

TABLE OF CONTENTS

	Page
ABSTRACT (IN THAI)	i
ABSTRACT (IN ENGLISH)	iv
DEDICATION	vii
ACKNOWLEDGEMENTS	viii
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF ABBREVIATION	xxiv
CHAPTER I INTRODUCTION	1
1.1 Rationale and Background	1
1.2 Experimental Aims and Objectives	2
1.3 Hypothesis	3
1.4 Scope and limitation of study	4
1.5 Anticipated Outcomes	5
CHAPTER II LITERATURE REVIEWS	7
2.1 Stress and Stress Responses	7
2.2 Memory	11
2.3 Memory Impairment Induced by Stress	16
2.4 Neuro-endocrine Control of Sexual Response	17
2.5 Stress and Sexual Dysfunction	26
2.6 Oxidative Stress and Stress	27
2.7 Selected Thai medicinal plants	32
CHAPTER III EVALUATION OF THE ANTI-STRESS POTENTIAL OF <i>MORINGA OLEIFERA</i> LEAVES, <i>ANACARDIUM</i> <i>OCCIDENTALE</i> LEAVES AND <i>NELUMBO NUCIFERA</i> FLOWERS	35
3.1 Introduction	35
3.2 Materials and methods	35
3.3 Results	40
3.4 Discussion	46
3.5 Conclusion	46

TABLE OF CONTENTS (Cont.)

	Page
CHAPTER IV EFFECT OF APHRODISIAC HERBS ON MALE SEXUAL DYSFUNCTION IN IMMOBILIZATION STRESS RATS	47
4.1 Introduction	47
4.2 Materials and Methods	49
4.3 Results	57
4.4 Discussion	95
4.5 Conclusion	105
CHAPTER V EVALUATION OF MEMEORY ENHANCING AND NEUROPROTECTIVE EFFECTS OF <i>MORINGA OLEIFERA</i> , <i>ANACARDIUM OCCIDENTALE</i> AND <i>NELUMBO NUCIFERA</i> IN STRESS-EXPOSED RATS	107
5.1 Introduction	107
5.2 Materials and Methods	109
5.3 Results	117
5.4 Discussion	155
5.5 Conclusion	162
REFERENCES	165
APPENDICES	185
APPENDIX A Determination of Total Phenolic Compounds	187
APPENDIX B Determination of Flavonoid Content	191
APPENDIX C Determination of Tannin	195
APPENDIX D Determination of FRAP Activity	199
APPENDIX E Determination of DPPH Radical Scavenging Activity	203
APPENDIX F Determination of in Vitro Acetyl Cholinesterase (AChE) Inhibition	207

TABLE OF CONTENTS (Cont.)

	Page
APPENDIX G Determination of in Vitro Monoamine Oxidase-B (MAO-B) Inhibition	211
APPENDIX H Determination of in Vitro Phosphodiesterase-5 (PDE-5) Inhibition	215
APPENDIX I Preparation of Phosphate Buffer Saline Solution	219
APPENDIX J Preparation of Tissue Sections	223
APPENDIX K Cresyl Violet Staining For Nissl Substance	227
APPENDIX L Hematoxylin and Eosin Staining for Testis	231
APPENDIX M Immunohistochemical Study of Tyrosine Hydroxylase (TH) Enzyme	235
APPENDIX N Preparation of Tissue Homogenates	239
APPENDIX O Determination of Protein	243
APPENDIX P Determination of Testosterone and Corticosterone	247
APPENDIX Q Determination of Lipid Peroxidation	251
APPENDIX R Determination of Catalase Activity	255
APPENDIX S Determination of Superoxide Dismutase Activity	259
APPENDIX T Determination of Glutathione Peroxidase Activity	263
APPENDIX U Determination of Acetylcholinesterase	269
APPENDIX V Determination of Monoamine Oxidase A and B activity	273
APPENDIX W Determination of Phosphodiesterase-5 (PDE-5) Activity	277
APPENDIX X Western Blotting Analysis of ki-67 and eNOS	281
RESEARCH PUBLICATIONS	287
VITAE	289

LIST OF TABLES

		Page
Table 2-1	Behavioral and physical adaptation during acute stress	7
Table 3-1	Gradient program of HPLC analysis	39
Table 3-2	Total phenolic contents, total flavonoid contents and tannin of <i>M.oleifera</i> leaves, <i>A.occidentale</i> leaves and <i>N.nucifera</i> flowers extract	41
Table 3-3	Antioxidant activity of <i>M.oleifera</i> leaves, <i>A.occidentale</i> leaves and <i>N.nucifera</i> flowers extract	41
Table 3-4	Acetylcholinesterase inhibition (IC50) of <i>M.oleifera</i> leaves, <i>A.occidentale</i> leaves and <i>N.nucifera</i> flowers extract	42
Table 3-5	Monoamine oxidase B suppression (IC50) of <i>M.oleifera</i> leaves, <i>A.occidentale</i> leaves and <i>N.nucifera</i> flowers extract	42
Table 3-6	Phosphodiesterase 5 inhibition (IC50) of <i>M.oleifera</i> leaves, <i>A.occidentale</i> leaves and <i>N.nucifera</i> flowers extract	43
Table 3-7	The contents of gallic acid, ferulic acid and quercetin of <i>M.oleifera</i> leaves, <i>A.occidentale</i> leaves and <i>N.nucifera</i> flowers extract by HPLC analysis	43
Table 5.1	Effect of <i>M.oleifera</i> leaves extract on oxidative stress markers (SOD,GSH-Px, CAT, MDA)	124
Table 5.2	Effect of <i>A.occidentale</i> leaves extract on oxidative stress markers (SOD, GSH-Px, CAT, MDA) in hippocampus of stress-exposed rats	137
Table 5.3	Effect of <i>N.nucifera</i> leaves extract on oxidative stress markers (SOD, GSH-Px, CAT, MDA)	150

LIST OF FIGURES

		Page
Figure 2-1	Homeostatic systems exert their effects in an inverted U-shaped dose-response curve	8
Figure 2-2	Brain circuits playing the role on the regulation of the neuroendocrine stress response	11
Figure 2-3	Schematic diagram illustrating syntactic plasticity or long term potentiation (LTP)	13
Figure 2-4	Various forms of learning and memory	16
Figure 2-5	Information process related to memory function and disruption by stress	17
Figure 2-6	The interactions between autonomic and somatic innervations in the control of male sexual cycle	19
Figure 2-7	Neural control of the corporeal smooth muscle	21
Figure 2-8	Nitric oxide–cyclic guanosine monophosphate (cGMP) signaling in cavernous smooth muscle	22
Figure 2-9	A schematic representation of the interactions between the stress system and the reproductive axis	27
Figure 2-10	Main reactive oxygen species; RH; organic molecule.	29
Figure 2-11	Antioxidant defenses, metabolism and biological effects. of reactive oxygen species (ROS)	31
Figure 2-12	Enzymatic elimination of ROS	32
Figure 2-13	<i>Moringa oleifera</i> Lam	33
Figure 2-14	<i>Anacardium occidentale</i> Linn	34
Figure 2.15	<i>Nelumbo nucifera</i> Gaertn	34
Figure 3-1	Finger print chromatogram of 50%hydro-alcoholic extract of <i>M.oleifera</i> leaves	39
Figure 3-2	Finger print chromatogram of 95% hydro-alcoholic extract of <i>A.occidentale</i> leaves	44

LIST OF FIGURES (Cont.)

		Page
Figure 3-3	Finger print chromatogram of 50% hydro-alcoholic extract of <i>N.nucifera</i> flowers	44
Figure 4-1	The fingerprint chromatogram of 50%hydroalcoholic extract of <i>Moringa oleifera</i> leaves used in this study	49
Figure 4-2	The fingerprint chromatogram of 50%hydroalcoholic extract of <i>Anacardium occidentale</i> leaves used in this study	50
Figure 4-3	The fingerprint chromatogram of 50%hydroalcoholic extract of <i>Nelumbo nucifera</i> flowers used in this study	51
Figure 4-4	The schematic diagram represents the experimental protocol	53
Figure 4-5	The effect of hydro-alcoholic extracts of <i>M. oleifera</i> leaves extract on mounting latency of stress-exposed rats	58
Figure 4-6	The effect of hydro-alcoholic extracts of <i>M. oleifera</i> leaves extract on mounting number of stress-exposed rats	59
Figure 4-7	The effect of hydro-alcoholic extracts of <i>M. oleifera</i> leaves extract on intromission latency of stress-exposed rats	59
Figure 4-8	The effect of hydro-alcoholic extracts of <i>M. oleifera</i> leaves extract on intromission number of stress-exposed rats	60
Figure 4-9	The effect of hydro-alcoholic extracts of <i>M. oleifera</i> leaves extract on ejaculation number of stress-exposed rats	60
Figure 4-10	The effect of hydro-alcoholic extracts of <i>M. oleifera</i> leaves extract on ejaculation frequency of stress-exposed rats	61
Figure 4-11	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on serum testosterone level of stress-exposed rats	62
Figure 4-12	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on serum corticosterone level of stress-exposed rats	63

LIST OF FIGURES (Cont.)

		Page
Figure 4-13	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on phosphodiesterase-5 activity in penis of stress-exposed rats	64
Figure 4-14	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on monoamine oxidase-B in medial preoptic area and nucleus accumbens of stress-exposed rats.	65
Figure 4-15	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on histomorphology of rat testis stained with Haematoxylin and eosin (H&E)	66
Figure 4-16	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on tyrosine hydroxylase immunoreactive neurons in core and shell of nucleus accumbens of stress-exposed rats	68
Figure 4-17	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on tyrosine hydroxylase immunoreactive neurons in ventral tegmental area of stress-exposed rats	69
Figure 4-18	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on endothelial nitric oxide synthase in penis of stress-exposed rats	70
Figure 4-19	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on mounting latency of stress-exposed rats	72
Figure 4-20	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on mounting number of stress-exposed rats	73
Figure 4-21	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on intromission latency of stress-exposed rats	73
Figure 4-22	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on intromission number of stress-exposed rats	74

LIST OF FIGURES (Cont.)

		Page
Figure 4-23	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on ejaculation latency of stress-exposed rats	74
Figure 4-24	The effect of hydro-alcoholic extract of <i>A.occidentale</i> leaves extract on ejaculation frequency of stress-exposed rats	75
Figure 4-25	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on serum testosterone level of stress-exposed rats	76
Figure 4-26	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on serum corticosterone level of stress-exposed rats	76
Figure 4-27	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on phosphodiesterase-5 activity in penis of stress-exposed rats	77
Figure 4-28	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on monoamine oxidase-B in medial preoptic area and nucleus accumbens of stress-exposed rats.	78
Figure 4-29	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on histomorphology of rat testis stained with Haematoxylin and eosin (H&E).	79
Figure 4-30	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on tyrosine hydroxylase immunoreactive neurons in core and shell of nucleus accumbens of stress-exposed rats.	81
Figure 4-31	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on tyrosine hydroxylase immunoreactive neurons in ventral tegmental area of stress-exposed rats	82
Figure 4-32	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on endothelial nitric oxide synthase in penis of stress-exposed rats	83

LIST OF FIGURES (Cont.)

		Page
Figure 4-33	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on mounting latency of stress-exposed rats	85
Figure 4-34	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on mounting number of stress-exposed rats	85
Figure 4-35	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on intromission latency of stress-exposed rats	86
Figure 4-36	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on intromission number of stress-exposed rats	86
Figure 4-37	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on ejaculation latency of stress-exposed rats	87
Figure 4-38	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on ejaculation frequency of stress-exposed rats	87
Figure 4-39	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flower extract on serum testosterone level of stress-exposed rats	89
Figure 4-40	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flower extract on serum testosterone level of stress-exposed rats	89
Figure 4-41	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on phosphodiesterase-5 activity in penis of stress-exposed rats	90
Figure 4-42	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on monoamine oxidase-B in medial preoptic area and nucleus accumbens of stress-exposed rats	91
Figure 4-43	The effect of hydro-alcoholic extracts of <i>N. nucifera</i> flowers extract on histomorphology of rat testis stained with Haematoxylin and eosin (H&E)	92
Figure 4-44	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on tyrosine hydroxylase immunoreactive neurons in core and shell of nucleus accumbens of stress-exposed rats	93

LIST OF FIGURES (Cont.)

		Page
Figure 4-45	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on tyrosine hydroxylase immunoreactive neurons in ventral tegmental area of stress-exposed rats	94
Figure 4-46	The effect of hydro-alcoholic extracts of <i>N. nucifera</i> flowers extract on endothelial nitric oxide synthase in penis of stress-exposed rats	95
Figure 4-47	Schematic diagram showed the possible underlying mechanism of <i>M.oleifera</i> on sexual performance in stressed rats	99
Figure 4-48	Schematic diagram showed the possible underlying mechanism of <i>A.occidentale</i> on sexual performance in stressed rats	102
Figure 4-49	Schematic diagram showed the possible underlying mechanism of <i>N.nucifera</i> on sexual performance in stressed rats	105
Figure 5-1	The fingerprint chromatogram of 50%hydroalcoholic extract of <i>Moringa oleifera</i> leaves used in this study	109
Figure 5-2	The fingerprint chromatogram of 50%hydroalcoholic extract of <i>Anacardium occidentale</i> leaves used in this study	110
Figure 5-3	The fingerprint chromatogram of 50%hydroalcoholic extract of <i>Nelumbo nucifera</i> flowers used in this study	111
Figure 5-4	The schematic diagram represents the experimental protocol of this study	112
Figure 5-5	The effect of hydro-alcoholic extracts of <i>M. oleifera</i> leaves extract on escape latency of stress-exposed rats	118
Figure 5-6	The effect of hydro-alcoholic extracts of <i>M. oleifera</i> leaves extract on retention time of stress-exposed rats	118
Figure 5-7	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on serum corticosterone level of stress-exposed rats	119
Figure 5-8	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on acetylcholine esterase of stress-exposed rats	120

LIST OF FIGURES (Cont.)

		Page
Figure 5-9	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on monoamine oxidase type A and B of stress-exposed rats	121
Figure 5-10	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on superoxide dismutase activity in hippocampus of stress-exposed rats	122
Figure 5-11	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on glutathione peroxidase activity in hippocampus of stress-exposed rats	123
Figure 5-12	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on catalase activity in hippocampus of stress-exposed rats	123
Figure 5-13	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on malondialdehyde level in hippocampus of stress-exposed rats	124
Figure 5-14	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on the density of survival neurons in CA1 of hippocampus of stress-exposed rats	125
Figure 5-15	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on the density of survival neurons in CA2 of hippocampus of stress-exposed rats	126
Figure 5-16	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on the density of survival neurons in CA3 of hippocampus of stress-exposed rats	127
Figure 5-17	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on the density of survival neurons in dentate gyrus of hippocampus of stress-exposed rats	128

LIST OF FIGURES (Cont.)

		Page
Figure 5-18	The effect of hydro-alcoholic extracts of <i>M.oleifera</i> leaves extract on Ki-67 proliferative marker in hippocampus of stress-exposed rats	129
Figure 5-19	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on escape latency of stress-exposed rats	130
Figure 5-20	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on retention time of stress-exposed rats	131
Figure 5-21	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on serum corticosterone level of stress-exposed rats	132
Figure 5-22	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on acetylcholineesterase activity in hippocampus of stress-exposed rats	133
Figure 5-23	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on monoamine oxidase type A and B of stress-exposed rats	134
Figure 5-24	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on superoxide dismutase activity in hippocampus of stress-exposed rats	135
Figure 5-25	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on glutathione peroxidase activity in hippocampus of stress-exposed rats	135
Figure 5-26	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on catalase activity in hippocampus of stress-exposed rats	136
Figure 5-27	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on malondialdehyde level in hippocampus of stress-exposed rats	136

LIST OF FIGURES (Cont.)

		Page
Figure 5-28	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on the density of survival neurons in CA1 of hippocampus of stress-exposed rats	138
Figure 5-29	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on the density of survival neurons in CA2 of hippocampus of stress-exposed rats.	139
Figure 5-30	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on the density of survival neurons in CA3 of hippocampus of stress-exposed rats	140
Figure 5-31	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on the density of survival neurons in dentate gyrus of hippocampus of stress-exposed rats	141
Figure 5-32	The effect of hydro-alcoholic extracts of <i>A.occidentale</i> leaves extract on Ki-67 proliferative marker of stress-exposed rats	142
Figure 5-33	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on escape latency of stress-exposed rats.	143
Figure 5-34	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on retention time of stress-exposed rats	144
Figure 5-35	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on serum corticosterone levels of stress-exposed rats	145
Figure 5-36	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on acetylcholineesterase activity in hippocampus of stress-exposed rats	146
Figure 5-37	The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on monoamine oxidase type A and B of stress-exposed rats	147

LIST OF FIGURES (Cont.)

	Page
Figure 5-38	148
The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on superoxide dismutase activity in hippocampus of stress-exposed rats	
Figure 5-39	148
The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on glutathione peroxidase activity in hippocampus of stress-exposed rats	
Figure 5-40	149
The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on catalase activity in hippocampus of stress-exposed rats	
Figure 5-41	149
The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on malondialdehyde level in hippocampus of stress-exposed rats	
Figure 5-42	151
The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on the density of survival neurons in CA1 of hippocampus of stress-exposed rats	
Figure 5-43	152
The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on the density of survival neurons in CA2 of hippocampus of stress-exposed rats	
Figure 5-44	153
The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on the density of survival neurons in CA3 of hippocampus of stress-exposed rats	
Figure 5-45	154
The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on the density of survival neurons in dentate gyrus of hippocampus of stress-exposed rats	
Figure 5-46	155
The effect of hydro-alcoholic extracts of <i>N.nucifera</i> flowers extract on Ki-67 proliferative marker of stress-exposed rats	

LIST OF FIGURES (Cont.)

	Page
Figure 5-47 Schematic diagram showed the possible underlying mechanism of <i>M.oleifera</i> on neuroprotective and memory enhancing effects in stressed rats	158
Figure 5-48 Schematic diagram showed the possible underlying mechanism of <i>A.occidentale</i> on neuroprotective and memory enhancing effects in stressed rats	160
Figure 5-49 Schematic diagram showed the possible underlying mechanism of <i>N.nucifera</i> on neuroprotective and memory enhancing effects in stressed rats	162

LIST OF ABBREVIATIONS

5-HT	5-hydroxytryptamine or serotonin
Ach	Acetylcholine
AChE	Acetylcholinesterase
ACTH	Adrenocorticoteophic hormone
ADP	Adenosine diphosphate
ATP	Adenosine triphosphate
AMPA	α -Amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid
ANOVA	Analysis of variance
AO	<i>Anacardium accidentale</i>
ATP	Adenosine triphosphate
AVP	Arginine vasopressin
BDNF	Brain derived growth Factor
BLA	Basolateral complex of amygdala
BW	Body weight
°C	Celsius degree
Ca ²⁺	Calcium ion
CA1	Cornu ammonis area 1
CA2	Cornu ammonis area 2
CA3	Cornu ammonis area 3
CaMKII	Ca ²⁺ /calmodulin-dependent protein kinase II
cGMP	Cyclic guanosine monophosphate
CGRP	Calcitonin gene-related peptide
Cl ⁻	Chloride ion
cm	Centimeter
CNS	Central nervous system
CO ₂	Carbon dioxide
COX-2	Cyclooxygenase 2
CREB	cAMP response element-binding
CRH	Corticotrophin Releasing Hormone

LIST OF ABBREVIATIONS (Cont.)

DA	Dopamine
DG	Dentate gyrus
DHT	Dihydrotestosterone
DNA	Deoxy ribonucleic acid
DPPH	2,2-diphenyl-1-picrylhydrazyl
DW	Distilled water
e.g.	For example
eNOS	Endothelial nitric oxide synthase
etc	Et cetera
FA	Ferulic acid
FADH ₂	Flavin adenine dinucleotide (reduced form)
GABA	Gamma-aminobutyric acid
g/kg BW	Gram per kilogram body weight
GLU	Glutamate
gm	Gram
GSH-Px	Glutathione peroxidase
GTP	Guanosine triphosphate
h	hour
H ⁺	Hydrogen ion
H ₂ O ₂	Hydrogen peroxide
HO [·]	Hydroxyl radical
HPA	Hypothalamic pituitary adrenal
HPG	Hypothalamus Pituitary Gonadal
i.c.v.	Intracerebroventricular
i.p.	Intraperitoneal
K ⁺	Potassium
kg	Kilogram
KPBS	Krebs phosphate buffer saline
LD50	Lethargy dose

LIST OF ABBREVIATIONS (Cont.)

LTP	Long Term Potentiation
M	Mole
ml	Milliliter
min.	Minutes
mg	Milligram
Mg ²⁺	Magnesium
mg/kg BW	Milligram per kilogram body weight
MAO	Monoamine oxidase enzyme
MAOA	Monoamine oxidase enzyme type A
MAOB	Monoamine oxidase enzyme type B
MDA	Malondialdehyde
MO	<i>Moringa oleifera</i>
MPOA	Medial preoptic area
MWMT	Morris water maze test
Na ⁺	Sodium
NAc	Nucleus accumbens
NAD	Nicotinamide adenine dinucleotide
NADH	Nicotinamide adenine dinucleotide (oxidized form)
NADP ⁺	Nicotinamide adenine dinucleotide phosphate (oxidized form)
NADPH	Nicotinamide adenine dinucleotide phosphate (reduced form)
NMDA	N-methyl-D-aspartate
nm	Nanometer
nmoles	Nanamoles
NANC	Nonadrenergic-noncholinergic
Na ⁺	Sodium ion
NE	Norepinephrine
NMDA	N-methyl-D-aspartate
NN	<i>Nelumbo nucifera</i>
NO	Nitric Oxide

LIST OF ABBREVIATIONS (Cont.)

NOS	Nitric Oxide synthase
NPY	Neuropeptide Y
NR2B	N-methyl D-aspartate receptor subtype 2B
Nss	Normal saline solution
NTS	Nucleus of the solitary tract
O ₂	Oxygen
O ₂ ⁻	Superoxide anion
OH ⁻	Hydroge
OH [·]	Hydroxy radical
PDE-5	Phosphodiesterase type 5
PFC	Prefrontal cortex
PKA	Protein kinase A
PKC	Protein kinase C
PKG	Protein kinase G
POMC	Pro-opiomelanocortin
PVN	Paraventricular Nucleus
QE	Quercetin equivalents
RNS	Reactive nitrogen species
ROS	Reactive oxygen species
SAM	Sympathetico adrenomedullary system
S.E.M.	Standard error of mean
SDS	Sodium dodecyl sulfate
SOD	Superoxide dismutase
TBA	Thiobarbituric acid
TH	Tyrosine hydroxylase
TPTZ	Tripyridyltriazine
Vit C	Vitamin C
VIP	Vasoactive intestinal polypeptide
VTA	Ventral tegmental area
μl	Microliter