Elaboration of lutein-loaded nanoliposomes using supercritical CO_2

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One of the major challenges in therapy is to find a drug carrier that better protects therapeutic molecules for a targeted drug delivery. Many studies have been carried out on nanomedicine development to encapsulate active substance. The encapsulation of therapeutic molecules avoids a too rapid degradation of active principle after its administration and limits the side effect occurrence. However, the use of nanoparticles may be limited by a low encapsulation efficiency or by a low biocompatibility of the vector or coating agent. In order to overcome these limitations, several sustained drug delivery systems have been developed including liposomes. The encapsulation of pharmaceutical molecules in nano-sized liposomes makes it possible to obtain fully biodegradable systems targeting cells, limiting the degradation of the molecules of interest and allowing an efficient and rapid cell internalization.

In this work, a process for the elaboration of liposomes using a supercritical fluid will be presented. The process developed is a batch one. This process was used to encapsulate a therapeutic molecule: lutein. Lutein is a molecule with antioxidant properties used in particular to prevent the degeneration of the retina.

The encapsulation tests were performed by changing temperature (35, 40 and 45°C), pressure (10 and 15 MPa) and lutein/lecithin mass ratio (0.5 and 1 % w/w). The different tests were carried out with egg yolk lecithin as a source of phospholipids with a constant concentration of 0.14% w/w. Comparison of the results obtained for the different operating conditions is based on the size of the liposomes formed (mean diameter and size distribution) and the Encapsulation Efficiency (EE) of lutein. The results obtained are presented in Figure 1.

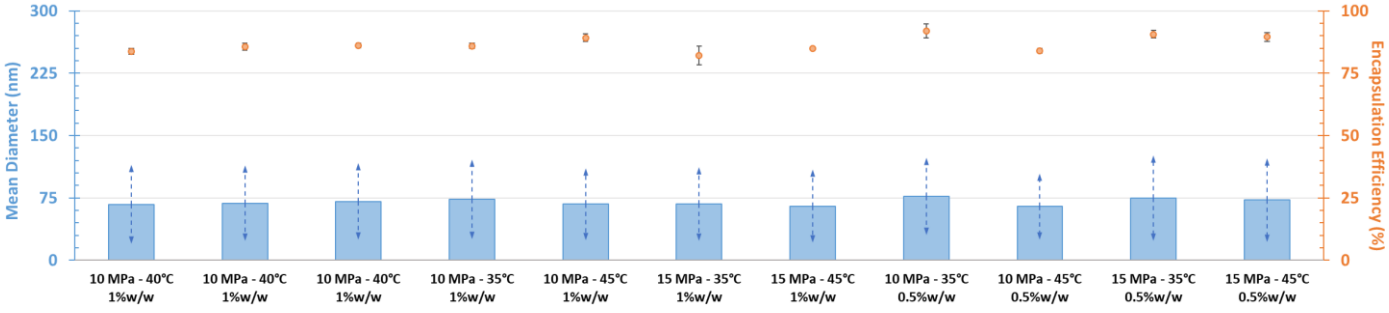

Figure 1: Size and encapsulation efficiency (EE) obtained for the different operating conditions for the two processes.

This batch process has given interesting results since spherical liposomes with narrow size distributions and high encapsulation efficiencies were obtained. Indeed, the batch process allows to obtain nanosized liposomes, with a diameter ranging from 65 and 77 nm. The nanosized liposomes exhibit a narrow size distribution, resulting in a lower and constant polydispersion index (PDI): the PDI is 0.279 ± 0.011. Concerning the lutein encapsulation , this process allows an average encapsulation efficiency of 87% for a maximum of 98% (10 MPa, 35°C and 0.5 w/w). Tests repeated under the same conditions have demonstrated the repeatability of this process (10 MPa, 40°C and 1%w/w).