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Biomimetic Marine Material Chitosan and its Applications

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Biomimetic materials provide advantages for biocompatibility and/or biodegradability for biomedical applications. Designing novel biomaterials from abundant natural products helps formation of non-toxic and non-immunogenic biomaterial. Saccharide plays key roles in biochemical pathways and its structural property give advantages to designing innovative biomedical products. Chitosan [β-(1→4)-2-amino-2-deoxy-D-glucose] is a biocompatible basic polysaccharide homopolymer and it is nontoxic and is biodegradable. Chitosan digestion in the body converts chitosan to harmless amino sugar products and they are absorbed in the body safely [1]. Chitosan is the partially deacetylated form of chitin which is derived from crustaceans such as shrimp and craps. However, most commercial products consist of N-acetylglucosamine (NAG) and N-glucosamine repeat units. Chitosan is similar to cellulose but differs in the second carbon, an amino group replaced hydroxyl group.

Chitosan has been employed in tissue engineering, pharmaceutical industry, and in nanoparticle design. Several applications can be counted for chitosan based products such as wound-healing accelerators, artificial kidney membrane, drug delivery systems, growth factor delivery systems, absorbable sutures, blood anticoagulants, artificial skin, antimicrobial systems, and supports for immobilized enzymes. Further, several products were developed in tissue engineering for bone, cartilage, tendon and ligament, skin, liver, and nerve. Chitosan biomimetic properties were found functionality in the areas of orthopedics, contact lenses, hypocholesterolemic activity, dentistry, and plastic surgery.

Forming scaffolds with proper cells in combination with biomolecules to restore or replace tissue-organs is innovative solution in tissue engineering, personalized gene therapy, and stem cell applications. Since, biodegradable chitosan is polyelectrolyte with modifiable functional groups; this biopolymer is used in these processes. In addition, its antibacterial, antifungal, and antitumor activity makes the compound suitable in medical applications [2].

This abundant and inexpensive material has been contributed to the application of modern medicine and yet several studies are underway to develop unique biomaterials. The commercial products are not limited to the aforementioned areas but for personal care, hair care, skin care, and for dietary foods. One of the unique properties of chitosan is its stability and this factor is employed in sterilization of clinical materials. Sterilization of chitosan based material by autoclave, alcohol rinsing, and γ-radiation showed minimal effect on the clinical products. This adaptability makes the chitosan based products preferable in clinical use [3].

In the review of Dr. Halim, chitosan history, properties, processing, and factors influencing chitosan were discussed deeply. The work emphasized the requirement of further research to augment potential use of chitosan in hydrogels, porous scaffolds, films, and nanoparticles. The article main emphasis is on biomedical applications of chitosan but chitosan is also employed in food, paper, textile, and pollution control as well.

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