PRODUCTION OF ENCAPSULATED QUERCETIN NANOPARTICLES BY SFEE

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Quercetin is a bioflavonoid and it has a strong antioxidant-, antiviral-, antibacterial-, antihistaminic-and anti-inflammatory effect. Due to these properties quercetin is a highly promising material against a wide variety of diseases, including cancer. A major limitation for the clinical application of quercetin is its low bioavailability that makes it necessary to administrate in high doses (50 mg/kg). One way to increase the bioavailability of quercetin is to produce encapsulated quercetin particles in nanometric scale, using Supercritical Fluid Extraction of Emulsions (SFEE) technology.

In SFEE process a previously produced oil in water emulsion (o/w) is contacted with supercritical carbon-dioxide ($scCO_2$) in order to extract the organic part from the emulsion, which cause the rapid supersaturation of quercetin and hence quercetin precipitation in sub-micrometric scale and encapsulation in a surfactant material. Primary experimental runs were done with Pluronic L64 ® as a surfactant material, and in products are obtained needle like quercetin particles, which are similar to unprocessed quercetin. As Pluronic L64 ® was not able to encapsulate quercetin further experimental runs were done using soy bean lecithin as a surfactant material. In these experimental runs multivesicular system was obtained with encapsulated quercetin particles in sub-micrometric scale, without any presence of crystalline quercetin particles. Mean diameter size of these vesicles were around 100 nm, encapsulation efficiency was around 70% and encapsulated quercetin was stable up to two weeks with a residual organic content less than 300 ppm.

Further experiments were done using the combination of surfactant materials in order to increase the amount of encapsulated quercetin in the SFEE treated aqueous suspensions: Lecithin, Pluronic L64 ®, poly-vinyl-alcohol (PVA), Eudragit E100 In case of the combination of lecithin – Pluronic L64 ® an increased amount of encapsulated quercetin with a similar particle size distribution is obtained in the aqueous suspensions after SFEE treatment, than in the experimental runs did only with lecithin. In a further experimental plan we managed to increase the encapsulated quercetin up to 0.31 g/L, equal with an encapsulation efficiency of 90%, and significantly higher than the solubility of quercetin in pure water: 0.01 g/L. Encapsulated quercetin is stable up to two weeks with a mean particle size distribution around 100 nm and with a residual organic content below 350 ppm.

Scaled up-, continuous SFEE experiments are also done with soy bean lecithin – Pluronic L64 ® in order to produce aqueous suspensions in higher volume. We managed to produce ten times more suspension with a similar particle size distribution and antioxidant activity results than in the case of previously applied batch process. Moreover 6.5 times less SFEE treatment duration comparing to batch process was enough to decrease the residual organic content below 400 ppm.

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