CHRIST
(DEEMED TO BE UNIVERSITY)
BANGALORE · INDIA

Notice for the PhD Viva-Voce Examination

Ms Akshatha B (Registration Number: 1981601), PhD scholar at the School of Sciences, CHRIST (Deemed to be University), Bangalore will defend her PhD thesis at the public viva-voce examination on Thursday, 25 July 2024 at 11.00 am in Room No. 044, Ground Floor, R & D Block, CHRIST (Deemed to be University), Bengaluru - 560029.

Title of the Thesis	:	**Impact of Heavy Metals on Growth and Biosynthesis of Important Secondary Metabolites from *Mucuna pruriens* (L.) DC and *Withania somnifera* (L). Dunal**
Discipline	:	**Biotechnology**
External Examiner (Outside Karnataka)	:	**Dr Geetha N** Professor Department of Botany Bharathiar University Coimbatore - 641046 Tamil Nadu
External Examiner (Within Karnataka)	:	**Dr H G Ashok Kumar** Professor Department of Biotechnology R V College of Engineering Bengaluru Karnataka
Supervisor	:	**Dr Praveen N** Associate Professor Department of Life Sciences School of Sciences CHRIST (Deemed to be University) Bengaluru - 560029 Karnataka

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

Registrar

Place: Bengaluru
Date: 16 July 2024

ABSTRACT

Herbal medicine has a long history of utilizing medicinal plants to treat various ailments for a long time. However, heavy metal toxicity in herbal medicines has been documented. The occurrence of heavy metals in medicinal plants is a consequence of exposure to tainted agricultural sources. The consumption of medicinal plants contaminated with heavy metals has caused detrimental health implications. On the other hand, plants when subjected to heavy metal stress exhibit changes in secondary metabolite production. Thus, the assessment of heavy metal stress on plant growth, secondary metabolite production, and its bioaccumulation must be worked on. The present study investigates the effect of heavy metals such as lead, cadmium and mercury on germination, growth, biochemical variations, heavy metal accumulation, and biosynthesis of secondary metabolites in two of the most valuables ayurvedic medicinal plants *Mucuna pruriens* (L.) DC and *Withania somnifera* (L). Dunal. The *M. pruriens* seeds were exposed to 25 -250 ppm of Cd and Hg and 200-2000 ppm Pb and the seeds of *W. somnifera* were exposed to 20-200 ppm of Cd, 10-100 ppm Hg and 100-1000 ppm of Pb for 21 days to evaluate the LD50 value. *M. pruriens* showed 50% germination at 150 ppm of Cd, 175 ppm of Hg, and 1200 ppm of Pb. *W. somnifera* showed 50% germination at 70 ppm of Hg, 140 ppm Cd and 400 ppm Pb. The LD50 value obtained was used to select the appropriate Cd concentrations for further studies to be carried out in the polyhouse. The seeds of *M. pruriens* were sown in soil pretreated with metals ranging from 50-200 ppm Cd, 25-225 ppm Hg and 400- 1600 ppm Pb, whereas the two months old *W. somnifera* were exposed to 40-200 ppm Cd, 20-100 ppm Hg and 200-1000 ppm Pb. The heavy metals impacted the growth of plants and significantly varied biochemical parameters, such as carbohydrate, chlorophyll, flavonoid, protein, proline, phenol, MDA content, metabolite content, and antioxidant activity. The heavy metal accumulation in the plants increased in proportion to increasing doses, with the highest accumulation of Cd (120.97 mg/kg), Hg (183.82 mg/kg) and Pb (1253.02 mg/kg) in the roots of 90-day-old.

Mucuna plants and Cd (130.03 mg/kg), Hg (77.68 mg/kg) and Pb (544.93 mg/kg) in the roots of 120-day-old *W. somnifera.* L-DOPA content in *M. pruriens* and withanolide content in *W. somnifera* showed an increase as the Cd concentration increased and further decreased with further increase in Cd concentration. The highest L- DOPA content (22.69 mg/g DW) was obtained in the roots of 90 days old *M. pruriens* treated with 100 ppm of Cd. The highest withaferin A content (5.57 mg/g DW) and highest withanolide A content (5.31 mg/g DW) in leaf and root of 60 ppm Hg treated, 120-day old *W. somnifera* was observed. The heavy metal treated plants can tolerate stress up to a certain heavy metal concentration by enhancing proline content, secondary metabolites, and antioxidant activity. Although metal accumulation occurs in a dose-dependent manner, making the plant unsuitable for direct consumption, the increased L-DOPA content and withanolide content in the plant can be purified and commercially utilized.

Keywords: Mucuna pruriens, Withania somnifera, heavy metals, antioxidant activity, L-DOPA, withanolide

Publications:

1. **Banadka A**, Nagella P. (2022). Effect of heavy metals on germination, biochemical, and L-DOPA content in *Mucuna pruriens* (L.) DC. *J App Biol Biotech.*;10(6):117-126. DOI: 10.7324/JABB.2022.100613
2. **Banadka A**, Nagella P. (2023). Effect of heavy metals on germination, biochemical, antioxidant and withanolide content in *Withania somnifera* (L.) Dunal. Plant Science Today. https://doi.org/10.14719/pst.2366
3. Jameel, M.A., **Banadka, A.,** Rashmi, R., Nagella, P., Alessa, F. M., & Almaghasla, M. I. (2023). Cadmium toxicity in medicinal plants: An overview of the tolerance strategies, biotechnological and omics approaches to alleviate metal stress. *Front. Plant Sci., 13.* https://doi.org/10.3389/fpls.2022.1047410