P2-4

Effect of Proanthocyanidin-ACP Nanoparticles on Promoting Biomimetic Remineralization of Dentin

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Introduction

Dental caries could result in the loss of minerals and exposure of collagen fibrils in dentin, which is a highly organized organic-inorganic complex. The exposed collagen fibrils might be degraded by the activated matrix metalloproteinases. Proanthocyanidin (PA) has been known to be an efficient matrix metalloproteinases inhibitor. Amorphous calcium phosphate nanoparticles are used as nano-precursors to deliver biomimetic mineralization of collagen fibrils and dentin.

Objective

The aim of this study was to synthesize proanthocyanidin-amorphous calcium phosphate (PA-ACP) nanoparticles and investigate their effect on promoting dentin remineralization and inhibiting collagen degradation, in order to provide a new perspective for biomimetic dentin repairing.

Methods

Synthesis of PA-ACP nanoparticles and N-ACP nanoparticles (Template method)

- **Characterization of the nanoparticles**
- **Cytotoxicity test**
- **Release of Ca^{2+} and PO_4^{3-}**

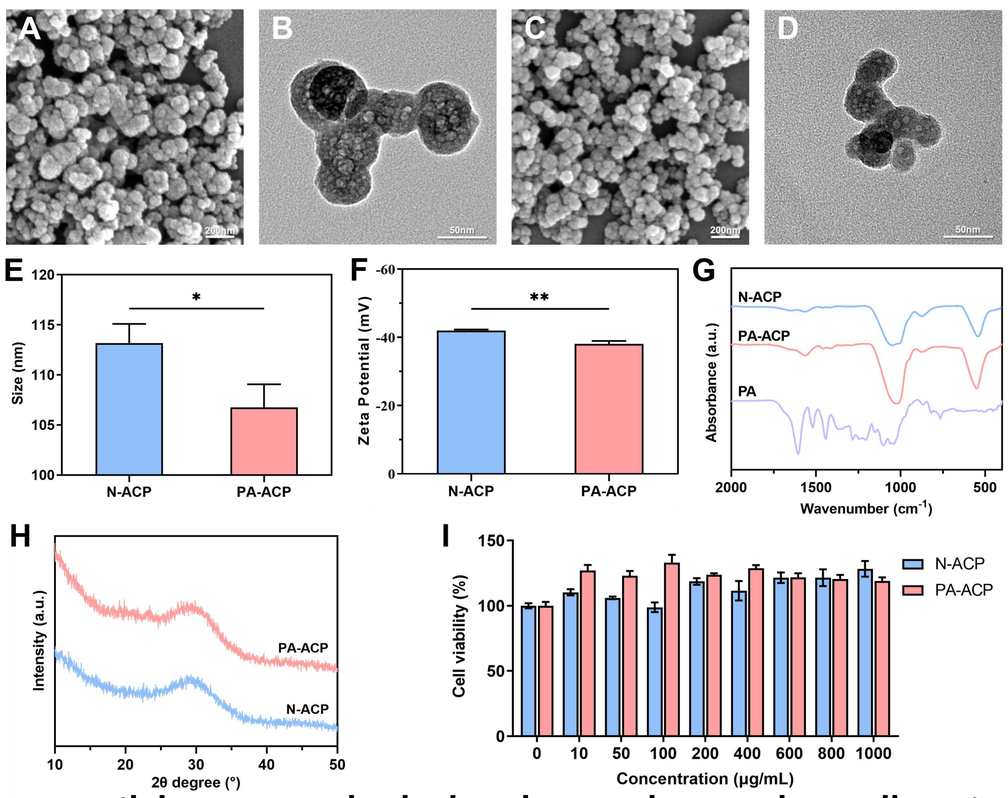
Zymography of demineralized dentin

Mineralization of collagen fibrils

Remineralization of demineralized dentin

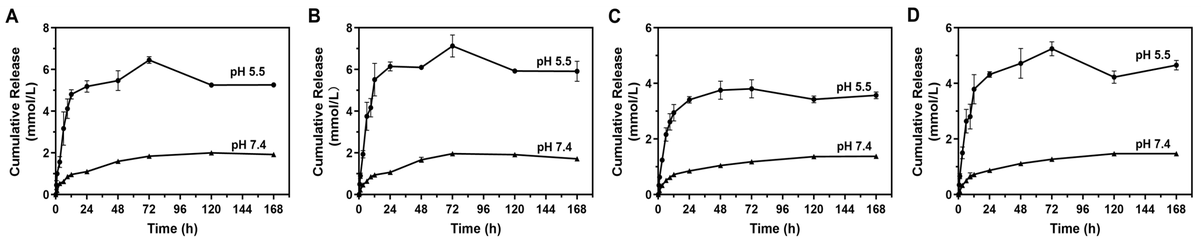
Results

1. Characterization of the nanoparticles



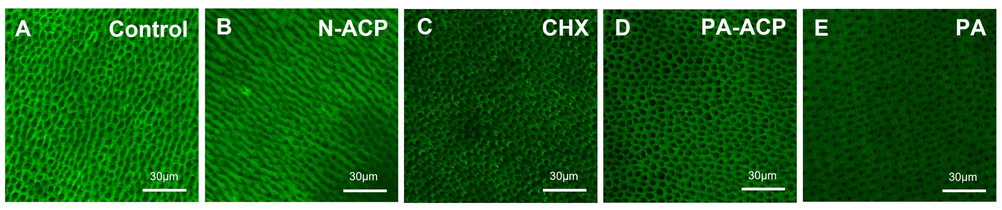
The nanoparticles were spherical and amorphous, whose diameter was from 105~115 nm. The nanoparticles showed no significant cytotoxic effect on the growth and proliferation of HDPCs.

2. Release of Ca^{2+} and PO_4^{3-}



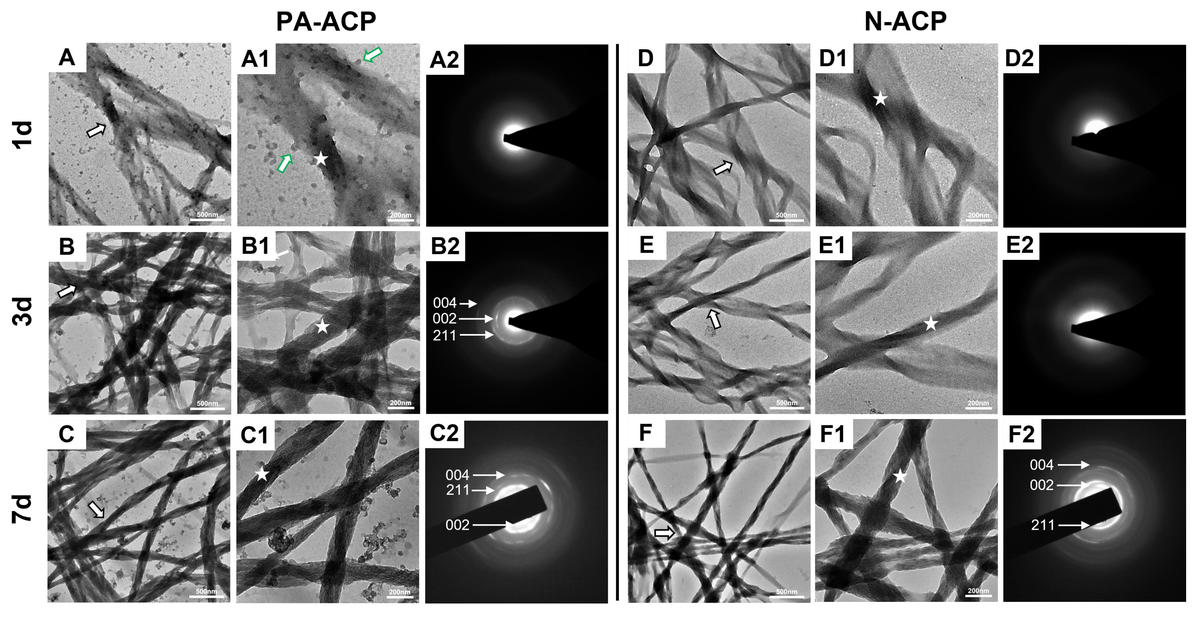
An initial burst release of Ca^{2+} and PO_4^{3-} was observed in the first 48 hours, which then slowed to a steadier release. Decreasing the pH from 7.4 to 5.5 resulted in a faster release of Ca^{2+} and PO_4^{3-}.

3. Zymography of demineralized dentin



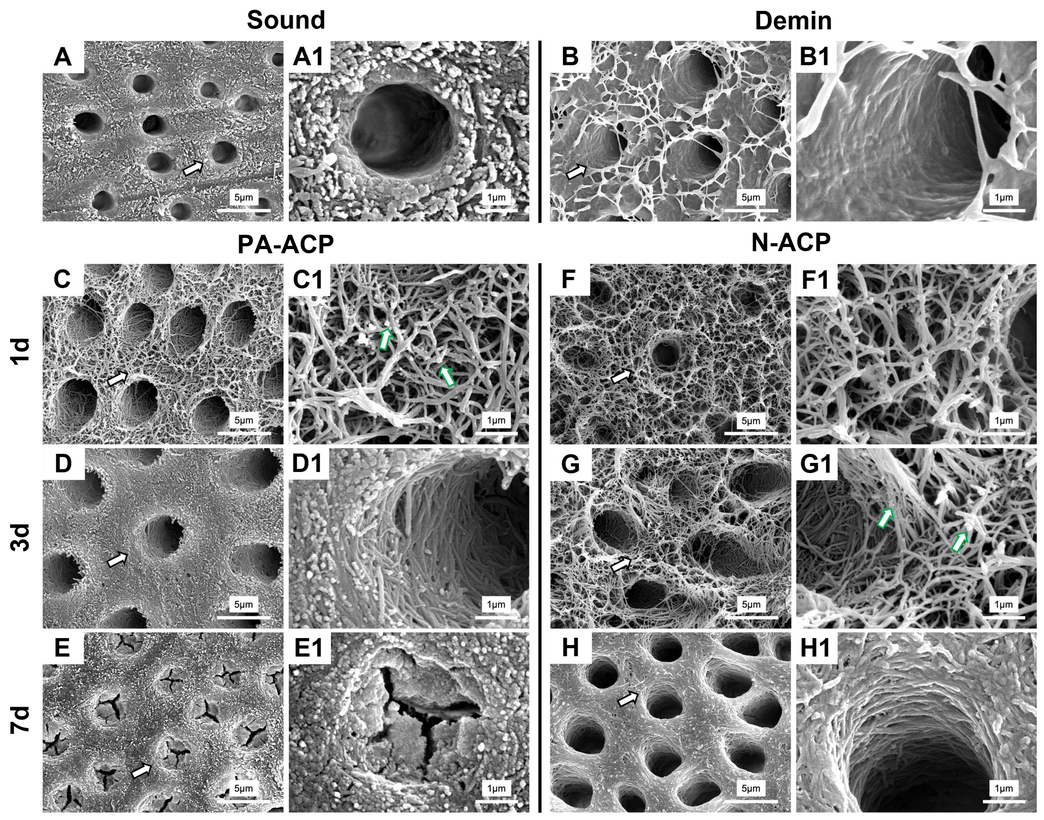
After treated with PA-ACP, the collagenase activity of the demineralized dentin matrix decreased by ~40% compared to that of N-ACP group.

4. Mineralization of collagen fibrils



In N-ACP group, collagen fibrils were partially mineralized after 7 days. In contrast, collagen fibrils were partially mineralized after 3 days and almost completely mineralized after 7 days in PA-ACP group.

5. Remineralization of demineralized dentin



Dentin samples in N-ACP group and PA-ACP group were both obviously remineralized after 7 days, but PA-ACP also induced the dentin tubules occlusion.

Conclusion

- **PA-ACP nanoparticles were successfully synthesized, and Ca^{2+} and PO_4^{3-} could be sustainedly released.**
- **The nanoparticles could effectively induce biomimetic remineralization of demineralized dentin, accelerate the remineralization process and inhibit the collagenase activity, indicating their potential application in biomimetic repair of dentin.**

Reference

1. Chen R, Jin R, Li X, et al. Dental Materials. 2020;36(11):1397-406. 2. Yu F, Xu RC, Huang L, et al. Materials Science & Engineering C-Materials for Biological Applications. 2020;112.