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Fluoride content of available bottled drinking water in Tripoli, Libya

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Abstract: The present study was carried out to evaluate the fluoride content of bottled water brands available in the market of Tripoli city and to measure if it is consistent with local standards. A total of 23 commercially available brands were collected and examined for fluoride content. 22 samples were locally produced and one was imported. The average fluoride levels of each sample was determined using the procedure outline in the Palintest photometer method and then compared with the fluoride content printed on the bottle labels. In all bottled water brands investigated, 19 brands of the analyzed samples did not state the fluoride levels on the labels of the bottles. The determined fluoride concentrations ranged from 0 to 2.75 ppm. For each brand, the fluoride level was not similar to the labeled fluoride. 82.6% (19 brands) had a fluoride content lower than the Libyan standards, 1 brands had a fluoride content higher than the Libyan standards, and 7 brands had zero fluoride content. All the samples examined had fluoride content outside the range regulated by Libyan standards. There was a significant variation between the F levels stated by the manufacturer on the bottle labels and the values measured during the investigation.

Keywords: Fluoride, bottled water, oral health, Palintest

1. Introduction

Everything that lives on land, from plants to insects to humans, needs fresh water to survive. In fact, water is the main constituent in human body weight, on average, 60-70% of an adult's body weight is composed of water. Nowadays, the water demand that meets health requirements, and is free of contaminants has led to a new industry, the bottled water industry. Bottled drinking water is frequently used instead of tap water because of its convenience, pleasing taste, and perceived purity [11]. In the last few years, the consumption of bottled water has increased worldwide. Between 2006 and 2011, the world consumption changed from 178 billion to more than 231 billion liters. Drinking water is usually the single largest contributor to daily fluoride intake [16].

Fluoride can be naturally found in natural water sources used for bottling at different levels, or can be added to reach the optimum content; it is a very effective mineral that has an influence on oral health; where it prevents decay in general when ingested and absorbed through the digestive system. The levels of fluoride ingested by humans differ from one individual to another according to the source they

are exposed to, level, and amount ingested [9]. Excessive amounts of fluoride may cause health problems as well, the bottled water fluoride content may be highly variable among different brands, and that may lead to dental fluorosis especially in infants and children when receiving greater concentrations than the optimal levels recommended for their age group [1],[2]. An awareness of the exact concentration of drinking water whether public or bottled is required for an effective and safe preventive fluoride program [2]. Fluoride can sometimes be obtained from different sources in addition to drinking water, for example, in Karbala-Iraq black tea consumption is very common and the high content of fluoride in the tea leaves should be taken into consideration [13],[17]. As a result, all the sources of fluoride are important, and the total fluoride intake from all sources is critical in the development of fluorosis [10],[8],[18],[12],[4],[5]. Standards and limits have been developed by many international and local organizations to determine fluoride levels in drinking water that meet the needs of human health. In most of the early projects, it was found that most of the commercially available bottled water failed to list the content of fluoride [14],[20].

Fluoride, at some concentrations is known to influence many cellular functions in the human body in many ways. Some studies have demonstrated that high doses of fluoride can cause DNA damage, and change cell-cycle regulatory proteins, which in turn induce apoptosis [24]. However, the mechanism of apoptosis induced by fluoride is still unclear, especially in terms of identifying the signaling pathways that are closely involved in this process (Fig. 1) [24].

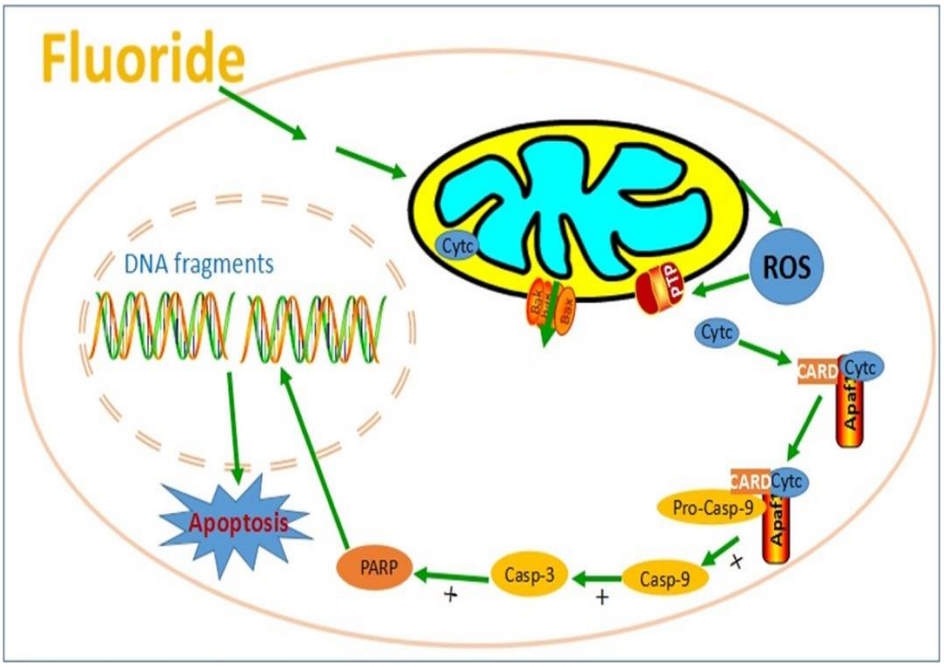

Fig.(1): Mitochondrion-mediated pathway of fluoride-induced cell apoptosis. Note: "+" means "activate"

Hence, this study is designed to discuss the fluoride concentration in commercially available bottled drinking water in Tripoli according to local standards, to find out if significant differences existed among the products, and to explore packaging date as a variable on the fluoride content in bottled waters.

1. Materials and methods

An experimental study was carried out to measure and discuss the fluoride content of commercially available bottled water in Tripoli, Libya. To assess the F measured, the results obtained were compared to the recommended optimal fluoride levels in water according to Libyan standards. The samples were analyzed at FADCC Laboratory; The F analysis was made by the photometric method using the plainest.

A total of 23 commercially available different bottled water brands, which were chosen from those available in major supermarkets and grocery stores in Tripoli, Libya, were collected and examined during (January-February) 2019. twenty-two brands were produced in Libya and one brand was imported (it was the only one brand found in the study area at the time of collecting samples). . twenty-one of the brands were within their expiration dates, while two did not state the expiration date. All the bottled water containers were made of plastic. Fluoride in the bottled water does not interact with the material of the bottle (glass or plastic) or the other minerals in the water [6,15]. The bottles were stored at room temperature in a dark place in their original closed container until they were examined. In order to check for the labelling of fluoride concentrations, the labels of the bottles were studied for comparison. The average for each sample was estimated, table (1). To assess the reliability of the method, a statistical analysis was employed to derive descriptive data using SPSS (Statistical Package for Social Science).

3. Results and discussion

Of the 23 samples of water examined, our findings are shown in Table (1), for each water sample, the fluoride concentration depicted on the label is shown in mg/L or (NM) if not mentioned. The mean F contents ranged between 0 and 2.751 ppm Table (1). Regarding the quality of the labeling of bottled waters, none of the samples had fluoride content listed on the labels. A clear variation between labeled and tested fluoride was estimated, which might be attributed to the soil mineral content of the underground reservoirs. Previous research attempts to evaluate the fluoride content of bottled water in several countries concluded that most of the early projects found that most of the commercially available bottled water failed to list the fluoride content[1],[21]. The Fluoride content of each sample was judged according to the Libyan standard limits, where the standards have recommended that the fluoride in water in general be 1ppm without setting the minimum permissible level of F in drinking water. The World Health Organization (WHO) recommends that to maximize beneficial effects and minimize harmful effects, the level of F in drinking water should be ideally set between 0.7 and 1.2 ppm with a maximum of 1.5 ppm [22],[3]. Accordingly, a clear variation in fluoride concentration in the bottled water examined was found. The highest F concentration measured was 2.751 ppm, which is above the Libyan standard level recommended; the majority of tested samples had F levels below optimum health according to the standards used. All the samples examined, including the bottled water produced outside of Libya, have fluoride content outside the range regulated by the WHO, table (2). Hence, it is necessary that all concerned authorities take action to restrict the import and sale of these products.

Table (1): Fluoride levels in the analyzed bottled water (mg F/L).				
Country of origin	Brand name	Labeled fluoride F(ppm)	Measured fluoride F(mean ± SD) ppm	Manufacture Expiry date
Local	1	NM	0 ± 0	M
Local	2	NM	0.2765 ± 0.0105	M
Local	3	0.24	0 ± 0	M
Local	4	0.97	0.181 ± 0.001	M
Local	5	NM	0.57 ± 0.0034	M
Local	6	0.2	0 ± 0	M
Local	7	NM	0 ± 0	M
Local	8	NM	0 ± 0	M
Local	9	0.02	0.0595 ± 0.0005	M
Local	10	NM	0.3708 ± 0.0002	M
Local	11	NM	0.396 ± 0.004	M
Local	12	NM	2.751 ± 0.009	M
Local	13	NM	1.952 ± 0.001	M
Local	14	NM	0.494 ± 0.006	M
Local	15	NM	0 ± 0	M
Local	16	NM	0.1565 ± 0	NM
Local	17	NM	0.036 ± 0.001	NM
Local	18	NM	0.502 ± 0.002	M
Local	19	NM	0.554 ± 0.014	M
Local	20	NM	0 ± 0	M
Local	21	NM	1.564 ± 0.006	M
Local	22	NM	2.05 ± 0.01	M
imported	23	NM	0.503 ± 0.003	M

NM: Not Mentioned.

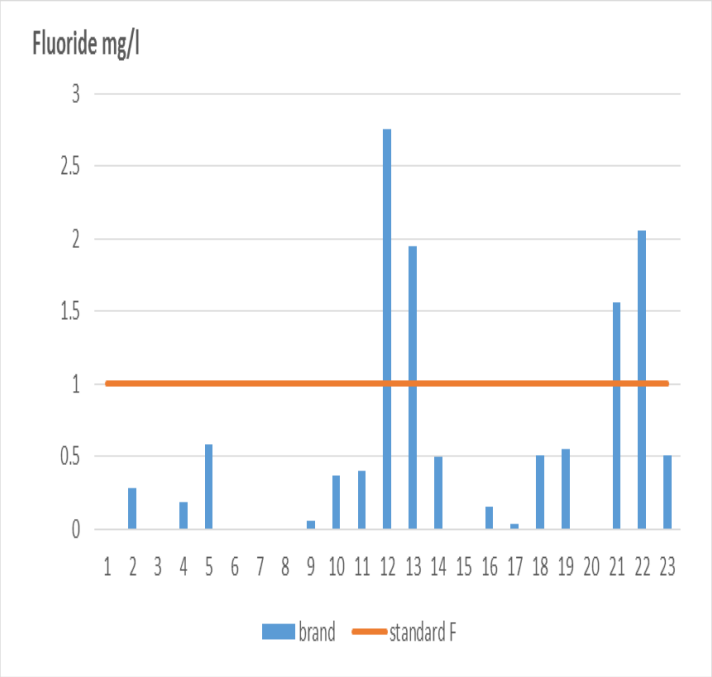

Fig. 2 Fluoride content compared to Libyan standard

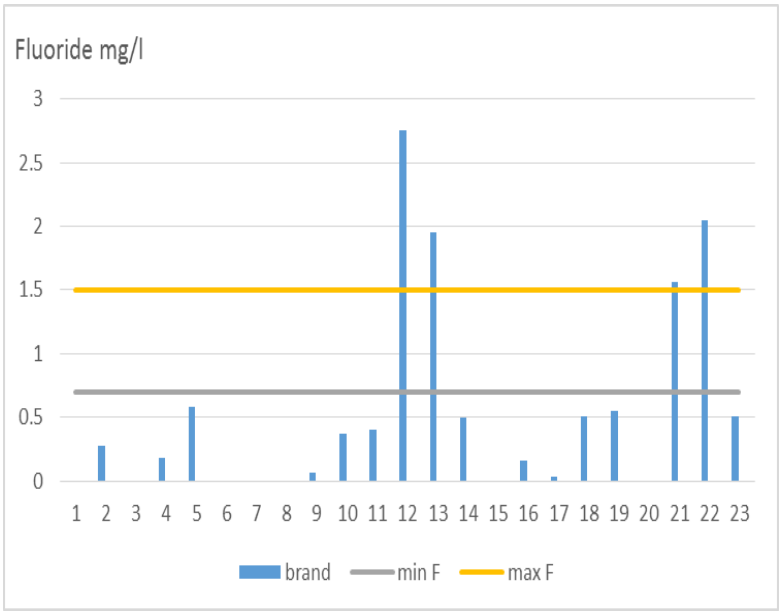

Fig.3 Estimated Fluoride compared to WHO

Table 2: International and local optimal fluoride level.

Standard	Fluoride mg/l Standard limit	References
Libyan standard	1	Libyan standards
World Health Organization	0.7-1.5	WHO 2011

4. Conclusion

This study concluded that all of the fluoride levels offered in the labels were different from the actual fluoride concentration tested; it is also noted that in most brands fluoride content is lower than the optimum level needed for human health; and sometimes above the level recommended according to the standards; especially for those who rely on bottled water as their main source of fluoride. It was also noted that for some brands the packaging date was not mentioned. Moreover there was a significant variation between the F levels stated by the manufacturer on the bottle label and the values measured during the investigation. However, there needs to be a public awareness so that the oral health care providers and consumers have accurate information on the fluoride content of the water they drink.

References

[1] Abdullah M. Aldrees, Saad M. Al-Manea, Fluoride content of bottled drinking waters available in Riyadh, Saudi Arabia. The Saudi Dental Journal (2010) 22, 189–193

[2] Ahiropoulos , V. , 2006. Fluoride content of bottled waters in North Greece. Int. J. Paediatr. Dent. 16(2)111-116

[3] American Dental Association (updated on June 5, 2002). American Dental Association Statement on Water Fluoridation Efficacy and Safety. Available from: <http://www.ada.org/prof/resources/positions/statements/fluoride2.asp> (accessed 29.08.09).

[4] Clark D. C., Hann H. J., Williamson M . F., Berkowitz J., Influence of Exposure to Various Fluoride Technologies on the Prevalence of Dental Fluorosis, Community Dentistry and Oral Epidemiology, 1994; vol. 22, 461–464.

[5] Clark D.C., Trends in prevalence of dental fluorosis in North America, Community Dentistry and Oral Epidemiology, 1994; vol. 22, 148–152.

[6] Centers for Disease Control and Prevention (CDC), 2013. Community water fluoridation. Division of Oral Health. Available: <http:// www.cdc.gov>.

[7] David Robinson; Val Reed, The A-Z of social research jargon, Aldershot, Hants, England ; Brookfield, Vt., USA : Ashgate/ARENA, ©1998

[8] Fejerskov O., Thylstrup A., Larsen M . J., Clinical and Structural Features and Possible Pathogenic Mechanisms of Dental Fluorosis, Scandinavian Journal of Dental Research, 1977, vol. 85, 510 – 534.

[9] Jagtap.S.,2012Yenkie,M.K. Labhsetwar, N.,Rayalu,S., 2012.Fluoride in drinking water and defluoridation of water. Chem. Rev. 112,2454-2466.

[10] Kiristy M . C., Levy S. M ., Warren J. J., Guha-Chowdhury N., Heilman J. P., Marshall T., Sources of Fluoride Intake in Children, Journal of the American Dental Association, 1996, vol. 127, 895 – 902.

[11] laiumandier JA, Ayers LW.Fluoride and bacterial content of bottled water s tap water. Arch Fam Med 2000;9:24

[12] Levy S. M ., Maurice T. J., Jakobsen J. R., Feeding Patterns, Water Sources and Fluoride Exposures of Infants and 1-Year-Olds, Journal of the American Dental Association, 1993; vol. 124, 65–69.

[13] Mahvi AH, Zazoli MA, Younecian M, Esfandiari Y. Fluoride content of Iranian black tea and tea liquor. Fluoride 2006;39(4):266-8.

[14] McFadyen, E.E., McNee, S.G., Weetman, D.A., 1982. Fluoride content of some bottled waters. Br. Dent. J. 153 (12), 423– 424.

[15] Mohamed Yehia Z. Abouleish, Evaluation of fluoride levels in bottled water and their contribution to health and teeth problems in the United Arab Emirates. The Saudi Dental Journal (2016) 28, 194–202.

[16] Murray JJ. Appropriate use of fluoride of human health. Geneva: world Health Organization, 1986

[17] Reza Fouladi Fard, Amir Hossein Mahvi, Sara Sadat Hosseini, Mohammad Khazaei, FLUORIDE CONCENTRATIONS IN BOTTLED DRINKING WATER AVAILABLE IN NAJAF AND KARBALA, IRAQ, Research report Fluoride 47(3)249–252 July- September 2014

[18] Richards A., Kragstrup J., Josephsen J., Fejerskov O., Dental Fluorosis Developed in Post-Secretory Enamel, Journal of Dental Research, 1986; vol. 65, 1406–1409.

[19] Rodwan-Junior JG. Bottled water 2011: the recovery continues [Internet]. New York: International Bottled Water Association; 2012. [cited 5 set 2014]. Available from: http://www.bottledwater.org/files/2011BWstats.pdf.

[20] Stannard, J., Rovero, J., Tsamtsouris, A., Gavris, V., 1990. Fluoride content of some bottled waters and recommendations for fluoride supplementation. J. Pedod. 14, 103–107.

[21] Studlick, J., Bain, R., 1980. Bottled waters-expensive ground water. Ground water 18, 340.

[22] WHO drinking-water quality series. Fluoride in drinking water. Edited by Bailey K, Chilton J, Dahi E, Lennon M, Jackson P, Fawell J, 2006.

[23] World Health Organization. Report of an expert committee on Oral Health Statues and Fluoride use and Oral Health. WHO Technical Report Series No 846. WHO:Geneva, Switzerland 1994.

[24] (Barbier O, Arreola-Mendoza L, Del Razo LM: Molecular mechanisms of fluoride toxicity. Chem Biol Interact 188(2): 319- 333, 2010 ..... DANIEL ARAKI RIBEIRO1,2, CAROLINE MARGONATO CARDOSO2, VERONICA QUISPE YUJRA2, MILENA DE BARROS VIANA1, ODAIR AGUIAR JR.1, LUCIANA PELLEGRINI PISANI1 and CELINA TIZUKO FUJIYAMA OSHIMA2 . Fluoride Induces Apoptosis in Mammalian Cells:In Vitro and In Vivo Studies. ANTICANCER RESEARCH 37: 4767-4777 (2017))