Electronic Supplementary Material (ESI) for RSC Advances.

Supporting information

Reversible encapsulation of silver nanoparticles in to the helix of amylose (water soluble starch)

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Inspection of Fig. S1A suggests that the absorbance of Ag-nanoparticles increases with $[Ag^+]$ but the position of the wavelength maxima (425 nm) and shape of the spectra remains constant for the entire concentrations of Ag^+ ions. On the other hand, all features of the spectra also strongly depends on the [extract] (Fig. S1B). The perfect transparent yellowish-brown color remains stable for months with no visible sign of precipitation, aggregation and oxidation. AgNPs formed with D. deltoidea tuber extract were found to be very stable, possibly because of the different constituents present in the extract that prevent the agglomeration even after 30 days.

Fig.S1A

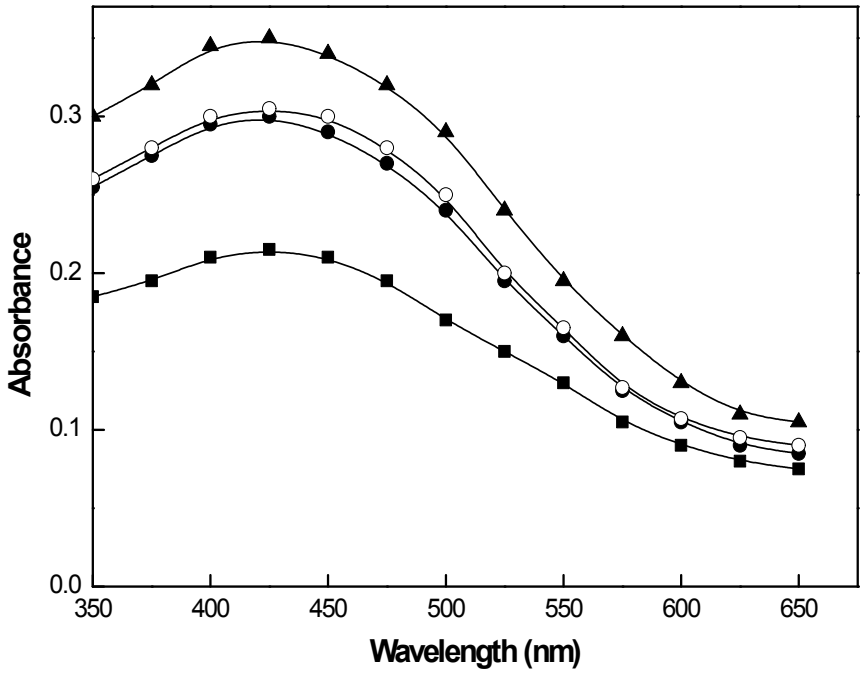

Fig.S1B

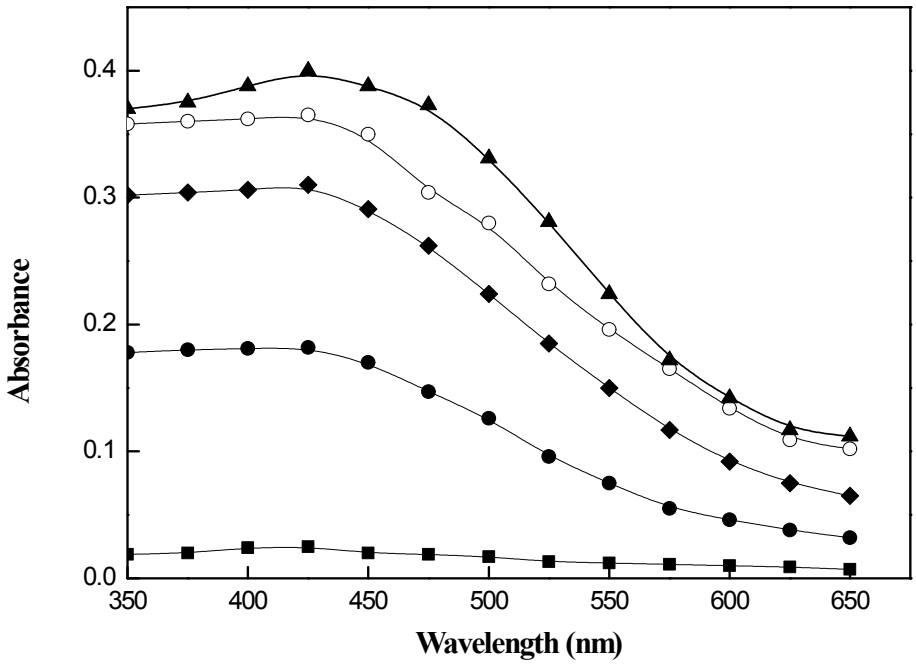

Fig.S1. Effects of [Ag^+] (= 3.3 (■), 10.0 (●), 16.6 (♦), and 23.3 × 10^{-4} mol dm^{-3} (○)) and [extract] (= 3.3 (■), 10.0 (●), 16.6 (♦), 23.3 (○) and 33.3% v/v (▲)) on the UV-visible spectra of AgNPs. *Reaction conditions*: [extract] = 33.3 % v/v and [Ag^+] = 16.6 × 10^{-4} mol dm^{-3} for the variation of [Ag^+] (Fig. S1A) and [extract] (Fig. S1B).

Fig. S2

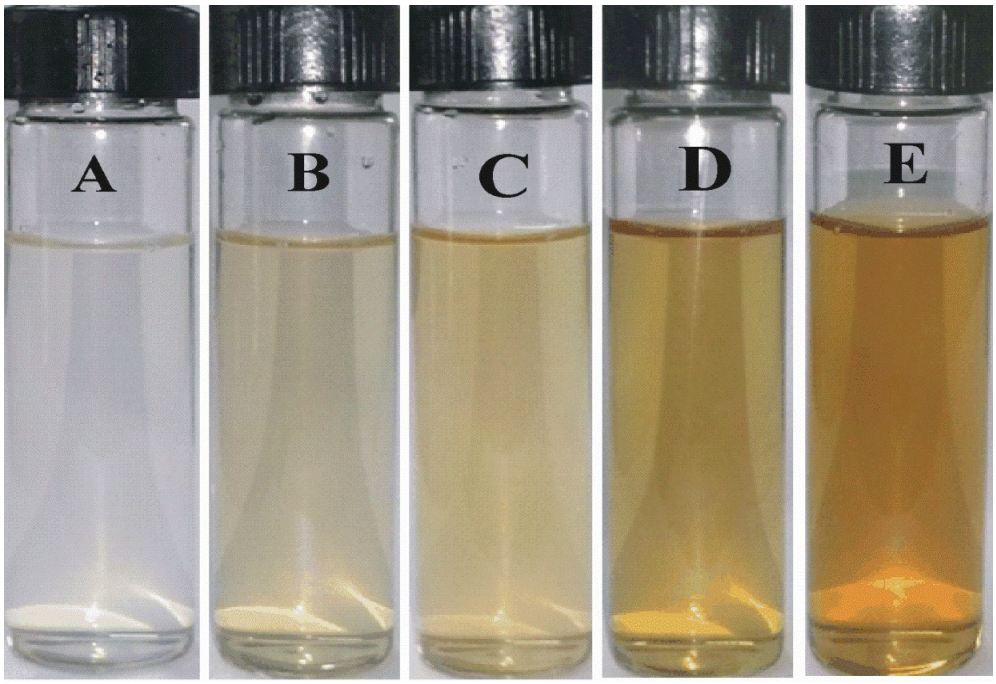

Fig.S2. Optical images of Ag^+ ions only (A) and AgNPs formation in absence and presence of starch (2.0 cm^3; 2.0 % w/v) at different time intervals. Reaction conditions: [Ag^+] = 16.6 × 10^{-4} mol dm^{-3}, [extract] = 33.3 % v/v, and time = 10 (B), 30 (C), 90 (D) and 180 min (E).

We do not see any marked difference in the overall nature of the spectrum, shape and size of the extract- and starch-capped AgNPs produced. On the other hand, we observed a significant difference in the optical images of AgNPs prepared by aqueous extract of Dioscorea deltoidea in the absence and presence of starch (Fig. 2 and supporting information Fig.S2), which might be due to the fast adsorption of AgNPs into the helix chain of amylose through electrostatic interaction between the positive surface of AgNPs and lone-pairs electrons of –OH groups. Anisotropy among the Ag-nanoparticles could be due to the recent report by Bakshi et al. mentioning that the metallic gold crystals formed using zein protein were gradually enclosed by protective molecules, which eliminated rapid sintering of smaller nanoparticles leading to the formation of nanoparticles having mixed morphology.[1] We obtained mostly triangular truncated Ag-nanoplates of 11.2 to 87.6 nm with no drastic change in the shape and size with and without starch (Fig. 2). The hydrophobic nature of steroidal diosgenin and lack of appropriate surface adsorption allows the growing nuclei to grow into independent AgNPs without any kind of self-aggregation and the growth is much slow in comparison to that in the presence of starch.

[1] A. Mahal, P. Khullar, H. Kumar, G. Kaur , N. Singh, M. Jelokhani-Niaraki and M. S. Bakshi, *ACS Sustainable Chem. Eng.*, 2013, **1**, 627−639.

Fig. S3A

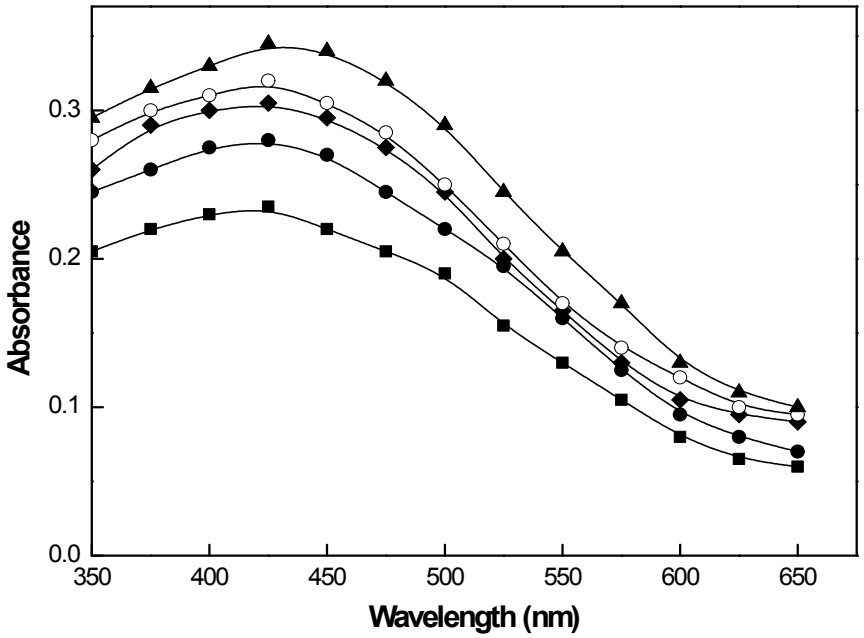

Fig. S3B

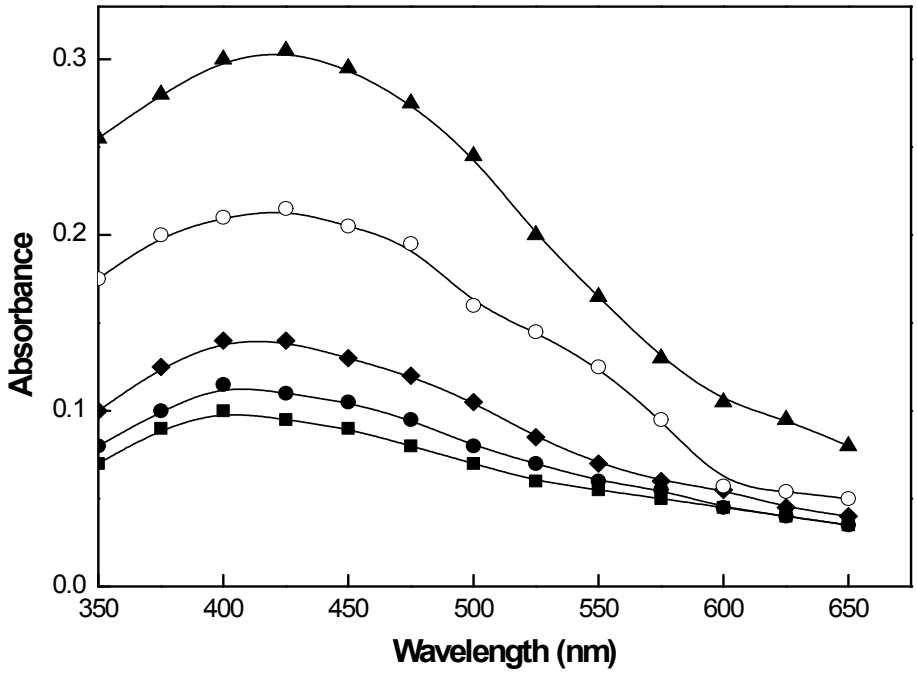

Fig.S3. Effects of [Ag^+] (= 3.3 (■), 10.0 (●), 16.6 (♦), 23.3 (○) and 33.3 × 10^{-4} mol dm^{-3} (▲)) and [extract] (= 3.3 (■), 10.0 (●), 16.6 (♦), 23.3 (○) and 33.3% v/v (▲)) on the UV-visible spectra of AgNPs in presence of starch (2.0 cm^3; 2.0 % w/v). *Reaction conditions*: [extract] = 33.3 % v/v and [Ag^+] = 16.6 × 10^{-4} mol dm^{-3} for the variation of [Ag^+] (Fig. S3A) and [extract] (Fig. S3B).

Fig. S4.

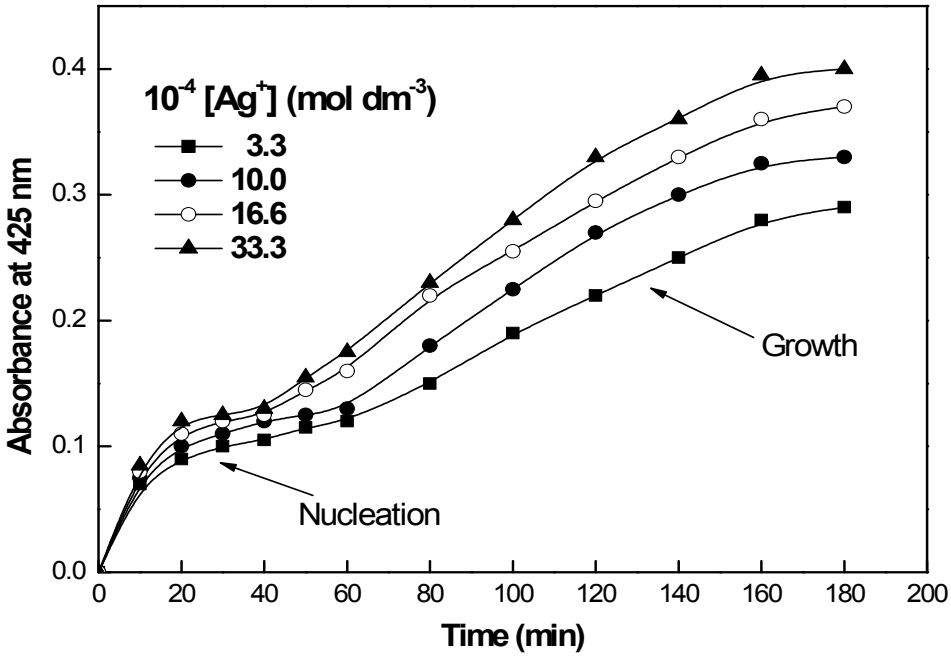

Fig.S4. Reaction time plots for AgNPs formation at different [Ag^+]. *Reaction conditions*: [extract] = 33.3 % v/v, and [starch] = 2.0 cm^3; 2.0 % w/v.