A definition of nanomedicine is the science and technology of complex systems of nanoscale size that can be used for the prevention, diagnosis and treatment of diseases. The complex system consisting of a nanocarrier and a drug enter, therefore, in this definition. Our group has developed a number of nanocarriers intended to transport and deliver drugs across mucosal barriers (1, 2). These nanocarriers are particularly important in the case of drugs that are very unstable in biological fluids and can not cross epithelial barriers. Biotech compounds such as peptides, proteins, and nucleic acid based-drugs enter within this category of drug. In fact, despite the great potential of these macromolecules their clinical application has been greatly restricted by their extremely short action and the necessity of being administered by injection.

Taking this information in mind, a major goal of our research has been to design nanocarriers intended for the oral administration of macromolecules. The criteria for the design of these nanocarriers were: (i) they should protect the associated peptide from degradation in the gastro-intestinal fluids (ii) they should facilitate the intestinal absorption of the associated peptide. As a basic material for the formation of these nanocarriers we chose the polysaccharide chitosan. The selection was based on the fact that chitosan exhibits mucoadhesive properties and, hence, it was thought to facilitate the contact of the associated peptide with the absorptive intestinal epithelium (3). Two different types of structures were designed: (a) Chitosan nanocapsules, consisting of an oily core surrounded by a chitosan wall and (b) chitosan nanoparticles, which are nanomatrices of cross-linked chitosan alone or in association with other hydrophilic polymers such as poloxamers and glucomann. For the preparation of chitosan nanocapsules (Fig. 1A) we used the solvent displacement technique (4), whereas the formation of chitosan nanoparticles (Fig. 1B) was based upon the principle of ionic gelation (5). Three different macromolecules have been associated until now to these nanostructures: the peptides insulin and salmon calcitonin and the polysaccharide heparine. Insulin and heparin are examples of molecules which have a great market potential but whole exploitation is highly limited by their necessity of being injected. On the other hand, salmon calcitonin is presently being administered intranasally, although its bioavailability and, hence, clinical efficacy is still quite reduced. The nanocarriers have been tested in vivo (rats) for their ability to enhance the absorption of the selected macromolecules, following oral administration. The results obtained until now represent a proof of concept of the efficacy of these new nanomedicines for overcoming the intestinal barrier. As an example, in figure 2, it is shown the pharmacological effect (decrease in the serum calcium levels) following oral administration of salmon calcitonin-loaded chitosan nanocapsules. In summary, nanosciences and nanotechnologies offer great opportunities in the design of new medicines aimed at resolving the biopharmaceutical problems of drugs.
Figure 1:
TEM micrograph of chitosan nanocapsules (A) and chitosan/glucomannan nanoparticles (B)

A) 

B) 

Figure 2:
Pharmacological response (decrease in the serum calcium levels) of salmon calcitonin associated to chitosan nanocapsules, following oral administration to rats

References: