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Fluoride Concentration in Both Tap Water and Drinking Bottled Water (Commercial) in Baninah Area -Benghazi, Northeastern Libya

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Abstract: Drinking bottled water has become both popular and increasingly controversial. as a result of the use of these techniques, some of the necessary elements in water are exposed to remove it such as fluoride. For this reason, the present study aimed to determine the fluoride content in both Tap Water and some types of Bottled water (Commercial) in the Baninah area -Benghazi. Six different types of bottled water from the local market, and three sampling point of tap water (water network supply) were collected for analysis of pH, electrical conductivity (EC), total dissolved solids (TDS), and fluoride for all samples. The results revealed a decrease in total dissolved salts in some types of bottled water compared to the Libyan standard specifications for the quality of drinking water. While the Fluoride content in bottled water and tap water showed fluoride concentrations lower than 1.5 mg/l according to the WHO standards and Libyan standards for drinking water. This requires a medical study to know the other sources that compensate for the lack of fluoride in the water (tap water network supply - bottled water).

تركيز الفلوريد في كل من مياه الصنبور ومياه الشرب المعبأة (التجارية) في منطقة بنينة – بنغازي ، شمال شرق ليبيا

الكلمـــات المفتاحيـــة :
الفلوريد ،
مياه الصنبور ،
المياه المعبأة ،
بنينة .

المستخلص : أصبح شرب المياه المعبأة شائعًا ومثيرًا للجدل على نحو متزايد. نتيجة لاستخدام هذه التقنيات ، تتعرض بعض العناصر الضرورية في الماء لإزالتها مثل الفلورايد. لهذا السبب هدفت الدراسة الحالية إلى تحديد محتوى الفلورايد في كل من مياه الحنفية وبعض أنواع المياه المعبأة (التجارية) في منطقة بنينة – بنغازي. تم جمع ستة أنواع مختلفة من المياه المعبأة في زجاجات من السوق المحلي ، وثلاث نقاط أخذ عينات من مياه الصنبور (إمدادات شبكة المياه) لتحليل الأس الهيدروجيني ، والتوصيل الكهربائي (EC) ، والمواد الصلبة الذائبة الكلية (TDS) ، والفلورايد لجميع العينات. أظهرت النتائج انخفاض إجمالي الأملاح الذائبة في بعض أنواع المياه المعبأة مقارنة بالمواصفات القياسية الليبية لجودة مياه الشرب. بينما أظهر محتوى الفلوريد في المياه المعبأة ومياه الصنبور تركيزات فلوريد أقل من 1.5 ملجم / لتر وفقًا لمعايير منظمة الصحة العالمية والمعايير الليبية لمياه الشرب. وهذا يتطلب دراسة طبية لمعرفة المصادر الأخرى التي تعوض نقص الفلورايد في المياه (إمدادات شبكة مياه الحنفية – المياه المعبأة).

INTRODUCTION

Global demands for trusted drinking water are widening and the inability to meet supplies is important to increasing water conflicts (Sivakumar, 2011). Usual groundwater and surface water are the essential drinking water sources, whereas desalination of brackish and seawater is playing an increasing role. Bottling water began in 1820 in the United States and was fairly popular in the Nineteenth Century. Whilst the 1980s, bottled water became a 'craze' and products rapidly sprang up to meet the demand. (Nutt and Wilson, 2010; Wehr, 2011). Drinking bottled water has become both continuously

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accepted and continuously argumentative (Askari et al., 2021). In comparison with other countries, Libyan markets aren't an outlandish case. Despite the improved quality of drinking water in water distribution systems, the use of bottled water is progressively expanding (Collins and Wright, 2014; Hu et al., 2011). Some people believe, especially those living in locations where tap water quality standards have been violated of bottled water is safer or tastes better for this reason people choose to pay for a good (bottled water) (Bach et al., 2012). The growing consumption of bottled water is due to Perceptions of the safety, taste, and convenience of bottled water. Users are more doubtless to believe that bottled water is safer and tastes greater if tap water or they live in states with more widespread violations of water quality standards (Viscusi et al., 2015).

Fluoride is the ionic form of the element fluorine. Fluoride is found everywhere in the air, water, soil and foodstuff. In the 1930s the first study linked the Natural fluoride concentration of drinking water with decreased caries occurrence in teeth (O Mullane et al., 2016). Geological information may supply info proper for estimating doubtless drinking water fluoride concentrations, utilizing information on the distribution of rock types to point to doubtless fluorine, calcium, and sodium exposures from which the population fluoride vulnerability could be derived. Correct geological information of this nature isn't accessible at the global level (Fewtrell et al., 2006). Groundwater is the main source of water in the study area, as it is fed from the Sidi Mansour field and some wells in the Baninah field. In addition, the local population uses bottled water for drinking. Drinking water generally contributes the most to daily fluoride intake (Murray., 1986). The World Health Organization specifies a maximum acceptable concentration of fluoride in drinking water of 1.5 mg/L (Organization, 2004). For example, high or low levels of certain ions, such as fluoride, chloride, magnesium and calcium, can lead to various diseases, hardness and other health problems due to water drinking consumption (Sengupta, 2013). Fluoride levels in groundwater vary depending on the minerals in the rocks and ores through which the water flows (Fawell et al., 2006; Vural and Gundogdu, 2020). High levels of fluoride in groundwater can cause dental fluorosis (staining of teeth). On the other hand, fluoride in drinking water is deficient. Because fluoride enters the body primarily from drinking water sources, the geochemical state of fluoride in a given area or neighborhood is extremely important for studying the incidence of dental disease in that area (Dissanayake, 1991). Reverse osmosis (RO) helps remove fluoride and other chemical contaminants from drinking water supplies because their molecules are larger than water molecules. On the other hand, the beneficial effects of fluoride in reducing dental caries may require supplementation when drinking water is exposed to water purification systems that reduce fluoride to well below optimal levels (Khairnar et al., 2018). This study attempted to identify Fluoride Concentration in both Tap Water and Some Types of Bottled Water (Commercial) in the Baninah area -Benghazi.

MATERIALS AND METHODS

Study Area: Baninah is a town east of Benghazi in Libya, about 15 km east of the city centre. The study area is located in the area coordination of latitude 32.08.4570 and longitude 20.25.5113 in the Baninah area, Northeastern Libya. The study area depends on groundwater for the main water supply in the public water network as a source of domestic water. In addition, the residents of the area depend on bottled water as a source of drinking.

Figure: (1) The sampling location at Baninah Village.

Sampling and Analysis.: A total of 9 water samples were collected as follows: 6 different types of bottled water (local market), and 3 samples from tap water (a water distribution network). Tap water (water network supply) was collected in August 2022 from 3 points sampling in the Baninah region. The information about the location of these points sampling (coordinates) of the tap water (water network supply) is given in table (1).

Table (1). Coordinates the point sampling (water network supply).

Points sampling	Latitude	Longitude
Tap water (Number 1)	32.07 748	20.25 980
Tap water (Number 2)	32.08 610	20.25 998
Tap water (Number 3)	32.08 742	20.25 226

Each sample was analyzed three times. conductivity and the Total dissolved solids(TDS) by using Microprocessor HI 9835 (HANNA) meter were measured while the Fluoride concentration of water samples was measured using the SPADES method using DR 3900 spectrophotometer. according to the standard method(APHA, 1999). All the samples were analyzed in the laboratory of the agriculture faculty at Benghazi university.

RESULTS AND DISCUSSION

Groundwater is the primary source of drinking water in this area and some people are using bottled water for drinking. Tables (2 and 3) illustrate four parameters determined for 3 taps of water and determined for 6 Types of Bottled Water (Commercial) in the Baninah area -Benghazi which was the most used in the study area.

Table: (2) Mean of conductivity EC, pH, T.D.S and F at some Taps Water in Baninah Village.

Location	T.D.S	EC	pH	F
Tap Water in Baninah Village (Number 1)	1344	2320	7.95	1.03
Tap Water in Baninah Village (Number 2)	1410	2429	7.97	0.63
Tap Water in Baninah Village (Number 3)	1385	2386	8.02	0.62
Permissible level (mg/L)	1000	-	6.5-8.5	1.5

All the Parameters Value are Expressed in mg/l; Except pH, and Conductivity EC (µS cm-1).

Table: (3) Mean of conductivity EC, pH, T.D.S and F in Some Types of Bottled Water (Commercial) in the Baninah area -Benghazi.

Location	T.D.S	EC	pH	F
Bottled Water (Aseel)	102	176	7.49	< 0.01
Bottled Water (Areen)	63	107	7.43	< 0.01
Bottled Water (Aquafine)	78	135	7.42	< 0.01
Bottled Water (Alain)	102	176	7.32	< 0.01
Bottled Water (Pure)	72	124	7.30	0.07
Bottled Water (Kharoba)	96	165	7.6	0.04
Permissible level (mg/L)	100	-	6.5-7.5	1.5

All the Parameters Value are Expressed in mg/l; Except pH, and Conductivity EC (µS cm-1).

The pH values : The pH of water is a crucial factor in determining different types of uses, including drinking, bathing, cooking, washing, and agriculture, among others (WHO, 2011). The pH values of the Tap water in Baninah village in the study area ranged from 7.97 to 8.03 with an average of 7.98 (Table 2). This shows that the Tap water in Baninah village in the study area is mainly alkaline. According to (WHO, 2011), the safe limit of the pH lies between 6.5 and 8.5 pH. It is indi-

cating the neutral nature of pH throughout the area of study. This water is suitable for drinking, and this is confirmed. On the whole, Groundwater quality catchment is affected by geology with very little anthropogenic influence(Zakaria et al., 2021). The geology of the catchment region and the water's ability to act as a buffer generally have an impact on the pH of groundwater(Weber Jr and Stumm, 1963).

Electrical conductivity (EC): Electrical conductivity (EC) is related to the concentration of ions in the water. The EC is an excellent index of the amounts of TDS in water, with a high EC indicating a high level of TDS in the water. The higher value of EC is due to the high dissolved solids which may subscribe to the conductivity(Srinivas et al., 2000). Table (2) shows the high amount of Electric Conductivity (EC) in the water supply in the study area (2429 µS/ cm) in the tap water of the study area. These conductive ions come from dissolved salts and inorganic substances such as alkalis, chlorides, sulfides, and carbonate compounds.

Total Dissolved Solids (TDS): Table (2) and figure (2) show the high amount of total dissolved solids (TDS) in the water supply in the study area was (1410 mg/l). which is compared to WHO and Libyan standards (WHO, 2011). The type and quantity of dissolved salts originate from the dissolving or weathering of the soil's minerals, such as gypsum, lime, and other slowly dissolved ones(Joshi et al., 2009). In another meaning, TDS in drinking water originate from natural sources, urban runoff, industrial wastewater, and sewage(WHO, 2011). This increase in the concentration of total dissolved salts and the low quality of tap water is reflected in the volume of bottled water consumption. Not surprisingly, the consumption of bottled water is sometimes higher in communities with serious problems with tap water(Colburn and Kavouras, 2021; Doria, 2006).

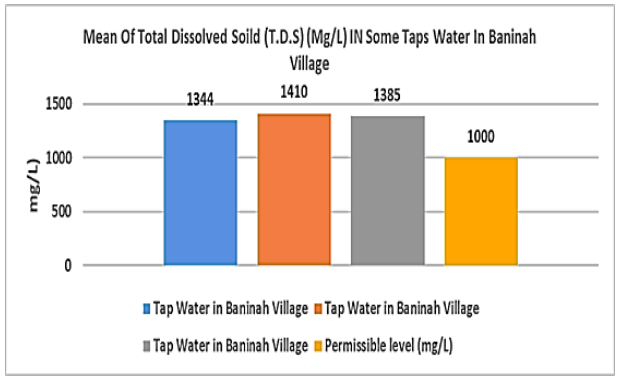

Figure (2) The mean of total dissolved solids (T.D.S mg/l) compared with Permissible level (mg/L) in some Taps of Water at Baninah Village.

Table (3) and Figure (3) show the total dissolved solids (TDS) in bottled water. Where the highest amount of dissolved salts was recorded at 102 mg/litres of Alain Company, and the lowest amount of salts recorded in Areen Company's sample was 63, which was less than the permissible limits in the Libyan specification for bottled water (Center, l. N. 2008). Minerals are therefore necessary for good taste and to make up for the deficiency in the public's health (Islam et al., 2016). However, if there aren't any minerals in the water, the body won't get what it needs, and there won't be any flavor.

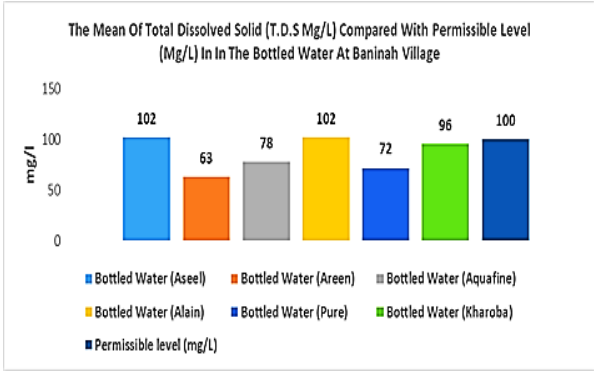

Figure (3) the mean of total dissolved solids (T.D.S mg/l) compared with the Permissible level (mg/L) in the bottled water at Baninah Village.

Fluoride Concentration: In this study, Fluoride concentrations were determined in three points of tap water. Figure 4 shows The result of the samples analyzed in the study area. The highest concentration of fluoride in Tap water was (1.03 mg/L) in Baninah vil-

lage. In addition, the average fluoride was 0.76 mg/L in tap water. Naturally, fluoride in drinking water is known to reduce dental caries among consumers, but excessive fluoride intake can cause skeletal and dental fluorosis that may either benefit or harm the health of consumers. (Guissouma et al., 2017; Sham et al., 2021; Vishali et al., 2020). The permissible limits of fluoride (1.5 mg/L) are set by the WHO and Libyan standards (WHO, 2011).

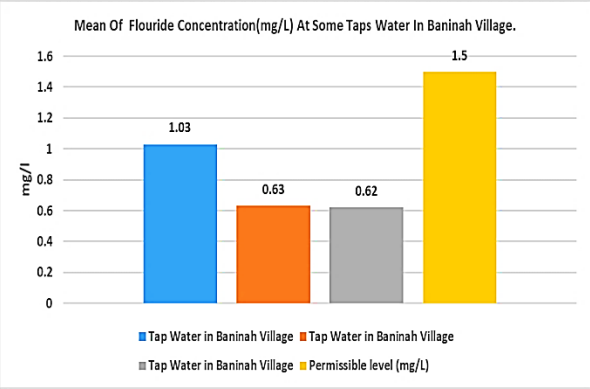

Figure (4) the mean Fluoride Concentration F (mg/l) compared with the Permissible level (mg/L) in some Taps Water at Baninah Village.

The lowest Fluoride Concentration observed in the bottled water as Aseel, Areen, Aquafin, and ALAIN was (< 0.01 mg/L) while the rest of the bottled water was 0.07 and 0.04 in bottled water as Pure and kharoba respectively. that shown in Figure (5).

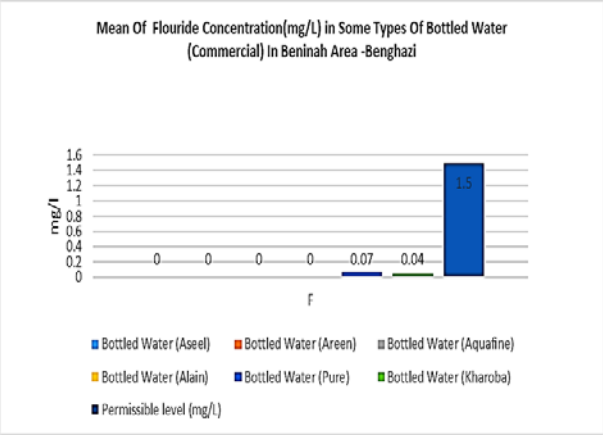

Figure (5) the mean Fluoride Concentration F (mg/l) compared with the Permissible level (mg/L) in the bottled water at Baninah Village.

CONCLUSION

The objective of this study was to determine Fluoride Concentration in both Tap Water and Some Types of Bottled Water (Commercial) in the Baninah area -Benghazi. The main conclusions follow.

- To conclude, six Types of Bottled Water (Commercial) in the Baninah area -Benghazi were investigated in terms of fluoride parameters and compared with the WHO guidelines for drinking water quality.

- The decrease in total dissolved salts in some types of bottled water compared to the Libyan standard specifications for the quality of drinking water(Standardization, 2008), and this in turn leads to serious health problems when you continue to rely on it completely.

- Fluoride measurements in bottled water showed that some of the samples had fluoride levels below 0.01 mg/L in bottled water ASEEL, AREEN, AQUAFINE, and ALAIN. whereas bottled water KHAROBA and PURE showed that the samples had fluoride levels of 0.04 mg/l and 0.07 mg/l respectively. Again, the lowest fluoride levels were in Bottled Water (Commercial) in the study area.

- Reverse osmosis system is an effective method of de-fluoridation. Given the beneficial effect of fluorides in reducing tooth decay, when drinking water is exposed to water purification systems that significantly reduce fluoride to a suboptimal level, it may be necessary to use fluoride supplementation if necessary.

- In tap water, fluoride concentration in the public drinking water supply (tap water) was found to be in the range of 0.62–1.03 ppm, which is far below the recommended levels of Libyan Standard (1.5 ppm) (Center, L. N. 1992; WHO, 2011).

- The increase in total dissolved salts in the public drinking water supply (tap water) compared to the Libyan standard specifica-

tions for the quality of drinking water.

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