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## Gabapentin co-solvent system and micro emulsion for transdermal delivery: Characterization and *in vitro* study

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**Background:** Gabapentin, 2-[1-(aminomethyl) cyclohexyl] acetic acid is an excitatory amino acid antagonist. Clinically, gabapentin is used orally for the treatment of post therapeutic neuralgia and adjunctive therapy for partial seizures. Drug properties such as insufficient metabolism, short plasma half-life and bioavailability having an inverse relationship to the drug dose could constitute hindrance to its clinical use. This presents a need for an alternative route of drug administration that bypasses these drawbacks. Transdermal drug delivery is an alternative route. Therefore, the objective of the present study was to investigate the potential of co-solvent system and microemulsion formulation for transdermal delivery of gabapentin. To characterize the physicochemical properties of drug-loaded oil-in-water (o/w) and water-in-oil (w/o) cremophor 40-based microemulsions were used in comparison to their blank counterparts.

**Methods:** The co-solvent systems are ethanol-water and propylene glycol-water (90:10, 80:20, 70:30 v/v) mixture respectively and were prepared by homogenous mixing. The microemulsion formulation is made of coconut oil, water and mixture of cremophor 40 and ethanol (1:1 and 1:2 w/w respectively) and was prepared by aqueous titration method. The physicochemical properties of the microemulsion formulations (pH, droplet size, surface tension and viscosity) were determined using reported procedures. *In-vitro* evaluation was performed using modified Franz diffusion cells. Fourier transform infrared spectroscopy (FTIR) was performed to determine the skin permeation mechanism of gabapentin from co-solvent system and microemulsion formulation respectively.

**Results:** The physicochemical properties of drug-loaded microemulsions and their blank counterparts were generally alike, however, slight variation in pH and viscosity were observed probably due to the intrinsic properties of the drug. The ethanol-water system (70:30 v/v) gave higher flux ( $63.29 \pm 1.6 \text{ mgcm}^{-2}\text{h}^{-1}$ ) for gabapentin when compared to propylene glycol-water system at the same composition ( $24.12 \pm 1.5 \text{ mgcm}^{-2}\text{h}^{-1}$ ). The w/o microemulsion formulations resulted in higher fluxes ( $128.215 \pm 1.84 \text{ mgcm}^{-2}\text{h}^{-1}$  and  $61.14 \pm 0.89 \text{ mgcm}^{-2}\text{h}^{-1}$  respectively) for gabapentin when compared to o/w formulations ( $10.9 \pm 1.2 \text{ mgcm}^{-2}\text{h}^{-1}$  and  $9.3 \pm 2.1 \text{ mgcm}^{-2}\text{h}^{-1}$  respectively). The FTIR results suggest the mechanism of permeation to be disruption of lipid bilayers and keratin denaturation of the stratum corneum.

**Conclusion:** The results demonstrate that incorporation of gabapentin into microemulsions did not change the microemulsion type. The obtained fluxes suggest that the co-solvent system (ethanol-water 70:30 v/v) and w/o microemulsion type respectively, can be successfully used as potential vehicles in developing transdermal therapeutic systems for gabapentin.

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