Materials Today: Proceedings 75 (2023) 9–14

Contents lists available at ScienceDirect

Materials Today: Proceedings

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

Natural rubber-based pressure sensitive adhesive as a drug carrier

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ARTICLE INFO

Article history:
Available online 26 October 2022

Keywords:
Natural rubber
Pressure-sensitive adhesive
Transdermal patch
Propranolol
Ibuprofen

ABSTRACT

Natural rubber (NR) has been utilized in several products from its interesting unique properties. This study aimed to develop the pressure-sensitive adhesives (PSA) as the transdermal patches from NR by two-roll mill kneading technique. Hydroxyethyl cellulose (HEC) was blended as a tackifier agent. The propranolol HCl and ibuprofen at different parts per hundred of rubber (phr) were loaded into this developed PSA. The appearance, thickness, crystallinity, contact angle, water sorption and erosion, adhesion, and *in vitro* drug permeation of these patches were evaluated. The thickness of all patches was in the range of 0.46–1.07 mm. The drug-loaded patches showed diverse unique topographies depended on both type and amount of drug incorporation. From powder X-ray diffraction analysis, the plain NR-PSA showed the amorphous structure, while the halo pattern inserted with sharp drug peaks were observed on drug-loaded PSA. The contact angle of all samples was in the range of 80–90° indicating their hydrophobic surface. However, they displayed an increased % water sorption with the time of soaking. The 2–4 N adhesion force was evident for all fabricated drug-loaded PSAs. The propranolol HCl permeated from PSA notably lower than ibuprofen. The residual of the drugs in patches was about 85–90 %. These results provided the basic physicochemical properties for the further development of PSA as the transdermal patch.

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1. Introduction

Natural rubber (NR) has been widely used in electronic, automotive, sport, household, and medical applications because of its various unique outstanding properties including highly elastic, high strength and tack, rolling resistance, hydrophobicity, low gas permeability, etc. [1,2]. However, NR itself is not sufficient to offer the required adhesion and tack for the specific application. The tackifier blending as the pressure-sensitive adhesives (PSAs) at proper specific blend ratios can improve NR properties. PSA is defined as a solvent-free viscoelastic material that remains permanently of tackiness at room temperature [2]. Therefore, PSA could be applied in several products, including transdermal patches. PSA supports the adhesion of the patch to the skin; furthermore, it performs as a matrix for controlled release of the drug and other active compounds [3]. Transdermal patches are comfortable to be used efficiently for controlled drug delivery as the non-invasive route since they can minimize the side effects, improve patient compliance and bioavailability [4].

Hydroxyethyl cellulose (HEC) is an aqueous-soluble non-ionic polymer widely used as a binder, film former, thickener, tackifier, dispersion stabilizer, extender and slumping reducer in pharmaceutical formulations [5]. It is also used as a tackifier in NR formulated PSA [6–9]. Propranolol HCl is a weak basic, nonselective β-adrenergic blocking agent (β-blocker) used as first-line therapy for hypertension in patients with stable ischemic heart disease/

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https://doi.org/10.1016/j.matpr.2022.10.096