



**DETERMINATION OF TRIHALOMETHANES IN TAP  
WATER OF DIFFERENT ORIGIN IN REPUBLIC OF  
MACEDONIA**

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NISH SEPTEMBER 2013

## Introduction

- Trihalomethanes are small organic compounds similar in structure to methane, with three hydrogen atoms substituted with chlorine or bromine. They are formed in water when disinfectants such as the chlorine used in water-treatment plants react with organic matter; for example, humic acids, which are found in the source water, especially in case of surface waters. Humic acids are the organic portion of soil formed by the decay of leaves, wood, and other plant materials. Disinfectants reduce the levels of microbes in the water supply; however, as the use of disinfectants in water increases, the risk of formation of trihalomethanes increases. Thus, trihalomethanes can be found in most disinfected drinking water supplies. The most important trihalomethanes in disinfected water are chloroform, dichlorobromomethane, chlorodibromomethane, and bromoform.

## ✓ Objective of the study

- The main objective of this work was to identify and quantify the concentration of chloroform, dichlorobromomethane, chlorodibromomethane, and bromoform in potable water from different origin after chlorination, in order to evaluate water safety for human consumption according to the National Regulation for Water Safety (46/08).

## ✓ Samples

- The study included 60 samples of potable water from water facilities that draw water from accumulations and 70 samples of potable water from water facilities that draw water from boreholes and springs. The concentrations of trihalometanes was measured in potable water in following major cities: Skopje, Bitola, Prilep, Veles, Strumica, Štip, Gostivar, Kičevo and Tetovo. Samples were collected during the period between May 2012 to April 2013.

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## ✓ Methods

- Analysis of trihalomethanes in potable water was performed by gas chromatography ECD detector with headspace sampler.

**Table 1. Instrumental conditions**

- **Gas Chromatographic (Varian Star 3400 CX) condition:**
- **Column (Bonded; poly(5% diphenyl/95% dimethyl siloxane) with temperature program: 50 °C - 2 min increasing 10 °C/min up to 200 °C for 10 min (total program 27 min). Flow rate of carrier gas nitrogen 1.5 mL/min.**
- **Injector Temperature - 150 °C.**
- **Detector (ECD) temperature - 280 °C.**
- **Split ratio: 1:10**
- **Internal standard: 1-3 Dichloropropane**

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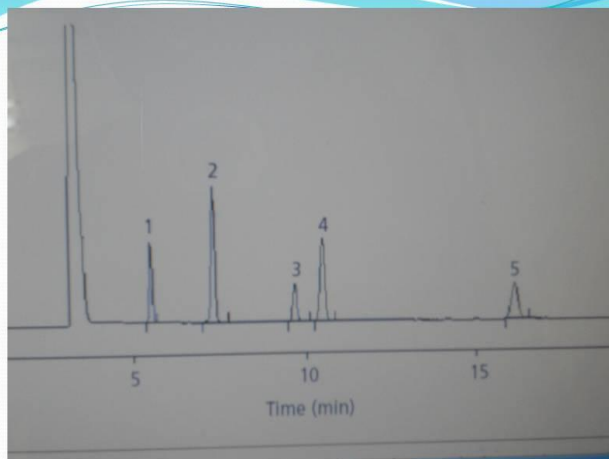


Figure 1. Chromatogram of trihalomethanes on poly 5% diphenyl/95% dimethyl siloxane: 1. Chloroform 2. Dichlorobromomethane; 3. Internal standard; 4. Chlorodibromomethane; 5. Bromoform

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## ✓ Results

The concentrations of trihalometanes was measured in potable water in following major cities: Skopje, Bitola, Prilep, Veles, Strumica, štip, Gostivar, Kičevo and Tetovo. Water facilities in Strumica, Kumanovo and Veles are supplied with water which is drawn from accumulations, and the other cities were supplied with water from facilities which draw water from boreholes and springs.

The obtained results for individual THMs in samples of potable water that draw water from accumulations, range from 15 - 55  $\mu\text{g/l}$  for chloroform; 12 - 27  $\mu\text{g/l}$  for dichlorobromomethane; 2-6  $\mu\text{g/l}$  for chlorodibromomethane and 3 - 13  $\mu\text{g/l}$  for bromoform. The obtained results for individual THMs in samples of potable water that draw water from boreholes and springs range from 5 - 15  $\mu\text{g/l}$  for chloroform; 1 - 5  $\mu\text{g/l}$  for dichlorobromomethane; 1- 3  $\mu\text{g/l}$  for chlorodibromomethane and 1-5  $\mu\text{g/l}$  for bromoform. According to the national Regulation for Water Safety (46/08), the content of chloroform in 7 of tested samples of potable water that draw water from accumulations exceeded the MRL value (30  $\mu\text{g/l}$ ).

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Concentration of major trihalomethanes in potable water from different origin (geometric mean - $\mu\text{g/L}$ ) is shown in Figure 2.

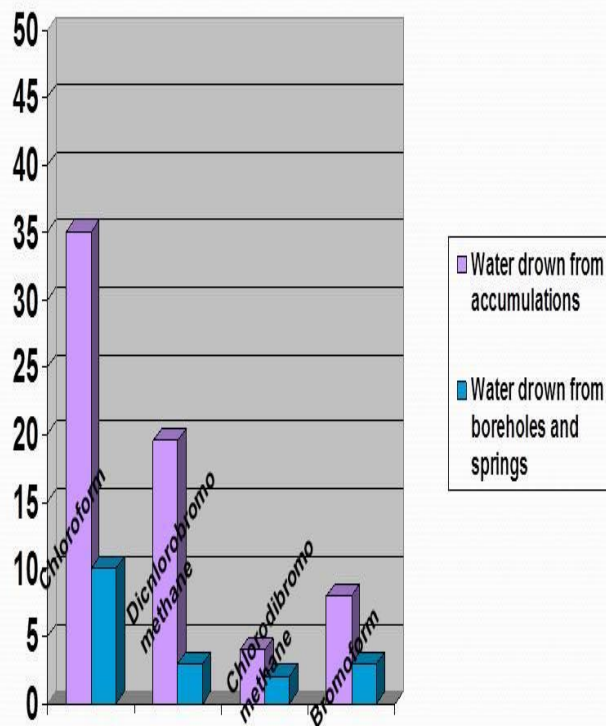


Figure 2. Concentration of major trihalomethanes in potable water from different origin (geometric mean - $\mu\text{g/L}$ )

The major cities where the concentration of trihalomethanes in potable water was measured are shown in Figure 3.

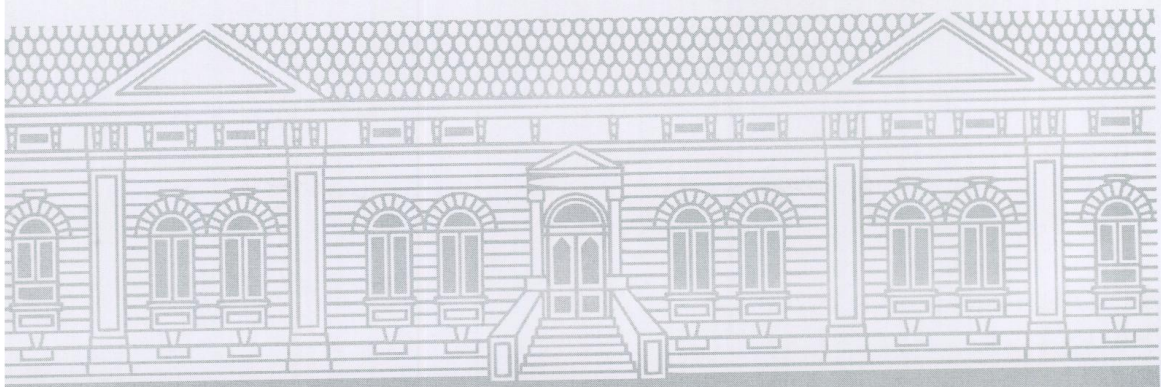


Figure 1. The major cities where the concentration of THMs was measured: 1. → Supplies from accumulations; 2. → Supplies from boreholes and springs.

#### ✓ Conclusion

- According to our investigations, the concentration of THMs in potable water after chlorination that comes from water facilities as wells and springs show significant decreasing trend in comparison with concentration of THMs in potable water that draw water from accumulations ( $p < 0.05$ ). This is due to the higher concentration of humic materials in surface water.





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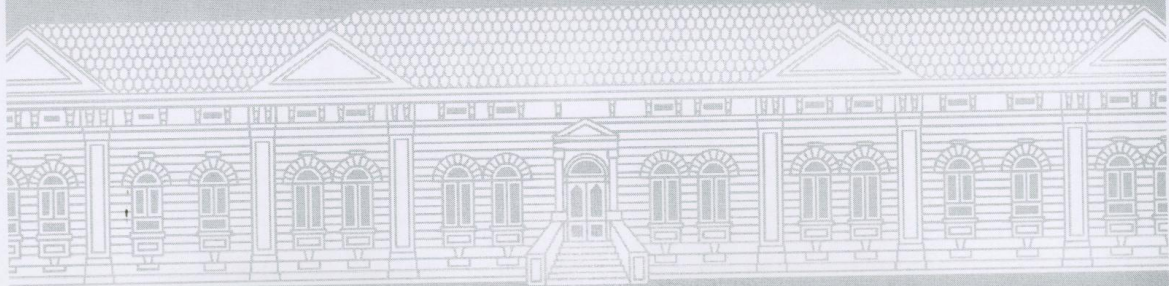
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**BOOK OF ABSTRACTS**  
ZBORNİK REZIMEA

NIŠ, 2014.



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**Publisher**

Izdavač

Institut za javno zdravlje Niš  
Medicinski fakultet u Nišu, Univerzitet u Nišu  
Srpsko lekarsko društvo podružnica Niš

**For publisher**

Za izdavača

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The content of this publication is available online at [www.izjz-nis.org.rs](http://www.izjz-nis.org.rs)  
Sadržaj ove publikacije je dostupan na internet adresi [www.izjz-nis.org.rs](http://www.izjz-nis.org.rs)

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Odlukom o akreditaciji (153-02-1827/2013-01 od 13.05.2013. godine) programa kontinuirane zdravstvene edukacije Zdravstvenog saveta Srbije u julskom roku 2013. godine, "47. DANI PREVENTIVNE MEDICINE" akreditovani su kao međunarodni kongres.

ISBN 978-86-915991-2-6

2. ODREĐIVANJE TRIHALOMETANA U VODAMA ZA PIĆE RAZLIČITOG POREKLA  
U REPUBLICI MAKEDONIJI

**2. DETERMINATION OF TRIHALOMETHANES IN TAP WATER OF DIFFERENT  
ORIGIN IN REPUBLIC OF MACEDONIA**

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Trihalomethanes (THMs) are formed in water the chlorine used in water-treatment plants react with organic matter. THMs are suspected carcinogens.

The goal of this study is determination of the concentration of THMS in potable water after chlorination. The study included 60 samples of potable water from water facilities that draw water from accumulations and 70 samples of potable water from water facilities that draw water from boreholes and springs. Samples were analysed by GC-ECD method with headspace technique. The obtained results for individual THMs in samples of potable water that draw water from accumulations, range from 15 – 55 µg/l for chloroform; 12 – 27 µg/l for dichlorobromomethane; 2-6 µg/l for chlorodibromomethane and 3 – 13 µg/l for bromoform. The obtained results for individual THMs in samples of potable water that draw water from boreholes and springs range from 5 – 15 µg/l for chloroform; 1 - 5 µg/l for dichlorobromomethane; 1- 3 µg/l for chlorodibromomethane and 1-5 µg/l for bromoform. According to the national Regulation for Water Safety (46/08), the content of chloroform in 7 of tested samples of potable water that draw water from accumulations exceeded the MRL value (30 µg/l).

The concentration of THMs in potable water after chlorination that comes from water facilities as wells and springs show significant decreasing trend in comparison with concentration of THMs in potable water that comes from accumulations ( $p < 0.05$ ).

**Keywords:** THMs, chloroform, dichlorobromomethane chlorodibromomethane, bromoform