Dermal Penetration Enhancement by Dermaportation – Preliminary investigations of a novel technology

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Introduction: Dermaportation is a modified inductive energy technology to enhance skin penetration of drugs. The proposed mechanism of action is bio-induction caused by the generation of an electric effect in the stratum corneum. This reduces the barrier effect of the bilayer lipids to increase skin penetration of a concurrently applied solute. Inductive medicine has been investigated for enhancing healing of venous ulcers [1], bone fractures [2] and has been shown to affect a range of cellular functions [3].

Objective: The aim of the study was to investigate the effect of Dermaportation cycles (waveforms) on epidermal penetration of a small model solute (caffeine).

Methods: *In vitro* diffusion across excised human epidermis was determined using Franz type diffusion cells (Fig. 1) maintained at 37°C . The donor compartment consisted of 100 μg of caffeine in 1 mL phosphate buffered saline (PBS). The receptor compartment was filled with PBS and stirred throughout. Aliquots (500 μL) were taken from the receptor at 0, 0.5, 1, 1.5, 2, 3 and 4 h and immediately replaced with an equal volume of PBS. An aliquot was also taken from donor phase at 4 h. Dermaportation was applied for 30 min from time 0.5 to 1 h after application of the donor solution. Four different Dermaportation waveforms were compared with passive diffusion. Caffeine content in all samples was assayed by HPLC. Experiments were conducted in triplicate.

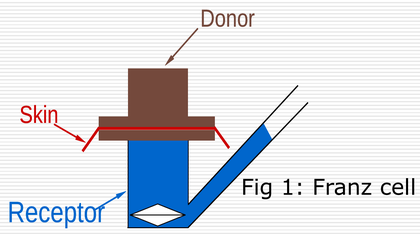

Fig 1: Franz cell

Results: Cycles 2 and 3 waveforms caused a greatest increase in epidermal penetration of caffeine immediately after Dermaportation (0.5 – 1 h). The enhancement effect of Cycle 4 was less pronounced. Cycle 1 waveform, which is similar to that which has been used previously to induce bone cell proliferation, showed minimal enhancement of caffeine penetration across human epidermis.

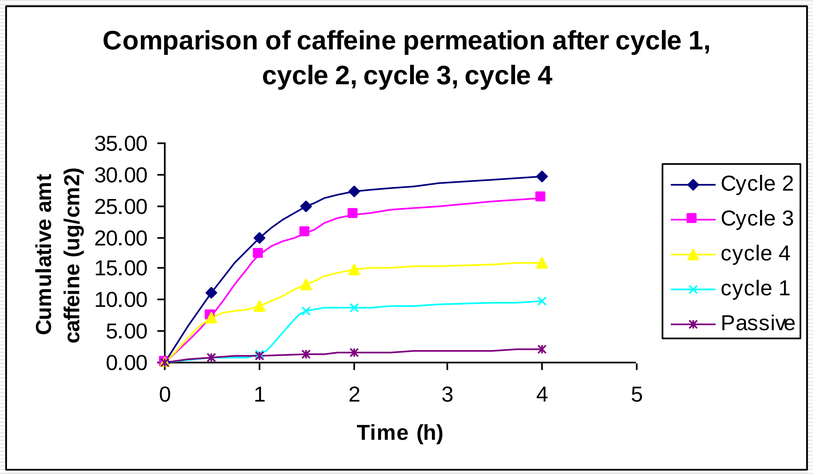

Fig 2: Cumulative amount of caffeine penetrated human epidermis to receptor phase on passive diffusion and with Dermaportation (n=3, ± s.d.)

Table 1: Flux of caffeine across human epidermis during (0.75 h timepoint) and after application of Dermaportation or passive diffusion

Time (h)	Flux (μg/cm²)				
	Passive	Cycle 1	Cycle 2	Cycle 3	Cycle 4
0	0	0	0	0	0
0.75	0.55	0.62	17.62	19.24	3.5
1.25	0.40	1.89	9.9	6.9	6.7
1.75	0.63	0.84	5.01	6.0	4.7
3.5	0.14	0.39	1	1.33	0.82

Conclusions: Marked enhancement ratios (ratio of flux Dermaportation to passive) of 35 and 32 were obtained during Dermaportation application with cycle 3 and cycle 2 waveforms respectively. The Dermaportation technology is being further investigated to determine energy waveform characteristics that will provide optimal skin penetration enhancement with a range of therapeutically relevant solutes.

References

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