Colloids and Surfaces A: Physicochem. Eng. Aspects 413 (2012) 260–265

Contents lists available at SciVerse ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

journal homepage: www.elsevier.com/locate/colsurfa

Influence of the preparation method on the physicochemical properties of econazole-loaded poly(butyl cyanoacrylate) colloidal nanoparticles

Georgi Yordanov*

Faculty of Chemistry, Sofia University St. Kliment Ohridski, 1 James Bourchier Blvd., 1164 Sofia, Bulgaria

ARTICLE INFO

Article history:
Received 31 October 2011
Received in revised form 8 December 2011
Accepted 21 December 2011
Available online 27 December 2011

Keywords:
Econazole
Poly(butyl cyanoacrylate)
Nanoparticles
Nanoprecipitation
Emulsion polymerization
Poloxamer 188
Polysorbate 80
Dextran 40

ABSTRACT

This article describes the influence of the preparation method on the physicochemical properties of econazole-loaded poly(butyl cyanoacrylate) nanoparticles. The nanoparticles were prepared by using two different methods – nanoprecipitation and emulsion polymerization. Three different non-ionic colloidal stabilizers (poloxamer 188, polysorbate 80 and dextran 40) were used to obtain nanoparticles with various surface coatings. The econazole-loaded nanoparticles were characterized for morphology, size distribution, chemical composition, zeta-potential, drug loading efficiency and drug content. It was found that the average nanoparticle size, yield and drug content depend mainly on the preparation method, while the utilization of different colloidal stabilizers resulted in nanoparticles with different ζ-potentials. The colloidal stability of the formulations was found to depend on the method of preparation, as well as on the type of colloidal stabilizer.

1. Introduction

Econazole (ECN) is an antifungal medicine of the imidazole class (Fig. 1a) with a broad antimycotic activity with some action against Gram-positive bacteria [1–3]. It is used topically in dermatomycoses also orally and parenterally. Econazole prevents fungal organisms from producing vital substances required for growth and function. Recent advancements in pharmaceutical nanotechnology have provided many proofs for therapeutic benefits from classical antifungal agents formulated in novel colloidal drug delivery systems [4–7]. There are studies that have reported the preparation of various colloidal formulations of econazole, including entrapment of the drug in alginate nanoparticles [4], PLG nanoparticles [4,8], micelles [9], submicron emulsions [10], liposomes [11], nanosized vesicles [12], and lipid nanoparticles [13]. Although, the nanoparticles of poly(butyl cyanoacrylate) (PBCA; Fig. 1b) are considered as one of the promising polymer carriers for drug delivery [14–23], to the best of the author's knowledge there is no systematic study on the influence of the preparation method on the properties of ECN-loaded PBCA nanoparticles that can be found in the available literature.

There are two main strategies for the preparation of polymeric nanoparticles: (i) dispersion of preformed polymers, and (ii) polymerization of monomers. There are many different methods based on these two general approaches [24]. PACA-based colloidal systems are classically prepared by emulsion polymerization of the respective monomers in aqueous medium [25,26]. The mechanism of polymerization can be anionic, radical or zwitterionic. Previous studies on the preparation of poly(alkyl cyanoacrylate) nanoparticles by polymerization-based methods demonstrated that many physicochemical characteristics of the polymer and the nanoparticles strongly depend on the conditions of the reaction (pH, time of polymerization, type of surfactant, concentration of monomer, etc.) [27–29]. The nanoprecipitation approach has also been adapted for the preparation of PBCA nanoparticles, starting from presynthesized PBCA polymer [23]. In comparison with the polymerization-based methods, the nanoprecipitation has the advantage that the used polymer is well characterized and its characteristics do not depend on the conditions of the colloid preparation. The nanoprecipitation has also two additional advantages: (i) it does not require acidic medium for the formation of nanoparticles (which is usually the case in most of the classic preparations of PBCA nanoparticles by polymerization-based methods) and is therefore suitable for the entrapment of acid-sensitive drugs; and (ii) avoids utilization of the highly reactive alkyl cyanoacrylate monomers, which can react with some drugs. Drugs, which are stable in acidic medium, can be entrapped in PBCA nanoparticles by

* Tel.: +359 2 8161 331; fax: +359 2 9625 438.
E-mail address: g.g.yordanov@gmail.com

0927-7757/$ – see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.colsurfa.2011.12.060