

Visual and Optical Absorbance Detection of Melamine in Milk by Melamine-Induced Aggregation of Gold Nanoparticles

ABSTRACT

The present study reported a facile method for the determination of melamine in milk powder products based on the aggregation of reactant-free 5 nm gold nanoparticles (AuNPs). The strong electrostatic attraction between the positively charged exocyclic amine groups present in the melamine molecule and the negatively charged ions bound to the AuNPs induced aggregation of the AuNPs, resulting in visible color changes that could be seen with the naked eye and monitored by ultraviolet–visible (UV–Vis) absorbance spectra. The method shows high sensitivity with detection limits of 1×10^{-9} M for visual detection and 1×10^{-11} M for UV–Vis analysis, which is far below the safety limit of melamine ingestion in infant formula ($1 \text{ ppm} = 7.9 \times 10^{-6}$ M) and the detection limit acquired by most AuNP-based melamine detection methods. Good recoveries were obtained over the range of 94.7–95.5% with a relative standard deviation of mean recovery (RSD) ranging from 1.40 to 5.81. The method provides a simple, feasible, fast and real-time detection of melamine adulterants in infant formula by the naked eye, without the aid of advanced instruments.