess the reliability of the method, one batch number (of three) for

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each of the bottled water samples was randomly selected, and the samples were re-analyzed.

RESULTS

The F concentration in the 15 brands of bottled drinking water and the two groundwater tap sources are shown in Table 1.

Table 1. F concentration (mg/L) and pH of 3 batches each of bottled water and two tap water samples in Agra City^a

Brand	Fluoride (mg/L)			pH
	Batch 1	Batch 2	Batch 3	
Aone Water	0.80	0.81	0.79	7.1
Aqua1	0.81	0.80	0.78	7.3
Aquafina	0.84	0.81	0.81	7.5
AquaGold	0.85	0.82	0.80	7.3
AquaPure	0.79	0.80	0.79	7.4
Best Water	0.81	0.81	0.80	7.6
Bislari	0.81	0.80	0.76	7.7
Cool Spring	0.85	0.81	0.82	7.5
Himalaya	0.45	0.58	0.47	7.4
Jal	0.86	0.80	0.83	7.5
Kinley	0.80	0.79	0.80	7.4
Neer	0.83	0.80	0.82	7.4
Purita	0.70	0.69	0.68	7.4
Railneer	0.65	0.68	0.65	7.2
Weather Spring	0.59	0.66	0.64	7.4
G1	1.6	1.7	1.6	7.9
G2	1.8	1.8	1.7	7.8

^aAccording to the respective manufacturers, all bottled waters were prepared from groundwater sources with removal of F by reverse osmosis.

All the bottled waters had F content below 1 mg/L, ranging from 0.45 to 0.86 mg/L, whereas the two tap water samples had much higher levels of 1.6 and 1.7 mg/L. The mean pH of the bottled water samples was 7.5 with a range of 7.1 to 7.7. The pH of the tap water samples was 7.8 and 7.9.

DISCUSSION

Knowledge of the F content of drinking water is essential for the public as well as health care professionals to know, especially dentists.⁸ The type of water filter used impacts the amount of fluoride and bacteria removed from the water and affects the safety of bottled water. Faucet-mounted or pitcher filters generally remove only impurities but not F, whereas under-the-sink units such as reverse osmosis and distillation generally remove 90% or more of the F.⁹

As found here, the concentration of F in the bottled drinking waters purchased in Agra City ranged between 0.45 and 0.86 mg/L. To the best of our knowledge no such study has been conducted to date in Agra City. These results can be compared with those reported for bottled waters available in other cities (Table 2).

Table 2. Various bottled water F reported in the literature

Year, location	No. of bottles	Reported F levels (mg/L or ppm)
2006, Northern Greece ²	22	0.05–4.8
1991, Canada ⁶	17	0.06–4
2006, Australia ¹⁰	10	0.001–0.1
2010, Riyadh, Saudi Arabia ¹²	21	0.32–1.1
2010, Bangalore, India ¹³	14	0.06–0.32
2008, Iran ¹⁴	17	0.00–0.59

The requirement of bottled water to meet standards for F content has become a major concern where bottled water is consumed by large populations, especially in the urban sectors of Indian subcontinent. In many countries, bottled water companies do not list the concentration of ingredients on the bottle label.¹⁰⁻¹⁴

Planning of preventive dental care programs depend on having an accurate assessment of the current F intake habits by the population since enamel fluorosis from excessive ingestion of F can lead to long-term adverse health effects. For this reason, the need for more studies to examine the F content of commercially available bottled waters and to report the findings in the literature is obvious.

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