



PROCESSING OF POLYMER NANOFIBERS THROUGH ELECTROSPINNING AS DRUG DELIVERY SYSTEMS



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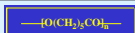
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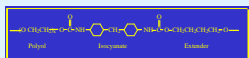
Abstract

The use of electrospun fibers as drug carriers could be promising in the future for biomedical applications, especially postoperative local chemotherapy. In this research work, electrospun fibers were developed as a new system for the delivery of ketoprofen as non-steroidal anti-inflammatory drug (NSAID). The fibers were made either from polycaprolactone (PCL) as a biodegradable polymer or polyurethane (PU) as a non-biodegradable polymer, or from the blends of the two. The release of the ketoprofen was followed by UV-VIS spectroscopy in phosphate buffer of pH 7.4 at 37 and 20°C. The results showed that the release rates from the polycaprolactone, polyurethane and their blend are similar. However, the blend of the polycaprolactone with polyurethane improved its visual mechanical properties. Release profiles from the electrospun mats were compared to cast films of the various formulations.

Polycaprolactone (PCL)



Polyurethanes (PU) (Tecophilic Resin HP-60D-60)



Experimental

In the Current Work, a New System of Controlled Drug Release via Electrospinning Technique was Developed

Also, electrospun polycaprolactone as biodegradable system and polyurethane as non-biodegradable system for drug delivery was prepared.

Polycaprolactone has poor mechanical properties; therefore, it was blended with polyurethane to improve its mechanical properties.

The electrospun fibers were used as controlled-release system and were compared with casting films with the same composition.

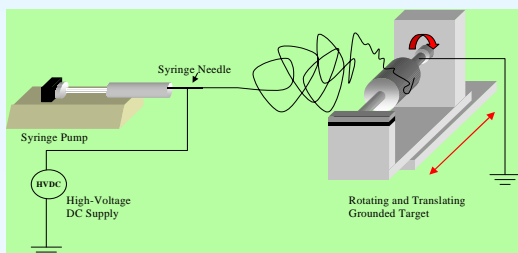


Figure 1: Schematic of Electrospinning System

Preparation of Polymer Solution and Fiber Aggregates

Table 1: Summary of Electrospinning parameters applied for Electro-spinning of polyurethane, polycaprolactone and their blends.

Sample code	Applied Voltage (kV)	Feeding Rate (mL/h)	TCD* (cm)	Polarity
PU	20	5-11	20	-ve
PCL	20	6-7	15	+ve
PU/PCL (75/25)	20	6	15	+ve
PU/PCL (50/50)	22	6-8	15	+ve
PU/PCL (25/75)	21	6	15	+ve

Table 2: Summary of fiber diameter of polyurethane, polycaprolactone and their blends from 15 mL polymer solution.

Sample code	Fiber Diameter (µm)
PU	3.12-6.25
PCL	2.0-6.66
PU/PCL (75/25)	1.0-7.0
PU/PCL (50/50)	1.75-6.45
PU/PCL (25/75)	1.0-4.25

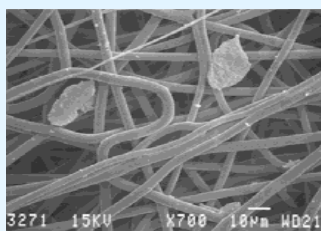


Figure 2: SEM micrograph of electrospun polyurethane fiber containing ketoprofen before drug release.



Figure 3: SEM micrograph of PU/PCL (75/25) mat containing ketoprofen before drug release.

Release Study

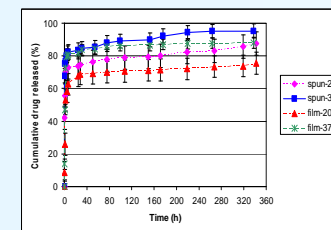


Figure 4: *In vitro* ketoprofen release profile from electrospun mat and film made from PU, in phosphate buffer (pH 7.4) at the body temperature (37°C) and at room temperature (20°C).

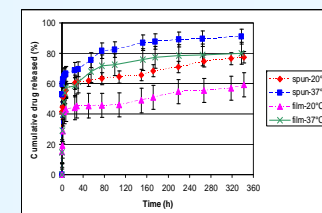


Figure 5: *In vitro* ketoprofen release profile from electrospun mat and film (PU/PCL: 75/25), in phosphate buffer (pH 7.4) at the body temperature (37°C) and at room temperature (20°C).

Summary and Conclusion

The system was based on the encapsulation of ketoprofen in the electrospun fibers as a new approach for drug delivery system using electrospinning technique.

- These fibers were either biodegradable such as PCL or non-biodegradable polymers such as PU.
- The release was monitored by UV spectrophotometer at $\lambda_{max} = 260$ nm as a function of time in phosphate buffer of pH 7.4 at the body temperature 37°C and at room temperature (20°C).
- The temperature of the medium played an important role, higher temperature for the release medium showed higher release rates.

The *in vitro* release profiles for ketoprofen showed that:

- The release rates from the polycaprolactone, polyurethane and their blend almost similar.
- The blend of the polycaprolactone with polyurethane improved its visual mechanical properties.

References

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- El-Refaie Kenawy, Mohamed El-Newehy, Fouad Abdel-Hay, and Raphael M. Ottenbren, *Biomacromolecules*, 8,196-201, 2007.
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