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Chitosan in Medicine – A Mini Review

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Introduction

Chitosan is a polysaccharide made up of deacetylated β-(1-4) D-glucosamine and acetylated units of N-acetyl-D- glucosamine. Generally, chitosan is synthesized by de acetylating chitin using excess sodium hydroxide as reagent and water as solvent. Chitin can be obtained from the exoskeletons of shell mollusks, crustaceans and few species of fungal cell walls as they contain chitin in them. Chitin is one of the most abundant natural poly amino saccharide next to cellulose.

Chitosan is being used commercially in seed treatment and as bio-pesticides for protecting against fungal infections. It is used as a fining agent in wine making process and also in storage of wine and other alcohols [1]. Chitosan is also used in enhancing tensile strength of biopolymers which are being used widely replacing synthetic hydrocarbon polymers [2, 3]. Some researches proved it is useful in bioremediation process to remove heavy metals and dyes from environment [4]. Removal of pharmaceutical traces from water bodies using chitosan is also being considered by the researchers [5].

The use of chitosan for immobilizing the biomolecules is being studied extensively [6]. Despite of its bio compatible properties its approval for human use is still pending by FDA. Only few countries like Japan and Korea had proposed the use of chitosan in potable water. Chitosan had become one of the primary targets in drug delivery research as almost all the countries are working to obtain globally acceptable criteria for human medical use [7].

Biomedical Uses

For biomedical uses purified chitosan can be obtained from the market. The advantage of chitin or chitosan is that they are non-toxic, biodegradable, and antigenicity is very less and non-pathogenic to experimental animals [8, 9], hence efforts are being made for its human use. Chitosan helps in rapid clotting of blood, and is approved to use in bandages and hemostatic agents in the United States and Europe [10]. US and UK successfully used bandages coated with chitosan during Iraq and Afghanistan war successfully [10, 11]. Chitosan usage in bandages is highly recommended due to its hypo-allergic, antibacterial and analgesic properties, making the wounds heal quickly [12,13].

Some scientists concluded that in some animals the use of chitosan and its derivatives showed positive results in treating joint defects in bones [14]. In some species Chitosan activates genes this gene activating property has to be studied well to use it as a potential biomedical and genetic therapy tool [15].

Chitosan is supposed to lower the fat content in the body by altering the fat absorption in the duodenum and increasing the lipid excretion helping in weight loss and decreasing obesity [16, 17]. However, the fat lowering role of chitin is poorly understood and unproven. Some scientists stated that the Chitosan is relatively insoluble in water, becomes viscous in digestive system and inhibits absorption of dietary lipids [18, 19]. This also results in slow emptying of stomach and also alters bile secretions cumulatively affecting the fat digestion and absorption in the body. However the U.S. Food and Drug Administration (FDA) warned commercial firms who claimed about the health benefits of chitosan as the human trials still not completed [19].

Chitosan in Drug Delivery

The amino group on chitosan is water soluble and has weak acidic pKa. Hence, it can be easily transported in acidic environments and making it an efficient drug vehicle to carry across the acidic environments to the target organ or site [20]. Moreover due to its weak acidic pKa it can easily bind with negatively charged surfaces including bio membranes. This bio-adhesive property can be used to develop target specific drug carriers. Muco-adhesive property of chitosan enhances the binding of drug carried by it and prolongs its release time into the system increasing the bioavailability of the drug [21].

Many researchers are focusing on the delivery of insulin using chitosan based nano particles. Fortunately most of the scientists got positive results in delivering the insulin at controlled levels in the target tissues or organs [22]. To bypass the enzymatic degradation of drugs in extreme environment of Gastro intestinal tract, encapsulation or loading of drug in the chitosan based gels is being studied widely. Many experiments by researchers showed positive results, promising the protective and drug targeting capability of chitosan [23]. Chitosan is being studied at nano level to understand its physical chemical and biological properties for using chitosan based nano particles in drug delivery [24]. Studies are being carried out to use chitosan in gene delivery opening the doors for effective gene therapies. Chitosan is also being used in transdermal drug delivery due to its adhesive and bio inert properties.

However, there is a need to standardize the composition of chitosan and the usage process for human usage, to get approval from WHO or FDA.

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