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# Nanocapsules prepared with sorbitan monostearate and polysorbate 80 are more effective in scatter the light than those prepared with phosphatidylcholine

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**Abstract** – Co-encapsulation of octyl methoxycinnamate and quercetin were performed by interfacial deposition using two surfactant systems ($NC_I$: Epikuron 170® or $NC_{II}$: Span 60® and polysorbate 80). The $NC_{II}$ formulations scattered the light more effectively than $NC_I$ due their higher scattering efficiency.

Polymeric nanocapsules have been described as a new generation of carriers for UV blockers [1]. A previous study [2] demonstrated that the presence of the stabilizers sorbitan monostearate (SM) and polysorbate 80 (P80) instead of phophatidylcholine in nanocapsule suspensions caused a better photostability of co-encapsulated quercetin (antioxidant) and octyl methoxycinnamate (chemical sunscreen) because of the light scattering of nanocapsules, which, act as physical sunscreen. In this work, we investigated the physicochemical basis of those findings. To reach our objective, we determined the number of particles per volume (*N*) by turbidimetry and the light scattering properties of the polymeric nanocapsules. Thermal analyses and optical microscopy were also performed. Nanocapsule formulations containing octyl methoxycinnamate (OMC) and quercetin were prepared by interfacial deposition [2] of poly(ε-caprolactone) using two different surfactant systems Epikuron 170® (phophatidylcholine) or SM and P80 ($NC_{I\text{-}QUE}$ and $NC_{II\text{-}QUE}$, respectively). For comparative purposes, similar formulations containing exclusively OMC were also prepared ($NC_I$ and $NC_{II}$, respectively). The nanocapsules presented zeta potentials ranging from -11 to -26 mV and mean diameters varying from 171 to 221 nm (polydispersity indexes <0.15). $NC_{I\text{-}QUE}$ and $NC_{II\text{-}QUE}$ showed similar ($p>0.05$) *N* values (particles·cm$^{-3}$) of $1.93 \times 10^{13}$ and $1.66 \times 10^{13}$, respectively. On the other hand, the *N* value for $NC_{II}$ was smaller ($0.91 \times 10^{13}$) than the value determined for $NC_I$ ($1.44 \times 10^{13}$) ($p<0.05$), demonstrating that the light scattering was not a consequence of a higher *N* in the suspension. In order to verify if the photostability of quercetin (QUE) and OMC could be related to a higher light scattering of suspensions due to the nature of its components, the Rayleigh ratio values were determined. The presence of QUE interfered in those results because they were similar ($p>0.05$) for $NC_{I\text{-}QUE}$ and $NC_{II\text{-}QUE}$ ($1.4x10^{-3}$±0.06 and $1.5x10^{-3}$±0.06, respectively), while they were different ($p<0.05$) for $NC_I$ and $NC_{II}$ ($1.0±0.3x10^{-4}$ and $6.9±0.1x10^{-4}$, respectively). Multiple light scattering was determined using a Turbiscan® equipment. The formulations $NC_I$, $NC_{II}$, $NC_{I\text{-}QUE}$ and $NC_{II\text{-}QUE}$ showed photon transport length values ($l^*$) of 234 ± 10, 168 ± 14, 245 ± 34, and 172 ± 18 µm, respectively. As consequence, the formulations containing SM and P80 presented the highest scattering efficiency ($p<0.05$), demonstrating that the qualitative composition of the nanocapsule suspensions influenced the light scattering. Differential scanning calorimetry demonstrated that the surfactants did not interact with the crystalline portion of PCL in the nanocapsules (Fig. 1). In addition, thermogravimetric analysis showed that SM and P80 provided better chemical stability for the nanocapsules containing quercetin than Epikuron 170® (Fig.2). Microscopy analysis showed quercetin nanocrystals in the formulations (Fig. 3) explaining the influence of quercetin in the spectroscopic analyses. In conclusion, nanocapsules prepared with sorbitan monostearate and polysorbate 80 are more effective in scatter the light than those prepared with phosphatidylcholine.

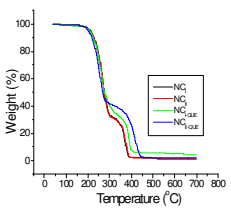


**Figure 1:** TGA profiles of $NC_I$, $NC_{II}$, $NC_{I\text{-}QUE}$ e $NC_{II\text{-}QUE}$.

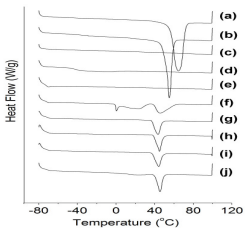


**Figure 2:** DSC thermograms of (a) PCL, (b) Span 60®, (c) QUE, (d) Epikuron 170®, (e) OMC, (f) PCL:OMC 1:3 m/m, (g) $NC_I$, (h) $NC_{II}$, (i) $NC_{I\text{-}QUE}$, (j) $NC_{II\text{-}QUE}$.

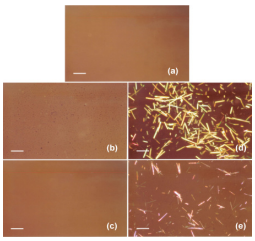

**Figure 3:** Optical microscopy photographs (a) QUE in acetone solution (1mg/mL), (b) $NC_I$, (c) $NC_{II}$, (d) $NC_{I\text{-}QUE}$, (e) $NC_{II\text{-}QUE}$. Bar = 50µm.

**References:**

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[2] V. Weiss-Angeli, F.S. Poletto, L.R. Zancan, F. Baldasso, A.R. Pohlmann, S.S. Guterres, J. Biomed. Nanotech. 4 (2008) 80-89.