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يونيورسيتي إسلام انتارابغسا ملسيا

DEVELOPMENT OF CIPROFLOXACIN-LOADED PCL-PEG HYDROGEL

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INTRODUCTION

1. HYDROGEL FOR WOUND HEALING APPLICATION

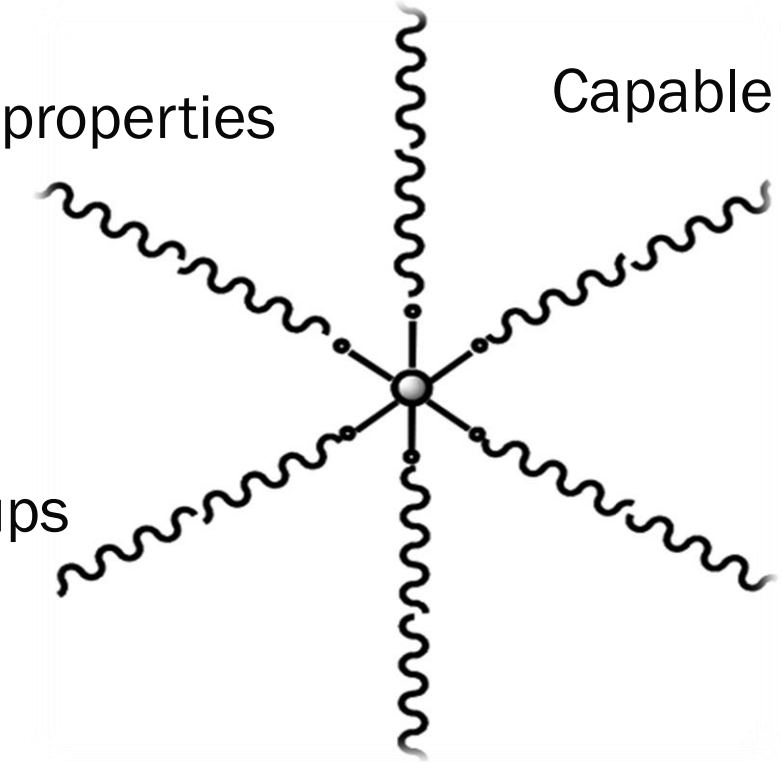
- ✓ high water content
- ✓ improve healing time
- ✓ provides sufficient humidity for the wound
- x Limited encapsulation efficiency for hydrophobic drug
- x Low mechanical stability

Yadav, Almokdad, Shaluf, & Debe, 2019; Masood et al., 2019), Blumlein & McManus, 2015

2. STAR-SHAPED AMPHIPHILIC POLYMERS

Superior physicochemical properties

Capable to encapsulate and contain molecules



Higher functional end groups

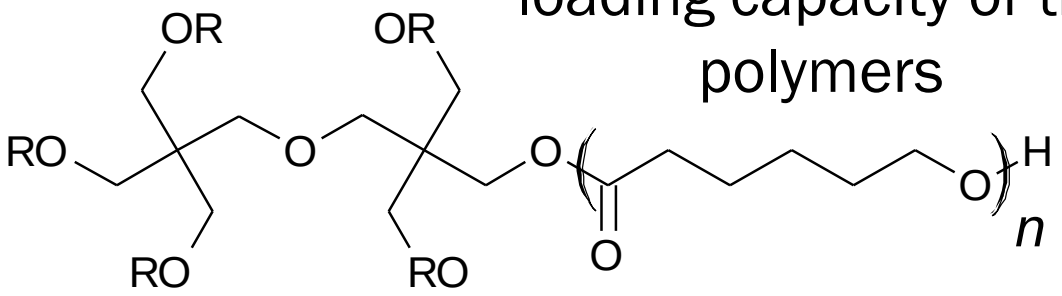
Hydrophilic parts enhance stability and solubility in aqueous medium and water-based hydrogel

Hydrophobic parts carries and protects the drugs

(Sulistio, Gurr, Blencowe, & Qiao, 2012; Tinajero-Díaz et al., 2014; Yang, Oo, Deen, Li, & Loh, 2017), (Francesko, Petkova, & Tzanov, 2019; Koehler, Brandl, & Goepferich, 2018)

3. PCL

improve the hydrophobic drug loading capacity of the polymers

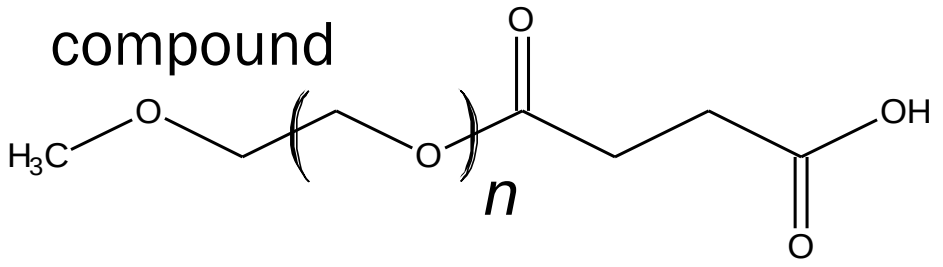


- ✓ FDA-approved
- ✓ good solubility
- ✓ low melting point
- ✓ excellent blend-compatibility
- ✓ low rate of degradation

(Ismail et al., 2019, Dwivedi et al., 2020; Woodruff & Hutmacher, 2010)

- ✓ High hydrophilicity
- ✓ Non-toxic
- ✓ Variety of physical properties

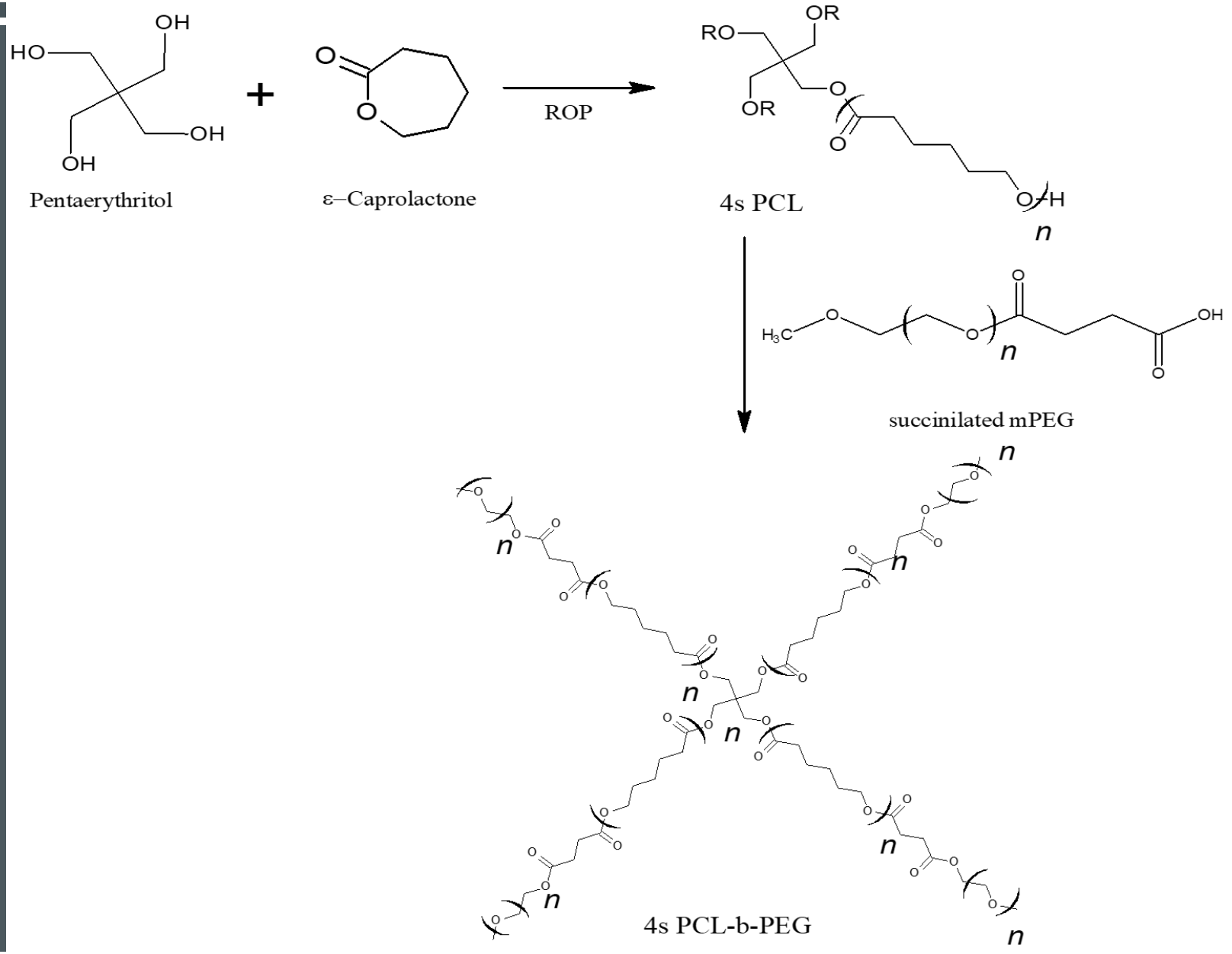
increases the hydrophilicity of the compound



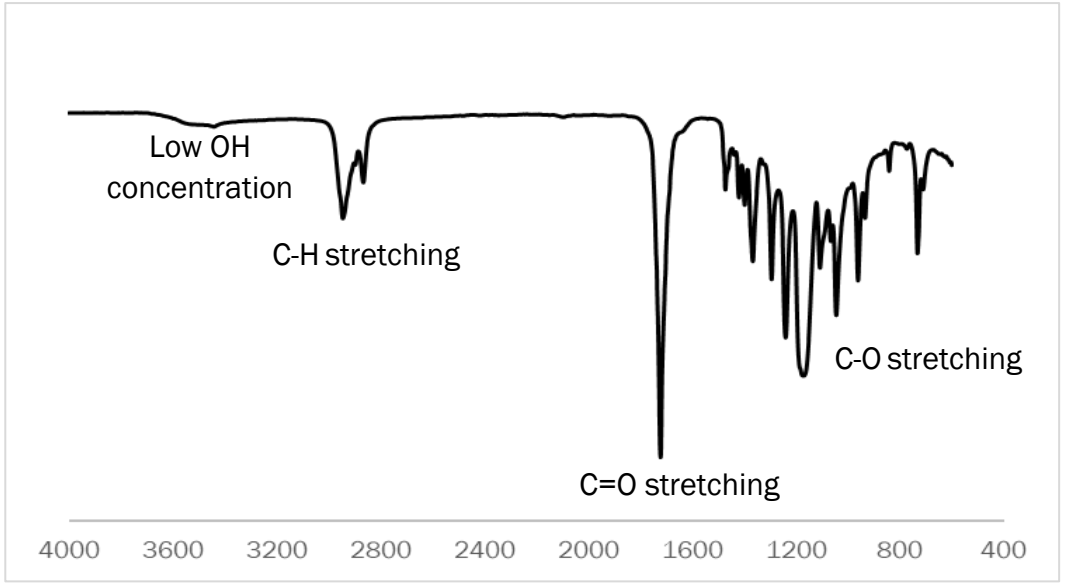
4. PEG

(Ismail et al., 2019, Gullapalli & Mazzitelli, 2015; Parray, Hassan, Ahmad, & Islam, 2020)

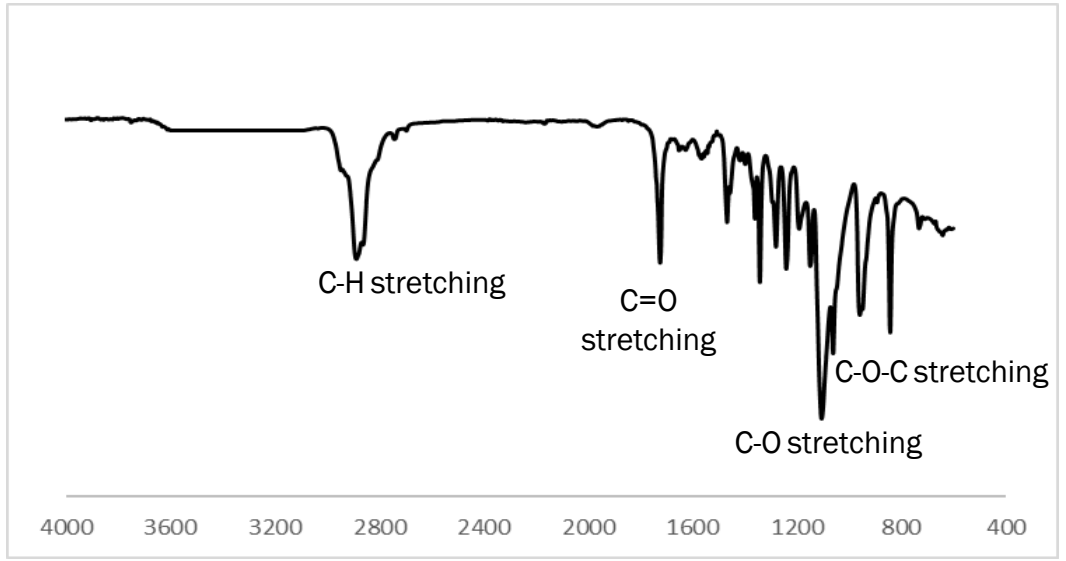
SCHEMATIC ROUTE FOR SYNTHESIS OF STAR-SHAPED POLYMER



FTIR ANALYSIS

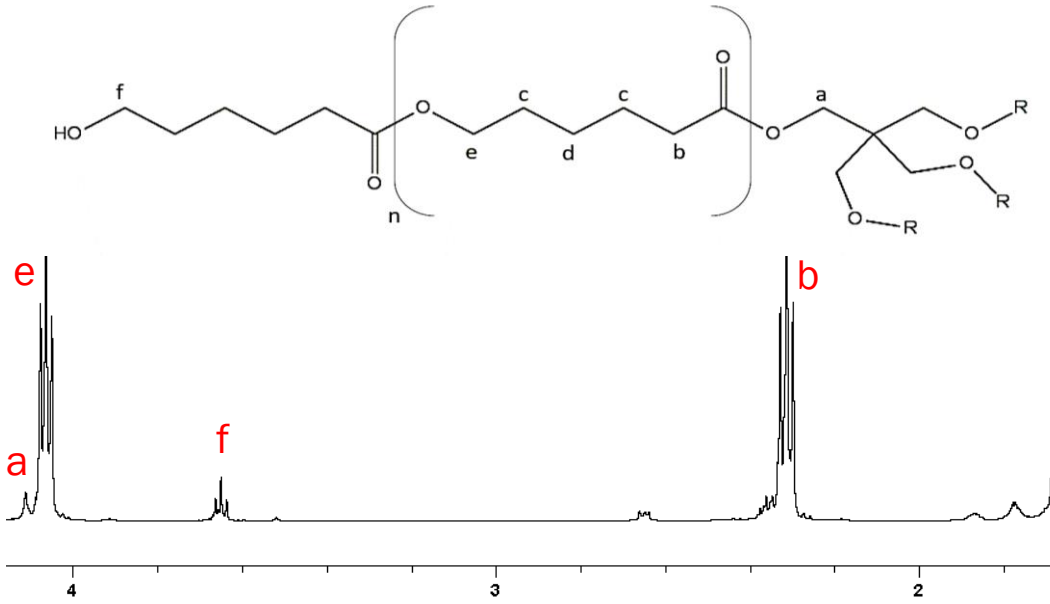


4s PCL

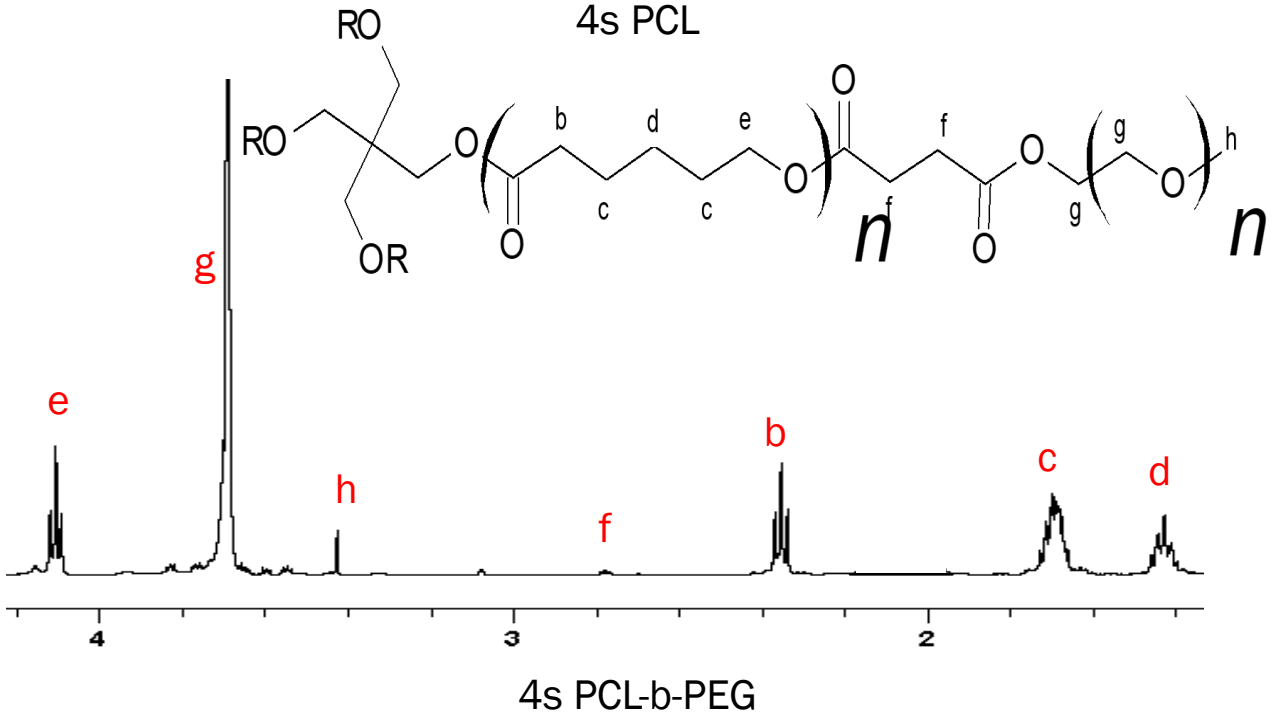


4s PCL-b-PEG

NMR ANALYSIS



4s PCL



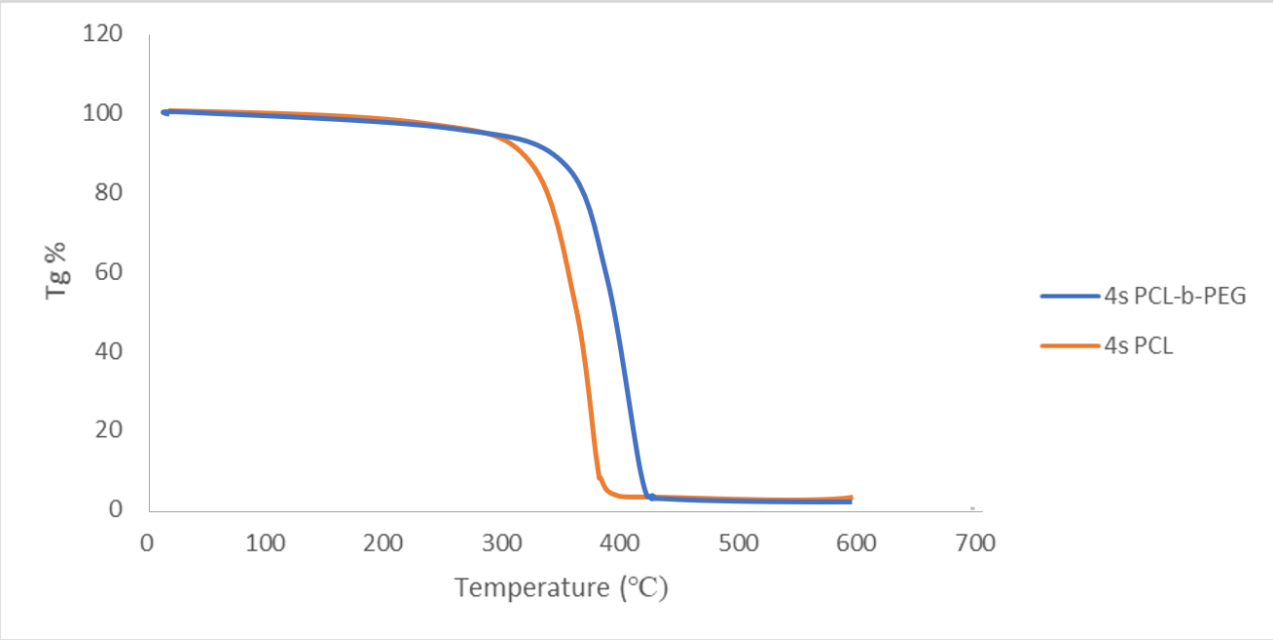
4s PCL-b-PEG

MOLECULAR WEIGHT ANALYSIS

Sample	[a]$M_{n,theoretical}$ (g/mol)	[b]DP_{star}	[b]$M_{n,NMR}$ (g/mol)
4s PCL	10100	14	9800
4s PCL-b-PEG	30100	14	30400

[a]Theoretical M_n was determined from monomers feed ratio.
[b]Calculated from ^{1}H-NMR spectra.

THERMAL ANALYSIS



Sample	$T_{d\text{-}initial}$(°C)	$T_{d\text{-}max}$[b](°C)
4s PCL	343.6	382.2
4s PCL-b-PEG	369.2	407.3

[a]T_m = melting transition temperature obtained from DSC thermograms.
[b]$T_{d\text{-}max}$ = temperatures of maximum decomposition obtained from DTG thermograms.

HYDROGEL FORMULATION

Materials	Formulation A (% w/w)	Formulation B (%w/w)
PCL-b-PEG	0.25	0.5
Ciprofloxacin	0.3	0.3
Carbopol 940	0.5	0.5
Methyl paraben	0.08	0.08
Propyl paraben	0.02	0.02
Trifluoroethanol	33.0	33.0
Deionized water	Up to 100	Up to 100
Triethylamine	q.s	q.s

CHARACTERIZATION OF HYDROGEL

Formulations		Opacity	Homogeneity	pH	Viscosity (Cp)	Drug encapsulation efficiency	Drug loading
PCL-PEG 4.10	A	Opaque	Good	7.32 ± 0.02	9865	99.99638 ± 0.00011	99.99999 ± 3.43626E-07
	B	Opaque	Good	7.28 ± 0.02	9941	99.99633 ± 0.00018	99.99999 ± 5.43562E-07

CONCLUSION

- Four arms star-shaped copolymer were successfully synthesized and characterized
- The star polymer is successfully incorporated into hydrogel formulation

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