

FLUORIDE CONTENT OF BOTTLED WATERS RECOMMENDED FOR INFANTS AND CHILDREN IN POLAND

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SUMMARY: The aim of this study was to determine the fluoride (F) content of 10 brands of Polish bottled waters recommended for use by infants and young children and to report on the accuracy of the labeling of the F concentration. Analyses were performed with an ion-selective F electrode (09-37 type) and a RAE 111 chloride-silver reference electrode (MARAT). All brands mentioned the F concentration on the label. Differences between tested F levels and those displayed did not exceed 0.11 mg/L. Mean F concentrations in the bottled waters ranged from 0.08 to 0.3 mg/L, meeting recent recommendations for the maximum F content in water used to reconstitute milk formula.

Keywords: Bottled water in Poland; Children's fluoride intake; Fluoride in bottled water; Infant fluoride intake.

INTRODUCTION

Results of studies carried out in various countries suggest that some brands of bottled water, when used to reconstitute milk formula concentrate and cereals or added to juices and other beverages, may increase children's F intake beyond levels believed to lead to dental fluorosis.¹⁻⁶ Some authors detected extremely high F levels in commercially available bottled waters exceeding 4.0 ppm,^{3,7} which raises concerns for adverse health affects of excessive F intake.^{8,9} Moreover, many bottled waters, did not show the F content on their labels or the labeling was inaccurate.^{1-7,10-14} Regulations of the Polish Minister of Health concerning natural mineral waters, spring waters, and table waters do not oblige manufacturers to display the precise level of F content in the product.¹⁵

Of the 12 Polish brands of mineral water tested by Borysewicz-Lewicka et al., all had the F concentration labeled, but for 3 brands the tested F concentration differed from the concentration printed on the label.¹²

The aim of this study was to determine the F content in Polish bottled waters recommended for the use by infants and young children and to report on the accuracy of the labeling of F concentration.

MATERIALS AND METHODS

Ten brands of noncarbonated bottled water with low sodium content and either low or medium mineral content were evaluated: five are classified as mineral water and five as spring waters. All products received favorable opinions from respectable health institutions (Table 1) confirming they can be safely recommended for children.

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Table 1. Polish bottled waters analyzed, manufacturers, and organizational recommendations

Water brand	Type of water	Manufacturer	Positive opinion from
Waters with low mineral and low sodium content recommended for infants			
Dobrawa	spring water	WOMIR-SPA Sp. z o.o.	Institute of Mother and Child
Zywiec Zdroj	spring water	Zywiec Zdroj S.A.	Institute of Mother and Child
Mama i Ja	spring water	Wosana S.A.	Child's Health Center
Primavera	spring water	Polska Woda Sp. z o.o.	Child's Health Center
Waters with medium mineral and low sodium content recommended in the diet of children over one year of age			
Nestle Aquarel	spring water	Nestle Waters Polska S.A.	Institute of Mother and Child
Naleczowianka	mineral water	Nestle Waters Polska S.A.	Institute of Mother and Child
Jurajska	mineral water	Jurajska S.P.	Institute of Mother and Child
Cisowianka	mineral water	Naleczow Zdroj Sp. z o.o.	Polish Society for Magnesium Research
Arctic	mineral water	Hoop S.A.	Child's Health Center
Ustronianka	mineral water	Ustronianka Sp. z o.o.	Medical University of Silesia

Three samples of each brand of bottled water in plastic bottles, each with a different batch number and date of bottling, were purchased in supermarkets of the city of Poznan. Analyses were performed in the laboratory of the Technical University of Poznan with an ion-selective F electrode (09-37 type) and a RAE 111 chloride-silver reference electrode (MARAT). After shaking the bottle of water, a 10.0-mL sample was taken and mixed with an equal volume of TISAB buffer to maintain an appropriate ionic strength and pH. The average reading for each brand was compared with the F content printed on the label.

RESULTS

All brands mention the F concentration on the label. The mean F concentrations in samples of waters ranged from 0.08 ppm in “Mama i ja” and “Zywiec Zdroj” to 0.3 ppm in “Jurajska” water. Differences between mean tested F levels and those displayed on labels ranged from 0.0 mg/L for “Jurajska” water to 0.11 mg/L for “Mama i ja” (Table 2).

Table 2. F content (mg/L) of ten Polish bottled waters recommended for infants and children

Water brand	Labelled content	Batch 1	Batch 2	Batch 3	Mean ±SD
Dobrawa	0.1	0.09	0.10	0.08	0.09±0.01
Zywiec Zdroj	0.07	0.08	0.07	0.08	0.08±0.01
Mama i Ja	0.19	0.08	0.08	0.09	0.08±0.01
Primavera	0.08	0.11	0.08	0.08	0.09±0.02
Nestle Aquarel	0.2	0.21	0.21	0.22	0.21±0.01
Naleczowianka	0.3	0.26	0.29	0.30	0.28±0.02
Jurajska	0.3	0.30	0.30	0.29	0.30±0.01
Cisowianka	0.21	0.18	0.22	0.19	0.20±0.02
Arctic	0.27	0.27	0.26	0.26	0.26±0.01
Ustronianka	0.3	0.22	0.30	0.26	0.24±0.04

DISCUSSION

Because the prevalence and severity of dental fluorosis are related to the amount of F ingested during the critical periods of enamel formation, the increased F intake must occur during infancy and early childhood to affect the most aesthetically important teeth. Thus, the assessment of F levels in fluids and foods consumed by infants and young children is necessary in order to estimate the risk of dental fluorosis in this population.^{2,3,5,16}

As shown by various authors, the F content in bottled water may be highly variable among different brands, and this fact may have oral implications for infants and children, who often have bottled water as their primary source of drinking water.^{1-4,6,7,10}

In the study conducted by MacFadyen et al. in the United Kingdom, concentrations of F in 24 brands of bottled water ranged from 0.10 up to 5.8 mg/L.⁷ Similarly, Ahiropoulos observed a wide range of F concentrations (0.05 to 4.8 mg/L) testing 22 brands of bottled water available in Northern Greece.³

In 1994 Toumba et al. found F concentrations in British bottled water varied from 0.10 to 0.80 mg/L.⁶ In a 1995 study by Van Winkle et al. F concentrations in bottled waters in Iowa ranged from 0.34 to 1.36 mg/L,¹ and in a 2004 study by Grec et al. the F content in Brazilian bottled waters ranged from 0.01 to 2.04 mg/L.⁴

Results of our study are similar to those obtained recently by Zohouri et al.¹⁰ and by Dobaradaran et al.¹⁴ The fluoride content of bottled waters in North-East England and Iran ranged from 0.01–0.37 mg/L and 0.00–0.59 mg/L, respectively.

Some authors state that concentration of F in drinking bottled water below level 0.5–1.0 mg/l recommended by WHO,¹⁷ can result in inadequate F intake of the population, increasing risk of dental caries.^{11,13} However, as noted recently by Burgstahler⁸ and by Osmunson,¹⁸ modern research provides little support for recommendation of fluoridated water for the prevention of dental caries.

With regard to infant F intake, milk formulations themselves may sometimes contain high levels of F, and, when reconstituted with fluoridated water, they can pose a risk of dental fluorosis in children.^{5,19} Buzalaf et al. observed that the use of waters with F concentrations of 0.623 and 0.839 mg/L for reconstituting baby milk formula, would give rise to a daily F intake higher than the limit that is considered acceptable (0.07 mg of F per kg of body weight) for children up to one year of age.²

Polish waters, from those sampled, meet recent recommendations of the American Dental Association (ADA), according to which diluents of liquid concentrate or powdered infant formula should be F-free or contain low levels of F to reduce the risk of dental fluorosis.²⁰ The concentration of F in our study stayed within a range 0.0 to 0.3 mg/L, as proposed by Fomon et al., who analyzed risk of dental fluorosis associated with infant feeding practices.¹⁶

Similar to the findings of other authors, we detected differences between tested F concentrations and those displayed on labels. However, the differences in our study were relatively small and can be probably be attributed to variation of the F content in water source over time, as well as seasonal fluctuations.¹⁰

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REFERENCES

- 1 Van Winkle S, Levy SM, Kiritsy MC, Heilman JR, Wefel JS, Marshall T. Water and formula fluoride concentrations: significance for infants fed formula. *Pediatr Dent* 1995;17:305-10.
- 2 Buzalaf MA, Damante CA, Trevizani LM, Granjeiro JM. Risk of fluorosis associated with infant formulas prepared with bottled water. *J Dent Child* 2004;71:110-3.
- 3 Ahiropoulos V. Fluoride content of bottled waters available in Northern Greece. *Int J Paediatr Dent* 2006;16:111-6.
- 4 Grec RH, de Moura PG, Pessan JP, Ramires I, Costa B, Buzalaf MA. Fluoride concentration in bottled water on the market in the municipality of São Paulo. *Rev Saude Publica* 2008;42:154-7.
- 5 Levy SM, Kohout FJ, Guha-Chowdhury N, Kiritsy Mc, Heilman JR, Wefe JS. Infants' fluoride intake from drinking water alone, and from water added to formula, beverages, and food. *J Dent Res* 1995;74:1399-407.
- 6 Toumba KJ, Levy S, Curzon MEJ. The fluoride content of bottled drinking waters. *Br Dent J* 1994;176:266-8
- 7 MacFadyen EE, McNee SG, Weetman DA: Fluoride content of some bottled spring waters. *Br Dent J* 1982;153:423-4.
- 8 Burgstahler AW. Fluoridated bottled water [editorial]. *Fluoride* 2006;39:252–4.
- 9 Doull J, Boekelheide K, Farishian BG, Isaacson RL, Klotz JB, Kumar JV, et al., Committee on Fluoride in Drinking Water, Board of Environmental Studies and Toxicology, Division on Earth and Life Studies, National Research Council of the National Academies. *Fluoride in drinking water: a scientific review of EPA's standards*. Washington, DC: The National Academies Press; 2006
- 10 Zohouri FV, Maguire A, Moynihan PJ. Fluoride content of still bottled waters available in the North-East of England, UK. *Br Dent J* 2003;195:515-8.
- 11 Johnson SA, DeBiase C. Concentration levels of fluoride in bottled drinking water. *J Dent Hyg* 2003;77:161-7.
- 12 Borysewicz-Lewicka M, Chlapowska J, Wagner L, Trykowski J. An evaluation of the fluoride content in some Polish mineral waters. *Czas Stomat* 1999;52:29-32. [in Polish].
- 13 Cochran NJ, Saranathan S, Morgan MV, Dashper SG. Fluoride content of still bottled water in Australia. *Aust Dent J* 2006;51:242-4.
- 14 Dobaradaran S, Mahvi AH, Dehdashti S. Fluoride content of bottled drinking water available in Iran. *Fluoride* 2008;41:93–4.
- 15 Regulations of the Polish Minister of Health concerning natural mineral waters, spring waters and table waters with further changes and completions. *Official Journal of Laws* 2004, No. 276 item 2738
- 16 Fomon SJ, Ekstrand J, Ziegler EE. Fluoride intake and prevalence of dental fluorosis: trends in fluoride intake with special attention to infants. *J Public Health Dent* 2000;60: 131-9.
- 17 World Health Organization. *Fluorides and Oral Health: Report of a WHO Expert Committee on Oral Health Status and Fluoride Use*. WHO, Geneva 1994.
- 18 Osmunson B. Water fluoridation intervention: Dentistry's crown jewel or dark hour? [guest editorial]. *Fluoride* 2007;40(4):214-21.
- 19 Chlubek D. Interaction of fluoride with milk constituents. *Ann Acad Med Stettin* 1993;39:23-38. [in Polish].
- 20 ADA Division of Communications. For the dental patient: infants, formula and fluoride. *J Am Dent Assoc* 2007;138:132.