

Phosphate-Dependent Modulation of Antibacterial Activity and Cytocompatibility in Bioactive Glasses for Orthopedic Applications

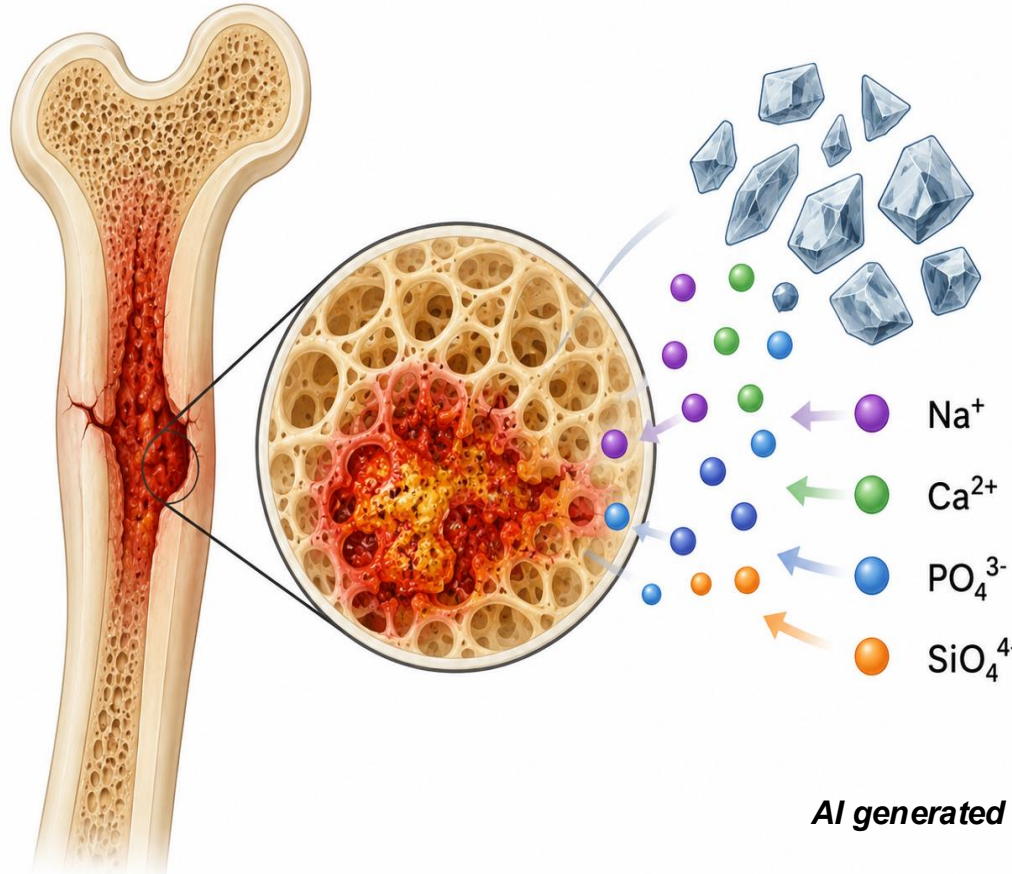
Abdellah Atta (1,2), Meixin Su (3), Delia S. Brauer (3), Georg Matziolis (1), Victoria Horbert (1,2)

1. Orthopaedics, University Hospital Jena, Campus Eisenberg, Waldkliniken Eisenberg, Friedrich-Schiller-University Jena, Jena, Germany
2. Experimental Orthopedics, University Hospital Jena, Campus Eisenberg, Waldkliniken Eisenberg, Friedrich-Schiller-University Jena, Jena, Germany
3. Otto Schott Institute of Materials Research, Friedrich Schiller University Jena, Jena, Germany

Introduction & Aim



Bioactive glasses (BG) are promising materials for orthopedic applications because they combine **osteostimulative** potential with **antibacterial** activity. However, **ion release** and increasing **alkalinity** may compromise **cell compatibility**^{1,2,3,4}

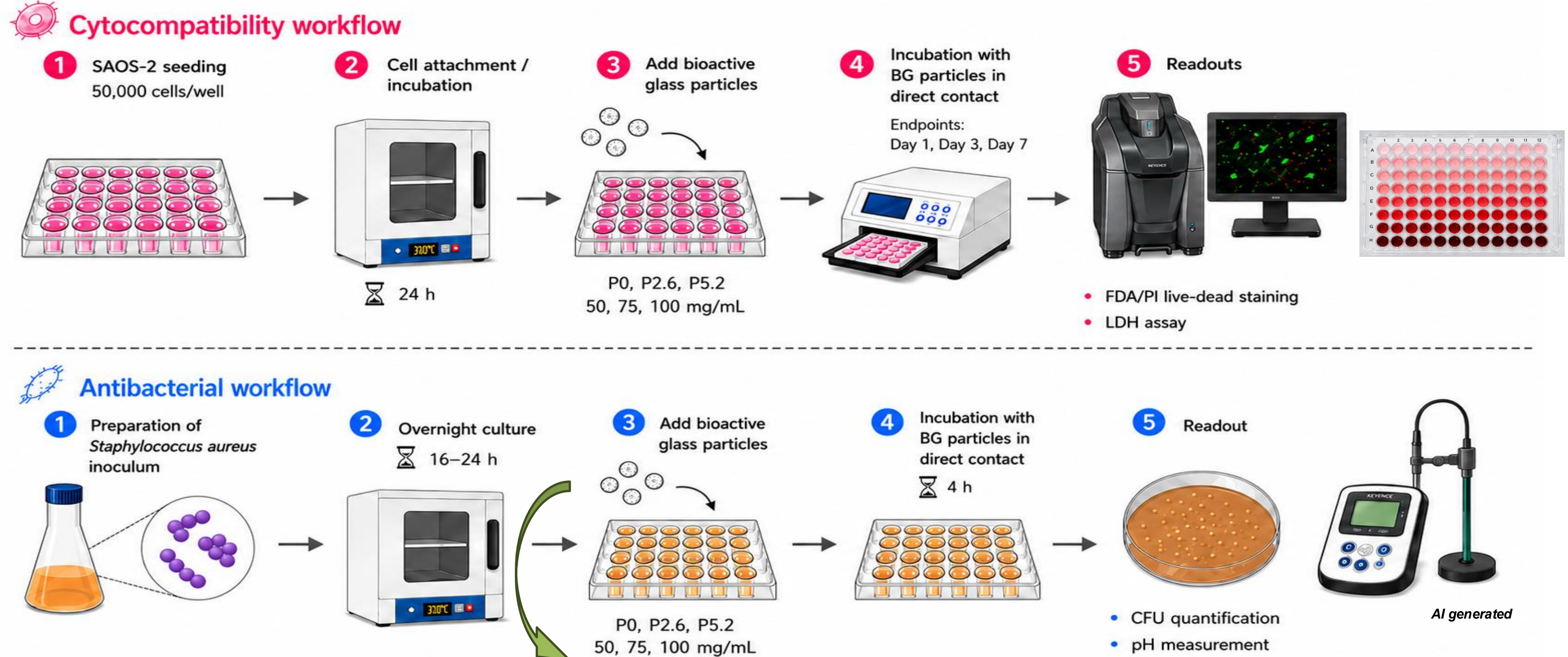


This study investigated whether systematic variation of **phosphate content** can tune the **balance** between **antibacterial** efficacy and **cell compatibility**

Materials and Methods



Biological workflow established using phosphate-modified bioactive glasses

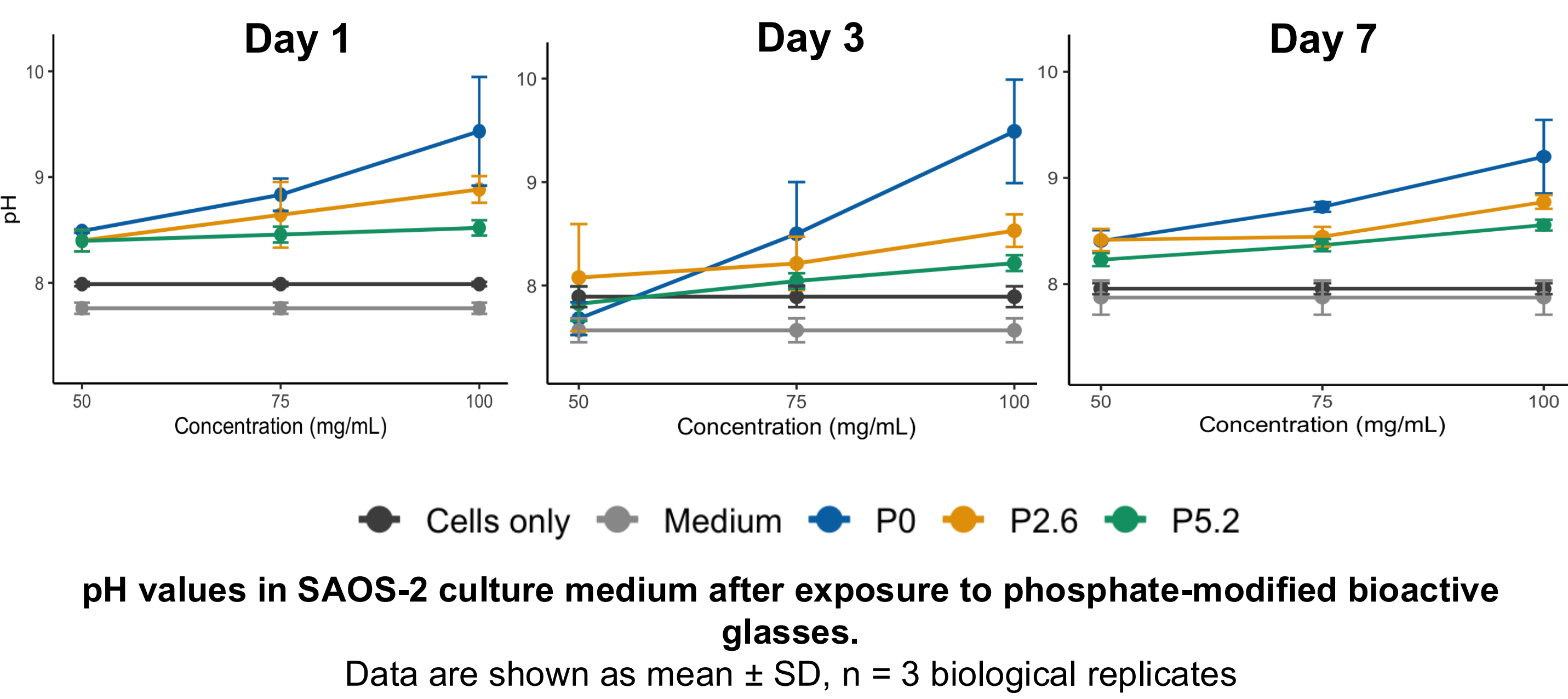


Bioactive glass composition (mole%)				
Bioactive glass	P ₂ O ₅	SiO ₂	CaO	Na ₂ O
P0	0.0	51.45	25.46	23.09
P2.6	2.6	46.10	26.90	24.40
P5.2	5.2	40.75	28.34	25.71

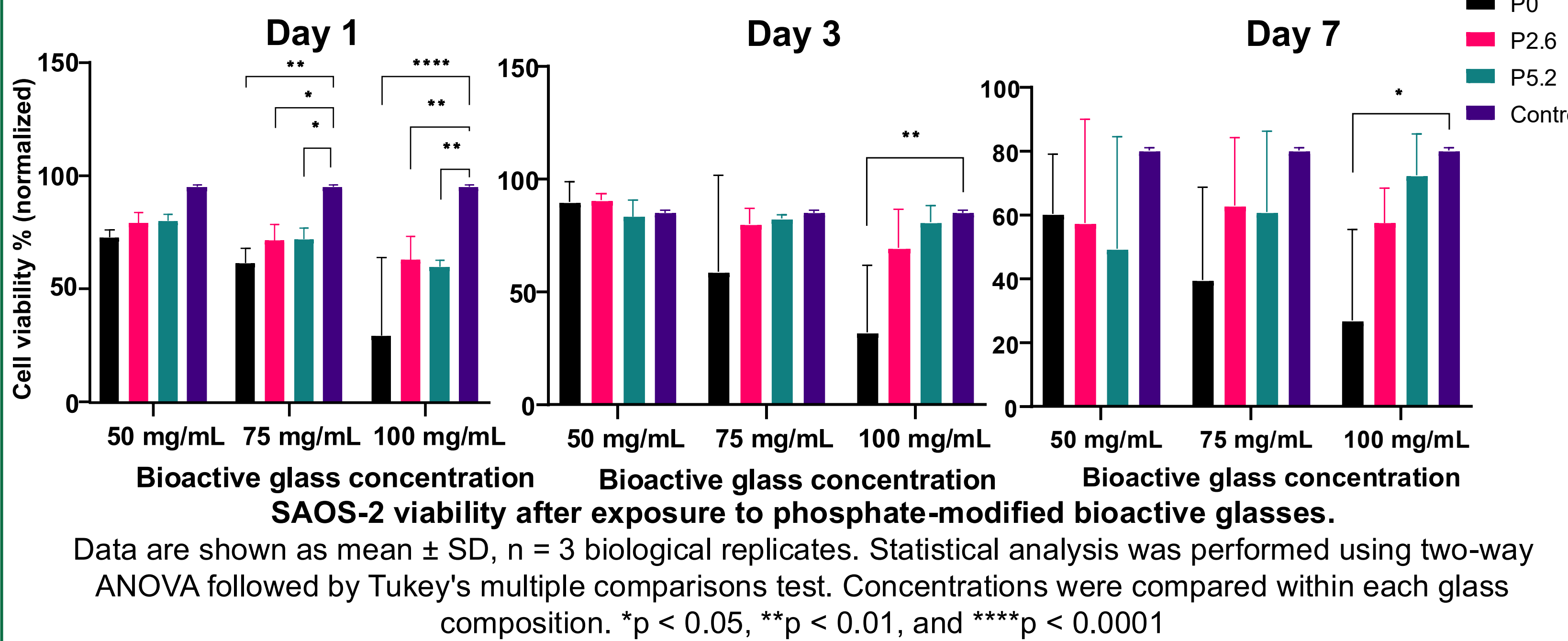
Results



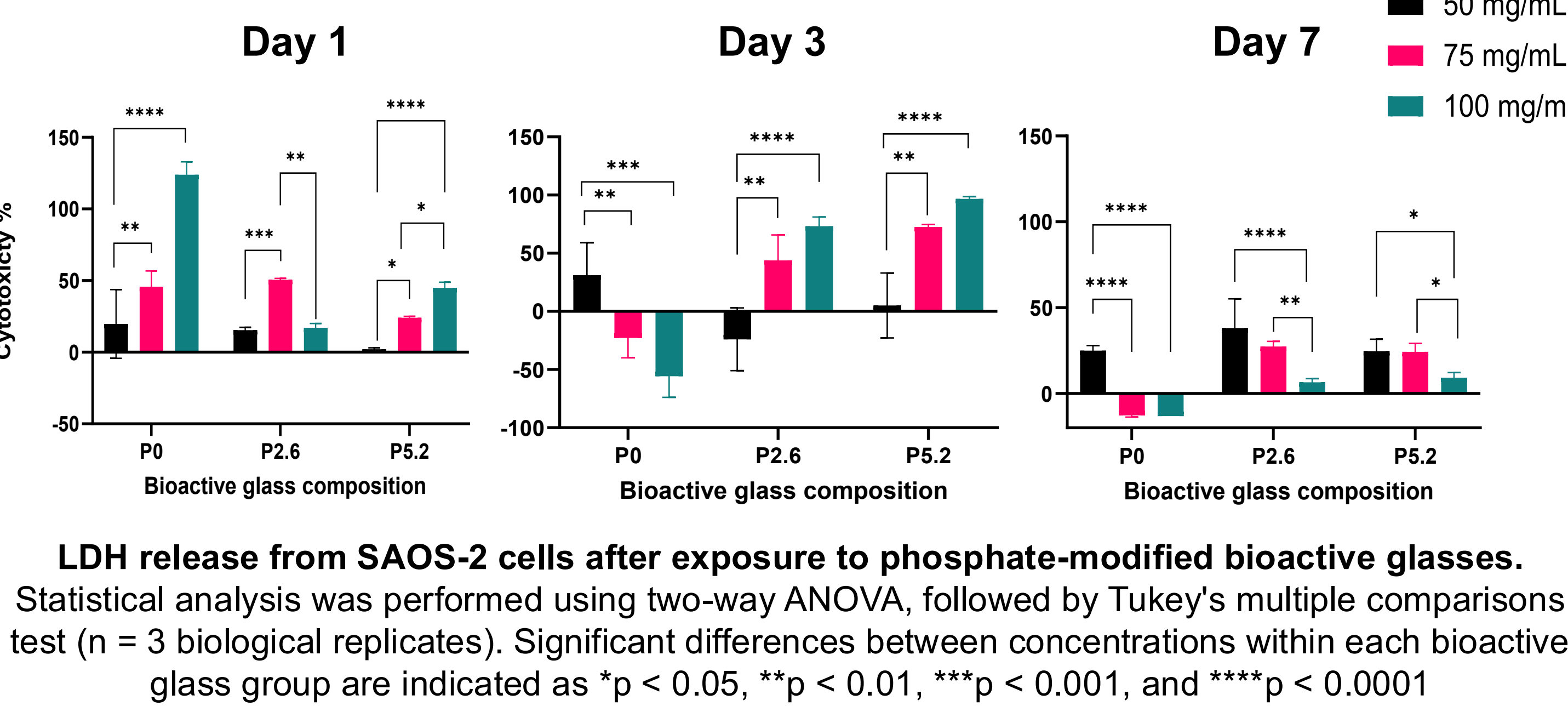
1. P0 induced the strongest pH increase



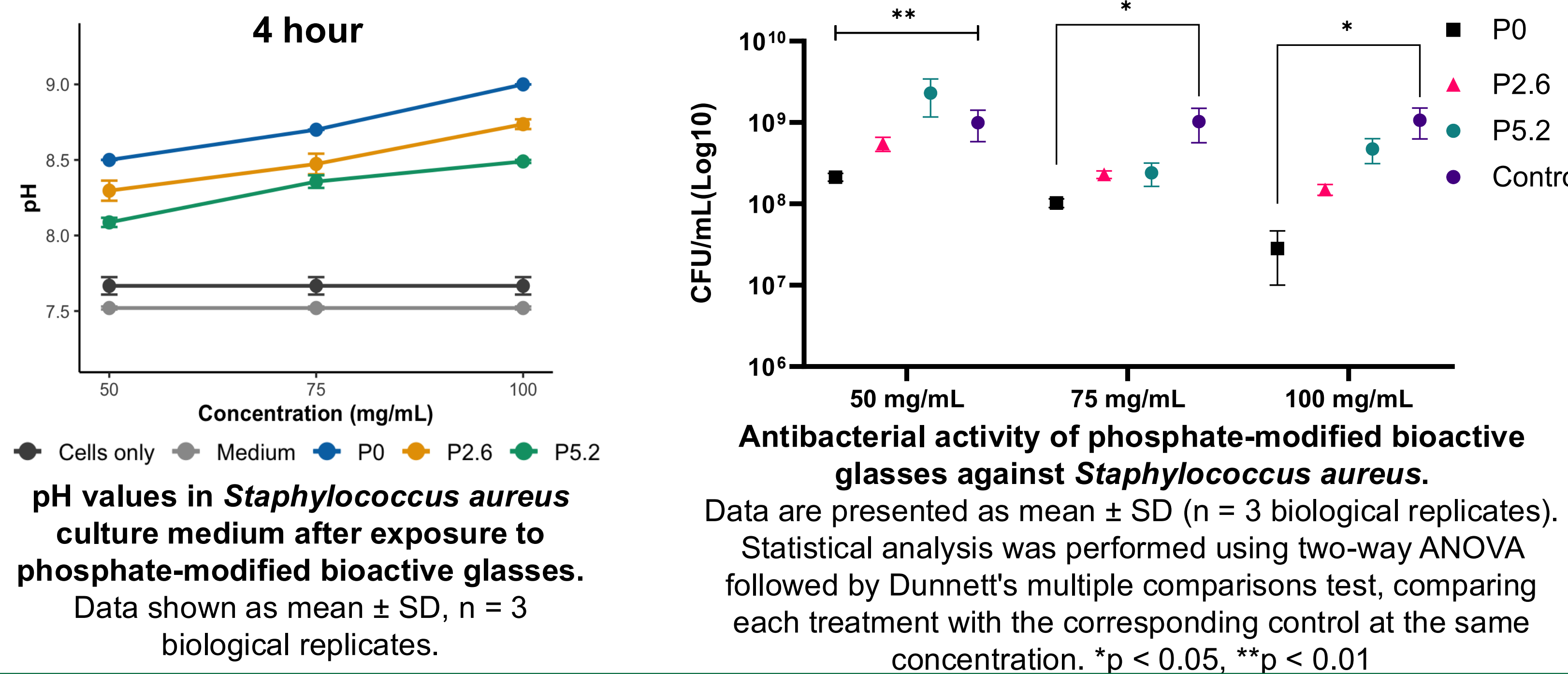
2. Phosphate content affected SAOS-2 viability



3. LDH-supported concentration-dependent cytotoxicity



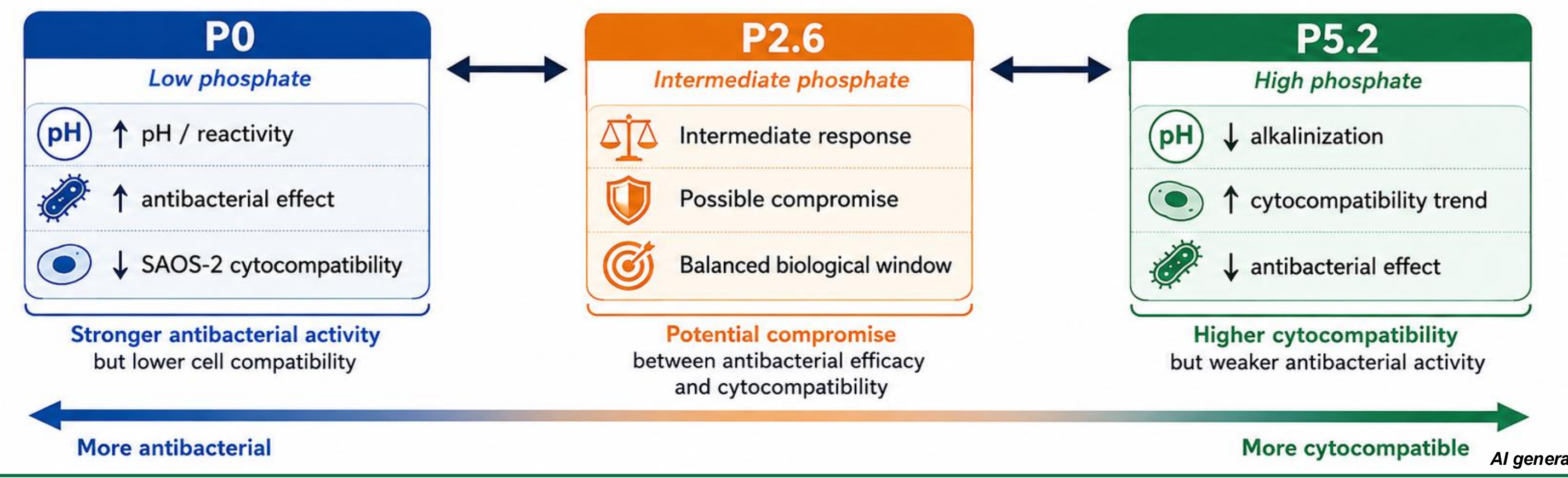
4. P0 showed the strongest antibacterial effect



Take home message



Phosphate-dependent trade-off



Outlook

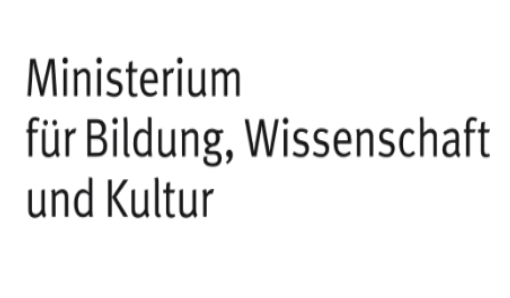


- Integration of a **co-culture model** to study **osteoblast-bacteria interactions** in a more **physiologically** relevant environment.
- Application of the established **3D hydrogel model** to investigate **osteoblast responses** to bioactive glass **surface features**.
- Exploration of **omics approaches** (e.g., transcriptomics, proteomics, metabolomics) to uncover **molecular mechanisms** underlying **osteogenic** and **antibacterial** effects.

References



- [1] Samuel et al., *BioMed Eng OnLine*, 2025
[2] Piatti et al., *Biomater Sci*, 2024
[3] Elahpour et al., *Adv Mater Interfaces*, 2024
[4] Dragomir et al., *Antibiotics*, 2025



EBJIS-MSIS 2026 | 17-19 SEPTEMBER · PORTO · PORTUGAL

