

SANDEEP GOYAL, Ph.D.

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EDUCATION

- Ph.D. in Chemistry from Tata Institute of Fundamental Research, Mumbai, India. July, 2007 – June, 2013
- M.Sc. (H.S.) in Chemistry from Panjab University, Chandigarh, India. July, 2005 – June, 2007

TEACHING EXPERIENCE

EDUSQUARE, Ludhiana

Feb, 2020 – Current

- Chemistry Faculty

RESEARCH EXPERIENCE

Vanderbilt University, Nashville, TN

June, 2018 – June, 2019

Research Assistant Professor (with Prof. Renã A.S. Robinson)

- Development of robust and reproducible method for serum and plasma proteomics.

Rush University Medical Centre, Chicago, IL

October, 2016 – May, 2018

Postdoctoral Research Fellow (with Prof. D. L. Williams)

- Expression, purification, and metabolomics studies of P450 3050A1 from *Schistosoma mansoni*.

University of Arizona, Tucson, AZ

September, 2015 – October, 2016

Postdoctoral Research Associate I (with Prof. W. R. Montfort)

- Developed the protocol for liquid chromatography (LC)-mass spectrometry (LC-MS) on triple quadrupole instrument for the characterization and quantification of cGMP.
- Developed the *in-vitro* model for characterization of phospho peptide of soluble guanylyl cyclase (sGC) using Liquid chromatography (LC)-mass spectrometry (LC-MS).
- Purified the sGC protein from bovine lung.

Vanderbilt University, Nashville, TN

May, 2013 – August, 2015

Postdoctoral Research Fellow (with Prof. F. P. Guengerich)

- Demonstrated that post-lanosterol intermediates are metabolized by four human CYP P450s. The product separation, purification, identification, and quantification was done by LC-MS/MS, GCMS, and NMR.
- Showed that oxidation of 7-dehydrocholesterol and desmosterol is caused by CYP P450 46A1. Again the product separation, purification, identification, and quantification was done by LC-MS/MS, GCMS, and NMR.
- Characterized that 2-Oxo-*N*-Arachidonoylserotonin is the oxidative product of *N*-Arachidonoylserotonin (catalyzed by CYP P450 2U1) by LC-MS/MS, NMR and chemical synthesis.

Tata Institute of Fundamental Research, Mumbai

July, 2007 – June, 2013

Graduate student (with Prof. S. Mazumdar)

- Identified the oxidative product of monounsaturated fatty acids (metabolized by CYP P450 175A1) to be epoxy and hydroxyl product by mass spectrometry.
- Showed that P450 175A1 can form covalent linkage with heme by mass spectrometry.
- Modified heme active site in P450 175A1 to enhance its peroxidase activity.

TECHNICAL SKILLS

Mass Spectrometry	LC-MS, HRMS-Fusion Lumos (Orbitrap), LC-ESI/APCI-MS/MS (LCQ, LTQ, QQQ, QE-HF, QTRAP, and GCMS)
Proteomics	Serum/Plasma proteomics, immuno-depletion, protein digestion (in-solutions and in-gel digestion), C-18 clean-up, TiO ₂ enrichment, fractionation and TMT-tagging
Applications	Qual browser, Proteome Discoverer, Chem draw, Graph Pad prism, Origin, DS visualizer
Molecular Biology	PCR, site-directed mutagenesis, molecular cloning, plasmid preparation and isolation, SDS-PAGE electrophoresis, DNA gel electrophoresis, gel extraction, western blot

Protein expression	Recombinant protein expression of soluble and membrane proteins of mammalian and bacterial proteins, Characterization of protein using techniques such as UV-visible, Circular dichroism, resonance Raman spectroscopy
Chromatography	AKTA-FPLC, Bio-Rad, and Gradi-Frac systems, protein purifications using ion exchange, size-exclusion and affinity chromatography methods
Enzymology and Assay	In vitro metabolic assays by P450s, metabolites separation, purification and identification Kinetics assay, binding and inhibition studies using spectroscopy
Spectroscopy	UV-Visible, resonance Raman, circular dichroism, and stopped-flow

AWARDS AND SCHOLARSHIPS

1. International Travel Award/Grant by Society of Biological Inorganic Chemistry, MD, USA.
2. International Travel Award/Grant by Department of Science and Technology (DST), Govt. of India.
3. International Travel Award/Grant by Council of Scientific and Industrial Research (CSIR), India.
4. Student Travel Award by Taiwan Biological Inorganic Chemical Society, Taiwan.
5. Second Best Poster Award in School and Symposium on Advanced Biological Inorganic Chemistry.
6. Qualified Bhabha Atomic Research Center (BARC) exam for Ph.D. in 2008.
7. Qualified CSIR-UGC (CSIR) for Junior Research Fellowship and Lectureship in June 2007 and December 2007.
8. Qualified Graduate Aptitude Test in Engineering (GATE) exam for Ph.D. in 2007.
9. Qualified Tata Institute of Fundamental Research (TIFR) exams for Ph.D. in 2007.
10. Awarded Summer Research Fellowship by Indian Academy of Sciences, Bangalore.
11. Fifth rank holder in merit of national level OCET test of Panjab University, Chandigarh.
12. Awarded State Merit Scholarship for B.Sc.
13. First position in B.Sc. (Medical) in college.
14. Second position in intra college science quiz.
15. Awarded National Merit Scholarship for matriculation.

MENTORING EXPERIENCE

1. Project Student: Debashish Kundu (P450 expression, purification and enzymatic assays).
2. Project Student: Killi Valavan (P450 expression, purification and enzymatic assays).

PUBLICATIONS

1. Evaluating a targeted multiple reaction monitoring approach to global untargeted lipidomic analyses of human plasma.
Khan, M. J; Codreanu, S. G; **Goyal, S**; Wages, P. A; Gorti, S. K. K; Pearson, M. J; Uribe, I; Sherrod, S. D; McLean, J. A; Porter, N. A; Robinson, R. A. S. (2020) Rapid Communication in Mass Spectrometry 34, e8911
2. Brain expression of the vascular endothelial growth factor gene family in cognitive aging and alzheimer's disease.
Mahoney, E. R; Dumitrescu, L; Moore, A. M; Cambronero, F. E; Jager, P. L. D; Koran, M. E. I; Petyuk, V. A; Robinson, R. A. S; **Goyal, S**; Schneider, J. A; Bennett, D. A, Jefferson, A. L; and Hohman, T. J. (2019) Mol Psychiatry
3. Cytochrome P450 metabolism of the post-lanosterol intermediates explains enigmas of cholesterol synthesis.
Acimovic, J¹; **Goyal, S**¹; Kosir, R; Golicnik, M; Perse, M; Belic, A; Urlep, Z; Guengerich, F. P; and Rozman, D. (2016) Nature Scientific Reports 6, 28462 (¹First co-author)
4. Specificity of protein covalent modification by the electrophilic proteasome inhibitor carfilzomib in human cells.
Federspiel, J. D¹; Codreanu, S. G¹; **Goyal, S**; Albertolle, M. E; Lowe, E; Teague, J; Wong, H; Guengerich, F. P; and Liebler, D. C. (2016) Molecular and Cellular Proteomics 15, 3233-3242 (¹First co-author)
5. Isotope-Labeling studies support an electrophilic compound I iron active species (FeO³⁺) for the carbon-carbon bond cleavage reaction of the cholesterol side chain cleavage enzyme, cytochrome P450 11A1 (P450_{scc}).
Yoshimoto, F.K; Jung, I. J; **Goyal, S**; Gonzalez, E; and Guengerich, F. P. (2016) Journal of American Chemical Society 138 (37), 12124-12141

6. Role of substituents on the reactivity and product selectivity in reactions of naphthalene derivatives catalyzed by the orphan thermostable cytochrome P450, CYP175A1.
Banerjee, S; **Goyal, S**; and Mazumdar, S. (2015) *Bioorganic Chemistry* 62, 94-105
7. Oxidation of 7-dehydrocholesterol and desmosterol by human P450 46A1.
Goyal, S; Xiao, Y; Porter, N. D; Xu, L; and Guengerich, F. P. (2014) *J. Lipid Res.* 55 (9), 1933-1943
8. Oxidation of endogenous *N*-Arachidonoylserotonin by human cytochrome P450 2U1.
Siller, M¹; **Goyal, S**¹; Yoshimoto, F. K; Xiao, Y; Wei, S; and Guengerich, F. P. (2014) *J. Bio. Chem.* 289, 10476-10487 (¹First co-author)
9. Oxygenation of monoenoic fatty acids by CYP175A1, an orphan cytochrome P450 from *Thermus Thermophilus*.
Goyal, S¹; Banerjee, S¹; and Mazumdar, S. (2012) *Biochemistry* 51 (40), 7880-7890 (¹First co-author)
10. The structural design of the active site for covalent attachment of the heme to the protein matrix: studies on thermostable cytochrome P450.
Goyal, S; Deshpande, M. S; and Mazumdar, S. (2011) *Biochemistry* 50 (6), 1042–1052
11. Modification of the heme active site to increase the peroxidase activity of thermophilic cytochrome P450: A rational approach.
Behera, R. K¹; **Goyal, S**¹; and Mazumdar, S. (2010) *J. Inorg. Biochem.* 104 (11), 1185-1194 (¹First co-author)
12. Magnetic and Mössbauer spectral studies of nano crystalline cobalt substituted magnesium ferrites.
Chandra, K; Singhal, S; and **Goyal, S**. (2008) *Hyperfine Interactions* 183, 1-3, 75-80

WORKSHOP

Attended Metabolomics Workshop at Michigan Regional Comprehensive Metabolomics Resource Core (MRC2) at University of Michigan, Ann Arbor, Michigan.

ORAL PRESENTATIONS

1. The structural design of the active site for covalent attachment of the heme to the protein matrix: studies on thermostable cytochrome P450 at 5th Asian Bioinorganic Chemistry Conference at Kaohsiung, Taiwan.
2. Polymers in drug delivery systems at Summer School on Frontiers in Polymer Chemistry at IISc, Bangalore, India.

POSTER PRESENTATIONS (AS PRIMARY PRESENTER)

1. Poster presentation at National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE) at Orlando, Florida.
2. Poster presentation at Metabolomics Workshop at Michigan Regional Comprehensive Metabolomics Resource Core (MRC2) at University of Michigan, Ann Arbor, Michigan.
3. Poster presentation at Gordon Research Conference (GRC) on Drug Metabolism at Holderness School, NH.
4. Poster presentation at Drug Metabolism and Disposition Conference at Indianapolis, USA.
5. Poster presentation at International Conference on Cytochrome P450 at Seattle, WA, USA.
6. Poster presentation at 5th Asian Bioinorganic Chemistry Conference at Kaohsiung, Taiwan.
7. Poster presentation at Modern Trends in Inorganic Chemistry at IISc, Bangalore, India.
8. Poster Presentation at School and Symposium on Advanced Biological Inorganic Chemistry at TIFR, India.
9. Participated in Fluorescence in Biology: An International Conference at TIFR, Mumbai, India.
10. Poster presentation at the First Chandigarh Science Congress session at PU, Chandigarh, India.
11. Participated in IIIrd National Annual Symposium on Recent Trends in Chemistry at PU, Chandigarh, India.

REFERENCES

1. Prof. Renã A. S. Robinson, Department of Chemistry, Vanderbilt University, Nashville.
email: rena.as.robinson@vanderbilt.edu, Tel: 001-615-343-0129
2. Prof. D. L. Williams, Department of Immunology/Microbiology, Rush University Medical Centre, Chicago.
email: David_Williams@rush.edu, Tel: 001-312-942-1375
3. Prof. W. R. Montfort, Department of Chemistry and Biochemistry, University of Arizona, Tucson.
email: montfort@email.arizona.edu, Tel: 001-520-621-1884
4. Prof. F. P. Guengerich, Department of Biochemistry, Vanderbilt University, Nashville.
email: f.guengerich@vanderbilt.edu, Tel: 001-615-322-2261
5. Prof. S. Mazumdar, Department of Chemical Sciences, TIFR, Mumbai.
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