CHARACTERIZATION OF HYDROGEL BIOMATERIAL AS A POTENTIAL HYDROCORTISONE DELIVERY SYSTEM FOR TOPICAL THERAPY OF PSORIASIS

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MDPI

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INTRODUCTION

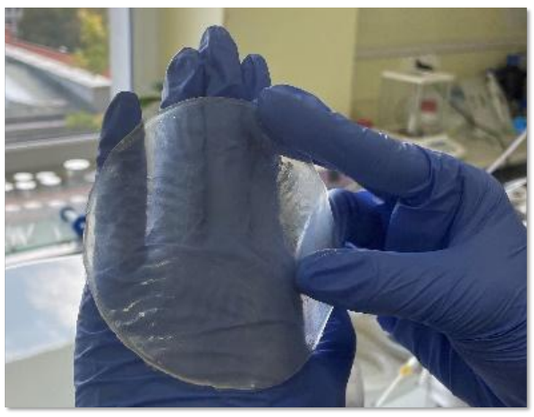
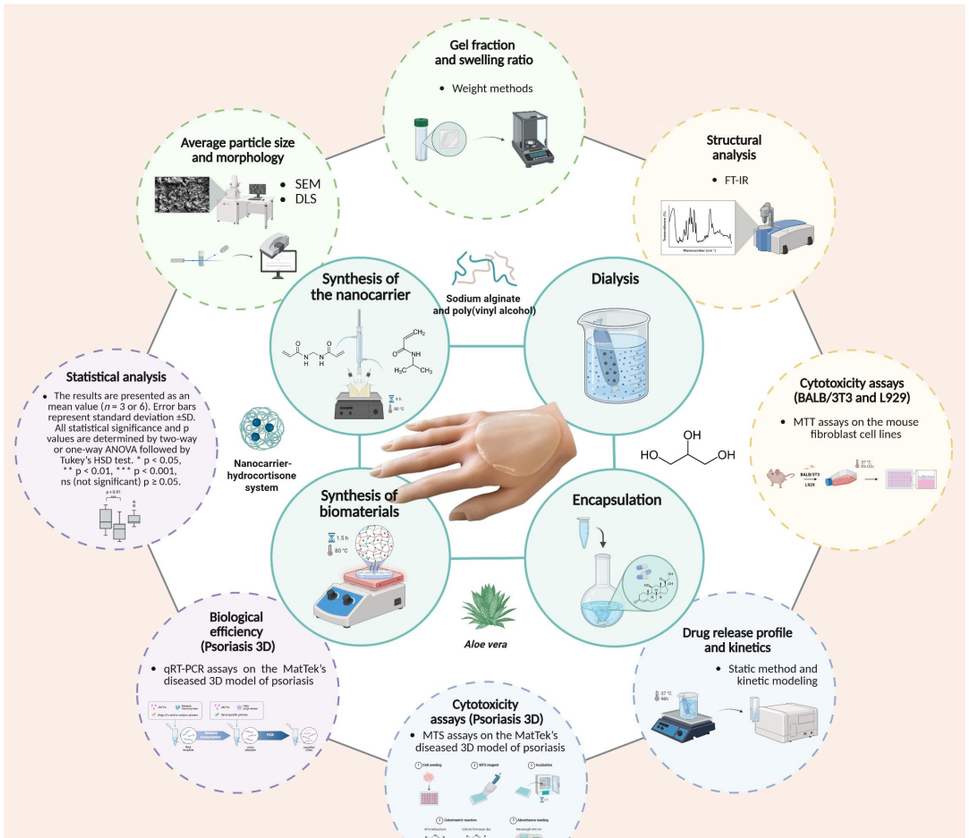


Figure. 1. Photograph of the hydrogel biomaterial obtained.

In spite of the progressive development of modern therapies for psoriasis, its complete cure remains impossible. The effectiveness of traditional topical therapies may be limited by **many side effects and application inconveniences**, including the oiliness of the formulations, and the need for frequent application, which can affect patient compliance. Therefore, studies were conducted on hydrogel biomaterials, characterized by **prolonged and controlled release of active substances**, which should potentially increase the therapeutic effect[1].

METHODS



RESULTS

Table 1. The average particle size and PDI of nanocarrier-drug systems.

Sample	Average particle size (nm)	Polydispersity index (PDI)
TH25	131.3	0.202
TH40	124.8	0.178
TH50	137.0	0.186

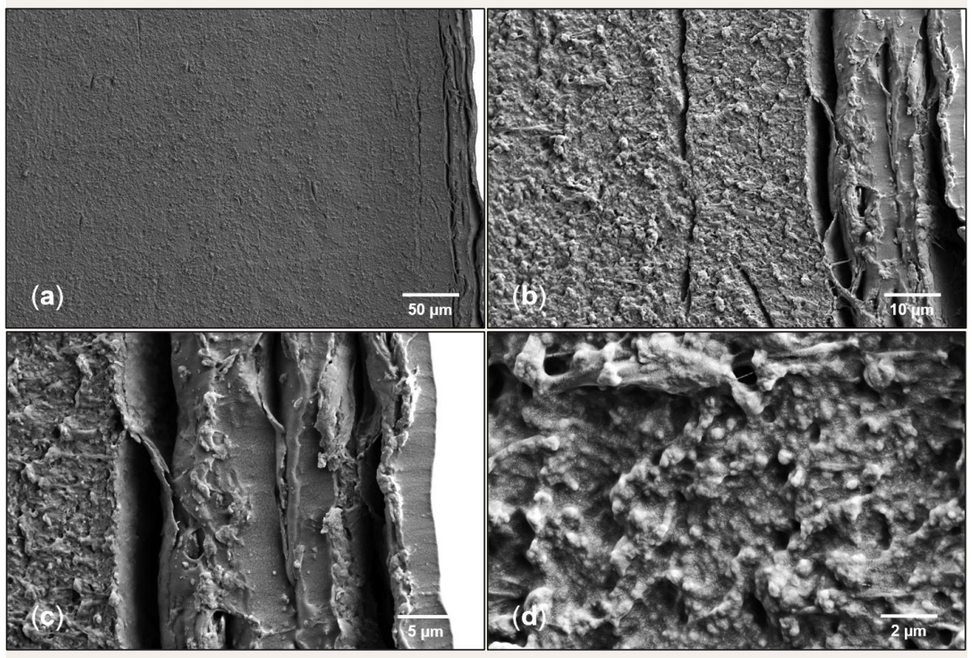


Figure 2. SEM micrographs of the hydrogel biomaterial at magnifications of: (**a**) 1,000×; (**b**) 5,000×; (**c**) 10,000× and (**d**) 25,000×.

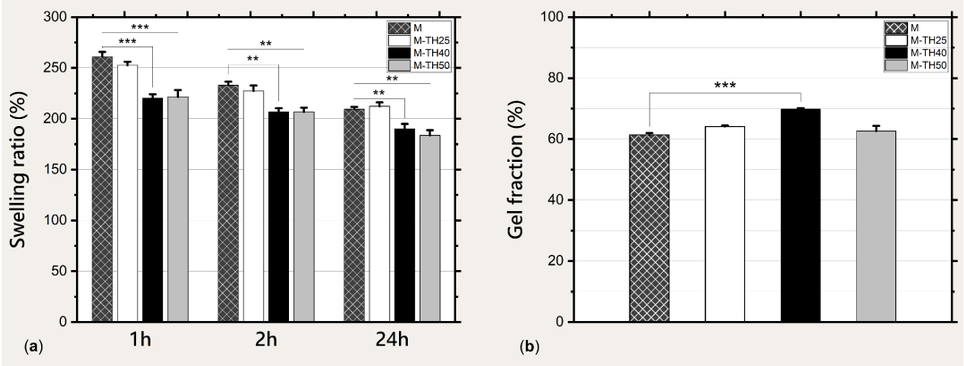


Figure 3. (**a**) Gel fraction and (**b**) swelling ratio of the analyzed hydrogel biomaterials.

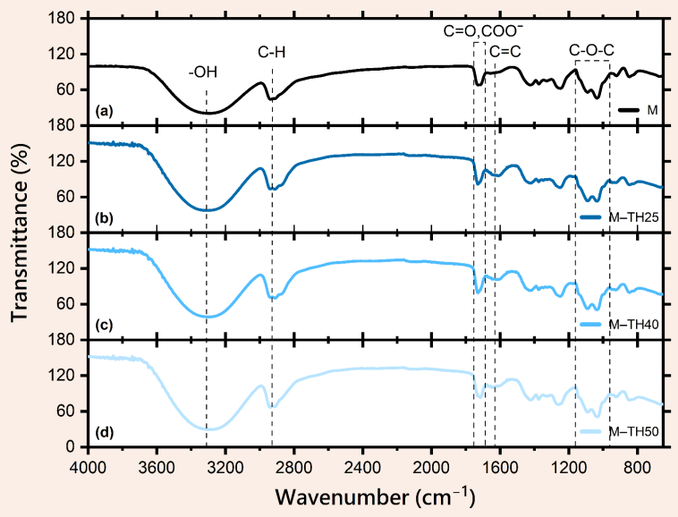


Figure 4. FT-IR spectra of hydrogel biomaterials: (**a**) M; (**b**) M-TH25; (**c**) M-TH40; (**d**) M-TH50.

Table 2. Band assignments of the FTIR spectra of hydrogel biomaterials.

Identification	Wavenumber (cm⁻¹)			
	M	M-TH25	M-TH40	M-TH50
O-H stretching vibration	3288	3311	3296	3288
C-H asymmetric stretching vibration	2940	2912	2910	2940
C=O stretching vibration	1715	1730	1730	1715
C=C asymmetric stretching vibration	1611	1608	1622	1647
C=C symmetric stretching vibration	1423	1423	1424	1423
CH_2 wagging vibration	1375	1375	1375	1375
C-O-C vibration from glycosidic bonds	1258	1251	1251	1261
C-O-C stretching vibration	1090	1090	1091	1090
C-C stretching vibration C-O-C vibration from glycosidic bonds	1036	1036	1036	1035

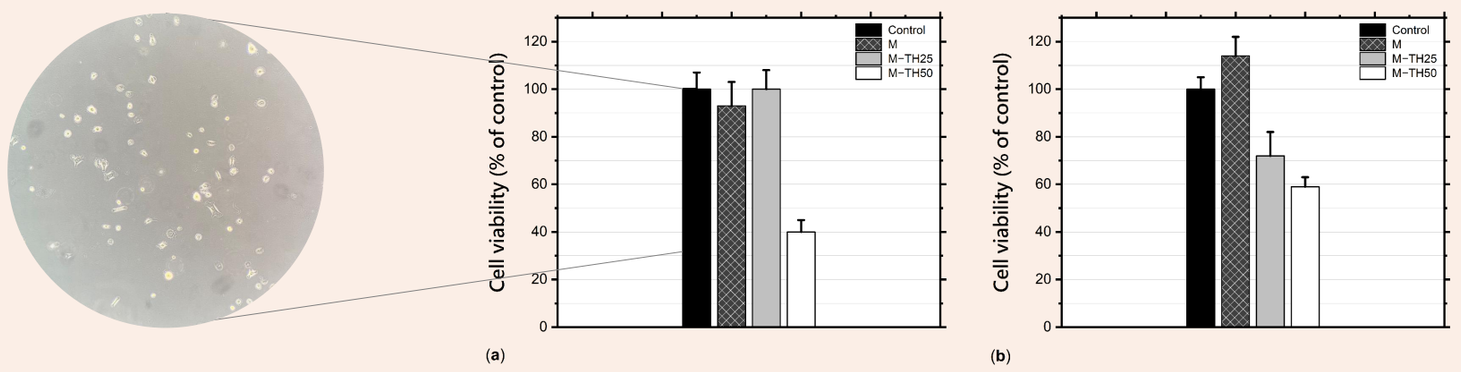


Figure 5. The viability of: (**a**) BALB/3T3 and (**b**) L929 cells in the presence of hydrogel biomaterials (M, M-TH25 and M-TH50) after 24 h of incubation.

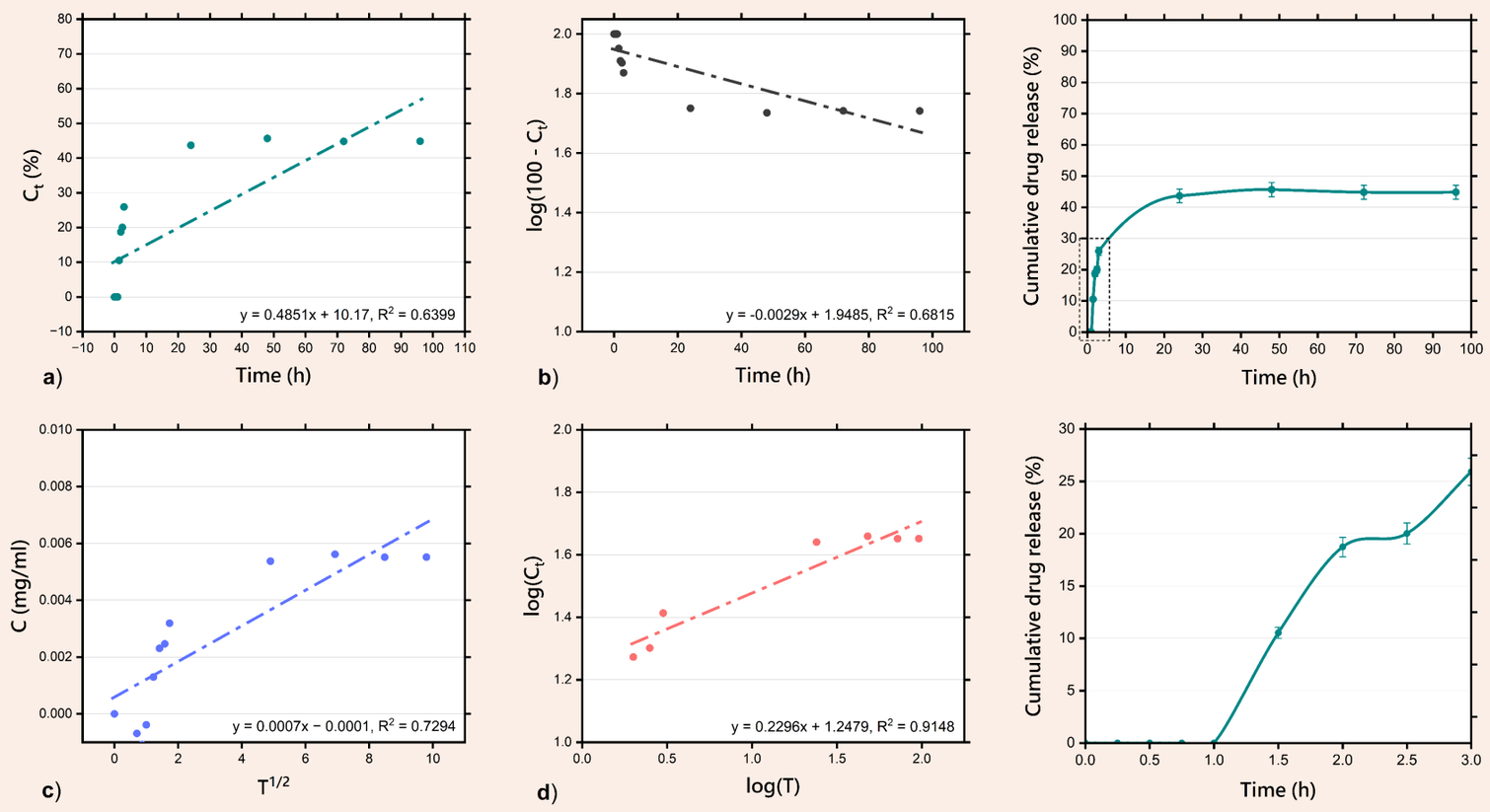


Figure 6. The kinetics of hydrocortisone release from the hydrogel biomaterial (M-TH40) according to the model: (**a**) zero-order; (**b**) first-order; (**c**) Higuchi; (**d**) Korsmeyer-Peppas.

Figure 7. Hydrocortisone release profile from hydrogel biomaterial (M-TH40) in PBS.

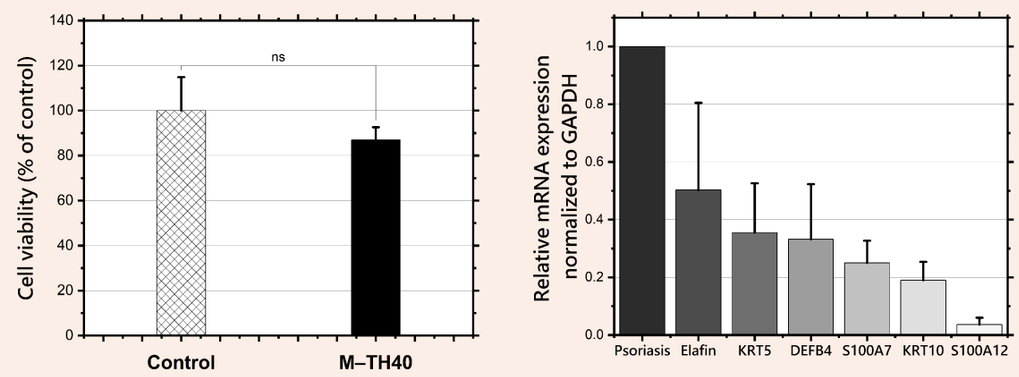
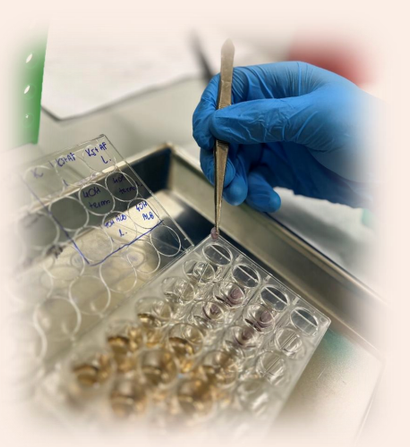


Figure 8. 3D cell viability and mRNA expression of the selected genes after 24 h of incubation with M-TH40 sample.



DISCUSSION

- Encapsulation of hydrocortisone (25–50 mg) in a polymeric nanocarrier **does not cause significant changes or disturb its monodispersity**.
- The dependence of the swelling ratio of biomaterials on incubation time is probably due to changes in the polymer network, which may result from the **slow leaching of active substances** from *Aloe vera* and, in smaller parts, hydrocortisone.
- Analysis of FT-IR spectra confirmed the presence of functional groups characteristic for the biomaterials studied.
- Hydrocortisone release occurred in a **controlled and prolonged way** (up to 96 hours) **with no undesirable and rapid drug release in the first phase**.
- The kinetics of hydrocortisone release from the hydrogel biomaterial is most clearly characterized by the **Korsmeyer-Peppas model**, and the release followed **Fickian diffusion kinetics**.
- The hydrogel biomaterial was confirmed to be **non-toxic to human epidermal tissues affected by psoriasis**, and it effectively **inhibits the expression of key markers** associated with inflammation and hyperproliferation in psoriasis.
- Morphologically, the tissue model closely matched psoriatic altered human tissues, thus achieving a **close-to-real environment** without the need for animal models at this stage. Therefore, the project is in line with the **3Rs principle (replacement, reduction, refinement)**.

REFERENCES

1. Li, J., Mooney, D. Designing hydrogels for controlled drug delivery. Nat Rev Mater **1**, 16071 (2016). https://doi.org/10.1038/natrevmats.2016.71