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Bromate in Sudanese Bottled Water

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Abstract: The objective of this paper is to monitor bromate in bottled water due to the fact that Long-term exposure to bromate may increase consumers' risk of cancer(1,3), random samples fromtap waterand different bottledbrands were analyzed for bromate content and their physical properties. The obtained results revealed that bromate content exceeds the SSMO ,FDA AND IBWA limits of maximum content not exceeding 10 ppb in three samples, although two of them were taken from the same aquifer which eliminates the source factor and indicates that the main reason is the ozonation process employed in the disinfection of water. The study recommended to reduce ozone quantity and contact time In addition to the avoidance of direct sunlight exposure which will encourage liquid or gaseous chlorine to generatephoto activation bromate in bromide-containing water.It is also important to introduce safer technologies like membrane or iron exchange filtration.

Keywords:

1. INTRODUCTION

Bromide is found everywhere in drinking water,it is introduced into source water primarily by contact with bromide-containing soils or seawater having high bromide content. Bromide is converted into carcinogenic bromate during ozonation processes employed in some drinking water and wastewater treatment plants(1), the chances of bromate in water are higher when ozone is used as a disinfectant for mineral water, and especially in the presence of calcium chloride, which is a bromide derivative. Therefore bromate is a normal constituent of bottled water. The level of bromide may fluctuate depending on the source of water, and it will be higher or lower depending on where it is found. Other factors include the amount of ozone contact time, and a variety of water chemistry factors including pH, organic material, hardness and alkalinity.

2. MATERIALS AND METHODS

Monitoring of bromate in drinking water and its precursor bromide in source water is required. The purpose of this study was to survey bromide and bromate concentrations in randomly selected Sudanese bottled waters ofvarious brands and a sample of tap water in Khartoum state area, using an HPLC procedure in a UKAS accredited Laboratories with detection limit of 0.009 µg/L for bromate in November 2010. The method allowing the detection of bromate at the µg/L level in drinking water, and it does not require an expensive sample preparation.

3. RESULTS AND DISCUSSION

The results show that tap water in Alryadh of Khartoum city has a normal concentration for the bromate due to the absence of salt water intrusion in river Nile surface water; whereas some bottled water samples that underwent ozonation contained high levels of bromate. The bromate tests conducted on four samples taken from three bottled water producing companies, two of them from the same aquifer adjacent to the Blue Nile in Khartoum, one from Khartoum North and the 4th sample is taken from tap water in Alryadh of Khartoum city.
The final results are presented in the following table

table (1)

Sample No.	Bromate Content ppm	Physical Properties
Sample (1)	ppb< 10.0	Satisfactory
Sample (2)	69.4	Satisfactory
Sample (3)	110.3	Satisfactory
Sample (4)	ppb< 10.0	Unsatisfactory

The results were further detailed for the sample considered satisfactory in their bromate content by analyzing other important chemical properties.

Table (2). Further details of chemical composition on sample

Chemical characteristic	Sample 1 (range)
pH	7.8-8.0
TDS	161-179 mg/L
Total chlorides	701-10.6 mg/L
Na	15.35-16.94 mg/L
K	1.740-1.904 mg/L
Ca	29.23-31.83 mg/L
Mg	13.58-14.94 mg/L
Total hardness	122-132 mg/L
Zn	0.001 mg/L
pb	<0.001 mg/L
Cd	<0.001 mg/L
Fe	<0.003 mg/L
Mn	<0.001 mg/L
Cu	<0.001 mg/L
Ni	<0.005 mg/L
Al	0.002 mg/L
As	<0.001 mg/L
Ba	0.643-0.664 mg/L
Se	<0.001 mg/L
Cr	<0.001 mg/L
Ag	<0.001 mg/L
U	<0.001 mg/L
Be	<0.001 mg/L
Mo	0.002 mg/L
Sb	0.001 mg/L
Bromate content	<0.10ppb

Surprisinglysome samples from the same aquifer have different values indicating the influence of ozonation quantity and.; although the quantity of the original bromide in the source is the same . The tap water, although good in bromate content, its physical properties are not satisfactory. The details of other chemical constituents and properties on the sample considered satisfactory did not show any deviation from the standard of bottled water published by SSMO (Sudanese standards and metrology organization)

Based on the best available scientific data bromide does not seem to pose an immediate health risk to individuals,but, caution must be exercised in the use of bottled drinking water containing bromate exceeding the legal limits, it is worth mentioning that, the FDA, EPA and WHO have stipulated a 10µg/L (3)for bottled water, No studies have been done by the researcher to confirm or deny the health risks associated with bromate exposure but from the literature, individuals such as women who are of child bearing age, pregnant, young children and aged may be particularly susceptible to bromide toxicity and may experience nausea, vomiting, abdominal pain, diarrhea, hemolytic anemia, pulmonary edema, renal failure and deafness.

Long-term exposure to bromate may increase consumers' risk of cancer, according to the US government's environmental Protection Agency (1,2,3).

4. CONCLUSION

In addition to that the public is demanding a product that has not been treated with chemicals, meeting the increasingly rigorous hygiene standards required in the production of bottled water is becoming more of a challenge, particularly in the light of impending regulations in Sudan by Sudanese metrology and standards organization on bromate levels.

The main recommendation of this study is to limit doses of ozone and to reduce sources of and concentration of organic precursors, to control ozone contact time, and ozone/ dissolved organic carbon ratio. In addition to the avoidance of direct sunlight exposure which will encourage liquid or gaseous chlorine to generate photo activation bromate in bromide-containing water. Other important precautions include the use of new and improved technology like membrane and iron exchange filtration systems to eliminate bromate formation.

It is also important to establish international collaboration among countries to show information on matters relating to water safety.

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