CONTENTS

		Page
CONTENTS		viii
LIST OF TABLES		xi
LIST OF FIGURES		xiii
CHAPTER		
1.	INTRODUCTION AND LITERATURE REVIEW	1
1.1	Overview	1
1.2	Arsenic contaminated in the environment	1
1.2.1	Arsenic in soil	3
1.2.2	Arsenic in plants	4
1.2.3	Arsenic in water	5
1.3	The analytical techniques for arsenic analysis	5
1.4	Health Effects of arsenic on human	8
1.5	Source and value of exposure	9
1.6	Arsenic contamination in Ronphibun Sub-district	10
1.6.1	Background information of arsenic contamination	10
1.6.2	Distribution of arsenic in Ronphibun Sub-district	12
1.6.3	Risk assessment studies	13
1.7	Objectives	14
1.8	Anticipation outcome	14
2.	METHODOLOGY	15
2.1	Chemical and material	15
2.2	Instruments	15
2.3	Hydride Generation Atomic Absorption Spectrophotometry (HGAAS)	17
2.4	Optimization of the analytical method	18
2.4.1	Carrier gas (Ar) flow rate	18

CONTENTS (CONTINUED)

		Page
2.4.2	Effect of $NaBH_4$ concentration	18
2.4.3	Effect of HCl concentration	18
2.4.4	Effect of KI / Ascorbic acid concentration	18
2.4.5	Effect of reduction time	19
2.4.6	Optimum of atomization temperature	19
2.5	Sampling site and sample preparation	19
2.5.1	Soil sampling and preparation	22
2.5.2	Plant sampling and preparation	22
2.6	Comparison of the extraction methods	24
2.6.1	Autoclave extraction method	24
2.6.2	Hot plate extraction method	24
2.7	Samples Extraction	24
2.7.1	Soil extraction	24
2.7.2	Plant extraction	24
2.8	Determination of total arsenic in soils and edible plants	25
2.9	Standard addition method	26
2.10	Method of validation	26
2.10.1	Detection limit (DL)	26
2.10.2	Precision	27
2.10.3	Accuracy	27
2.10.4	Recovery	27
2.10.5	Linear dynamic range	28
3	RESULTS AND DISSCUSSION	29
3.1	Optimization of parameters used for FIAS 100-AAnalyst 800	29
3.1.1	Effect of carrier gas flow rate (Ar)	29
3.1.2	Effect of $NaBH_4$ concentration	29
3.1.3	Effect of HCl concentration	30
3.1.4	Effect of Potassium iodide / Ascorbic concentration	31

CONTENTS (CONTINUED)

		Page
3.1.5	Effect of reduction time	32
3.1.6	Effect of atomization temperature	32
3.2	Comparison of the method used for extraction	33
3.3	Standard addition	35
3.4	Method of validation	36
3.4.1	Detection limit (DL)	36
3.4.2	Precision	36
3.4.3	Accuracy	36
3.4.4	Percent Recovery	36
3.4.5	Linear dynamic range	37
3.5	Total amount of arsenic in soil and edible plant samples	37
3.5.1	Arsenic level in soil	37
3.5.2	Arsenic level in plants	40
3.6	Relationship between arsenic contents of soil and plant	44
3.7	Risk assessment study	48
4	CONCLUSION	51
REFERENCES		53
APPENDICES		62
A		63
B		66
C		68
D		79
E		80
VITAE		81

LIST OF TABLES

Table		Page
1- 1	Some arsenic compounds and their chemical structure which are found in the environment	2
1- 2	Arsenic contents in the soil of various countries	4
1- 3	Analytical method used with arsenic determination	7
1- 4	Estimated daily intake of arsenic for each individual	10
1- 5	Arsenic concentration from various environmental media in Ronphibun Sub-district	12
2- 1	The Village names of the sampling area in Ronphibun Sub-district, Nakhorn Si Thammarat	20
3- 1	Arsenic concentration in Certified Reference Material (CRM) PACS-2	36
3- 2	Bioconcentration factor value (BCF) of each plant growing on Ronphibun Sub-district Nakhorn Si Thammarat	46
3- 3	Risk index of people in Ronphibun Sub-district consuming arsenic contaminated food	50
A- 1	Stock solution and all chemical reagents list	63
A- 2	The parameters used for Perkin Elmer model 5000	63
A- 3	The parameters used for Perkin Elmer FIAS -AAanlyst 800	64
A- 4	Name and GPS position of each sampling site	65
C- 1	Optimization of carrier gas (argon)	68
C- 2	The effect of $NaBH_4$ concentration on the peak area of arsine	68
C- 3	The effect of HCl concentration (%v/v) on the peak height and peak area of arsine	68
C- 4	The effect of KI/ Ascorbic acid reagent using as reducing agent on the peak area of arsine	69
C- 5	The effect of reduction time on the peak area of arsine	69
C- 6	The effect of optimization temperature on the peak area of arsine	69
C- 7	Comparison of the method used for extraction	70
C- 8	The result of the standard addition in soil ($B_{79/1}$ M_9)	70
C- 9	The result of the standard addition in *Curcuma Longa*. plant ($B_{79/1}$ M_9)	70

LIST OF TABLES (CONTINUED)

Table		Page
C- 10	The detection limit for arsenic measurement using hydride generation of AAS Perkin Model 5000	71
C- 11	The detection limit for arsenic measurement using hydride generation of FIAS 100-AAnalyst 800	71
C- 12	The % RSD calculation from soil sample ($M_{14}B_{204}$)	72
C- 13	The % RSD calculation from *Carica* sp. (M_2B_{10})	72
C- 14	Percent recovery	73
C- 15	Linear dynamic range for AAnalyst 800 and Perkin Elmer Model 5000	73
C- 16	Arsenic concentration in soil samples at the Ronphibun Sub-district	74
C- 17	Arsenic concentration in edible plants	73
C- 18	The bioconcentratin factor of edile plant sample	76
D- 1	Total population in Ronphibun Sub-district, Nakhorn Si Thammarat	79

LIST OF FIGURES

Figure		Page
1- 1	Biological transformations of arsenic	3
1- 2	Illustration of skin cancer caused by arsenic	9
1- 3	Map of Ronphibun Sub-district, Nakhorn Si Thammarat Province	11
2- 1	Perkin Elmer model 5000 coupled with Flow injection system	16
2- 2	Perkin Elmer model AAnalyst 800 coupled with Flow injection analysis system 100 (FIAS100)	16
2- 3	The sampling location	21
2- 4	Compositing sampling protocol	22
2- 5	Edible plants collected from Villages No. 1, 2, 8, 9, 11, 13 and 14 grown in Ronphibun Sub-district	23
2- 6	Samples extraction (A: soil extraction. and B: plant extraction)	25
3- 1	The effect of carrier gas (argon) flow rate on the peak area of arsine generated from FIAS -AAnalyst 800 system	29
3- 2	The effect of $NaBH_4$ concentration on the peak area of arsine generated from FIAS 100- AAnalyst 800 system	30
3- 3	The effect of HCl concentration (%v/v) on the peak height and peak area of arsine generated from FIAS 100- AAnalyst 800 system	31
3- 4	The effect of KI/ Ascorbic acid reagent using as reducing agent on the peak area of arsine generated from FIAS 100- AAnalyst 800 system	31
3- 5	The effect of reduction time on the peak area of arsine generated from FIAS 100-AAnalyst 800 system	32
3- 6	The effect of optimization temperature on the peak area of arsine generated from FIAS 100-AAnalyst 800 system	33
3- 7	Peak are generated from extractants of soil samples for extraction using autoclave and hot plate	34
3- 8	Comparison standard calibration curve and standard addition curve method for soil sample	35
3- 9	Comparison standard calibration curve and standard addition curve method for plant sample	35

LIST OF FIGURES (CONTINUED)

Figure		Page
3- 10	Peak are generated from FIAS 100 -AAnalyst 800 system (A)	37
3- 11	Distribution of arsenic concentration in soil samples collected from Villages No. 1, 2, 8, 9, 11, 12, 13 and 14 in Ronphibun Sub-district, Nakhorn Si Thammarat	39
3- 12	Box and outliner plot presents Q_1, Q_2 and Q_3 of arsenic level in soil of each Village (Moo) in Ronphibun Sub-district Nakhorn Si Thammarat	40
3- 13	Box plot of arsenic concentration presented in plants that have edible root	41
3- 14	Box plot of arsenic concentration presented in the plants that have edible leaves	42
3- 15	Box plot of arsenic concentration presented in the plants that have edible fruit	43
3- 16	The relationship between soil arsenic and accumulated in different part of plants growing in Ronphibun Sub-district Nakhorn Si Thammarat	45
3-17	Box plot of arsenic concentrations of arsenic accumulated in edible part of plants which are grown in both high and low contaminated area	45