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Effects of Poloxamers as Excipients on Electrospun Polycaprolactone (PCL) Fibres' Physicomechanical Properties, Cellular Biocompatibility and *In Vitro* Drug Release

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Abstract

Electrospinning is a versatile technique used to fabricate nanofibrous structures with a wide range of applications, including tissue engineering and drug delivery systems. Polycaprolactone (PCL) is a commonly used polymer in electrospinning due to its biocompatibility, biodegradability, and mechanical properties. However, PCL alone may not possess the desired properties for certain applications. To enhance the functionality of PCL fibres, the addition of excipients such as poloxamers has been explored. Poloxamers are triblock copolymers that exhibit unique physicochemical properties, including thermosensitivity, surfactant properties, and biocompatibility. This article aims to explore the effects of poloxamers as excipients on the physicomechanical properties, cellular biocompatibility, and in vitro drug release of electrospun PCL fibres.

Keywords: Polycaprolactone • Ethylene oxide • Biodegradability • Poloxamer

Introduction

The controlled release of therapeutic agents from electrospun PCL fibres is a significant advantage in drug delivery systems. Poloxamers can be utilized as carriers for hydrophobic drugs, improving their solubility and stability within PCL fibres. The addition of poloxamers can modulate the drug release profile, leading to prolonged and sustained release kinetics. The amphiphilic nature of poloxamers allows them to form micelles or self-assembled structures within the fibres, facilitating the encapsulation and controlled release of hydrophobic drugs. With a variety of uses, including tissue engineering and drug delivery systems, electrospinning is a flexible method for creating nanofibrous structures. Due to its biocompatibility, biodegradability, and mechanical qualities, Polycaprolactone (PCL) is a frequently used polymer in electrospinning. For some applications, PCL might not have the required features on its own. Excipients like poloxamers have been investigated as possible additions to PCL fibres to improve their functioning. Poloxamers are triblock copolymers with special physicochemical characteristics, such as biocompatibility, surfactant qualities, and thermosensitivity. This paper examines the impact of poloxamers as excipients on the physicomechanical characteristics, cellular biocompatibility, and in vitro drug release of electrospun PCL fibres. Poloxamers have been demonstrated to drastically alter the performance of electrospun PCL fibres. The addition of poloxamers often leads to improved fibre morphology, with enhanced fibre alignment, reduced bead formation, and increased fibre diameter control. The presence of poloxamers can also enhance the mechanical properties of PCL fibres, such as tensile strength and Young's modulus, making them more suitable for load-bearing applications [1].

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Literature Review

Furthermore, poloxamers can modify the morphology and diameter of electrospun fibres. It has been observed that the addition of poloxamers can reduce fibre diameter and increase the alignment of fibres, leading to a more organized and interconnected fibrous network. This alteration in fibre morphology can impact the overall mechanical integrity of the scaffold and provide better support for cell attachment and proliferation. The biocompatibility of electrospun PCL fibres is crucial for their successful application in tissue engineering and regenerative medicine. Poloxamers have been found to enhance the cellular response to electrospun PCL fibres. Studies have shown that the addition of poloxamers can improve cell adhesion, spreading, and proliferation on the fibrous scaffolds. The presence of poloxamers in PCL fibres can enhance the hydrophilicity of the scaffold, facilitating better cell-material interactions [2]. Poloxamers possess surfactant properties, which can improve the wetting ability of the fibres and promote cell adhesion. Additionally, the improved mechanical properties of the fibres, resulting from the presence of poloxamers, can provide a more favorable microenvironment for cell growth and tissue formation.

Discussion

Electrospun PCL fibres have been widely investigated as drug delivery systems. The incorporation of poloxamers can influence the drug release kinetics from the fibres. Poloxamers can act as pore formers, creating an interconnected porous structure within the fibres, thereby increasing the surface area available for drug diffusion. This leads to enhanced drug release rates from the fibrous scaffold. Furthermore, the thermosensitive nature of poloxamers can provide controlled drug release under specific temperature conditions. By utilizing the thermosensitivity of poloxamers, drug release from the PCL fibres can be triggered or modulated by external stimuli, such as changes in temperature. This capability offers potential applications in hyperthermia treatment, where localized drug release can be achieved by heating the target site [3].

The addition of poloxamers as excipients in electrospun PCL fibres significantly influences their physicomechanical properties, cellular biocompatibility, and *in vitro* drug release behavior. Poloxamers enhance the flexibility, elasticity, and mechanical stability of the fibres. The improved hydrophilicity and cell-material interactions resulting from poloxamer incorporation promote better cellular responses, including adhesion, spreading,

and proliferation. Moreover, poloxamers contribute to controlled drug release from electrospun PCL fibres by modulating the pore structure and creating thermosensitive properties. These advancements have broad implications for tissue engineering and drug delivery applications, allowing for the development of more effective and versatile systems [4].

Further research is needed to optimize the concentration and combination of poloxamers to achieve desired outcomes in specific applications. Understanding the effects of poloxamers on electrospun PCL fibres' properties will continue to contribute to the development of advanced biomaterials and therapeutic delivery systems. The incorporation of poloxamers as excipients in electrospun PCL fibres holds significant promise for improving their physicochemical properties, cellular biocompatibility, and drug release characteristics, thereby expanding their potential applications in biomedical fields. Polycaprolactone (PCL) is a widely used synthetic polymer in biomedical applications due to its biocompatibility, biodegradability and mechanical properties [5]. Electrospinning is a versatile technique that allows the fabrication of nanofibrous structures from polymer solutions. However, the properties of electrospun PCL fibres can be further improved by incorporating excipients such as Poloxamers. Poloxamers are nonionic triblock copolymers composed of Poly Ethylene Oxide (PEO) and Poly Propylene Oxide (PPO) blocks. This article aims to discuss the effects of Poloxamers as excipients on the physicomechanical properties, cellular biocompatibility, and *in vitro* drug release of electrospun PCL fibres. Poloxamer inclusion frequently results in greater fibre alignment, less bead formation, and higher control over fibre diameter. The addition of poloxamers can also improve the tensile strength and Young's modulus of PCL fibres, making them better suited for load-bearing applications [6].

Conclusion

The addition of Poloxamers to PCL electrospinning solutions can significantly influence the physicomechanical properties of the resulting fibres. Poloxamers act as plasticizers and can enhance the flexibility and elongation of PCL fibres. The inclusion of Poloxamers can decrease the glass transition temperature of PCL, leading to improved processability during electrospinning. Furthermore, Poloxamers can increase the tensile strength and modulus of PCL fibres, resulting in mechanically robust structures. The choice of Poloxamer type and concentration can be tailored to achieve the desired mechanical properties of the electrospun fibres. Biocompatibility is a crucial aspect when considering the use of electrospun fibres in biomedical applications. Poloxamers have been widely investigated for their biocompatible properties. When incorporated into electrospun PCL fibres, Poloxamers can enhance cellular interactions and promote cell adhesion. The presence of Poloxamers on the fibre surface can create a hydrophilic environment, facilitating cell attachment and proliferation. Additionally, Poloxamers possess low toxicity and have been shown to support cell viability and maintain cell functionality. These biocompatible properties make Poloxamers suitable excipients for electrospun PCL fibres intended for tissue engineering and regenerative medicine applications.

Acknowledgement

None.

Conflict of Interest

None.

References

1. Hirun, Namon, Pakorn Kraisit and Vimon Tantishaiyakul. "Thermosensitive polymer blend composed of poloxamer 407, poloxamer 188 and polycarbophil for the use as mucoadhesive in situ gel." *Polymers* 14 (2022): 1836.
2. Oh, Kyung T., Tatiana K. Bronich and Alexander V. Kabanov. "Micellar formulations for drug delivery based on mixtures of hydrophobic and hydrophilic Pluronic® block copolymers." *J Control Release* 94 (2004): 411-422.
3. Zarrintaj, Payam, Joshua D. Ramsey, Ali Samadi and Zhaleh Atoufi, et al. "Poloxamer: A versatile tri-block copolymer for biomedical applications." *Acta Biomater* 110 (2020): 37-67.
4. Beachley, Vince and Xuejun Wen. "Effect of electrospinning parameters on the nanofiber diameter and length." *Mater Sci Eng C Mater Biol Appl* 29 (2009): 663-668.
5. Minsart, Manon, Sandra Van Vlierberghe, Peter Dubruel and Arn Mignon. "Commercial wound dressings for the treatment of exuding wounds: An in-depth physico-chemical comparative study." *Burns Trauma* 10 (2022): tkac024.
6. Suksiriworapong, Jiraphong, Tanaporn Rungvimolsin, Atitaya A-gomol and Varaporn Buraphacheep Junyaprasert, et al. "Development and characterization of lyophilized diazepam-loaded polymeric micelles." *Aaps PharmScitech* 15 (2014): 52-64.

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