DEVELOPMENT OF A COMPLEMENTARY CHEMILUMINESCENCE/HPLC METHOD FOR PREDICTING THE CHEMICAL FATE OF 1-BROMO-3-CHLORO-5,5-DIMETHYLHYDANTOIN UNDER AQUEOUS CONDITIONS

Jennifer Ruth Miller Jones

A Thesis Submitted to the
University of North Carolina in Partial Fulfillment
Of the Requirements for the Degree of
Master of Science

Department of Chemistry

University of North Carolina at Wilmington

2003

Approved by

Advisory Committee

_____ _____

_____
Chair

Accepted by

_____
Dean, Graduate School

TABLE OF CONTENTS

ABSTRACT

The quality of drinking water, particularly in developing countries, has been an ever-present concern in the United States and abroad, and has sparked a flurry of ongoing research both in water filtration technologies and oxidizing biocides. Various *N*-halamines and *N,N'*-halamines have been studied and tested for their effectiveness as water disinfectants, and results have shown that many of these compounds exhibit both bactericidal properties and antimicrobial activities. One microbial inhibitor, 1-bromo-3-chloro-5,5dimethyhydantoin (BCDMH) is available in briquette-form, and is a ready addition to a water filtration system thereby offering an affordable water filtration technology that can be applied in remote areas, operate with no electricity, and be simple to operate and maintain. This feature is particularly applicable to areas where contaminated drinking water introduces a health hazard. Therefore, we became interested in the fate of BCDMH when subjected to the variety of conditions expected for well water treatment specific to the harsh conditions of Bangladesh.

We have developed complementary chemiluminescence/HPLC methods to monitor the decomposition of BCDMH under aqueous conditions similar to those of Bangladesh. We are able to quantify the appearance of dimethylhydantoin (DMH) by HPLC while also monitoring the decomposition of BCDMH by chemiluminescence.

The results show that both methods give good selectivity, linearity, and repeatability under pristine conditions, but added ingredients, such as those expected in Bangladesh water have an effect. The HPLC method produced results with smaller differences between different sample compositions. The chemiluminescence technique gave varied results based upon added metals and their oxidation states. Metals that are

readily oxidized, such as iron (II) and arsenic (III) give lower chemiluminescence readings. The combination of the two techniques gives insight as to the decomposition of the BCDMH and subsequent availability as an antimicrobial agent.

ACKNOWLEDGEMENTS

Thank you so much Dr. Tyrell for always encouraging me and helping me to understand what is really important in life. You taught me that the achievements and goals in life are measured not by the onlookers, but by the participants. More importantly, you made me realize that that my ambition and drive to succeed does not come from a competition with others but from within myself. Thank you.

I would like to thank Dr. Skrabal for his patience, support and for always having time to answer my questions. Thanks for standing by me.

Thank you Dr. Hancock for your time and interest in my project.

Thanks to Dr. Bill Cooper for the use of the Luminometer.

Thank you also to Shearon Appleton, Libbie Schaffer, and Dr. Barbara Heath for just making things work.

Stefanie Flippin, where would I be without you? Thanks for the never-ending supply of support, encouragement, patience, and coffee. Thank you most of all for your honesty – a trait of a true friend.

Thank you, Mom and Dad for never doubting my abilities or me.

I was so fortunate to work in a lab with such outstanding people. Ned Hill and Joel Barden, you made this experience much more than just a research project. Ned, Of course I am grateful for the various equipment that you contributed to my research, and all the knowledge of your experience you shared with me, but I am especially thankful for friendship. Joel, your ability to make me laugh at all the right times has not gone unnoticed. Thanks for making these last two years so enjoyable.

DEDICATION

I would like to dedicate this thesis to my husband, Chad Jones, whose sacrifices for my education have been many. Thank you.

LIST OF TABLES

LIST OF FIGURES