Title:	Green synthesis of a plant-derived protein protected copper quantum cluster for intrauterine device application
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Abstract:	Fluorescent copper quantum clusters (CuQCs) have received great interest in recent times due to their attractive features, such as water solubility, low cost, wide availability of Cu and good biocompatibility. Recently, considerable efforts have been devoted to the preparation and applications of CuQCs. Herein, we report a simple one-pot green method for the preparation of fluorescent CuQCs using a plant-derived protein, gluten, as a stabilizing agent. Gluten, a naturally abundant, low-cost and sustainable plant-protein derived from wheat, was employed both as a reducing and stabilizing agent to produce blue emitting CuQCs. The CuQCs were characterized by UV–Vis absorption, fluorescence, FT-IR, TEM, and XPS. We further incorporated CuQCs into a polymer to study the release rate of Cu2+ ions from a CuQC–polymer composite, since copper ions are well known for their fungicidal properties and contraceptive action in copper-T (CuT). The CuQCs were incorporated into a model polymer, polyurethane (PU), by melt compounding, and the mixtures were extruded in the form of a wire. It was observed that the CuQCs were uniformly dispersed within the polymer matrix. An in vitro experiment was carried out to quantify the potential release of Cu(II) ions for contraceptive applications. The developed nanocomposite releases Cu(II) ions for 90 days, which suggests the potential application of the CuQCs in the medical field like the development of short-term intrauterine devices (IUDs). Compared to conventional IUDs, here the CuQC–PU nanocomposite reduces the burst release of the Cu2+, and the release rates can be tuned by changing the composition of the materials. These results suggest that the CuQC–PU nanocomposites have great potential to replace current commercial intrauterine devices.
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