



Volume - 8  
Issue - 2  
April - June 2017

*Editor-in-Chief*

Dr. C.S. Shastry  
Principal

*Executive Editor*

Dr. Akhilesh Dubey

*Staff Editors*

Mr. Prashant Nayak  
Mr. Srinivas Hebbar  
Dr. Rajesh K.S.  
Mrs. Zeena Fernandes

*Student Editors*

Ms. Limra B.H  
Ms. Deeksha S

### Contents

Editorial	2
Glimpses of the Conferences Attended by the Staffs and Research Scholars of NGSMIPS	2
Campus Buzz	3-4
Department Activities	5
Emergence of Online Pharmacies in India	5-6
Green Nanotechnology	7
Successfully Completed Training Course in the USA	8
Annual Day Celebrations	8

### VISION

To build a humane society through excellence in education and health care.

### MISSION

To develop Nitte University as a centre of excellence, imparting quality education, generating competent, skilled manpower to face the scientific and social challenges with a high degree of credibility, integrity, ethical standards and social concern.

*'For Private Circulation Only'*



# The NGSMIPS Herald

The Official news letter of the Nitte Gulabi Shetty Memorial Institute of Pharmaceutical Sciences, Mangalore



Ranked #27  
by NIRF



UG course  
accredited by NBA



## NGSM Institute of Pharmaceutical Sciences

(A constituent Institution of Nitte University)

Placed under Category "A" by MHRD, Govt. of India  
Accredited with Grade "A" by NAAC  
UG program accredited by NBA



## From the Editor's desk

Dear Friends and Colleagues,

Translational research is the need of an hour. Firstly, we need to understand what is translational research?

It is the application of knowledge and techniques from basic science to enhance human health and well-being. According to me, "It is the translation of findings from fundamental research into medical practices and of course into meaningful research.

Now, the question arises here, are we doing translation research? Are we doing productive research? Which type of research are we doing? Still a matter of debate.

Again, the question arises here, how to fulfil this elusive dream of executing translational research?

According to me, through the collaboration, elusive dream of executing translation research can be achieved. But let me remind you collaboration should happen on the floors but not merely on papers, because in most of the cases, we see collaboration takes place on papers which do not reach into floors.

Often we talk about academia-industry collaboration, is it really happening? or just a paper theory.

In the perspective of collaboration, we need to understand the real need and desire of academia and industry.

For the pharmaceutical industry, academia should be the combination of medical and pharmaceutical sciences, however, unfortunately in this combination medical science is missing immensely and therefore pharmaceutical industries are less interested in doing collaborative research with academia. Pharmaceutical industry relies on two important thoughts, first is in the basic research that identifies novel molecular targets and secondly is in the clinical trials. By and large latter one is poorly contributing which is, of course, the part of the medical sciences.

In order to execute and achieve translational research, real collaboration would be required. Real collaboration takes place when pharmaceutical sciences, medical sciences and pharmaceutical industry functions together for the same cause on the floor. The ultimate goal of translational research is to improve human health-an outcome that benefits all of the society. Participating in translational research also has more direct and immediate rewards for individual investigators and the institutions that support their work.

I hope that this editorial will serve as a beginning point for looking forward on this important issue.

**Dr. Akhilesh Dubey**  
Executive Editor

## Glimpses of the conferences attended by the staffs and research scholars of NGSMIPS



## CAMPUS BUZZ

### Annual Day Celebrations 2017

The College day a celebration of Nitte Gulabi Shetty Memorial Institute of Pharmaceutical Sciences was held on 3rd April 2017 at the KSHEMA auditorium amidst a lot of fanfare and excitement. The day began with a prayer invoking blessings from the Almighty. Dr. Narayana Charyulu-Vice Principal delivered the welcome address and introduced the Chief Guest Capt. Ganesh Karnik, MLC, Karnataka and Opposition Party Chief Whip.

Dr. Satish Bhandary the Dean of K.S. Hegde Medical Academy, Dr. Rajshekar, Director curriculum development, Nitte University, were among the other prominent dignitaries invited. Presenting the College Annual Report, the Principal Dr. C.S. Shastry gave a comprehensive picture of the academic achievements, ongoing funded projects, research impetus and the concerted effort of the college towards institute-industry collaboration for placement and internship of students with pharmaceutical companies.

Addressing the students, the chief guest Capt. Karnik complimented the students for their academic achievements. He also said that besides technical expertise, the most important quality to be acquired is discipline. Dr. Satish Bhandary, Dean KSHEMA congratulated the students for their splendid performance both in curricular and extracurricular.

Prizes were distributed to students recognizing their achievements in academic, sports and cultural and artistic fields. This was followed by a refreshments break and a spectacular entertainment program thereafter. Mr. Bharath Raj, Assistant Professor, Department of Pharmacy Practice and Coordinator Cultural Activities Committee managed the proceedings. Mr. Marlon Miranda, president of the student's council shared his experience and the Ms. Nihla delivered the vote of thanks.

### KDPMA Pharma veterans engage students in an open house and Q&A session.

The Institute Industry collaboration and placement cell of NGSM Institute of Pharmaceutical Sciences organised an open house interaction and a Q&A session for the graduating batches of 2017 with the President, Secretary and Past President of the Karnataka Drugs and Pharmaceuticals Manufacturers' Association on 2nd May 2017. The event started with the playing of 'universal Shanthi Mantra'. Principal Dr. C.S. Shastry welcomed and introduced the guests.

Mr. Biligiri, Director-Technical, Jagdale Industries and the past president of KDPMA delivered a presentation on "Environment in Pharma Manufactory." He stressed upon the critical need for students to develop a strong positive attitude and impeccable discipline and said that these were the top two traits besides the technical skills the employers were looking for most crucial employable parameters while hiring or selecting candidates for their companies.

Mr. Sunil Attavar, Chairman and Managing Director of Group Pharmaceuticals Limited and President, KDPMA and Mr. Harish K. Jain, Director, Embiotic Laboratories Pvt. Ltd. and Secretary, KDPMA jointly delivered a presentation on "Pharmacy-A Spectrum of Opportunities." The presentation elaborated on the multiple avenues in Plant Operations/Quality Management, Marketing, Regulatory and Government, Research, etc. that the students can look forward to after graduation. The pharma veterans also motivated students to think of being entrepreneurs or job creators than being job seekers. They said that there were a lot and growing scope in the distribution, retail, marketing, research, consultancy fields. They also called upon the faculty to involve self and students in creating value addition to the college and community by engaging in research, building innovation clubs, present innovative ideas and attract venture capital from angel investors.

Post the presentation, the students had an engrossing questions and answer session with the experts from the industry and got satisfying answers for their concerns and apprehensions concerning their career in the pharmaceutical field.



### Pooled Campus Interview by LOTUS TEVA

The Institute Industry Collaboration and Placement (IICP) cell of NGSM Institute of Pharmaceutical Sciences, Paneer Campus, Deralakatte hosted a pooled campus interview for LOTUS-TEVA, a Bengaluru-based clinical research organisation on 30th June 2017 for positions in Bioanalytical, Clinical and QA departments. The Vice Principal Dr. R. Narayana Charyulu welcomed candidates and the HR team of Lotus-Teva led by the HR manager Ms. Suman Raveesh. The proceedings started with company presentation which was followed by written test, group discussion and technical interview. M. Pharm students from pharmacy colleges of Mangaluru and nearby colleges of Kasargod, Kannur also attended the interview. 4 students were shortlisted and the official announcement of the result of the interview would be received from the company shortly. Mr. Vivek Pai K, Placement officer managed the proceedings.



### Talk about philosophy of Dr. B. R. Ambedkar

NSS unit of NGSMIPS participated in a lecture organised by NSS unit of Nitte University on the topic of philosophy of Dr. B. R. Ambedkar by Prof. Dr. Rajaram Tolpady, Mangaluru University, at Lecture Hall 5, K.S. Hegde Medical Academy, Deralakatte, Mangaluru on 28th April 2017 at 3.00 pm. All the NSS volunteers, NSS programme officers and Staff members of all the constituent colleges of the Nitte University were present in the programme. Prof. Dr. Rajaram Tolpady then enlighten the gathering with the philosophy of Dr. B. R. Ambedkar

### Swacch Bharath Abhiyan

NSS unit of NGSMIPS participated in Swacch Bharat Abhiyaan organised by NSS unit of Nitte University in association with Ramakrishna Mission Math, Mangaluru, on 4th June 2017 at Nitte University Campus, Deralakatte, Mangaluru at 7 am. Sri Ganesh Karnik, MLC, Karnataka, Chief-guest of the programme spoke about the importance of Swacch Bharat Abhiyaan in India at today's date and also explained the role of Ramakrishna Mission Math who actively taking initiative for conducting the programme in Mangaluru and in villages. Dr. S. Ramananda Shetty, Vice-Chancellor, Dr. Indrani Karunasagar, Director of Research and Development, Nitte University, were present in the programme. Prof. Dr. R. Narayana Charyulu, Vice Principal, NGSMIPS, Dr. Santanu Saha, NSS Programme officer, NGSMIPS, Dr. Gururaj M.P, Mr. Vijay Kumar staff members of NGSMIPS had participated in the programme.

### Preparation of Seed Ball

NSS unit of NGSMIPS participated in a "Seed ball preparation" held on 7th May 2017 at Canara Girl's High School, Mangaluru. The programme was organised by Uttishta Bharata-Mangaluru in association with Nitte University, Savayava Balaga Ayudh Mangaluru, Mangaluru Tamil Welfare Association, NSS wing of Sahyadri Sanchaya and Canara College NSS Alumni. NSS volunteers, NSS Programme officers, of all the constituent colleges of Nitte University and NSS coordinator of Nitte University were present in the programme. During the programme, all the participants prepared thousands of seed balls with help of soil, cow-dung and cow-urine.

### Guest lectures conducted/ Invited Talks/Seminars/ Conference attended/Staff training

- **Dr. Prerana Shetty**, Associate Professor, Department of Pharmaceutical Chemistry and **Dr. Nimmy Chacko**, Assistant Professor, Department of Pharmacology, attended a workshop on Biodosimetry organised by Department of Radiation Oncology & Central Research Laboratory, K. S Hegde Medical Academy, Mangaluru, held on 4th-6th May, 2017.
- **Dr. R. Narayana Charyulu**, Vice Principal and Head, Department of Pharmaceutics, had chaired a scientific session entitled, " Research: Getting started, Published and getting funded" during the International Seminar

on Advanced Concepts of Pain, Cancer and Research organised by Malik Deenar College of Pharmacy, Kasargod, Kerala, held on 23rd May 2017.

- **Dr. Sneh Priya, Dr. Jobin Jose, Dr. Anup Narayanan V, Mr. Srinivas Hebbar, Mrs Zeena Fernandes, Mr. Ravi G.S, Mr. Shanon Ben Mascarenhas and Ms. Avril Candida Mathias** had attended an International Seminar on Advanced Concepts of Pain, Cancer and Research organised by Malik Deenar College of Pharmacy, Kasargod, Kerala, held on 23rd May 2017.
- **Dr. B.C Revanasiddappa**, Associate Professor, Department of Pharmaceutical Chemistry, delivered a guest lecture on "Inorganic Pharmaceuticals" organised by Deen Dhayal Upadhya Kaushal Kendra at St. Aloysious College, Mangaluru, held on 16th June 2017.
- **Dr. Murali Badhanthadka**, Professor, Department of Pharmacology, invited as a resource person in one day seminar and delivered a talk on the topic entitled, "Challenges and opportunities in anti-diabetic drug discovery" organised by department of industrial chemistry, Mangalore University, Mangalagangothri, held on 25th April 2017.
- **Mr. Chandrashekar D**, Chief Librarian delivered an oral presentation on the topic entitled, "Best practices in NGSM Institute of Pharmaceutical Sciences Library" at Two-day National Level Conference on Professionalism in Library and Information Services for User Empowerment: Opportunities and Challenges (PROFUSE 2017) organised by Department of Library and Information Science, Mangalore University, Mangalagangothri held during 27-28th April 2017.
- **Mr. Ravi G.S**, Research Scholar, Department of Pharmaceutics, has completed distance learning general course on intellectual property right by world intellectual property organisation during 18th April - 1st June 2017 at NGSMIPS, Mangaluru.
- **Dr. Prasanna Shama Khandige**, Head, Department of Pharmacology, undergone a faculty training programme conducted by, St. John Fisher College, Wegmans School of Pharmacy Rochester, New York USA. The training was held from 17th April 2017 to 13th May 2017, organised by pharma bridge program at the International Federation of Pharmacy (FIP) with partial grant. The programme was hosted by Dr Christine R. Birnie, RPh, Ph.D, Dean and Professor, Dr. Kobi T. Nathan Assistant Professor, Pharmacy Practice department of St. John Fisher College Wegmans School of Pharmacy. This training has covered a practical site exposure at pharmacy school, hospital, community pharmacies according to regulations of United State of America. The out come from this training will be useful for the improvement of pharmacy practice training for our pharmacists at our institution and country.

## DEPARTMENT ACTIVITIES

## RESEARCH/REVIEW PUBLICATIONS/PRESENTATIONS/PAPER REVIEWED

## DEPARTMENT OF PHARMACEUTICAL CHEMISTRY

**Paper Presented:** Dr. Prerana Shetty Associate Professor, presented a poster on the paper entitled, "Antidepressant activity of anisomelesmalabrica" at 10th annual international conference on clinical pharmacology for healthy ageing held on 30th April - 1st May 2017 at Nehru Center, Mumbai.

## DEPARTMENT OF PHARMACEUTICS

## Paper Presented

1. **Mr. Ravi G.S.**, Research Scholar, delivered an oral presentation on the research paper entitled, "Lyophilized Phytosomal Nano Carriers of Rutin for Hepatoprotective Activity" at International conference on novel formulation strategies held in Hotel Radisson, Hitech City, Hyderabad held during 20th - 21th April, 2017.
2. **Ms. Avril Candida Mathias**, Research Scholar, delivered an oral presentation on the research paper entitled, "Formulation of Nano Lipid Vesicles for the treatment of Rheumatoid Arthritis" at International conference on novel formulation strategies held in Hotel Radisson, Hitech City, Hyderabad held during 20th - 21th April, 2017.
3. **Dr. Anoop Narayanan V**, Assistant Professor, presented a poster on the paper entitled, "Nano Curcumin Films: Development and Evaluation of an Intra Oral Drug Release System for Treatment of Oral Thrush" at National conference on current perspectives in novel drug delivery systems organised by department of pharmaceuticals, PSG college of Pharmacy, Coimbatore held during 16th - 17th June, 2017.
4. **Dr. Sneha Priya**, Assistant Professor, presented a poster on the paper entitled, "Formulation and evaluation of Nanoemulsion of Quetiapine Fumarate for the treatment of Psychotic Disorders" at National conference on current perspectives in novel drug delivery systems organised by department of pharmaceuticals, PSG College of Pharmacy, Coimbatore held during 16th - 17th June 2017.

**Research Publication:** Nirmala P, Marina Koland, Narendra C. Optimization of formulation of multiparticles containing calcium ion influx inhibitor. CIBTech J Pharm. Sci, 2017; 6(1): 1-18.

**International Examiner:** Dr. Akhilesh Dubey, Assistant Professor, Department of Pharmaceutics, served as External International Examiner for Rhodes University, Port Elizabeth, South Africa in April 2017. He examined a Master of Science (Pharmacy) thesis by Mr. BA Witika, entitled: "The Development, Manufacture and Characterisation of Niosomes intended to deliver Nevirapine to the Brain."

## DEPARTMENT OF PHARMACOLOGY

## Paper Presented

1. **Dr. Nimmy Chacko**, Assistant Professor, presented a poster on the paper entitled, "Antioxidant studies using costusigneus leaf extract" at 10th annual international conference on clinical pharmacology for healthy ageing held on 30th April - 1st May 2017 at Nehru Center, Mumbai.
2. **Mrs. Zeena Fernandes**, Assistant Professor, presented a poster on the paper entitled, "Pharmacological screening of ixoracoccinealinn extract on learning and memory in rats" at 10th annual international conference on clinical pharmacology for healthy ageing held on 30th April - 1st May 2017 at Nehru Center, Mumbai.

**Paper Reviewed:** Dr. Murali Badhanthadka, reviewed manuscript entitled, "Selective cannabinoid 2 receptor stimulation reduces tubular epithelial cell damage following renal ischemia reperfusion injury" for British Journal of Pharmacology in April 2017.

## DEPARTMENT OF PHARMACY PRACTICE

**Paper Presented:** Dr. Uday Venkat Mateti, Assistant Professor, delivered an oral presentation on the paper entitled, "Role of clinical pharmacist in the management of chronic kidney disease" at one day national seminar on Role and Responsibilities of Pharmacist in Clinical practice organised by Vaagdevi College of Pharmacy, Warangal, held on 12th April 2017.

**Publication (Letter to Editor):** Uday Venkat Mateti. Use of proton-pump inhibitors and risk of kidney failure: an alarming sign. J Egypt Soc Nephrol Transplant, 2017; 17: 42.

## EMERGENCE OF ONLINE PHARMACIES IN INDIA

**Dr. Prasanna Shama Khandige**  
Assistant Professor  
Department of Pharmacology

Online pharmacies in India have enormously increased due to growing e-commerce in India. An online pharmacy is an internet-based vendor of prescription drugs, and the term encompasses both legitimate and illegitimate pharmacies. Online pharmacies have been increasing in India, with the rise attributed to little regulation of the industry.

The Drugs and Cosmetics Act, 1940, and the Drugs and Cosmetics Rules, 1945, have guidelines on the sale of Schedule Hand Schedule X drugs. These can be sold only on prescription and there are specific rules, including for labelling and bar coding.

It appears that electronic prescriptions should be valid especially in the light of the Pharmacy Practise Regulations of 2015 declared by Pharmacy Council of India in January 2015. In these regulations, "Prescription" is defined by regulation 2 (j) [3] 'means a written or electronic direction from a Registered Medical Practitioner On basis of existing regulations it appears that a scanned copy of prescription will be perfectly considered as a valid prescription. However, whether such electronic prescriptions can be used to buy medicine from online pharmacies has been questioned.

## Pharmacy and Online Pharmacy: Licensing and Registration Requirements

Indian pharmaceuticals market is the third largest in terms of volume and thirteenth largest in terms of value. India is the largest provider of generic drugs internationally with the Indian generics accounting for 20 % of global exports in terms of volume. India enjoys an important position in the global pharmaceuticals sector. The country also has a large pool of scientists and engineers who have the potential to steer the industry ahead to an even higher level. Presently over 80 per cent of the antiviral drugs used globally to combat AIDS are supplied by Indian Pharmacy Industry. The Indian pharmacy industry, which is expected to grow over 15 % p.a until 2020, will outperform the global pharmacy industry, which is set to grow at an annual rate of 5 % until the same period. The market is expected to grow to 55 billion dollars by 2020, thereby becoming the sixth largest pharmaceutical market globally, as stated by Mr. Arun Singh, Indian Ambassador to the US.

## Deciding the Type of Pharmacy

Before registering for a traditional pharmacy, a person must decide on the type of pharmacy that he wants to run.

1. **Hospital Pharmacy:** This pharmacy is set-up inside a hospital to cater to the in-hospital needs of medicine.
2. **Standalone Pharmacy:** This is the most common set-up and includes all the pharmacies that are present in a residential area.
3. **Chain Pharmacy:** Chain pharmacies are usually present in malls and are part of a chain of pharmacies.
4. **Township Pharmacy:** If a pharmacy is set-up in a township then it is acknowledged as the township pharmacy.

**Registration of Pharmacy Business:** The registration of a traditional pharmacy is governed by the Indian pharmacy Act of 1948. It states that a pharmacist must register all his particulars to the state government through an official gazette. After the submission, a registration tribunal decides on the registration. Usually hospital, chain and township pharmacies are setup under private limited company constitution whereas standalone pharmacies are set up under proprietorship or partnership constitution. Presently, Limited Liability Partnership (LLP) constitution has gained immense popularity among standalone pharmacists as it promotes the rights of partners unlike a partnership constitution.

#### Registration of Tax

In India the most important tax registration includes VAT registration, therefore a pharmacist must contact the State's Sale Tax or VAT Department for the same.

**Obtaining Drug License:** Before selling medicines, a drug store must obtain drug license from the Central Drugs Standard Control Organization and State Drugs Standard Control Organization.

**Mainly there are two major drug license issued by the Drugs Control Organization:**

**Retail Drug License (RDL):** This license is required to run a general chemist shop. To get this license you must deposit a requisite fee and must possess a degree or diploma in pharmacy from a recognized institute or university.

**Wholesale Drug License (WDL):** This license is issued to people or agencies who wish to set up a wholesale business for drugs and medicines. Unlike RDL, there are no stringent conditions to get this license.

**Apart from these special requirements, there are some minimum conditions that must be followed by Pharmacists to procure any drug license:**

1. For a retail drugstore the minimum requirement of area is 10 square meters, and that for a common retail and wholesale pharmacy is 15 square meters.
2. A drugstore must have a refrigerator and air conditioner.
3. Both retail and wholesale pharmacies must have a registered pharmacist who must be present while selling the medicines.

#### Documents Required For Registration-

1. Application forms,
2. Challan of fee deposited,
3. Declaration form,
4. Site plan (Blue print),

5. Key plan (Blue print),
6. Basis of possession of the premises,
7. Proof of ownership of the premises, if rented,
8. Proof of constitution of the firm (Certified copy),
9. Affidavit of non-conviction of Proprietor/Partners/Directors under Drugs & Cosmetics Act-1940,
10. Certified copy of Registration Certificate of Delhi Pharmacy Council/Experience Certificate of the Registered Pharmacist/Competent person and qualification certificates,
11. Bio-data form.
12. Affidavit of Registered Pharmacist/Competent person regarding full-time working with the firm duly attested by Notary Appoint.

#### Legal Procedures for Setting up an Online Pharmacy

Lately, people are shifting towards Online Pharmacies as they are most convenient method of buying medicines. Through online pharmacies customers can procure even rare medicines with utmost ease and privacy. Loads of online pharmacies have become prevalent in India but they too need to abide by certain legal procedures before being functional.

#### Setting Up an Online Pharmacy

Any person can set up an online drugstore only if he is registered with a licensed traditional drugstore or if it has partnered with a licensed dealer to execute the online orders.

#### Green Zone

According to the Indian laws, the following practices are legal for online pharmacies:

- Except over-the-counter drugs, all other drugs require a prescription.
- The contact details of an online drugstore must be of the state from which they have procured the drug license.
- The licensed drugstore has to verify and certify the delivered drugs.

#### Grey Zone

These practices are uncertain as per the Indian law.

- Shipping of medicines from one state to another.
- The provision of taking the money prior to delivery of medicine.

#### Red Zone

These practices are illegal as per Indian Laws:

- Selling Schedule H and Schedule X medicines without prescription.
- Selling medicines to minors.
- Selling medicines that are not approved by State Drug Control Organization.
- Exporting medicines without approval from the drug department of the respective country.

Though traditional pharmacies cater to the medicinal needs of the major population of India but still there is a need for online pharmacies that fit into the Indian Legal system because the online pharmacies create an advantageous situation for both consumers as well as pharmacists.

# GREEN NANOTECHNOLOGY

Mr. Ravi G.S

Research Scholar

Department of Pharmaceutics

Green nanotechnology is used to enhance the environmental sustainability in the process producing negative externalities that include green nano products used in the support of sustainability. This green nanotechnology described as the development of clean technology to minimize potential environment and human health risks with the use of nanotechnology products. As nanomaterials are being produced by various ways, it should be taken into consideration that environment should be least affected by these methods. For example, usage of nontoxic solvents, usage of less temperature, low energy etc.

## Goals:

Green nanotechnology involves two separate but related goals. On the one hand, the remarkable characteristics possible at the nanoscale promise myriad ways of making existing products and processes safer and more sustainable. On the other hand, researchers are increasingly finding ways to render nanotechnology less toxic throughout its life cycle. Green nanotechnology utilizes the principles of 'Green Chemistry' and 'Green Engineering' which ensures the product is manufactured,

1. Without the use of toxic ingredients
2. Using eco-friendly materials
3. At low temperature using less energy
4. With renewable inputs wherever possible
5. With life-cycle thinking in all design and engineering stages

## Applications:

- Reducing the generation of waste by utilizing environment friendly approaches.
- Nanomaterials used for better manufacturing procedures by reducing poisonous substances.
- Nanomaterials and nanodevices (Eg: water and air filters) should be used to reduce pollution.
- Nanomaterials used for effective energy production (Eg: Photovoltaics and fuel cells).

## Bio-inspired green nanomaterial synthesis:

Nature has devised various processes for the synthesis of nano and micro length scaled inorganic materials which have contributed to the development of relatively new (Fig. 1) and largely unexplored area of research based on the biosynthesis of nanomaterials. Biosynthesis of nanoparticles is a kind of bottom up approach where the main reaction is reduction/oxidation. The microbial enzymes or the plant phytochemicals with anti-oxidant or reducing properties are usually responsible for reduction of metal compounds into their respective nanoparticles.

## Bio-inspired green nanoparticles over chemically synthesized nanoparticles:

In keeping with global efforts to reduce generation of hazardous waste and to develop energy effective production routes, green chemistry and biochemical processes are progressively integrating with modern developments in science and technology. Hence, any synthetic route or chemical process should address the fundamental principles of green chemistry by using environmentally benign solvents and nontoxic chemicals. The green synthesis of nano materials should involve three main steps based on green chemistry perspectives, namely

- (1) The selection of a biocompatible and nontoxic solvent medium.
- (2) The selection of environmentally benign reducing agents, and
- (3) The selection of nontoxic substances for stabilization of the nanoparticles.

Employing these principles in nanoscience will facilitate the production and processing of inherently safer nanomaterials and nanostructured devices. Green nanotechnology thus aims at development of nanomaterial production methods with reduced hazardous waste generation and safer applications. Further, biochemical processes can occur at low temperatures, because of the high specificity of the biocatalysts. Hence, a synthetic route that include one or more biological steps will result in consistent energy saving and lower environmental impact with respect to conventional methods. To optimize safer nanoparticle production, it would be desirable to employ bio-based methods, which could minimize the hazardous conditions of material fabrication. Taking inspiration from nature, where living organisms produce inorganic materials through biologically guided process known as biomineralization, should be adopted as a superior approach to nanomaterials assembly.

## Biological application of green nanoparticles:

The reason why these nanoparticles are attractive for medical purposes is based on their important and unique features such as surface to mass ratio that is much larger than that of other particles, their quantum properties and their abilities to adsorb and carry other compounds such as drugs, probes and protein. In the ever expanding field of nanomaterial research, metal nanoparticle received particular attention due to their wide application (Fig. 2) in catalysis, electronics, sensing, photonics, environmental cleanup, imaging, and drug delivery.

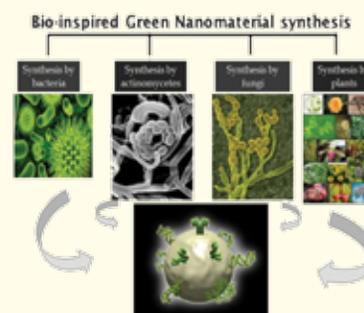


Fig. 1: A schematic representation of bio-inspired green nanomaterial synthesis.

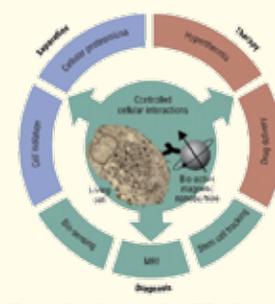


Fig. 2: A schematic representation on biological application of green nanomaterials.

## References:

1. Nath D, Banerjee P. Green nanotechnology - a new hope for medical biology. *Environ Toxicol Pharmacol*. 2013 Nov;36(3):997-1014.
2. Jahangirian H, Lemraski EG, Webster TJ, Rafiee-Moghaddam R, Abdollahi Y. A review of drug delivery systems based on nanotechnology and green chemistry: green nanomedicine. *Int J Nanomedicine*. 2017 Apr 12;12:2957-2978.
3. Exploring Nanotechnology in Healthcare. Edited by Dr. N. Udupa, Manipal University Press, Manipal, India.

# SUCCESSFULLY COMPLETED TRAINING COURSE IN THE USA



## ANNUAL DAY CELEBRATIONS



*Book Post*