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DETERMINATION OF TRIHALOMETHANES IN DRINKING WATER IN SOUTHERN MAURITIUS

by

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ABSTRACT

Trihalomethanes (THMs) levels were determined in water samples collected from Riviere du Poste and Mont Blanc treatment plants found in Southern Mauritius. A gas chromatograph coupled with an electron capture detector (GC-ECD) was used to analyse the samples. An average of 20.3µg/L of total THMs was obtained with a range of 13.0µg/L to 24.8µg/L.

Keywords: Trihalomethanes, gas chromatography, electron capture detector.

INTRODUCTION

The formation of trihalomethanes (THMs) during the process of chlorination of drinking water was first reported by Rook (1974). The THMs are formed by the reaction of chlorine with the organic matters or humic acids present in water. The THMs are suspected carcinogen and/or mutagenic compounds (WHO, 1984); the different members are: chloroform ($CHCl_3$), dichlorobromomethane ($CHCl_2Br$), dibromochloromethane ($CHBr_2Cl$) and bromoform ($CHBr_3$).

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Many studies have been carried out to investigate the occurrence and concentration levels of THMs in chlorinated drinking water. The total THMs (TTHMs) level in drinking water in Kentucky, USA was found to be near 100 µg/L (Allgeier *et al.* 1980), around 25µg/L in Sweden (Norin & Renberg, 1979), around 15µg/L in Jordan (Alawi *et al.* 1994), and up to 70µg/L in Alexandria, Egypt (Hassan *et al.*, 1996). These values are below the maximum contamination level (MCL) of 100µg/L recommended by US Environmental Protection Agency (EPA, 1983).

In Mauritius, no studies have been reported about THM levels in drinking water. We here report the results of a study done on the determination of THMs in chlorinated water samples collected in the south of Mauritius.

MATERIALS AND METHODS

Water samples were collected at the Riviere du Poste (RP) and Mont Blanc (MB) treatment plants, both found in the southern part of Mauritius. Seven stations receiving water from these 2 treatment plants were selected for sampling.

The water samples were collected in 500ml amber glass bottles, previously cleaned with detergents and rinsed with large volumes of distilled water, and then dried for 2h at 100^{0}C. Sampling was done on a monthly basis from October 1997 to March 1998. The bottles were completely filled with water samples so that no headspace was left in them. To prevent the formation of THMs in water, the samples were preserved with 0.5g of ascorbic acid. 250ml of water sample were shaken with 5ml of petroleum ether for 3min. The organic extract was separated and 0.5µl of it was injected into the gas chromatograph (GC).

A Unicam 4600 series GC coupled with an electron capture detector (GC-ECD) was used for the identification and quantification of THMs. The GC was fitted with a 30m DB-5 capillary column of 0.25mm internal diameter and a film thickness of 0.25µm. The detector temperature was 300^{0}C and that of the injector was 200^{0}C. The oven temperature was maintained at 40^{0}C for 4min, then increased to 100^{0}C at a rate of 10^{0}C/min. Standard solutions of $CHCl_3$, $CHClBr_2$, $CHCl_2Br$ and $CHBr_3$ in methanol were purchased from Supelco. Pesticide grade methanol and petroleum ether (Aldrich) were used as solvents.

RESULTS AND DISCUSSION

The concentration of trihalomethanes in drinking water from the Southern part of Mauritius was determined using GC-ECD. Thirty-five water samples were collected at seven different stations at different dates covering a period of 5 months between October 1997 to March 1998. Water from four stations (RP1, RP2, RP3 and RP4) comes from the Riviere du Poste treatment plant and the other three stations (MB1, MB2 and MB3) receive water from Mont Blanc treatment plant. A typical chromatogram obtained for a water sample analysed by GC-ECD is shown in Fig.1.

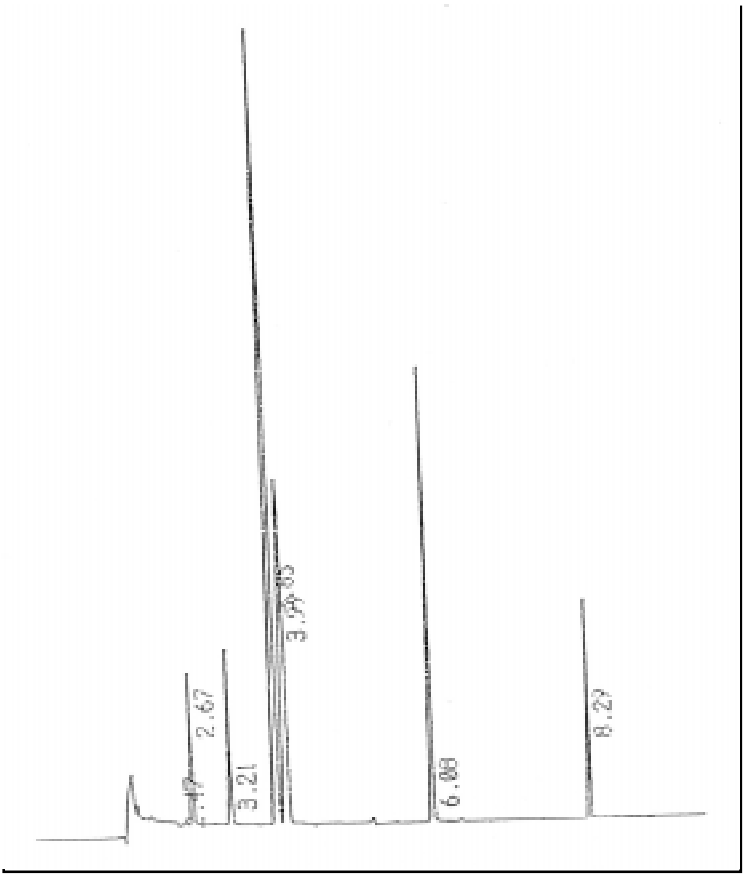

Fig. 1. Chromatogram for a water sample: $CHCl_3$ (t_R=2.67); CCl_4, internal standard (t_R=3.21); MeOH, solvent (t_R=3.85); $CHBrCl_2$ (t_R=3.99); $CHBr_2Cl$ (t_R=6.08); $CHBr_3$ (t_R=8.29)

The analytical quality control scheme applied in this study included analysis of standards, duplicate samples and the analysis of field blanks. Field blanks were prepared and handled in the same way as the samples in order to check for any contamination during sample collection and transportation. The average recovery for the individual THMs using a series of standards were in excess of 98% for all THM.

Table 1 shows average values obtained for the individual THMs and total THMs concentrations for the samples analysed in this study. The mean concentration of total THMs was 30.3µg/Lwith a range of 13.0µg/L at MB3 to 24.8 µg/L at RP1. It is worth noting that the average concentrations are obtained from 5 values for samples collected at different dates. If the concentrations of individual samples are considered, the range for total THMs concentration is 0.0µg/L at MB1 (for sample collected in October 1997) to 54.0µg/L at MB2 (for sample collected in March 1998). In all cases the total THMs concentrations are below the maximum contamination level (MCL) of 100µg/L as recommended by US Environmental Protection Agency (EPA, 1983).

The general trend observed in our study for the mean individual THM level is as follows: $CHCl_2Br > CHCl_3 > CHClBr_2 > CHBr_3$. In the literature, other trends have

Table1. Mean values in µg/L of individual and total THMs detected in drinking water from Riviere du Poste (RP) and Mont Blanc (MB) treatment plants

	$CHCl_3$	$CHBrCl_2$	$CHBr_2Cl$	$CHBr_3$	TTHMs
RP1	4.1	16.9	3.0	0.8	24.8
RP2	4.2	11.9	2.9	1.0	20.0
RP3	8.1	8.9	4.3	2.9	24.2
RP4	5.4	15.8	3.4	1.4	26
MB1	4.1	4.1	2.1	1.2	11.5
MB2	7.5	11.7	1.5	2.0	22.7
MB3	8.4	1.5	2.1	1.0	13.0

been reported. For example Hassan *et al.* (1996) reported the order $CHCl_3$ > $CHCl_2Br$ > $CHClBr_2$ > $CHBr_3$ for a study on drinking water from Alexandria, Egypt. In another study carried out on drinking water in Bahrain the trend $CHBr_3$ > $CHClBr_2$ > $CHCl_2Br$ was observed and $CHCl_3$ was not detected (Al-Saleh & Al-Haddad, 1994). The formation of the different members of THMs depends on several factors: concentration of humic acid in water, amount of free chlorine present, pH and temperature of water (Alawi *et al.* 1994; Rock, 1977; Scott & Horing, 1983). The formation of bromo-substituted THMs, for example, is favoured in alkaline medium (Alawi *et al.*1994). And as these above factors vary in different environment, no general trend is observed by the various authors working in this field.

CONCLUSION

The concentration of total trihalomethanes (TTHMs) determined in drinking water in Southern Mauritius averaged 20.3µg/L with a maximum of 54.0µg/L. These values are generally low compared to the maximum allowable concentration of 100µg/L set by the US EPA (1983). In this study for most of the samples analysed, $CHCl_2Br$ was found to be the major contributor to the total THMs.

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