Journal of Pharmaceutical Research Vol. 13, No. 2, April - June 2014 : 40-44

ZINC OXIDE AND ZINC OXIDE NANOPARTICLES AS ENHANCERS IN TOPICAL PHARMACEUTICAL AND COSMETIC PRODUCTS

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Received on: 17.04.2014 Revised: 15.05.2014 Accepted: 19.05.2014

ABSTRACT

Objectives: Scientists have widely investigated the use of chemical enhancers to improve drug transport through the skin. In this study, ZnO and ZnO nanoparticles (ZnO-NPs) has been used as dermal absorption enhancers for Ibuprofen (IP).

Methods: Seven different formulations containing IP, ZnO, or ZnO-NPs were prepared. Dermal absorption experiments were performed at 32°C using a diffusion cell containing phosphate buffer saline (pH 7.4) and a slice of chicken skin. Cumulative amounts of skin permeated IP, ZnO or ZnO-NPs were plotted over time.

Results: After 60 minutes, 90, 8 and 81 mg ZnO, ZnO-NPs and IP were passed through the skin, respectively. This amount for IP was 105, 114, 131 and 183 mg in presence of 100 mg ZnO, 100 mg ZnO-NPs, 200 mg ZnO-NPs, and 500 mg ZnO-NPs, respectively.

Maximum amount of not-permeated IP was seen for formulation 1 (IP without enhancer) and minimum not-permeated IP was seen for formulation 5 (IP with 500 mg ZnO-NPs as enhancer).

Conclusion: ZnO and more strongly ZnO-NPs could act as enhancers for transdermal delivery of IP. Such effect was improved by increase in concentration of ZnO-NPs. Therefore, ZnO-NPs can be used as enhancer in dermal drug delivery formulations.

Key words: *Zinc Oxide; Zinc Oxide nanoparticles; Ibuprofen; Enhancer; skin permeation.*

INTRODUCTION

Transdermal drug administration possesses many advantages including decreased first-pass drug metabolism, no gastro-intestinal degradation, long term delivery (>24 hours) (especially for transdermal patches) and controlled delivery and termination[1]. The main barrier for transdermal drug delivery, is the skin's topmost layer, stratum corneum (SC). The SC must be altered to increase the advantages of transdermal drug administration. This has been the subject of research for pharmaceutical scientists over the last couple of decades[2]. Extensive research on chemical enhancers has been performed over the last 20 years which form the main component of formulation-based approaches for transdermal drug delivery[3]. It is now believed that formulation components influence extent and rate of passive transdermal absorption[4]. Permeation of a drug through the skin in the presence of an enhancer is related to chemical structure of enhancer and physico-chemical interactions of the enhancer with the drug or with the skin components[5-7]. More than 200 chemicals have been shown to enhance skin permeation of drugs. Chemical penetration enhancers (CPEs) should build blocks to make new skin microstructures without irritation[3].

Zinc is a relatively low price, biocompatible and non-toxic essential element for human health[8]. Forslind found that zinc could alter the physical structure of the skin layers without affected by metabolism in skin layers[9]. Parat et al. proved that zinc has antioxidant and cytoprotective effects on skin keratinocytes in cell (HaCaT) culture[10]. Zinc Oxide (ZnO) has been applied topically to heal wounds and for treatment of other skin disorders[7,11,12]. The zinc distribution in the skin showed a peak in the epidermal layer decreasing toward the SC, with an exception in the SC which was free of zinc[13].

Variety of nanoparticles (NPs) including elemental, hydrophobic or hydrophobic-polymeric NPs have been widely used for improving the delivery of pharmaceuticals across the skin[14,15]. In this study, ZnO and ZnO nanoparticles (ZnO-NPs) were used as dermal absorption enhancers for a model drug.

Since non-steroidal anti-inflammatory drugs (NSAIDs) are vastly used in dermal products and their skin

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