



## Content of Fluoride in Available Bottled Water from the Republic of Macedonia

Ambarkova Vesna<sup>1\*</sup>, Kochubovski Mihail<sup>2</sup>, Ljuben Guguvcevski<sup>1</sup> and Vanco Spirov<sup>3</sup>

<sup>1</sup>Department of Pediatric Dentistry, Faculty of Dentistry University Sv.Cyril & Methodius Skopje, Greece

<sup>2</sup>Department of Pediatric Dentistry, Institute of Public Health of the Republic of Macedonia, Greece

<sup>3</sup>Department of Pediatric Dentistry, University Dental Clinic Center Ss.Pantelejmon, Greece

### Abstract

**Aim of the Paper:** To determine the content of fluoride in drinking bottled water available in the country.

**Material and Methods:** Thirty-five commercial brands of bottled water (12 out of 23 domestic production and imported brands) were procured from bigger markets in the Republic of Macedonia. Determination of the content of fluorine is performed using ion selective electrode (Thermo Orion Ion plus Fluoride Electrode) and Ionometar (pH/ISE meter - Thermo-Orion) of the public health Institute.

**Results:** The content of fluoride in packaged water from domestic production ranged from 0,035 in Spring to 1,086 in vision with an average 0,368 ( $\pm$  0,305), while imported bottled water ranged from 0.032 in ordinary water ROSA to 2.220 in bottled water KOM, with an average 0,631 ( $\pm$  0,497). 12 packaged water from domestic production only in three of them emphasized the concentration of fluoride in their declaration, two of whom she corresponded to the concentration which we have determined. 23 imported packaged water in 15 of them emphasized the content of fluoride in their declaration, while 6 of them featured content of the declaration did not correspond to the concentration of fluorine which we have determined.

**Conclusion:** This study showed that bottled water contains different concentrations of fluoride. Parents that use bottled water to prepare powdered milk for babies and baby foods should be aware that it may contain higher concentrations of fluoride and put their child at risk the occurrence of dental fluorosis.

### OPEN ACCESS

#### \*Correspondence:

Ambarkova Vesna, Department of Pediatric Dentistry, Faculty of Dentistry University Sv.Cyril & Methodius Skopje, Republic of Macedonia, Greece,  
E-mail: ambveki@yahoo.com

Received Date: 24 Nov 2016

Accepted Date: 30 Dec 2016

Published Date: 05 Jan 2017

#### Citation:

Vesna A, Mihail K, Guguvcevski L, Spirov V. Content of Fluoride in Available Bottled Water from the Republic of Macedonia. *J Dent Oral Biol.* 2017; 2(2): 1028.

**Copyright** © 2017 Vesna A. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

**Keywords:** Bottled water; Mineral water; Fluoride

### Introduction

Proper use of fluoride contributes to the improvement of oral health worldwide and in our country [1]. The aqueous drinking a principal means by which fluorine is introduced into the human body and only 6.8% of the population receives optimally fluoridated naturally water main public water systems [2]. The drinking water in the country has a low content of fluorine, which is correlated with high average DMFT score of 6.88 among the 12 year olds of our population. The concentration of fluoride in drinking water from public water utilities in the country moves from 0-0., 4 mg/l [3,4]. Water used for drinking directly or indirectly in addition to juices and food is an important source of intake of fluoride in the body. Lately there is a trend of increased use of natural drinks because developing a passion for exercise, fitness, frequent travel and the trend of consuming food out of home. All these trends along with people's concerns about the taste and quality of water from public water supply systems, contribute to more people use bottled water. The recent floods that occurred in the country and which were followed by a public invitation from the Institute of Public Health to citizens not to consume drinking water from a public water supply in the flooded areas and regions, necessitated by the consumption of bottled drinking water. Besides that our country is rich in water [4], the amount of imported bottled water is continuously increasing in the last six years (Figure 1) [5].

The concentration of some elements, such as calcium, sodium, iron, silver and aluminum in bottled water are regulated in most countries, one of which is ours. The appearance of fluorine in drinking water varies depending on the type/composition of the soil. The content of fluoride in

**Table 1:** The content of fluorine in 12 packaged water from domestic production.

Brand of bottled water	Source of water	Type of water	Concentration of fluoride	Concentration of fluoride marked on the declaration	pH value
Vizijana	Klechovce village	Natural	1,086	1.00	not indicated
Kozuvcanka	Mrezicko village	Spring	1,046	not indicated	6.5
DobraVoda	Topolovic	Natural	0,81	not indicated	not indicated
Akva Kokino	Nagoricane village	Natural	0,34	not indicated	not indicated
Pela Rosa	Kremenica	Natural	0,32	0.14	6.6
Germinal	Germijan village	Natural	0,3	not indicated	not indicated
Pelisterka	Medjitija village	Natural	0,149	not indicated	7
Davina	Skopje		0,105	0.4	7.5
Gorska	Trnskot	Spring	0,084	not indicated	6
Ladna	Breza-Lisec	Spring	0,080	not indicated	not indicated
Aqua Kiss	Kochani		0,071	not indicated	not indicated
Izvorska	Vasov Grad	Spring	0,035	not indicated	not indicated

**Table 2:** Content of fluoride in 23 imported packaged water.

Brand of bottled water	Source of water	Country of origin	Concentration of fluoride in the water	Concentration of fluoride marked on the declaration	pH value marked on the declaration
Ком	Barzia village	Bulgaria	2,22	2.2	9.0
Zlatibor	Spring on the mountain Zlatibor	Serbia	1,52	not indicated	not indicated
Knjaz Milos	Arangelovac	Serbia	1,41	1,3	not indicated
Heba	"HEBAA".Bujanovac Spa	Serbia	1,28	1,45	not indicated
Klokoti	Vitina	Kosovo	1,15	not indicated	not indicated
Studenac	Earls springs Lipik	Croatia	1,07	1,5	not indicated
Озкаинач	Yaşam Kaynağı	Turkey	0,935	0,72	6.5
Uludag	Caybasi Koyu	Turkey	0,81	not indicated	not indicated
Bursa	Bursa	Turkey	0,79	not indicated	not indicated
Jamnica	Spring Jamnica, on the river Kula, near the Karlovac city	Croatia	0,77	0,9	not indicated
Voda Voda	Spring on the river in the mountain Suvobor	Serbia	0,71	0,48	7.23
Radenska klasik	Kraljevi Vrelec	Slovenia	0,47	0,5	not indicated
Lutraki	Lutraki Spa	Greece	0,325	not indicated	8.31
Studena	Psunj, spring Studena	Croatia	0,227	0,25	not indicated
Gala	Maljen mountain	Serbia	0,25	not indicated	not indicated
Akva Viva	"PARK" Arangelovac	Serbia	0,123	0,18	not indicated
Prolom	Prolom Spa	Serbia	0,12	0,12	9.2
Korpi	Akarnan mountains in Western Greece	Greece	0,075	not indicated	7.3
Evian	From the heart of the Alps	France	0,069	0,07	7.2
Jana	Sv.Jana source of the river Kupa	Croatia	0,06	0,04	not indicated
San Benedeto	Dolomiti, San Pellegrino, thermal springs	Italy	0,05		7.68
Vikos	Near the canyon Vikos	Greece	0,05		7.62
Rosa	Vlasina-Topli Do	Serbia	0,032		not indicated

bottled water can be very variable and if above optimal levels may have a negative impact especially on the oral health of children who drink bottled water as the primary source of drinking water. According to WHO recommendations (Guidelines for drinking-water quality Third Edition, 2004) [6] and also according to our current regulations (Regulations for water safety Official Gazette no.46/08) [7], the content of fluorine in water drinking to 1.5 mg/l. The protective role of fluoride in drinking water from the cavities is most apparent at concentrations of 0.8-1.2 mg/l. Because nowadays people consume

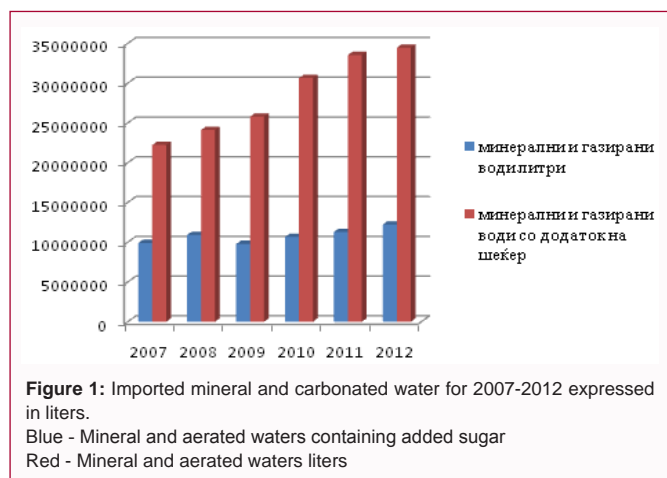
more bottled drinking water, the need to determine the content of fluoride in it. Aim of the paper is to determine the content of fluoride in packaged drinking water available in the market in the country. These data will be useful as dentists dealing with clinical practice as well as those working in public health and to use when you need to implement fluoride prophylaxis of individual or mass level.

## Material and Methods

During 2008 35 commercial brands of bottled water were

**Table 3:** The average, minimum and maximum content of fluoride in bottled water.

Bottled water	Average value	standard deviation	Minimum value	Maximum value
Imported water	0,631	± 0,497	0,032	2,220
Domestically produced water	0,368	±0,305	0,035	1,086



**Figure 1:** Imported mineral and carbonated water for 2007-2012 expressed in liters.  
 Blue - Mineral and aerated waters containing added sugar  
 Red - Mineral and aerated waters liters

purchased from major markets in the Republic of Macedonia. After shaking the bottle with water, 1 ml of each sample is taken and mixed with 0.1 ml Total Ionic Strength Adjustment Buffer. The concentration of fluoride in all 35 samples was determined using the ion selective electrode (Thermo Orion Ion Plus Fluoride Electrode) and Ionometar (pH/ISE meter - Thermo-Orion) of the Public Health Institute. Chemical analysis was used 10% TISAB Aluminon. Fluorine solutions standards with a concentration of 0.01 to 1.00 mg/l were used to calibrate measurements.

**Results**

From 35 packaged water, 12 (34%) was produced in Macedonia respectively Table 1 presents the most widely used brands of bottled water in our country, the established concentration of fluoride, and tagged values for fluoride and pH of the declaration. The concentration of fluoride in bottled water from domestic production is within the lowest value of 0.035 for spring to the highest value of 1,086 for Vizijana. From 12 branded packaged water (domestic production), only three had pointed the content of fluoride on its declaration, from which two did not correspond to the content that we have determined. Table 2 presents imported packaged water with the concentration of fluorine which we have determined and it ranged from the lowest value of 0,032 mg/l in bottled water Rosa originating from Serbia to 2,220 in water Kom originating from Bulgaria. As for the quality of labeling of packaged water, 17 (48.5%) packaged water not emphasized fluorine content on their label, while 18 packaged waters emphasized contents of fluorine, in 8 that does not correspond to the content we have determined. Table 3 presents the average, maximum and minimum values that we received for mineral waters and those imported from domestic production.

**Discussion**

Several authors have dealt with the determination of the concentration of fluoride in the water packaged in their countries [8-12]. The concentration of fluorine in packaged Evian water 0.15 mg/l in the study of Tomba et al. [8] at the study Zohouri et al. [12] as in our study it is 0.06mg/l. Because the method for analyzing fluorine is similar in all studies, differences between measured concentrations

of fluoride in different studies may be explained as a variation of the content of fluoride over time, depending on the source of bottled water, as well as seasonal fluctuations. Healthcare professionals should be aware that the value of the tags cannot be credible as this study demonstrated in 44.4% of the branded packaged water no alignment between the determined value of fluorine and that pointed on labels. The large number of domestic manufacturers of packaged water does not emphasize the content of fluoride on their declaration because they are legally required to highlight the content of fluoride on the label if it is greater than 1 mg/l. According to the Rulebook on the special requirements for natural mineral water (Official Gazette of RM no.32/06) [13-16]. Article 14 states that if the natural mineral water contains more than 1 mg/l should be appointed to the product or another prominent position "contains fluoride". If natural mineral water contains more than 1.5 mg/l fluoride should be indicated that the product is not suitable for regular/repeated use of infants and children under 7 years old. According to our analyzes we conducted on natural mineral water from home production only Kozuvcanka (1,046 mg/l), vision (1,086 mg/l) and Good Water (0,810 mg/l) contain higher values of fluoride that are within the recommended values of WHO and our legislation. It is also very important water consumers to have accurate information on the concentration of fluoride in the water, which they consume. Having in mind this situation, we recommend packaged water be analyzed at least twice a year at the Institute of Public Health of the Republic of Macedonia or in other accredited independent laboratory. The natural mineral waters with low or very low content of fluorine, like type of Gorska, Aqua Kokino, Ladna could be used by the general population including child population. It is worth noting that the first Cold bottled water is recommended for the youngest by the Association of Psychiatrists of Macedonia.

When we evaluate the effect of the consumption of bottled water on total intake of fluoride in one individual, three factors should be considered:

1. The amount of bottled water consumed daily.
2. The intake of fluoride from other sources, such as swallowing toothpaste with tooth brushing and food with high content of fluorine.
3. The use of bottled water for preparing milk feeds and dissolution of the pulp food for newborns.

**Conclusion**

1. Manufacturers of bottled water did not emphasize the content of fluorine labels or hoist that is incorrect.
2. Dentists should be aware of the concentration of fluorine in the water we drink his patients from childhood, whether it is packaged or tap water.
3. Parents who use bottled water to prepare the milk meal for your baby, you should be aware that if it contains high concentrations of fluoride to expose their children to risk of dental fluorosis.

**References**

1. Ambarkova V, Kokoceva-Ivanovska O, Zabokova-Bilbilova E, Petanovski

- H, Carcev M. Fluorine content of bottled drinking water available in the Republic of Macedonia. 18-th Congress of the Balkan Stomatological Society. 2013; 25-28.
2. Ambarkova V, Topitsoglou V, Iljovska S, Carcev M. Natural fluoridated drinking water from the Republic of Macedonia. *Macedonian Stomatological Review*. 2005; 29: 177-182;
  3. National strategy for prevention of oral diseases in children from 0 to 14 years of age in the Republic of Macedonia for the period from 2008 to 2018. Ministry of Health. Republic of Macedonia. 2007.
  4. Gjorgjev D Kocubovski M Velev D Filjanski P Cvetkovska T. Some key indicators for hard drinking water in urban water supply systems in Macedonia. Second consultation on water management in the Republic Macedonia, Ohrid. 1995; 43-51.
  5. State Statistical Office of Macedonia MakStat -statistichka database imported quantity of water according to the Foreign Trade.
  6. WHO: Guidelines for drinking water quality (3-th ed), 2004.
  7. Guidelines for water safety Official Gazette no.46 / 08.
  8. Toumba KJ, Levy S, Curzon ME. The fluoride content of bottled drinking water. *Br Dent J*. 1994; 176: 266-268.
  9. Al-Omran AM, El-Maghraby SE, Aly AA, Al-Wabel MI, Al-Asmari ZA, Nadeem ME. Quality assessment of various bottled waters marketed in Saudi Arabia. *Environ Monit Assess*. 2013; 185: 6397-6406.
  10. Mills K, Falconer S, Cook C. Fluoride in still bottled water in Australia. *Aust Dent J*. 2010; 55: 411-416.
  11. Thippeswamy HM, Kumar N, Anand SR, Prashant GM, Chan D. Fluoride content in bottled drinking waters, carbonated soft drinks and fruit juices in Davangere city, India. *Indian J Dent Res*. 2010; 21: 528-530.
  12. Zohouri FV, Maguire A, Moynihan P J. Fluoride content of still bottled water available in the North-East of England, UK. *Br Dent J*. 2003; 195: 515-518.
  13. Michael Kocubovski, P Filjanski, D Gjorgjev, D Velev, L Kolevska. New Standards of FAO / WHO quality natural mineral water. Proceedings of the XXIII-th October meetings of medical and sanitary laboratory technicians of the Republic of Macedonia "Ohrid. 1995; 65-66.
  14. Zaklina Ristovska M. Kocubovski. Quality mineral water "Kumanovka" - Kumanovo. Proceedings XXIII October meetings of medical laboratory and sanitary technicians of the Republic of Macedonia. Ohrid. 1995; 66.
  15. Michael Kocubovski, Velev D, Gjorgjev D, Kolevska L, Dimitrov Z, Filjanski P. The specific characteristics of the natural mineral water "KATLANOVKA." Fourth counseling water management in Macedonia. Ohrid. 1997; 295-298.
  16. Guideline of the special requirements for safety of natural mineral water (Official Gazette of RM no.32/06).