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## Temperature modulated drug permeation through liquid crystal embedded cellulose membranes

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## Abstract

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Stimuli-sensitive membranes may act as "on-off switches" or "permeability valves", producing patterns of pulsatile release, where the period and rate of mass transfer can be controlled by external or environmental triggers. In this study, cellulose nitrate (CN) and cellulose acetate (CA) monolayer membranes containing thermotropic liquid crystals (LC) were developed as thermoresponsive barriers for drug permeation. A low molecular thermotropic LC, n-heptyl-cyanobiphenyl (K21), with nematic to isotropic phase transition temperature ( $T_{n-i}$ ) of 41.5 °C was chosen to modulate drug permeation. Methimazole and paracetamol as hydrophilic and hydrophobic drug models were used, respectively. It was found that upon changing the temperature of the system around the  $T_{n-i}$ , both cellulose membranes without LC showed no temperature sensitivity to drug permeation, whereas the results for LC entrapped membranes exhibited a distinct jump in permeability when temperature was raised to above the  $T_{n-i}$  of the liquid crystal for both drug models. On the other hand, drug permeation through these LC embedded membranes can be thermally modulated. Thermoresponsive drug permeation through the membranes was reversible, reproducible and followed zero order kinetics. Liquid crystal embedded cellulose acetate membranes showed more temperature sensitivity than liquid crystal embedded cellulose nitrate membranes, apparently due to higher LC loading in their porous matrix compared to CN membranes. The pattern of on-off permeation through LC embedded membranes was more distinguished for methimazole compared to that of paracetamol, seemingly due to its lower molecular weight. © 2007 Elsevier B.V. All rights reserved.

## Reaxys Database Information

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## Author keywords

Composite membrane; Methimazole; Paracetamol; Thermoresponsive drug delivery; Thermotropic liquid crystals

## Indexed Keywords

EMTREE drug terms: cellulose; cellulose acetate; n heptyl cyanobiphenyl; paracetamol; pyroxylin; thiamazole; unclassified drug

EMTREE medical terms: article; drug penetration; hydrophilicity; hydrophobicity; kinetics; liquid crystal; membrane permeability; phase transition; priority journal; reproducibility; temperature sensitivity

MeSH: Acetaminophen; Cellulose; Drug Delivery Systems; Liquid Crystals; Membranes, Artificial; Methimazole; Microscopy, Electron, Scanning; Permeability; Temperature  
Medline is the source for the MeSH terms of this document.Chemicals and CAS Registry Numbers: cellulose, 61991-22-8, 68073-05-2, 9004-34-6; cellulose acetate, 9004-35-7; paracetamol, 103-90-2; pyroxylin, 9004-70-0; thiamazole, 60-56-0; Acetaminophen, 103-90-2; Cellulose, 9004-34-6; Membranes, Artificial; Methimazole, 60-56-0  
Manufacturers: Drug manufacturer: Macherey, Germany; Merck, Germany; Whatman, United Kingdom; Alvahi, Iran; Sobhan, Iran.

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