Alginate-Chitosan Based Nanosystem as Carrier of Therapeutic Agents

Josué Juárez[1], Patricia D. Martinez-Flores[1], Joselyn A. García-Mar[1], Marco A. López-Mata[2], Gerardo García-González[3], Gerardo E. Rodea[4], David Encinas-Basurto[5], Antonio Topete[6]

[1]Universidad de Sonora, Departamento de Física, Posgrado Nanotecnología, Hermosillo, Sonora, México
[2]Universidad de Sonora, CD. Obregón, Sonora, México
[3]Facultad de Medicina, Universidad Autónoma de Nuevo León, Monterrey, Nuevo León, México
[4]Hospital Infantil de México Federico Gómez, Ciudad de México, México
[5]Universidad de Sonora, Navojoa, Sonora, México
[6]Universidad de Guadalajara, Guadalajara, Jalisco, México

josue.juarez@unison.mx

Abstract

Infections caused by bacteria are among the top ten most important health concerns, and they are exacerbated by the emergence of multi drug resistant strains [1]. Therefore, it is necessary to use alternative strategies for treatment through the design, development, and application of functional biomaterials. In this regard, phage therapy has re-emerged as an option for treating bacterial infections. However, phage therapy can fail due to various physiological factors such as pH, temperature, the immunological respond, and so [2], [3]. To overcome these drawbacks, phages can be entrapped in biopolymers-based nanosystems, providing both physical and physiological protection, and thereby enhance the therapeutic effect. In this report, a functional bionosystem based on polysaccharides (alginate and chitosan) was synthesized as a promising biomaterials for entrapping phages with activity against *Staphylococcus aureus* and *Pseudomona aeruginosa* [4], [5]. Alginate-chitosan nanoparticles (Alg-Cs Np) were obtained by ionic gelation method assisted by an ultrasonic probe, mixing three different formulations (Alg-mCs, mAlg-mCs and mAlg-Cs), in a Alg:Cs ratio range from 1:0.385 to 1:0.625 (w:w), adjusting the pH of the corresponding biopolymer solution (Alg and mAlg 4.5, Cs and mCs 5.0). Prior to this, both biopolymers were modified chemically (10%) by attaching hydrophobic molecules to modulate the hydrophilicity and hydrophobic balance. On one hand, alginate was modified by attaching 1-decanol (mAlg) through an esterification reaction, while chitosan was modified with octanoic acid (mCs) via amidation reaction. The success of both reactions was confirmed through FTIR-ATR spectroscopy. DLS, AFM and zeta potential analyses were conducted to determine the hydrodynamic size, shape, and surface charge of alginate-chitosan nanoparticles, respectively. Nanoparticles showed quasi-spherical shape with hydrodynamic sizes from 500 nm to 900 nm, and zeta potentials ranging from -39 mV to -45 mV. The loading capacity of mAlg-Cs based nanoparticle was evaluated using albumin nanoparticles (200 nm) as a phage model demonstrating an encapsulation efficiency of over 80%. Based on these results, Alg-Cs Nps showed promising applications in the field of biomedicine as bacteriophage and drug transport-loading-release systems.

References

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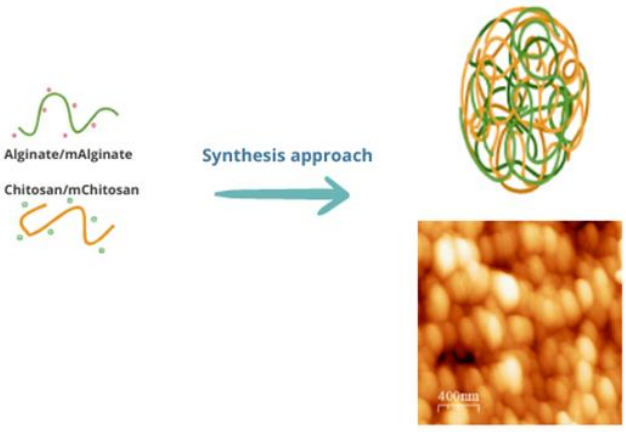

Figure 1. Synthesis approach of Alg-Cs based nanoparticles.