

A Brief Report on Invited Impact Pharmacy Lecture Series 2023 – Lecture 04

(New connections and New learning)

Date: 03.03.2023

Name of the presenter:

Dr Sunil Sharma
Professor
School of Chemistry
University of St Andrews
Scotland, United Kingdom



Title of the presentation:

Biocatalysis and genochemetic strategies for natural product modifications

Program Organized by:

Dept. of Pharmacy Practice & Pharmacy Education Unit
JSS College of Pharmacy, Ooty

New Connections and New Learning: Pharmacy Practice- "Learning in the flow of work"

Making learning a part of everyday work – and everyone's experience at work differs of course and it multiplies at different places. Internship training for Pharm D students is an opportunity to learn new and provide service to the needy patient population. To enhance their learning experience, the institute has created new connections and learning opportunity at various practice settings. Our students are very excited to be at new practice site(s) to learn and demonstrate/shape their competencies.

Dr Sunil Sharma is alumnus of JSS College of Pharmacy, Ooty and he completed his Master of Pharmacy (Pharmaceutical Chemistry) in the year 1994-96. He served as Lecturer at JSS College of Pharmacy, Ooty between 1999 – 2003. He completed his PhD (Synthetic organic chemistry) from University of East Anglia, Norwich between 2004 – 2008. He also worked as Post Doctoral Fellow & Senior Research Associate, School of Pharmacy, University of East Anglia (2008-2014) and as Senior Research Fellow, at School of Chemistry, University of St. Andrews. His research area of interest include synthesis of bioactive molecules and developing analytical tools for biochemical processes, total synthesis of natural products, multi-step synthesis and development of bio-analytical methods. His experience includes synthesis design and commercialization on multinational collaborative projects involving biologists and IP experts. He is also leading business proposition development for X-Genix Ltd, a pre spin-out company from UStaN. He has also published various research papers in international peer reviewed journals.

Dr Sharma started his presentation with a note that how interdisciplinary pharmacy learning in Indian pharmacy schools helped him to find out the importance of chemistry including synthesis, developing various schemes for chemical synthesis and analytical methods development.

He explained about the Green chemistry is the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances. Green chemistry applies across the life cycle of a chemical product, including its design, manufacture, use, and ultimate disposal. Green chemicals either degrade to innocuous products or are recovered for further use. Plants and animals suffer less harm from toxic chemicals in the environment. Lower potential for global warming, ozone depletion, and smog formation. Less chemical disruption of ecosystems.

Green chemistry, also called sustainable chemistry, is an approach to chemistry that attempts to prevent or reduce pollution. It also tries to improve the efficiency of chemical products by changing how chemicals are designed, manufactured, and used. Some further examples of applied green chemistry are supercritical water oxidation, on water reactions, and dry media reactions. Bioengineering is also seen as a promising technique for achieving green chemistry goals. Further, he also explained about the 12 principles of green chemistry.

GenoChemetics: a new paradigm in natural product analogue synthesis. Gene expression enables selective chemical functionalization with the potential to open a multitude of horizons in natural product research, medicinal chemistry, and chemical biology. Further, he added that Bacterial natural products represent an unparalleled starting point for drug discovery, and there is much interest in the generation of analogs of such compounds in order to explore modes of action, determine structure-activity-relationships and improve bioavailability and bioactivity.

Natural products and their analogs may of course be accessed through total synthesis; excellent recent examples include the total synthesis of the antibiotic Marinomycin and generation of Rifamycin and the structurally related metabolite Salinisporamycin. . Such studies are invaluable in developing methodology, revealing potential biogenic mechanisms and providing the only access to molecules generated by rare or hard to culture organisms. However, the approach of total synthesis can be challenging, time consuming and costly. Analog generation through semi-synthesis is also limiting; with the selective chemical modification of complex molecules remaining as a longstanding challenge within chemical synthesis, and usually demanding the presence of innate chemical orthogonality within the molecule.

He also added various examples of discovering the new generation antibiotics and establishing the mechanism of action of the discovered antibiotics.

The session was then concluded by Dr Sunil Sharma by taking questions from staff and students. More than 85 students and staff were fruitfully benefited with this invited virtual guest lecture.

Dr S Ponnusankar
Co-ordinator

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sunil sharma is presenting

Interdisciplinary Skills from JSS

Upper Rim Appended Hybrid Calixarenes via Click Chemistry
 Sean P. Box*, Rebecca A. Brinage, Nathalie L'Hermite, and Sunil V. Sharma

ORGANIC LETTERS
2007
Vol. 9, No. 19
3713–3716

Scheme 4. Chemo-enzymatic Synthesis of Hybrid Calixarenes

sunil sharma, Vishwas HN, Sriшти Rai, Rihana Bogum P (Rihana ...), Manojkumar Venkatesan, Mohsina Hyder, 38 others, You

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Interdisciplinary Skills from JSS

Angewandte Chemie
Communication | S. Faloutsos

Chemical and Chemoenzymatic Syntheses of Bacillithiol: A Unique Low-Molecular-Weight Thiol amongst Low G + C Gram-Positive Bacteria*

Dr. Sunil V. Sharma, Dr. Vishwas H. Nair, Dr. Johannes Sauer, Sushanta Kishore, Sreyas J. Kishore, Anand K. Reddy, Dr. Madhava S. Reddy, Dr. Venkatesh Ch. Janga, Dr. Gaurav Ch. Janga, Harish Ch. Janga
 Received January 17, 2023; revised March 15, 2023; accepted March 15, 2023

Colorimetric assay for thiols
Analytical chemistry training

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Progress in Organic Chemistry

The Emergence of Organic Synthesis and Its Impact on Science and Society

Krutheesh Shanmugam can now join this meeting

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What is green chemistry?

- Environmentally friendly processes
- Sustainability

Benign Disposal

Recycle/Re-use

Reduce - Chemical usage, Energy usage

Replace - Hazardous materials, processes; Inefficient processes; Non-sustainable components

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Green chemistry: 12 principles

1. Prevent waste
2. Atom Economy
3. Less Hazardous Synthesis
4. Design Benign Chemicals
5. Benign Solvents & Auxiliaries
6. Design for Energy Efficiency
7. Use of Renewable Feedstocks
8. Reduce Derivatives
9. Catalysis (vs. Stoichiometric)
10. Design for Degradation
11. Real-Time Analysis for Pollution Prevention
12. Inherently Benign Chemistry for Accident Prevention

www.acs.org/greenchemistry

ACS Chemistry for Life, ACS Green Chemistry Institute

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Genochemetics approach

Pioneered by Prof. Goss

'Gene expression enabling synthetic diversification'

Gene plasmid

Producing species

NP

Chemical diversification

NP

NP

Salman S can now join this meeting

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UPAs target MraY

UDP-MurNAc-pentapeptide

Peptidoglycan biosynthesis

UPAs

Cytoplasm

Periplasm

Cross-linked Peptidoglycan

Figure from: N. Auberger, R. Filan, B. Al-Dabbagh, A. Bouhss, M. Crovoisier, C. Gravier-Pelletier and Y. Le Merre; *Org. Biomol. Chem.*, 2011, 9, 8301-8312
S. Ishikawa, M. Yamaguchi, and A. Matsuda, *Current Medicinal Chemistry* 2015, 22(34), 3953
M. Winn, R.J. M. Goss, K. Kimura, T.D.H. Bugg, *Nat. Prod. Rep.*, 2010, 2, 279-304

sunil sharma, Vishwas HN, Sriшти Rai, Suguna K, Manojkumar Venkatesan, K Varsha, 41 others, You

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Total synthesis: Uridyl Peptide Antibiotics (UPAs)

Threonine

Urea formation

Final peptide assembly and Deprotections

Uridine

9 steps

2 steps

5-6 steps

7 steps

Boojamra et al., *J. Am. Chem. Soc.* 2001, 123, 870-874

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Applications of Cross-Coupling Reactions in Pharma

Imatinib (leukemia)

Valsartan (high blood pressure, heart disease)

Eletriptan (migraine)

Canagliflozin (type-2 diabetes)

Dolutegravir (anti-HIV)

Boscalid (crop protection)

Sotidagb (anticancer)

Ledipasvir (hepatitis C)

Gidner, P.G & Colecot, T.J., *Organometallics* 2015, 34, 5497-5508
Lipshutz, B. H. et al., *Green Chem.* 2016, 21, 6258 - 6262

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