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Research Article

Cellulose Acetate 398-10 Asymmetric Membrane Capsules for Osmotically Regulated Delivery of Acyclovir

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The study was aimed at developing cellulose acetate asymmetric membrane capsules (AMCs) of acyclovir for its controlled delivery at the absorption site. The AMCs were prepared by phase inversion technique using wet process. A 2^3 full factorial design assessed the effect of independent variables (level(s) of polymer, pore former, and osmogen) on the cumulative drug release from AMCs. The buoyant optimized formulation F7 (low level of cellulose acetate; high levels of both glycerol and sodium lauryl sulphate) displayed maximum drug release of 97.88 ± 0.77% in 8 h that was independent of variation in agitational intensity and intentional defect on the cellulose acetate AMC. The *in vitro* data best fitted zero-order kinetics (r^2 = 0.9898). SEM micrograph of the transverse section confirmed the asymmetric nature of the cellulose acetate capsular membrane. Statistical analysis by Design Expert software indicated no interaction between the independent variables confirming the efficiency of the design in estimating the effects of variables on drug release. The optimized formulation F7 (desirability = 0.871) displayed sustenance of drug release over the drug packed in AMC in pure state proving the superiority of osmotically active formulation. Conclusively the AMCs have potential for controlled release of acyclovir at its absorption site.

1. Introduction

Asymmetric membrane capsule is a controlled drug delivery device which consists of a drug core surrounded by a membrane of asymmetric structure (relatively thin, dense region supported on a thicker, porous region). Similar to a conventional hard gelatin capsule, the asymmetric membrane capsule (AMC) consists of a cap and a body that snugly fit into each other. The cap is shorter in length and has a slightly larger diameter than the body which is longer and has a smaller diameter. In contrast to gelatin capsules, however, the walls of AMCs are made from water-insoluble polymer(s) such as cellulose acetate, ethyl cellulose, cellulose acetate butyrate, and their mixtures [1]. Thus, the capsule shell does not dissolve to instantly release the drug filled in it. Instead, the drug is released over a prolonged duration by diffusion through the capsule walls and/or via osmotic pumping by convection through pores in the capsule walls [2]. The use of asymmetric membranes as rate controlling membrane of drug delivery devices is being widely explored. The basic mechanism of drug release from asymmetric membrane capsule is osmosis. When the capsule comes into contact with water, water imbibes into it and dissolves the soluble component in the core, forming the solution of the drug. The hydrostatic pressure was generated within the core which acts as a driving force to deliver the drug through preexisting pores, after all components are depleted and asymmetric membrane coating remains intact [3].

Asymmetric membrane capsules have been proven to be efficient gastroretentive systems carriers for osmotically regulated delivery of highly water-soluble drug, ranitidine hydrochloride, by a report published from our lab [4]. This concept is being extrapolated for a poorly water-soluble drug, acyclovir, based on the literature support of suitability of AMCs for delivery of poor water-soluble drug due to high water flux capability [5–7].

Acyclovir is an antiviral agent used for the treatment of *Herpes simplex* virus types I and II and *Varicella zoster* virus. It has an oral bioavailability of 10–20% with a very short biological half-life of 2–4 h, so high frequent dosing is required [8]. The absorption of acyclovir from the gastrointestinal tract is variable and incomplete; 10–30% of an oral dose may be