

Mathematical modeling of drug release from spherical matrix systems: Analysis of the effect of absorption rate on rate of drug release

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The significance of controlled release drug delivery systems lies in their ability to deliver the drug at a steady rate thus reducing the dosage interval and providing a prolonged pharmacodynamic effect. But despite the steadily increasing practical importance of these devices, little is known regarding their underlying drug release mechanisms. Mathematical modeling of these drug delivery systems could help us understand the underlying mass transport mechanisms involved in the control of drug release. Mathematical modeling also plays an important role in providing us with valuable information such as the amount of drug released during a certain period of time or when the next dosage needs to be administered. Thus, potentially reducing the number of in-vitro and in-vivo experiments which in some cases are infeasible.

There is a large spectrum of published mathematical models and approaches available in the literature describing drug release by various mechanisms (diffusion, dissolution, erosion of polymer etc.) and taking into account the various factors effecting drug release (like pH of the release medium, dimensions of dosage etc.). However, very few of these models take into account the effect of physiological parameters which play an important role in drug release phenomena. Most of the mathematical models are developed taking into account in vitro conditions wherein a perfect sink condition is maintained, but in real systems this may not be true. Even though controlled release drug devices are expected to release drugs at a steady rate, the physiological characteristics of the gastrointestinal tract (where these devices remain for a long period) such as variation in pH, blood flow, gastro intestinal (GI) motility, presence of food etc, may effect the rate of drug release.

In this work we developed an analytical model for diffusional release of a drug out of a spherical matrix into a finite volume compartment (simulating the GI tract) taking into account a first order absorption rate constant. The model results clearly show that absorption rate has a significant effect on drug release rate.