



Dr. Imran Hussain is currently serving as an Assistant Professor of Bioengineering at Integral University, Lucknow, India, with extensive academic and research experience in biochemistry, molecular biology and cancer biology. He obtained his Master in Agricultural Biotechnology from IIT Kharagpur. He earned his PhD in Biochemistry from the University of Texas at Arlington, USA, and has completed postdoctoral research at the University of Texas Southwestern Medical Center and the University of Oklahoma Health Sciences Center, USA. He has published extensively in reputed international journals, authored and edited academic books, book chapters, and holds multiple granted patents in biomedical and diagnostic technologies.



Dr. Sujeet Pratap Singh is faculty member at the Amity Institute of Biotechnology, Amity University Lucknow, with over 19 years of teaching and research experience in Industrial Biotechnology, Bioprocess Technology, and Microbial Applications. An alumnus of IIT Kharagpur, he has published several research papers and book chapters in reputed international journals and publishers including Springer and CRC Press. He is the co-author/editor of multiple biotechnology textbooks and holds granted patents in healthcare and sustainable technologies. Dr. Singh is actively involved in research, innovation, academic administration, and intellectual property development, and is also the founder of ThinkNew, an IPR-focused startup supporting innovators and researchers.

EMERGING TRENDS IN BIOTECHNOLOGY

Emerging Trends in Biotechnology

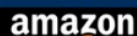


Dr. Imran Hussain
Dr. Sujeet Pratap Singh



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Emerging Trends in Biotechnology

Editors:

Dr. Imran Hussain

Assistant Professor

Department of Bioengineering

Integral University, Lucknow, UP

Dr. Sujeet Pratap Singh

Assistant Professor

Amity Institute of Biotechnology

Amity University, Lucknow, UP



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Preface

Biotechnology stands at the forefront of scientific innovation, transforming the way we understand and interact with living systems. From advancements in genetic engineering and molecular diagnostics to breakthroughs in sustainable agriculture, environmental management, and personalized medicine, the field continues to evolve at an unprecedented pace. The present volume, *Emerging Trends in Biotechnology*, thoughtfully edited by Dr. Imran Hussain and Dr. Sujeet Pratap Singh, brings together diverse perspectives and cutting-edge developments that reflect the dynamic nature of this discipline.

This book offers a comprehensive overview of contemporary research areas, including synthetic biology, bioinformatics, nanobiotechnology, and translational research. It highlights not only the scientific progress achieved in recent years but also the practical applications that address global challenges such as food security, climate change, and human health. By integrating theoretical insights with real-world applications, this volume serves as a valuable resource for students, researchers, and professionals alike.

Dr. Imran Hussain has meticulously curated contributions that emphasize interdisciplinary approaches and innovation-driven research. The chapters presented in this book underscore the

importance of collaboration between academia, industry, and policy frameworks in advancing biotechnology for societal benefit. Moreover, the inclusion of emerging tools such as artificial intelligence and omics technologies reflects the future direction of the field.

I am confident that this book will inspire readers to explore new ideas, foster critical thinking, and contribute to the advancement of biotechnology. It is a timely and significant contribution that will undoubtedly serve as a reference for years to come. I congratulate Dr. Imran Hussain for his dedicated efforts in bringing together this important work and extend my best wishes for its success.

Editors:
Dr. Imran Hussain &
Dr. Sujeet Pratap Singh

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Molecular Insights and Therapeutic Advances in Breast Cancer

*Heena Bano and Rahul Singh **

Department of Bioengineering, Integral University, Lucknow

*Corresponding author: rsingh@iul.ac.in

Abstract

Breast cancer is a complex and heterogeneous disease with multifactorial etiologies encompassing genetic, environmental, and lifestyle factors. It stands as one of the most prevalent malignancies affecting women worldwide, characterized by uncontrolled cell proliferation within the breast tissue. Advances in molecular biology have uncovered significant insights into tumorigenesis, including the pivotal roles of genes such as BRCA1/2, p53, and HER2, alongside critical pathways like apoptosis, autophagy, and necroptosis. Contemporary diagnostic approaches integrate traditional methods such as mammography with sophisticated genomic profiling to enable early detection and personalized treatment planning. Therapeutic strategies have evolved from conventional chemotherapy and surgery to include targeted therapies and immunotherapy, enhancing treatment outcomes. However, challenges such as drug resistance, tumor recurrence, and treatment side effects persist. This chapter aims to provide a detailed overview of the mechanisms underlying breast cancer development, molecular diagnostics, current therapeutic interventions, and emerging treatment paradigms.

Keywords: Breast cancer, Breast cancer mechanism, HER2, Signaling pathways, Therapeutic interventions, Diagnosis