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Adding Functionalized Nano-Structured Poly Lactic-co-glycolic Acid to Co-formulated Hydrophobic Drugs to Increase their Solubility during Co-Precipitation

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Introduction

The pharmaceutical industry is constantly evolving, seeking innovative solutions to improve the delivery and effectiveness of drugs, particularly those that face challenges such as poor solubility and low bioavailability. Among the many compounds that suffer from such issues, hydrophobic drugs are particularly problematic due to their inability to dissolve in aqueous environments, resulting in poor absorption in the gastrointestinal tract and reduced therapeutic efficacy. This is a major challenge in drug formulation, especially for drugs targeting systemic diseases, such as cancer, infections and chronic conditions. Several approaches have been developed over the years to address these limitations, with the co-precipitation technique emerging as one of the most promising methods to improve the solubility of hydrophobic drugs. One significant advancement in this field is the use of functionalized nano-structured Poly Lactic-Co-Glycolic Acid (nfPLGA), a biocompatible and biodegradable polymer, in conjunction with hydrophobic drugs during co-precipitation.

Description

Hydrophobic drugs are characterized by their inability to dissolve in aqueous solutions, a property that leads to low solubility and poor bioavailability. These drugs tend to aggregate or crystallize in an aqueous environment, limiting their absorption across biological membranes and preventing them from reaching effective therapeutic concentrations. This is a major hurdle in drug development, as a drug's solubility is directly linked to its bioavailability and overall therapeutic efficacy.The pharmaceutical industry has identified several strategies to improve the solubility of hydrophobic drugs, such as altering the chemical structure of the drug, using salt forms, or creating drug conjugates. While these methods have shown some promise, they often come with limitations, such as increased manufacturing complexity, stability issues and sometimes increased toxicity. The quest for alternative solutions has led researchers to explore the use of nanotechnology, particularly the incorporation of nanostructured carriers, to enhance drug solubility.

Among the various nanocarriers, Poly Lactic-Co-Glycolic Acid (PLGA), a copolymer of lactic acid and glycolic acid, has gained considerable attention due to its biocompatibility, biodegradability and ability to form nanoparticles that can encapsulate hydrophobic drugs. However, while PLGA has demonstrated promising results in improving drug solubility, functionalizing it with specific groups can further enhance its ability to solvate and deliver hydrophobic drugs effectively. PLGA has been widely utilized in drug delivery due to its favorable properties, such as controlled release, biodegradability and minimal toxicity. However, its effectiveness in delivering hydrophobic drugs can be improved by functionalizing the polymer to enhance its interactions with the drug molecules. Functionalization refers to the process of introducing functional groups or altering the surface properties of the polymer to improve its solubility, stability and drug-loading capacity [1,2].

Conclusion

In conclusion, the addition of functionalized nano-structured Poly Lactic-Co-Glycolic Acid (nfPLGA) to co-formulated hydrophobic drugs via co-precipitation offers a promising solution to improve the solubility, bioavailability and therapeutic efficacy of hydrophobic drugs. By enhancing drug solubility, controlling release profiles and offering targeted delivery, nfPLGA-based formulations can significantly improve the treatment of a wide range of diseases, particularly those involving hydrophobic compounds. However, challenges related to scalability, stability and safety must be addressed to fully capitalize on the potential of nfPLGA-based drug delivery systems in clinical practice. With continued research and development, nfPLGA-based co-formulations may become a cornerstone in the next generation of drug delivery technologies.

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