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Research Article

Preparation of Chitosan Nano-Particles by Method of Chemical Hydrolysis

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Abstract

Due to the vital contribution of Nanotechnology science in advancement of various industries, its necessary role in textile and medical industries cannot be ignored also. One of the bio-compatible polymers with biodegradability and non-toxicity is Chitosan. Chitin and Chitosan are natural amino poly saccharin, according to the unique structure and high-performance of its multi-dimensional characteristics, it has brilliant and workable usage in various industries, particularly in the medical, textile, surface modifying, tissue engineering, wound healing and drug delivery that have been focused on it mostly during recent years. If mentioned polymer transmits to Nano-phase in range of Nano surface it will cover up the surfaces with very lesser amounts of the substance. We are facing at pioneer research on the preparation of Chitosan Nano-particles to enhance the ratio of surface area to volume and increased use of bio-polymer at mentioned industries. To prepare the Nano-chitosan, Chitosan was hydrolysed in acidic medium molecular weight and particle size by TEM and SEM has been confirmed. Chitosan crystalline particles were analysed by X-ray diffraction XRD also.

Keywords: Chitosan; Nanotechnology; Textile; Tissue Engineering; Nanoparticles

Introduction

Due to the vital contribution of Nanotechnology science in advancement of various industries, its necessary role in textile and medical industries cannot be ignored also. One of the bio-compatible polymers with biodegradability and non-toxicity is Chitosan. Occupied area per unit volume of Nano-materials, are more than area which are occupied by structures with micron size, and much larger than the micron scale. When the sample split to surface area than the surface area comes to Nano scale. This ratio, in Nano-material, is a crucial factor and desirable for using in Nano composites, reaction systems, catalytic activity, and drug delivery and so on. For example, as a sample Nano particles, according to the external environmental increases related to the contact area with the surface to volume ratio in higher degree will result the catalytic activity or drug delivery that will be observed [1,2].

With the transmission of micro particles to Nano particles we will encounter the two most crucial factors that comes in below:

1. The rise of ratio of surface area to volume.
2. Entry into the territory of particle size quantum effects.

Biodegradable polymers derived principally from renewable sources-come (as opposed to synthetic polymers that have more oil source) so production could be keeping nonrenewable resources for future generations. The biodegradable polymers have ability to return to nature by microorganisms in a process of natural products such as carbon dioxide, water, methane and land biomass to be converted. Most synthetic polymers such as polyolefin, polyvinyl petroleum-based nylon and so are resistant to biological degradation and carbon bonds are not broken down by enzymes of microorganisms.

Hydrophobic polymers and low level compared with high molecular weight synthetic polymers resistance to attack by enzymes of microorganisms that is caused [3]. Furthermore, other biodegradable polymers are biodegradable polymers in the natural environment in general, the polymers, which after decomposition by microorganisms and completely natural products such as water, carbon dioxide and biomass (fungi and bacteria) or enzymes become biodegradable that are called. Polysaccharides that are

composed to monosaccharide and its remarkable features that are coming as below:

- Plentiful in nature
- Widely found in many countries
- Have renewable resources
- Bio-polymers are stable, and are hydrophilic
- Polymers with ability to modify

In terms of biological and chemical: nontoxic, the ability to analyze, and are flexible and absorbent. That includes:

1. Hydrophilic high polymer (due to hydroxyl groups in the glucose units)
2. The presence of large numbers of smaller groups that side like amide groups or hydroxyl amine first.
3. Chemical reactivity of these groups.
4. The flexible structure of the polymer chains.

According to the reactive side groups, polysaccharides show qualified reactivity and, accordingly, the derivatives of polysaccharides generally derive from two main ways.

1. The cross-linking reaction through amine groups or hydroxyl.
2. linked polysaccharide with an organic or inorganic material.

Some types of polysaccharides include starch, cyclodextrins, amylase, pectin, alginate, and chitin and chitosan [4,5].

Chitosan

Chitosan (Figure 1) is a linear polymer which is obtained with structural polysaccharide hydrolysis natural polymer chitin$C_8H_{13}NO_5$. Chitosan is a cationic polymer that is achieved by heating chitin in sodium hydroxide. Degree of acetylating than acetyl groups glucose amine to amine groups on the chitosan structure shows a significant factor in the solubility and other properties of chitosan is considered. commercial chitosan is usually having percent acetylating above 70%, and between 10 thousand to 2.1 million Daltons in molecular weight are positively charged free electron pair of positive ions by atomic absorption nitrogen's that They are produced in almost exceptional in nature and to permit the polymer to create a bond with the negatively charged biological levels [6].

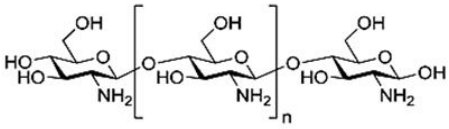

Figure1: Chitosan

Chitosan Properties

Chitosan properties can be examined through two sides also.

A) Chemical properties of Chitosan:

Chemically, it can be said that Chitosan is a linear polymer with amine and hydroxyl groups that are active.

B) Biological properties of Chitosan:

The biological properties of Chitosan are:

1. Biocompatibility (natural, safe and non-toxic)
2. Biodegradability
3. The antimicrobial activity [7].

Chitosan solution

Because of the free amine groups of Chitosan in units of D-glucose amine, it is soluble in acidic conditions and the number of units in chitin deacetylated Chitosan is low but high enough. Chitosan, deacetylated product of chitin in acids such as acetic acid &formic [7,8].

a. Chitosan applications

Chitosan is biodegradable, nontoxic, biocompatible polymer. According to the features that listed many applications in various fields including medicine, tissue engineering, drug delivery systems, cosmetic and hygiene industries, packaging, filtration, wound dressings, membranes for wastewater treatment industry etc. [9, 10].

b. Nano-Chitosan applications inbio-polymer

There are many enhancive applications foe Nano ratio particles of chitosan in bio polymer, which the most significant are modification of surfaces, textile dyeing features approval, antimicrobial materials for food packaging, Drug/Gene Delivery , Tissue Engineering and green application for textile finishing.

Materials

Chitosan from the company Aldrich (Germany) with an average molecular weight and the degree of acetylating 75-85%, Sodium tri poly phosphate with a purity of 60% and a molecular formula $Na_5P_3O_{10}$, Dae-Jung Company And sodium carbonate with Na_2CO_3 as molecular formula. Also, Citric acid and acetic acid from the company Merck, Germany.

Equipment

A digital scale for weighing products in various stages of the German model. KERN PEJ220-3M was used with accuracy of 0.00001. To settle the deposition of Nanoparticles of Chitosan centrifuge with model Hettich Universal320 of Germany was used. Chitosan particles to basic physical grinding before chemical treatment were used, manufactured by Retsch, to make the solution homogenized, ultra sound with model of Braun Labsobnic was used. To identify and assess the microstructure of Chitosan par-

ticles Philips device model EM208 transmission electron microscope was used to build, Voltage is 100 kW and the ability to zoom up to 180,000 times. Surface samples are examined by microscope with a thin layer of gold or carbon deposition on the surface of non-conductive samples. To obtain crystals of the Chitosan and size of the Nano Chitosan XRD device with model of PW1800 PHILIPS Co.

Methods

Preparation of Nano-chitosan

According to previous research, we can conclude that the best process to become micro particles to Nano-Chitosan is as follows:

0.5% chitosan concentration of 1.5% by weight relative to the weight of the fabric weight of acetic acid is dissolved in a bath containing 980 ml of water. Then volume was stirred with a magnetic stirrer on 15 minutes. Then on ultrasonic device for 30 minutes at 45 watts, then 5.0% by volume of sodium tri poly phosphate volumetric is prepared with distilled water. This solution by syringe or pipette drops to the chitosan solution while ultrasonic devices are added. Turbid solution is indicative of the formation of nanoparticles. After completion of shedding a drop of up to 30 minutes' ultrasonic devices stay again. The final solution was centrifuged to be deposited. The deposits are dried and the powder mill, which the levels are shown on as a schematic view on figure1.[11, 12]

Figure 1: Schematic Diagram of Producing Chitosan Nano Particles Via Method of Chemical Hydrolysis.

Results and Discussion

Transmission electron microscopy results, (TEM)

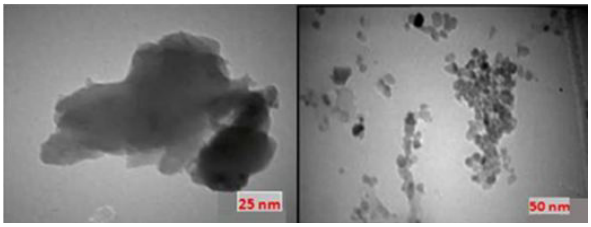

Figure 2: (A and B) SEM image of chitosan Nano- particles

(Figure 2) Shows that chitosan Nano particles are separate circular. We can observe, spherical particles of diameter in the range of 6 to 100 nm, in TEM images. However, in some areas because of elevated levels of particles and the particles may accumulate together [13].

Scanning electron microscopy test results from chitosan and Nano-Chitosan

To study the surface properties and microstructure of Nano-Chitosan and chitosan was prepared. As (Figure 3&4) show the chitosan and Nano-Chitosan in the mean length of 56.07 m and diameter of chitosan nanoparticles is measured around 0.59 nm [14, 15].

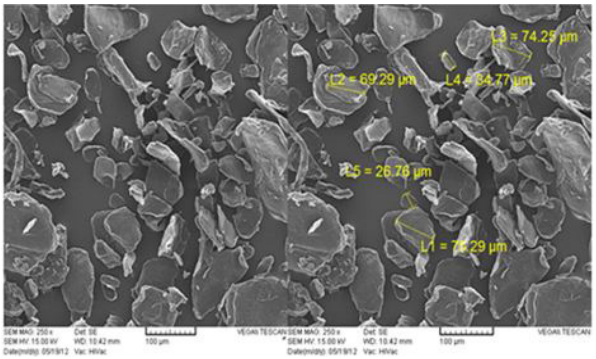

Figure3: Scanning electron micrographs of chitosan

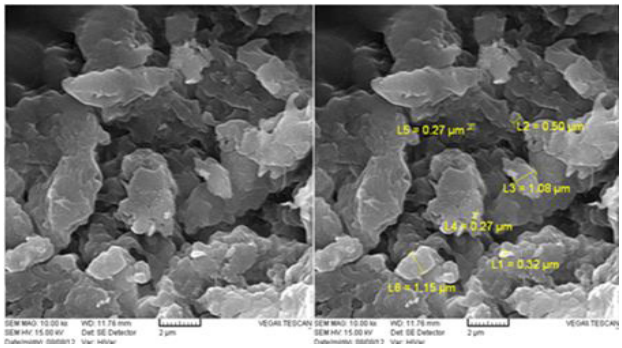

Figure 4: SEM images of chitosan Nano particles

The results of X-ray diffraction

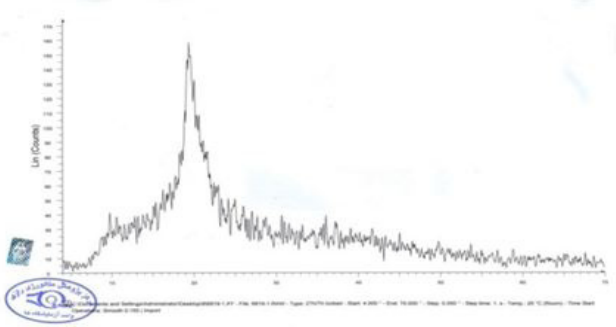

Figure 5: X-ray diffraction pattern of dispersion of chitosan Nanoparticles

Index and strong peak at an angle of 20 ˚ = 2Θ chitosan crystals indicates that using Scherrer equation (formula 1) can be obtained. Approximate diameter of crystallites chitosan (Table 1),[14,15]

$D = K \lambda / \beta \cos\theta$

Formula1. Debye-Scherrer [14]

Parameter Formula 1 is as follows:

K = 0.89 constant, Copper anodes wavelength λ = 1.54

Θ =Bragg diffraction angle, β = XRD full width at half the peak pattern, D = diameter crystals

Size of crystal (nm)	2˚Θ	FWHM˚	Sample
5.92	20.13	3.82	Nano Chitosan

Table 1: diameter of crystallites chitosan

Conclusions

Chitosan and its derivatives have bright future in textile 7 medical sciences. As particles are transfer and release of Chitosan in the weak acid, amine groups due to the first, is the best explanation for the popularity of this polymer. In addition, biocompatibility by several enzymes and gelling unique polymer has become known. Chitosan also as a candidate to treat burns can also be used. Property due to non-toxic, biocompatible and cationic nature as a temporary scaffold reform and stimulate the growth of new tissue is used in tissue engineering. In the textile industry, textiles are vulnerable to bacteria; hence the use of antibacterial agents to prevent or delay the growth of bacteria and essential as a standard principle in the preparation of textiles is of high importance. The Chitosan Nanoparticles were prepared according to the hydrolysis method. The microstructure of these tests to detect Nano Chitosan was used and confirmed by SEM, XRD, TEM, the results indicate the formation of Chitosan Nanoparticles. According to previous research of Nanoparticles, such as metal oxides are causing positive changes in appearance and performance

References

1. Habibi S (1988) improved flame resistance of polyester efficiency using Nano clay. Islamic Azad University. Science and Research
2. Habibi SA and Rezvani (1992) A review of the medical properties of chitosan.Benefits and Uses National Conference on Nanotechnology.
3. Tahmasbpour JCB (1388) Application of Nanotechnology in Biology and Medical Sciences. Tehran scholar.
4. [Habibi S (1392) Nanotechnology in Textile. Tehran. Amir Kabir University.
5. Monarul Islam MD (2011) Preparation of Chitosan from Shrimp Shell and Investigation of Its Properties. International Journal of Basic & Applied Sciences IJBAS-IJENS11: 77-80.
6. Potential applications of chitosan in veterinary medicine. Advanced Drug Delivery Review (2004) 56: 1467-80.
7. Syram Ramakrishna (1387) Introduction to electrospinning and nanofibers. Tehran. Metalon.
8. Costa-Pinto AR andReis LR (2011) Scaffolds Based Bone Tissue Engineering: The Role of Chitosan. Tissue Engineering.
9. ARCA HC andSENEL S (2008) Chitosan Based Systems for Tissue Engineering Part 1: Hard Tissues. FABAD J. Pharm. Sci. 33: 35-49.
10. Santosa C andSilva CJ (2014)Preparation and characterization of polysaccharides/PVA blend nanofibrous membranes by electrospinning method. Carbohydr Polym99: 584-92.
11. Burkhard P (2007) Peptide nanoparticles for drug delivery applications. Euro Cell 14: 115.
12. Bhuiyan R, Shaid A, Khan MA (2014) Cationization of cotton fiber by chitosan and its dyeing with reactive dye without salt. Chemical and Materials Engineering 2: 96-100.
13. Abbas AS (1990) Principles and concepts and applications of nanobiotechnology. Tehran,publication of scientific works. Tarbiat Modarres University.
14. Vellingiri K and Ramachandran T, Senthikumar M (2013) Eco-Friendly application of Nano Chitosan in antimicrobial Coating in Textile Industry. Nano Sciences and Nano technology 3: 75-89.
15. Gharaei P (1393) Study the microstructure and its effect on the properties of nano-fiber chitosan / gelatin / TPU. Islamic Azad University 27-32.