X-ray diffraction (XRD) and Fourier Tranform Infrared Spectrophotometer (FTIR). Antimicrobial applications against E. coli, S.aureus and acinetobacter bacterias are compared and discussed.

Keywords: Zn Nanoparticle; Phytochemicals; Antimicrobial application.

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The Future of Precision Oral Health: Integrating Digital Twins, Single-Cell Multi-omics, and AI-Driven Bioinformatics

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Abstract

As we enter 2026, the landscape of dentistry is being redefined by the convergence of high-fidelity bioinformatics and autonomous digital workflows. This presentation explores the transition from population-based care to hyper-personalized "Oral Digital Twins"-virtual patient replicas that integrate longitudinal clinical data with real-time biological inputs. In Periodontology and Oral Medicine, the focus has shifted toward single-cell RNA sequencing (scRNA-seq), allowing for the mapping of cellular heterogeneity in the oral microenvironment to predict disease refractory patterns with unprecedented resolution. In Orthodontics and Implantology, bioinformatics-powered predictive modeling now utilizes Finite Element Analysis (FEA) and AI agents to simulate biomechanical responses in bone remodeling before physical intervention. Furthermore, the rise of "Salivanomics 2.0" leverages deep learning to analyze point-of-care proteomic data for the early detection of systemic biomarkers and oral squamous cell carcinoma. By synthesizing multi-omics data with generative AI, bioinformatics provides the essential framework for regenerative dentistry and automated treatment planning. This abstract highlight how these cutting-edge computational tools are moving from bench to chairside, establishing a new global standard for evidence-based, minimally invasive, and predictive dental practice.

Keywords: Oral Digital Twins; Salivanomics 2.0; Multi-omics Integration; Predictive Biomechanics; Deep Learning in Dentistry.

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Nanostructured Metal Oxide and Self-Assembled Systems for enhanced Phytochemical Bioavailability

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Abstract

Self-assembled nanostructures and metal oxide nanoparticles have emerged as versatile platforms for advanced biomedical and functional applications. This presentation highlights recent developments in the design, synthesis, and characterization of metal oxide nanoparticles and self-assembled nanosystems aimed at addressing key challenges such as poor solubility, limited stability, and low bioavailability of phytochemicals. Strategies involving controlled self-assembly, surface functionalization, and optimization of nano–bio interactions are discussed to enhance therapeutic efficacy and targeted delivery. Representative studies demonstrate improved bioavailability, sustained release behavior, and enhanced biological performance of phytochemical-loaded nanocarriers. The approaches presented emphasize the potential of nanotechnology-enabled formulations to bridge traditional bioactive compounds with modern materials science, offering promising directions for future translational and device-oriented applications.

Keywords: Metal oxide nanoparticle; Nanoparticles; Self assembled systems.