https://doi.org/10.53230/tgm.1310-912X.2024.1001.12

NANOSTRUCTURED MATERIALS WITH POTENTIAL APPLICATIONS IN REGENERATIVE MEDICINE

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A number of causes such as chronic diseases (including autoimmune), physical trauma, cancers and viruses (e.g. SARS-CoV-2) can severely damage human tissues. The body is rarely able to repair acute injuries without external intervention, most commonly a transplant from a donor. Transplants often result in a strong immune response from the recipient, which can cause rejection of the donor tissue and even further damage to peripheral tissues and organs.

Nanobiotechnology is developing innovative methods to regenerate tissues damaged by various diseases or chemical and physical factors. At the core of these methods are nanoscaffolds based on various polysaccharides and nanocomposites. They have the potential to advance tissue engineering and drug delivery. Various basic scaffold materials have been tried in the past decades. One of the most versatile, antibacterial and biocompatible is a polymer called chitosan. Some of the most common methods for synthesizing nanoscaffolds are solvent casting, salt leaching, gas foaming, freeze drying, phase separation, electrospinning, and 3D printing.

The goal of each nanoscaffold is to mimic the extracellular matrix (EM). EM differs greatly depending on the needs of the cells which it surrounds. These differences can be biochemical, physical like electrical conductivity for muscle cells and high piezoelectric conductivity for lung tissue, or structural. These specific requirements can be met by adding specific particles to the nanocomposite that makes up the nanoscaffold. Another challenge that comes up when designing a scaffold is the fact that sometimes when different materials are added to a particular biopolymer, the 3D structure becomes brittle and cannot withstand the cells that must grow on it.

Nanomedicine allows more precise study of biomolecules and their interactions, as well as facilitated delivery of compounds with different carriers such as quantum dots, metal oxides, and others. Nanomaterials have a flexible design and small size, making them easily modifiable and compatible with the target area.

The properties of chitosan as an accessible, antibacterial and biodegradable biopolymer complement the versatility of nanomaterials, enabling the use of conventional scaffold fabrication methods for specific biomedical needs. The mechanical strength of graphene oxide (GO) and the antimicrobial properties of silver nanoparticles (Ag NPs) can be studied together to address critical challenges in traditional scaffold design. Based on this approach, fabrication of chitosan scaffolds combined with varied concentrations of GO and Ag NPs is planned. The materials will be synthesized by sol-gel method, electrospinning, or a combination of both. Their antibacterial properties and potential applications in regenerative medicine will be studied.

Keywords: *nanocomposites, nanoscaffolds*