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Titanium-ceramic composites with antibiotic additives – the relationship between microstructure and biological activity

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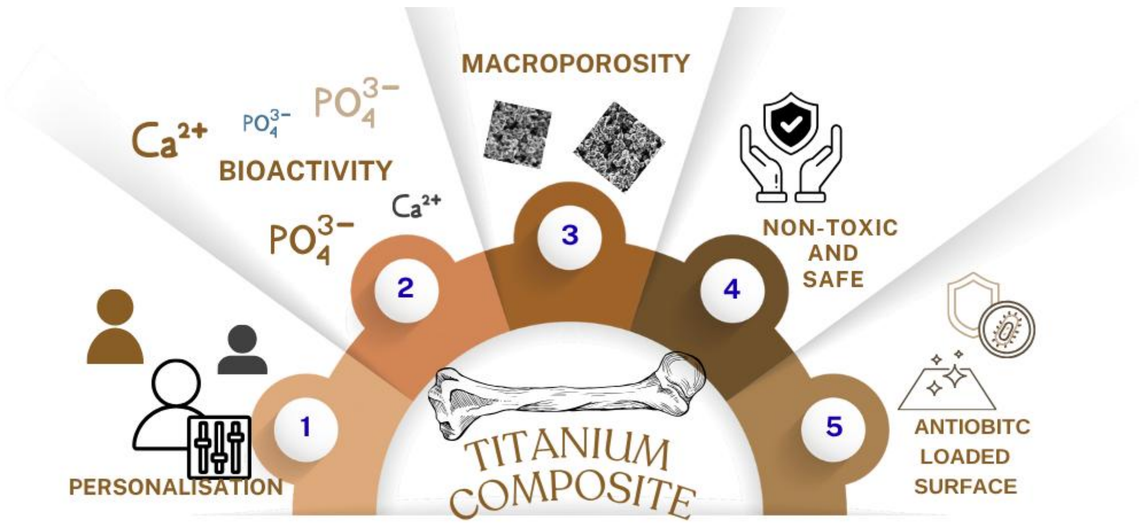
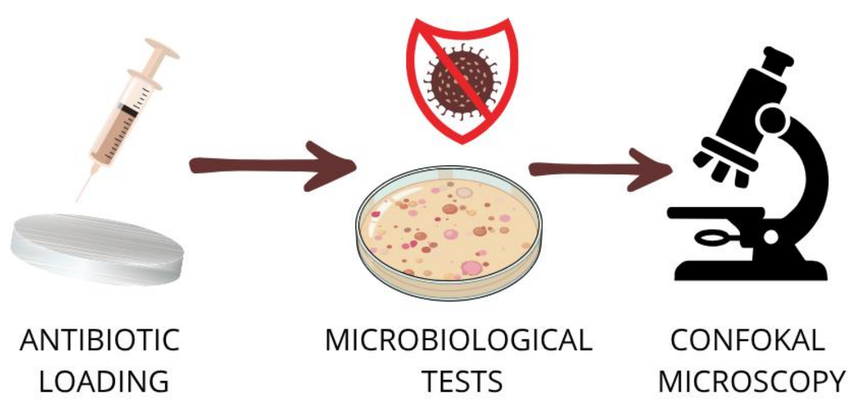
INTRODUCTION & AIM

Composites based on Ti6Al4V titanium alloy and hydroxyapatite (HA) are promising materials for implants due to their mechanical properties and bioactivity. The introduction of gentamicin can give them antimicrobial properties, which are important in preventing post-implantation infections. The aim of the study was to evaluate the effect of sintering temperature on the physicochemical and antimicrobial properties of Ti6Al4V/HA composites modified with gentamicin against Staphylococcus aureus and Pseudomonas aeruginosa. At the same time, the sintering temperature can affect both the microstructure and the effectiveness of antibiotic release. Composite samples were prepared by cold pressing and sintering in a protective atmosphere at two different temperatures. The sintering temperature had a significant impact on the microstructure and porosity of the composites. After sintering, the surface was modified with gentamicin. Morphology analysis was performed using SEM microscopy and confocal fluorescence microscopy. XRD diffraction analysis and biofilm analysis were also performed. The sintering temperature used significantly affects the final antimicrobial properties of Ti6Al4V/HA composites. The sintering temperature influences the formation of a more porous structure, which increases the effectiveness of gentamicin against Gram-positive and Gram-negative pathogens. Optimizing the parameters of heat treatment may therefore be crucial for the design of implant materials with antibacterial properties.

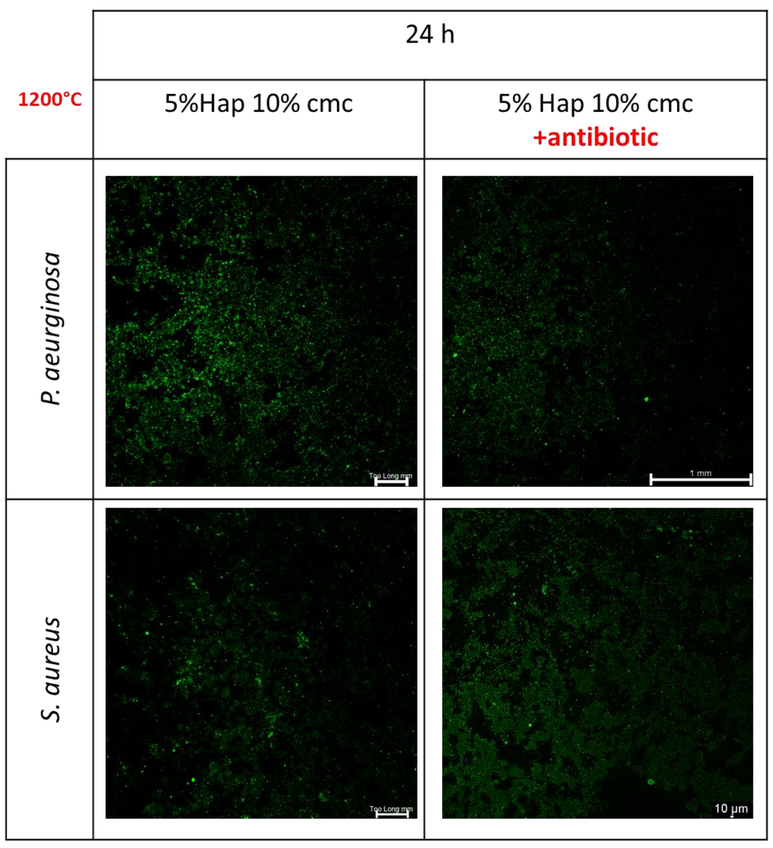
METHOD



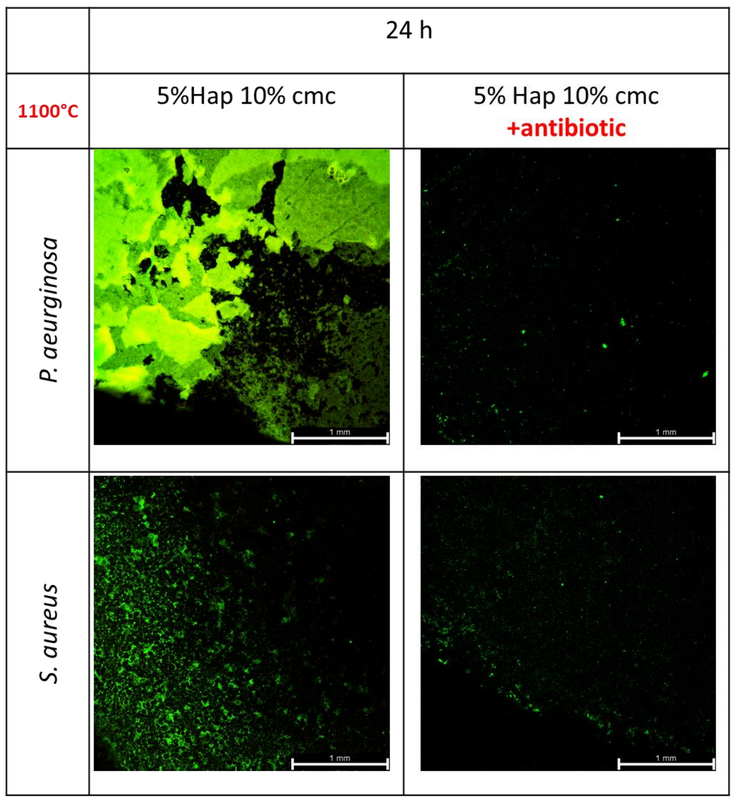


RESULTS & DISCUSSION

1200 °C



1100 °C



CONCLUSION

1. Sintering temperature has a significant impact on antibacterial activity.
2. The addition of an antibiotic markedly reduces bacterial colonization.
3. The P. aeruginosa strain exhibits a higher adhesion and colonization capability.
4. The incorporation of CMC (as a porogen) promotes the formation of a porous structure, enhancing antibiotic release.

ACKNOWLEDGMENTS

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