IN VITRO DIGESTION STUDY ON SOLID LIPID NANOPARTICLES AND NANOSTRUCTURED LIPID CARRIERS DELIVERING INSULIN

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Purpose. The research was aimed to compare the digestion of two different kind of lipid nanoparticles (NP): Solid Lipid Nanoparticles (SLN) and Nanostructured Lipid Carriers (NLC), delivering insulin-chitosan complexes.
Methods. Lipid Nanoparticles were prepared by high-shear homogenization of lipids (Precirol® for SLN and a mixture of Precirol® and Miglyol®/squalene for NLC) and an aqueous phase containing Tween®80 and Pluronic®F127, as surfactants. The NP were loaded dissolving an insulin-chitosan complex in the aqueous phase. Lipase and co-lipase digestion was performed on both loaded and unloaded lipid carriers. Briefly, 150 μl of SLN/NLC were incubated at 37°C with a mixture of lipase (2000 U) and co-lipase (30 μg), buffered at pH 7.4. The reaction was monitored by sampling each 15 minutes until 1 hour and was stopped by addiction of HCl 0.01 N. The entity of digestion was evaluated by extraction and quantification of free fatty acids. To assess if any variation in digestion profile could occur because of physical differences among them, SLN and NLC were characterized also in term of particle size and zeta potential. Mucoadhesive properties were also evaluated.
Results. Among the unloaded nanoparticles, SLN were the most digested, followed by Miglyol-NLC, whereas digestion for squalene-NLC was close to zero. The loading with insulin-chitosan complex resulted in a reduction of NP digestion, with the exception of squalene-NLC, whose digestion showed a slight initial burst effect. This could be attributed to a change in lipid distribution, where squalene could be conceivably pushed to the surface of the NP. Loading induced a slight increase in particle size for all NP and even more important modifications in Z-potential, that became strongly positive for SLN and Miglyol-NLC. The positive charge was likely due to the presence of chitosan on the surface of these NP, that however did not acquired mucoadhesive properties.
Conclusions. In order to obtain nanocarriers quite resistant to enzymatic degradation, more attention should be paid to NLC, that resulted less digested than SLN. Furthermore the choice of the liquid lipid, as well as the structure of the final assembling of loaded nanocarriers, emerged to be fundamental to modulate digestion rate.