Curriculum vitae

DIGAR SINGH, Ph.D.

Assistant Professor (Microbiology),
Department of Botany & Microbiology,
H.N.B. Garhwal University (A Central University)

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Work experience

University of North Texas, Denton, TX, The USA

Aug' 2022 – July' 2023

- ***Research Associate***
- Bio-Discovery Institute, Department of Biological Sciences

Advisor: Prof. Ana Paula Alonso

Research Project 1: Non-targeted metabolomic approaches for examining how the fungal endophytes uniquely bio-transforms chemical milieu of plant holobiont (Psychotria species).

Research Project 2: Probing the effects of fungal antibiotic expression (Penicillin and Mycophenolic acid) in host plant's (*Nicotiana bethamiana*) central metabolism.

Konkuk University, Seoul, South Korea

Mar' 2019 – June' 2022

- ***Research Professor***
- Department of Biosciences and Biotechnology

Advisor: Prof. Choong Hwan Lee

Research Project: Probing metabolite cross-feeding (MCF) between *Aspergillus* and *Bacillus* species. The project involved examining the effects of bi-direction MCF on growth, metabolism, and phenotypes (Fungi: conidiation, Bacteria: biofilm formation) of interacting species.

Konkuk University, Seoul, South Korea

Mar' 2016 – Feb' 2019

- ***Assistant Professor (KU-Brainpool)***
- Department of Biosciences and Biotechnology

Advisor: Prof. Choong Hwan Lee

Research Project 1: Probing headspace volatilome of *Aspergillus* species using SPME-GC-TOF-MS-based untargeted metabolomics.

Research Project 2: Volatile organic compounds (VOCs)-mediated interaction between Aspergillus species and its effects on growth, morphology, and mycotoxin production.

Major contributions to the field

- Using non-targeted metabolomic approaches, I established the role of '1-Octen-3-ol' in modulating *Aspergillus* metabolism, growth, morphogenesis, and mycotoxin production (Patent KIPO: 10-2236079).
- Determined how the metabolite cross-feeding (MCF) influence niche construction during 'Bacterial-Fungal' Interactions.
- Determined how the fungal leaf endophytes influence plant holobiont and chemical diversity.

Research interests & approaches

- Metabolomic approaches in holobiont and host-microbiome interactions.
- Simulating and testing 'Host-Microbiome' models.
- Computational Metabolomics & high throughput 'multi-omics' approaches.

Education

 # *Ph.D. in Biotechnology* ***July' 2009 – July' 2014***

- ***Indian Institute of Technology Guwahati***
- **Specialization:** Fungal entomotoxin alkaloids.
- **Thesis title:** Studies on production, analysis and cytotoxicity of indolizidine alkaloid, swainsonine, from an insect pathogenic fungus *Metarhizium anisopliae*.
- **Coursework CGPA:** 8.17/10 (36 credits)
- **Ph.D. advisor:** Prof. Gurvinder Kaur Saini.
- **Salient features of the Ph.D. thesis work:** We developed a work pipeline toward fermentative optimization, LC-MS/MS characterization, and unraveling entomotoxicity mechanisms of swainsonine on insect cell cultures.

 # *M.Sc. in Microbiology* ***Aug' 2007 – July' 2009***

- ***G. B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand, India***
- **Specialization:** Characterization of endophytic bacteria.
- **Dissertation:** Biochemical and molecular characterization of the bacterial endophytes from native sugarcane varieties of Himalayan region.
- **Coursework CGPA:** 8.17/10 (36 credits)

 # *B.Sc. (Chemistry, Botany, and Zoology)* ***June' 2003 – May' 2006***

- ***Kumaun University, Nainital, Uttarakhand, India***
- **Coursework (marks obtained): 70.51 %**

Research outputs

Patent(s):

- Lee CH, **Singh D**. A Method for Modulating Metabolism of *Aspergillus*. Konkuk University Industry-Academy Co-operation (**Date of application: 13.11.2019**). **Korean Intellectual Property Office (KIPO), Registration No. 10-2236079.**

Publications (selected):

1. SH Kim, **Singh D**, SA Kim, MJ Kwak, D Cho, et al. Strain-specific metabolomic diversity of *Lactiplantibacillus plantarum* under aerobic and anaerobic conditions. **Food Microbiology**, Elsevier, 116, 2023, 104364.
2. Choi SR, Lee H, **Singh D**, Cho D, Chung JO, et al. Bidirectional Interactions between Green Tea (GT) Polyphenols and Human Gut Bacteria. **Journal of Microbiology and Biotechnology,** 33, 10, 2023, 1-12.
3. **Singh D**, Lee SH, Lee CH. Non-obligate Pairwise Metabolite Cross Feeding Suggest Ammensalic Interactions Between *Bacillus* and *Aspergillus* species. **Communications Biology,** Nature Portfolio Group, 5, 1, 2022, 1-12.
4. Kim SH, **Singh D**, Son SY, Lee S, Suh DH, et al. Characterization and temporal dynamics of the intra- and extracellular environments of *Lactiplantibacillus plantarum* using multi-platform metabolomics. **LWT - Food Science and Technology**, Elsevier Science London, 175, 2022, 114376
5. **Singh D**, Son SY, Lee CH. Critical thresholds of 1-Octen-3-ol shape inter-species *Aspergillus* interactions modulating the growth and secondary metabolism. **Scientific Reports,** Nature Portfolio Group, 10, 1, 2020, 1-14.
6. **Singh D**, Lee S, Lee CH. Fathoming *Aspergillus oryzae* metabolomes in formulated growth matrices. **Critical Reviews in Biotechnology,** Taylor and Francis Group, 39, 1, 2019, 35-49.
7. **Singh D**, Lee CH. Volatiles Mediated Interactions between *Aspergillus oryzae* Strains Modulate Morphological Transition and Exometabolomes. **Frontiers in Microbiology,** Frontiers Media S.A. 9, 2018, 628.
8. **Singh D**, Lee CH**.** Intra-species Volatile Interactions Affects Growth Rates and Exometabolomes in *Aspergillus oryzae* KCCM 60345. **Journal of Microbiology and Biotechnology,** Korean Soc Microbiology & Biotechnology, 28, 2018, 2, 199-209.
9. **Singh D**, Lee S, Lee CH**.** Metabolomics for empirical delineation of the traditional Korean fermented foods and beverages. **Trends in Food Science and Technology,** Elsevier Science London, 61, 2017, 103-115.
10. **Singh D**, Son SY, Lee CH. Perplexing metabolomes in fungal-insect trophic interactions: A *terra incognita* of mycobiocontrol mechanisms. **Frontiers in Microbiology,** Frontiers Media S.A. 7, 2016.
11. **Singh D,** Kaur G. Production, HPLC analysis, and *in situ* apoptotic activities of swainsonine in lepidopteran, *Sf*-21 cell line. **Biotechnology Progress**, Wiley, 30, 2014, 1196-1205**.**
12. **Singh** D, Kaur G. The antileukemic cell cycle regulatory activities of swainsonine purified from *Metarhizium anisopliae* fermentation broth. **Natural Product Research,** Taylor & Francis Ltd., 28, 2014, 22, 2044-2047**.**
13. **Singh D,** Kaur G. Swainsonine, a novel fungal metabolite: optimization of fermentative production and bioreactor operations using evolutionary programming. ***Bioprocess and Biosystems Engineering,*** Springer, 37, 2014, 8, 1599-1607**.**
14. Lee S, Oh D, **Singh D**, Lee JS, Lee S, Lee CH. Exploring the metabolomic diversity of plant species across spatial (leaf and stem) components and phylogenic groups. **BMC Plant Biology,** BMC England, 20, 2020, 1, 1-10.
15. Mun HI, Kim YX, Suh DH, Lee S, **Singh D**, et al. Metabolomic response of Perilla frutescens leaves, an edible-medicinal herb, to acclimatize magnesium oversupply. **PLoS One,** Public Library Science, 15, 2020, 7, p.e0236813.

16. Son SY, Park YJ, Jung ES, **Singh D**, Lee YW, et al. Integrated Metabolomics and Transcriptomics Unravel the Metabolic Pathway Variations for Different Sized Beech Mushrooms. **International journal of molecular sciences**, MDPI, 20, 2019, 23:6007.
17. Seo HS, Lee S, **Singh D**, Shin HW, Cho SA, Lee CH. Untargeted metabolite profiling for koji-fermentative bioprocess unravels the effects of varying substrate types and microbial inocula. **Food Chemistry**, Elsevier Science Ltd., 266, 2018, 161-169.
18. Park J, Suh DH, **Singh D**, Lee S, Lee JS, Lee CH. Systematic metabolic profiling and bioactivity assays for bioconversion of Aceraceae family. **PLoS One.** Public Library Science, **13**, 2018, 6, 13:e0198739.
19. Son SY, Lee S, **Singh D**, Lee NR, Lee DY, Lee CH. Comprehensive secondary metabolite profiling toward delineating the solid and submerged-state fermentation of *Aspergillus oryzae* KCCM 12698. **Frontiers in Microbiology**, Frontiers Media S.A. 9, 2018, 1076.
20. Lee S, Lee DE, **Singh D**, Lee CH. Metabolomics Reveal Optimal Grain Preprocessing (Milling) toward Rice Koji Fermentation. **Journal of Agricultural and Food Chemistry,** ACS, 66, 2018, 11, 2694-2703.
21. Jung ES, Park HM, Hyun SM, Shon JC, **Singh D**, et al. The Green Tea Modulates Large Intestinal Microbiome and Exo/Endogenous Metabolome altered through Chronic UVB-exposure. **PLoS One**. Public Library Science, 12, 2017, 11:e0187154.
22. Sim I, Suh DH, **Singh D**, Do SG, Moon KH, et al. Unraveling Metabolic Variation for Blueberry and Chokeberry Cultivars Harvested from Different Geo-Climatic Regions in Korea. **Journal of Agricultural and Food Chemistry,** ACS, 65, 2017, 41, 9031-9040.
23. Park YJ, Jung ES, **Singh D**, Lee DE, Kim S, et al**.** Spatial (cap & stipe) metabolomic variations affect functional components between brown and white beech mushrooms. **Food Research International,** Elsevier Science Ltd., 102, 2017, 544-552.
24. Lee MY, Kim HY, Lee DE, **Singh D**, Yeo SH, et al. Construing temporal metabolomes for acetous fermentative production of *Rubus coreanus* vinegar and its in vivo nutraceutical effects. **Journal of Functional Foods**, Elsevier Science Ltd., 34, 2017, 311-318.
25. Suh DH, Lee HW, Jung ES, **Singh D**, Kim SH, Lee CH. *In vivo* metabolomic interpretation of the anti-obesity effects of hyacinth bean (*Dolichos lablab* L.) administration in high-fat diet mice. **Molecular Nutrition & Food Research**, Wiley, 61, 2017, 8, 1600895.
26. Jang YK, Shin GR, Jung ES, Lee S, Lee S, **Singh D**, et al. Process specific differential metabolomes for industrial gochujang types (pepper paste) manufactured using white rice, brown rice, and wheat. **Food Chemistry**, Elsevier Science Ltd., 234, 2017, 416-424.
27. Lee DE, Lee S, **Singh D**, Jang ES, Shin HW, et al. Time-resolved comparative metabolomes for Koji fermentation with brown-, white-, and giant embryo-rice. **Food Chemistry**, Elsevier Science Ltd., 23, 2017, 251-266.
28. Lee S, Lee S, **Singh D**, Oh JY, Jeon EJ, et al. Comparative evaluation of microbial diversity and metabolite profiles in *doenjang*, a fermented soybean paste, during the two different industrial manufacturing processes. **Food Chemistry**, Elsevier Science Ltd., 221, 2017, 1578-1586.
29. Son SY, Lee S, Kim NK, Lee S, **Singh D**, et al. Metabolite Fingerprinting, Pathway Analyses and Bioactivity Correlations for the Plant Species belonging to Cornaceae, Fabaceae, and Rosaceae Families. **Plant Cell Reports**, Springer, 35, 2016, 9, 1917-1931.
30. Kim HY, Heo DY, Park HM, **Singh D**, Lee CH. Metabolomic and Transcriptomic Comparison of Solid-State and Submerged Fermentation of *Penicillium expansum* KACC 40815. **PLoS One**, Public Library Science, 11, 2016, 2, e0149012.

Conference & Proceedings (selected)

- **Singh D**, Scott KL, Cocuron JC, Slot JC, Chaverri P, Alonso AP (2023). Poster Presentation: Fungal leaf endophytes enrich functional metabolomes in wild Rubiaceae. Metabolomics 2023, hosted by Metabolomics Society, Niagara Falls, Canada.
- **Singh D** (2017). Oral Presentation: Volatiles mediated intra-species interactions among *Aspergillus oryzae* strains effects morphological transitions and exometabolomes. Invited Lecture at XII International Fungal Biology Conference (IFBC), 2017, Seoul, Republic of Korea August 22-25, 2017.

- **Singh D**, Kaur G (2013). Poster Presentation: Mass directed purification, quantification, and *in vitro* cytotoxicity of an indolizidine alkaloid, Swainsonine from *Metarhizium anisopliae*. 5th congress of European Microbiologists (FEMS-2013), Leipzig, Germany, July 21-25, 2013.
- **Singh D**, Kaur G (2012). Poster Presentation: Swainsonine: production optimization and modeling, HPLC quantification and in vitro cell cycle regulatory activities in HL60 cell line. ICEHT-2012, 6th Annual convention of association of biotechnology and pharmacy (ABAP), SVU university, Tirupati, Andra-Pradesh, India. December 20-22, 2012.
- **Singh D**, Kaur G (2010). Poster Presentation: Media optimization and culture conditions for the enhanced production of Swainsonine from *Metarhizium anisopliae*. 51st Annual conference-(Association of Microbiologists of India) AMI, BIT Mesra, Ranchi, Jharkhand, India. December 14-17, 2010.

Journal affiliations

- Invited Reviewer (Nov 2022) – **Frontiers in Plant Science**; 1664462X (Online); Publisher: Frontiers communication.
- Invited Reviewer – **Natural Product Research**; ISSN: 6419 (Print) and 1478-6427 (Online); Publisher: Taylor & Francis online.
- Invited Reviewer (February 2015) – **Journal of Microbiology and Biotechnology**; ISSN: 1017-7825 (Print) and 1738-8872 (Online); Publisher: The Korean Society for Microbiology and Biotechnology (KMB).
- Invited Reviewer (December 2019) - **Food Chemistry**; ISSN: 0308-8146 (Print) and 1873-7072 (Online); Publisher: Elsevier Sci. Ltd. (England).
- Invited Reviewer (July 2020) – **Phytochemistry**; ISSN: 0031-9422; Publisher: Elsevier Sci. Ltd. (England).

Teaching experience (Post-Ph.D.) – 1.5 Years

Guest Faculty in the Department of Botany and Microbiology at **H.N.B Garhwal University (A Central University), Srinagar, Garhwal, Uttarakhand**, **09/2014 – 02/2016.**

- **Subjects:** General Microbiology, Immunology, Agriculture Microbiology, & Environmental Microbiology.

Awards & Honors

- Awarded **'Travel Fellowship by DBT-CTEP'** for attending 5th Congress of European Microbiologists (FEMS-2013), Leipzig, Germany, July 21-25, 2013 by the Department of Biotechnology, Govt. of India towards the **'Grant Proposal Code: DBT/CTEP/02/201300692'**.
- **Best Poster Award at ICEHT-2012**, 6th annual convention of Association of Biotechnology and Pharmacy. SVU university, Tirupati, Andhra Pradesh, India. December 20-22, 2012.
- Qualified **Graduate Aptitude Test Examination (GATE-2009)** in Life Sciences with 95.86 percentile conducted by Ministry of Human Resource and Development (MHRD), Govt. of India.

- Qualified **CSIR-NET-JRF (June 2009)**, a national level examination for the research fellowship and lectureship with all India rank (AIR-249) conducted by Council of Scientific & Industrial Research. Govt. of India.

Technical expertise

- Untargeted metabolomics (MS-DIAL platforms).
- MS raw data alignment (MetAlign) and analysis (MS-DIAL).
- Metabolite annotation (MZMine, MS-FINDER, and Compound Discoverer).
- Metabolite characterizations using online databases (Metlin, MoNA, HMDB, and GNPS).
- Multivariate analyses on SIMCA/ MS-DIAL (PCA, PLS-DA, and OPLS-DA).
- Correlation analyses (PASW statistics, Cytoscape, and MeV).
- Microbiology: All the basic techniques in microbiology including isolation, handling, growth dynamics, and maintenance of fungal and bacterial cultures. Microbial culture analyses based on staining & microscopic methods (light & electron microscopy, *i.e.,* FE-SEM). Isolation and biochemical & molecular characterization of N-fixing sugarcane endophytes.
- Metabolite biochemistry: metabolite extractions (liquid-liquid, SPE, & SPME), quantification (enzymatic and chromatographic), and bioactivity phenotypes.
- Molecular biology and proteomics: Genomic material isolation from Bacteria/Fungi (DNA, RNA or Plasmid). PCR (RT and Gradient), Restriction digestion/ligation, 16s rDNA restriction analysis, agarose gel electrophoresis, proteins estimation, & PAGE (Native & SDS) etc.
- Bioprocess optimization: Basic Knowledge of conventional and modern optimization tools (One factor at a time, PB & RSM, Artificial Neural Network & Genetic Algorithms).

References

Prof. Gurvinder Kaur Saini (Ph.D.)

(PhD Thesis supervisor)

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