Nanoparticles made of amphiphilic biotransesterified cyclodextrins: ultrastructure and thermal behavior

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Aiming at designing nanocarriers to deliver bioactive compounds to a target site in sufficient amount and without premature degradation, we have developed colloidal nanovectors based on cyclodextrin (CD) amphiphilic derivatives. βCDs were acylated on their secondary face using thermolysin as biocatalyzer. After dissolution in acetone, a series of βCD-C_n (n = 6 to 14) derivatives were nanoprecipitated in water. The resulting particles were observed by cryo-TEM and SAXS patterns were collected at ESRF upon heating to 130°C. After cooling, the suspensions were observed by cryo-TEM as well. Periodic structures were detected when the alkyl chains contained at least 8 carbons. In most cases, the position of SAXS peaks was consistent with a hexagonal structure when the degree of substitution (DS) of the parent derivative was higher than 5. βCD-C_n (n = 8, 10, 12) particles were barrel-like while βCD-C_{14} particles had tortuous multidomain shapes. Axial projections of the hexagonal organization were sometimes observed. The particles prepared from βCD-C_{10} and βCD-C_{14} derivatives with DS<5 were spherical, exhibiting a multilamellar structure. Upon heating to 130°C, no structural transition was observed in these systems. Hexagonal-to-hexagonal transitions were detected at 80-100°C in βCD-C_n systems with n = 10, 12 and 14. Upon cooling, βCD-C_{10} particles converted to multilamellar nanospheres while βCD-C_{14} particles exhibited bulkier prismatic shapes and were constituted of hexagonally-packed hollow hoops.