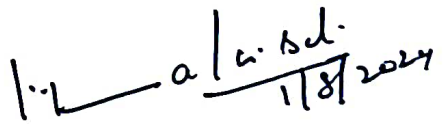


## DECLARATION

I declare that the thesis entitled "*In planta* assimilation and characterization of metal nanoparticles in *in vitro* shoots of *Withania somnifera* and its therapeutic evaluation using Rotenone induced SH-SY5Y cells" submitted by me for the award of Doctor of Philosophy (Ph.D) is the record of work carried out by me during the period from 2017 to 2024 under the guidance of **Dr. Kalaiselvi Senthil, Professor, Department of Biochemistry, Biotechnology and Bioinformatics, Avinashilingam Institute of Home Science and Higher Education For Women** and has not formed the basis for the award of any Degree, Diploma, Associateship, Fellowship, Titles in this Institute or any other University or other similar Institution of Higher Learning.

  
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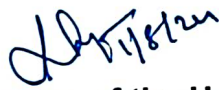
  
Signature of the Supervisor

Dr. KALAISELVI SENTHIL  
Professor

Dept. of Biochemistry, Biotechnology & Bioinformatics  
Avinashilingam Institute for Home Science  
and Higher Education for Women  
Coimbatore - 641043 Tamil Nadu, India.

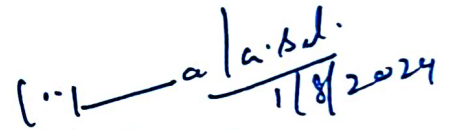
## CERTIFICATE

I certify that the thesis entitled "*In planta* assimilation and characterization of metal nanoparticles in *in vitro* shoots of *Withania somnifera* and its therapeutic evaluation using Rotenone induced SH-SY5Y cells" submitted for the award of Doctor of Philosophy (Ph.D) by KANIMOZHI N is the record of research work carried out by her during the period from July 2017 to August 2024 under my guidance and supervision, and that this work has not formed the basis for the award of any Degree, Diploma, Associate ship, Fellowship or other titles in this Institute or any other University or Institution of Higher Learning.



Signature of the HoD

**Dr.S.GAYATHRI DEVI, M.Sc., M.Phil., Ph.D.,**  
Professor and Head  
Dept. of Biochemistry, Biotechnology and Bioinformatics  
Avinashilingam Institute for Home Science  
and Higher Education for Women  
Coimbatore - 641 043



Signature of the Supervisor

with designation

**Dr. KALAISELVI SENTHIL**  
Professor  
Dept. of Biochemistry, Biotechnology & Bioinformatics  
Avinashilingam Institute for Home Science  
and Higher Education for Women  
Coimbatore - 641043 Tamil Nadu, India.

Signature of Dean of respective school

Dean, School of Biosciences  
Avinashilingam Institute For Home Science  
and Higher Education for Women  
Coimbatore - 641 043

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## LIST OF ABBREVIATIONS

AgNO <sub>3</sub>	Silver nitrate
Ag NPs	Silver nanoparticles
AgEIVS	Silver exposed <i>in vitro</i> shoots
AMPK	AMP-activated protein kinase
ATP	Adenosine triphosphate
BAP	6-Benzylaminopurine
cAMP	cyclic Adenosine MonoPhosphate
cDNA	Complementary DNA
CREB	CAMP response element-binding protein
Cyt c	Cytochrome c
DA	Dopamine
DJ-1	Protein deglycase/ Parkinson disease protein 7
DMEM	Dulbecco's Modified Eagle's Medium
DMRT	Duncan's multiple range test
DNA	Deoxy ribonucleic acid
Drp1	Dynamic related protein1
DW	Dry weight
EDX	Energy Dispersive X-ray Spectroscopy
Erk	Extracellular signal-regulated kinase
ETC	Electron Transport Chain
FACS	Florescence-activated cell sorting
FBS	Fetal Bovine Serum
FDA	Food and Dietristics Adminisstration
FE-SEM	Field Emission – Scanning Electron Microscopy
Fis1	Mitochondrial fission 1 protein
FITC	Fluorescein isothiocyanate
FR	Field root
FS	Field shoot
FTIR	Fourier-transform infrared spectroscopy
GC-MS	Gas Chromatography Mass Spectrometry
GI	Growth Index

GSK-3 $\beta$	Glycogen synthase kinase 3 beta
GST	Glutathione S-transferasee
GTPase	Guanosine triphosphatase
H2DCFDA	2',7'-dichlorofluorescein diacetate
HPTLC	High Performance Thin Layer Chromatography
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
IMM	Inner mitochondrial membrane
IVR	<i>In vitro</i> root
IVS	<i>In vitro</i> shoot
iNOS	Inducible nitric oxide synthase
LRRK2	Leucine-rich-repeat-kinase-2
LOQ	Limit of Quantification
Mfn1/2	Mitofusin1/2
Miro	Mitochondrial Rho
MMP	Mitochondrial Membrane Potential
MNPs	Metal Nanoparticles
MPTP	1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine
mRNA	Messenger Ribo nucleic acid
MS	Murashige and Skoog medium
MTT	3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide
mtTFA	mitochondrial transcription factor A
NADPH	Nicotinamide Adenine Dinucleotide Phosphate
NCCS	National Centre for Cell Science
NCLX	Na <sup>+</sup> /Ca <sup>2+</sup> /Li <sup>+</sup> exchanger
NF $\kappa$ B	Nuclear factor kappa-light-chain-enhancer
NPs	Nanoparticles
Nrf1, 2	Nuclear respiratory factor
Nurr1	Nuclear receptor-related factor 1
OMM	Outer mitochondrial membrane
P38	Mitogen-activated protein kinase
P53	Tumor protein P53
Parkin	E3 ubiquitin ligase
PbAc	Lead acetate

Pb NPs	Lead nanoparticles
PD	Parkinson's Disease
PGC1 $\alpha$	Peroxisome proliferator-activated receptor- gamma coactivator
PI3K/PKB/AKT	phosphatidylinositol 3-kinase/protein kinase B
PINK1	PTEN-induced kinase1
Rf	Resolution front
ROS	Reactive Oxygen Species
RNS	Reactive Nitrogen Species
RT-qPCR	Reverse Transcription – Polymerase Chain Reaction
SIRT	Sirutulin
SNpc	Substantia Nigra pars compacta
TEM	Transmission Electron Microscopy
TH	Tyrosine hydroxylase
TIM	Translocase of the inner mitochondria
TOM	Translocase of the outer mitochondria
TRAP1	Tumour necrosis factor 1 receptor associated protein
WFA	Withaferin A
WHO	World Health Organization
WN	Withanone
WTA	Withanolide A