

**CONCENTRATION OF HEAVY METALS IN DRINKING  
WATER AND HEALTH RISK FROM SEMI-URBAN  
AREA**

**NOORFAZIRA BINTI MOHAMED @ BUSU**

**Final Year Project Report Submitted in  
Partial Fulfillment of the Requirements for the  
Degree of Bachelor of Science (Hons.) Chemistry  
In the Faculty of Applied Sciences  
Universiti Teknologi MARA**

**JULY 2017**

## ABSTRACT

### CONCENTRATION OF HEAVY METALS IN DRINKING WATER AND HEALTH RISK FROM SEMI-URBAN AREA

Heavy metals exposure was dangerous to human health and ecosystem. Reducing an exposure to the heavy metal especially through drinking water related with management of drinking water in communities is important. The objectives of this study were to determine the concentration of selected heavy metal (Cr, Cd, Zn and Pb) in drinking water and to estimate the health risk using health risk assessment (HRA). This study also carried out to identify the level of knowledge, attitude and practice (KAP) regarding heavy metal contamination in drinking water. The concentration of selected heavy metals was analysed by using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) and the information of KAP level was measured using a set of questionnaires. There was a potential non-carcinogenic health risks could be occurred from the Cd, Cr and Pb exposure via dermal contact ( $HQ > 1$ ). The carcinogenic health risk showed there was the greater probability of cancer to develop within population in study area of Cr compared to Pb. The population has good knowledge (58.44%) in term of water supply, quite low positive attitude (43.33%) on believing the dangerous of heavy metals contamination in drinking water and better practice (67.50%) in terms of drinking water management. Identifying the quality of drinking water through HRA and KAP could give more knowledge for the communities to improve the management of drinking water quality in the future. Therefore, it is strongly recommended the responsible authorities to take some corrective measures in order to decrease the level of heavy metals contamination in drinking water.

## TABLE OF CONTENTS

	<b>Page</b>
<b>ACKNOWLEDGEMENTS</b>	iii
<b>TABLE OF CONTENTS</b>	iv
<b>LIST OF TABLES</b>	vi
<b>LIST OF FIGURES</b>	vii
<b>LIST OF ABBREVIATIONS</b>	viii
<b>ABSTRACT</b>	xi
<b>ABSTRAK</b>	xii
<b>CHAPTER 1 INTRODUCTION</b>	
1.1 Background of study	1
1.2 Problem statement	3
1.3 Significance of study	4
1.4 Objectives of study	5
1.5 Scope and limitation of study	5
<b>CHAPTER 2 LITERATURE REVIEW</b>	
2.1 Water	6
2.2 Drinking water	7
2.3 Heavy metal	8
2.3.1 Cadmium (Cd)	10
2.3.2 Chromium (Cr)	10
2.3.3 Lead (Pb)	11
2.3.4 Zinc (Zn)	12
2.4 Knowledge, attitude and practice (KAP)	12
2.5 Health risk assessment (HRA)	13
<b>CHAPTER 3 METHODOLOGY</b>	
3.1 Materials	16
3.1.1 Chemicals and reagent	16
3.1.2 Glassware and Apparatus	16
3.1.3 Equipment and Analytical Instrument	17
3.2 Study Sites	17
3.3 Sample Collection	18
3.4 Sample preparation and analysis	18
3.5 Statistical Analyses	19
3.6 Questionnaires	19

3.7	Health risk assessment (HRA)	20
<b>CHAPTER 4 RESULTS AND DISCUSSION</b>		
4.1	Heavy metal analysis in drinking water sample	24
4.2	Comparison with other studies	28
4.3	Correlation Analysis	31
4.4	Knowledge, Attitude and Practices	32
	4.4.1 Knowledge	32
	4.4.2 Attitude	33
	4.4.3 Practices	34
4.5	Health risk assessment	37
	4.5.1 Hazard Quotient (HQ)	38
	4.5.2 Lifetime Cancer Risk (LCR)	41
<b>CHAPTER 5 CONCLUSION AND RECOMMENDATIONS</b>		43
<b>CITED REFERENCED</b>		45
<b>APPENDICES</b>		53
<b><i>CURRICULUM VITAE</i></b>		55

## LIST OF TABLES

Table	Caption	Page
3.1	<i>RfD</i> value for ingestion and dermal of Cr, Cd, Pb and Zn	22
3.2	<i>SF</i> value for ingestion and dermal of Cr and Pb	22
4.1	Comparison of metal between three selected restaurants with one-way ANOVA ( $p < 0.05$ )	27
4.2	Concentration of heavy metals in drinking water (high concentration shown in bold)	29
4.3	Correlation analyses of metal in drinking water (strong correlation $> 0.68$ was shown in bold)	31
4.4	Percentage (%) of Knowledge, Attitude and Practices (KAP)	36
4.5	Hazard Quotients (HQ) of Cd, Cr, Pb and Zn through oral ingestion and dermal contact ( $HQ > 1$ showed in bold)	40
4.6	Lifetime Cancer Risk (LCR) of Cr and Pb through oral ingestion and dermal contact (Exceed limit ( $1 \times 10^{-6} < LCR < 1 \times 10^{-4}$ ) showed in bold)	42