



FLUORIDE CONTENT IN BOTTLED WATER MARKETED IN MAKASSAR, INDONESIA

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ABSTRACT

Background: Bottled water is a popular choice because it is guaranteed, easy to obtain, and more practical. Bottled water consumption has increased in recent years around the world including Indonesia. One of the requirements of drinking water content packaging is fluoride. According to the World Health Organization (WHO) limitations that fluoride ion has a beneficial effect when the levels are about 0.7 mg / L, but very dangerous if more than 1.5 mg / L.

Objective: To determine the content of fluoride in drinking water packaging consumed by people in Makassar.

Method: Research experiment laboratories with double blind technique. Samples are bottled drinking water taken randomly in one of the supermarkets in Makassar. Testing of fluoride content refers to SNI 01-3554 - 2006 on test method of bottled drinking water for fluoride ion analysis. The sample is measured uptake by using Spectrophotometer.

Results: A total of 84.62% drinking water with low fluoride content between <0.05 - 0.67 mg / L and 15.38% drinking water with optimum concentration (> 0.7 mg / L). The average Fluoride content of packed water is 0.29 mg / L, while the Fluoride content of water from the Makassar Water Supply Company (PDAM) and the well water are 0.9 mg / L and 0.82 mg / L respectively.

Conclusion: Drinking fluorine content of packaged water consumed by the community is below the optimum level.

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INTRODUCTION

Drinking water is one source of community life. Bottled drinking water is the community's choice because it is safe, easy to obtain, and more practical. Bottled drinking water is currently widely consumed by people from urban to rural. (Cochrane *et al.*, 2006) Bottled water consumption has increased in recent years worldwide. Between 2006 and 2011, global consumption changed from 178 billion to over 231 billion liters. China, Indonesia and Thailand are examples of countries where bottled water consumption increases by more than 10%. (Venturini and Frazao, 2015). However, considering the content in bottled water is very important, one of the bottled drinking water contents is fluoride.

Fluoride is a highly electronegative chemical element among all chemical elements. In general, it binds to other elements in the form of Fluoride salts such as Calcium Fluoride (CaF₂), Fluorapatite (C₁₀ (PO₄)₆ F₂), Cryolite, and so on. (Grget *et al.*, 2013). The entry of fluoride into the body can occur systemically and locally. Systemically, among others, through fluoridation of drinking water and fluoride tablets, fluoride-containing kitchen and milk salts, while locally through topical fluoride and health-care applications. The presence of fluoride in water comes from the degradation of mineral fluoride compounds and is present in groundwater (Marya, 2011; Rabb-waytowich, 2009). According to the limits issued by the World Health Organization (WHO) that fluoride ions have a beneficial effect when they are about 0.7 mg/L, but very dangerous if more than 1.5 mg/L.

(Peraturan Menteri, 2010) The fluoride ion replaces the Ca₅(PO₄)₃OH hydroxyapatite ion an essential mineral that makes up the tooth enamel and bone. Fluoride is also useful as caries prevention by strengthening the enamel layer and reducing the dissolution of the acid produced from bacterial metabolism (Peckham and Awofeso, 2014; Adzakiyah *et al.*, 2015). This study aims to determine the content of fluoride in drinking water packaging consumed by people in Makassar.

MATERIALS AND METHODS

The research type is experimental with double blind technique, with cross sectional design. The research was conducted in January 2017. The samples used in this study were all brands of bottled drinking water displayed by supermarkets “Lotte Mart Mall Panakukkang” in Makassar and samples taken at random. The sample of drinking water to be tested is labeled and coded. Testing of fluoride content refers to SNI 01-3554 - 2006 on test method of bottled drinking water for fluoride ion analysis. Bottled water samples were diluted first, and then taken as much as 100 ml and added reagents of 10 ml Zirconium acid and 7 ml of HCl then mixed until homogeneous and color change occurred. Furthermore, the solution is allowed to stand for 5 minutes. Furthermore, the sample is measured uptake by using Spectrophotometer. The same way is done to the blank that is only using aquades as a substitute for the sample. The fluoride content in the sample was calculated using a calibration curve or linear regression line equation. The results of the calculation of fluoride content in the bottled water in each sample have different levels.

RESULTS

The number of samples examined by Fluoride was 15 samples, consisting of 13 bottled drinking water (13 brands), 1 sample from drinking water consumed by the general public sourced from PDAM water and 1 from the source of well water. In Figures 1, the average Fluoride content in packed drinking water is 0.28 mg/L. This content is much lower than the optimum Fluoride concentration, as per the requirements of WHO.

Table 1. The results of the average water fluoride levels in the drinking water consumed by the community

Source	Code	Mean (mg/L)	Level
Bottled Water	A	0.49	Low
	B	0.95	Optimum
	C	0.37	Low
	D	< 0.05	Low
	E	0.10	Low
	F	0.67	Optimum
	G	< 0.05	Low
	H	0.20	Low
	I	0.36	Low
	J	< 0.05	Low
	K	< 0.05	Low
	L	< 0.05	Low
	N	0.33	Low
Water from PDAM company		0.90	Optimum
Water from wells		0.82	Optimum

Table 1 shows the value of fluoride content in bottled drinking water consumed by people in the community with the highest levels found in the type of drinking water of Brand B packaging that is 0.95 mg/L. While the lowest fluoride content <0.5 mg/L found in 5 brands of drinking water.

Drinking water from PDAM has a fluoride content of 0.90 mg/L. Drinking water from well water has a fluoride content of 0.82 mg/L, this is the optimum content. Figure 2 describes the category of fluoride content in drinking water that has been studied, as much as 84.62% of drinking water that has low fluoride content that is between <0.05 - 0.67 mg/L, as many as 15.38% of drinking water studied has—optimum fluoride content of 0.7 - 1.2 mg/L, while 0% of drinking water studied had high fluoride content of > 1.5 mg/L.

Table 2. Mineral content in one of bottled drinking water (Brand code F)

Type of minerals	Content
Flouride (F)	0.67 mg/l
Magnesium (Mg)	0.12 mg/l
Sulfide (S ²⁻)	<0.05 mg/l
Chloride (Cl ⁻)	<0.05 mg/l
Potassium (K)	0.38 mg/l
Sodium (Na)	0.38 mg/l
Calsium (Ca)	0.29 mg/l

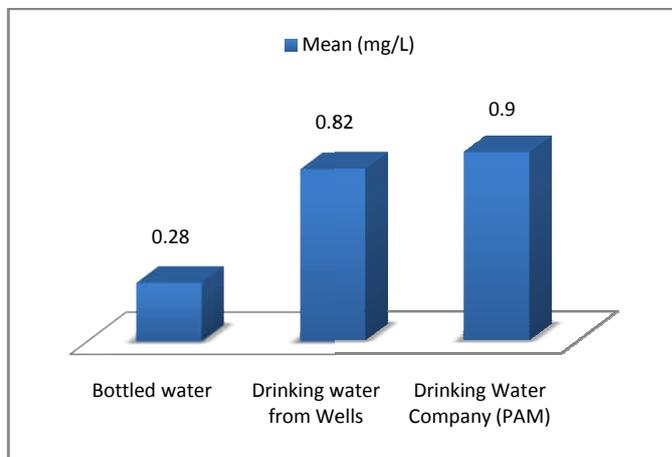


Fig. 1. Mean Fluoride content by drinking water source

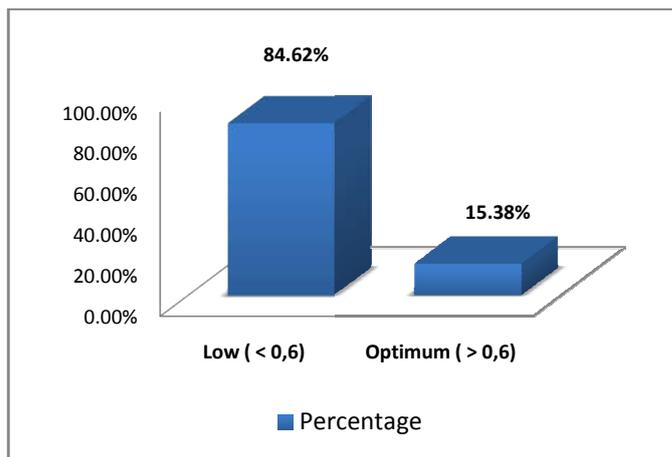


Fig. 2. Percentage Levels of Fluoride content in Packaged Drinking Water (n=13)

DISCUSSION

In this study the fluoride levels examined had a minimum value of <0.05 mg/L, and a maximum value of 0.95 mg/L. The recommended optimum fluoride content is 0.7-1.2 ppm. Higher levels of fluoride above the optimum level were found in three samples of packed drinking water. No sample has a

level that exceeds the optimum level. A total of 13 bottled drinking water samples that have fluoride levels below the optimum level of $0.05 - 0.67\text{ ppm}$. This is in line with a study conducted by Uzma (2016) regarding the determination of fluoride concentration in bottled water in the study can conclude that the average fluoride content in bottled water is 0.62 mg/L. (Jabeen *et al.*, 2016) The results of this study indicate the content of fluoride content in bottled water is no different from fluoride levels from studies conducted in other countries. In this study fluoride content in drinking water sourced from well water that is equal to 0.82 mg/L. These levels have an optimum level. This is in line with research conducted by Zulfi *et al* (2012) on the difference between the consumption of well water and river water carries to children aged 6-8 years. In the study it was concluded that the average content of fluoride content in drinking water sourced from well water is 0.72 mg/L, (Risqi *et al.*, 2012) which means the fluoride content of the study is not much different from the fluoride content in this study. This is because the well water is a groundwater that the mineral content in it varies levels according to the geographical location of the groundwater source is obtained. Groundwater sources from around the sea differ in minerals with other regions, for example in mountain areas. Well water around the sea gets a supply of water from groundwater as well as from the recharge of seawater that contains much more fluoride minerals. The depth of the well can also affect the levels of fluoride in groundwater. The deeper the well water, the higher the fluoride content dissolves in the water. (Angela, 2005; Sumiok *et al.*, 2015)

The result of measurement of drinking water fluoride contents of PDAM is 0.90 mg/L. The fluoride content in each of the packed drinking water samples can be influenced by the availability and solubility of fluoride minerals in the soil, rocks or porosity of the soil for water passage, time, temperature, pH and the presence of other minerals binds to fluoride. (Ambarkova *et al.*, 2007) The depth of the water source also affects the fluoride content in water.

The deeper the soil, the higher the mineral content dissolves in the water. (Insyrah, 2012). Table 2. In this research, the Fluoride content of 0.67 mg/L, the magnesium content of 0.12 mg/L, the sulfide content of <math><0.05\text{ mg/L}</math>, the Chloride content of <math><0.05\text{ mg/L}</math>, Potassium content of 0.38 mg/L, the content of 0.38 mg/L, and the calcium content of 0.29 mg/L. This is similar to the research conducted by Azrina *et al* (2012), on the evaluation of mineral content in drinking water in Malaysia. In this study it can be concluded that mineral content in branded drinking water in Malaysia such as Fluoride 0.27 mg/L, Magnesium 0.03 mg/L, Potassium 0.60 mg/L, Sodium 0.67 mg/L, and Calcium 0.18 mg/L. (Azlan *et al.*, 2012) This shows the results that the authors obtain is not much different from the results of previous studies. The bottled water contains the sodium that the body needs that increases energy. The more activity, the more sodium it needs. Sulfate is a sodium salt, which, according to Subtle Waters, helps the liver in detoxifying the toxins of the system. It also aids digestion and stimulates the gallbladder. Calcium and magnesium are other nutrients dissolved in mineral water. A person needs about 800 mg a day of calcium to maintain strong bones and prevent osteoporosis. Magnesium works with calcium to provide enzymes that produce energy that stimulates and coordinates muscle and nerve interactions. Individuals may feel dizzy, nervous or headache throbbing when one lacks magnesium.

Fluoride is another mineral trace that provides nutrients to maintain healthy bones and teeth. Generally known as fluoride, this mineral makes teeth and bones strong, and helps in preventing bone and gum infections. Like sulfates, too much fluor has a negative effect on humans. Bottled drinking water can also strengthen the heart (Moazeni *et al.*, 2014).

The problem at the moment is that people tend to consume bottled drinking water, for reasons hygienic enough, clean and fast to be consumed without going through the process again. The people of Indonesia, especially the people in Makassar, still low attention to mineral content in bottled water. Society is generally affected by advertisements that are broadcast in electronic media, such as on TV. They think that is the best drinking water to consume. Probably because it is so much bottled drinking water circulating in Makassar generally do not include the mineral content in packaging wrapping labels. Bottled drinking water consumption in Indonesia during 2014 was recorded at 23.1 billion liters. The record grew 11.3% of demand in 2013 by 20.48 billion liters (Konsumsi Air Minuman Dalam Kemasan di Indonesia Capai 23,1 www.tribunnews.com › *Bisnis* › *Industri*) Based on where the fluoride content in mineral water ranges from 0.5 mg/L, it is still well below the safe limit. As an illustration, even zam-zam water contains higher levels of fluoride (0.75 mg/L), although it is also below the safe threshold, ie no more than 1.5 mg/L. The same limits are also set by the World Health Organization (WHO, 2011) of 1.5 mg/L. Tighter restrictions are even specified in SNI 01-3553-2006 on Drinking Water in Packaging, wherein the content of fluoride in mineral water should not exceed 1 mg/L.

While the fluoride content in mineral water ranges from 0.5 mg/L, it is still well below the safe limit. As an illustration, even zam-zam water contains higher levels of fluoride (0.75 mg/L), although it is also below the safe threshold. It is evident from the results of this study that the average low fluoride content was obtained from 13 samples from bottled drinking water. Average levels are much smaller than the optimum levels recommended, so the risk of local communities to get caries due to lack of fluoride levels that are sourced from drinking water is very large. Fluoride levels in the optimum range have a role in the process of remineralization to prevent the formation of caries and inhibit the caries process that occurs. Fluoride levels far above the optimum levels allowed the community to have a high risk of fluorosis that causes discoloration of the teeth, the fragility of hard tooth tissue, resulting in the loss of most dental crowns. (Ambarkova *et al.*, 2007) This is similar to research conducted by Reza Fouldi Fard *et al* (2014), regarding the concentration of fluoride in bottled water contained in Najaf and Karbala, Iraq (Fard *et al.*, 2014). Stating that the fluoride content in bottled water only ranges from 0.073-0.067 mg/L so it is assumed that it does not meet the health requirements in accordance with the Minister of Health of the Republic of Indonesia Regulation No. 492 / MENKES / PER / IV / 2010 regarding the requirements and quality control water is a fluoride content of 1.5 mg/L. (Peraturan Menteri, 2010)

Conclusion

Based on the results of research conducted can be concluded that the content of drinking water fluoride drink consumed by the average community is below the optimum level.

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