

## Green Synthesis of Gold Microspheres Using *Schinus molle* Leaf Extract

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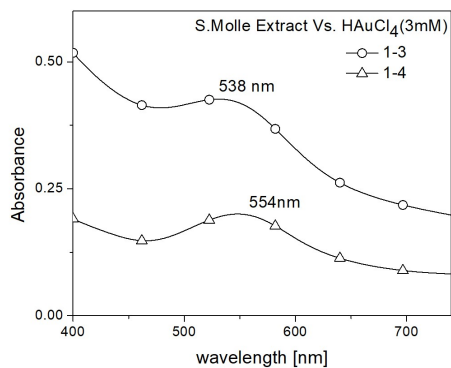
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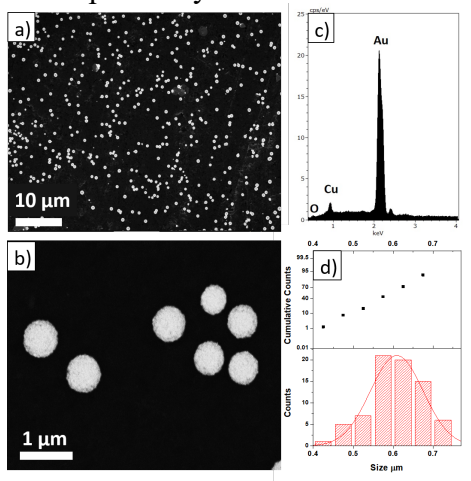
In recent years, the sub-micrometer metallic particles have attracted the interest of researchers due to its excellent optical properties which are useful for a variety of applications in nanoscale optical components, biomolecular sensing, medical imaging and photothermal therapy [1-2]. Development of inspired biological synthesis of metallic particles has received enormous attention because it is non-toxic, environmentally friendly and clean method [3]. In the present work, we suggest a biochemical method to synthesize monodisperse gold microspheres using an aqueous extract of *S. Molle* (*Schinus molle* L.) as a reducing agent and stabilizing agent at room temperature. By mechanical milling, fine powders of *S. Molle* were obtained in order to extract the active compounds more efficiently. The extract was prepared using 2g of the plant powder in 100 mL of distilled water at 70 °C for 20 min. Subsequently, reaction mixtures at different volume ratios of plant extract/salt precursor ( $\text{HAuCl}_4 \cdot 3\text{H}_2\text{O}$  5mM) (1-3 and 1-4) were prepared. The characterization of metallic particles was carry out by UV-vis, SEM, and XRD. The color change of the reaction from yellow to purple and finally to golden indicated first the formation of gold nanoparticles and seconded its growth to micrometric sizes in the reaction mixture. 5 mL aliquots of each the experiment were collected and analyzed by UV-vis spectroscopy. The appearance of absorption bands between 500-550 nm, which is due to the presence of gold nanoparticles in solution [4]. As the concentration of salt precursor increases, the intensity of the absorption band decreases and moves to longer wavelengths indicating a growth of the metallic particles (Fig. 1). SEM analysis confirmed the presence of gold particles. Fig. 2 (a) shows quasi-monodisperse gold microspheres which presented in a significant amount. Fig. 2 (b) shows an SEM micrograph taken at higher amplifications where the rough surface is observed indicating a higher active surface area in comparison to a smooth particle. Fig. 2 (c) displays an energy dispersive spectrum analysis (EDS) confirmed the existence of gold in the solid state. Metallic gold shows a characteristic peak at approximately 2.3 keV suggesting that the obtained particles were pure [5]. From the particle size analysis (Figure 2d) it is observed a size distribution between 0.45 to 0.73  $\mu\text{m}$  with average size of 0.6  $\mu\text{m}$ . X-ray diffraction pattern in Fig. 3 shows the crystalline nature of the gold particles biosynthesized by aqueous *S. Molle* extract. The pattern displays five diffraction peaks observed in the  $2\theta$  range of 30°-85° and indexed with the crystallographic planes (111), (200), (220), (311) and (222) of the face-centered cubic of gold structure, in agreeing JCPDS data file [99-101-2322]. These results indicate the effectiveness of *S. Molle* to synthesize gold microspheres. In summary, gold microspheres were synthesized by a green method using an aqueous extract of *Schinus molle* L. as a reducing and stabilizing agent. UV-vis spectroscopy showed the SPR absorption bands characteristic of Au particles. The diffraction peaks in XRD analysis evidence the crystalline nature of the biosynthesized particles. The morphological studies by electron microscopy show Au microspheres with an average size of 0.6  $\mu\text{m}$  and rough surface which can be used for a broad range of applications [6].

## References:

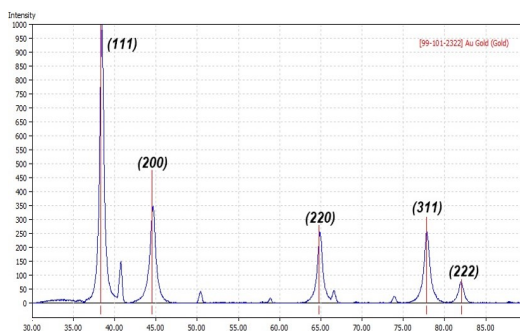
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**Figure 1.** UV-Vis spectra of Au microspheres synthesized at different plant extract concentration.



**Figure 2.** (a-b) SEM of Au microspheres obtained using *S. Molle* extract, (c) EDS analysis and (d) particle size analysis.



**Figure 3.** XRD pattern of gold microspheres biosynthesized.