Formulation and Evaluation of Polymeric Nanoparticles of an Antiviral Drug for Gastroretention

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ABSTRACT
The aim of present study was to formulate and evaluate nanoparticles of acyclovir by using different hydrophilic polymers. Acyclovir was selected as a suitable drug for gastroretentive nanoparticles due to its short half life, low bioavailability, high frequency of administration, and narrow absorption window in stomach and upper part of GIT. The nano-precipitation method was used to prepare nanoparticles so as to avoid both chlorinated solvents and surfactants to prevent their toxic effect on the body. Nanoparticles of acyclovir were prepared by using hydrophilic polymers such as bovine serum albumin, chitosan, and gelatin. The prepared formulations were then characterized for particle size, polydispersity index, zeta potential, loading efficiency, encapsulation efficiency and drug-excipient compatibility. The prepared nanoparticulate formulations of acyclovir with different polymers in 1:1 ratio have shown particle size in the range of 250.12-743.07 nm, polydispersity index (PDI) in the range of 0.681-1.0, zeta potential in the range of -14.2 to +33.2 mV, loading efficiency in the range of 8.74-17.54%, and entrapment efficiency in the range of 55.7%-74.2%. Nanoparticulate formulation prepared with chitosan in 1:1 ratio showed satisfactory results i.e. average particle size 312.04 nm, polydispersity index 0.681, zeta potential 33.2 mV, loading efficiency 17.54%, and entrapment efficiency 73.4%. FTIR study concluded that no major interaction occurred between the drug and polymers used in the present study.

KEYWORDS: Nanoparticles; gastro-retentive; nano-precipitation, polydispersity index, zeta potential; entrapment efficiency.

Introduction
The oral route of drug administration is the most convenient and commonly used method of drug delivery due to their considerable therapeutic advantages such as ease of administration, patient compliance, and flexibility in formulation (Garg et al., 2008; Gupta et al., 2007). However, this route has several physiological problems, such as inability to restrain and locate the controlled drug delivery system within the desired region of the gastrointestinal tract due to variable gastric emptying and motility. Furthermore, the relatively brief gastric emptying time in humans, which normally means 2-3 hours through the major absorption zone, i.e., stomach and upper part of the intestine, can result in incomplete drug release from the drug delivery system leading to reduced efficacy of the administered dose (Rouge et al., 1996). These difficulties have prompted researchers to design a drug delivery system which can stay in the stomach for prolonged and predictable period (Deshpande et al., 1996; Hwang et al., 1998). Several attempts are being made to develop a controlled drug delivery system, which can provide therapeutically effective plasma drug concentration for a longer period, thereby reducing the dosing frequency and minimizing fluctuations in plasma drug concentration at steady-state by delivering the drug in a controlled and reproducible manner (Sood et al., 2003). Different methodologies have been reported in the literature to increase the gastric retention of drugs, like intra-gastric floating systems, hydro dynamically balanced systems, extendable or expandable, microporous compartment system, microballoons, bio/muco-adhesive systems, high-density systems, and super porous biodegradable hydro gel systems (Singh et al., 2000). After oral administration, such a dosage form would be retained in the stomach for several hours and would release the drug there in a controlled and prolonged manner, so that the drug could be supplied continuously to its absorption sites in the upper gastrointestinal tract (Streubel et al., 2006). Prolonged gastric retention improves bioavailability, reduces drug waste, and improves solubility of drugs that are less soluble in a high pH environment. It is also suitable for local drug delivery to the stomach and proximal small intestine (Rao et al., 2005). Gastroretention helps to provide better availability of new products with suitable therapeutic activity and substantial benefits for patients.

ABBREVIATIONS: Bovine serum albumin (BSA); molar (M); ultraviolet (UV); Fourier transform infra red (FTIR); polydispersity index (PDI).