CARBOXYMETHYL CELLULOSE DISSOLVING MICRONEEDLES CONTAINING TETRACYCLINE HYDROCHLORIDE FOR THE TREATMENT OF ACNE VULGARIS

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BACKGROUND

METHODS

DMAPs CASTING

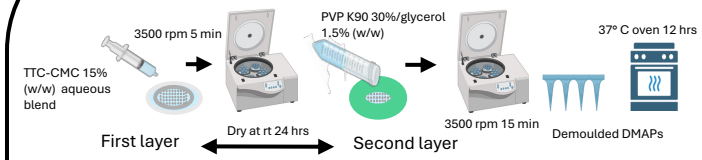


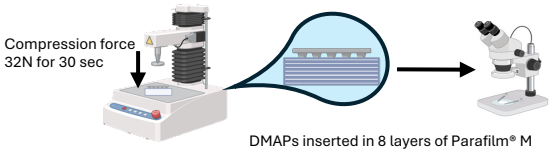
TABLE 1: AQUEOUS BLENDS COMPOSITION

FORMULATION	CMC % w/w	PVP K90 % w/w	GLYCEROL % w/w	TTC % w/w
F1	15	30	1.5	2.5
F2	15	30	1.5	10
F3	15	30	1.5	5

CMC: Carboxymethyl cellulose; PVP: Polyvinyl pyrrolidone; TTC: Tetracycline hydrochloride

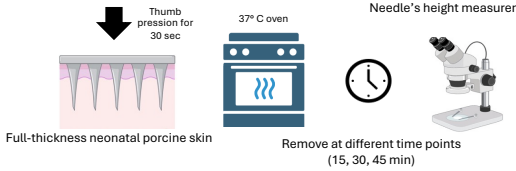
DMAPs CHARACTERIZATION

INSERTION CAPACITY

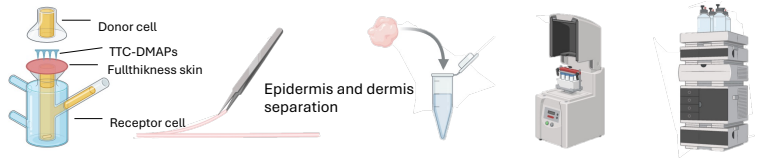


DMAPs inserted in 8 layers of Parafilm® M

DISSOLUTION STUDIES



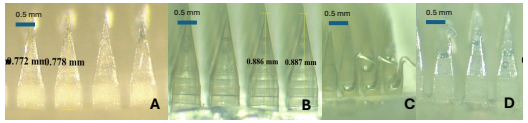
DERMATOKINETIC STUDIES



Skin processed with tissue lyser, TTC extracted and quantified by HPLC

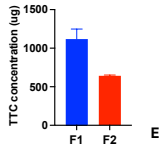
RESULTS

MORPHOLOGICAL ANALYSIS



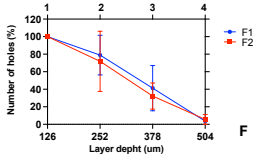
Digital light microscope images of TTC-loaded DMAP formulations: F1 (A), F2 (B), and F3 (C–D); F3 contain elevated TTC concentration, leading to higher viscosity and disrupted needle formation.

DRUG CONTENT

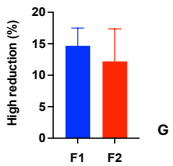


(E) TTC concentration in the needle tips for F1 and F2. (mean ± SD, n=4).

INSERTION CAPACITIES

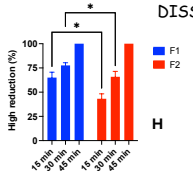


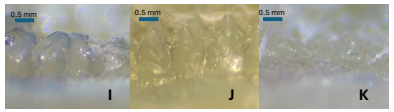
MECHANICAL PROPERTIES



Both formulations achieved insertion depth up to 378 µm (F), with a height reduction of less than 15% following a compression force of 32N for 30 sec against a steel block (G)

DISSOLUTION RATE

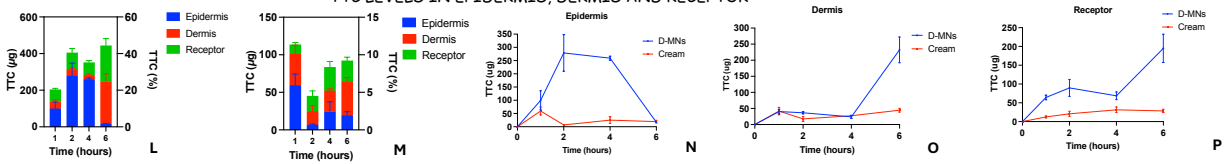




15 minutes 30 minutes 45 minutes

Both TTC-loaded DMAP formulations fully dissolved within 45 min in situ. FT2 exhibited a faster dissolution (77.6% height reduction at 30 min vs. 65.9% for FT1), likely due to its higher TTC loading (1118.8 µg vs. 641.3 µg). This suggests that FT2 may provide faster and greater drug release at the application site, potentially enhancing therapeutic efficacy in acne treatment (H-K).

TTC LEVELS IN EPIDERMIS, DERMIS AND RECEPTOR



Dermatokinetic studies comparing TTC-loaded DMAPs with a conventional TTC-loaded cream showed ~40% of the initial dose deliver into the skin after 6 hrs for DMAPs, vs. ~10% for the cream (L-M). DMAPs achieved markedly higher TTC levels in the dermis (232 µg at 6 h) compared to the cream (44 µg), suggesting improved delivery to the pilosebaceous units where *C. acnes* resides (N-P).

CONCLUSIONS

TTC-loaded dissolving microneedle array patches (DMAPs) based on biodegradable CMC were successfully developed, showing excellent mechanical properties, efficient skin insertion, and rapid dissolution. Compared to a conventional TTC cream, DMAPs significantly enhanced TTC delivery into the dermis—the key site of *C. acnes* infection, achieving approximately fourfold higher drug deposition. These results highlight the potential of DMAPs as an effective localised therapy for acne, potentially reducing reliance on systemic antibiotics and lowering the risk of antibiotic resistance. Future studies will include microbiological assessments to further evaluate the antibacterial efficacy of the DMAP system against *C. acnes*.

REFERENCES

Simonart *et al BJD* 2008. Alkilani *et al, DD,* 2024 . Lee *et al, Biomaterials*, *2008*. Prausnitz, Adv Drug Deliv Rev, 2004. Donnelly *et al,* Adv Funct Mater, 2012.