Characterisation of ionic liquids nanoemulsion loaded with piroxicam for drug delivery system

Siti Balkis Mahamat Nor a,b, Pei Meng Woi a,b,⁎, Sook Han Ng c,⁎⁎

a Department of Chemistry, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia
b Center of Ionic Liquids (UMCiL), University of Malaya, 50603 Kuala Lumpur, Malaysia
c School of Pharmacy, International Medical University, 57000 IMU Bukit Jalil, Kuala Lumpur, Malaysia

A R T I C L E  I N F O

Article history:
Received 16 November 2016
Accepted 9 March 2017
Available online 10 March 2017

Keywords:
Nanoemulsions
1-Butyl-3-methylimidazolium chloride
1-Hexyl-3-methylimidazolium chloride
hexafluorophosphate
Piroxicam

A B S T R A C T

In this study, ionic liquid-in-oil nanoemulsions (IL/o NEs) system were formulated by using two types of ionic liquids, 1-hexyl-3-methylimidazolium chloride [Hmim][Cl] and 1-buty1-3-methylimidazolium hexafluorophosphate [Bmim][PF 6] in differences mass ratio with Tween-80/Span-20 1:1, 1:2, 2:1 and 2:3. They were tested for stability study before undergo characterisation, rheology behaviour and released study in order to get the best result of NE system. The high concentration of Tween-80 in the formulation of NEs shows high stability from separation, creaming, sedimentation and flocculation. The droplet sizes, zeta potential, drug encapsulation efficiency (%) and pH value for all formulations were considered in the range of 100 to 500 nm, −37.3 to −55.3 mV, 60.02% to 98.76% and 4.72 to 5.50 respectively. Spherical droplets were seen in the transmission electron microscopy (TEM) images of the nanoemulsions. Rheological studies showed non-Newtonian shear thinning behaviour at low shear rate up to 14 S−1 of NE for both ionic liquids. Nanoemulsions insertion of Piroxicam was used to investigate the in vitro drug releases via dialysis bag method. The permeation of drug demonstrated the optimized surfactant ratio is 2:1 and ionic liquid is [Hmim][Cl] with 93% of drug released. It is concluded that the NEs prepared from ionic liquids offered a good potential as a carrier for drug delivery of Piroxicam.

⁎⁎ Corresponding author.

⁎ Correspondence to: P.M. Woi, Department of Chemistry, Faculty of Science, University Malaya, 50603 Kuala Lumpur, Malaysia.

E-mail addresses: pmwoi@um.edu.my (P.M. Woi), sookhan_ng@imu.edu.my (S.H. Ng).

http://dx.doi.org/10.1016/j.molliq.2017.03.042

© 2017 Elsevier B.V. All rights reserved.

1. Introduction

In recent years, the use of ionic liquids (ILs) as a potential environmentally benign solvent in pharmaceutical industries are become interest. ILs are salts comprise of cations and anions and can be categorised into; hydrophobic and hydrophilic. They can be synthesised with differences properties by changing anions/cation combination [1] and have been used as a “green” replacement for toxic, hazardous, flammable and highly volatile organic solvents [2]. Since they are organic salts which are liquids at ambient room temperature [3] and have low melting points, they can act as solvents for various reactions [4]. Numerous reports also demonstrated ILs as solvent and were used as enhancer, active pharmaceutical ingredients (APIs) [5], and preservative [6]. Regarding to the previous study [7,8], ILs show an excellent solvent in solubilising hydrophobic and hydrophilic drug. They were used as a component of microemulsion carrier system whether ionic liquid in oil (IL/o) [9] or ionic liquid in water (IL/w) [10] system which depends on the polarity of ILs.

In pharmaceutical processing, the used of IL as a solvent is still debatable even it is known as “green solvent” especially in medicine and biomedicine, and in biology-related area. Most researchers concerns about ILs toxicity as the main challenge in drug delivery application, due to lack of scientific knowledge on it. However, nontoxic ILs for pharmaceutical can be produced by altering their physical chemical properties by changing anions/cations combination [2]. Fortunately, there are some literature demonstrated synthesizing of nontoxic ILs by selecting biocompatible organic cations and inorganic anions [11,12]. Recent study had proven that the incorporation of ether groups into the ester side chain of the ILs lower the toxicity comparable to alkyl derivatives [13]. Moreover, some researchers demonstrated low/negligible toxicity of ILs towards HaCaT cells [6] and ICP-81 leukaemia as well as the glioma cells [14]. As ILs are debatable about their toxicity, it should be noted there are a lot of pharmaceutical excipients demonstrated similar toxicities to ILs for example dimethylsulfoxide and non-ionic surfactant. Thus, ILs with low toxicity and exhibit good biodegradability should be explored its potential as pharmaceutical ingredients.