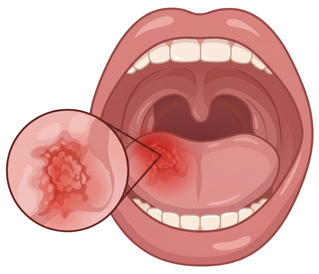
Biofabrication of polyhydroxyalkanoate-based dual drug-loaded mucoadhesive patches for localised therapy of oral lichen planus

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Background



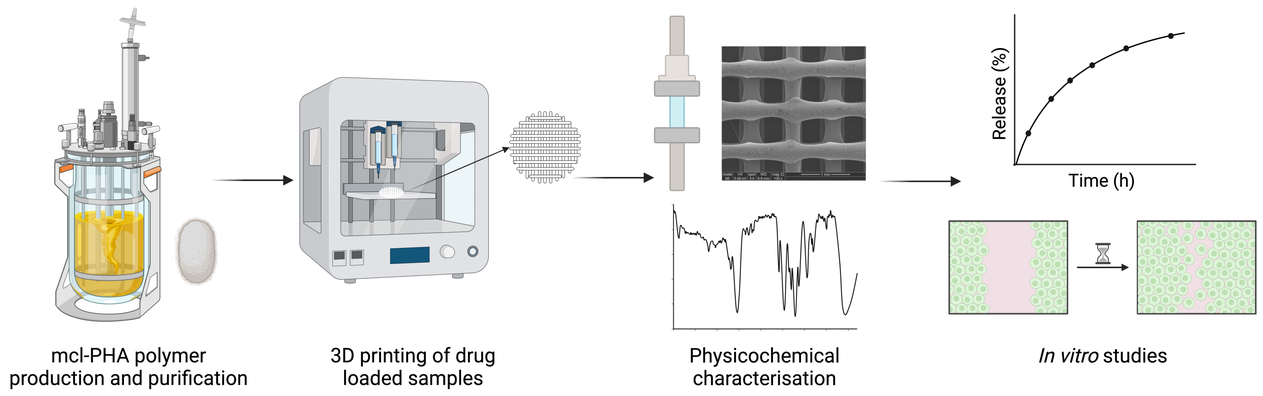
Oral lichen planus

- Oral lichen planus (OLP) is a chronic T-cell–mediated inflammatory disease of the oral mucosa, causing white striae or painful erosions.
- Treatment is required to reduce inflammation and pain, improve oral function, control recurrence, and minimise the risk of malignant transformation
- Conventional treatments provide symptomatic relief but are limited by poor retention, recurrence, and side effects, necessitating improved localised therapies

Aim

- To develop and evaluate a localised dual-drug therapeutic strategy for oral lichen planus to reduce inflammation and promote mucosal healing

Methods



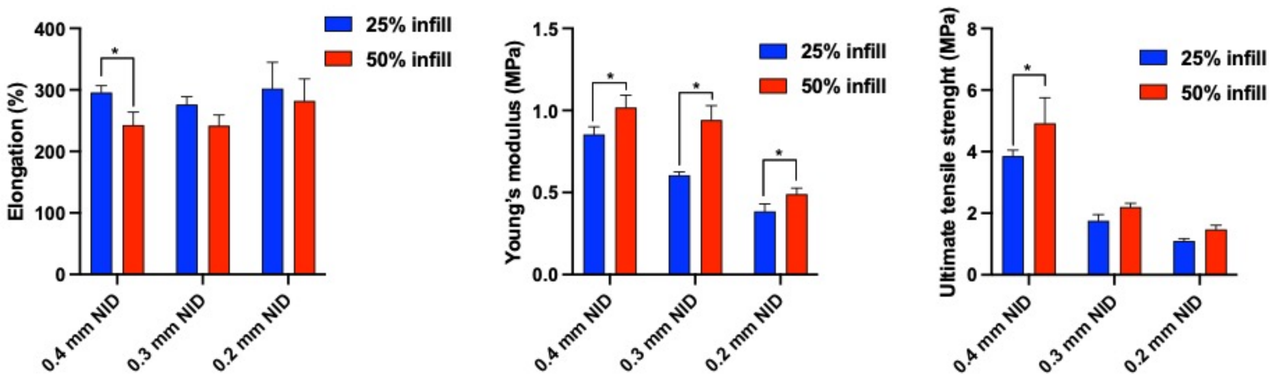
mcl-PHA polymer production and purification

3D printing of drug loaded samples

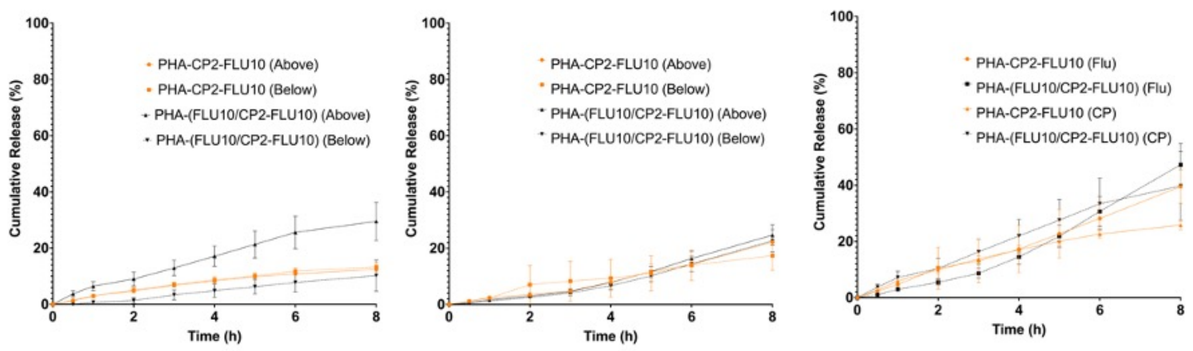
Physicochemical characterisation

In vitro studies

Mechanical properties of 3D printed pure mcl-PHA patches



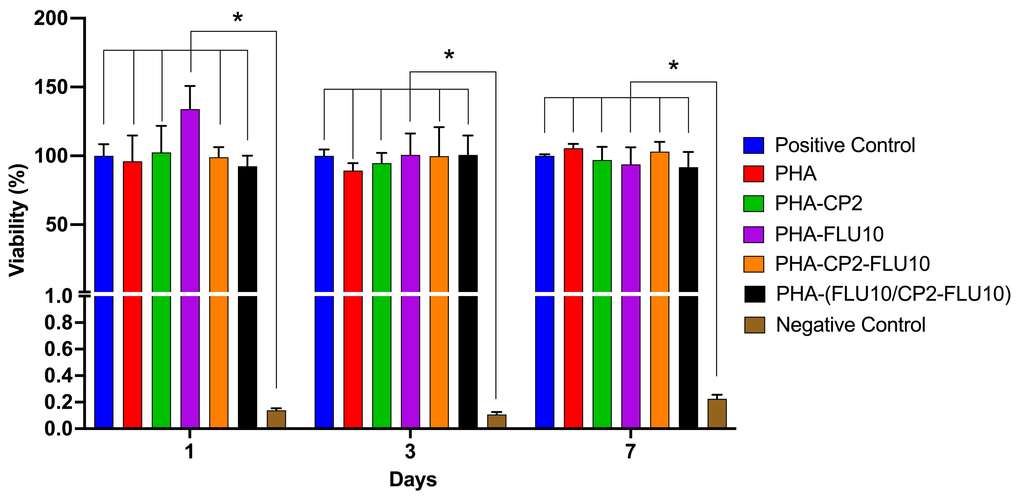
In vitro drug release



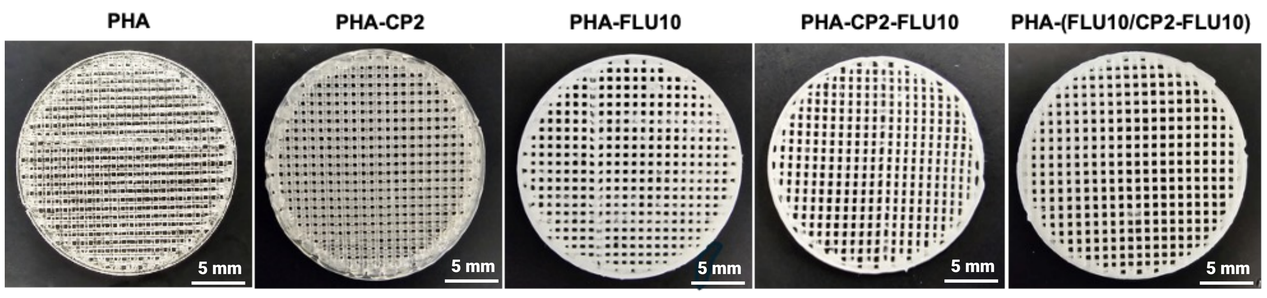
Drug-loaded 3D printed oral mucosal patches

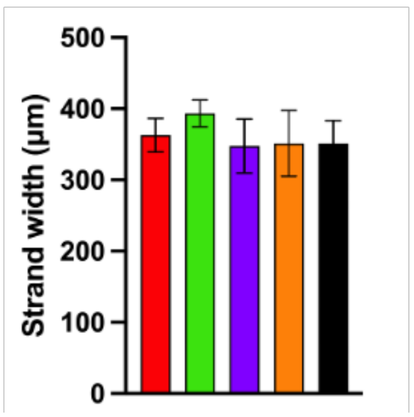
Group name	Detailed composition / description
PHA	Plain mcl-PHA (no drug loaded)
PHA-CP2	mcl-PHA loaded with 2% clobetasol propionate (CP)
PHA-FLU10	mcl-PHA loaded with 10% fluconazole (Flu)
PHA-CP2-FLU10	mcl-PHA loaded with dual drugs: 2% CP + 10% Flu
PHA-(FLU10/CP2-FLU10) (Gradient group)	Layered gradient patch: two layers of 10% Flu followed by two layers containing 2% CP + 10% Flu

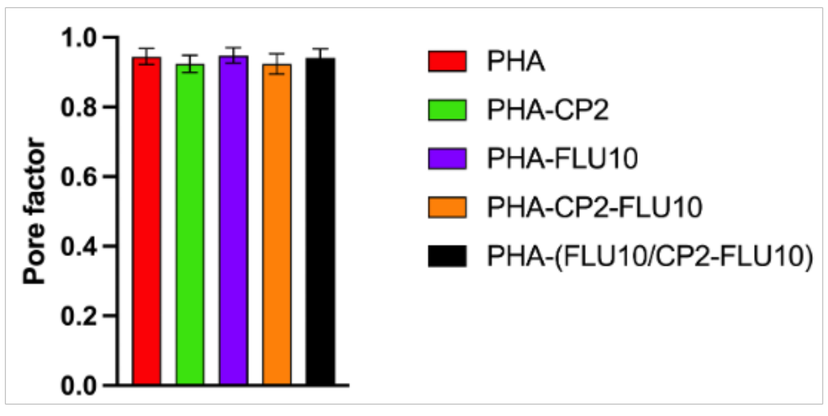
Cytocompatibility of 3D printed patches



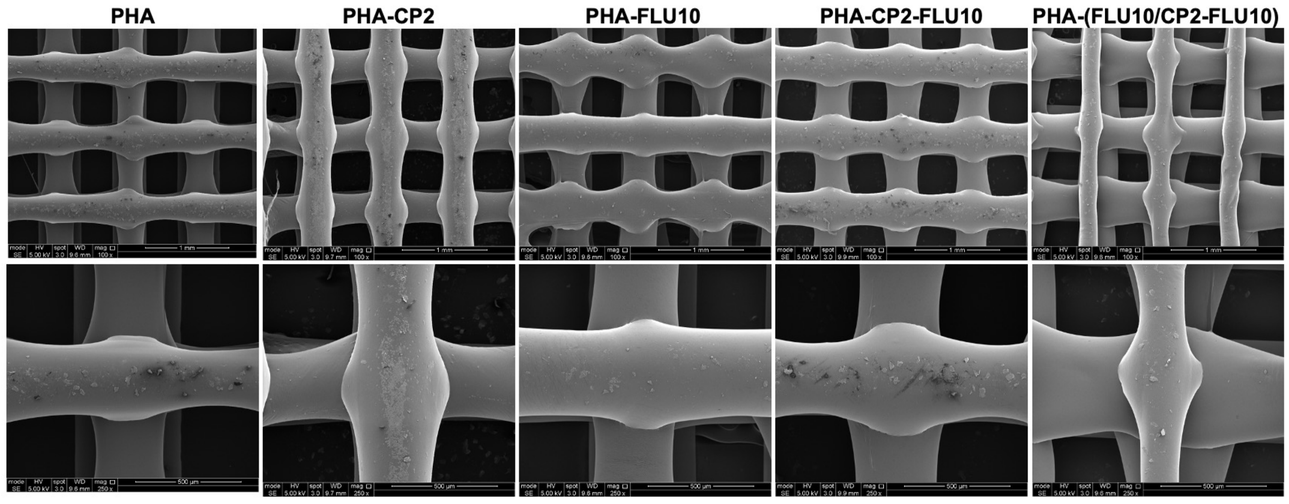
Characterisation of 3D printed oral mucosal patches



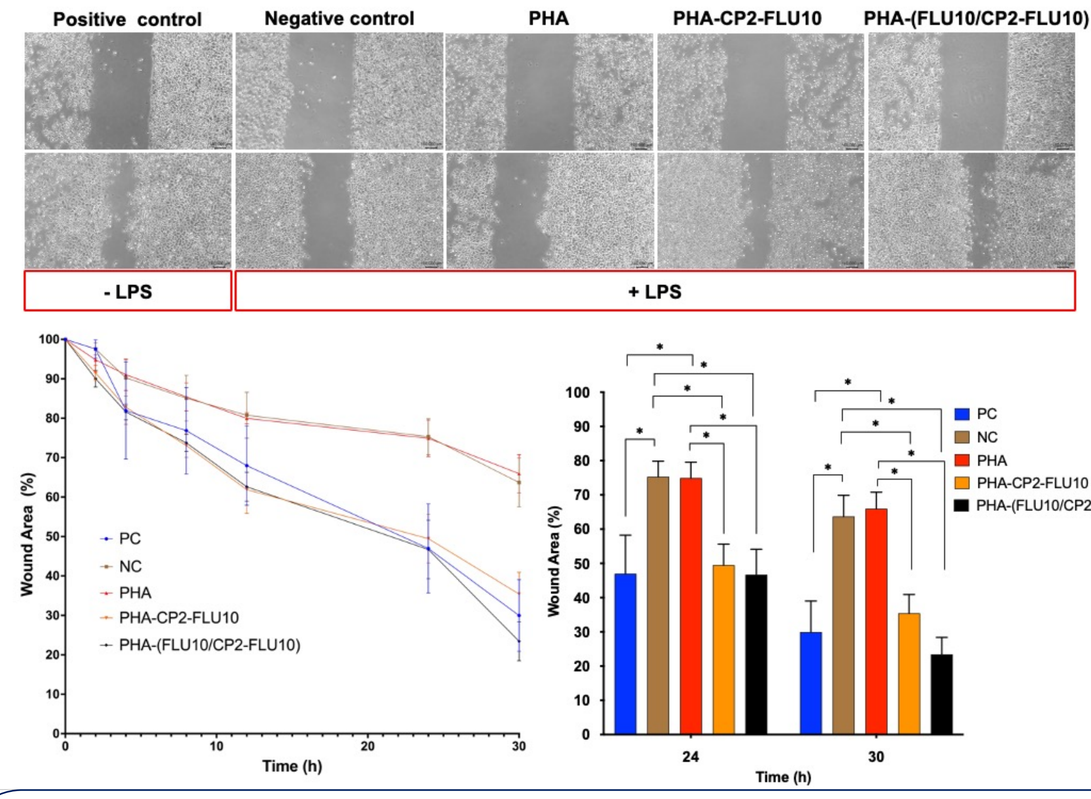




Scanning electron microscope images



Wound healing under inflammatory conditions



Conclusions

- 3D-printed mcl-PHA mucoadhesive patches successfully enabled localised, dual-drug delivery with suitable mechanical properties, print fidelity, and cytocompatibility for oral mucosal applications.
- Drug incorporation did not compromise material integrity, and the system exhibited controlled, diffusion-dominated and spatially tunable release, particularly in gradient constructs.
- Overall, the platform demonstrates strong potential as a site-specific therapeutic strategy for inflammatory oral conditions, such as oral lichen planus, and supports effective mucosal healing.

References

[1] R. A. Macartney, A. T. R. Fricker, G. U. N. Tajalla, A. M. Smith, S. Kishida, S. Fedele, I. Roy, J. C. Knowles, *J. Mater. Sci. Mater. Med.* **2026**, *37*, 56.

[2] R. A. Macartney, A. T. R. Fricker, A. M. Smith, S. Fedele, I. Roy, J. C. Knowles, *Anal. Methods* **2025**, *17*, 3694.

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Conflict of interest

IR is a Director of PHAsT Limited, (CSO) that develops biomedical grade polyhydroxyalkanoates (PHAs) for a variety of applications including healthcare and biomedical applications. However, the material used in this work weren't developed by PHAsT limited and were produced in IR's laboratory.