

Editorial

Therapeutic effects of 'Chitosan' Nanoparticles: An Update

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Dear Editor,

It is quite known that there are a lot of drugs that act against microbes which usually act by inhibiting microbial growth or by killing the organisms itself. Inadequate drug delivery systems and side effects are main obstacles in the path of administering these drugs. As a result many drugs cannot attain therapeutic index in human body and many are notorious for side effects like cutaneous irritation, peeling of skin, scaling and gut flora reduction according to the route of administration. Ultra small and controllable size, large surface area to mass ratio, high reactivity and functional structure are unique physicochemical properties of nanostructured particles such as nanoparticles [1]. Chitin can be N-deacetylated to produce chitosan (CS) and thus is a natural polysaccharide. The various fields where chitosan is used, includes controlled drug delivery systems due to its significant biological and chemical properties such as biodegradability, biocompatibility, bioactivity and policationity. It has also been widely used in food and bioengineering industries, including the encapsulation of active food ingredients, in enzyme immobilization [2]. The source of chitin and the conditions of chitin/chitosan production process is

important since these directly reflect medical property. Weight-averaged molecular weight (MW) and degree of *N*-acetylation (DA), other physicochemical parameters like polydispersity (MW/MN) and crystallinity or the pattern of acetylation (*PA*) affect solubility of chitin and chitosan [3].

One of the most important complications in ICU settings includes blood stream infections after introducing an intravascular catheter into the circulation. This is referred to as Catheter related blood stream infections (CRBSIs) and biofilms formed by bacteria result in persistent infections. More often it is complicated with drug resistance and to overcome this antibiotic resistant, biofilms degrading enzyme, β -N-Acetylglucosaminidase (NAGase) is used. Through ionic gelation method chitosan nanoparticles were fabricated and β -N-Acetylglucosaminidase (NAGase) was encapsulated. [4]. In the management of migraine an intranasal mucoadhesive nanoparticle of Rizatriptan benzoate (RZB) was developed. For an easy and reproducible preparation chitosan nanoparticles and RZB can be loaded. And again using ionic gelation technique this method is near to efficiency in entrapment. Using different methods like Differential scanning calorimetry (DSC), X-ray

diffraction (XRD) spray dried nanoparticles were evaluated to study crystalline/amorphous nature of nanoparticles, and mucoadhesive test. Results showed that percentage mucoadhesion on nasal mucosa of goat to be 29.4%. Further evaluation in phosphate buffer pH 6.5 shows release behavior of CS nanoparticles were suitable for intranasal drug delivery [5]. Using sonication and centrifugation techniques chitosan nanoparticles loaded by ketoprofen was used in a study for chitosan efficiency determination. Optimization conditions of sonication including amplitude and sonication time were included while performing preliminary tests. Turbidity data showed that the optimum condition for sonication on amplitude and sonication time at the percentage of 20% and at 60 minutes, respectively. Decreasing of turbidity number of emulsion reduced particle size when PSA analysis was done. Chitosan nanoparticles loaded by ketoprofen had spherical form when analyzed by SEM and had semi crystalline properties when assessed with XRD analysis [6].

Chitosan is safe, biocompatible, biodegradable and environment friendly and is one of the best polymers in the field of Nanomedicine. Great emphasis should be given in formulating new methods for production of chitosan nanoparticles in the field of pharmaceutical industry. Its importance should be noted as some authors showed few drugs were carried by chitosan sulphate. Using different LMW chitosan HCl and sodium sulfate, the size of chitosan sulfate nanoparticles were determined and confirmed by Laser diffraction, DSC and FTIR spectroscopy and tested for its dissolution rate [7]. As a delivery system for therapeutic macromolecules like antigen it also attracted attention of other authors who focused on

hydrophilic nanoparticles. It has been showed *in vitro* studies that there is an initial burst release of approximately 60% in the first ten hours for these nanoparticles and next 60 hours a slow and much reduced additional release. Fabricated chitosan nanoparticles may be future drug delivery system alternative to traditional adjuvant systems [8].

REFERENCES

1. Zhang L, Pornpattananangku D, Hu CM, Huang CM. Development of nanoparticles for antimicrobial drug delivery. *Curr Med Chem* 2010; 17(6):585-94.
2. Rampino A, Borgogna M, Blasi P, Bellich B, Cesàro A. 2013. Chitosan nanoparticles: Preparation, size evolution and stability. *Int J Pharm* 2013; 455:219-228.
3. Nagpal K, Singh SK, Mishra DN. Chitosan Nanoparticles: A Promising System in Novel Drug Delivery. *Chem Pharm Bull* 2010; 58:1423-1430.
4. Sorlier P, Denuzière A, Viton C, Domard A. Relation between the Degree of Acetylation and the Electrostatic Properties of Chitin and Chitosan. *Biomacromolecules* 2001; 2:765-772.
5. Jadhav SS, Bhalerao AV. Formulation and characterization of chitosan nanoparticles loaded with rizatriptan benzoate. *Der Pharmacia Lettre* 2013; 5(4):218-223.
6. Van den Broek LAM, Knoop RJJ, Kappen FHJ, Boeriu CG. Chitosan films and blends for packaging material. *Carbohydr Polym* 2015; 116(Suppl. C):237-242.
7. Mayyas MA Al-Remawi. Properties of Chitosan Nanoparticles Formed Using Sulfate Anions as Crosslinking Bridges. *American Journal of Applied Sciences* 2012; 9 (7): 1091-1100.
8. Shukla SK, Mishra AK, Arotiba OA, Mamba BB. Chitosan-based nanomaterials: A state-of-the-art review. *Int J Biol Macromol* 2013; 59:46-58.

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