TABLE OF CONTENTS

		Page
ACKNOWLEDGEMENTS		
ABSTRACT IN ENGLISH		
ABS	TRACT IN THAI	vi
ТАВ	SLE OF CONTENTS	viii
LIST	r of tables	xi
LIST OF FIGURES		
ABBREVIATIONS AND SYMBOLS		
CHA	APTER 1 INTRODUCTION	1
1.1	Statement and significant of problem	1
1.2	The objectives of the present study	5
1.3	Keywords and definition	5
1.4	Conceptual frame works	6
CHATER 2 LITERATURE REVIEWS		
2.1	Introduction of fungicides	8
2.2	Types of fungicides	9
2.3	Mode of action	
2.4	Carbendazim	15
	2.4.1 Toxicity of carbendazim	15
	2.4.2 Analysis of carbendazim residues	17

		Page
	2.4.3 Maximum residue limits of carbendazim	18
2.5	Mancozeb	19
	2.5.1 Toxicity of mancozeb	22
	2.5.2 Analysis of mancozeb residues	25
	2.5.3 Maximum residue limits of mancozeb	27
2.6	Health risk assessments	28
	2.6.1 Hazard identification	30
	2.6.2 Dose-response assessment	32
	2.4.3 Exposure assessment	38
	2.4.4 Risk characterization	45
CHATER 3 MATERIAL AND METHOD		52
3.1	Chemical	52
3.2	Apparatus	53
3.3	Methods	54
	3.3.1 Study site	54
	3.3.2 Sample selection and collection	55
	3.3.3 Sample preparation	57
	3.3.4 Consumer participant enrollment	57
	3.3.5 Laboratory results	61
	3.3.6 Questionnaire data	e 67
	3.3.7 Health risk assessment	67

CHAPTER 4 RESULTS AND DISCUSSION		
4.1 Consumer data	70	
4.2 Vegetable consumption	73	
4.3 Development of method for determination of carbendazim residues	74	
4.3.1 Method efficiency	76	
4.3.2 Calibration curve, reproducibility, LOD and LOQ	80	
4.3.3 Carbendazim residues in 8 kinds vegetable samples	85	
from Chiang Mai city		
4.4 Development of method for determination of mancozeb residues	85	
4.4.1 Optimization of extraction	85	
4.4.2 Calibration curve, reproducibility, LOD and LOQ	89	
4.4.3 Mancozeb residues in 3 kinds vegetable samples	91	
from Chiang Mai city		
4.5 Health risk assessment	93	
CHAPTER 5 CONCLUSIONS	96	
REFERENCES		
APPENDIX 1		
APPENDIX 1 CURRICULUM VITAE 1		

LIST OF TABLES

Table			
2.1	Major chemical classes of fungicides	11	
2.2	Half-life of carbendazim	16	
2.3	Maximum residues limits of carbendazim	19	
2.4	Structure and quantity of imported dithiocarbamates in Thailand	21	
2.5	Half-life of mancozeb and ETU	24	
2.6	Maximum residues limits of mancozeb	27	
2.7	Paradigm for risk assessment, including problem formulation	28	
3.1	Common and scientific names of vegetable samples	55	
3.2	Numbers of population in the Sutep sub-district	58	
4.1	Information data of consumers	71	
4.2	Education of consumer	71	
4.3	Occupational of consumer	72	
4.4	Eating behaviors of consumers	72	
4.5	Rate of self-cooking meal	73	
4.6	Number of meal for Self-cooking	S 73	
4.7	Food consumption from 6 kinds of vegetables	e ⁷⁴ 0	
4.8	Recovery and precision of carbendazim from spiked vegetables	82	
4.9	Carbendazim residue in 8 kinds of vegetable samples from four	84	
	fresh markets in Chiang Mai city		

4.10	Peak area of mancozeb from spiked vegetable samples	91
4.11	Carbendazim residue in 8 kinds of vegetable samples	92
4.12	Exposure assessment of carbendazim from 5 kinds of vegetables	94
4 13	Calculated daily intake (CDI) of mancozeb from 3 kinds of vegetables	95



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright[©] by Chiang Mai University All rights reserved

Page

LIST OF FIGURES

Figure		
1.1	Structure of carbendazim	2
1.2	Chemical structure of mancozeb	4
1.3	Block diagram of the study	7
2.1	The amount of imported pesticides in Thailand (1998-2011)	10
2.2	Hyphae of a fungi	13
2.3	Fungal cell with organelles	13
2.4	Site-Specific Inhibitors	14
2.5	Multi-site Inhibitors	14
2.6	The four step risk assessment process	30
2.7	Possible exposure media and corresponding means of contact	40
2.8	Risk characterization	46
3.1	Map of the studied site	54
3.2	Five local fresh markets in Chiang Mai city	56
3.3	Flow diagram of sample preparation for carbendazim residue analysis	63
3.4	Flow diagram of sample preparation for mancozeb residue analysis	66
4.1	Effect of sample weight	S 76
4.2	Effect of extraction solvent volume	e77
4.3	Effect of extraction time	78
4.4	Effect washing solvent volume	79
4.5	Chromatograms of vegetable sample spiked with carbendazim	81

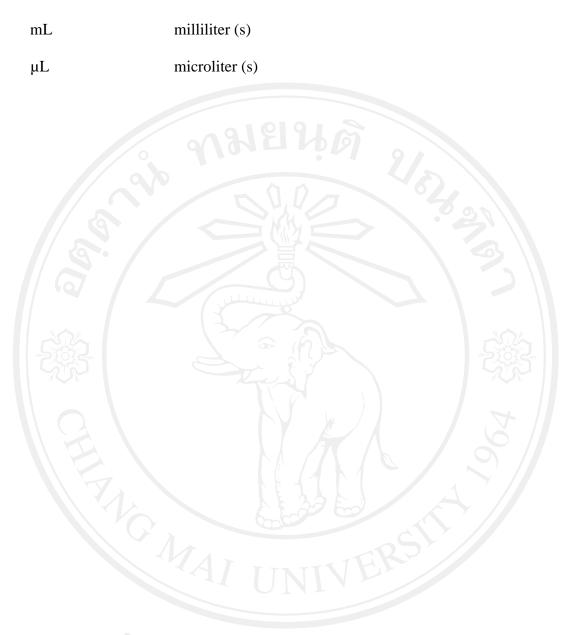
4.6	Effect of sample weight	85
4.7	Effect of concentration of stannous chloride	86
4.8	Effect volume of stannous chloride	87
4.9	Effect volume of isooctane	88
4.10	Effect of extraction time	88
4.11	Chromatograms of vegetable sample spiked with mancozeb	90
4.12	Chromatogram of blank and mancozeb exposed sample	92

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright[©] by Chiang Mai University All rights reserved

Page

ABBREVIATION AND SYMBOLS

ADI	acceptable daily intake
°C	degree celsius
C ₁₈	octadecyl
cm 🖌	centimeter (s)
CV	coefficient of variation
EA	ethyl acetate
FAO	Food and Agriculture Organization
GC-FPD	gas-chromatograph flame photometry detector
i.d.	inner dimeter
i.e.	that is
IS	internal standard
L	liter (s)
LOD	limit of detection
LOQ	limit of quantification
Max	maximum
Min	minimum Chiang Mai University
g	gram (s) ts reserved
kg	kilogram (s)
mg	milligram (s)
ng	nanogram (s)



ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright[©] by Chiang Mai University AII rights reserved