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Application of 3² experimental design in the preparation of casein nanoparticles as potential drug carriers

Nikolay Zahariev^{1,2}, Bissera Pilicheva^{1,2}

¹Department of Pharmaceutical Sciences, Faculty of Pharmacy, Medical University of Plovdiv, Plovdiv, Bulgaria

²Research Institute at Medical University of Plovdiv, Plovdiv, Bulgaria



Production of nanoparticles by nano spray drying is strongly influenced by the process parameters - polymer concentration, solubilizing agent concentration, inlet temperature, pumping speed, spray rate, as well as the spray mesh size.

The aim of the present study was to establish the optimal process parameters - polymer concentration and crosslinking agent concentration required to produce casein nanoparticles with optimal structural and morphological characteristics for use as drug carriers.

A full 3² factorial design was used to study the influence of process parameters. Three different concentrations of casein solution were varied: low concentration 0.05%, medium concentration 0.1% and high concentration 0.15%. The influence of the crosslinking agent concentration (CaCl₂, Mw = 110.98 g/mol) was also investigated: low concentration 0.5 M, medium concentration 1.0 M and high concentration 1.5 M. A spray membrane with a mesh size of 4.0 μm was used and the following spray conditions were applied: inlet temperature 40 °C, solution feed rate 50%, spray intensity 70%, drying gas speed 120 L/min, pressure 30 nbar.

Using the nano spray drying method, nine models of nanoparticles were obtained, which were characterized based on shape, size and size distribution, surface morphology and yield. Optimal conditions to produce casein nanoparticles were derived and promising models were selected to be studied as potential drug-delivery systems.

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