

A smart method for the fast and low-cost removal of biogenic amines from beverages by means of paramagnetic nanoparticles.

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In order to evaluate the morphological characteristics and the size distribution of the prepared MNPs@SiO₂, TEM analysis was carried out. Figure S1 box a and S1 box b show TEM image and the associated particle size histogram, respectively. MNPs@SiO₂ morphology appears roughly spherical shaped. MNPs present an average diameter of about 10.8 nm.

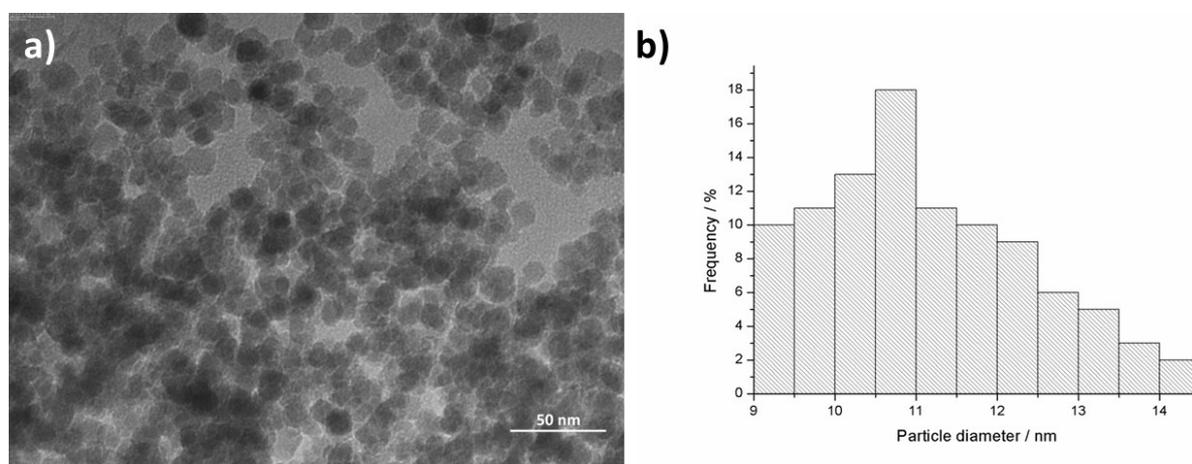


Figure S1: TEM image (box a) and associated particle size histogram (box b) of MNPs@SiO₂

Biogenic amine concentrations were chosen in order to be clearly detected with a UV-Vis spectrophotometer. UV-Vis spectra of a 10⁻³ M aqueous solution of histamine and of a 10⁻³ M aqueous solution of tryptamine are reported in Fig.S2, boxA and box B, respectively. Such a concentration did not allow to work by means of UV-Vis absorption spectroscopy in both case, but for opposite reasons: the histamine peak is not well-visible, while tryptamine solution absorption saturates the detector.

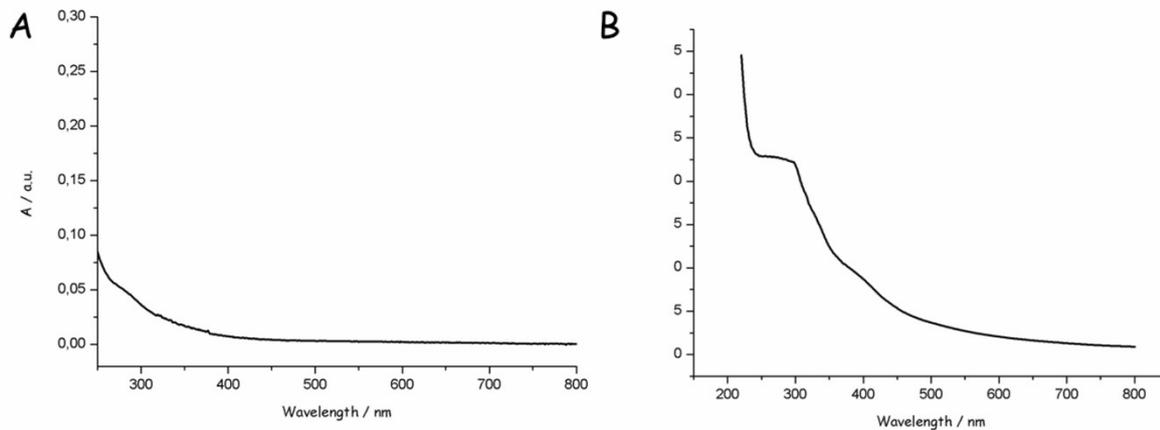


Figure S2. UV-Vis spectra of a 10^{-3} M aqueous solution of histamine (box A) and of tryptamine (box B).

UV-Vis spectra of a 10^{-2} M aqueous solution of histamine (figure S3A) and of a 10^{-4} mM aqueous solution of tryptamine (figure S3B), recorded before and after MNPs treatment, confirmed that BAs should anchor to the MNPs silica surface. The intensity of the absorption peaks is reduced in both cases, since supernatant concentration become smaller after treatment.

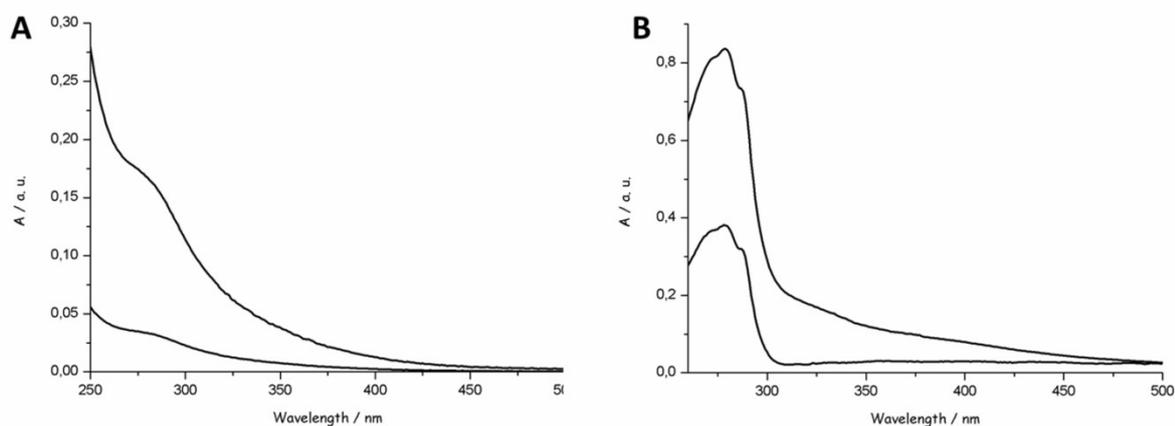


Figure S3. Effect of MNPs@SiO₂ treatment on BA aqueous solutions. In the box A, the removal of histamine is evident from the bleaching of absorption peak at around 290 nm. In the box B, the effect of the MNPs@SiO₂ treatment repetition on tryptamine concentration is evident.

FT-IR spectra of a cast film of phenylethylamine and of its adduct with $\text{MNPs}@SiO_2$ are reported in figure S4. The $1750\text{-}1200\text{ cm}^{-1}$ region shows the presence of the IR signals of the amine in both spectra, even if there are some differences in the spectrum of the complex. In particular the scissoring band of the NH group turns out to be shifted to higher frequencies and strongly reduced, as a consequence of the binding with the silica coating. The Si-O-Si asymmetrical stretching band is shifted to 1020 cm^{-1} and the $3700\text{-}2400\text{ cm}^{-1}$ region evidences drastic differences in the 3255 cm^{-1} signals (NH stretching mode) when phenylethylamine is linked to the MNPs surface. Figure S4 shows the FTIR spectra of a cast film of histamine and of $\text{MNPs}@SiO_2/\text{histamine}$ adduct, confirming the presence of the amine in the final complex.

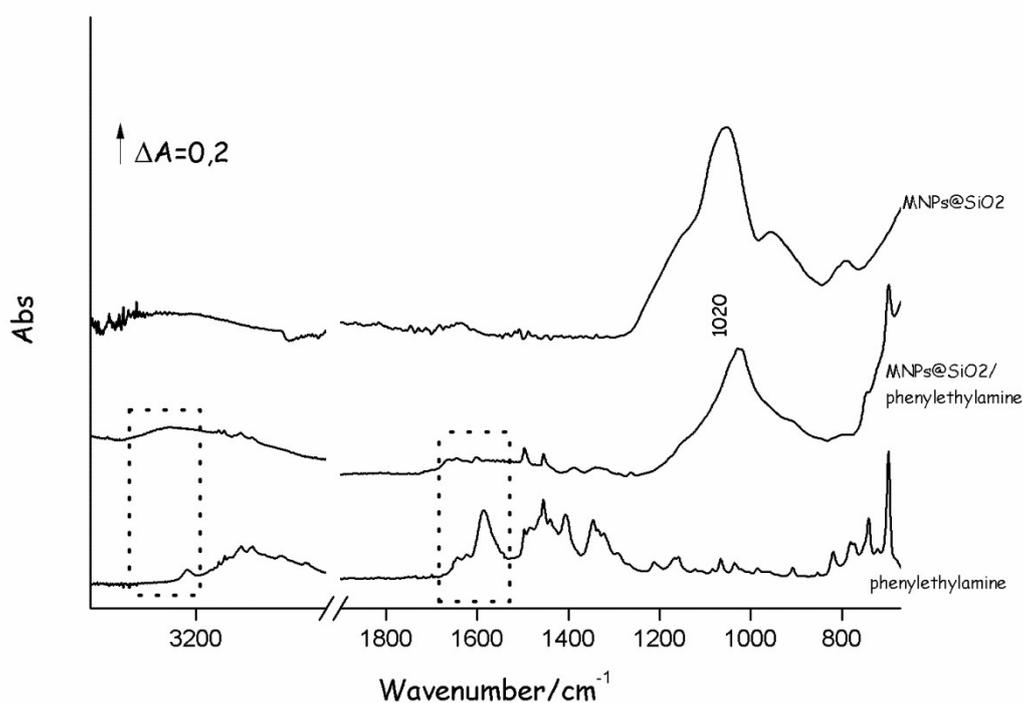


Figure S4. FTIR spectra of cast films of $\text{MNP}@SiO_2/\text{phenylethylamine}$ adduct and of phenylethylamine.

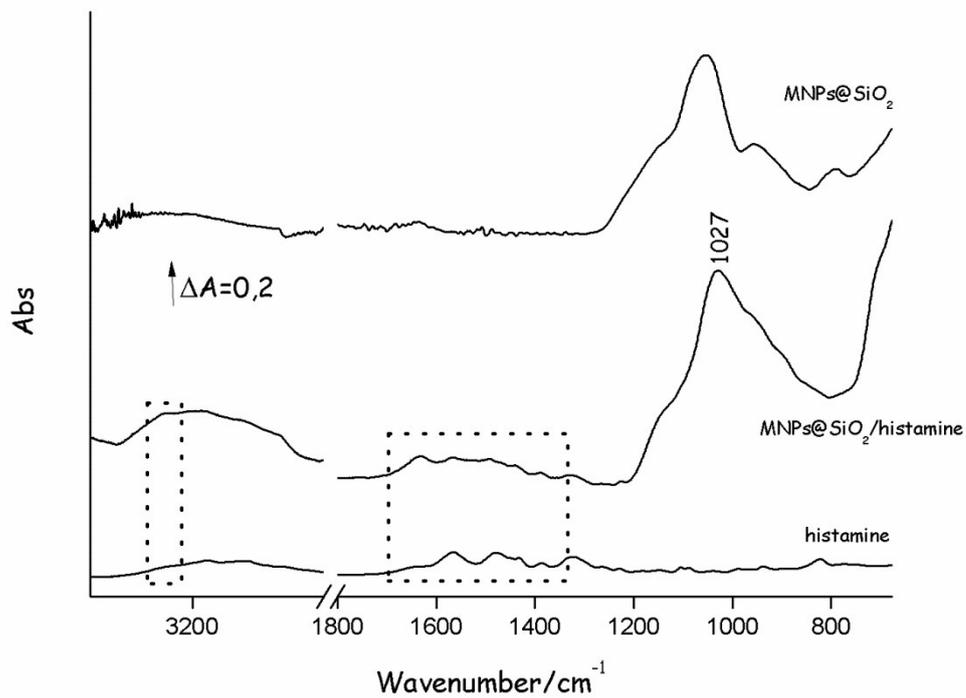


Figure S5. FTIR spectra of cast films of MNP@SiO₂/histamine adduct and of histamine.

Visible spectra obtained after the Folin-Ciocalteu reaction of the MNPs treated and not-treated sample wines are reported in figure S6.

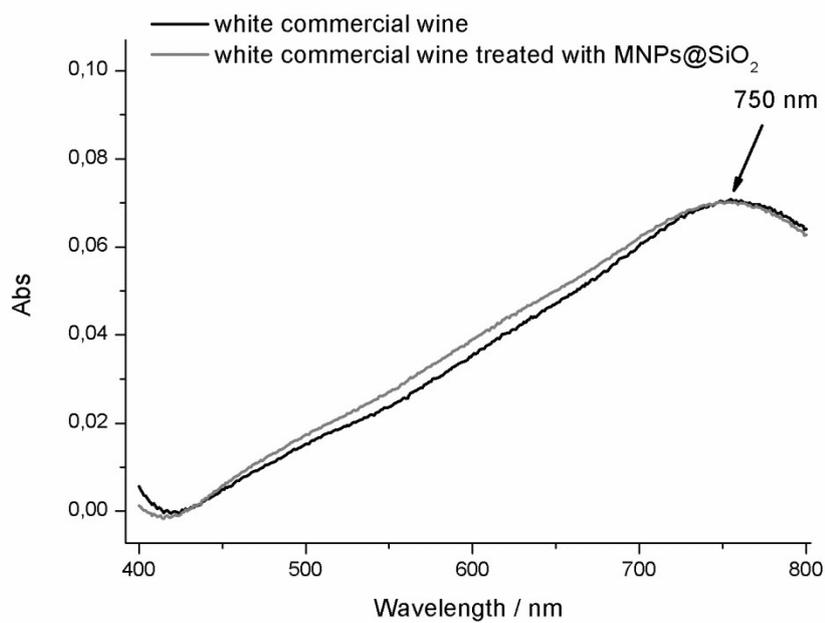


Figure S6. Visible spectra obtained after the Folin-Ciocalteu reaction of the MNPs treated and not-treated sample wines