



## Skin toxicology: There Models in Toxicology

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### Abstract

Our skin is exposed daily to substances; many of these are neutral and safe but others are potentially harmful. In order to estimate the degree of toxicity and damage to skin tissues when exposed to harmful substances, skin toxicology studies are required. If these studies are coupled with suitably designed mathematical models, they can provide a powerful tool that allows appropriate interpretation of data. This work reviews mathematical models that can be employed in skin toxicology studies. Areas covered: Two types of mathematical models and their suitability for assessing skin toxicology are covered in this review.

**Keywords:** Skin; Layer; Models

### Introduction

Our skin is daily exposed to substances many of which are neutral and safe while others are potentially harmful. In order to estimate of the degree of toxicity and damage to skin tissues when exposed to harmful substances skin toxicology studies are required. If these studies are coupled with suitably designed mathematical models it can provide a powerful tool which allows appropriate interpretation of data [1]. This work reviews mathematical models that can be employed in skin toxicology studies. Areas covered: Two types of mathematical models and their suitability to assessing skin toxicology are covered in this review [2]. The first type is focused on predicting penetration rate through skin from solute's physicochemical properties, whereas the second type models transport processes in skin layers using appropriate equations with the specific aim to predict the concentration of a given solute in viable skin tissues [3].

**Expert opinion:** Mathematical models are an important tool for accurate valuation of skin toxicity experiments, estimation of skin toxicity and developing new formulations for skin disease therapy. Comprehensive mathematical models of drug transport in skin, especially those based on more physiologically detailed mechanistic considerations of transport processes, are required to further enhance their role in assessing skin toxicology. Of experimental approaches increases the role of mathematical analysis and models in skin toxicology. Mathematical models of epidermal and dermal transport processes are important for the estimation of dermal exposure to drugs which is needed for assessing their toxicity [4]. These models can potentially aid directly by providing information on the rate of drug penetration through the skin and on the dermal concentration of drugs. The models are also useful in deeper analysis of experimental data,

often allowing reduction in the number of experiments and helping to interpret the in vitro experiments relative to the ones performed under in vivo conditions [5]. It is therefore somewhat surprising that Web of Science search of terms: skin, toxicology and mathematical modelling in "Title/Keywords/Abstract" returned no references, it is perhaps due to an association of the mathematical modelling of skin absorption mostly with the transdermal drug delivery area. It seems appropriate, therefore, to compile a review on mathematical models that can aid to the assessment or convey a better understanding of the toxicology of skin. This task is helped by recent reviews on mathematical modelling of drug transport processes in skin and skin permeability. In this work predicting drug penetration rate through skin will be first discussed and reviewed as the penetration rate is the key determinant of concentration of the drug in skin tissues. The concentration in viable layers of skin in turn is central in elucidating skin toxicity. The mathematical modelling of transport processes in deeper skin layers are reviewed with emphasis towards determining the concentration of drugs in viable skin layers.

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