



AMITY
UNIVERSITY
— MADHYA PRADESH —

AMIPHARM

An Official Newsletter of Amity Institute of Pharmacy

Volume 2 Issue 1

July-Dec 2024



AMITY INSTITUTE
OF PHARMACY



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ABOUT AMITY INSTITUTE OF PHARMACY

Established in 2018, the Amity Institute of Pharmacy (AIP) approved by the Pharmacy Council of India (PCI), offers a range of pharmacy programs aimed at developing skilled, compassionate, and industry-ready professionals.

AIP offers the following academic programs:

- **Diploma in Pharmacy (D. Pharm)** – a two-year diploma program.
- **Bachelor of Pharmacy (B. Pharm)** – a four-year undergraduate program.
- **Master of Pharmacy (M. Pharm)** – a two year post graduate program with specializations in **Pharmaceutics and Pharmacology**.

AIP is accredited by the Committee for the Control and Supervision of Experiments on Animals (CCSEA) for conducting preclinical studies in both education and research. It is also recognized by the Indian Pharmacopoeia Commission under the Pharmacovigilance Program of India (PvPI) for monitoring and reporting adverse drug reactions.

Situated on a sprawling, eco-friendly campus, the institute provides a serene and intellectually stimulating learning environment. Its infrastructure includes spacious, air-conditioned lecture theatres and state-of-the-art laboratories, equipped with advanced instrumentation that supports high-quality academic and research pursuits.

The curriculum emphasizes industrial training, practice school modules, and research projects, effectively bridging the gap between academic learning and industry expectations. AIP is dedicated to nurturing not only competent pharmacy professionals but also ethical leaders with strong values and “Sanskaras”, ready to make meaningful contributions at the national and global levels.

To promote career readiness, the institute offers comprehensive placement training and facilitates a wide range of placement opportunities. AIP also conducts impactful community outreach programs and public health initiatives, instilling a sense of social responsibility among students.

Beyond academics, students are encouraged to actively participate in co-curricular and extracurricular activities, contributing to a vibrant and inclusive campus culture that supports holistic development and celebrates student excellence.

Year of Establishment
2018

Sanctioned Strength
400+30+60 (B. Pharm +
M. Pharm +D. Pharm)

Total Student Strength
(344)



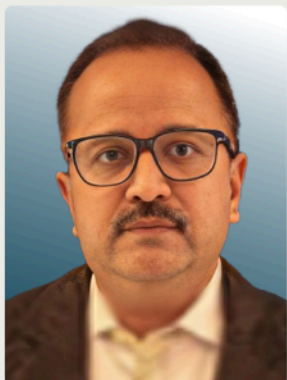
Academic Program's
Diploma, UG & PG

Name of the Program
D. Pharm, B. Pharm and M. Pharm
(Pharmaceutics & Pharmacology)

Faculty Ratio
1:13



FROM DIRECTORS DESK



Dear Readers

Welcome to the third edition of AMIPHARM, the official newsletter of Amity Institute of Pharmacy, Amity University Madhya Pradesh, Gwalior. This issue reflects the remarkable journey of our institute over the past six months—a period marked by academic excellence, innovation, and a steadfast commitment to holistic development.

AMIPHARM continues to serve as a vibrant platform that promotes education, sustainability, and inclusivity. It offers a space for thought leaders, scholars, and emerging professionals to connect, collaborate, and contribute to the dynamic field of pharmaceutical sciences.

During this reporting period, the institute has been enriched by a variety of impactful activities. Our committed faculty members organized seminars, workshops, and outreach programs that addressed emerging trends in pharmaceutical sciences. Their dedication to research has led to the publication of numerous articles in reputed journals and contributions to prestigious academic volumes published by Elsevier, Springer, and other leading platforms.

Equally inspiring has been the active involvement of our students, who have enthusiastically participated in a wide range of curricular, co-curricular, and extracurricular activities. From academic competitions and technical fests to cultural events and sports, their vibrant engagement continues to enrich the academic environment and uphold the institute's spirit of excellence.

As we celebrate these achievements, I extend heartfelt gratitude to our contributors, readers, and partners for their unwavering support. Your commitment to the mission of AMIPHARM and the advancement of pharmaceutical science is truly appreciated.

A handwritten signature in blue ink, appearing to read 'Neeraj Mishra', written over a light blue horizontal line.

Prof. Dr. Neeraj Mishra
Professor, AIP



PROF. (DR.) NEERAJ MISHRA
Editor-in-Chief



DR. VIKAS PANDEY
Editor



DR. RAJEEV SHARMA
Editor

STUDENT COORDINATORS



MR. SUBHAM AGRAWAL
B. Pharm VII Sem



MS. PALAK VELANKAR
B. Pharm VII Sem



MR. KUSHPAL RANA
B. Pharm V Sem



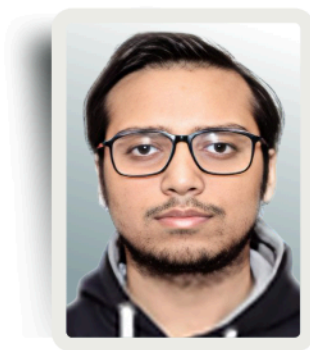
MS. ROSHNI
B. Pharm V Sem



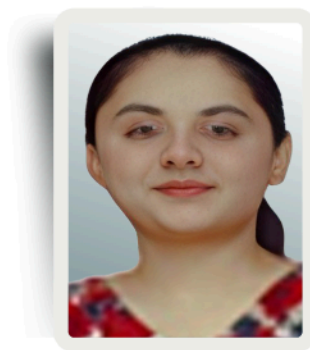
MR. ARPIT BAJPAI
B. Pharm III Sem



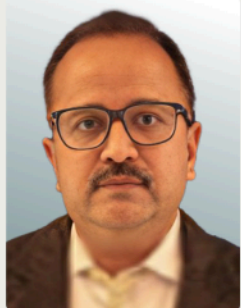
MS. MANSI CHAUBAL
B. Pharm III Sem



HARSH GUPTA
B. Pharm 1 Sem



MS. SIMARAN KAUR
B. Pharm I Sem



DR. NEERAJ MISHRA
Professor



DR. M. PRATHAP
Associate Professor



DR. VIKAS PANDEY
Associate Professor



DR. JOVITA KANOJIA
Associate Professor



DR. RAMAKANT JOSHI
Associate Professor



MR. KAPIL GUPTA
Associate Professor



MS. ANKITA KISHORE
Associate Professor



DR. RAJEEV SHARMA
Assistant Professor



DR. WASIM AKRAM
Assistant Professor



DR. RAM BABU TRIPATHI
Professor



DR. SATHISH K MITTAPALLI
Associate Professor



DR. PAWAN KUMAR GUPTA
Associate Professor



MR. DEEPESH PARASHAR
Associate Professor



MR. HERO KHAN PATHAN
Associate Professor



DR. AJAY MAHOR
Assistant Professor



DR. NAVEEN SHARMA
Professor



DR. MONIKA KAUSHIK
Associate Professor



DR. P. SAGAR
Associate Professor



MR. TALEVER SINGH
Associate Professor



DR. MANDEEP K SINGH
Assistant Professor



MRS. MV NEETHU
Assistant Professor



MR. ARVIND SINGH JADON
Assistant Professor

FACULTY OF PHARMACOGNOSY



MR. JAMAL BASHA DUDEKULA
Associate Professor



DR. NARENDRA KUMAR
Assistant Professor



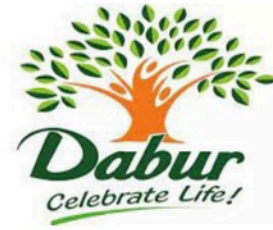
DR. SANGEETA HAZARIKA
Assistant Professor



DR. DEVYANI RAJPUT
Associate Professor



Gland Pharma Limited



Makin Laboratories Pvt. Ltd.
(A WHO GMP certified company)





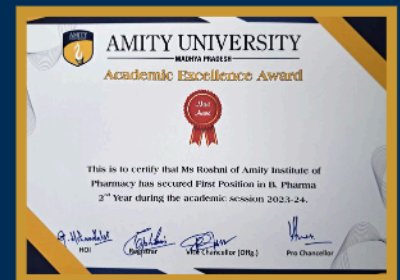
Mr. Surya Pratap Singh Sikarwar secured 1st prize in "Innovative ideas converging into start-ups", 3rd prize in "innovative start-up competition" and 2nd position in quiz competition in pharmacovigilance and ADR

Mr. Jay Krishna Kumar secured 2nd position in quiz competition during National Pharmacy Week and 2nd prize in poster making competition in "Innovative



Ms. Roshni and Mr. Prince Kumar B pharm 5th semester won First Prize in Rangoli Competition during 'National Pharmacy Week-2024'

Ms. Roshni B. Pharma 2nd year received Academic Excellence Award for the academic session 2023-24 on 'Raising Day', 19th Sep 2024.

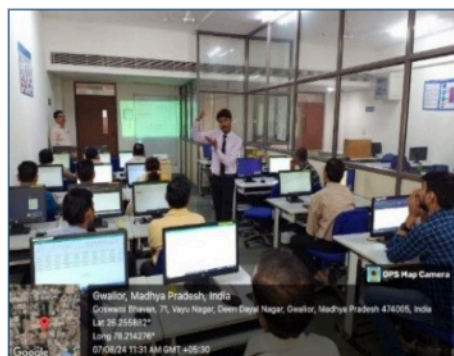


The Institute of Pharmacy proudly crowned Mr. Gurlal Gill 1st sem. as Mr. Fresher 2024 during the vibrant Fresher's Welcome organized for the B.Pharm students.

Amity Institute of Pharmacy, Amity University Madhya Pradesh, proudly congratulates 25 students for their successful campus placements in renowned organizations including Macleods Pharmaceuticals, MITS Healthcare, Panacea Smart Solutions, IDS Infotech, Rinex Technologies, and others. This milestone reflects AIP's commitment to academic excellence and career readiness through continuous guidance and industry engagement.

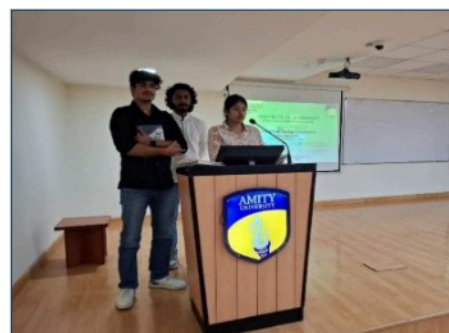
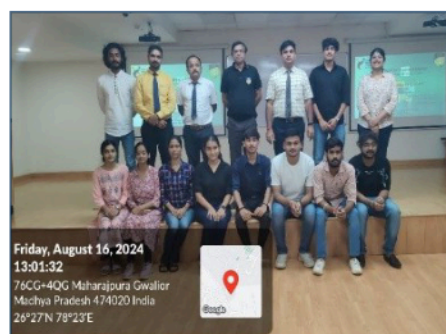
S. No.	NAME OF STUDENT	PLACEMENT COMPANY
1	Achlesh Tiwari	MITS Health Care Pvt Ltd
2	Adarsh Jain	Macleods Pharmaceuticals
3	Ankit Sharma	Rinex Technologies
4	Anshika Bhatnagar	IDS Infotech
5	Ashutosh Kumar Singh	IDS Infotech
6	Ayushi Chhabra	Macleods Pharmaceuticals
7	Bhuvnesh Yadav	Macleods Pharmaceuticals
8	Deshdeepak	Macleods Pharmaceuticals
9	Gaurav Tiwari	Macleods Pharmaceuticals
10	Harender Singh	Panacea Smart Solution
11	Himanshu Gupta	Macleods Pharmaceuticals
12	Manjeet Kumar	Macleods Pharmaceuticals
13	Mishika Singh	Panacea Smart Solution
14	Navdeep Asthana	Macleods Pharmaceuticals
15	Prakhar Singh	Macleods Pharmaceuticals
16	Pranjal Mishra	Macleods Pharmaceuticals
17	Radhika Gupta	Edclaps Innovation
18	Rhythm Milan	Panacea Smart Solution
19	Sakshi Mehra	Panacea Smart Solution
20	Sanjeev Kumar	Macleods Pharmaceuticals
21	Shivam Singh Chauhan	Macleods Pharmaceuticals
22	Shivani Gupta	E Team
23	Tanishka Khandelwal	MITS Health Care Pvt Ltd
24	Vivek Yadav	Macleods Pharmaceuticals
25	Yogesh Tomar	Macleods Pharmaceuticals

HANDS-ON TRAINING WORKSHOP ON MS OFFICE, A PROFESSIONAL DEVELOPMENT AND ADMINISTRATIVE TRAINING PROGRAM



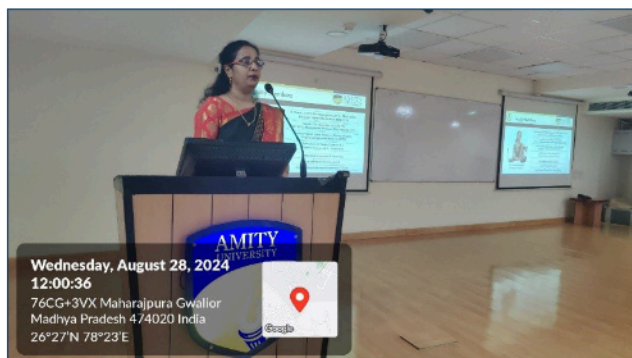
The Amity Institute of Pharmacy, AUMP, organized a two-day Hands-on Training Workshop on MS Office on 6th–7th August 2024 for non-teaching staff. Held at Computer Lab, the workshop aimed to enhance digital literacy and administrative proficiency through practical training in MS Office tools and Google Forms. Coordinated by Dr. M. Prathap and Ms. Ankita Kishore under the guidance of Dr. S. Mohana Lakshmi, the event saw active participation from 20 staff members. The program featured interactive sessions, hands-on exercises, and collaborative discussions, significantly boosting participants' confidence and efficiency in performing routine administrative tasks digitally.

INNOVATIVE STARTUP COMPETITION: PRESENTATION ON STARTUP IDEAS



The Amity Institute of Pharmacy, Amity University Madhya Pradesh, organized an "Innovative Startup Competition: Presentation on Startup Ideas" on 16th August 2024 under the Institution's Innovation Council (IIC 6.0). Over 100 B. Pharm students from 3rd, 5th, and 7th semesters presented unique startup ideas such as sustainable packaging and ambulance booking services. The event was judged by Dr. Vimal Kumar Gupta and coordinated by Dr. Naveen Sharma and Mr. Arvind Singh Jadon. Winners were awarded for their creativity and feasibility. The event encouraged innovation, critical thinking, and entrepreneurship among students, fostering a spirit of practical business development.

ORIENTATION PROGRAM B. PHARM BATCH (2024-2028)



Amity Institute of Pharmacy, Amity University Madhya Pradesh, organized an orientation program for the B. Pharm (2024–2028) batch on August 28, 2024. Dr. S. Mohanalakshmi, Director, addressed students, emphasizing institute values and student responsibilities. Faculty members introduced themselves, and sessions on PCI norms and disciplinary rules were conducted. The event concluded with a vote of thanks by Dr. Sangeeta Hazarika. The program was successfully coordinated by Dr. Sangeeta Hazarika, Ms. Devyani Rajput, and Dr. Jovita Kanoujia under the guidance of the Director, with active support from all staff members. The session marked a motivating start to the academic journey.

NATIONAL PHARMACOVIGILANCE WEEK CELEBRATION 2024

4th National Pharmacovigilance Week
17th-23rd September 2024
Theme - Building ADR Reporting Culture for Patient Safety

Schedule of Activities:

- Guest Lecture & Quiz Competition on ADR**
17th September 2024
Co-ordinators: Dr. P. Sagar, Ms. Neethu MV
Venue: Seminar Hall, C-Block
- Health Checkup Camp**
(ECG, BMD Test, Blood sugar & Blood Pressure)
20th September 2024
Organizer: Yasharth Super Speciality Hospital, Noida, NCR
Venue: Museum (Room No 214) & Pharmacology Lab No 219
- Cinematic Video* on Drug Safety and ADR and e-Poster Competition**
23rd September 2024
Co-ordinator: Mr. Talever Singh, Mr. Arvind Singh Jadon
Venue: Seminar Hall, C-Block

Conveners:
Prof (Dr.) S. Mohana Lakshmi
Director
Amity Institute of Pharmacy

Co-conveners:
Dr. Naveen Sharma
AMC Co-ordinator
Amity Institute of Pharmacy

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*Note: The cinematic video should be theme specific and not exceed 02:00 minutes.



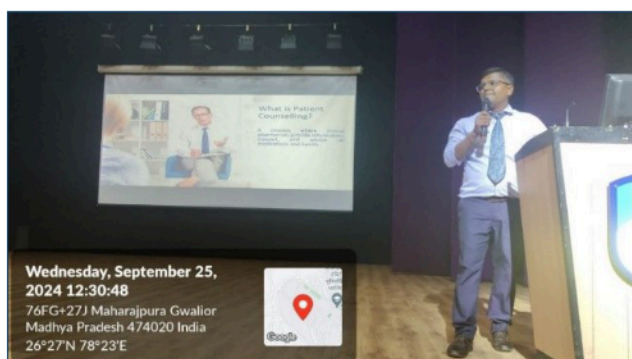
Amity Institute of Pharmacy, Amity University Madhya Pradesh, Gwalior, celebrated National Pharmacovigilance Week 2024 from 17th to 23rd September, as part of the initiative by NCC–PvPI, IPC, Ministry of Health and Family Welfare, Government of India. The event aimed to enhance awareness about drug safety and adverse drug reaction (ADR) reporting among students and healthcare professionals.

The celebration featured expert lectures by Dr. J. S. Namdhari, Dr. Punit Vasishta, and Dr. Shashank Shekhar Singh, who emphasized the role of pharmacovigilance in ensuring patient safety. A health check-up camp was conducted, offering ECG, BMD, blood sugar, and BP tests.

Student engagement was encouraged through short cinematic video and e-poster making competitions, promoting creativity and understanding of safe medicine practices.

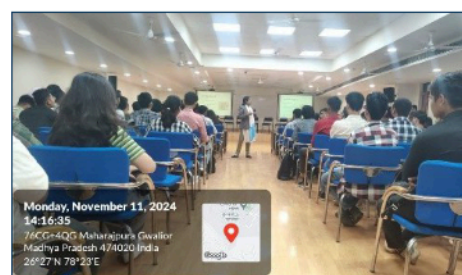
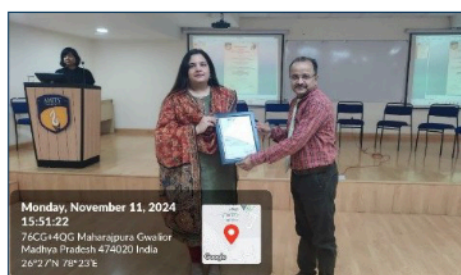
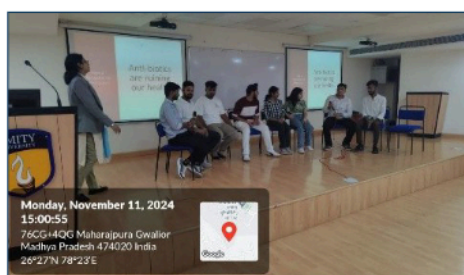
The week served as a valuable platform to reinforce the importance of pharmacovigilance in clinical practice.

WORLD PHARMACISTS DAY – 2024 THEME: PHARMACISTS: MEETING GLOBAL HEALTH NEEDS



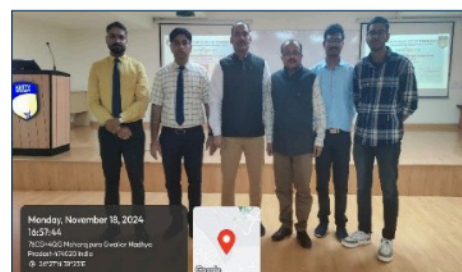
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GUEST LECTURE CUM WORKSHOP ON “SOFT SKILL (COMMUNICATION AND CAPACITY BUILDING)”



A guest lecture cum workshop on Soft Skills: Communication and Capacity Building was held at Amity Institute of Pharmacy, AUMP, Gwalior, for B. Pharm 1st and 5th semester students. Coordinated by Mr. Hero Khan Pathan under the guidance of Dr. Neeraj Mishra, the event featured experts Dr. Bishakha Mandal, Ms. Anvesha Singh, and Dr. Sarvesh Raj Rocque from AUMP. Topics included group discussion dynamics, pre-interview preparation, and resume excellence. The workshop enriched students' communication, interpersonal, and professional skills, aligning with career readiness goals. The session began with a Saraswati Vandana, symbolizing wisdom and knowledge.

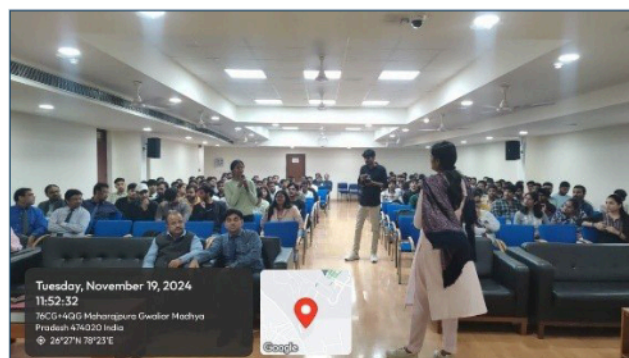
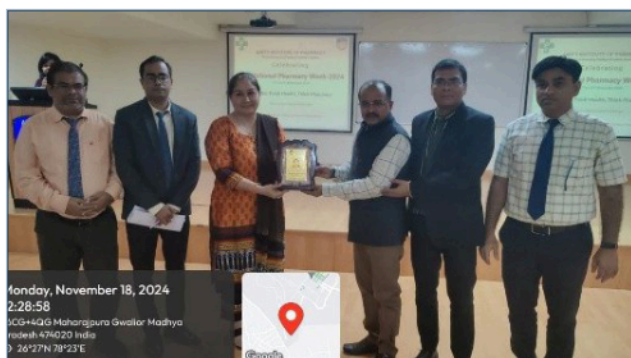
INTRA INSTITUTIONAL START-UP COMPETITION



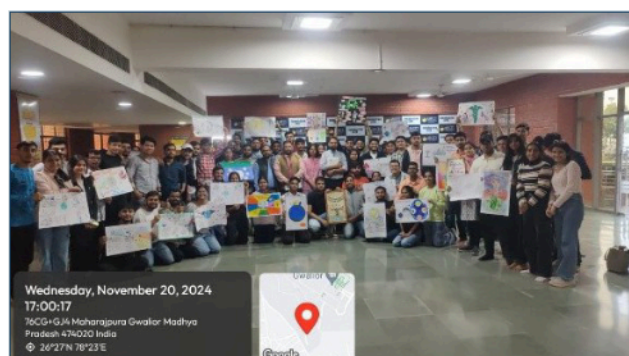
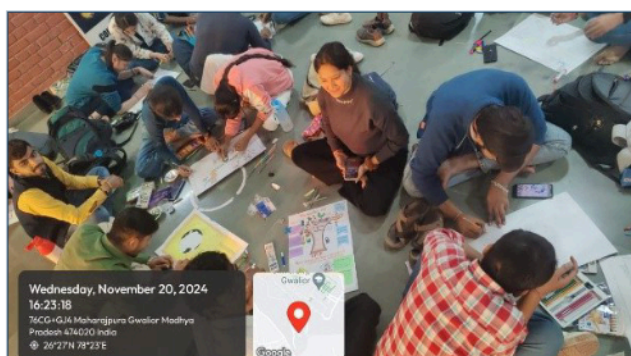
Amity Institute of Pharmacy, Amity University Madhya Pradesh, Gwalior, organized an event titled “Innovative Ideas Converting into Startup” on 18th November 2024 under the Institution's Innovation Council (IIC) 7.0, Ministry of Education. Guest speaker and judge Mr. Vivek Soni, Director, Practon Pharma Pvt. Ltd., shared insights on transforming ideas into businesses and overcoming entrepreneurial challenges. Alongside Dr. Neeraj Mishra, he evaluated startup ideas presented by students. The theme was “Intra/Inter Institutional Start-up Competition.” Winners included Harsh Raj (1st), Akshya Mondal (2nd), and Anupam Pathak (3rd) for their innovative business concepts, highlighting the spirit of innovation and entrepreneurship.

NATIONAL PHARMACY WEEK-2K24

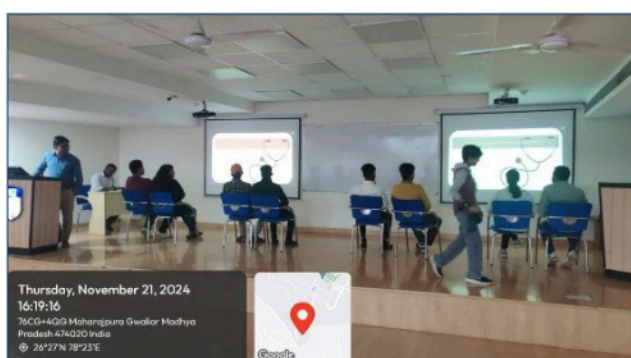
FELICITATION OF THE GUEST SPEAKER BY DIRECTOR (OFFG.), AIP STUDENTS AND EXPERT INTERACTION DURING THE LECTURE



STUDENTS POSTER MAKING SESSION



QUIZ COMPETITION



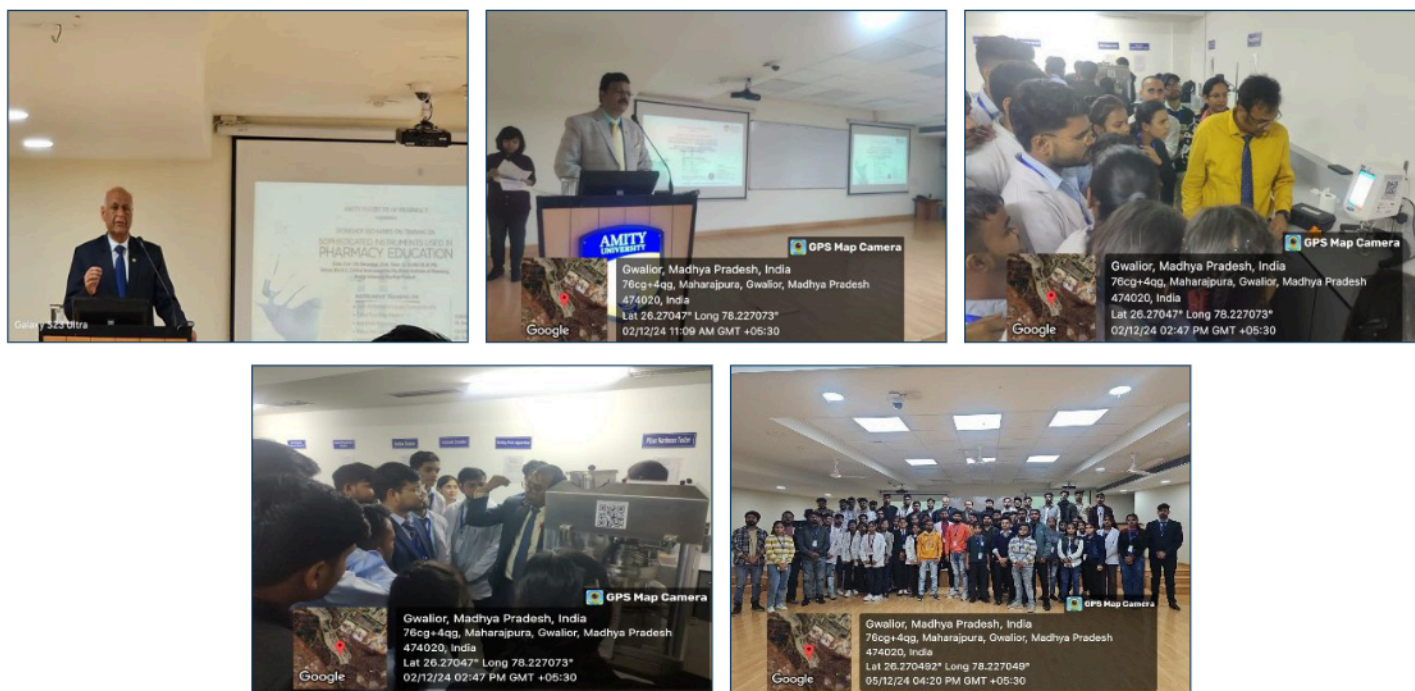
RANGOLI MAKING SESSION

CERTIFICATES AND PRIZE DISTRIBUTION



Amity Institute of Pharmacy, Amity University Madhya Pradesh, Gwalior, celebrated National Pharmacy Week 2k24 from 18th–22nd November 2024 with a series of educational and creative events. Highlights included expert lectures by Dr. Savita Sharma on Ayurveda advancements and Dr. Akanksha Garud on pharmacy career guidance. Students actively participated in poster-making, quiz, and rangoli competitions under various healthcare themes. The celebration concluded with a valedictory function, where winners were felicitated and volunteers appreciated. Coordinated by faculty under the guidance of institute leadership, the event successfully emphasized the pharmacist's evolving role in public health and patient care

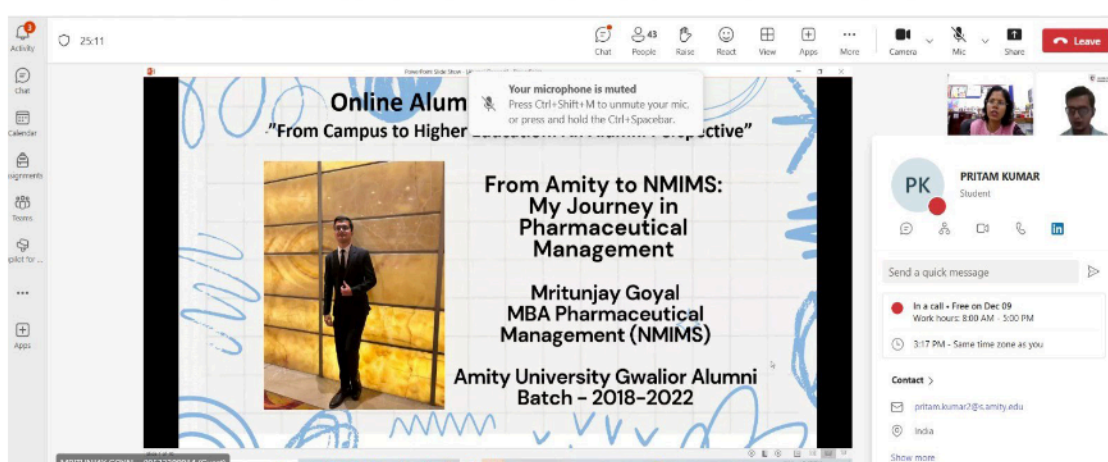
WORKSHOP & HANDS-ON TRAINING ON SOPHISTICATED INSTRUMENTS



Amity Institute of Pharmacy, Amity University Madhya Pradesh, Gwalior, organized a Workshop & Hands-on Training on Sophisticated Instruments from 2nd to 5th December 2024. The event aimed to bridge the gap between theoretical knowledge and practical application through hands-on sessions on advanced analytical instruments. Renowned resource persons, including Dr. Ramakant Joshi, Dr. Rajeev Sharma, and others, guided the training. The workshop enhanced students' research and analytical skills, preparing them for future academic and industrial roles. It successfully empowered participants with essential tools and techniques relevant to modern pharmaceutical education and professional development.

ONLINE ALUMNI CONNECT PROGRAM

"FROM CAMPUS TO HIGHER EDUCATION: AN ALUMNI PERSPECTIVE"

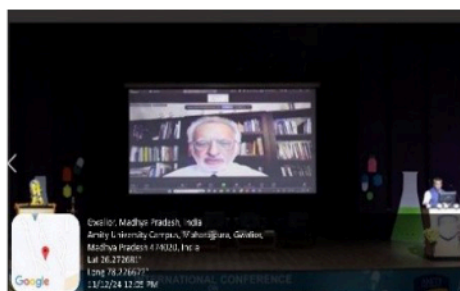


The Amity Institute of Pharmacy, Amity University Madhya Pradesh, Gwalior, organized an Online Alumni Connect Program titled "From Campus to Higher Education: An Alumni Perspective" on 7th December 2024. The session featured Mr. Mritunjay Goyal, an alumnus pursuing MBA in Pharmaceutical Management at Narsee Monjee Institute of Management Studies, Mumbai. The program aimed to inspire students, strengthen alumni ties, and enhance institutional value. Mr. Goyal shared valuable insights and experiences from his academic journey, motivating students to pursue higher education and prepare for future academic and professional success.

INTERNATIONAL CONFERENCE ON DRUG DISCOVERY AND DEVELOPMENT: PHARMACEUTICAL APPROACHES



RELEASING OF CONFERENCE PROCEEDINGS



ADDRESS BY VALEDICTORY CHIEF GUEST



POSTER PRESENTATION BY PARTICIPANTS



KEYNOTE ADDRESS BY DR. ANOOP KUMAR



ADDRESS BY VALEDICTORY CHIEF GUEST



POSTER PRESENTATION BY PARTICIPANTS



DISTINGUISHED DELEGATES AND PARTICIPANTS



**PRIZE AWARDING:
BY PRO CHANCELLOR AND DIGNITARIES**

The Amity Institute of Pharmacy, Amity University Madhya Pradesh, Gwalior, successfully organized an International Conference on "Drug Discovery and Development: Pharmaceutical Approaches" on 11th December 2024 in a hybrid mode. The conference was inaugurated by Chief Guest Dr. R. K. S. Dhakad, Professor & Dean, Gajraraja Medical College, Gwalior. The event was further enriched by distinguished speakers including Dr. Vijay Gombar, Senior Principal Scientist, Sciome LLC, USA; Dr. Ketan Patel, Associate Professor, St. John's University, USA; Dr. Vaishali M. Patil, Principal, Charak School of Pharmacy, CCS University, Meerut; and Dr. Anoop Kumar, Assistant Professor, DIPSAR, Delhi.

The conference was graced by Prof. (Dr.) M. P. Kaushik, Pro Vice-Chancellor (Research), AUMP, whose presence elevated the academic spirit of the event. Technical sessions were chaired by Dr. Inv. Shivakiran Makam, Chief Academics & Innovation Officer, HealthCare Global (HCG) Enterprises Ltd., Bengaluru.

The event was convened by Prof. (Dr.) Neeraj Mishra and organized by Dr. Ram Babu Tripathi, with enthusiastic involvement from the faculty and students of AIP, marking it a landmark academic achievement.

CRISPR-BASED THERAPY CASGEVY RECEIVES HISTORIC FDA APPROVAL

Published Date: October 27, 2024

Source: U.S. Food and Drug Administration

In a groundbreaking regulatory milestone, the U.S. Food and Drug Administration (FDA) approved Casgevy (exagamglogene autotemcel) on October 27, 2024, marking the world's first FDA-approved CRISPR-based therapy. Jointly developed by Vertex Pharmaceuticals and CRISPR Therapeutics, Casgevy is now approved for the treatment of sickle cell disease (SCD) and transfusion-dependent beta-thalassemia (TDT)—two debilitating inherited blood disorders.

The therapy uses CRISPR-Cas9 gene-editing technology to modify a patient's hematopoietic stem cells, enabling them to produce foetal haemoglobin (HbF) instead of the defective adult version. This one-time, ex vivo treatment eliminates or drastically reduces the symptoms and transfusion requirements of patients.

The approval follows the positive results from extensive Phase III trials that demonstrated significant therapeutic effects, with most participants remaining free of vaso-occlusive crises or transfusion needs for over a year.

This approval represents a historic moment in precision medicine, signalling the beginning of a new frontier in genetic treatments for rare and inherited diseases. It is also expected to influence global regulatory frameworks and inspire further investments in gene-editing pipelines. With Casgevy now available, researchers and clinicians alike are hopeful that monogenic disorders may eventually become curable with a single treatment.

AI-DESIGNED ANTIBIOTIC "ABAUCIN" TARGETS SUPERBUG ACINETOBACTER BAUMANNII

Published Date: August 12, 2024

Source: Nature Chemical Biology

In a significant stride toward combating antimicrobial resistance (AMR), scientists from MIT and McMaster University introduced abaucin, a novel narrow-spectrum antibiotic discovered through artificial intelligence. Published in Nature Chemical Biology on August 12, 2024, the study showcases the use of deep learning algorithms to screen over 6,000 compounds and identify abaucin's potent efficacy against *Acinetobacter baumannii*, a World Health Organization (WHO) critical-priority pathogen known for causing hospital-acquired infections.

What sets abaucin apart is its narrow-spectrum activity, which selectively targets *A. baumannii* without disrupting beneficial microbiota. Unlike broad-spectrum antibiotics, this selectivity

reduces the risk of resistance buildup in non-target bacteria. In preclinical trials using infected mouse models, abaucin successfully cleared infections that were previously untreatable with standard antibiotics.

The use of AI in drug discovery shortens the development timeline, minimizes trial-and-error processes, and helps identify novel chemical scaffolds often overlooked by traditional methods. This approach opens doors for precision antibiotics with enhanced safety and efficacy profiles.

Given the global rise in multidrug-resistant organisms, abaucin represents a critical innovation in antibiotic development, providing a new template for AI-assisted discovery platforms. It is now moving toward first-in-human clinical trials anticipated in early 2025.

ORAL INSULIN CAPSULE BY ORAMED SHOWS POSITIVE PHASE 2 RESULTS

Published Date: November 19, 2024

Source: Oramed Pharmaceuticals

In a major advancement for diabetic treatment options, Oramed Pharmaceuticals announced the successful Phase 2 trial results of their oral insulin capsule ORMD-0801 on November 19, 2024. This innovation may soon eliminate the need for painful daily injections for millions of patients with Type 2 diabetes.

The capsule utilizes a proprietary technology that includes enzyme inhibitors and absorption enhancers, which protect insulin molecules from being degraded in the stomach and promote their absorption in the small intestine. The trial, which enrolled over 300 participants across multiple sites, demonstrated comparable efficacy to subcutaneous insulin injections in controlling fasting blood glucose and HbA1c levels. Patients reported high satisfaction due to the ease of administration, lower incidence of hypoglycemic events, and increased adherence to treatment protocols. With oral delivery, the insulin mimics the body's natural route more closely by passing through the liver before systemic circulation, offering a more physiological glucose control.

Oramed's success could revolutionize diabetes management, especially in low-resource settings where storage and injection challenges hinder insulin use. The company plans to begin Phase 3 trials in early 2025 and is also investigating the use of the platform for delivering other peptide-based therapies.



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PLANT BASED EDIBLE VACCINES: AN INNOVATIVE CONCEPT TO IMMUNIZATION

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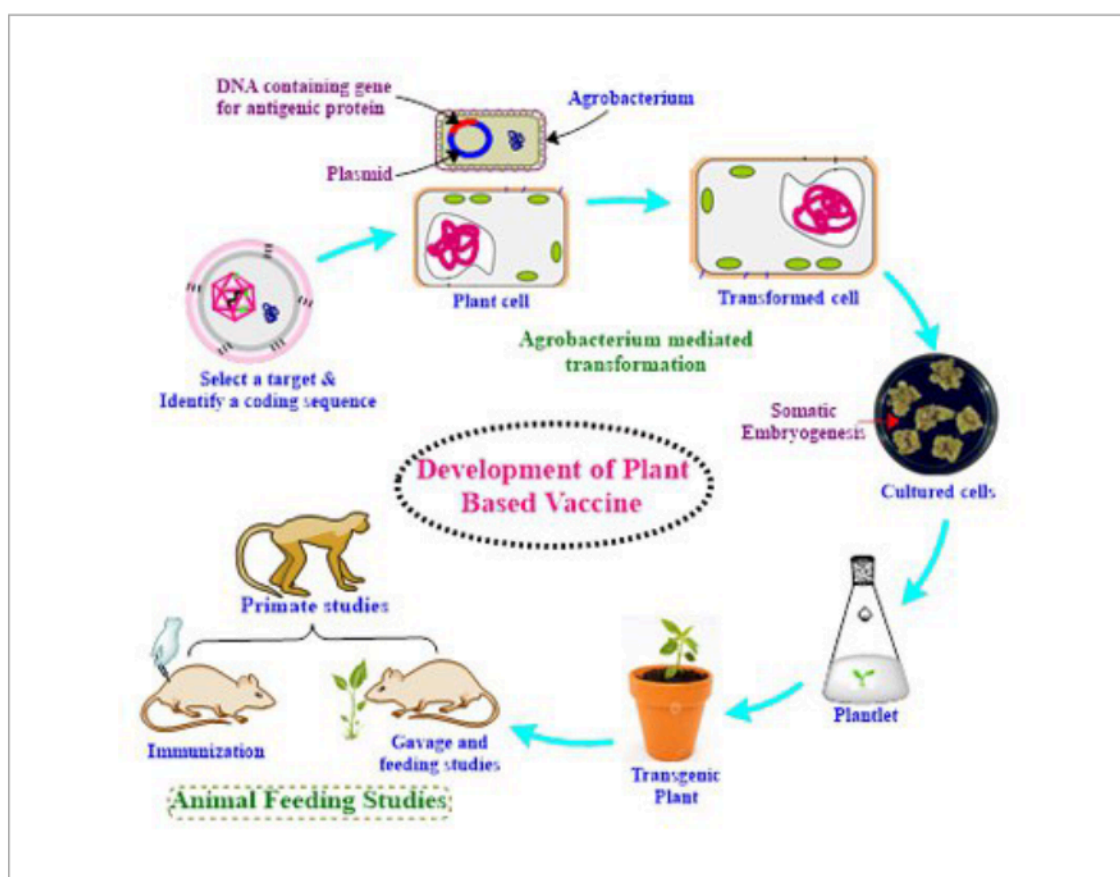
Introduction:

Vaccines have emerged as promising medical intervention for immunoprophylaxis particularly in developing countries being a cost-effective approach. Injectable vaccines pose some difficulties viz., inconvenient administration, need for regulated temperature from producer site to user end and affordability in terms of cost. Hence plant derived edible vaccines were discovered as an attractive alternative option since they do not face any of these limitations. The idea of edible vaccines came from a group of philanthropic organizations led by the World Health Organization (WHO) who launched the children's vaccine initiative to set goals for developing vaccines that are safe, heat stable, orally administered and widely accessible in 1990. They suggested that these goals can be fulfilled by producing subunit vaccines in edible tissues of transgenic crop plants [5]. Plant derived vaccines proffer increased safety, envision low-cost programs for mass vaccination, and propose a wider use of vaccination for human as well as veterinary use [4]. Introduction of modern molecular

and biotechnological methods have resulted in the development of vaccines that comprises recombinant proteins derived from pathogenic viruses, bacteria, or parasites (generally proteins are produced not by the pathogens themselves, but by expression of the gene encoding the protein in a "surrogate organism") [3]. In the late 90's, it was found that green plants can also be employed as "surrogate production organism" to generate antigens of human pathogens (including HBsAg). These proteins can induce priming and also can boost the immune response in humans upon oral administration. In addition, unlike almost all other cell lines used for production of vaccines, components of plant cells have always been an important part of the normal human diet. Plants, therefore, offer significant new opportunities for making safe and effective oral vaccines [1,6,7]. Various parts of plants (seeds, leaves, chloroplasts and fruits) can also be used as vehicles for the production of biomedical products. This will not only increase the cost effectiveness but also the safety of the vaccines as compared to biologicals produced in animal

tissues. The term “plant-derived edible vaccines” refers to antigens produced in edible parts of a plant, such as fruits, leaves, roots, or tubers. Vaccines expressed in non edible plant tissues may also be orally administered after processing. The term “edible vaccine” may have created the misconception that individuals would be able to grow and administer their own vaccines without the supervision of pharmaceutical and health professionals. Ultimately, for practical applications, plant-expressed vaccines will require some form of processing to produce uniform doses for administration by oral and other routes. Also, not all plant-derived vaccine antigens are edible; they may be effective only when administered by the appropriate method (topically;

intramuscularly, i.m.; intraperitoneally, i.p.; or subcutaneously, s.c.) [5]. Transgenic plants expressing antigens from pathogenic microorganisms offer many advantages as low-cost production systems and effective delivery systems for vaccines. This new technology might contribute to global vaccine programs and might have a dramatic impact on health care in developing countries. A number of infectious diseases, including smallpox, anthrax and plague have recently raised concern for their possible use in actions of bioterrorism. The economic and technical benefits offered by plant-derived vaccines propose these vaccines as ideal substitutes for traditional vaccines



Advantages of edible vaccines

Traditional or subunit vaccines are often associated with some difficulties like affordability, safety and storage particularly in developing countries. The concept of edible vaccine can help out to meet these challenges as they do not require cold chains for storage. Also they are safer to use as compared to their animal counterpart since the production of recombinant proteins in plants minimizes potential human or animal pathogen and toxic contamination in form of toxins. Plants are potentially more economical than industrial fermentation or bioreactor facilities, and the amounts of protein produced by plants are comparable to those produced by industrial approaches and thus they can be easily used for oral vaccines as the dosage required is generally high. Purification and costs associated limitations with it could also be eliminated using plant derived vaccines [10,11].



Mechanism of action

Mucosal surface lining the respiratory, digestive and urino-productive tracts are the common portals for the entry of pathogens and thus these collectively forms the largest immunologically active tissue in the body. Nasal and oral are the most effective route for mucosal immunization since the mucosal immune system is the first line of defence and the most effective site for vaccination against pathogens. The aim of oral vaccine is to stimulate both mucosal and humoral immunity against pathogens. Edible vaccines upon ingestion with oral route undergo mastication followed by degradation of plant cell in the intestine as a result of action of digestive enzyme on them. Peyer's patches are an enriched source of IgA producing plasma cells and have the potential to populate mucosal tissue and serve as mucosal immune effector site. The breakdown of edible vaccine occurs near peyer's patches, which consist of 30–40 lymphoid nodules on the outer surface of the intestine and also contain follicles from which the germinal center develops after antigenic stimulation. These follicles act as a site for the penetration of antigens in intestinal epithelium. The antigen then comes in contact with M-cells. M-cells express class-2 major histocompatibility complex molecules, and transport the antigens across the mucous membrane and these endocytosed antigens can activate B-cells within these lymphoid follicles. The activated B-cells leave the lymphoid follicles and migrate to diffuse mucosal associated lymphoid tissue where they differentiate into plasma cells that secrete the IgA class of antibodies. These

slgA (secretory antibodies) antibodies are transported across the epithelial cells into secretions of the lumen where they can interact with antigens present in the lumen. [2]

Summary

Vast no of evidence have quickly accumulated in support of plant-derived antigens as effective, safe and inexpensive means of acquiring or delivering a vaccine. The success of human trials with edible transgenic plant vaccines and successful challenge in animal studies has demonstrated the potential of plant-derived vaccines to expand the armament of preventative medicine. Edible plant derived vaccines hold great potential, especially in developing countries where transportation costs, poor refrigeration and needle use complicate vaccine administration. Edible vaccines, in particular, might overcome some of the difficulties of production, distribution and delivery associated with traditional vaccines. Significant challenges are still to be overcome before vaccine crops can become a reality. However, while access to essential healthcare remains limited in much of the world and the scientific community is struggling with complex diseases such as HIV and malaria, plant-derived vaccines represent an appetizing prospect. Strategies to improve the recombinant protein yield in plants include the development of novel promoters, the improvement of protein stability and accumulation using signals that target the protein to intracellular compartments, and the improvement of downstream processing technologies.

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NUTRACEUTICALS: THE FUTURE OF HEALTH AND WELLNESS

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INTRODUCTION

In recent years, the field of nutraceuticals has gained significant attention for its role in promoting health and preventing diseases. As modern medicine continues to advance, there is a growing interest in natural alternatives that complement pharmaceutical treatments. Nutraceuticals, encompassing nutrients, functional foods, and dietary supplements, provide essential health benefits beyond basic nutrition. Their ability to enhance well-being, boost immunity, and even aid in disease prevention makes them a promising area in healthcare.

UNDERSTANDING NUTRACEUTICALS

The term "nutraceutical" was coined by Dr. Stephen DeFelice in 1989, combining the words "nutrition" and "pharmaceutical." It refers to food or food-based substances that offer medical or health benefits, including disease prevention and treatment. Unlike conventional medications, nutraceuticals do not fit squarely into the legal categories of drugs or food, occupying a unique space between the two [1]. Nutraceuticals encompass a wide range of products, including:

- Isolated Nutrients (such as vitamins, minerals, and amino acids)
- Dietary Supplements
- Functional Foods
- Genetically Engineered "Designer" Foods
- Herbal Products

These products are designed to improve overall health and offer therapeutic benefits that address various medical concerns.

SIGNIFICANCE OF NUTRACEUTICALS IN HEALTHCARE

The increasing reliance on nutraceuticals stems from several key factors:

- **Consumer Trust:** People believe that food-based substances are safer than conventional pharmaceuticals.
- **Cost-Effective Healthcare:** Nutraceuticals may help reduce medical expenses associated with prescription drugs and hospital visits.
- **Chronic Disease Management:** They play a major role in managing lifestyle diseases such as diabetes, cardiovascular conditions, and obesity.
- **Scientific Advancements:** Research in biotechnology and molecular biology is enabling better identification and formulation of nutraceuticals.

Unlike pharmaceuticals, which often come with side effects, nutraceuticals provide natural and holistic benefits. Their ability to reduce health risks without toxicity concerns makes them an attractive option for both patients and healthcare providers [2].

CLASSIFICATION OF NUTRACEUTICALS

Nutraceuticals can be broadly classified into various categories based on their composition and health benefits [3]:

ANTIOXIDANTS

Antioxidants play a crucial role in preventing cell damage caused by free radicals. They help combat conditions such as cardiovascular disease, diabetes, high blood pressure, and inflammatory disorders. Common antioxidant-rich foods include:

- Berries (Blueberries, Strawberries, Raspberries)
- Green Tea
- Dark Chocolate
- Nuts and Seeds

These compounds slow down oxidation and reduce damage at the cellular level, promoting long-term health.

PREBIOTICS AND PROBIOTICS.

- **Prebiotics** are food components that support the growth of beneficial gut bacteria. They are found in foods like onions, garlic, bananas, and whole grains.
- **Probiotics** are live bacteria and yeast that aid digestion and boost immunity. Common probiotic sources include yogurt, kefir, and fermented foods like kimchi and sauerkraut.

Both prebiotics and probiotics contribute to gut health, which is essential for nutrient absorption, metabolism, and immune function.

OMEGA-3 FATTY ACIDS

Omega-3 fatty acids are essential for brain function, heart health, and reducing inflammation. Found in:

- Fatty fish (salmon, sardines, mackerel)
- Chia seeds
- Flaxseeds
- Walnuts

Their benefits include reducing bad cholesterol (LDL) and preventing cardiovascular diseases.

DIETARY FIBERS

Dietary fibers play a vital role in maintaining digestive health. They improve bowel movements, prevent constipation, and may reduce the risk of colon cancer.

- **Soluble Fiber:** Found in oats, legumes, and fruits (helps regulate blood sugar).
- **Insoluble Fiber:** Present in whole grains, vegetables, and brown rice (aids digestion and prevents bloating).

A fiber-rich diet helps maintain a healthy gut, reducing the likelihood of digestive disorders.

NUTRACEUTICALS AND DISEASE PREVENTION

The therapeutic benefits of nutraceuticals extend beyond nutrition—they actively contribute to preventing and managing diseases such as:

- Heart Disease: Omega-3 fatty acids and antioxidants help reduce cholesterol and prevent cardiovascular issues.
- Diabetes: Nutraceuticals with fiber and plant-based compounds regulate blood sugar levels.
- Cancer: Antioxidants such as polyphenols from green tea help prevent cellular mutations.
- Arthritis: Anti-inflammatory compounds from turmeric and omega-3 oils alleviate joint pain.

Nutraceuticals offer targeted health benefits, making them powerful tools for preventing chronic illnesses [4-6].

COMMERCIALLY AVAILABLE NUTRACEUTICALS

With the global shift toward natural healthcare solutions, several nutraceutical products are now widely available:

- Resveratrol (Red Wine Extract): Lowers cholesterol levels.
- Sesamin (Sesame Oil Extract): Helps reduce blood pressure.
- Boswellic Acids & Silymarin: Have anti-inflammatory properties.
- Conjugated Linoleic Acid (CLA): Supports weight management and fat metabolism.
- Statins (Plant-based supplements): Help prevent atherosclerosis

These products demonstrate how nutraceuticals are transforming healthcare, replacing conventional medicines in several cases [7].

THE FUTURE OF NUTRACEUTICALS

The nutraceutical industry is poised for major advancements in the coming years. Key trends include:

- Personalized Nutrition: Customized nutraceuticals based on genetic profiles.
- Innovative Delivery Systems: Nano formulations for better absorption.
- AI-Based Nutritional Recommendations: Tech-driven solutions for optimized health.
- Global Market Growth: Expanding consumer demand for functional foods.

Experts predict that nutraceuticals will reshape healthcare, promoting natural well-being and reducing dependency on pharmaceuticals [8].

CHALLENGES AND REGULATORY CONCERNS

Despite its rapid growth, the nutraceutical industry faces key challenges:

- Lack of standardized regulations for production and marketing.
- Variability in clinical research supporting health claims.
- Potential misuse due to aggressive commercialization.

To ensure consumer safety, governments must establish clear guidelines and promote ethical standards in the nutraceutical market.

CONCLUSION

Nutraceuticals represent a powerful intersection between food and medicine, offering preventive and therapeutic benefits without the drawbacks of synthetic drugs. As research advances and consumer awareness grows, nutraceuticals will become an integral part of global healthcare. However, the industry must balance innovation with scientific validation and ethical regulations to maximize its impact. Embracing nutraceuticals is not just about nutrition, it's about enhancing overall well-being in the modern era.

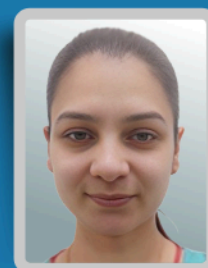
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PROBIOTIC-DERIVED EXTRACELLULAR VESICLES AS TOOLS AND TARGETS IN THERAPY FOR DISEASES

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INTRODUCTION

In recent years, probiotic-derived extracellular vesicles (EVs) have emerged as promising agents in therapeutic research. These nano-sized, lipid bilayer-bound particles, secreted by probiotic bacteria, were once considered insignificant remnants of cell processes. However, ongoing studies have firmly established their role in intercellular communication, immune regulation, and pathogen defence. Unlike live probiotics, EVs offer a safer, targeted, and efficient alternative with fewer risks of microbial imbalance or genetic transfer. This article explores how probiotic-derived EVs function as therapeutic tools, particularly in autoimmune, inflammatory, and infectious diseases, and their rising relevance in combating antibiotic resistance [1, 2].

WHAT ARE EXTRACELLULAR VESICLES?

Extracellular vesicles are small, membrane-bound vesicles actively secreted by various cell types across all domains of life, including bacteria. They serve as transporters of biologically active cargo such as proteins, lipids, nucleic acids (DNA,

mRNA, miRNA), and signalling molecules. These vesicles enable communication between cells and play a role in modulating numerous physiological and pathological processes. In the context of probiotics, EVs are derived from beneficial bacteria such as *Lactobacillus*, *Bifidobacterium*, and *Propionibacterium*, and carry components that exert health-promoting effects on host tissues [3].

ROLE IN AUTOIMMUNE AND INFLAMMATORY DISEASES MODULATION OF IMMUNE RESPONSES

Autoimmune diseases are characterized by an inappropriate immune response against self-tissues. Probiotic-derived EVs have shown potential in modulating such responses by restoring immune balance. These vesicles enhance the generation and function of regulatory T cells (Tregs), which are essential for maintaining immune tolerance and preventing inflammation.

Moreover, they inhibit the production of pro-inflammatory cytokines like TNF-, IL-6, and IL-1 while promoting anti-inflammatory mediators such as IL-10 and TGF-. This dual

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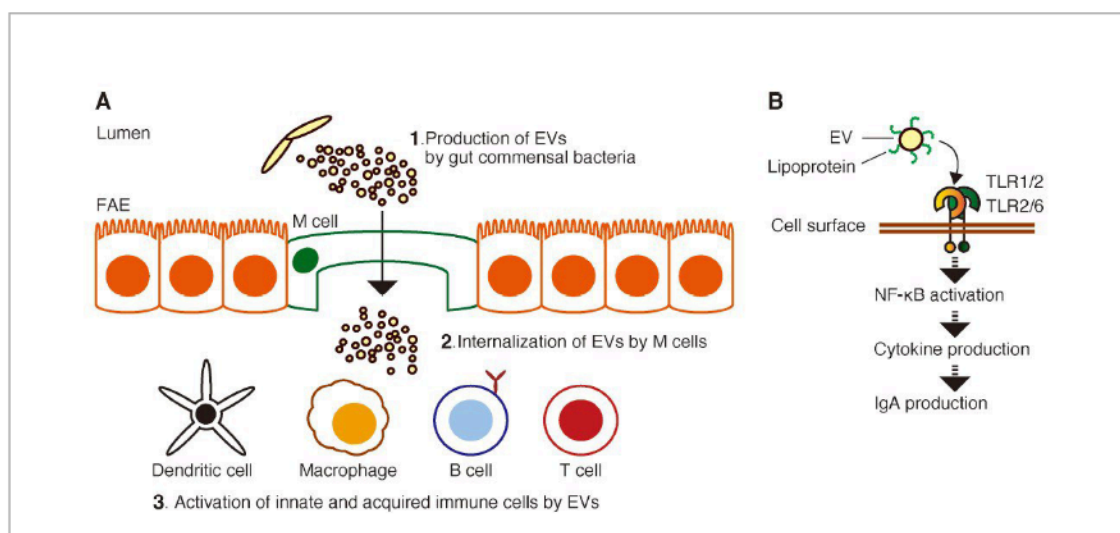


FIGURE 1: Immune activation in the gut mediated by probiotic-derived extracellular vesicles (EVs). (A) Probiotic EVs secreted into the intestinal lumen are transported across the follicle-associated epithelium (FAE) by M cells, facilitating their interaction with innate and adaptive immune cells within Peyer's patches (B) Lipoproteins present on the surface of EVs engage Toll-like receptor 2 (TLR2) on immune cells, leading to NF- κ B signaling pathway activation. This signaling induces the secretion of both pro-inflammatory and anti-inflammatory cytokines, as well as immunoglobulin A (IgA), thereby contributing to mucosal immune regulation.[6].

APPLICATIONS IN RA AND IBD

In rheumatoid arthritis, probiotic EVs can reduce synovial inflammation by decreasing pro-inflammatory cytokines and increasing anti-inflammatory ones. They also help in balancing Th17 and Treg cell populations, contributing to reduced joint destruction [7]. In IBD, characterized by chronic inflammation of the gastrointestinal tract, EVs help restore gut barrier integrity. They enhance tight junction formation, reduce intestinal permeability ("leaky gut"), and suppress local inflammatory responses. This promotes mucosal healing and restores a balanced immune environment in the gut. Additionally, their interaction with host microbiota can influence microbial diversity and functionality, further benefiting gut health [8].

PROBIOTIC EVS IN INFECTIOUS DISEASE MANAGEMENT ANTIVIRAL AND ANTIBACTERIAL IMMUNITY

Probiotic EVs contribute significantly to host defence

mechanisms. They carry antimicrobial peptides and enzymes capable of inhibiting pathogenic bacteria and viruses. Furthermore, these vesicles can stimulate innate immune cells—such as macrophages, neutrophils, and dendritic cells—to produce antimicrobial compounds and enhance phagocytic activity. Their effect on adaptive immunity is equally important, promoting the activation of T-helper cells that coordinate immune responses [9]. EVs can also induce the production of type I interferons (e.g., IFN- α / β), which are essential in antiviral defense by establishing a resistant state in cells and limiting viral replication. Additionally, they contribute to mucosal barrier integrity, preventing pathogen entry and colonization in tissues such as the respiratory and gastrointestinal tracts.

ENHANCING VACCINE EFFICACY

Recent studies have shown that probiotic EVs can act as natural vaccine adjuvants. They enhance antigen uptake by antigen-presenting cells (APCs) like dendritic cells and macrophages, leading to more effective priming of T and B cells. This results in stronger, more targeted immune responses [2, 10]. EVs can be engineered or naturally loaded with vaccine antigens, allowing them to function as nanocarriers. This is particularly advantageous in oral vaccine delivery, where EVs protect antigens from gastrointestinal degradation and deliver them to mucosal surfaces. By promoting mucosal immunity, they offer localized protection against respiratory and enteric pathogen

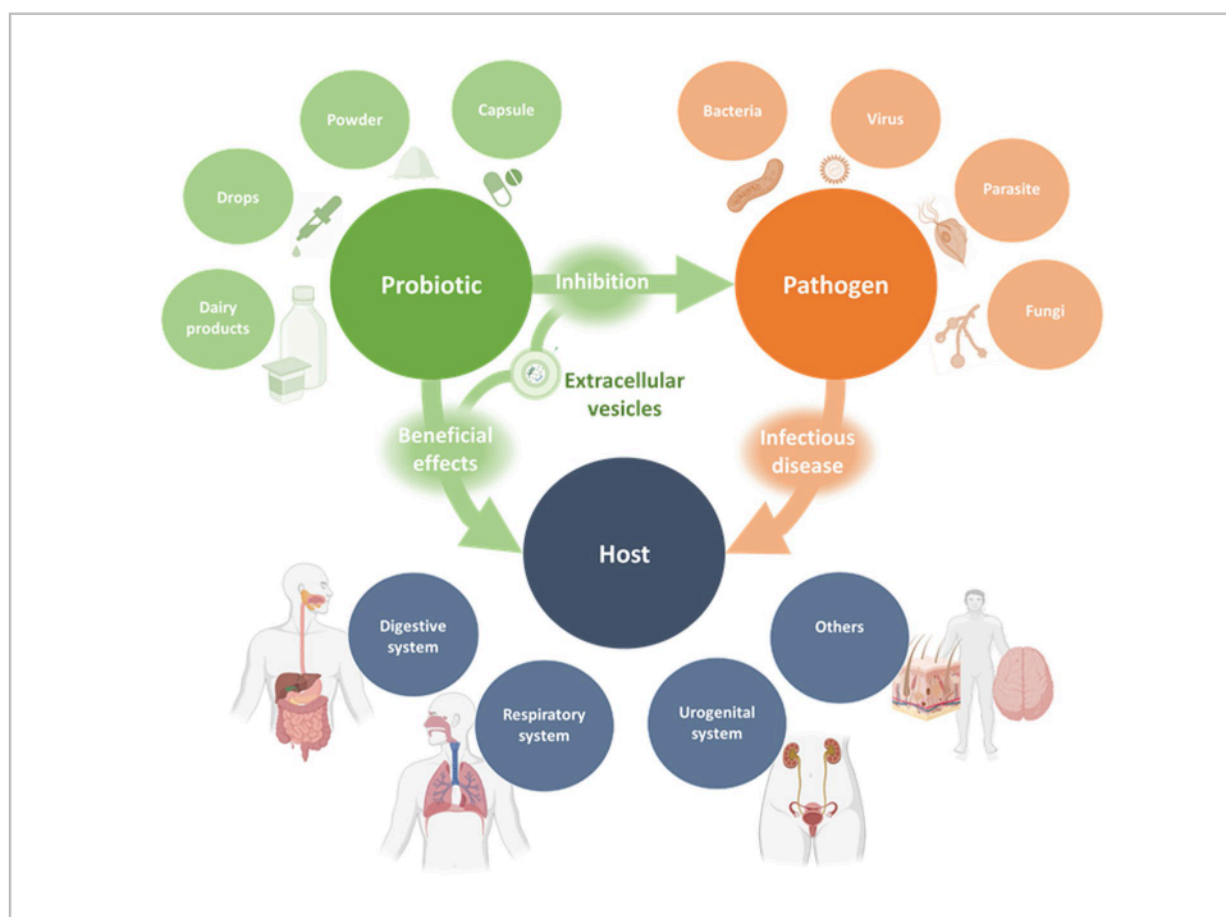


FIGURE 2 | Overview of interactions between probiotics, pathogens, and the host. Probiotics, delivered in various forms, support host defence against infections—either by directly inhibiting pathogens or indirectly through immune modulation, partly via extracellular vesicles (EVs) [1].

POTENTIAL IN COMBATING ANTIBIOTIC RESISTANCE

The global rise of antibiotic-resistant bacteria necessitates alternative therapeutic strategies, and probiotic-derived EVs present a promising solution. Some EVs contain intrinsic antimicrobial agents that can directly inhibit or kill resistant pathogens. Others act indirectly by disrupting bacterial biofilm formation—a key factor in resistance development. EVs can also downregulate the expression of virulence genes in pathogens, reducing their ability to cause disease [11]. Notably, EVs have shown synergistic effects with conventional antibiotics. By enhancing antibiotic delivery or increasing pathogen susceptibility, they can reduce the effective dose required for treatment. This helps lower the selective pressure for resistance development.

Additionally, EVs contribute to microbiota restoration following antibiotic use. A balanced gut microbiome is crucial

for limiting the overgrowth of resistant strains and maintaining overall host immunity.

SAFETY AND FUTURE PROSPECTS

One of the major advantages of using probiotic EVs over live bacteria is safety. Since EVs are non-replicative and cell-free, they eliminate risks associated with live probiotic administration, such as horizontal gene transfer or unintended colonization. Moreover, they are easier to standardize and modify for specific therapeutic goals. Despite these advantages, several challenges remain. The heterogeneity of EVs, influenced by bacterial strain, culture conditions, and isolation methods, can affect their consistency and efficacy. Standardized protocols for EV production, characterization, and storage are essential for their successful clinical application.

Advances in biotechnology, including CRISPR editing and nanocarrier design, may allow for customized EVs tailored to target specific diseases. Clinical trials are needed to evaluate their safety and effectiveness in humans, and regulatory frameworks must be developed to oversee their therapeutic use.

CONCLUSION

Probiotic-derived extracellular vesicles offer a powerful new approach to disease prevention and treatment. By modulating immune responses, enhancing antimicrobial defense, and supporting microbiota balance, they represent a bridge between probiotic therapy and nanomedicine. Their unique advantages—non-replicative nature, bioactive cargo, and capacity for targeted delivery—make them ideal candidates for tackling modern health challenges such as autoimmune disorders, infectious diseases, and antibiotic resistance. As research progresses, these tiny vesicles may revolutionize how we harness beneficial microbes for human health.

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THE EVOLUTION OF INDOLE CHEMISTRY: SYNTHETIC METHODS AND THERAPEUTIC APPLICATIONS

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ABSTRACT

The indole structure, a common and adaptable heterocyclic framework, is crucial in organic chemistry, forming the foundation for numerous natural compounds, drugs, and cutting-edge materials. This article provides a comprehensive overview of indole synthesis methods, tracing their development from traditional to modern approaches. We examine the Fischer indole synthesis, focusing on its historical

importance and mechanistic details, before moving on to explore the reissert indole synthesis, highlighting its specific contributions to creating indole-based compounds. Additionally, the analysis examines cutting-edge techniques such as reactions catalyzed by metals, C-H bond activation strategies, and environmentally friendly synthesis methods, providing an understanding of their operational principles, range of applications, and potential constraints. This thorough

analysis serves as an essential reference for chemists looking to exploit the indole scaffold's capabilities in innovative synthetic endeavors. Several active bioactive molecules, particularly anticancer agents, are made using the indole scaffold. Its presence in natural compounds has interested scientists who study biosynthetic pathways and develop new derivatives. This review provides examples of indole derivatives with various activities, focusing on their potential as anticancer drugs.

INTRODUCTION

Indole, also known as benzopyrone, has a benzenoid nucleus and 10 π -electrons (two from the lone pair on nitrogen and eight from double bonds), which is mainstay in organic chemistry due to widespread nature. The foundational role is reinforced in various bioactive molecules, like alkaloids, hormones and medicinal compounds, demonstrating their importance in various fields, including medicinal chemistry, materials science, and other disciplines [1]. Indole moiety is important in synthetic organic chemistry because it acts as a

fundamental foundational ingredient in the structure of complex natural products and synthetic molecules. Notably, the indole nucleus's insertion into compounds frequently confers beneficial pharmacological effects, making it a target for medicinal chemistry initiatives targeted at addressing various disorders [2]. Electrophilic substitutions are common on indoles, like the benzene ring, due to high π -electrons delocalization. Indole is the most widely distributed heterocycle. The indole nucleus is an important component of many naturally occurring alkaloids, medicines, and other compounds [3].

Adolf Baeyer successfully recovered Indole in 1886 by pyrolyzing oxindole with zinc dust. The precursor, oxindole, was first produced by reducing isatin, which was then removed by oxidizing Indigo (Figure 1). In industrial uses, indoles are made from coal tar [4]. Today, indole synthesis comprises a wide range of techniques, reflecting nearly a century of scientific study and development focused at exploiting the indole structure's inherent reactivity and adaptability for applications in medicinal chemistry, material science, and beyond (Figure 2).

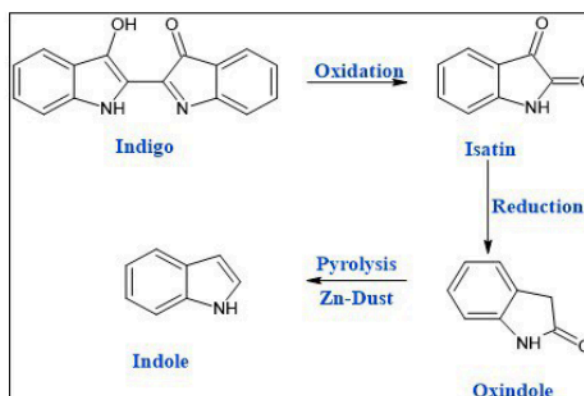


Figure 1: Indole synthesis from indigo

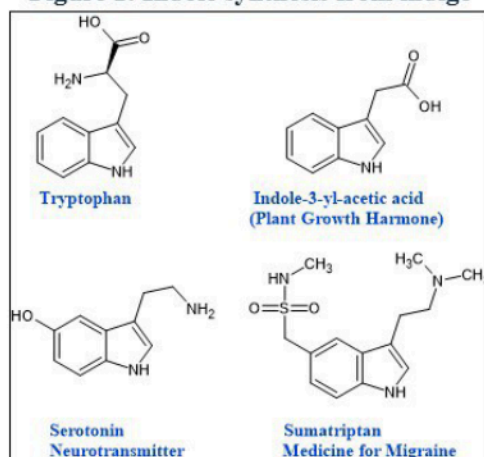


Figure 2: Indole pharmacophores

SYNTHETIC STRATEGIES OF INDOLE

CATALYZED VAPOR PHASE REACTION

Aniline (1) and ethylene glycol at 200 to 500°C presence of catalyst produce indole (2) and the scheme given in figure

THE FISCHER INDOLE SYNTHESIS

A method for creating indoles by incorporating two or three substituents onto a base molecule. This process involves heating an arylhydrazine (3) with an aldehyde or ketone, followed by an acid-catalyzed rearrangement of the resulting arylhydrazone. The final step produces an indole with the release of ammonia as a byproduct. Research has deepened the understanding of cyclization, enhancing regioselective indole synthesis (4) and reaction efficiency and yield and scheme given in figure 4 [5]

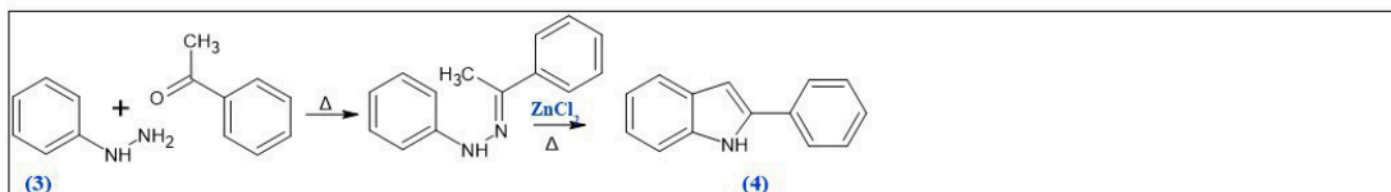


Figure 4: The Fischer indole synthesis from phenyl hydrazine and carbonyl compounds

MADELUNG INDOLE SYNTHESIS

A method that involves the base-catalyzed ring synthesis of 2-(acylamino)-toluenes (6) under severe circumstances from O-toluidine (5) (usually at temperatures ranging from 250 to 300°C). This approach is limited to the production of basic indoles, such as 2-methyl indoles (7), and cannot handle compounds with sensitive functional groups and scheme shown in figure 5 [6-8].

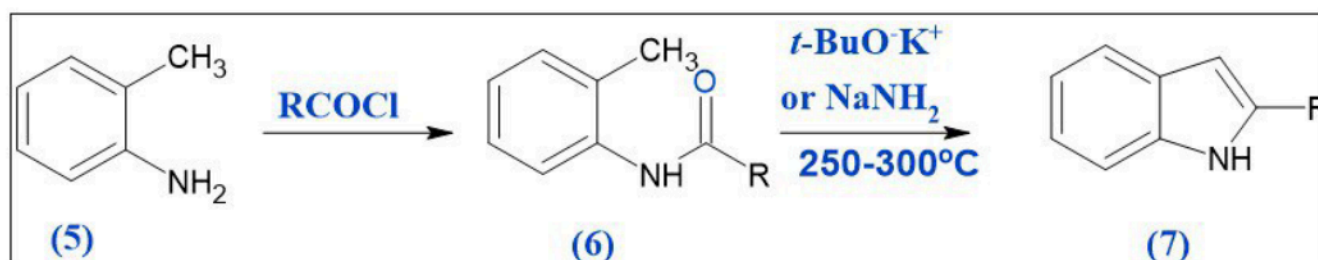


Figure 1: Madelung indole synthesis from O-toluidine and acyl chloride

REISSERT INDOLE SYNTHESIS

A base-catalyzed reaction between o-nitrotoluene (8) and oxalic ester (methyl oxalate) results in o-nitrophenylpyruvic ester (9), the nitro group is reduced to generate an amino group (10) and cyclization, producing indole-2-carboxylic acid, followed by decarboxylation gives indole (2) and scheme shown in figure 6 [9-10].

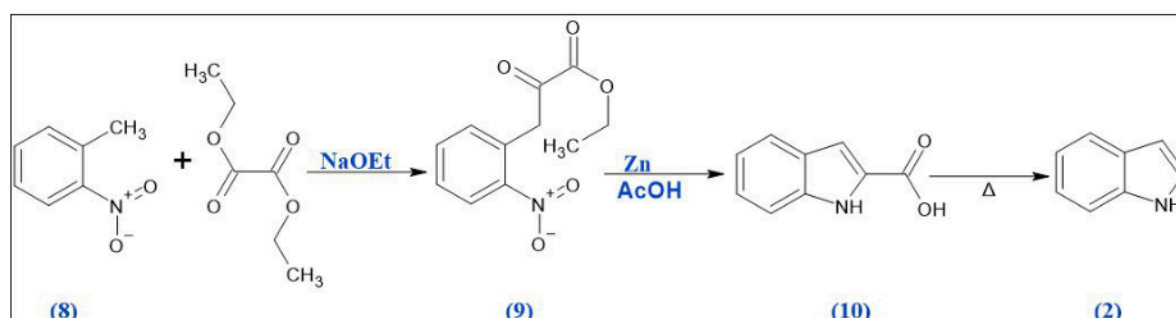


Figure 6: Reissert indole synthesis from O-nitro toluene and oxalic ester

RESULTS AND DISCUSSION

When a substituted phenyl hydrazine reacts with an aldehyde or ketone, it creates a phenylhydrazone, which then isomerizes to the corresponding enamine (ene-hydrazine). After protonation, a cyclic [3,3]-sigmatropic rearrangement results in an imine. Acid catalysis removes NH_3 from the resultant imine, forming a cyclic amino acetal and an energetically advantageous aromatic indole. The Robinson mechanism outlines three phases in this reaction: (a) converting hydrazone to ene-hydrazine, (b) forming carbon-carbon bonds, (c) cyclization with ammonia, elimination, and indole synthesis.

In the last few decades, numerous research organizations have focused on the study and clinical applications of indole-based compounds, which are abundant in nature. Additionally, it is certain that efforts have been made to develop and synthesize novel indole derivatives that provide favourable structural

characteristics for its many therapeutic uses, such as inflammatory, viral, and, most importantly, cancerous illnesses.

CONCLUSION

To summarize, the indole moiety is a significant and adaptable structure in organic synthesis, with applications ranging from natural products to medications and sophisticated materials. This review addressed indole synthesis strategies, ranging from classic to current. Indole-based compounds occur naturally and have been the subject of extensive investigation for many years. New indole derivatives have been developed for clinical applications, particularly in viral, inflammatory, and cancer disorders, which are major concerns today.

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Global pharmaceutical industries are shifting towards biotechnological research

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Biotech is at the centre of the fast-changing world of pharmaceuticals. Small-molecule medications are still very important, but we're witnessing a genuine movement towards therapies like monoclonal antibodies, gene therapy, and even personalised medicine. A lot of this shift is because we need to find new ways to treat diseases that regular pharmaceuticals don't work well on, such cancer, autoimmune diseases, and unusual genetic abnormalities. Biotech is obviously ramping up to cover some big gaps, but chemical medications aren't going away [1].

One important reason for this change is that biotech therapies may be considerably more specific and focused. Many biotech medicines are made to target specific molecules or cells, which helps cut down on side effects and makes them operate better. This is different from traditional chemical medications, which impact the whole body. Monoclonal antibodies, for example, may target cancer cells without hurting healthy ones. This has completely changed the way cancer is treated. During the COVID-19 pandemic, we also observed how quickly mRNA technology could be employed to make vaccinations that worked. It highlighted how strong and adaptable biotech is in real time [2].

Successful partnerships between biotech startups and major pharmaceutical companies have also fuelled the growth of the biotech industry. Increasingly, large drug companies are acquiring or investing in smaller, more innovative firms to gain access to cutting-edge technology and promising new research. This has led to a rise in mergers, licensing deals, and strategic collaborations across the industry. For big pharmaceutical companies, it's a smart strategy to stay competitive and expand their pipeline with fresh, groundbreaking therapies [3].

Advancements in genetics, bioinformatics, and precision medicine are also making it easier to develop treatments tailored to individual patients. Thanks to biotechnology, doctors can now customize therapies based on a person's genetic profile, leading to better outcomes and fewer side

effects. As DNA sequencing becomes more affordable and widely accessible, biopharma companies are harnessing this wealth of genetic and health data to create more precise, personalized medicines that truly align with each patient's unique biology [4].

Recent progress in biotechnological medicines compared to chemical ones

Compared to regular chemical pharmaceuticals, biotech medicines have gone a long way and are now having a huge effect. Biotech therapies, also known as biologics, are significantly bigger than small-molecule pharmaceuticals and are generated from live cells. Small-molecule drugs are made using chemical procedures. They are interesting because they can target illnesses more accurately, which frequently leads to greater results and fewer adverse effects. These new medicines are transforming the way we treat a lot of complicated disorders that earlier medications didn't work as well on.

Monoclonal antibody treatment is one of the most important advances in medicine. It is currently a main way to treat a lot of tumours, autoimmune illnesses, and infections. These antibodies are distinct from regular chemical medications since they exclusively target certain markers identified on sick cells. This protects healthy tissue from injury. Trastuzumab is used to treat a particular kind of breast cancer, while adalimumab helps persons with rheumatoid arthritis [5].

Another major advancement in biotechnology is gene therapy. This approach uses advanced techniques to correct or replace faulty genes responsible for certain diseases. Unlike traditional chemical medications, which typically manage symptoms and require ongoing use, gene therapy has the potential to offer long-term — and in some cases, one-time — cures.

For example, Zolgensma is a gene therapy that treats spinal muscular atrophy (SMA) with a single infusion, and Luxturna addresses certain inherited forms of vision loss caused by mutations in the RPE65 gene. These breakthroughs represent

a fundamental shift in how some genetic diseases can be treated — aiming to fix the root cause rather than just alleviate symptoms.

Many people first became aware of mRNA therapeutics through the rapid development of COVID-19 vaccines from Pfizer-BioNTech and Moderna. These innovative medicines work by instructing cells to produce specific proteins that either stimulate an immune response or combat disease. Thanks to their flexibility, mRNA therapeutics can be developed quickly and scaled up efficiently — a feature that proved crucial during the pandemic [6].

Looking ahead, scientists are exploring mRNA technology for a wide range of applications, including vaccines for cancer, rare genetic disorders, and even cardiovascular diseases. This platform represents a new era in medicine, offering targeted, adaptable, and fast-to-develop treatment options.

Another breakthrough in biotechnology is CAR-T cell therapy, which has made remarkable progress, particularly in the treatment of blood cancers. This innovative approach involves collecting a patient's own immune cells (T cells), genetically

modifying them to recognize and attack cancer cells, and then infusing them back into the patient's body. No traditional chemical drugs have matched this level of precision or lasting therapeutic effect, especially in hard-to-treat malignancies like certain leukemias and lymphomas.

In summary, biotechnology-based medicines are providing innovative treatment options for conditions that traditional chemical therapies have struggled to address. They offer the potential to treat previously untreatable diseases, deliver personalized therapies tailored to individual patients, and introduce groundbreaking therapeutic solutions.

While challenges such as high costs, complex manufacturing processes, and regulatory hurdles remain, the precision and promise of biotechnology continue to reshape the future of healthcare, paving the way for more effective, targeted, and durable treatments [7].

Biological products from the last several years

These items show how varied and advanced contemporary biological breakthroughs are, from gene and cell treatments to monoclonal antibodies and RNA-based medications.

Tofersen (Qalsody)

Approved: 2023 (FDA, USA)

Indication: Amyotrophic Lateral Sclerosis (ALS) associated with SOD1 mutation

Type: Antisense oligonucleotide (ASO)

Significance: It targets and reduces the production of toxic SOD1

protein in patients with a rare genetic form of ALS.

This is one of the few precision treatments for neurodegenerative diseases.

Leqembi (Lecanemab)

Approved: 2023 (FDA, USA)

Indication: Alzheimer's Disease

Type: Monoclonal antibody

Significance: Leqembi targets and removes beta-amyloid plaques in the brain. It represents a new class of disease-modifying therapies for Alzheimer's.

Hemgenix (etranacogene dezaparvovec)

Approved: 2022 (FDA, EMA)

Indication: Hemophilia B

Type: Gene therapy (AAV vector-based)

Significance: First gene therapy approved for Hemophilia B.

Roctavian (valoctocogene oxaparvovec)

Approved: 2023 (EMA, FDA)

Indication: Hemophilia A

Type: Gene therapy

Significance: This is the first gene therapy for Hemophilia A.

Beyfortus (Nirsevimab)

Approved: 2022 (EMA), 2023 (FDA)

Indication: Respiratory Syncytial Virus (RSV) prevention in infants

Type: Long-acting monoclonal antibody

Significance: Unlike traditional vaccines, Beyfortus offers passive

immunity by directly providing antibodies to protect

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The Genetic Blueprint for Precision Medicine: Tailoring Therapeutics to Individual Profiles

Aadarsh

B. Pharm Vth Sem.



INTRODUCTION:

Selling generic versions of popular medications generates enormous profits for the pharmaceutical industry. However, the development of personalized medications that address individuals according to their unique genetic composition is currently a top priority [1].

In order to find the subtle hereditary variations that put certain people at a higher risk of developing a disease, pharmaceutical corporations are working to compile a map of genetic markers. The pharmaceutical industry is eager to use this information to create safer, more effective medications that can target the unique biological features of each big illness with more precision. They want to reap enormous financial rewards well into the next century from their bountiful harvest of individualized pharmaceuticals [1,2].

An expert in human biology, John Keller, states that "distinguishing the large genetic variability among

individuals" is one of the most pressing issues facing the field at the moment. Keller works for the British American pharmaceutical corporation SmithKline Beecham PLC. In recent years, the field of medicine has experienced a paradigm shift, moving from the traditional "one-size-fits-all" approach to a more individualized strategy known as precision medicine. At the core of this transformation lies the utilization of genetic information to tailor therapeutic interventions that align with an individual's unique biological makeup. This personalized approach promises to enhance the effectiveness of treatments, minimize adverse effects, and revolutionize how we manage a range of complex diseases [1,3].

UNDERSTANDING PRECISION MEDICINE

Personalised medicine and precision medicine are terms that describe the same thing: tailoring medical treatment to each patient according to their unique set of circumstances,

including their genetic makeup, their surroundings, and their way of life. Precision medicine focusses emphasis on the unique biological pathways that impact illness development and therapy response in every individual patient, as opposed to traditional medicine's tendency to address huge populations as a whole.

Precision medicine can only be successful if the human genome can be understood. Bioinformatics techniques, genome-wide association studies (GWAS), and next-generation sequencing (NGS) have allowed researchers to pinpoint genetic variations associated with illnesses and medication responses with a level of precision never seen before [4].

THE ROLE OF THE HUMAN GENOME IN DRUG RESPONSE

In the area of study known as pharmacogenomics, our genetic composition considerably affects the way medications are metabolised. Changes in the efficiency and safety of drugs may be brought about by variations in genes that code for enzymes, transporters, and receptors that break down drugs. As an example, the effectiveness of the antiplatelet medication clopidogrel might vary from one person to another due to polymorphisms in the CYP2C19 gene. The risk of cardiovascular events is increased in patients with reduced-function alleles because their drugs may not be activated optimally [5].

Personalization of Medicine

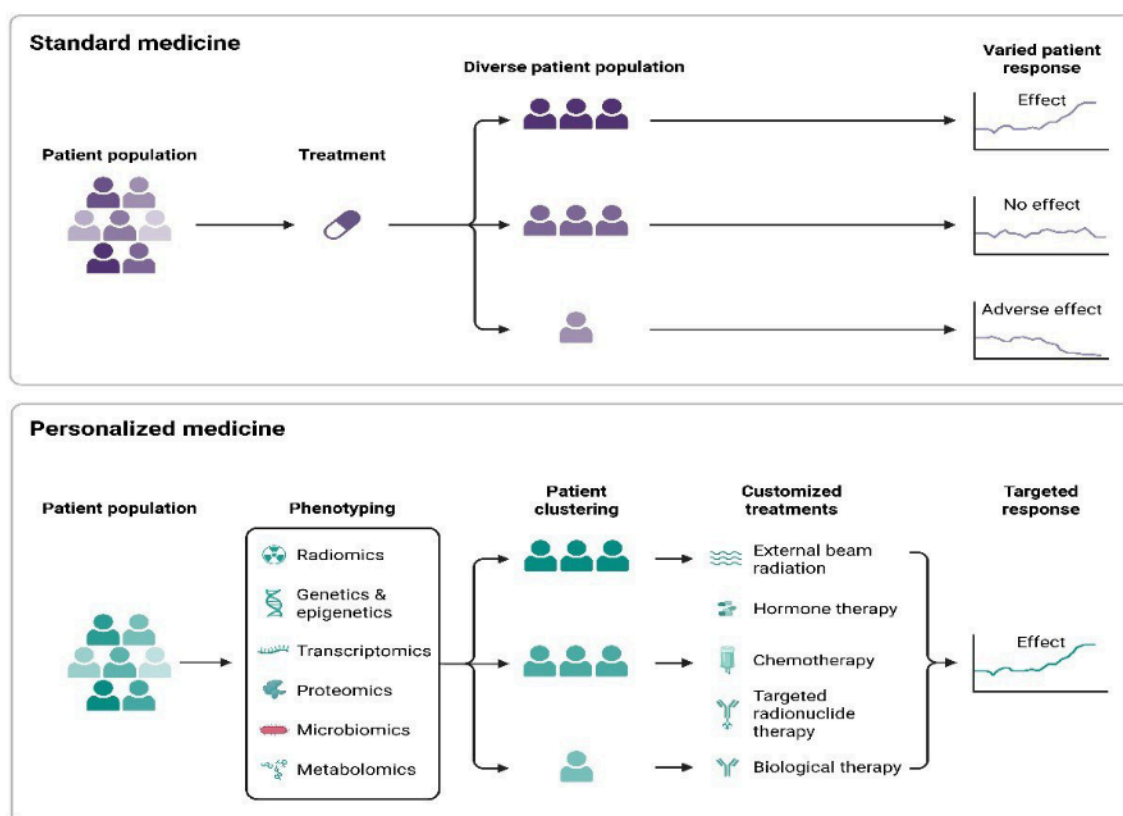


Figure 1: Personalization of Medicine: Standard vs. Personalized Approach

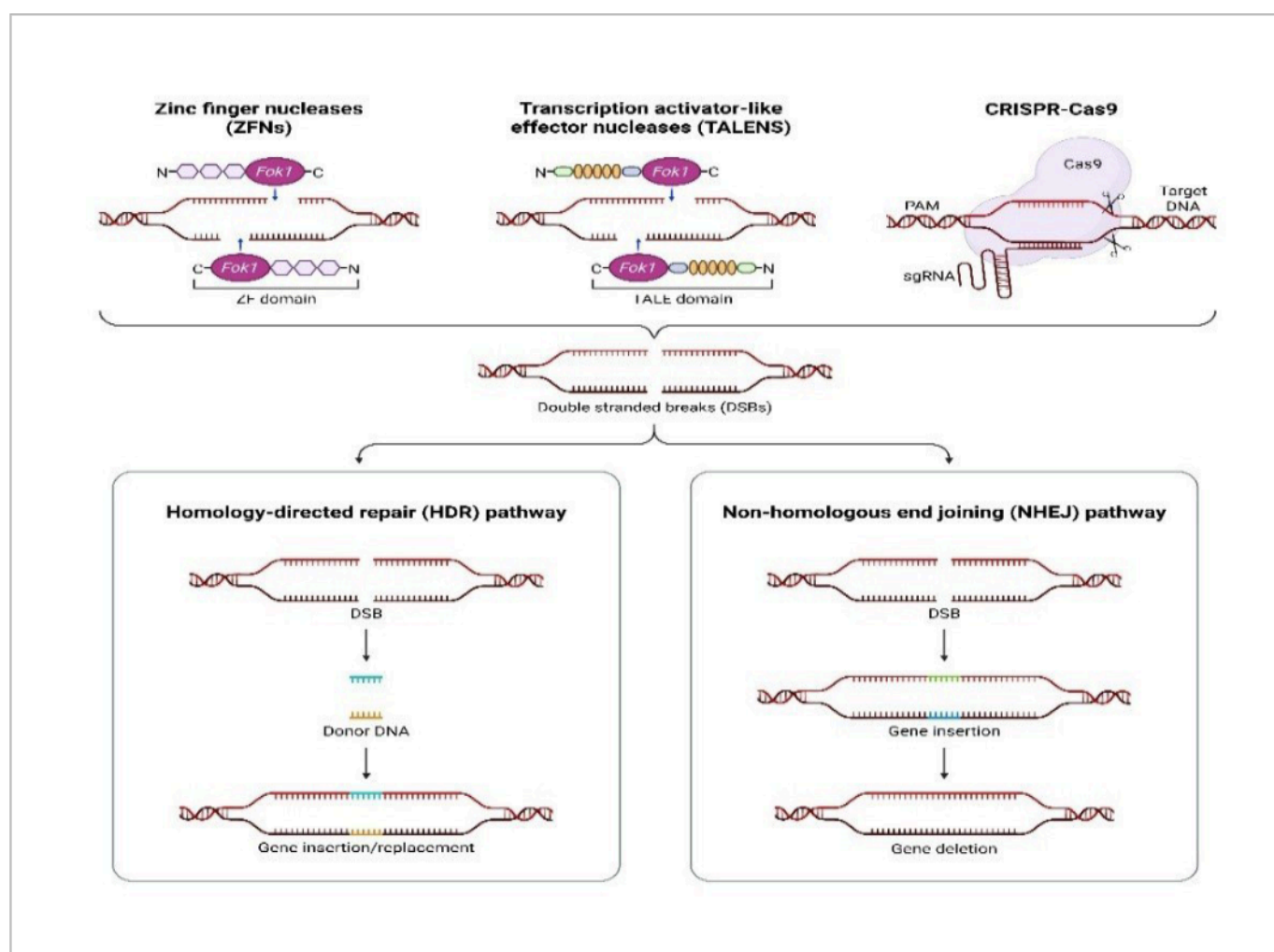


Figure 2: Mechanism illustrating the targeted deletion of a damaged gene segment

It shows the molecular process by which a damaged or mutated gene segment is recognized and removed through targeted mechanisms such as CRISPR-Cas9, endonuclease-mediated cleavage, or natural DNA repair pathways. It highlights steps including DNA damage recognition, cleavage of the faulty gene region, and possible replacement or repair using a template.

One further example that is often mentioned is the HER2 gene and its role in breast cancer. The monoclonal antibody trastuzumab is more effective in treating patients whose tumours overexpress HER2. Such tailored treatments would be ineffective or perhaps dangerous for certain individuals if HER2 testing weren't available [6].

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The author sincerely thanks Amity Institute of Pharmacy, Amity University, Gwalior Madhya Pradesh, India for their constant support and valuable suggestions in completing this manuscript.

DISEASE-SPECIFIC APPLICATIONS

ONCOLOGY

Presumably, precision medicine has had the greatest impact on cancer care. Genetic testing and tumour profiling have made it possible for doctors to categorize malignancies according to molecular traits rather than specific tissue origin. Tyrosine kinase inhibitors for melanoma or BRAF inhibitors for EGFR-mutated lung cancer are examples of tailored medicines made

possible by this method [7,8].

NEUROLOGY

One area where precision medicine is paving the way for personalised treatment and early detection is in neurodegenerative illnesses. As an example, having the APOE 4 allele raises the likelihood of developing Alzheimer's disease, which implies that those who have this gene might reap the

benefits of neuroprotective lifestyle changes or pharmaceuticals [9,10]

INFECTIOUS DISEASES

Management of infectious diseases is another area that might benefit from precision medicine. An area of ongoing study, for instance, is the use of host genetic data to predict susceptibility to infections or responsiveness to antiviral medication. In HIV therapy, the detection of the HLA-B*57:01 allele aids in the prevention of hypersensitivity responses to abacavir [11].

CHALLENGES IN IMPLEMENTATION

Precision medicine has great promise, yet there are hurdles to its broad implementation:

3.1. DATA PRIVACY AND ETHICAL CONSIDERATIONS:

Analyzing genetic data brings up questions about privacy, informed permission, and possible abuse.

3.2. THE PRICE AND AVAILABILITY OF GENETIC TESTING AND

TAILORED TREATMENTS: in areas with limited resources, these options may not be within reach due to their high cost.

3.3. CLINICIAN INVOLVEMENT: Few healthcare systems have the resources or personnel to decipher genetic data and incorporate it into standard treatment.

3.4. PROBLEMS WITH REGULATION AND INSURANCE

REIMBURSEMENT: The laws governing genetic testing and

insurance reimbursement procedures are still unclear.

4. FUTURE OUTLOOK & CONCLUSION

One anticipated outcome of the current technological trend is the inevitable incorporation of precision medicine into standard clinical operation. It will be easier for doctors to make decisions when genomic sequencing becomes more affordable and when EHRs that can store and analyze genetic information become more widely used.

Machine learning and artificial intelligence (AI) are also being used to decipher complicated genetic data, which assists in the search for new biomarkers and potential treatment targets. Further, the National Institutes of Health's "All of Us" study program is only one example of a large-scale effort to gather health and genetic data from many groups to make precision medicine more applicable to the broader public [12].

The answer to a more accurate and successful type of therapy lies in the genetic blueprint contained in every human. Through the use of genetics and data analytics, precision medicine is bringing about a new age where personalized profiles, rather than averages, will determine medicines. There are still obstacles, but the healthcare system of the future might be drastically different if genetic insights are used in clinical practice.

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Bioprinting Tissues and Organs: A Revolutionary Leap in Biomedical Science “When innovation bleeds into imagination- and saves lives”

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B. Pharm IIIrd Sem.



Introduction

3D bioprinting, a transformative fusion of additive manufacturing and biotechnology, is revolutionizing healthcare by enabling the fabrication of living tissues and organs. Below is a comprehensive overview of its advancements, applications, challenges, and future potential, synthesized from the latest research and market insights [1]. To replicate the intricate and varied structure of functional tissues or organs, a detailed understanding of their composition and organization is critical. Medical imaging technologies, such as computed tomography (CT) and magnetic resonance imaging (MRI), play a vital role by offering non-invasive insights into 3D structure and function across cellular, tissue, organ, and whole-body levels. These imaging techniques help in designing patient-specific constructs. Additionally, computer-aided design (CAD), computer-aided manufacturing (CAM) tools, and mathematical modelling are employed to gather and digitize complex structural data [2,3].

The 3D model of the tissue or organ is segmented into 2D horizontal layers, which are then fed into a 3D bioprinter for layer-by-layer assembly. The choice of 3D bioprinting methods, cell types (differentiated or undifferentiated), biomaterials (synthetic or natural), and supporting biochemical factors determines the final tissue or organ construction. By combining imaging, design, and fabrication, this integrated approach enables the recreation of sophisticated 3D organ structures, incorporating essential mechanical and biochemical cues that define the organ's architecture [2,3].

All tissues and organs consist of cells embedded within their

extracellular matrix (ECM)—a dynamic, tissue-specific network of structural and functional molecules secreted by the cells themselves. While tissues are often described as cells supported by a stromal framework, the ECM does more than just provide structural integrity and shape. It engages in a continuous, bidirectional interaction with resident cells, influencing their phenotype, gene expression, protein production, and function based on microenvironmental conditions such as oxygen levels, pH, mechanical forces, and biochemical signals. In response, cells secrete the necessary molecules to survive, function, and communicate with neighbouring cells. This reciprocal relationship is crucial for both prenatal development and postnatal tissue maintenance [4]. Beyond its developmental and homeostatic roles, the ECM can also serve as a bioactive scaffold that promotes regenerative healing after injury. It achieves this by releasing hidden peptides that attract and stimulate stem and progenitor cells, modulating immune responses, and providing tissue-specific molecular cues that guide cell behaviour. These properties make native ECM an optimal scaffold for tissue and organ reconstruction [4].

Current Applications and Achievements of 3D Bioprinting

While the bioprinting of fully functional, transplantable organs remains a long-term goal, significant progress has been made in applying this technology to clinical and research settings. Below are some of the most notable advancements:

Skin Grafts

Bio printed skin is one of the most advanced applications, offering promising solutions for burn victims and patients with

chronic wounds (e.g., diabetic ulcers). Researchers can layer keratinocytes, fibroblasts, and other skin cells with biomaterials to create living, multi-layered skin substitutes. These grafts not only provide wound coverage but also promote natural healing by integrating with the patient's own tissue. Companies like Organovo and Poietis have developed bio printed skin models for both therapeutic use and cosmetic testing [7].

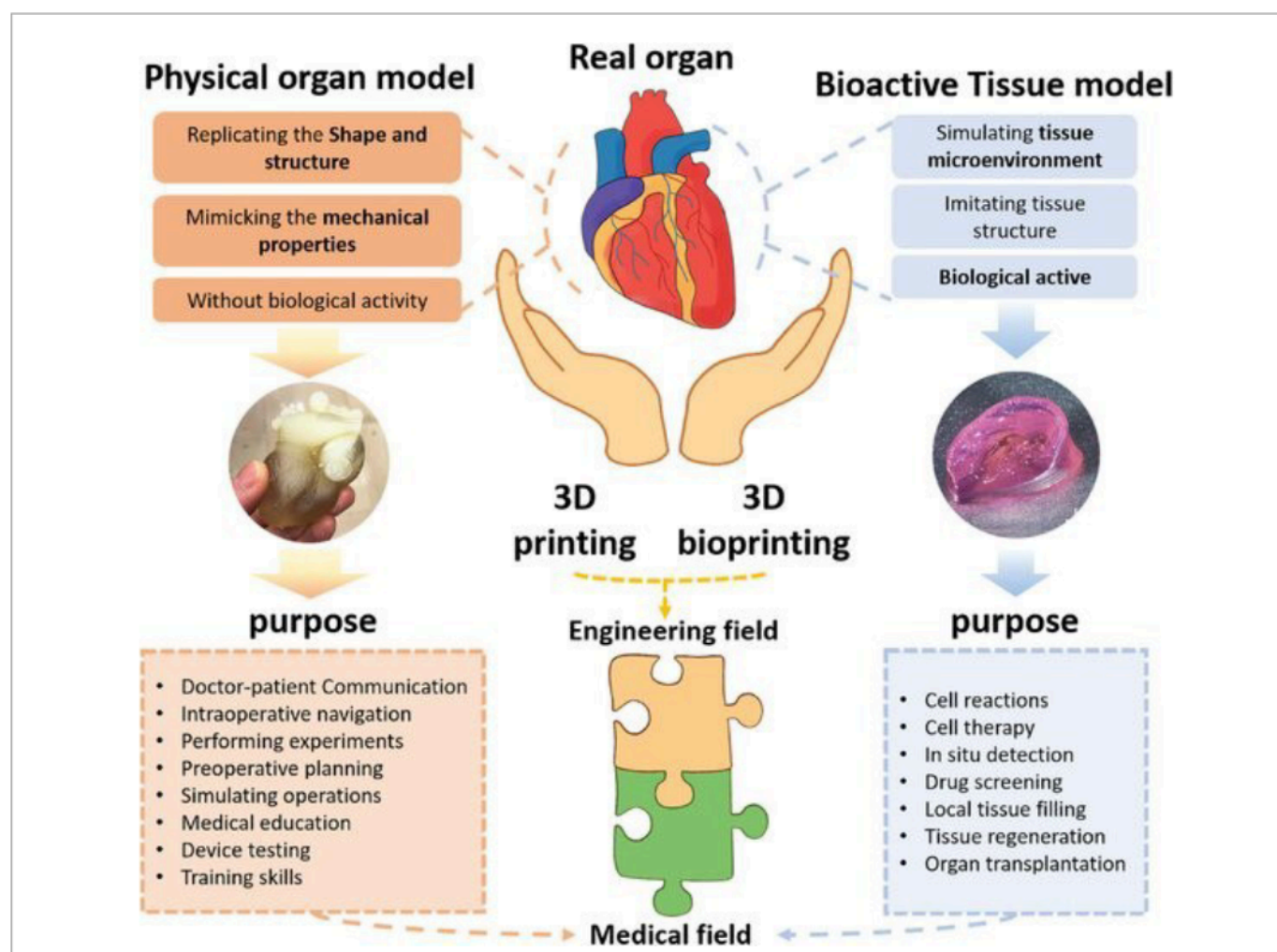


Figure 1: "The difference between organ model and tissue model (e.g., tissue/organ construct. Reproduced with permission. Copyright 2019, IOP Publishing), where 3D printing and 3D bioprinting play their respective roles.

CARTILAGE AND BONE STRUCTURES

Bioprinting has enabled the fabrication of patient-specific cartilage and bone implants for reconstructive and orthopaedic surgeries. For instance, 3D-printed cartilage is being tested for nasal and ear reconstructions, while bio printed bone scaffolds-often combined with stem cells and growth factors-are used to repair fractures or defects. The ability to customize shape and porosity enhances integration with natural tissue, reducing rejection risks [5].

CORNEAL TISSUE

Bio printed corneas are being developed to address the global shortage of donor corneas for vision-impaired patients. Scientists use bioinks containing collagen and

corneal stromal cells to create transparent, curvature-matched corneal substitutes. Early studies suggest these bio printed corneas could restore vision in cases of injury or disease, with ongoing research improving their mechanical stability and optical clarity [6].

MINIATURE LIVER MODELS

Pharmaceutical companies and research labs use 3D-bioprinted liver tissues for drug toxicity testing and disease modelling. Unlike traditional 2D cell cultures, these mini livers better replicate human liver function, allowing more accurate predictions of drug metabolism and side effects. This reduces reliance on animal testing and accelerates drug development [9].

ORGAN-ON-A-CHIP SYSTEMS

While not full organs, organ-on-a-chip (OoC) platforms integrate bio printed tissues with microfluidic systems to mimic organ-level functions. These devices are used to study disease mechanisms, test drug efficacy, and investigate personalized medicine approaches.[8]

Examples include:

- Heart-on-a-chip (for cardiac drug testing)
- Lung-on-a-chip (to model respiratory diseases)
- Gut-on-a-chip (for microbiome and absorption studies)

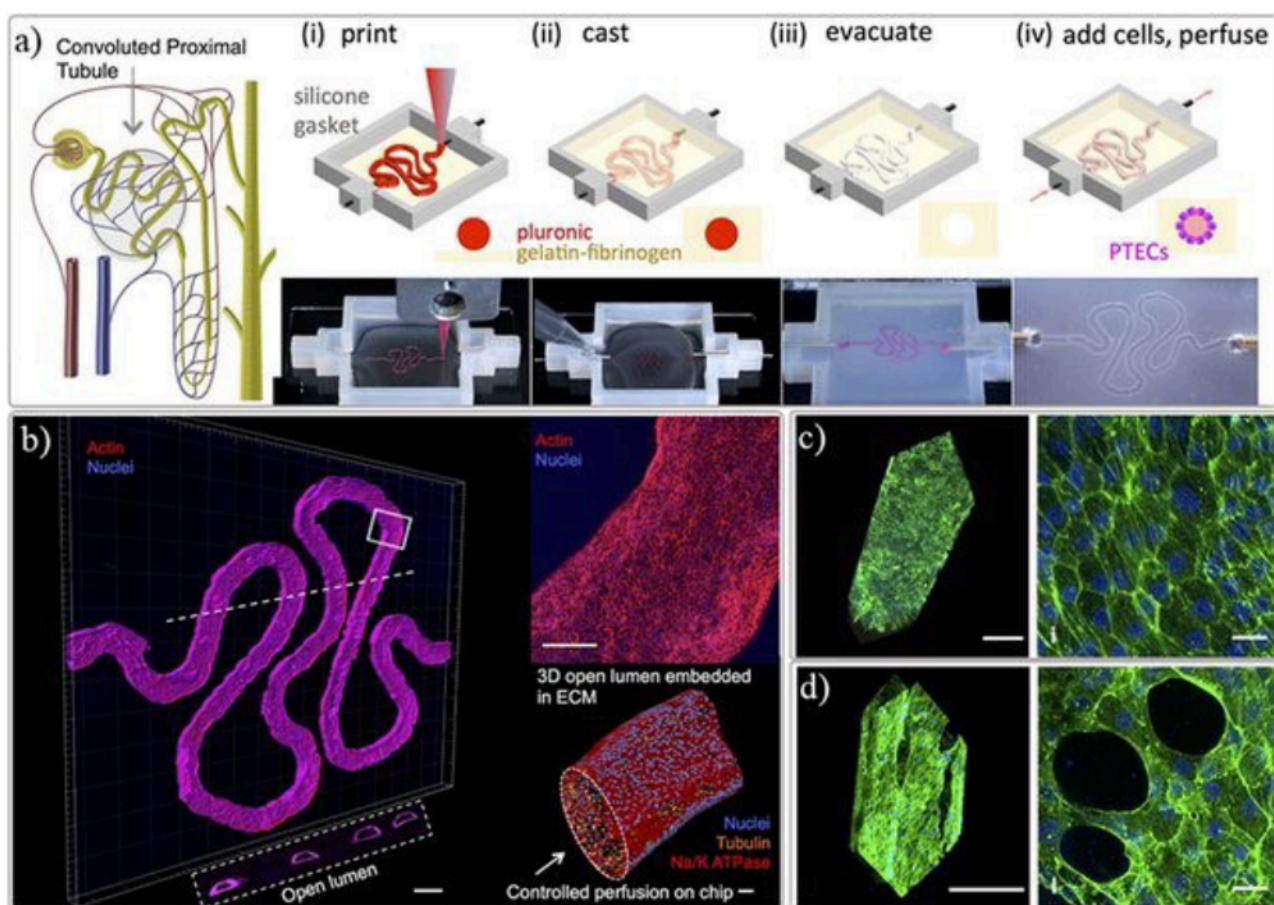


FIGURE 2.

Renal proximal tubule in vitro model within perfusable chip (A) manufacturing strategy using sacrificial 3D printing to create hollow channel after post-encapsulation with a gelatin-fibrin extracellular matrix hydrogel, (B) proximal tubule-like fully epithelialized after post-seeding and cultured with proximal tubule epithelial cells (PTECs), (C) control group of tubule model used to screen the toxicity effect of cyclosporine A and (D) disrupted epithelial barrier observed when model was exposed with a high concentration (100 μM) of the chemical compound. Adapted with permission from ref.

CONCLUSION

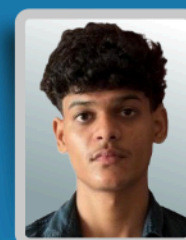
3D bioprinting represents a groundbreaking leap in regenerative medicine, enabling the fabrication of functional tissues like skin, cartilage, and mini organs for transplantation, drug testing, and disease modelling. While challenges remain in scaling up to complex organs, advancements in biomaterials, imaging, and bioinks are accelerating progress. This technology holds immense promise for personalized medicine, reducing organ shortages, and revolutionizing biomedical research- ushering in a future where lab-grown tissues and organs transform healthcare.

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CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD) AND SUPERBUGS

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B. Pharm 1st Sem.



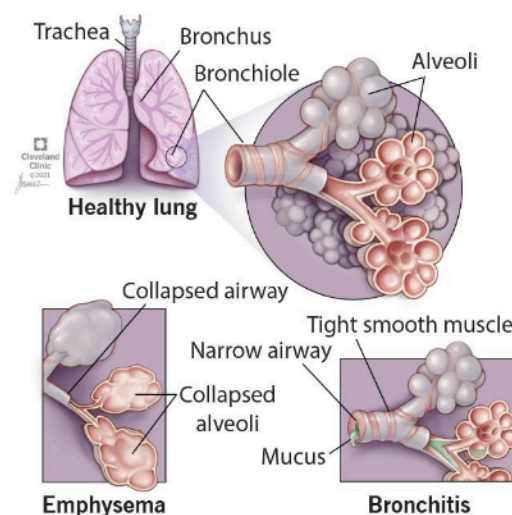
INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory condition characterized by airflow limitation and chronic inflammation of the lungs. It includes diseases such as chronic bronchitis and emphysema. COPD affects millions of people worldwide and is a leading cause of morbidity and mortality. One of the most significant challenges faced by COPD patients is their heightened vulnerability to infections, particularly those caused by multidrug-resistant organisms, often referred to as "superbugs" [1].

COPD AND INFECTION SUSCEPTIBILITY

The airways of COPD patients are often inflamed and structurally compromised, leading to impaired mucociliary clearance and a weakened local immune response. This makes them more susceptible to frequent respiratory infections. These infections can lead to acute exacerbations — sudden worsening of symptoms like breathlessness, coughing, and

Chronic Obstructive Pulmonary Disease (COPD)



sputum production — which accelerate lung function decline, increase hospitalization rates, and raise the risk of death [2].

SUPERBUGS: THE GROWING THREAT

Superbugs are bacteria that have developed resistance to multiple antibiotics, rendering standard treatments ineffective. Common examples include *Pseudomonas aeruginosa*,

Acinetobacter baumannii, *Klebsiella pneumoniae*, and methicillin-resistant *Staphylococcus aureus* (MRSA) [8]. These pathogens are particularly dangerous for COPD patients due to their compromised lung function and frequent hospitalizations, where exposure to drug-resistant bacteria is higher [3].

Infections with superbugs in COPD patients often result in severe complications, prolonged hospital stays, and increased healthcare costs. The challenge is compounded by the fact that many of these infections are difficult to diagnose quickly and require specialized tests to determine antibiotic susceptibility [4].

ANTIBIOTIC USE AND RESISTANCE

A major contributor to the emergence of superbugs is the overuse and misuse of antibiotics. In the context of COPD, antibiotics are often prescribed during exacerbations, even when the cause is viral or non-infectious. This indiscriminate use of antibiotics promotes the development of resistance among bacteria, making future infections harder to treat. Moreover, repeated courses of antibiotics in COPD patients can disrupt the natural microbial balance in the lungs, leading to colonization by resistant organisms [5].

PREVENTION AND MANAGEMENT

To combat the threat of superbugs in COPD, a multifaceted approach is essential. First, accurate diagnosis and appropriate

use of antibiotics are crucial. Guidelines recommend using sputum cultures and biomarkers like procalcitonin to determine if an infection is bacterial before prescribing antibiotics [6].

Second, infection prevention strategies such as vaccination (e.g., influenza and pneumococcal vaccines), smoking cessation, and pulmonary rehabilitation can significantly reduce the frequency and severity of exacerbations. Third, infection control measures in healthcare settings, such as hand hygiene, isolation protocols, and antimicrobial stewardship programs, are vital in preventing the spread of resistant organisms [7,9].

CONCLUSION

The intersection of COPD and superbugs presents a serious public health challenge. With the increasing prevalence of antimicrobial resistance, managing infections in COPD patients has become more complex and dangerous. Judicious antibiotic use, robust infection prevention, and ongoing research into new treatments are essential to protect this vulnerable population and curb the spread of superbugs in the broader community.

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