A novel and environmentally friendly colorimetric method for detection of cystine in human urine using unmodified gold nanoparticles

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Experimental section

Materials and measurements

Chloroauric acid ($HAuCl_4 \cdot 4H_2O$), ornithine (Orn), glycine (Gly), tyrosine (Try), lysine (Lys), arginine (Arg), glutathione (GSH), cysteine and cystine, were purchased from Sinopharm Group Chemical Reagent Co., Ltd. (Beijing, China). Homocysteine was purchased from Aladdin. Other chemical reagents were of analytical grade and used without further purification. All solutions were prepared with ultra-pure water (18.25 MΩ cm). Deionized water was purified by a Aquapro Ultrapure water system (Nanjing Quan Kun bio-technology Co. Ltd., China). UV-Vis absorption spectra were obtained on a TU-1901 double beams UV-Vis spectrophotometer (Beijing Purkinje General Instrument Co. Ltd., China). Photographs were obtained with a Sony DSC-W570 digital camera. TEM analysis was performed on a CM12 electron microscope (Philips, Ltd., Netherlands) operating at 120 kV.

Preparation and characterization of AuNPs

Gold nanoparticles (AuNPs) were prepared by citrate reduction of $HAuCl_4$ in liquid phase.[1] In breif, 0.5ml of $HAuCl_4$ solution (25 mM) was diluted to 35 ml with deionized water and heated up in a conical flask. After the solution was boiling, 1 ml of 38.8 mM trisodium citrate solution was quickly added with vigorous stirring. The solution was maintained at the boiling state for 5 min, during which time the color changed from yellow to wine red. A stable and monodispersed gold nanoparticle colloidal solution was obtained and stored at 4 ℃. The sizes of the AuNPs was 18 nm, determined by TEM. The final concentration of AuNPs was estimated to be about 3.89 nM based on an extinction coefficient of ~ 3.6×10^8 M^{-1} cm^{-1} at 520 nm for 18 nm particles using UV-Vis spectrometric measurements.

Typical experimental process for cystine detection

A volume of 50 μl of cystine with different concentrations was added to 1.5 ml ascorbic acid solution (2 mM), and the mixed solution was incubated at 40 ℃ for 15 min. Then 0.5 ml AuNPs solution was added, and the mixture was incubated for a further 5 min. The absorption spectrum was recorded on the UV-Vis spectrophotometer.

Variables optimization data

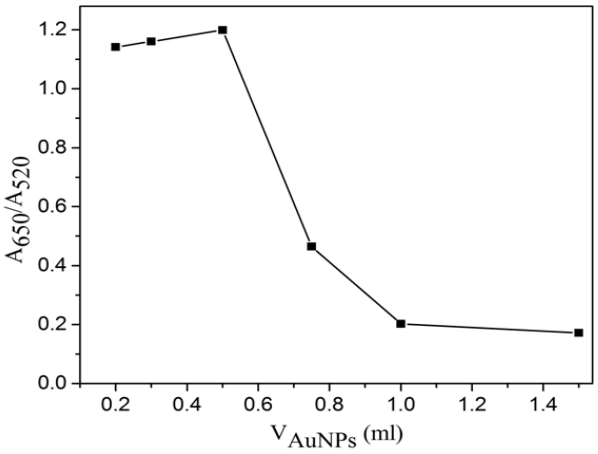

Fig. S1 Effect of volume of AuNPs (0.2, 0.3, 0.5, 0.75, 1.0 and 1.5 ml, respectively) on the absorption ratio A_{650}/A_{520}. (ascorbic acid: 2 mM, cystine: 10 μM)

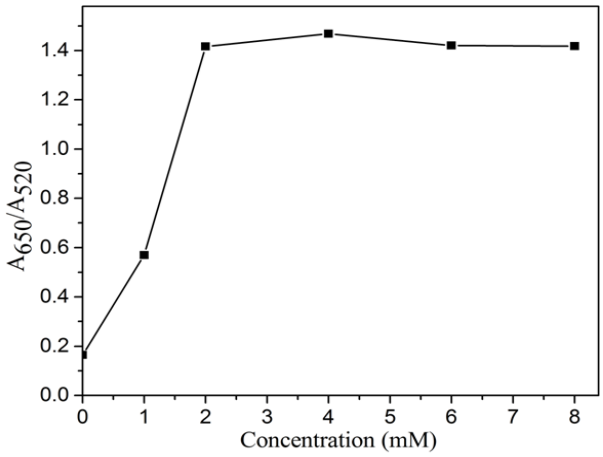

Fig. S2 Effect of concentration of ascorbic acid (0, 1, 2, 4, 6, and 8 mM, respectively) on the absorption ratio A_{650}/A_{520}. (cystine: 10 μM, AuNPs: 0.5 ml)

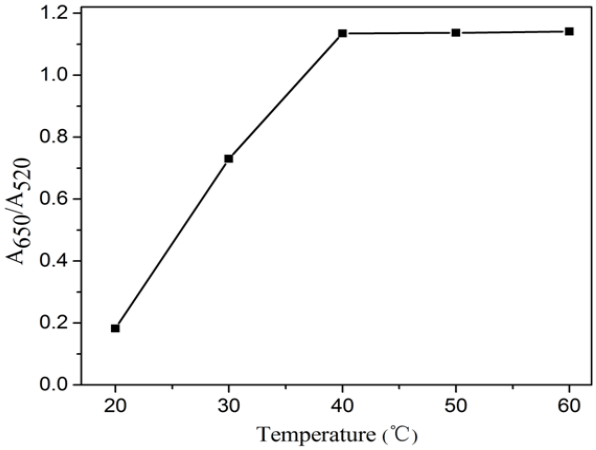

Fig. S3 Effect of reaction temperature (20, 30, 40, 50 and 60 ℃， respectively) on the absorption ratio A_{650}/A_{520}. (ascorbic acid: 2 mM, cystine: 10 μM, AuNPs: 0.5 ml)

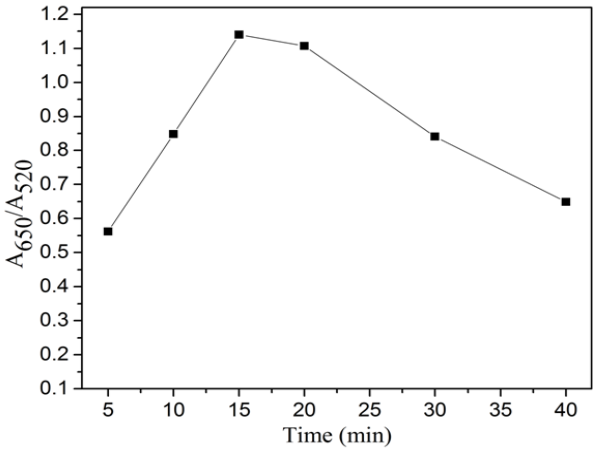

Fig. S4 Effect of reaction time (5, 10, 15, 20, 30 and 40 min, respectively) on the absorption ratio A_{650}/A_{520}. (ascorbic acid: 2 mM, cystine: 10 μM, AuNPs: 0.5 ml)

References

1. G .Frens, *Nature physical science*, 1973, 241, 20-22.