Contribution ID: **4** Type: **Poster Presentation**

The study of drug release processes: modeling

The advent of drug delivery systems has garnered considerable attention from researchers as a novel method for drug delivery. Among the advantages of such systems is the gradual release of drugs at a constant rate, which significantly reduces the frequency of drug administration and associated adverse effects.
This article aims to provide a comprehensive review of existing mathematical models which correspond to the known drug release mechanisms, classified as diffusion-, swelling-, and erosion-controlled systems. The modeling of drug transport through drug release systems involving chemical reactions and polymer erosion on the skin has been investigated for transdermal drug delivery systems. A mathematical model has been developed to predict the drug release rate and the position of the moving boundary layer within the system at any moment.
The presented model, considering linear and nonlinear changes in polymer matrix erosion, has been semi-analytically solved using the Galerkin and Lee methods; The outcome provides curves illustrating the relationship between the drug release rate, the amount of drug released, the position of the moving boundary, and system performance over time.
The results indicate that the drug release rate and the amount of drug released, augment with the increase in the ratio of the reaction rate constant to the diffusion coefficient and the initial drug concentration. Additionally, the system performance time decreases as the ratio of the reaction rate constant to the diffusion coefficient and the initial drug concentration increases. The solution of the presented model using the Galerkin and Lee methods yields similar results.

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