IODO-DISINFECTION BY-PRODUCTS: AN EMERGING CONCERN

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INTRODUCTION

Disinfection of drinking water is essential for public health protection, dramatically reducing mortality and morbidity caused by waterborne diseases[1]. However, unintended chemical disinfection by-products (DBPs) are produced during drinking water treatment via reactions between the oxidants used for disinfection (e.g. chlorine) and a diverse group of precursors, including natural organic matter (NOM)[1, 2]. Many DBPs have been implicated in adverse health risks, e.g. in reproduction and cancer (particularly bladder cancer)[3, 4]. In chlorinated water, halogenated DBPs are formed via direct reaction of chlorine, or of the secondarily formed bromine and iodine, with aquatic NOM to form a complex mixture of halogenated organic compounds. Bromine and iodine can be formed from the respective oxidation of bromide and iodide by chlorine/chloramine. Previously, the focus of DBP research was on the formation of chlorinated and brominated trihalomethanes (THMs) and haloacetic acids (HAAs), because one or both of these groups of DBPs are regulated in the USA, Europe and Australia. Very recently, there has been a growing interest in iodinated DBPs, particularly because iodinated compounds are likely to be more toxic than both brominated and chlorinated analogues, since iodine is more biologically reactive than bromine or chlorine. Some iodinated organic compounds are also known to cause medicinal off-flavours. The occurrence of several iodo-acetic acids has recently been reported in drinking waters and these iodo-acids were found to be highly cytotoxic.

In Australia, water desalination and water reuse are being increasingly utilised to provide alternative drinking water sources in the current drying climate, along with surface waters and groundwaters of more marginal quality. Wastewaters contain iodide, and seawater and many marginal quality surface waters and groundwaters contain elevated concentrations of iodide ions. The current Australian Drinking Water Guideline (ADWG) value for iodide is 0.1 mg/L, with the proposed guideline level for iodide in the revised guidelines currently under consideration being 0.5 mg/L. While iodide itself in drinking water may not be a problem, as a certain amount of iodide is required to avoid goiter, the potential for these waters to form iodinated DBPs is an emerging issue for water utilities. With higher concentrations of iodide in alternative water sources, increasing concentrations of iodo-DBPs in potable water may be expected in the future.

There have been no published studies to date of iodide concentrations in source waters or iodinated DBPs in disinfected waters in Australia. The aim of this study was to analyse the iodide concentrations in some key water sources and investigate the formation of some iodo-DBPs in the corresponding treated waters.

METHODOLOGY/ PROCESS

Iodide concentrations were measured in a number of source and quenched treated (including disinfected) drinking waters. The concentrations of iodo-trihalomethanes (I-THMs) and the regulated THMs in the quenched treated drinking waters were analysed.

RESULTS/ OUTCOMES

Iodide concentrations in a number of regional source waters (surface waters and groundwaters) were found to be significant, with nearly half of the samples containing iodide concentrations higher than the current ADWG value.

The only analytical method available in Australia to analyse for I-THMs has been developed in this project. A simple and sensitive (ng/L level) method to concurrently analyse six iodo-THMs and the four regulated THMs was developed. This method was based on solid-phase microextraction followed by gas chromatography-mass spectrometry. Typical chromatograms will be presented in this paper. Detection limits for the I-THMs ranged from 0.6 – 3.3 ng/L. Precision for the I-THMs ranged from 2-9%. In a treated (chlorinated) water sample from the north-west of Western Australia, all ten THMs were detected. On a mass basis, the I-THMs represented 5% of the total THMs concentration in the sample. Results from other sampling sites will also be presented in this paper.

CONCLUSION

A significant proportion of the source waters in this study contained high iodide concentrations. As such, these waters have the potential to form the more toxic iodinated DBPs upon disinfection. Iodo-DBPs are a class of emerging DBPs of increasing concern for Australian water utilities.

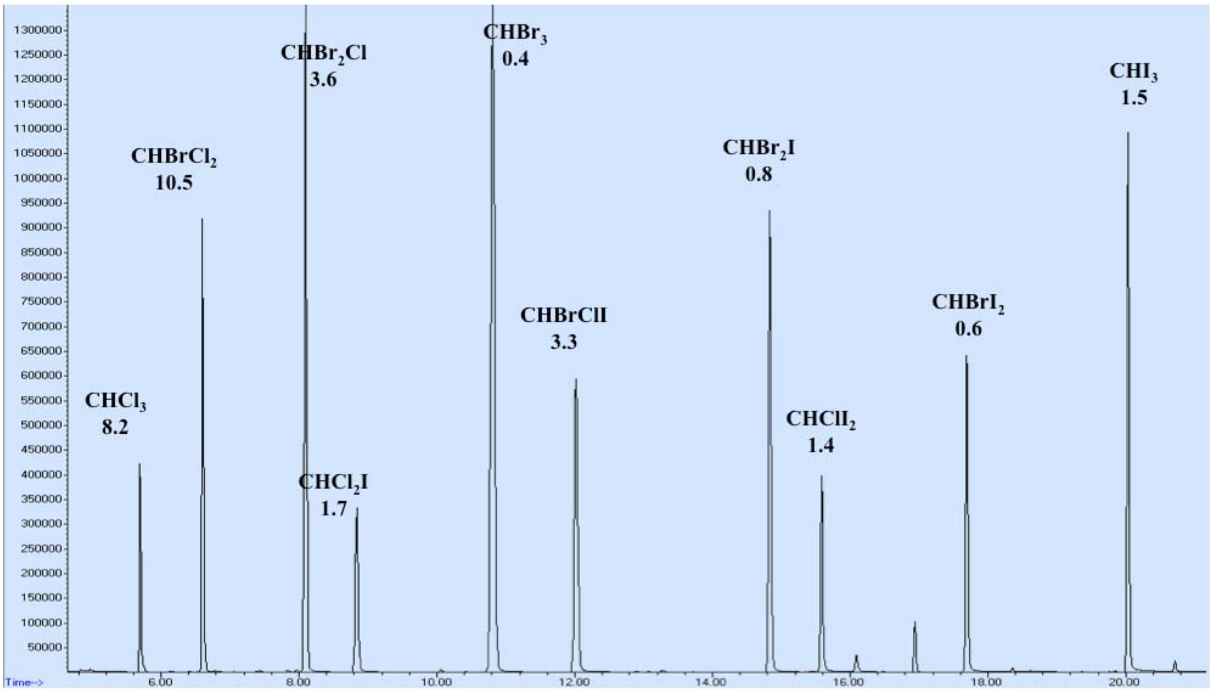

Figure 1: Typical chromatogram of six iodo-THMs and the four regulated THMs and detection limits