Particulate molecular materials for drug delivery: challenges in its large-scale preparation

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The obtaining of particulate micro and nanostructured molecular materials and the understanding of how to manipulate them at nanoscopic and supramolecular level are currently playing a crucial role in drug delivery and clinical diagnostics [1-3]. It has been observed that polymeric nanoparticles, micelles, microemulsions, nanosuspensions, nanovesicles, and nanocapsules are efficient drug carriers that can significantly help to develop new drug delivery routes, more selective and efficient disease-detection systems, drugs with a higher permeability to biological membranes with controlled released profiles, and to enhance their targeting towards particular tissues, cells or intracellular compartments.

The potential of «bottom-up» strategies, based on molecular self-assembling, is much larger than that of «top-down» approaches for the preparation of such micro- and nanostructures. For instance, by precipitation from conventional liquid solutions it should be possible to control particle formation, and hence particle size and size distribution, morphology and particle supramolecular structure. However, this is still a dream up to now when conventional liquids are used.

The solvent power of compressed fluids (CFs), either in the liquid or supercritical state, can be tuned by pressure changes, which propagate much more quickly than temperature and composition solvent changes. Therefore, using compressed solvent media, it is possible to obtain supramolecular materials with unique physicochemical characteristics (size, porosity, polymorphic nature morphology, molecular self-assembling, etc.) unachievable with classical liquid media [4,5]. Small changes in temperature and pressure of CFs result in large but homogenous changes in the fluid's density, and hence in its solvent power. This tunable range in density (solvation ability) cannot be achieved so easily with any conventional solvent. The most widely used CF is compressed CO_2 (cCO_2), which is non-toxic, non-flammable, cheap and easy recyclable. It has gained considerable attention, during the past few years as a «green substitute» to organic solvents and even to water in industrial processing. During the past few years, CFs based technologies, in particular precipitation procedures, are attracting increasing interest for the preparation of particulate molecular materials with application in the field of drug-delivery and nanomedicine [6-8].

In this presentation a few examples of particulate drugs and encapsulated medicines inside vesicles, prepared in a large scale, with CFs will be presented.

References

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