

SPECIMEN FORMAT FOR THESES OF MONTH

Faculty : School of Physical and Computational Sciences

Department : Department of Biochemistry, Biotechnology and Bioinformatics

Branch/ Area: : Biotechnology

Sub Subject Heading: : Biotechnology

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Title of the thesis : A study on Neuroprotective potential of *in vitro* and field tissues of *Withania somnifera* using *Caenorhabditis elegans* model

(i) In Roman Script -

(ii) In roman Script -

Nomenclature of Degree: : Ph.D

Month & Year of Enrolment: : July 2017

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Month &Year of Award : 2025

Name of Supervisor : Dr.Kalaiselvi Sethil

Designation of Supervisor : Associate Professor,
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Centre/department/school in which research was conducted : Department of Biochemistry, Biotechnology and Bioinformatics
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Abstract within 300 words:

Withania somnifera is a prevalent medicinal herb used all over the world as a domestic remedy for addressing several age-related ailments. Ayurveda refers the field grown *W. somnifera* roots as a Rasayana medication. The quality and quantity of traditionally cultivated plants present a significant obstacle to their utilization in herbal formulations. This study aims to demonstrate that *in vitro* shoot tissues of *W. somnifera* could be used as an alternative and be as bioactive as roots grown in the field. The HPTLC quantification of major withanolides and GC-MS profiling of metabolites revealed that the pharmacological actives of IS showed the overall similar metabolite profile as in FR. As measured by DPPH radical scavenging activity, the antioxidant potential of *in vitro* shoots (IS) was also higher than that of field grown tissues (FR & FS) and *in vitro* roots (IR). The animal model study in *Caenorhabditis elegans* presented numerous lines of evidence regarding the effectiveness of the IS on the health and life expectancy over the FR, IR and FS. Along with this, the study compares the molecular level mechanisms underlying the beneficial effects of FR, IR, FS and IS supplementation by using gene-specific mutants. The efficacy of *W. somnifera* extracts to prevent α -synuclein aggregation, its associated pathologies, and its capability for neuroprotection were studied in Parkinson's disease-modeled worms. The finding of this study highlighted that IS is equally bioactive as traditionally used FR. Moreover, the IS extracts efficiently prolongs the lifespan, health span and stress resistance via insulin/insulinlike growth factor-1 signaling and mitochondrial electron transport chain complexes. The IS extract is more effectual for suppressing oxidative stress, a remarkable neuroprotectant in Parkinson's disease modeled worms. As the first study to investigate the bioactivity of *W. somnifera* shoots cultivated *in vitro*, these results could contribute to the scaling up of IS culture systems and *in vitro* shoot tissues for treating neurological and age-related ailments, extending patients' lives, and improving their quality of life.

i) Major objectives :

- Validation of the in vitro grown shoots & roots of *W. somnifera* powders as per API standards.
- Comparison of total metabolites of in vitro and field *W. somnifera*
- To demonstrate in vitro culture system as an efficient neuroprotectant using the *C.elegans* model

ii) Hypothesis:

- Null hypothesis (H0): The in vitro cultures of *W. somnifera* cannot be used as an alternative to field-grown material in order.
- Alternate hypothesis (HA): The *in vitro* cultures of *W. somnifera* can be used as an alternative to field-grown material in order.

iii) Methodology :

- Development of *in vitro* root and shoot culture of *W.somnifera*
- Pharmacogenetic, physicochemical validation of the *W. somnifera* powders developed using in vitro and field grown tissues.
- Compare the total metabolome profile of *W.somnifera* tissues
- To study toxicity and neuroprotective activity in *C.elegans* as a model organism.

iv) Findings:

- In vitro cultured shoot and root powders exhibit all pharmacogenetic, physicochemical characteristics within the standard limit as per API.
- In vitro shoot and root culture also exhibited strong antioxidant potential, Moreover, they are free from microbial as well as heavy metal contamination.
- In vitro developed *W. somnifera* tissues more efficiently increase lifespan and progeny production without any toxicity.
- IS extracts being more potent for the treatment of Parkinson's disease and neuroprotection in *C. elegans*.
- Hence, they can be used as an alternative to field-grown material in order to meet the global demand.

Examiners

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