Statement of the Research Achievements

Broad Area: Nanobiotechnology and Advanced Drug Delivery (nanomedicine)

Technologies Transferred to Industry (ToT): 01

- Tamoxifen self nano emulsifying drug delivery system (SNEDDS) alone and in combination with antioxidant (quercetin) with enhanced oral bioavailability and reduced hepatotoxicity for improved breast cancer therapy. I**ndian Patent number 296411 granted on May 02, 2018**; the technology has been licensed to VAV Life Sciences, Mumbai for further development and commercialization.

Technologies shortlisted by National Research Development Corporation (NRDC)*: 02

- Gemcitabine-Phospholipid complex for improving metabolic stability and deliverability of Gemcitabine
- Betamethsaone and Calcipotriol loaded nanoemulgel for topical psoriasis therapy

Basic Engineering Design Package (BEDP) has been prepared by NRDC

The talk with industries for licensing other technologies is in progress

Nano drug delivery systems for oral delivery of poorly absorbable small drug molecules, vaccine and insulin:

- Variety of nano systems viz. SNEDDS, lipid nanoparticles, nanostructured lipidic carriers, polymeric nanoparticles, lipid-polymer hybrid nanoparticles, drug nanocrystals, bilosomes, layersomes, lipid nanocapsules, liquid crystalline nanoparticles etc. for increasing oral bioavailability, reducing toxicity and improving therapeutic efficacy of anticancer drugs (doxorubicin, paclitaxel, docetaxel etc), antioxidants and their combination (curcumin, quercetin, genistein etc.), immunosuppressant (cyclosporine), antifungal (amphotericin B), antiviral (ritonavir, efavirenz), antihypertensive (olmesartan, candisertan etc). Vaccine (serum albumin as model antigen, tetanus and diphtheria toxoids, hepatitis B etc), insulin and various other drug molecules have been investigated.

Multifunctional nano drug delivery systems for targeted anticancer drug delivery:

- Various drug delivery systems viz. polymeric and lipidic nanoparticles, polymeric micelles and mixed micelles liposomes, liquid crystalline nanoparticles, core shell lipid nanocapsules, carbon nanotubes, cyclodextrin nanoparticles etc. surface functionalized with polyethylene glycol (PEG) and tumor targeting ligand e.g. folic acid, estradiol, hyaluronic acid, RGD peptide, antibody (VEGF), anacardic acid, Vitamin ETPGS, adenosine, etc. for tumor drug targeting and therapy have been explored.

Nanocarriers for topical drug delivery for treatment of skin related diseases

- Lipid based systems (solid lipid nanoparticles, nanostructured lipidic carriers, modified liposomes and nanoemulsion) based gel containing combination of drugs including herbal drugs have been developed and their efficacy in topical treatment of psoriasis, acne and ageing with lesser side effects has been demonstrated
- Polymeric nanoparticles along with microneedles were investigated for needle free transcutaneous immunization using model antigens and tetanus toxoid.

- A topical gel formulation using high permeation vesicles containing anticancer drugs has been developed for localized transdermal drug delivery for improved breast cancer therapy without systemic drug exposure.

Combinatorial macromolecule dual drug conjugates of anticancer drugs and their nanoformulations

- Gemcitabine-Curcumin, Gemcitabine-Methotrexate and Gemcitabine-Docetaxel dual drug conjugates and their nanoformulations showed synergistic anticancer efficacy and reduced toxicity as compared to individual drug.

Non-viral vectors for site specific gene delivery:

- Hyaluronic acid (HA) and Chondrotin sulphate (CS) modified polyethyleneimine (PEI)-DNA polyplexes (HA-PEI-DNA and CS-PEI-DNA), lipid polymer hybrid nanoplexes, Estradiol functionalized CNTs and epsilon-poly-l-lysine nanoplexes have been developed which showed 5-20 times higher transfection efficiency and reduced toxicity in vivo.

Drug-Phospholipid complex for improving deliverability of drugs

- Gemictabine-phospholipid complex improved metabolic stability and plasma half life of gemcitabine, while erlotinib-phospholipid complex increases water solubility of the drug therefore improve its oral bioavailability. Similarly, insulin-phospholipid complex increased gastrointestinal stability and permeability of insulin.

Lipid-Drug conjugate for improving deliverability of drugs

- Amphotericin B- Lipid (Oleic acid) conjugate has been prepared that improved acid stability of amphotericin B, increased intestinal permeability, increase oral bioavailability and reduces hemolytic and nephrotoxicity (due to differential aggregation behavior). This conjugate further showed ~1000 times increase in oil solubility, making feasible development of lipid based systems with improved drug loading (SNEDDS and liposomes) which further improved oral bioavailability (in case of SNEDDS) and deliverability (liposomes)
- Doxorubicin- lipid (palmitic acid, stearic acid and oleic acid) conjugates were prepared that also increased intestinal permeability, oral bioavailability and making feasible development of SNEDDS.

Miscellaneous

- Voriconazole Dry Powder Inhalable formulation for the Invasive Pulmonary Aspergillosis showed ~15 times enhancement in lung bioavailability as compared to the intravenous dose.
- A universal step wise freeze drying cycle capable of stabilizing different types of nanocarriers was successfully designed and developed.
- Galactosylated liposomes for mononuclear phagocytic system (MPS) targeting of antiretroviral drug stavudine for the treatment of HIV infection.
- Cationic emulsomes for the sustained and targeted cytosolic delivery of antiviral drug zidavudine for treatment of liver based viral infections.
- Mannosylated liposomes containing antimicrobial agent for the treatment of bacterial biofilm infections e.g. dental plaques etc.

Prestigious Honours & Awards Received:

2022: Fellow of AAPS, by the American Association of Pharmaceutical Scientists (AAPS)

2021: AAiPS Distinguished Young Educator and Research Scholarship Award, by American Association of Indian Pharmaceutical Scientists (AAiPS)

2018: ABAP Gold Medal for Advanced Research in Nanoscience and Technology- 2018 by Association of Biotechnology and Pharmacy (ABAP), India

2018: Shiv Nath Rai Kohli Memorial Mid-Career Best Scientist Award 2017-2018

2018: The PharmInnova Award 2017-18 for best Research Guide for the National Level Innovative Thesis Competition for the M.Pharm. Thesis supervised in Pharmaceutics and Pharmaceutical Technology category by Rajnibhai V. Patel Trust. (Ms. Rhythm Arora)

2017: The PharmInnova Award 2016-17 for best Research Guide for the National Level Innovative Thesis Competition for the Ph.D Thesis supervised in Pharmaceutics and Pharmaceutical Technology category by Rajnibhai V. Patel Trust (Dr. Harshad Harde)

2016: Illustrious Alumnus Award of Dept of Pharmaceutical Sciences, Dr. Hari Singh Gour University, Sagar at its Diamond Jubilee Celebration on February 6-7, 2016

2015: The PharmInnova Award 2014-15 for best Ph.D Thesis in Pharmaceutical Sciences by Rajnibhai V. Patel Trust (Dr. Amit Kumar Jain)

2013: Rising Suns in Asia Award at 40th CRS Annual Meeting, Hawaii, USA

2013: Bharat Jyoti (The Glory of India) Award

2012: Member of Indian Delegation team selected by DST to visit South Korea for Indo-Korea Joint Workshop on Nanotechnology

2011: INSA Medal for Young Scientists (in Medical Science)

2011: Alkyl Amines Young Scientist Award

2011: First speaker from India to deliver invited talk & Chair the Scientific Session at 38th Annual CRS meeting at Maryland, USA

2009: OPPI Young Scientist Award (Novel & Improved Drug Delivery Systems)

2008: Member of Indian Delegation team selected by DST to visit France for Indo-French Joint Workshop on Nanotechnology

2006: Best Oral Presentation Award at Alexander von Humboldt Stiftung, Germany sponsored Kolleg on "Bio-Nano-Geo-Sciences: Addressing issues of concern to mankind" Palampur (H.P.) March 2006

2005: Punjab State Young Scientist Award

1999: IDMA G.P. Nair Award

Editorial membership:

- Editor: AAPS PharmSciTech (Springer, USA) (I.F. 3.3) (Since 2014)
- Editorial Advisory Board Member: Molecular Pharmaceutics (American Chemical Society; ACS (I.F. 4.9)
- Editorial Board Member: Drug Delivery and Translational Research (Springer, USA) (I.F. 5.4)
- Theme Editor: Theme issue on "Long-Acting Therapeutics: Development Strategies and Clinical Significance" of Advanced Drug Delivery Reviews (Elsevier, USA) (I.F. 16.1)
- Guest Editor: Theme issue on "Lipid Based Drug Delivery Strategies for Oral Drug Delivery" for AAPS PharmSciTech (Springer, USA) (I.F) 3.3

Research Outcome:

Patents: **14** (Granted); **01** (Filed)
Publications: Research Articles (International) **203**; Review Articles (International): **23**
National: **08**; Technical Bulletin: **03**
Books: **02** (International)
Book Chapters: **11**
Cumulative impact factor: **1174.77, h-index: 61, i10-index: 190**
Invited Talks: **30** (at Foreign Countries); **166** (within India); Conference presentations: **160**
Total citations**: 12534 (as on August 28, 2023) as per Google scholar**
Google Scholar ID: http://scholar.google.co.in/citations?hl=en&user=aFapK-8AAAAJ

Research Supervision:

- Post Doc: **02** (completed)
- Ph.D.: **17** (completed); **10** ongoing
- Master's: **125** (completed); **10** ongoing

aaps American Association of Pharmaceutical Scientists

Sanyog Jain, M.Pharm., Ph.D., FAAPS

As a distinguished contributor and acknowledged leader in the advancement of the pharmaceutical sciences, you are designated a

Fellow

of the American Association of Pharmaceutical Scientists

In testimony whereof, are hereunto affixed the proper signature and seal of the Association.

October 16, 2022

SEAL

President

AAiPS

American Association of Indian Pharmaceutical Scientists

AAiPS 2021 Distinguished Young Educator and Research Award

In Collaboration with Indian Pharmaceutical Association (IPA)

THIS CERTIFICATE OF RECOGNITION IS AWARDED TO

Sanyog Jain, Ph.D.

Associate Professor, Department of Pharmaceutics
National Institute of Pharmaceutical Education & Research (NIPER) Punjab, India

For his sustained academic excellence in the pharmaceutical research and Education, particularly in the area of nano drug delivery systems for various Biomedical applications including targeted anticancer drug delivery, oral delivery of vaccines, peptides and therapeutics, topical and transdermal drug delivery platforms.

Sampat Singhvi, Ph.D.
Chair, AAiPS Award Committee
November 30, 2021

Rupa Doshi
President
(Rupa Doshi, Ph.D.

Association of Biotechnology and Pharmacy

KNOWLEDGE IS POWER

Has Great Pleasure in Conferring
Gold Medal for Advanced Research in
Nanoscience and Technology
to

Dr. Sanjeg Jain

for his Distinguished and Dedicated Service to the Profession
in the Field of Nanoscience and Technology

Date: 12-11-2018 www.abap.co.in General Secretary

Shib Nath Rai Kohli Memorial Mid Career Best Scientist Award 2017-18

Panjab University is pleased to award a cash prize of INR Fifty Thousand

to

Dr. Sanyog Jain

Associate Professor, Department of Pharmaceutics, National Institute of Pharmaceutical Education and Research (NIPER), Mohali, in recognition of his research contributions in the field of **Pharmaceutical Sciences**

The selection is by a high-powered committee of experts and based on predefined criteria

Prof. Ramanjit K. Johal
Director, Research Promotion Cell

Prof. Arun K. Grover
Vice-Chancellor

March 4, 2018

Rajnibhai V. Patel

PharmInnova Award

Best Thesis in Pharmaceutical Sciences

This is to certify that

Dr. Sanyog Jain

is awarded as Best Research Guide for the National Level "Innovative Thesis Competition" 2014-15 for the Thesis submitted by his / her student Mr. Amit K. Jain under Ph. D. (Pharmacy) Category

Organized by "Rajnibhai V. Patel Trust"

Under the patronage of :

DEPARTMENT OF SCIENCE AND TECHNOLOGY

Ketan R. Patel
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Troikaa Pharmaceuticals Ltd.

BHARAT JYOTI AWARD

CERTIFICATE OF EXCELLENCE

Presented to

Dr. Sanyog Jain

For Meritorious Services, Outstanding Performance And Remarkable Role

By

Dr. Bhishma Narain Singh

Former Governor of Tamilnadu & Assam

at a Seminar on
Economic Growth & National Integration
At New Delhi on 9th February, 2013.

Gurpreet Singh
Secretary General

India International Friendship Society

INSTITUTE OF CHEMICAL TECHNOLOGY

[UNIVERSITY UNDER SECTION-3 OF UGC ACT-1956)]
MATUNGA, MUMBAI-400 019

CITATION

Dr. Sanyog Jain is awarded Alkyl-Amines Young Scientist award for his outstanding achievements at a young age.

He earned his B.Pharm. (1998) and M.Pharm. (2000) with Gold Medals and thereafter Ph.D. (2006) from Dr. Hari Singh Gour University Sagar (M.P.) After working as Lecturer and Research fellow /Scientist in the same university, CSIR and DRDO laboratories, he joined NIPER in 2008 as Assistant Professor of Pharmaceutics.

He is a highly productive scientist having contributed to the area of targeted and controlled drug delivery, vaccine delivery through non-parenteral route using tailored formulation of colloidal drug carriers, lipid nano particles and carbon nano-tubes. He has exploited these drug delivery techniques for various biomedical applications.

He has over 40 international publications and 8 patents to his credit. His work has been recognized by INSA Medal for Young Scientist in 2011 and he was the first Indian speaker, invited by Controlled Release Society (CRS) to deliver a lecture at their 38th Annual meeting in Maryland, U.S.A. Dr. Jain is also a recipient of many national awards, including "Budding Nanotechnologist Award." in 2010.

In recognition of his outstanding contributions, the Alkyl Amines–ICT Young Scientist award is bestowed on him this day.

Vice Chancellor

October 1, 2011

भारतीय राष्ट्रीय विज्ञान अकादमी

Indian National Science Academy

FOUNDED IN 1935

Sanyog Jain

has been awarded the

INSA Medal for Young Scientists

for the Year 2011

at the Anniversary General Meeting

of the Academy on December 30, 2011

VICE PRESIDENT

PRESIDENT

ORGANISATION OF PHARMACEUTICAL PRODUCERS OF INDIA

OPPI Young Scientist Award 2009

Sponsored by Johnson & Johnson, Martin & Harris, MSD Pharma & Pfizer

Citation

OPPI is pleased to recognise and honour

Dr. Sanyog Jain

Department of Pharmaceutics
NIPER, Mohali

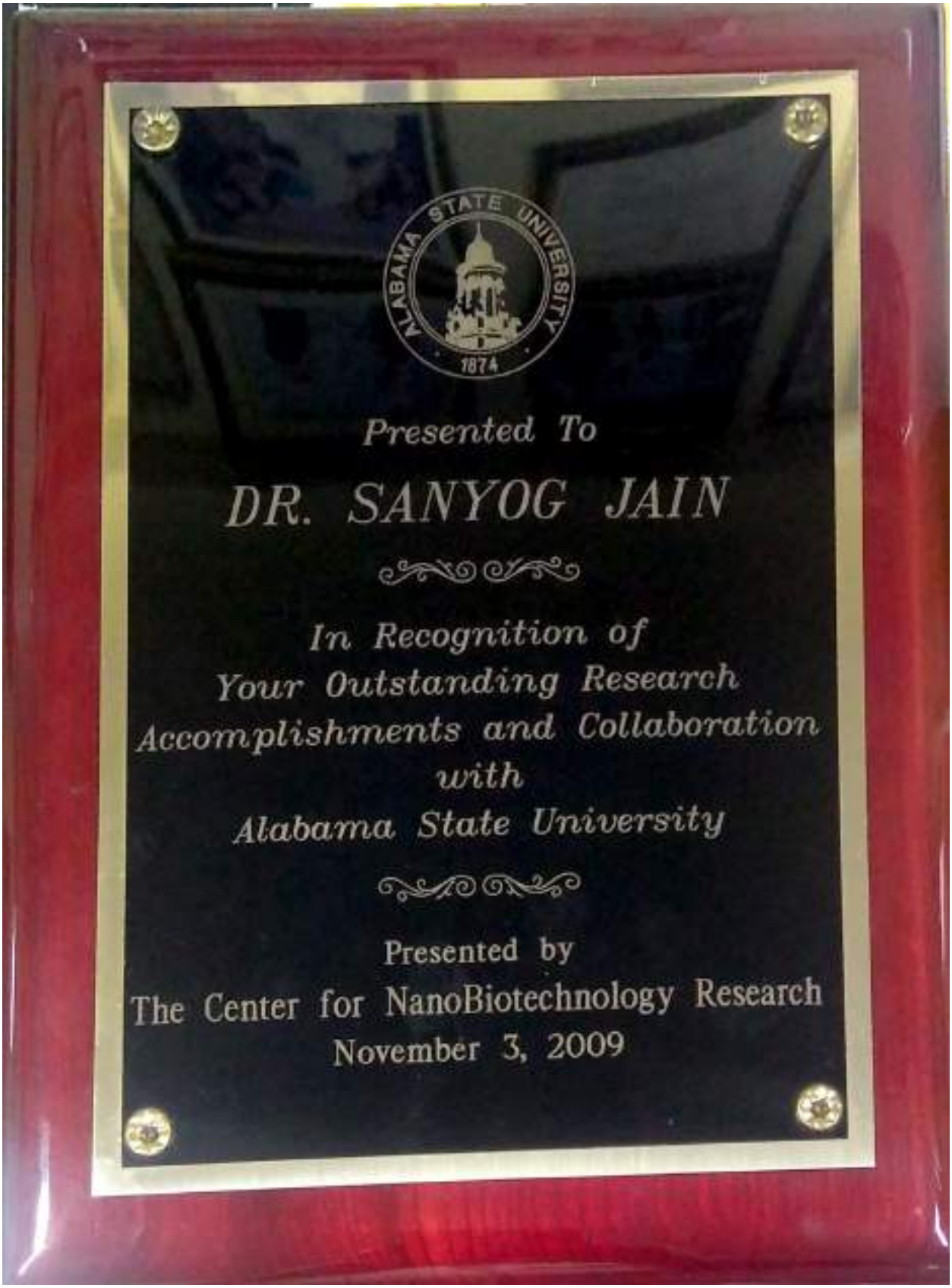
for outstanding research work in Pharmaceutics

Dr. Sanyog Jain, Assistant Professor at Department of Pharmaceutics, NIPER has carried out novel research work in the area of Pharmaceutics on nano clinical systems developed for Site Specific Delivery for Treatment of Various Life Threatening Infections

Ranga Iyer
President

K G Ananthakrishnan
Chairman- Technical Committee

Tapan Ray
Director General


ALABAMA STATE UNIVERSITY
1874
Presented To
DR. SANYOG JAIN
In Recognition of
Your Outstanding Research
Accomplishments and Collaboration
with
Alabama State University
Presented by
The Center for NanoBiotechnology Research
November 3, 2009