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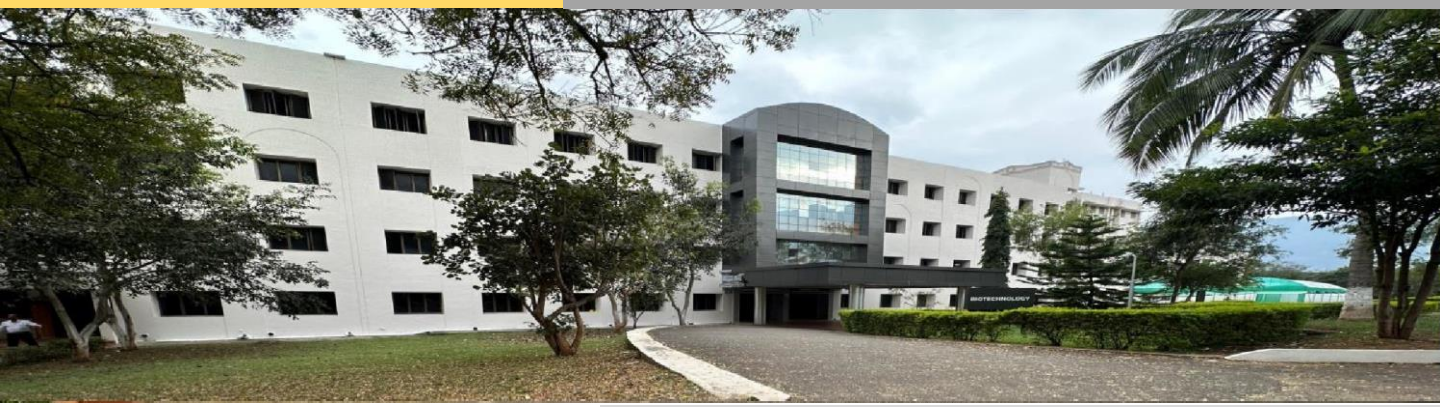
# BIOLUMIERE

Newsletter by the Division of Biotechnology



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## CONVERGING BIOPRINTING AND ORGANOIDS TO BETTER RECAPITULATE THE TUMOR MICROENVIRONMENT

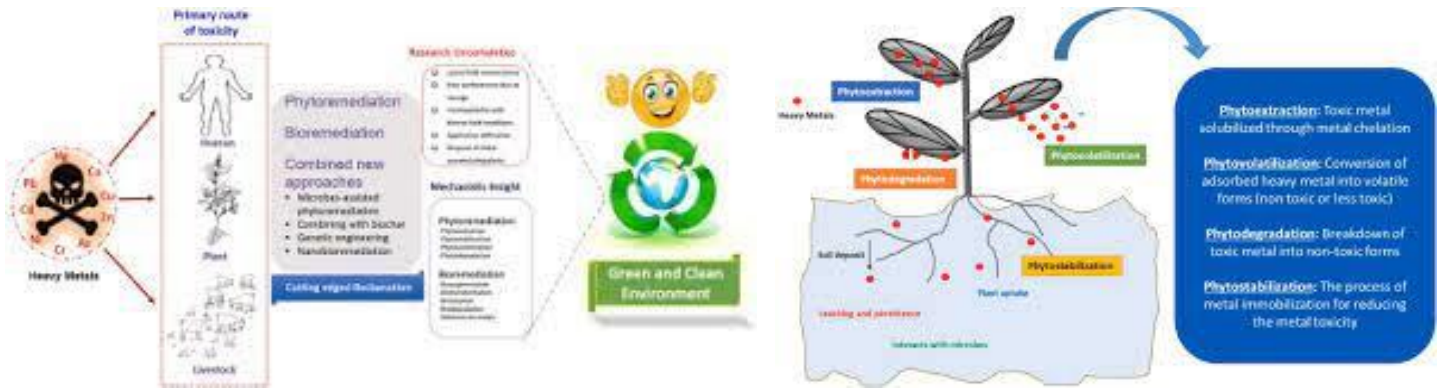
Recently, the use of Tumour organoids in bioprinting models has evolved an innovative approach that simulates volumetric tumor tissues. Bioprinting shows exceptional potential for preclinical tumor modeling, with significant advantages in 2D cell cultures replicating the tumor microenvironment (TME). Bioprinting can replicate the TME more effectively by providing a tumor-specific extracellular matrix (ECM), biophysical properties, and precise geometric architecture. Furthermore, the potential to incorporate organ-on-a-chip with bioprinting tumor organoids to improve the biomimicry and predictability of therapeutic performance are discussed whereas Organ-on-a-chip comprises complex chambers and microchannels that can interconnected to simulate multiorgan communication and enable dynamic fluidic circulation. This allows the manipulation of physical and biochemical signals of TME. Incorporating tumor-on-a-chip and 3D bioprinting enables the reproduction of vascular perfusion and microcirculation systems. The design of 3D bioprinting tumor models involves essential considerations regarding assembly strategy, selection of cellular building blocks, and replication of complicated characteristics.

RUTH SHARON M P [URK21BT1007]

## BIOLOGICAL AND GREEN REMEDIATION OF HEAVY METAL CONTAMINATED WATER AND SOILS: A STATE-OF-THE-ART REVIEW

Contamination by heavy metals, organic pollutants, and hazardous waste has dire consequences for ecosystems and organism health. Current chemical and physical treatments face challenges due to extended timelines, high costs, and inefficacy in highly contaminated areas. Bioremediation, using biological mechanisms with microorganisms and plants, emerges as a cost-effective and eco-friendly solution, garnering attention for its high efficacy and the abundance of biological materials. This report reviews and discusses biological and green remediation tactics, technological advances, and applications for heavy metal remediation in soil and water. Employing a modified PRISMA review protocol, the study critically assesses research gaps, offering a schematic illustration of bioremediation mechanisms. It underscores the method's potential as a low-cost and sustainable technology while highlighting research bottlenecks for real-world applications.

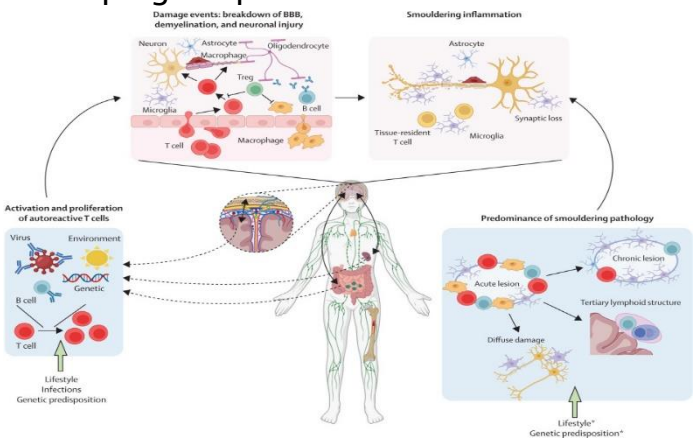
ABITHA Y [URK21BT1013]

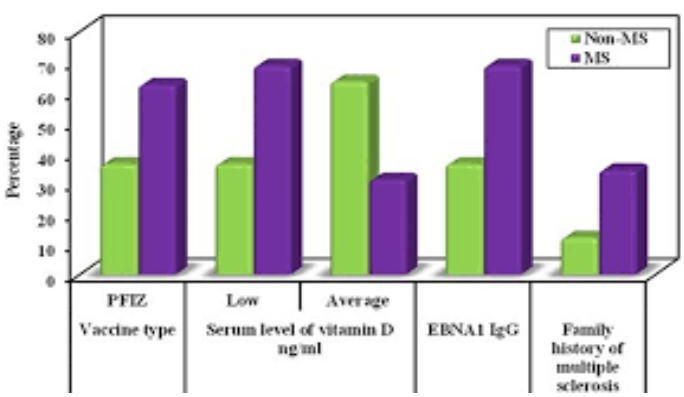



## NEW ONSET OF MULTIPLE SCLEROSIS POST-COVID-19 VACCINATION AND CORRELATION WITH POSSIBLE PREDICTORS IN A CASE-CONTROL STUDY

Various inflammatory diseases have been associated with administering various vaccines. Several reports have associated vaccine administration with the demyelinating diseases of the central nervous system (CNS). However, no clear or strong scientific evidence exists to support the association of vaccine administration with the onset of demyelinating diseases. Some CNS demyelination diseases such as acute disseminated encephalomyelitis (ADEM) and neuromyelitis optica spectrum disorders (NMOSD) were reported following the administration of COVID-19 vaccines. In this study, new onset multiple sclerosis (MS) following COVID-19 vaccine administration was reported. Univariate and multivariate logistic regression analysis was performed and a significant correlation between the risk factors and the development of MS post-COVID-19 vaccination was identified. The risk factors, identified in this study, can be used as significant independent predictors for developing MS post-COVID-19 vaccinations.

JENEFA D [URK21BT1008]

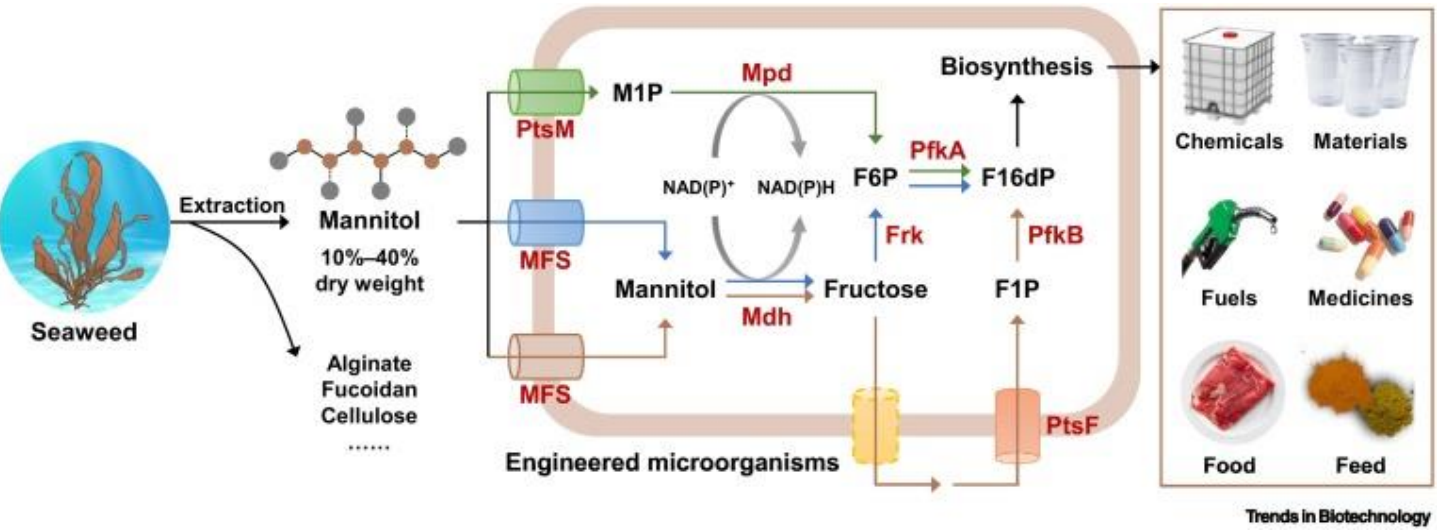


## INTEGRATING THE MARINE CARBON RESOURCE MANNITOL INTO BIOMANUFACTURING

Mannitol is a readily accessible component of seaweed with a higher energy content than glucose, making it a promising feedstock for biomanufacturing. Microbial metabolism of mannitol. Two types of mannitol metabolic pathways have been identified in microorganisms. The first type is the phosphotransferase system (PTS)-mediated phosphorylation of mannitol, followed by dehydrogenation of mannitol-1-phosphate to form the glycolysis intermediate fructose-6-phosphate. The second type of mannitol metabolic pathway is shared by S.cerevisiae and Corynebacterium glutamicum. Instead of PTS-mediated uptake and phosphorylation, mannitol is first transported into cells via major facilitator superfamily-type transporters and then oxidized to fructose by NAD-dependent dehydrogenases. Before entering glycolysis, phosphorylation of fructose is catalyzed by cytoplasmic fructokinase in S.cerevisiae or undergoes fructose efflux by an unknown exporter and reuptake by the fructose-specific PTS in C.glutamicum. Despite the existence of native mannitol metabolic pathways, most S.cerevisiae and C.glutamicum strains cannot utilize mannitol naturally due to constitutive repression of the catabolic genes by transcriptional regulators.

RITHIK SAI [URK21BT1040]




## OPTICAL STIMULATION FROM RAY-TRACING IN BIOTECHNOLOGY AND PHOTOBIOLOGY

The advent of LED technology opened up new possibilities for the implementation of versatile and complex illumination systems for photobiological and biophotonic studies. New lighting systems also increase the requirement for accurate and reproducible characterization of existing light parameters such as photon flux density.. Optical simulations based on ray-tracing software can compensate the limitation of direct measurements and make more information regarding light quantities available. Here we discuss irradiance distribution in UV inactivation studies and the determination of photon flux density in light-stress experiments with microalgae using ray-tracing software and comparing simulation results with optical measurements. Furthermore, we demonstrate the possibility to improve existing irradiation conditions by common optical engineering optimization techniques. This will be shown by means of a photobioreactor illumination as well as an application in the field of photodynamic therapy.

HANSEL SINU ABRAHAM [URK21BT1038]

# STUDENT PUBLICATIONS


**PHYSICAL SCIENCES REVIEWS**
**DE GRUYTER, IF:1.3, 2023**
**KRISHNANJANA NAMBIAR (URK20BT1035) & Team**

**TITLE: DEVELOPMENT OF BIOPOLYMERS FROM MICROBES AND THEIR ENVIRONMENTAL APPLICATIONS.**

Inventions begin with the invasion of humans and furnish a better livelihood. In some cases, it turns out to be imperative. The environmental issues of using synthetic polymers, including bio-incompatibility, toxicity, high cost, poor hydrophilicity, and pro-inflammatory degradation of byproducts, are increasing the need for and application of eco-friendly, alternative polymeric substances from medicine to biotechnology, which includes the industries of medicine, cosmetics, confectionery, wastewater treatment, etc., as tissue scaffolds, wound dressings, drug packaging material, dermal fillers, moisturising cream, carriers, sun protectants, antiperspirants, and deodorants; gelling agents; stabilisers, emulsifiers, etc. Biopolymers are available in different compounds, produced by microbes, plants, and animals, where microbes, for example, Pseudomonas aeruginosa and Kamagataeibacter sucrofermetans, retain these compounds at an exorbitant level, helping them to sustain adverse conditions. Moreover, compared to plant and animal biopolymers, microbial biopolymers are preferred due to their ease of production, design, and processing at an industrial levels. In this regard, polyhydroxyalkanoates (PHA) and poly-3-hydroxybutyrate (PHB) have together attained assiduity for their biodegradable properties and possess similar features as petrochemical-based polymers, commonly synthetic polymers like polyethylene, polypropylene, etc. This attributes to its non-toxic nature, i.e., it behaves eco-friendly by degrading the components through a carbon-neutral energy cycle to carbon dioxide and water.


**ENVIRONMENTAL TECHNOLOGY & INNOVATION**
**ELSEVIER, IF:7.1, 2023**
**Shalma S (PRK21BT1020) & Team**

**TITLE: WASTE FISH SCALE FOR THE PREPARATION OF BIO-NANOCOMPOSITE FILM WITH NOVEL PROPERTIES.**

The aim of this work was to study utilization of waste fish scales to develop a bio-nanocomposite films with corn starch, embedded with ZnO nanoparticles and turmeric as an alternative to synthetic plastics films to pack the food. Four different types of bio-nanocomposite films were prepared using varying amounts of fish scale powder and corn starch. The films were examined for their physical and chemical characteristics, including texture, color, solubility in hot water, tensile strength, organic content, and shape. Environmental pollution caused by the extensive use of non-biodegradable products is among the primary concerns in present time. The carbon footprint of the environment is increased by the non-biodegradable plastic-based food packaging and wrapping materials. The films were characterized by FTIR, UV–Vis spectrophotometry and SEM. The developed bio-nanocomposite films demonstrated enhanced water barrier, mechanical and antimicrobial properties. The unique features of the bionano composite with pH indication property demonstrated their potential usage in food packaging applications. Overall, bio-nanocomposite film showed reduced spoilage and increased shelf life. The results could be of great relevance for the sustainable utilization of waste fish scale and replacement of synthetic polymers films for food packaging as an alternative with environmental sustainability. These environmentally friendly biodegradable packaging materials help increase a food product's shelf life without lowering its quality, making them preferable to packaging constructed of petroleum-based polymers.

# STUDENT PUBLICATIONS


**EUROPEAN JOURNAL OF PHARMACOLOGY**
**ELSEVIER, IF:5.195, 2023**
**Shervin Prince (RRK22BT1002) & Team**

**TITLE: B-CARYOPHYLLENE BLOCKS REACTIVE OXYGEN SPECIES-MEDIATED HYPERLIPIDEMIA IN ISOPROTERENOL-INDUCED MYOCARDIAL INFARCTED RATS.**

Myocardial infarction (MI) is a leading cause of death. Lipid-lowering interventions have been shown to decrease coronary events and mortality of MI and heart failure. Here we assessed the anti-hyperlipidemic effects of β-caryophyllene in isoproterenol-induced myocardial infarcted rats. β-Caryophyllene pre-and co-treatment was given to rats orally for 3 weeks. Isoproterenol was administered to rats to induce MI. Further, the activity of liver 3-hydroxy-3-methylglutaryl-coenzyme. A reductase and plasma thiobarbituric acid reactive substances were amplified and the levels of heart glutathione-S-transferase, vitamin C and vitamin E were lessened by isoproterenol. Histopathology of Sudan III staining revealed an accumulation of fats in the heart of isoproterenol-induced rats. A down-regulated expression of liver sterol regulatory element-binding protein-2 and liver low-density lipoprotein-receptor genes was observed by a reverse transcription-polymerase chain reaction study. Moreover, the in vitro study revealed the potent free radical scavenging and antioxidant effects of β-caryophyllene. β-Caryophyllene's antioxidant and anti-hyperlipidemic properties are the possible mechanisms for the observed protective effects in this investigation. β-Caryophyllene pre-and co-treatment modulated lipids and lipoproteins, deactivated HMG-CoA reductase, reduced LPO, enhanced antioxidants, and improved SREBP-2/LDL-R pathway, by its antioxidant, and anti-hyperlipidemic mechanisms in isoproterenol-induced myocardial infarcted rats.


**CHEMOSPHERE**
**ELSEVIER, IF:8.8, 2023**
**Emisha L (URK20BT1083), Nishita Wilfred (URK21BT1050) & Team**

**TITLE: BIODEGRADATION OF MICROPLASTICS: ADVANCEMENT IN THE STRATEGIC APPROACHES TOWARDS PREVENTION OF ITS ACCUMULATION AND HARMFUL EFFECTS.**

Microplastics (MPs) are plastic particles in a size ranging from 1 mm to 5 mm in diameter, and are formed by the breakdown of plastics from different sources. They are emerging environmental pollutants, and pose a great threat to living organisms. Improper disposal, inadequate recycling, and excessive use of plastic led to the accumulation of MP in the environment. The degradation of MP can be done either biotically or abiotically. In view of that, this article discusses the molecular mechanisms that involve bacteria, fungi, and enzymes to degrade the MP polymers as the primary objective. As per as abiotic degradation is concerned, two different modes of MP degradation were discussed in order to justify the effectiveness of biotic degradation. Finally, this review is concluded with the challenges and future perspectives of MP biodegradation based on the existing research gaps. The main objective of this article is to provide the readers with clear insight, and ideas about the recent advancements in MP biodegradation. This article brings out the accumulation, and effects of MPs, and highlights the advances in the biodegradation of MP with its molecular mechanismwhich could pave way for further research on biodegradation process based on the present studies on advance biodegradation processes elucidated.

# ACHEIVEMENTS

## WORLD'S 2% SCIENTISTS

In a remarkable feat for Karunya Institute of Technology and Sciences (KITS), the noteworthy inclusion of five distinguished faculty members in Stanford University's esteemed top 2% scientist list for 2023 marks a collective triumph. Dr. Dibyajyoti Haldar, an Assistant Professor in the Division of Biotechnology, extends gratitude for being listed among the world's top 2% scientists, crediting the state-of-the-art research facilities at Karunya for this significant achievement. This recognition not only applauds individual achievements but also celebrates the collaborative spirit and dedication that define Karunya's academic community. It speaks volumes about the institution's role in shaping global scientific discourse and setting new benchmarks in research and innovation.

## PATENT ACHEIVMENTS

**DR. JIBU THOMAS**

**DR. DAVID PAUL**

## METABOLOMICS LAB

The development of a metabolomics lab in our division represents a significant advancement in the institution's research capabilities and its commitment to exploring the intricacies of biological systems at a molecular level. The establishment of a metabolomics lab typically involves the integration of cutting-edge analytical technologies, alongside sophisticated computational tools for data analysis.