



Introduction

Periodontal disease affect more than 3.5 million people globally¹. Sampling of fluids for rapid diagnostics remain challenging. Current sampling techniques is limited in both quality and volume of biomarkers². A range of advanced biocompatible hydrogels have been designed and characterised to demonstrate their potential in capturing macromolecules, standardising biofluid sampling technique, eliminate variability in biofluid volumes and concentrations of biomarkers. The aim of this work is to assess the uptake of a macromolecule (FITC-dextran) by Gantrez S97 and Polyvinyl alcohol (M 31,000 - 50,000) based hydrogel devices and evaluate their physicochemical characteristics. This serves as preliminary data for further work in using these hydrogels for gingival crevicular fluid sampling and analysis in PD diagnostics.

Fig.1. Gives the general aim of the study.

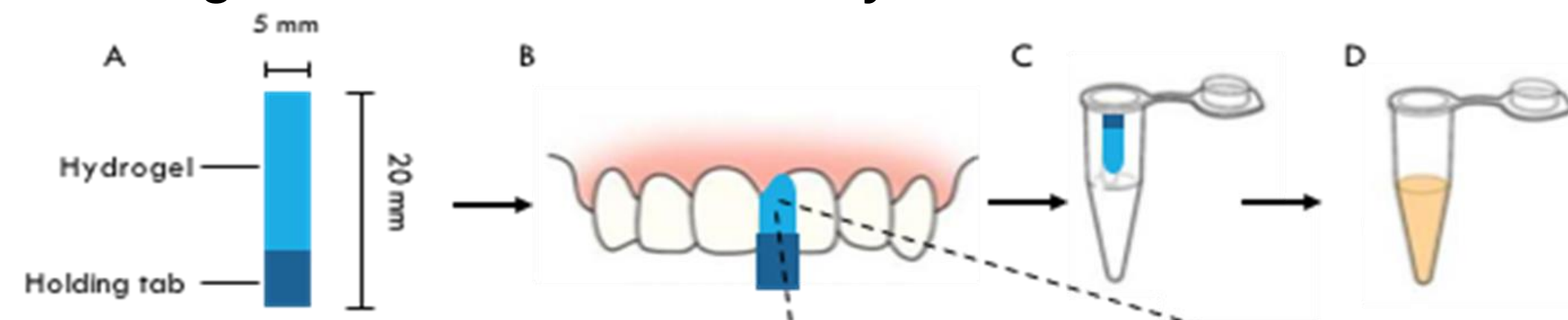


Fig. 1 Schematic representation of the A) proposed gingival crevicular fluid sampling device B) device in situ in periodontal pocket, C) removed fully intact and placed in elution buffer, D) eluted GCF sample for testing. E) schematic diagram of devices hydrogel matrix swollen having adsorbed GCF from the periodontal pocket.

Methods

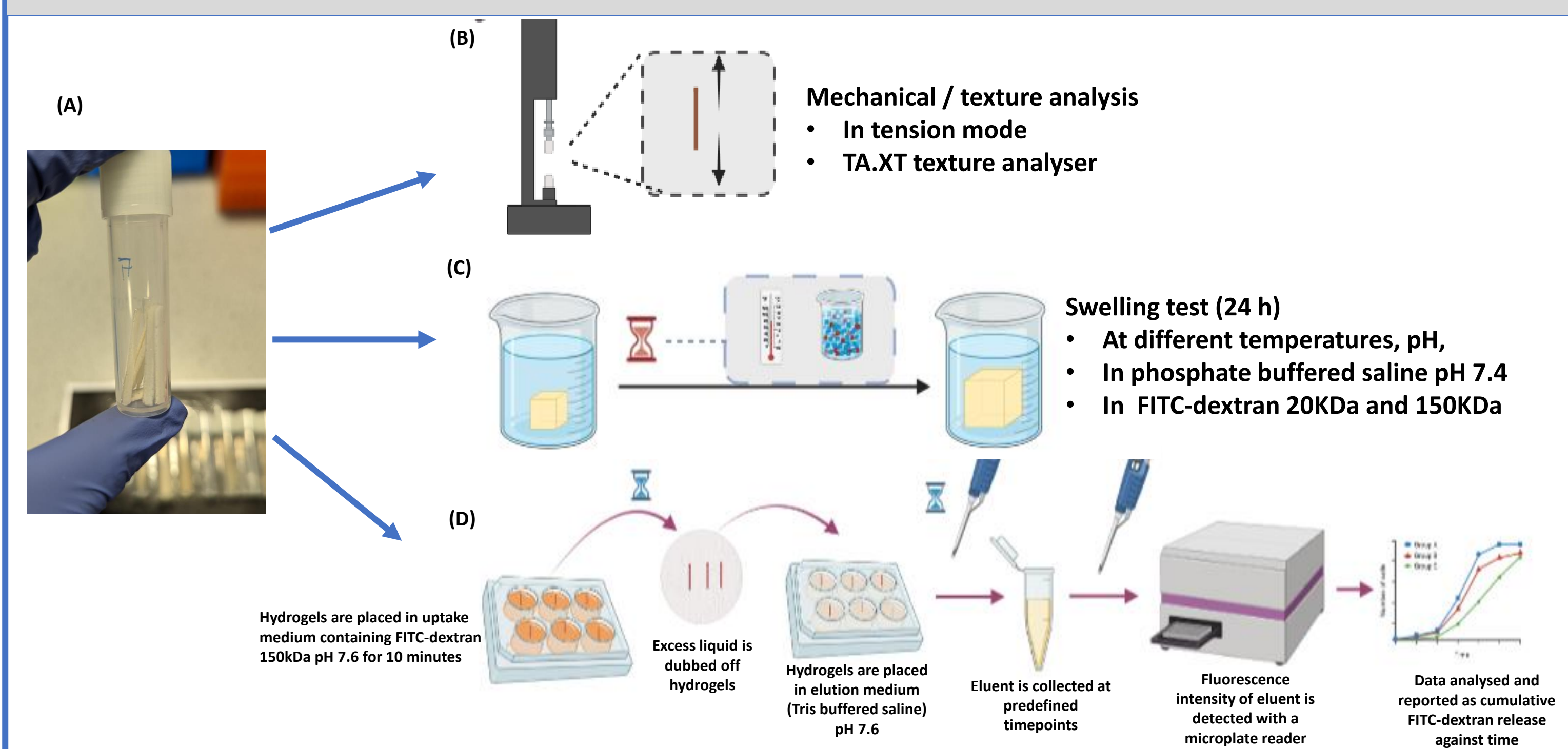


Fig. 2 : Illustration of the main tests on prototype hydrogel biofluid sampling device (A) Freshly prepared hydrogel formulations (B) Texture analysis of the hydrogels set up in a tension mode. (C) The swelling properties of the hydrogel samples (D) Uptake of FITC-dextran 150KDa in buffered saline

Results

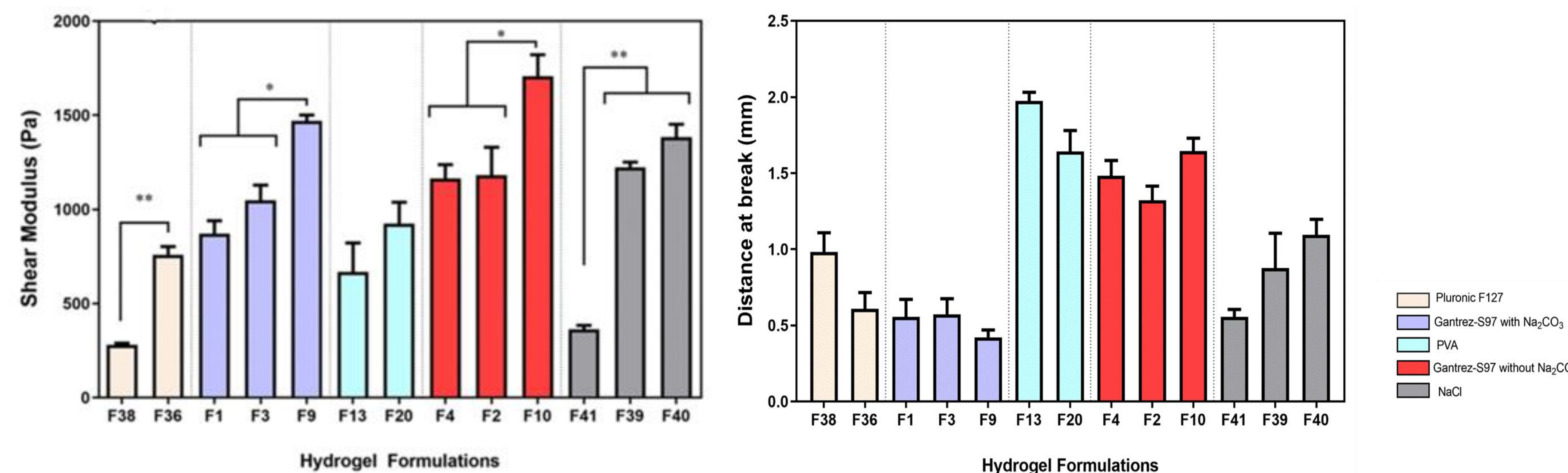


Fig. 3. A graph of shear modulus (Pa) of hydrogel formulations at 25°C.

Fig. 4: A graph illustrating the longest distance travelled by an applied force to break the hydrogel formulations during texture analysis

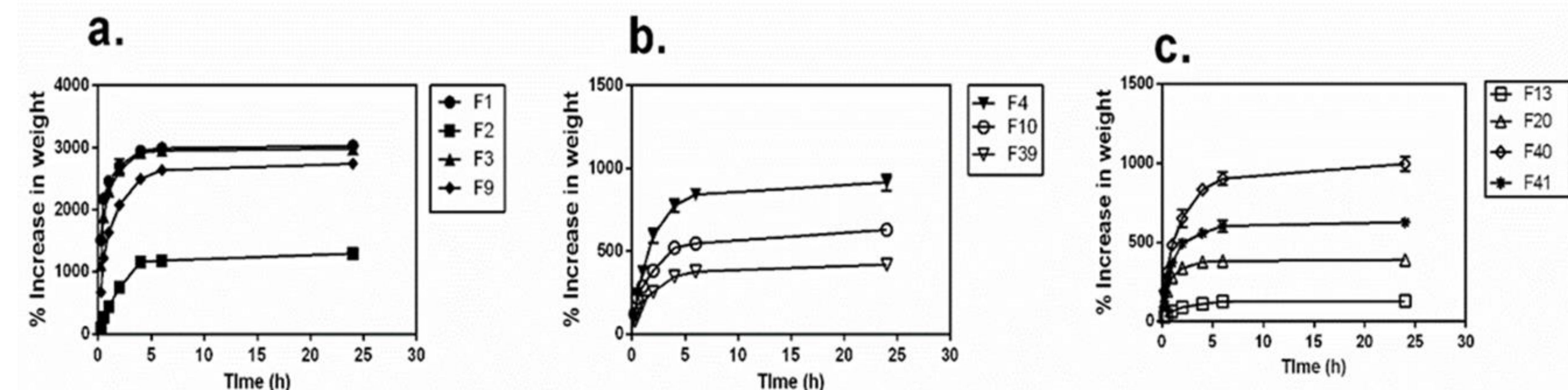


Fig. 6. Line graph A, B, C indicating percentage increase in weight of dried hydrogel films in PBS (pH=7.4) solution at specific time points (0.25, 0.5, 1, 2, 4, 6 and 24 h) for each formulation. (n=6 ± SD)

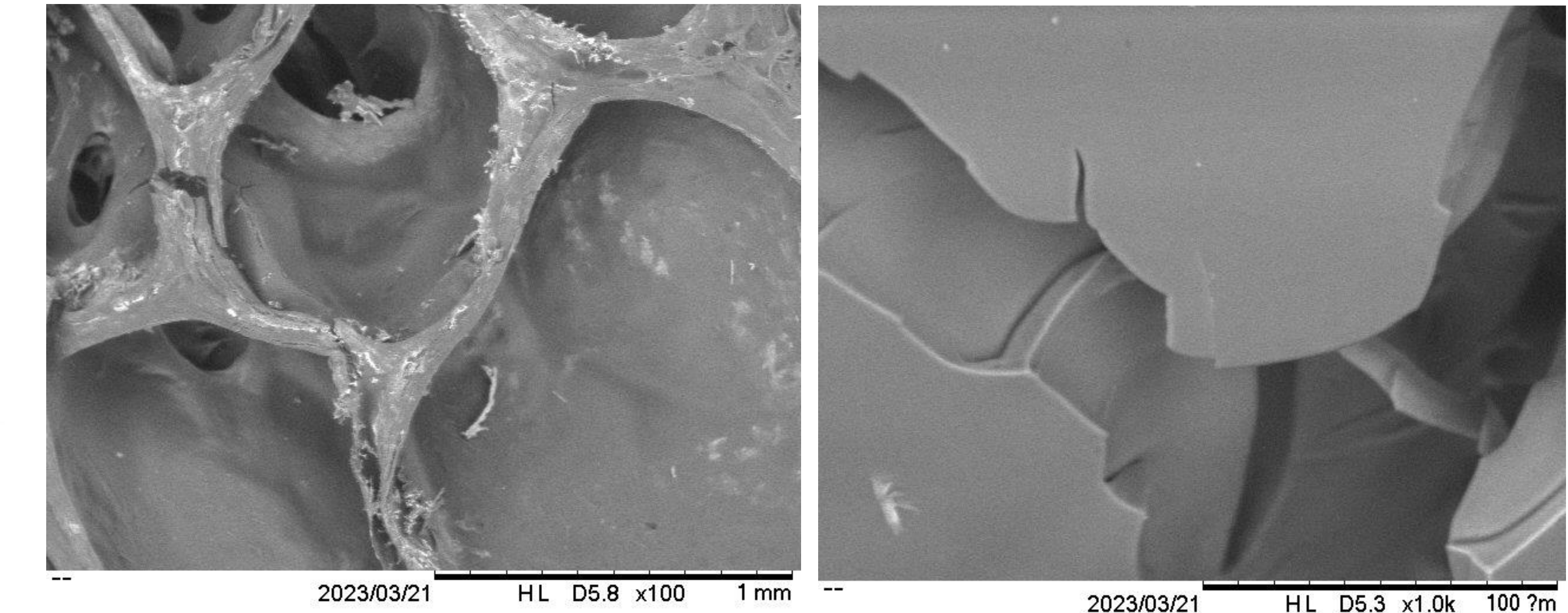


Fig.5. Representative scanning electron microscope (SEM) images of formulations showing surface characterisation

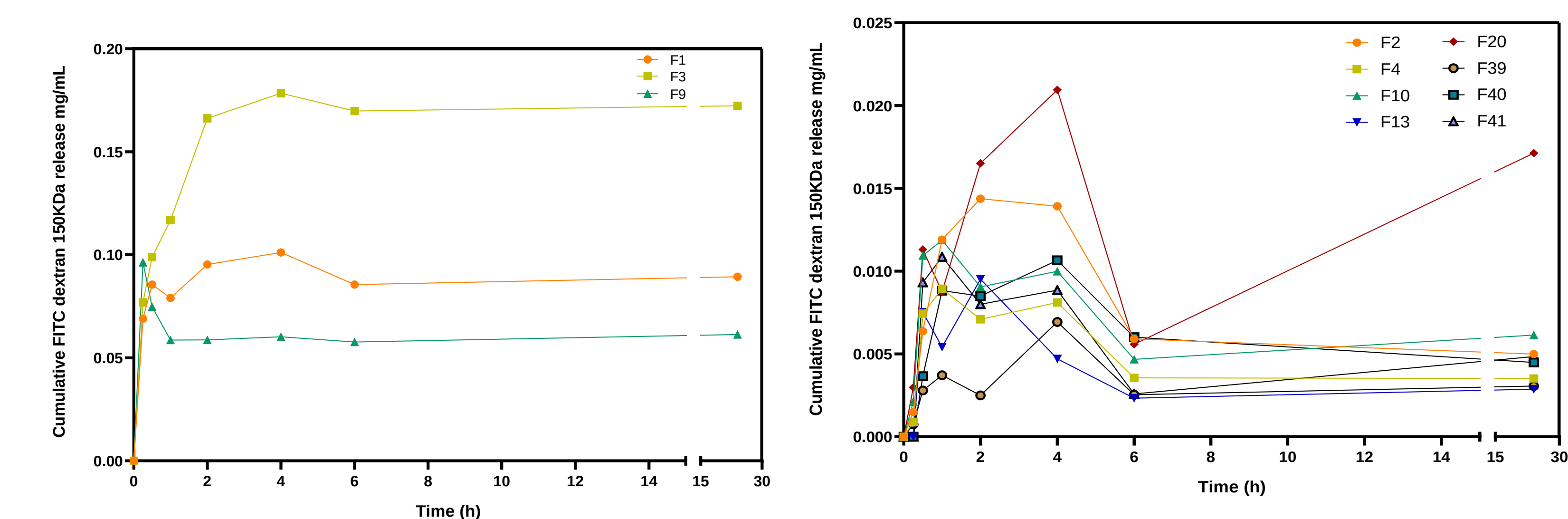


Fig. 7. : Cumulative FITC-dextran 150KDa released from hydrogel samples at time points 0.25, 0.5, 1, 2, 4, 6, and 24 h (A) release pattern for samples F1, F3, and F9 (B) release pattern for samples F2, F4, F10, F13, F20, F39, F40 and F41. n = 5 ± SD)

Conclusion

- Hydrogels exhibited a rapid release of FITC-dextran in the first hour followed by a sustained release over 24 h with 72% of samples showing erratic release after the first hour.
- Formulations F1, F3, and F9 which contained the same amount of Na₂CO₃ exhibited an initial burst and subsequent sustained release pattern. Hence will be considered for biological marker loading and release. Na₂CO₃ could be contributing significantly to stable FITC-dextran release pattern .
- Three formulations F1, F3, and F9 which contained Na₂CO₃ could be promising prototypes to capture and release relevant biomarkers in PD diagnosis.

References

- Patel, J., Wallace, J., Doshi, M., Gadanya, M., Yahya, I.B., Roseman, J. and Srisilapanan, P., 2021. Oral health for healthy ageing. *The Lancet Healthy Longevity*, 2(8), e521-e527.
- Gul, S. S., Abdulkareem, A. A., Sha, A. M. & Rawlinson, A. 2020. Diagnostic accuracy of oral fluids biomarker profile to determine the current and future status of periodontal and peri-implant diseases. *Diagnostics*, 10, 838.
- Kc, S., Wang, X.Z. and Gallagher, J.E., 2020. Diagnostic sensitivity and specificity of host-derived salivary biomarkers in periodontal disease amongst adults: systematic review. *Journal of clinical periodontology*, 47(3), pp.289-308.
- Ali, A., Hussain, M.A., Haseeb, M.T., Bukhari, S.N.A., Tabassum, T., Farid-ul-Haq, M. and Sheikh, F.A., 2022. A pH-responsive, biocompatible, and non-toxic citric acid cross-linked polysaccharide-based hydrogel from Salvia spinosa L. offering zero-order drug release. *Journal of Drug Delivery Science and Technology*, 69, p.103144.

Acknowledgement

This poster was possible because of the support of **Dr Eneko Larrañeta** of Queens University, Belfast with SEM imaging.