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Chemical *vs.* Physical Approaches to Enhance Drug Delivery to the Dermis

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Introduction

The biggest organ in the human body, the skin, has several distinctive qualities that are vital to human survival. Not only does it function as a strong barrier of protection, but it also facilitates communication with the outside world, takes part in thermoregulation, has hormonal activity and significantly contributes to triggering a sufficient immune response.

The biggest organ in the human body, the skin, has several distinctive qualities that are vital to human survival. Not only does it function as a strong barrier of protection, but it also facilitates communication with the outside world, takes part in thermoregulation, has hormonal activity and significantly contributes to triggering a sufficient immune response.

Description

Since ancient times, people have been applying therapeutic substances to their skin. This form of treatment is quite difficult in contemporary pharmacotherapy and there are many different preparations available for different indications. But thanks to a number of scientific discoveries, we are now able to use the skin not only for localised therapy but also to have some substantial impacts in the deeper layers of the skin and even to transport drugs transdermally [1].

While systemic side effects are diminished, the availability of the active substance at the site of action is raised. The drug's administration is straightforward, which improves patient compliance and improves treatment results. No matter if the objective is to transfer the active into the systemic circulation or to accomplish effects on the skin's surface, deeper layers, or both, administration on the skin is a problem owing to its heterogeneous nature [2]. The thick, keratinized superficial skin layer stratum corneum serves as the primary obstacle for active substances to cross on their way to the predicted site of action after dermal application.

For improving cutaneous medication delivery, a number of strategies have been put out thus far. While electrical current-based approaches (such iontophoresis) stand out as potential "active" ones, the use of chemical penetration enhancers has a long history of usage. In this work, custom adhesive dermal delivery systems based on iontophoresis and curcumin-loaded nanoemulsions with and without monoterpenes (eucalyptol or pinene) as chemical penetration enhancers were designed and evaluated with the goal of assessing the contributions of various approaches to dermal delivery. They were shown to have a high safety profile in an *in vivo* research using skin bioengineering methods [3].

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Iontophoresis is the topical administration of a low-density electrical current (less than 0.5 mA/cm^2) over a period of minutes or hours (in a continuous or discontinuous mode), combined with a medication formulation, to aid in the drug's transport through the skin and other tissues and biological membranes. Iontophoresis has the great advantage of allowing for the (trans)dermal delivery of peptides and oligonucleotides, which opens up new avenues in the drug delivery of biologics despite the fact that it is typically used for the delivery of small (molecular weights up to several kDa) polar/charged molecules.

They sought to evaluate the impact of nanoemulsions as drug delivery systems in comparison to another strategy for improving cutaneous administration called iontophoresis. In this study, unique adhesive dermal delivery systems based on iontophoresis and curcumin-loaded nanoemulsions with and without monoterpenes as chemical penetration enhancers were devised and evaluated for their safety profiles and capacities to transport curcumin into/through the skin. The two systems were compared after careful investigation, with the ultimate goal of producing an effective and palatable system for enhanced cutaneous medication delivery and offering some fresh perspectives on the impacts of iontophoresis.

The process of spontaneous emulsification was used to create nanoemulsions. In a nutshell, lecithin (0.2 g) was dissolved in the oil phase (2.0 g; MCT or its combination with eucalyptol or pinene-50:50) and polysorbate 80 (1.8 g) was then added (for 20 g of the nanoemulsion formulation). The ratio of surfactant to oil (SOR) was 1. The oil-surfactant mixture (4 g) was combined on a magnetic stirrer and then applied dropwise over the course of 5 minutes to 16 g of highly filtered water while being continuously stirred at 1000 rpm. Following the full addition of the oil-surfactant mixture, mixing was carried out for an additional 60 minutes. The created nanoemulsions were put into the glass bottles, sealed tightly and kept out of the light [4].

It was established via the trials that iontophoresis, when used in the suggested circumstances, in conjunction with a cutting-edge carrier with a nanostructure produced more effective skin delivery of curcumin than formulations comprising chemical penetration enhancers. Iontophoresis also provides a variety of opportunities for future study, with modifications in terms of applied voltage and exposure period to the current. It would be reasonable to anticipate that the active substance would be present in the skin in greater concentrations as the iontophoresis period was extended. The quantity of the component in the deeper layers of the epidermis, however, could not be quantified with the existing methods for the investigation of dermal availability, hence only a 15-min exposure was looked at in this study [5].

Conclusion

Finally, a useful advancement in the field of cutaneous medication administration would be the development of a mobile adhesive system that is effective for iontophoresis.

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