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Preparation of Collagen Nanoparticles for Tissue Engineering and Drug Delivery

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Introduction

Collagen has been utilised within nanoparticles as a result of a breakthrough in nanotechnology, which has implications for drug delivery and tissue engineering. This crucial and flexible polymer can be utilised to promote translational research, according to a review published in the journal Applied Sciences.

Tissue Engineering and Drug Delivery Systems: What's the Connection?

Tissue engineering is the process of creating new tissue. Skin grafts are a common application, however more ambitious projects entail creating complete organs. The monitoring of newly produced tissue is, however, a common constraint of tissue engineering [1].

Excitingly, nanotechnology may be able to assist in the resolution of this issue.

Nanoparticles range in size from 1-100 nm and are ideal for circumventing biological barriers within the body.

They can be functionalized to carry pharmaceuticals and have properties including reduced cytotoxicity, hydrophobic drug solubility that improves prolonged drug release, and increased tumor selectivity due to the enhanced permeability and retention effect.

Collagen's use in these applications merely enhances the properties of nanoparticles.

Collagen nanoparticle preparation

Collagen nanoparticles can be made using one of three methods: chemical, physical, or self-assembly.

Coacervation or colyelectrolyte complexation, as well as emulsification, are chemical techniques. Complex coacervation is the process of infusing natural salt or alcohol into a collagen solution to create structural changes, which then leads to the production of nanoparticles after crosslinking material, is added [2,3].

A physical method for forming spherical collagen nanoparticles in liquids is called nano spray drying. A dilute collagen solution is sprayed into a chamber at a high temperature in this procedure.

The chamber is filled with heated carbon dioxide, and nitrogen gas flows in the spray's direction, resulting in hollow nanospheres that are collected by an electrode. This physical approach encapsulates hydrophilic medicines and is both quick and inexpensive.

Proteins modified hydroponically are used in the self-assembly process for producing collagen nanoparticles. They can self-assemble into micelle NPs when added to aqueous liquids.

Desolvation or simple coacervation is a procedure in which a desolvation component, such as natural salt or alcohol, is added to a collagen solution containing a medication.

The desolvation factor alters the structure of collagen, lowering its solubility. The generated mass of collagen is subsequently crosslinked using a crosslinking agent such as glutaraldehyde, resulting in nanoparticles. When reducing the protein content and changing the size of nanoparticles, this approach can be useful.

Future therapies

Nanoparticles have become crucial for generating breakthrough cures and treatments as nanotechnology has moved into numerous industries.

The addition of collagen to nanoparticles improves their functionalization even more, resulting in benefits for drug delivery systems and tissue engineering [4,5].

The incorporation of gold nanoparticles into collagen nanoparticle scaffolds has been studied, resulting in interactions with growth factors and molecules for cell adhesion – an important component for lowering inflammation and forming granulation tissue that is immune-resistant.

The incorporation of collagen into nanoparticles marks the start of a fascinating journey in medicine and the pharmaceutical sector. Though still in its infancy, this study into new therapeutics has a lot of promise.

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