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A 3D HUMAN OSTEOBLAST SPHEROID MODEL REVEALS ENDOCRINE DISRUPTOR OSTEOTOXICITY AND THE EFFECTS OF POSTBIOTICS

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In everyday life, humans are simultaneously exposed to low concentrations of multiple contaminants through food, water, and environmental sources, reflecting a chronic mixture-based exposure scenario. Among environmental stressors, endocrine-disrupting chemicals (EDCs) such as bisphenol A (BPA) and perfluorooctanoic acid (PFOA) are of growing concern due to their widespread presence. However, the combined and long-term effects of such chemical mixtures on bone tissue remain poorly understood. In parallel, postbiotics emerged as bioactive microbial metabolites with potential positive effects on bone metabolism.

In this study, we employed a human hFOB1.19 osteoblast 3D bone model (spheroids) cultured under osteogenic conditions for 21 days to evaluate the toxicity of BPA and PFOA, alone or in combination, and the positive effects of postbiotics derived from a multi-strain probiotic formulation (105–107 CFU equivalents) at different time points.

EDCs exposure induced time-dependent morphometrical and molecular changes while did not affect cell viability. During early exposure, the mix of EDCs exerted antagonistic effects on spheroid area, solidity, and roundness, while at 21 days of exposure to BPA and BPA+PFOA, extracellular matrix (ECM) dysregulation through decreased roundness, increased COL1A2 level, and reduced mineralization were evident. PFOA alone also decreased ECM mineralization, indicating distinct but converging toxic mechanisms.

Postbiotic, particularly when derived from 106 CFU, improved spheroid morphometry, increased size and structural regularity, with higher roundness and reduced necrotic core, indicating improved spheroid organization.

Overall, both BPA and PFOA, and particularly their mixture, which reflects real exposure scenarios, impair spheroid ECM deposition and mineralization, while postbiotics support osteoblast spheroid architecture. Ongoing studies are evaluating whether the positive action of postbiotics on osteoblast spheroids can contrast EDCs toxicity.