

## Magnetic Nanoparticles Stability Analysis Coated with Plant Extract by Using Uv-Visible Spectrophotometer

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Magnetic nanoparticles have been interestingly studied due to their applications such as photocatalysis, magnetic drug delivery, road antennas, radio frequency circuits, high quality filters, medical imaging, sensors and biomedical applications [1]. We are interested in the properties that give them a biomedical application, such as superparamagnetism [1], the stability of nanomaterials in water and the crystal structure. In this paper, we evaluate the efficiency of the different plant extracts as nanomaterials natural coatings to improve the nanoparticles stability in water. The natural coatings are cheaper and low toxic than synthetic coatings. We also evaluate two methodologies to coat.

We used coating methodology described by Smolensky *et al.* (2012) [2] with certain modifications. In methodology 1 5mg Mn.75Zn.25Fe2O4 nanoparticles [1] were suspended in 5 mL chloroform. 10 mL Ethanol was added and the suspension centrifuged (5 min, 5000 rpm). The black pellet was collected, resuspended in ethanol, and sonicated (< 20 sec). The suspension was centrifuged again (5 min, 5000 rpm) and the particles collected. The centrifugation and sonication process were repeated twice resulting in stripped iron oxide nanoparticles. The stripped nanoparticles were then added to a solution of plant extract obtained as show in Table 1, in dichloromethane in a 1:1 mass ratio. The monophasic mixture was sonicated and 0.5 mL water was added. The mixture was then centrifuged (5 min, 13000 rpm) and the black-brown solid collected. Water was added and the centrifugation-wash procedure was repeated twice. The resultant particles were dried and then 5 mg of Mn.75Zn.25Fe2O4 + plant extract was resuspended in 2 mL of water. Then, it was sonicated in a Vortex. Methodology 2 was performed in the same way as methodology 1 with the exception that chloroform was not used to the first suspension the nanoparticles. To analyze the nanoparticles water stability the transmittance of water solution of Mn.75Zn.25Fe2O4 + plant extract and the water nanoparticles solution without plant extract were measured at 350 nm in a UV-Visible spectrophotometer (Genesys 10S UV-VIS, Thermo scientific) at 1, 60, 120, 180 and 1440 minutes.

The transmittance at 1 minute of the nanoparticles used in a specific water solution is less than 0.01%. It means that they have a high absorbance, more than 99%. When the nanoparticles lose stability, the absorbance is less. These parameters are related with the weight so we could estimate it.

The water stability measured as transmittance of the nanoparticles plant extract coated using methodology 1 and 2 can be observe in figure 1a and 1b respectably. It is possible note that the best nanoparticles stability is when they are coating with turmeric extract using methodology 1 (Figure 1b) staying stable until 1440 minutes while with methodology 2 (Figure 1b) were stable before the 180 minutes, after that time, they arrived at the stability of the nanoparticles without any coat. The nanoparticles coffee coating shows a contrasting behavior since the nanoparticles that were treated with chloroform in methodology 1 maintain stability until the 180 minutes, where they begin to destabilize

(Figure 1a), but when chloroform is not used the nanoparticles coffee coating do not show any stability (Figure 1b). The nanoparticles garlic coating showed little stability regardless of the methodology used.

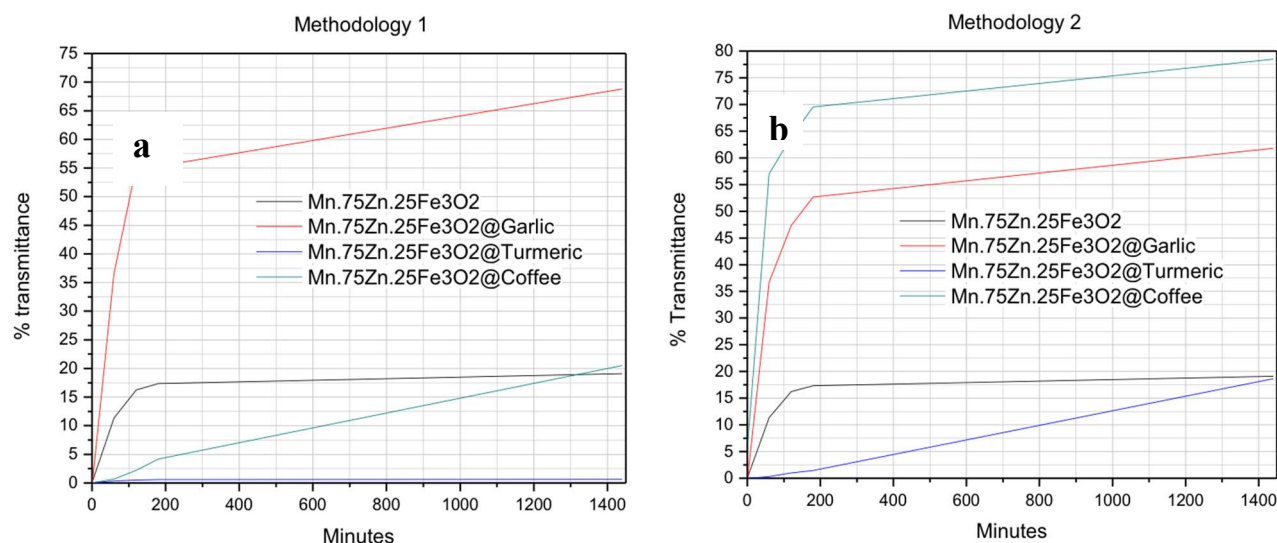
In general, the use of methodology 1 maintained the water stability of the nanoparticles coated with plant extracts, probably due to the chloroform strip the nanoparticles of possible contaminant to permit a good interaction between the core of the nanoparticle and the new core.

#### References:

- [1] Smolensky *et al*, National Institute of Health. **6(4)** (2011).  
 [2] K. Tiwari *et al*, MRS Advances **2(49)** (2017).

**Table 1.** Solutions of plant extract

Plant	Preparation of the sample	Solvent used	Methodology
Garlic	Garlic was dried at 80 °C by 4 hours. It was then crushed in a Micro-grinded with 4 marbles by 4 minutes.	Ethanol	15 grs of garlic were added to 45 mL of Solvent. Then , the soltion was sonicated by 60 minutes at 60 °C. Finally, the solution was centrifuged (5 min, 5000 rpm) and the resultant solution was collected.
Turmeric	Turmeric was crushed in a blender by 30 seconds, several times	Methanol	
Coffee	Coffee was crushed in a Micro-grinded with 4 marbles by 4 minutes.	Dichloromethane	



**Figure 1.** Concentration of nanoparticles deposits with respect to time of water solutions of nanoparticles covered with plant extracts. Figure 1a using the methodology 1, Figure 1b using methodology 2.