Percutaneous Iron Replenishment Therapy (PIRT): Is Passive Transdermal Delivery of Iron Possible?

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Purpose
The objective of the present study was to identify suitable chemical permeation enhancers (CPEs) for passive delivery of Ferric Pyrophosphate (FPP).

Methods
In vitro drug permeation studies were carried out using Franz diffusion cell set up across porcine epidermis. Epidermis integrity was confirmed prior to permeation studies by measuring the electrical resistance. Various transdermal CPEs such as fatty acids, fatty acid esters, azones, amides and surfactants were selected. Porcine epidermis was pretreated using fatty acids and glycols for 30 minutes prior to placement of FPP solution in the donor compartment. Permeation studies were carried out for 24 hours by placing 0.5 ml of FPP solution (50 mg/ml) in the donor and 5 ml of pH-5 PBS buffer in the receiver compartment. Amount of FPP permeated at different time points was analyzed using Inductive Coupled Plasma Mass Spectrometry (ICP-MS).

Results
Being hydrophilic in nature with high molecular weight, the passive permeation of FPP was poor; a cumulative amount of 26.6 ± 3.16 µg/cm² was permeated in 24 hours. DMSO 10% v/v enhanced the total amount of FPP permeated by ~2.8 folds compared to passive permeation. TPGS 5% and 20 % w/v enhanced the total amount of FPP permeated by ~1.8 and ~2 folds respectively. There was ~1.9 fold increase in the amount of FPP permeated with Urea at 10 % w/v and ~ 2.1 fold increases with SLS at 20 % w/v concentrations. In case of pretreatment of epidermis with CPEs, only 10 % oleic acid along with propylene glycol resulted in ~1.5 fold enhancement in the total amount of FPP permeated in 24 hours.

Conclusion
Passive delivery of iron would be very attractive because of its relatively better patient compliance and minimized gastric side effects, particularly in children and pregnant women. It would be an excellent mode of iron replenishment in patients who have problems in absorbing iron from their gut. This study helps to identify potential chemical enhancers that could be utilized for PIRT.

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