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Preparation and Modification of N,N,N-Trimethyl Chitosan Nanoparticles for Food Application

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Abstract – N,N,N-trimethyl chitosan (TMC) nanoparticles have been synthesized ionic gelation with TPP anions. The effect of certain preparation conditions, such as TMC and TPP content, on particle size, aggregation behavior are being investigated with techniques such as particle size analysis and zeta-potential. The presence of permanent positive charges on chitosan chain confers additional stability on the nanoparticles solutions.

N,N,N-trimethyl chitosan (TMC) is a cationic polyelectrolyte obtained by the huge methylation of chitosan parent polymer [1]. The resultant water soluble derivative has largely used for several applications mainly as nanoparticles [2]. Typical features obtained via ionic gelation process with sodium tripolyphosphate (TPP), are nanoparticles size in the range of 110-180 nm with drug entrapment efficiency up to 90%, for evaluation of bovine serum albumin as a model drug. Several others important applications have since emerged for TMC nanoparticles obtained by ionic gelation with TPP, such as: nasal and oral vaccine delivery system; protein carrier, insulin controlled release, and food industry. Considering this, the possibility of producing TMC nanoparticles with using TPP are being investigated in this work, aiming their food application as intelligent packaging. This make sense, once the development of new and natural products to prolong the shell-life of foods has been stimulated by a growing consumer demand for healthy, residue-free fresh products and also concern on ecological packaging.

TMC was obtained by quaternization reaction of chitosan with dimethylsulfate in an alkaline medium [1]. Figure 1 shows the morphological characteristics by Atomic Force Microscopy (AFM) analysis the cast chitosan (Fig. 1a) and TMC (Fig. 1b) films, where pronounced changes were observed. The TMC derivative presents a different topography. It shows the formation of an intense undulation profile, continuous and dense with no apparent isolated agglomerates. The irregularity of the surface is high, which leads to elevated values of Root Mean Square Roughness and Average roughness. The TMC–TPP nanoparticles are being obtained according to the procedure reported by Moura et al. [3], based on the ionic gelation of chitosan with TPP anions. Under magnetic stirring at room temperature, sodium TPP aqueous solution was added into chitosan solution. The preparations were mixed with a homogenizer (Polytron PT 3000 – Brinkmann) at 6000 rpm with continuous addition of TPP solution rate of 1 mL min^{-1}. The zone of opalescent suspension was further examined as nanoparticles.

The effect of certain preparation conditions, such as TMC and TPP content, on particle size, aggregation behavior are being investigated with techniques such as particle size analysis and zeta-potential. In addition, the Fourier transform infrared spectroscopy (FT-IR) spectroscopy will used to analyze the spectroscopic properties. The possibility of producing TMC-TPP nanoparticles with controlled sizes is of key importance to optimize its use in food industry because the use of nanotechnology can improve the functionality to edible films for food applications.

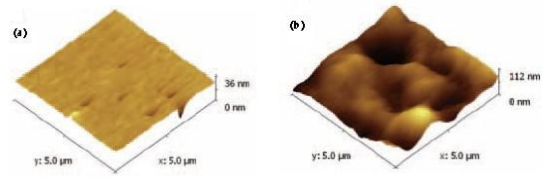

Figure 1: AFM topographic 3D images of films of **a)** chitosan; and **b)** TMC films deposited on cleaned glass slides.

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