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Nanovector-based Plant Resin Delivery: A New Method to Increase Solubility, Permeability and Bioavailability

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Introduction

The increasing prevalence of chronic diseases such as cancer, cardiovascular disorders, diabetes and inflammatory conditions has spurred interest in the development of novel drug delivery systems that can efficiently transport therapeutic agents to their target sites. One of the main challenges in modern pharmacology is overcoming the barriers associated with the poor solubility, permeability and bioavailability of many bioactive compounds, especially natural products derived from plant sources. These compounds, despite their potent therapeutic effects, often face issues such as poor water solubility, limited absorption through biological membranes and rapid elimination from the body, which can significantly reduce their effectiveness. Plant resins, which are complex mixtures of various bioactive compounds, have been historically utilized for their therapeutic potential in traditional medicine. Resins contain a variety of compounds such as terpenoids, flavonoids, alkaloids and other polyphenols that are known for their anti-inflammatory, antioxidant, antimicrobial and anticancer properties. However, like many plant-based compounds, the clinical use of these resins is hindered by their limited solubility and bioavailability. To overcome these challenges, nanovector-based delivery systems, such as nanoparticles, liposomes and solid lipid nanoparticles, have emerged as promising strategies for enhancing the solubility, permeability and bioavailability of plant-derived bioactive compounds.

Description

Plant resins are a rich source of bioactive compounds, many of which exhibit therapeutic effects that have been recognized for centuries in traditional medicine. However, despite their potential, the use of plant resins in modern pharmacotherapy is limited by several factors. These include poor solubility, low permeability through biological membranes and reduced bioavailability, which collectively result in suboptimal therapeutic outcomes. Many of the active compounds found in plant resins are hydrophobic, meaning they do not dissolve well in water. This limits their ability to be absorbed efficiently in the gastrointestinal tract when administered orally. The low solubility of these compounds also hampers their ability to reach therapeutic concentrations at the target site, reducing their overall effectiveness.

Bioavailability refers to the fraction of an administered dose of a drug that reaches the bloodstream and ultimately the target site. Poor solubility and limited permeability contribute to the low bioavailability of plant resin compounds. Even if a compound is absorbed into the bloodstream, it may undergo extensive first-pass metabolism in the liver, which can further reduce its bioavailability and therapeutic potential. Nanovector-based delivery systems have gained considerable attention as a promising solution to the challenges of poor solubility, permeability and bioavailability of plant-derived compounds. These systems involve the encapsulation of bioactive molecules within nanoparticles, liposomes, micelles, or other nanoscale carriers, which help protect the encapsulated drug from degradation, improve its solubility and facilitate its delivery to the target site. Nanovectors are typically composed of biocompatible and biodegradable materials, making them safe for use in drug delivery applications. The small size of these nanoparticles, typically ranging from 1 to 1000 nanometers, allows them to bypass many of the biological barriers that hinder the absorption and distribution of conventional drugs. Furthermore, nanovectors can be engineered to carry hydrophobic compounds, enhance the permeability of encapsulated agents through biological membranes [1,2].

Conclusion

Nanovector-based delivery systems offer a promising approach to overcome the limitations of plant resin bioactive compounds, including poor solubility, limited permeability and low bioavailability. By encapsulating these compounds in nanoparticles, liposomes, solid lipid nanoparticles, or micelles, their solubility, permeability and bioavailability can be significantly improved, leading to enhanced therapeutic efficacy. Nanovectors have the potential to revolutionize the use of plant resins in modern medicine, offering new opportunities for the treatment of various diseases, including cancer, inflammation, infections and skin disorders. However, further research is needed to optimize the design, stability and targeting capabilities of these delivery systems for clinical use.

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