Determination of Trihalomethane Levels in Chlorinated Drinking Water by Gas Chromatography-Mass Spectrometry Supplied in the State of Kuwait.

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Abstract

The present study was carried out as a preliminary assessment of the status of drinking water in Kuwaiti localities using appropriate methods. The occurrence of trihalomethanes (THM's) (i.e., $CHCl_3$, $CHBr_3$, $CHCl_2Br$, and $CHBr_2Cl$) were determined in drinking water samples and bottled water samples collected from different residential areas of Kuwait.

The parameters of USEPA 524.2 Method were evaluated using gas chromatography-mass spectrometry (GC-MS) with purge trap capabilities for THM's analysis in the shortest possible time. Optimization of the analytical parameters was focused on achieving optimal chromatographic responses by reducing the effect of water on the analysis. Because of the low detection level, single ion monitoring mass spectra were used for quantitative determination. Quality control measures were incorporated into the analytical procedures to ensure good performance during sample preparation and analyses. The mean average recoveries of THM's ranged from 98 to 102%.The levels of the individual THM's varied between 0.02 and 42 ppb in drinking water collected from different localities. The detection limit of the method was between 0.01 and 0.03 µg/ L depending on the type of individual compounds present in the water sample.

Introduction

THMs are a group of four chemicals that are formed along with other disinfection by products when chlorine or other disinfectants are used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. The trihalomethanes has been classified as carcinogens because they cause cancer in laboratory animals. Trichloromethane (Bromoform) the most common THM in water systems. Dibromochloromethane increase in the risk of cancer The current study was conducted to assess the quality of water to improve the management of disinfection procedures of Kuwait's WWPs and to provide more efficient tools for the prevention of possible human health impacts produced by the consumption of waters contaminated with THM compounds. Thus the aim of this study was to develop a rapid, specific and sensitive GC-MS purge-trap method for determination of THM's in both drinking and bottled water.

Materials and Methods

Thirty 40 ml screw-cap vials each equipped with a Teflon-coated silicon septum were used for analysis. A THM standard mix (Catalogue No. 8500) was purchased from Supelco. A purge-trap system with (Sola Tek 72) auto-sampler attached to a gas chromatography-mass spectrometer was used for the analysis of THM's in drinking water samples. A 5ml aliquot of the sample was injected using auto-sampler into the purge-trap sample concentrator attached to the gas chromatography-mass spectrometer. An inert gas (He) was bubbled through a portion of the aqueous sample at ambient temperature to transfer volatile compounds from the aqueous phase to the vapor phase. The vapor flowed through a sorbent column where the volatile components were absorbed. After the completion of purging the sorbent column was heated and back-flushed with inert gas (He) to desorb the components onto a gas chromatographic column.

Sample Collection

The State of Kuwait is divided into six governorates: Capital, Hawalli, Ahmadi, Jahra, Farwaniya and Mubarak Al-Kabeer. Each governorate is divided into a number of localities, and each locality is divided into a number of blocks. shown in Fig.1. Water samples were collected from those areas to determine the level of THMs in the drinking water.

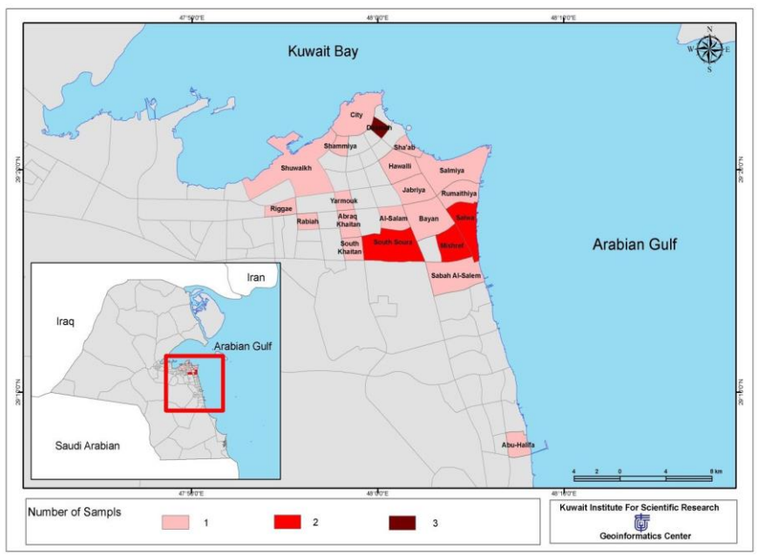

Fig1. Map of Kuwait showing the residential areas and sampling locations.

Results

This study was conducted to improve quality assessment and optimize management the Kuwait's WWPs disinfection procedures and to provide more efficient tools for the prevention of possible human health risk produced by consume waters contaminated by THM compounds. About 30 samples were analyzed for optimization. THMs in Kuwaiti drinking water was from 7.7 ppb to 45.9 ppb, which was lower than the maximum levels established by the USEPA rule of 80 ppb as shown in Table 1. Where THMs in the Kuwait's drinking water and bottled water was not significantly high as compared to USEPA limit. The total THMs in the Kuwait's drinking water and bottled water was not significantly high as compared to USEPA limit (Fig.2) & (Fig.3).

Fig.2. Relative TTHMs levels in the drinking water from different residential areas.

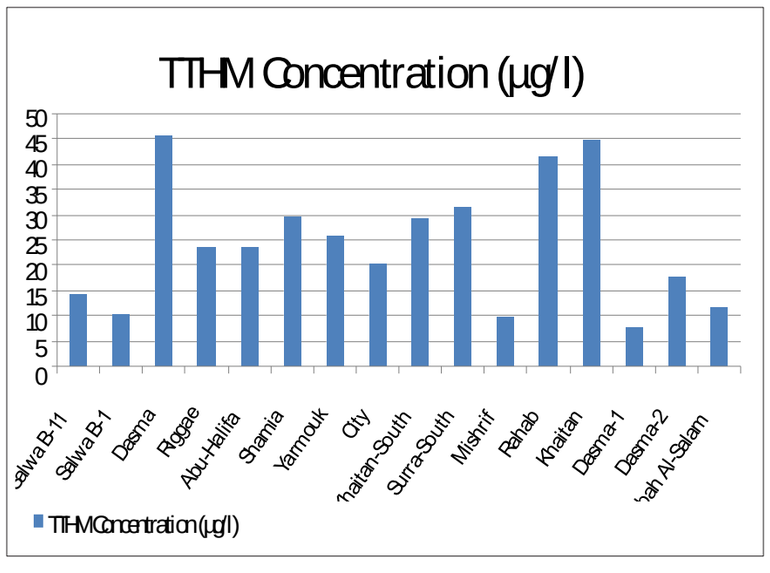

Fig.3. Relative THMs levels in the drinking water from Bottled Water.

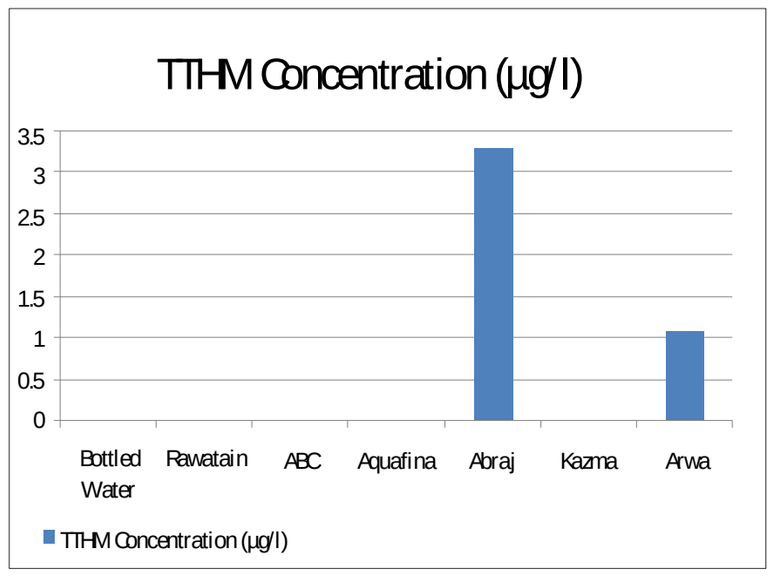

Table1. Trihalomethanes Concentrations in Drinking Water.

Location	Concentration (µg/l) THM			
	Chloroform	Dichlorobromomethane	Dibromochloromethane	Bromoform
Salwa B-11	0.09	0.06	2.70	11.5
Salwa B-1	0.02	0.30	1.40	8.90
Dasma	0.04	0.26	3.50	42.1
Riggae	0.08	0.60	2.50	20.7
Abu-Halifa	0.09	0.60	2.50	20.7
Shamia	0.06	0.50	3.30	26.1
Yarmouk	0.06	0.50	3.05	22.4
City	0.06	0.40	2.06	18.0
Khaitan-South	0.09	0.70	4.90	23.6
Surra-South	0.06	0.51	3.40	27.8
Mishrif	0.04	0.70	0.33	9.16
Rahab	0.04	0.35	3.80	37.5
Khaitan	0.09	2.96	10.0	32.0
Dasma-2	1.10	1.30	4.00	11.4
Dasma-1	0.8	0.90	2.00	4.00
Sabah Al-Salam	0.10	0.75	3.12	8.00
Bottled water				
Abraj	0.02	0.21	0.60	2.50
Kazma	ND	ND	ND	ND
Arwa	ND	0.10	0.20	0.80
ABC	ND	ND	ND	ND
Rawatain	ND	ND	ND	ND
Aquafina	ND	ND	ND	ND

THM= Trihalomethane; ND= Not Detected (i.e. less than detection range).

Conclusion

The present study provides information about contamination of THMs in drinking water. The fresh data on the contamination of drinking water will bring awareness among Kuwaiti population, it will strengthen Kuwaiti population capacity to deal with water contamination problem and also increase consumer confidence in the quality of drinking water available in different residential areas in Kuwait. It will improve the management of disinfection procedures of Kuwait.