Injectable antibacterial hydrogels from ε-polylysine and hyaluronic acid as a vehicle toward antibiotic-free infection treatment

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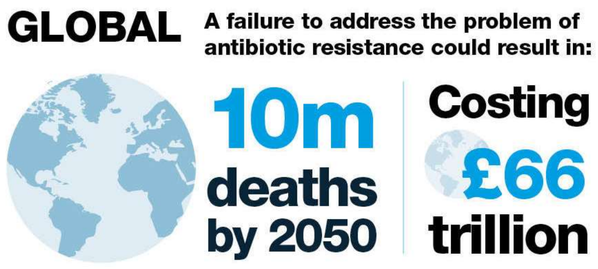
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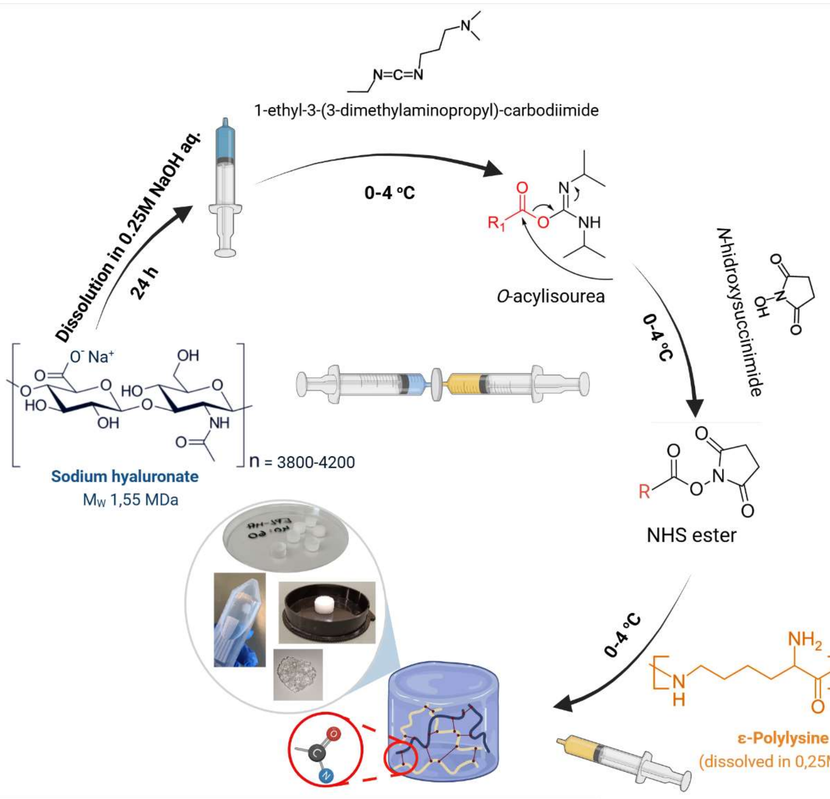
Kristine Salma-Ancane
Professor at Riga Technical University, Coordinator of Fun...

INTRODUCTION

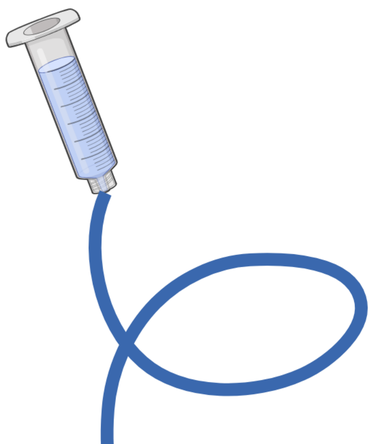
The growing threat of **antimicrobial resistance (AMR)** has created an urgent demand for **non-antibiotic biomaterials** capable of preventing infections without promoting bacterial resistance. Therefore, the objective for this research was to develop resistance-preventing antibacterial hydrogels based on a biopolymers – **ε-PL (ε-polylysine)** and **HA (hyaluronic acid)**.

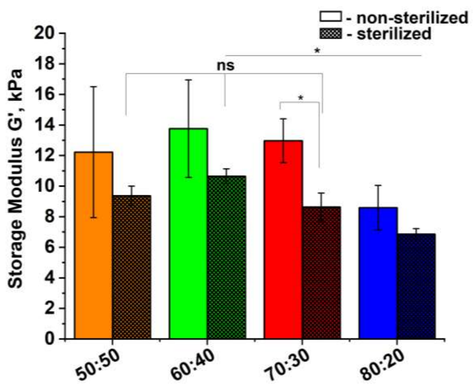


Synthesis strategy

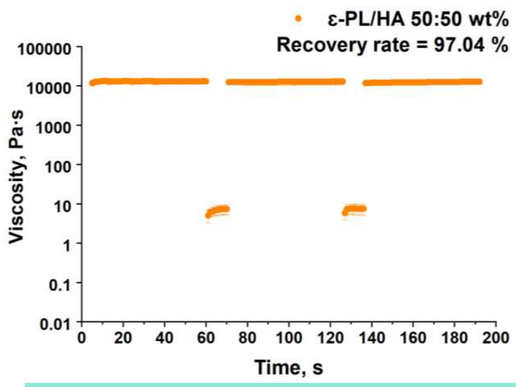


Results & Discussion

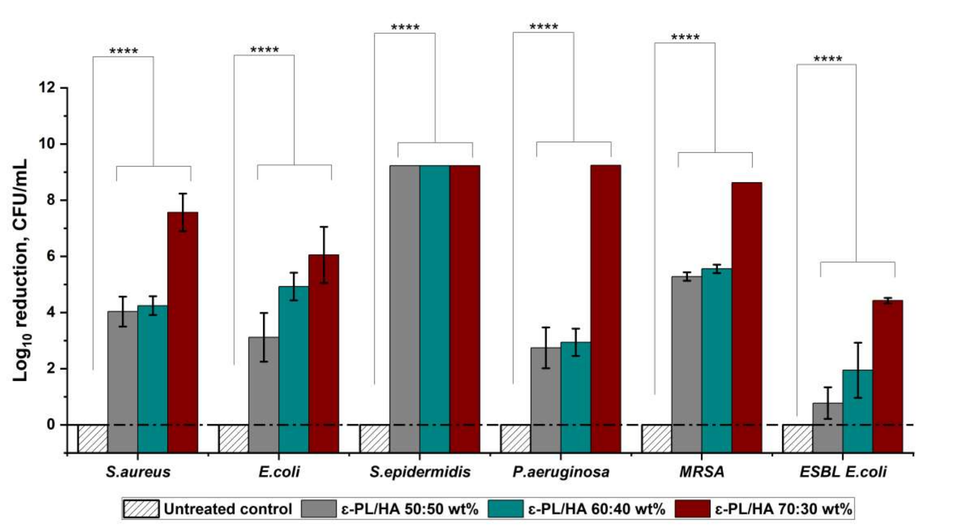




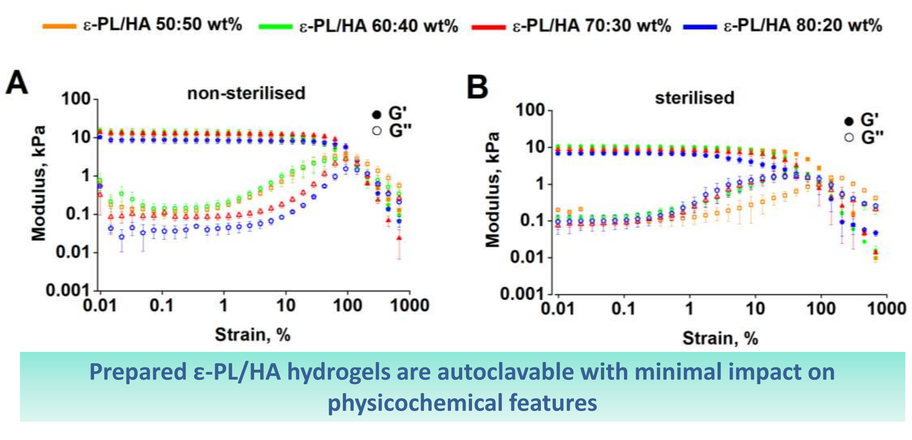
Prepared ε-PL/HA hydrogels showed mechanical stiffness in 7-15 kPa range required for musculoskeletal disorders



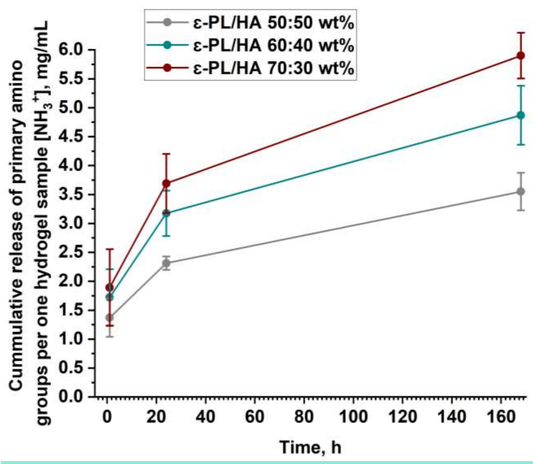
ε-PL/HA hydrogels are shear-thinning and shear-recoverable



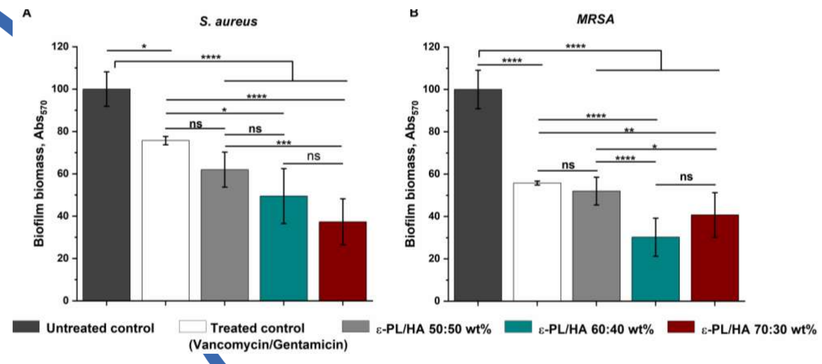
High ε-PL ratio-dependent antibacterial activity against reference and multidrug-resistant bacteria



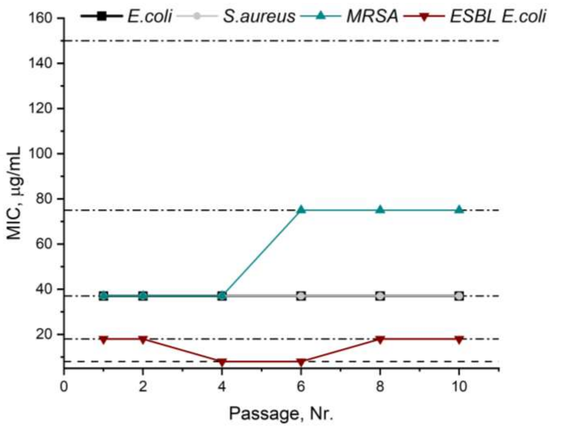
Prepared ε-PL/HA hydrogels are autoclavable with minimal impact on physicochemical features



Sustainable release of NH_3^+ groups capable for antibacterial activity



Anti-biofilm activity

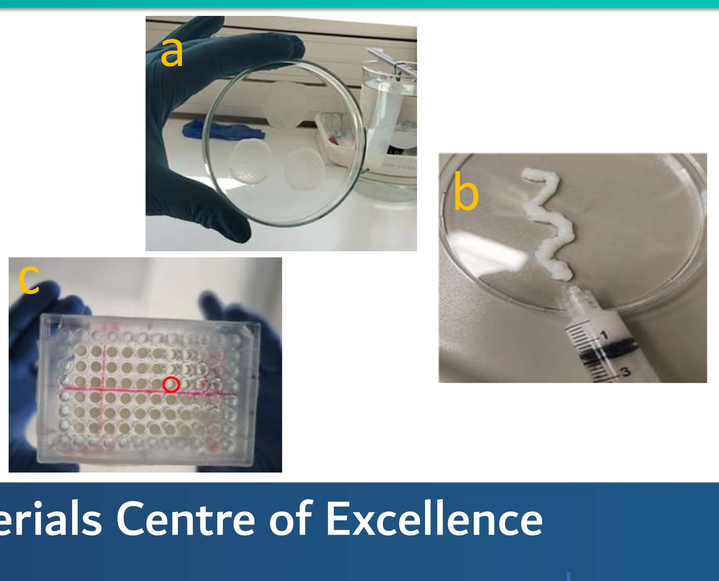


No resistance developed against ε-PL

Conclusions

Here we present perspective hydrogels based on naturally-derived components. While **HA** provides injectability, mechanical stability and ECM-mimicking environment for cells, **ε-PL** showed resistance-preventing properties and bactericidal activity against wide range of reference strains and drug-resistant clinical isolates, including biofilms. Presented biomaterials show perspective potential in development of new non-antibiotic antibacterial strategies such as implant coatings[a], HAp loaded composite hydrogels[b] or synergistic antibiotic adjuvants[c].

Salma-Ancane et al., *Int.J.Bio.Macrom.*, **2022**
Rubina et al., *Int.J.Bio.Macrom.*, **2024**
Sceglovs et al., *ACS Appl. Bio Mater*, **2025**
Sceglovs et al., *Carbohydr. Polym.* Technol. Appl., **2023**
Sceglovs et al., *Front.Microbiol.*, **2025**



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- Cooperation with other institutions
- Cooperation with industry

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