Elucidating Iodine–Starch Interactions in Degradable Starch Microspheres

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Iodine-iodide-triiodide (I_2-I^--I_3^-) solution has historically been used as an antiseptic to prevent and treat various topical infections. However, its use is limited by issues such as irritation and staining, which can be prevented using new carrier strategies. This study investigates the loading of iodine into degradable starch microspheres (DSM), with particular focus on iodine–starch interactions and the resulting structural changes upon uptake. Iodine complexation was achieved using I_2-I^--I_3^- solutions, yielding a characteristic purplish-red color within the DSM. Swelling and sedimentation analyses indicated a slight reduction in DSM density following iodine absorption, without compromising hydration capacity. A UV–Vis spectrophotometric method targeting the triiodide band at 352 nm enabled robust quantification of iodine by leveraging the equilibrium among iodine species. The iodine sorption profile showed a non-linear trend, with uptake increasing at higher concentrations, suggesting cooperative binding effects. Pre-organized I_3^- and I_2 molecules within starch helices, along with non-covalent interactions, enhance iodine retention. Small- and wide-angle X-ray scattering (SWAXS) analyses demonstrated iodine-induced ordering across multiple length scales, including a decrease in the dynamic correlation length and the emergence of characteristic peaks associated with iodine–amylose complexes. Overall, these findings provide insight into the physicochemical mechanisms governing iodine incorporation into DSM and highlight the structural consequences of loading, offering a framework for the design of starch-based carriers for controlled iodine release [1].

Keywords:
Starch microspheres, Iodine, Small- and wide-angle X-ray scattering (SWAXS)

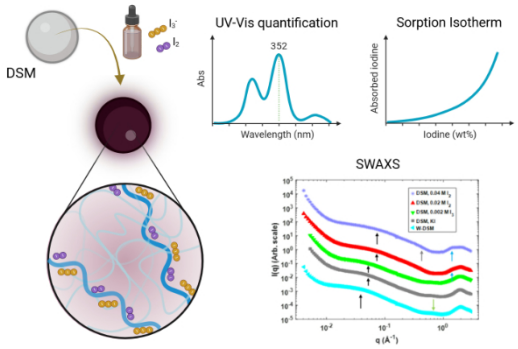

Figure 1. I_2–I^-–I_3^- incorporated into DSM induces a purplish-red color and enables UV–Vis detection at 352 nm, with concentration-dependent sorption and SWAXS patterns.

References:

[1] Vigato *et al* . Physicochemical and structural study of iodine loading in amorphous degradable starch microspheres. *Carbohydrate Polymer Technologies and Applications* **14,** 101115 (2026) . DOI: 10.1016/j.carpta.2026.101115

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