

Table of contents

	Page
ACKNOWLEDGEMENT	iii
ABSTRACT	iv
TABLE OF CONTENTS	viii
LIST OF FIGURES	x
LIST OF TABLES	xii
ABBREVIATIONS	xiv
CHAPTER I INTRODUCTION	1
1.1 Statement of problems	1
1.2 Ambient air pollution and their sources	3
1.3 Airborne particulate matter	4
1.4 The toxicity and genotoxicity of airborne particulate matter	6
1.5 The short-term test to detect environmental genotoxin	14
1.6 The alkaline Comet assay	16
1.7 Objective	19
CHAPTER II MATERIALS AND METHODS	20
2.1 Study sites	20
2.2 Sample collection and PM levels measurement	26
2.3 Sample extraction	28
2.4 Preparation for <i>Salmonella</i> mutation test	28
2.5 <i>Salmonella</i> mutation test	29
2.6 The Comet assay	30
2.6.1 Peripheral blood Mononuclear Cell (PBMC)	30
preparation from blood samples by Ficoll Hypaque	
gradient centrifugation technique	

2.6.2 Lymphocytes treatment	30
2.6.3 Cell embedding and electrophoresis	30
2.6.4 Image analysis	31
2.7 Data analysis	32
CHAPTER III RESULTS	33
3.1 Twenty four hour concentration ($\mu\text{g}/\text{m}^3$) of particulate matters, PM 2.5 and PM 10, in Chiang Mai city	33
3.2 Day-time and Night-time concentration ($\mu\text{g}/\text{m}^3$) of airborne particulate matters, PM 2.5 and PM 10, in Chiang Mai city	41
3.3 Mutagenicity of extractable organic matter from particulate matters, PM 2.5 and PM 10, collected in Chiang Mai city	48
3.4 <i>In vitro</i> genotoxic effect of the airborne particulate extract on Human peripheral blood leukocyte: DNA damage (COMET assay)	53
CHAPTER IV DISCUSSION AND CONCLUSION	58
4.1 Concentration of airborne particulate matters in Chiang Mai city	58
4.2 Mutagenicity and DNA damaging trends	60
4.3 Conclusion	63
REFERENCES	64
APPENDIX	73
VITA	78

LIST OF FIGURES

Figure	Page
1.1 Airmetrics Minivol portable sampler	8
1.2 Particulate matter size and its ability to penetrate into the respiratory	10
2.1 Sampling sites for particulate matters measurement in Chiang Mai city	21
2.2 Particulate matter measurement in the Bioassay laboratory in the Department of Biochemistry (site 1)	22
2.3 Particulate matter measurement in the secretary office of Biochemistry Department (site 2)	23
2.4 Particulate matter measurement at the terrace of the fifth floor of Multidisciplinary building, Faculty of medicine (site 3)	24
2.5 Particulate matter measurement at Puok Chang school	25
3.1 Daily 24-hour levels of airborne particulate matters, PM 10, from various sites in Chiang Mai city	36
3.2 Daily 24-hour levels of airborne particulate matters, PM 10, from indoor site (site 2), and from outdoor site (site 3)	37
3.3 Daily 24-hour levels of airborne particulate matters, PM 2.5, collected from one indoor site (site 1) and from One outdoor site (site 4) during June-October 1999	38
3.4 Daily 24-hour levels of airborne particulate matters, PM 2.5 and PM 10, collected during June-October 1999	39
3.5 Concentration of PM 2.5 subseted (%) to PM 10	40
3.6 Day-time and Night-time levels of airborne particulate matters, PM 2.5, collected at four sites during November 2000-March 2001	43

3.7 Day-time and Night-time levels of airborne particulate matters, PM 2.5, collected from outdoor site (site 3) and from indoor site (site 1) during November 2000-March 2001	44
3.8 Day-time and Night-time levels of airborne particulate matters, PM 2.5, collected from outdoor site (site 4) and from indoor site (site 1) during November 2000-March 2001	45
3.9 The visibility of Doi Suthep in the clear air day	47
3.10 The hardly visible Doi Suthep in the unclear air day	47
3.11 The Comet cell with short length of tail stained with ethidium bromide under fluorescent microscope (6250x)	57
3.12 The Comet cell with long length of tail stained with ethidium bromide under fluorescent microscope (6250x)	57

LIST OF TABLES

Table	Page
1.1 Ambient air standards of Thailand (1995) (Notification of National Environmental Board No. 10, 1992)	7
3.1 Monthly average 24 hour levels of airborne particulate matters, PM 2.5 and PM 10, concentration in ambient air of Chiang Mai city from four different stations during May-October 1999	35
3.2 Day-time and night-time average of airborne particulate matters, PM 2.5 and PM 10, concentration in ambient air of Chiang Mai city collected at various sites from November 2000-March 2001	42
3.3 Mutagenicity of particulate matters, PM 2.5 and PM 10, (revertant colonies/plate) to <i>S. typhimurium</i> TA100 with(+) and without (-) metabolic (S9mix) activation of sample extract at site 4	49
3.4 Mutagenicity of particulate matters, PM 2.5 and PM 10, (revertant colonies/m ³) to <i>S. typhimurium</i> TA100 with(+) and without (-) metabolic (S9mix) activation of sample extract at site 4	50
3.5 Day-time and night-time mutagenicity of particulate matter, PM 2.5 and PM 10, (revertant colonies/plate) to <i>S. typhimurium</i> TA100 with(+) and without (-)metabolic (S9mix) activation of sample extract	51
3.6 Day-time and night-time mutagenicity of particulate matter, PM 2.5 and PM 10, (revertant colonies/ m ³) to <i>S. typhimurium</i> TA100 with(+) and without (-)metabolic (S9mix) activation of sample extract	52
3.7 The Comet assay of 24-hour samples, PM 2.5 and PM 10, collected at site 3 and site 4 during June-October 1999	54
3.8 The head length of day-time and night-time sample, PM 2.5, collected at site 3 and site 4 during November 2000-March 2001	55

3.9 The tail length of day-time and night-time sample, PM 2.5,
collected at site 3 and site 4 during November 2000-March 2001

56

มหาวิทยาลัยเชียงใหม่
Chiang Mai University

ABBREVIATIONS AND SYMBOLS

BaP	Benzo(a)pyrene
°C	degree Celsius
DMSO	dimethylsulfoxide
DNA	deoxyribonucleic acid
EPA	Environment Protection Agency
g	gram
IARC	International Agency for Research on Cancer
l	liter
μl	microliter
μg	microgram
μg/m ³	microgram per cubic meter
μm	micrometer
mg	milligram
ml	milliliter
mM	millimole
NADP ⁺	nicotinamide adenine dinucleotide phosphate (oxidized form)
NADPH	nicotinamide adenine dinucleotide phosphate (reduced form)
PAHs	polycyclic aromatic hydrocarbons
S9 mix	S9 fraction + NADH + NADPH + G-6-P + cofactors
%	percent