Synthesis of high throughput Ibuprofen Nanoparticles via Supercritical CO_2 processing

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Abstract:

In pharmaceutical industry, poor water solubility and limited bioavailability has a major concern on new drug development. It is well established that the bioavailability of such drugs can be improved by reducing their particle size. A number of conventional strategies are available in literature for particle size reduction but they suffer with some disadvantages and handling concerns. Recently, supercritical CO_2 based processes are found to be more promising for micronization of pharmaceuticals as they have successfully addressed the above concerns and offer additional advantages like economic, non-toxic, scalable, environmentally compatible and etc.

In this paper, we report of synthesis of ibuprofen molecular clusters via supersonic jet expansion of the supercritical CO_2 drug formulation. These were collected in a special designed a two-stage collection vessel, cooled to liquid N_2 temperatures and resulted embedding of drug molecular clusters in 'dry ice', instantaneously. Ambient drying of these molecular clusters embedded in 'dry ice' resulted in a high yield ~ 80 % (w/w). Ambient disolving of the 'dry ice' into deionized water, resulted in true solubilization of drug molecular clusters in water. Afterword's, these solutions were drop-casted on silicon substrate and dried for overnight under ambient conditions, resulted in a stable, viscous films with liquid like behavior. Analytical characterizations showed that these water-solubilized ibuprofen solutions retained their chemical and structural identity after sc-CO_2 processing. This is interesting to note that raw ibuprofen powder is solid powder under ambient conditions with melting points of 75^o C. Our observations are expected to explore the sc-CO_2 processing strategy for other existing drug formulations and would open up new drug delivery platforms.

Keywords: poor water solubility, supercritical processing, RESS Process, ibuprofen, nonsteroidal anti-inflammatory drugs (NSAIDs) and drug molecular clusters.