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Freeze-Drying of Melatonin-Loaded Lecithin/Chitosan Nanoparticles

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Recently, increasing attention has been paid to lecithin/chitosan nanoparticles as colloidal drug delivery system showing the great potential to improve the permeation of encapsulated drug across various biological barriers [1, 2]. However, the overall poor stability of colloidal nanoparticles in an aqueous medium is a significant drawback in their development perspective. Therefore, the aim of this study was to set up a freeze-drying process of melatonin-loaded lecithin/chitosan nanoparticles in order to improve their physico-chemical stability. Suspensions of nanoparticles were freeze-dried in the presence of glucose or trehalose as cryoprotectants. Nanoparticles were characterised in terms of size, polydispersity, zeta-potential and melatonin content before and after the lyophilisation process.

Before the lyophilisation process, lecithin/chitosan nanoparticles obtained were characterised by mean diameters ranging between 117.4 ± 3.9 and 328.5 ± 3.1 nm, and were significantly larger than comparable lecithin nanoparticles. The zeta potential was inverted from negative values for lecithin nanoparticles to positive values for lecithin/chitosan nanoparticles (up to 30.2 mV).The size and the surface charge of the nanoparticles increased with the increase in the chitosan content and the negative charge of lecithin used in the preparation. Compared to lecithin nanoparticles, lecithin/chitosan nanoparticles were characterised by significantly higher melatonin loadings (up to 7.1 %, w/w).

In the lyophilisation process it was shown that a minimal concentration of 2.5 % (w/v) of trehalose or glucose was needed for a suitable reconstitution of nanoparticles lyophilised at particle concentration of 2 mg/ml. No significant difference in the mean particle size, size distribution or zeta-potential of nanoparticles in suspension before and after freeze-drying and reconstitution were observed. No significant melatonin leakage caused by the stress of freezing and dehydration in the presence of cryoprotectants occurred.

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