PCL Mesophase Drug Delivery Research

# Abstract

This study investigates the use of polycaprolactone (PCL) mesophases for controlled drug delivery of three compounds: dolutegravir (DTG), meloxicam (MLX), and dexamethasone (DEX). Statistical analysis revealed significant correlations (p < 0.05) between mesophase content and release kinetics at both 25°C and 50°C. [COMMENT-cc8f0515 by Dr. Smith: Consider adding more details about the mechanism of mesophase formation.]

# Introduction

Polycaprolactone has emerged as a promising biodegradable polymer for pharmaceutical applications. The crystallinity of PCL can be modulated through thermomechanical processing to create mesophase structures that influence drug release profiles.

## Drug Compounds

Three model drugs were selected: dolutegravir for HIV treatment, meloxicam as an anti-inflammatory agent, and dexamethasone as a corticosteroid. Each compound exhibits different solubility characteristics affecting release kinetics.

# Methods

Samples were processed using compression molding at temperatures of 25°C and 50°C. X-ray diffraction analysis was performed to quantify crystallinity changes. Release studies were conducted in phosphate-buffered saline with ANOVA statistical analysis.

# Results

Significant differences were observed between treatment groups. The correlation between mesophase content and drug release was highly significant with r² values exceeding 0.85 for all compounds tested.

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| Compound | Mesophase % | Release Rate (μg/mL/h) |
| DTG | 23.5 ± 2.1 | 15.2 ± 1.8 |
| MLX | 31.7 ± 3.4 | 22.1 ± 2.5 |
| DEX | 18.9 ± 1.9 | 12.7 ± 1.4 |

# Conclusion

This research demonstrates the potential of PCL mesophase engineering for precise control of drug release kinetics. The significant correlations observed support the hypothesis that processing-induced mesophases can be leveraged for pharmaceutical applications.