

Accepted Manuscript

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PII: S1386-1425(17)30905-8
DOI: doi:[10.1016/j.saa.2017.11.022](https://doi.org/10.1016/j.saa.2017.11.022)
Reference: SAA 15604

To appear in: *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*

Received date: 12 August 2017
Revised date: 1 November 2017
Accepted date: 6 November 2017

Please cite this article as: Nan Gao, Pengcheng Huang, Fangying Wu , Colorimetric detection of melamine in milk based on Triton X-100 modified gold nanoparticles and its paper-based application. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Saa(2017), doi:[10.1016/j.saa.2017.11.022](https://doi.org/10.1016/j.saa.2017.11.022)

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Colorimetric detection of melamine in milk based on Triton X-100 modified gold nanoparticles and its paper-based application

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Abstract In this study, we have developed a method for rapid, highly efficient and selective detection of melamine. The negatively charged citrate ions form an electrostatic layer on gold nanoparticles (AuNPs) and keep the NPs dispersed and stable. When citrate-capped AuNPs were further modified with Triton X-100, it stabilized the AuNPs against the conditions of high ionic strength and a broad pH range. However, the addition of melamine caused the destabilization and aggregation of NPs. This may be attributed to the interaction between melamine and the AuNPs through the ligand exchange with citrate ions on the surface of AuNPs leading Triton X-100 to be removed. As a result, the AuNPs were unstable, resulting in the aggregation. The aggregation induced a wine red-to-blue color change, and a new absorption peak around 630 nm appeared. Triton X-100-AuNPs could selectively detect melamine at the concentration as low as 5.1 nM. This probe was successfully applied to detect melamine in milk. Furthermore, paper-based quantitative detection system using this colorimetric probe was also demonstrated by integrating with a smartphone.

Keywords: Melamine; Gold nanoparticles; Triton X-100; Colorimetric detection; Test paper

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