Curriculum Vitae

MUKTI NATH MISHRA, *Ph.D.*
Scientist (Synthetic Biology)
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Education/ Career

Scientist (Synthetic Biology), CSIR-CIMAP, Lucknow, India.	Oct 2016 - Onward
DST-INSPIRE Faculty, Microbiology, IMS, BHU, Varanasi, India.	Apr 2014–Sep 2016
Post-Doctoral Research Fellow, NRC, OSU, Stillwater, Oklahoma, USA.	Jan 2013- Mar 2014
Post-Doctoral Research Fellow, TAMHSC, Texas, USA.	May2010-Dec 2012
Research training, Environmental Research Center, Leipzig, Germany.	Jul 2006 – Sep 2006
Ph. D. (Biotechnology), Banaras Hindu University, Varanasi, India.	Sep 2003-May 2009

Academic Merits/Fellowships

DST-INSPIRE Faculty Award (Institute Mode) in 2013.
CSIR-Nehru Post-Doctoral Research Fellowship in 2009.
BoerhingerIngelheimFonds (BIF), Germany, short term fellowship in 2006.
Qualified National Eligibility Test (NET)-CSIR-JRF in Life Sciences in 2003.
Qualified Graduate Aptitude Test in Engineering (GATE) in Life Sciences (Feb. 2003).

Memberships

American Society for Microbiology (ASM) (Membership No. 56827462)
The Biotech Research Society of India (BRSI) (Membership No. LM 489)

Current Research, (CSIR-CIMAP, Lucknow)

Emergence of drug resistant pathogens have complicated the therapeutic scenario, whichdictates an urgent need for novel, effective and affordable therapeutic agents. Limitations of chemical synthesis approaches have shifted the recent interest in mining the chemical diversity of natural products for their therapeutic potential which has provided several valuable therapeutic compounds. Since several terpene derivatives (such as Artemisinin) have been proved as valuable therapeutic agents and supply of these compounds are still in demand, I am using synthetic biology approach to engineer metabolic pathways of a non-photosynthetic carotenoid producing bacteriumto develop a system for biotechnological production of mono- sesqui-, diterpenoids.

Research Experience

DST-INSPIRE Faculty. Microbiology, Institute of Medical Sciences, BHU, Varanasi, India (Apr. 2014 to Sep 2016). As per the objectives of the DST-INSPIRE Faculty award, the role and regulation of the genes involved in efflux pump-mediated drug-resistance in *Mycobacterium*was explored. This grant was also utilized to understand the role and regulation of genes involved in stress-inducedstringent response-mediated drug resistance in a community-associated methicillin resistant *Staphylococcus aureus* (CA-MRSA).This work identified RelQ, a small alarmone synthase, as important factor mediating (p)ppGpp synthesis for expression of high level β-lactam resiatnace.

Post-Doctoral Research Associate, Noble Research Center, OSU, OK, USA (Jan. 2013 to Mar. 2014). Ethanol-induced stress response of methicillin-resistant *Staphylococcus aureus* was studied using transcriptomic approach. This study provided an insight in to ethanol stress response of MRSA by identifying differentially regulated genes.

Post-Doctoral Research Associate, Texas A&M Health Science Center, Texas (2010-2012). Mycobacterial drug efflux pumpswere characterized using Phenotypic MicroArray (Phenomics). This study established an appropriate protocol to use PhenotypeMicroArrays for *Mycobacterium* species, and revealed that*M. smegmatis* constitutively encodes a Na^+-dependent MATE multidrug efflux pump from *mmp* in an operon with four other putative genes encoding proteins for apparently unrelated functions.At the same time, I had the privilege ofworking on a project focused to enhance the specificity and effectiveness of cancer therapy by using combination of chemotherapy and gene therapy by activating prodrug and simultaneously suppressing the drug efflux in cancer cell-specific manner using

transcriptional targeting strategies. We observed that T-VISA regulated targeted expression of a mutant of human liver carboxylesterase (hCE1m6) to convert CPT-11 in to SN-38, and simultaneous expression of anti-ABCG2 shRNA to suppress efflux, enhances the specificity and effectiveness, respectively, of hCE1m6-mediated CPT-11 sensitivity of cancer cells.

Ph.D. (Biotechnology), School of Biotechnology, BHU, Varanasi, (2004-2009). (Topic: Molecular analysis of the role of Extra-Cytoplasmic Function (ECF) sigma factor in abiotic stress tolerance in *Azospirillumbrasilense*) Molecular and physiological analysis of the role of extra-cytoplasmic function sigma factor in abiotic stress tolerance was addressed in a plant growth promoting bacterium, *Azospirillumbrasilense*. This study revealed that *A. brasilense* possesses an elaborate system for sensing and responding to abiotic stresses with the help of several sigma factors. It has also elucidated the role of one of the 7 ECF sigma factors and its anti-sigma factor showing its involvement in regulation of carotenoid biosynthesis and tolerance to reactive oxygen species, salt, ethanol, temperature, desiccation and anti-bacterial peptides. The proteomic analysis has shown that this sigma factor may control several other functions directly or indirectly via other transcriptional regulators such as HxlR, IclR, TetR etc.

Research Publications

1. Sinha P, Srivastava GN, Tripathi R, **Mukti N. Mishra**, Anupurba S. 2020. Detection of mutations in the rpoB gene of rifampicin-resistant Mycobacterium tuberculosis strains inhibiting wild type probe hybridization in the MTBDR plus assay by DNA sequencing directly from clinical specimens. BMC Microbiol. 20:284. doi: 10.1186/s12866-020-01967-5.
2. Mishra S, Pandey P, Dubey AP, Zehra A, Chanotiya CS, Tripathi AK, **Mukti N. Mishra.** 2020. Engineering a carotenoid-overproducing strain of Azospirillum brasilense for heterologous production of geraniol and amorphadiene. App. Environ. Microbiol. DOI: 10.1128/AEM.00414-20.
3. Dubey AP, Pandey P, Singh VS, **Mukti N. Mishra**, Singh S, Mishra R, Tripath AK. 2020. An ECF41 family σ factor controls motility and biogenesis of lateral flagella in Azospirillum brasilense Sp245. J. Bacteriol. 202:e00231-20.
4. Pandey P, Dubey AP, Mishra S, **Mukti N. Mishra**, Singh VS, Tripathi AK. 2020. Regulation of Expression of β-lactamase (ampC) and Lytic Transglycosylase by a Cascade of RpoE7-> RpoH3 Sigma Factors Regulates Ampicillin Resistance in Azospirillum brasilense. The FASEB Journal 34:1-1.
5. Bhawini A, Pandey P, Dubey AP, Zehra A, Nath G and **Mukti N. Mishra**. 2019. RelQ Mediates the Expression of β-Lactam Resistance in Methicillin-Resistant Staphylococcus aureus. Front. Microbiol. 10:339. doi: 10.3389/fmicb.2019.00339
6. Singh SK, Kumar A, Nath G, Singh TB, **Mukti N. Mishra**. 2018. Resistance to anti leprosy drugs in multi-bacillary leprosy: A cross sectional study from a tertiary care centre in eastern Uttar Pradesh, India. Indian J Dermatol Venereol Leprol 84:275-279.
7. Pando JM, Pfeltz RF, Cuaron JA, Nagarajan V, **Mukti N. Mishra**, Torres NJ, Elasri MO, Wilkinson BJ, Gustafson JE. 2017. Ethanol-induced stress response of Staphylococcus aureus. Can J Microbiol 63:745-757.
8. Priyadarshini, Tiwari K, Das A, Kumar D, **Mukti N. Mishra**, Desikan P, Nath G. 2017. Evaluation of highly conserved hsp65-specific nested PCR primers for diagnosing Mycobacterium tuberculosis. Int J Tuberc Lung Dis 21:214-217.
9. AK Rai, AP Dubey, S Kumar, D Datta, **Mukti N. Mishra**, BN Singh, AK Tripathi. 2016. Carotenoid Biosynthetic Pathways Are Regulated by a Network of Multiple Cascades of Alternative Sigma Factors in Azospirillum brasilense Sp7. Journal of Bacteriology 198:2955-2964.
10. P. Prakash, S. C. U. Patne, A. K. Singh, M. Kumar, **Mukti N. Mishra**, Anil K. Gulati. 2016. PCR and Genotyping for HPV in Cervical Cancer Patients. Journal of Global Infectious Disease 8:100-107
11. **Mukti N. Mishra**, K. K. Vangara S. Palakurthi. 2014. Transcriptional Targeting of Human Liver Carboxylesterase (hCE1m6) and Simultaneous Expression of Anti-BCRP shRNA Enhances Sensitivity. Anti-Cancer Research 34:6345-6352.
12. **Mukti N Mishra** and Lacy Daniels. 2013. Characterization of MSMEG_2631 gene (mmp) encoding a Multidrug and Toxic Compound Extrusion (MATE) family protein in Mycobacterium smegmatis, and exploration of its polyspecific nature using Biolog Phenotype MicroArray. Journal of Bacteriology 195:1610-1621.

13. Gupta N., S. Kumar, **Mukti N. Mishra**, and A. K. Tripathi. 2013. The second pair of rpoE-chrR in Azospirillum brasilense Sp7 is constitutively expressed and required for survival under antibiotic and oxidative stress. Microbiology 159:206-218.
14. Kumar S., A. K. Rai, **Mukti N. Mishra**, M. Shukla, P. K. Singh, and A. K. Tripathi. 2012. RpoH2 sigma factor controls the photo-oxidative stress response in a non-photosynthetic rhizobacterium, Azospirillum brasilense Sp7. Microbiology 158:2891-2902.
15. **Mukti N. Mishra**, S. Kumar, N. Gupta, S. Kaur, A. Gupta, and A. K. Tripathi. 2011. The extra-cytoplasmic function sigma factor (RpoE) cotranscribed with its cognate anti-sigma factor confers tolerance to NaCl, ethanol and methylene blue in Azospirillum brasilense Sp7. Microbiology , 157:988–999.
16. Kaur S, **Mukti N. Mishra** and A. K. Tripathi. 2010. Gene encoding gamma-carbonic anhydrase is cotranscribed with argC and induced in response to stationary phase and high CO2 in Azospirillum brasilense Sp7. BMC Microbiology 4:10:184.
17. Kaur S, **Mukti N Mishra**, A. K. Tripathi. 2009. Regulation of expression and biochemical characterization of a β-class carbonic anhydrase from the plant growth promoting rhizobacterium, Azospirillum brasilense Sp7. FEMS Microbiol. Lett. 299:149-158.
18. **Mukti N Mishra**, Nagrajan T., I. M. Sharma and A. K. Tripathi. 2008. Mutation in a gene encoding anti-sigma factor in A. brasilense confers tolerance to elevated temperature, anti-bacterial peptide and PEG-200 via carotenoid synthesis. FEMS Microbiol. Lett. 287:221-229.
19. Nagarajan T, **Mukti N Mishra**, S. Spaepen, J. Vanderleyden, C. A. Gross, A. K. Tripathi. 2008. An extra-cytoplasmic function sigma factor and anti-sigma factor control carotenoid biosynthesis in Azospirillum brasilense. Microbiology. 154: 2096-2105.
20. Chowdhury. S. P., T. Nagarajan, R. Tripathi, **Mukti N Mishra**, D. Le Rudulier, and A. K. Tripathi. 2007. Strain-specific salt-tolerance and osmoregulatory mechanism in Azospirillum brasilense. FEMS Microbiol. Lett. 267:72-79.

Projects

- **As a principal investigator:** A three-year (14 Mar. 19 to 13 Mar. 22) DST-Core Research Grant titled "Metabolic engineering in a carotenoid over-producing bacterium for development of an efficient platform strain for zerumbone production" is going on. (Grant/File Number: CRG/2018/003748)
- **As a principal investigator:** A five-year (Apr. 14 to Mar. 19) DST funded project titled "Exploration of role and regulation of putative genes involved in multidrug efflux pump mediated intrinsic drug resistance in *Mycobacterium*".
- **As a co-principal investigator:** A three-year (May 19 to Apr. 22) DST-Core Research Grant titled "Computational design, synthesis and screening of non-hydroxamate lipophilic DXR inhibitors as potential antibacterial/antimalarial/anti-TB agents" is going on. (Grant/File Number: CRG/2018/001527)
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References:

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