Green Synthesis of Silver Nanoparticles Mediated by Bee Products

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Abstract

Since ancient times, honey and other bee products have been widely used as functional food ingredients and therapeutic agents due to the unique health benefits they provide (which includes antibacterial, antioxidant, antitumor, anti-inflamatory and antiviral activities) [1].

Recently, several investigations have shown that the high antioxidant potential of honey can also be exploited to develop new approaches to the efficient production and processing of nanomaterials [2-4], which offer interesting advantages over the conventional routes: they are quite simple, economically competitive and reduce risks to human health and the environment [5]. In addition, these green-chemical procedures provide new methods for the functionalization of nanostructures, especially for applications in biomedicine including drug delivery and tissue imaging [2, 5].

The powerful antioxidant action of honey has been attributed to its high content of phenolic compounds [1], however the identification of this compounds remains a difficult task. In an interesting work, Perez et al. [6] studied the antioxidant activity and the total polyphenol content in different kinds of nectar honey and honeydew honey, and they found that honeydew honeys generally showed higher antioxidant capacities. Therefore, bee products exhibit astonishing properties that remain to be elucidated fully and whose practical use could result in novel promising applications.

In the present contribution, eco-friendly syntheses of silver nanoparticles mediated by various bee products (raw honey, royal jelly, honeydew honey and propolis) have been explored. Studies performed by analytic techniques, such as X-ray diffraction (XRD), Transmission Electron Microscopy (TEM), Selected Area Electron Diffraction (SAED), Ultraviolet-Visible spectrophotometry (UV-Vis) and Infrared spectroscopy (IR), revealed that the obtained samples are consisted of colloidal silver nanoparticles with ultra-fine sizes and narrow size distributions. Such particles are embedded into organic matrices that stabilize them by inhibiting their great tendency to grow by coalescence processes. In addition, such matrices allow the colloidal dispersion of the silver nanoparticles into high-stable concentrated aqueous colloids. Figure 1a shows a TEM micrograph of the particles obtained with raw nectar honey. These particles are embedded in an organic matrix and display a median diameter of 2.7 ± 0.5 nm (see the particle size distribution presented in Figure 1b). High-resolution TEM (HRTEM) and SAED studies corroborated that these particles are nanoscopic crystals of metallic silver.

References

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Figures

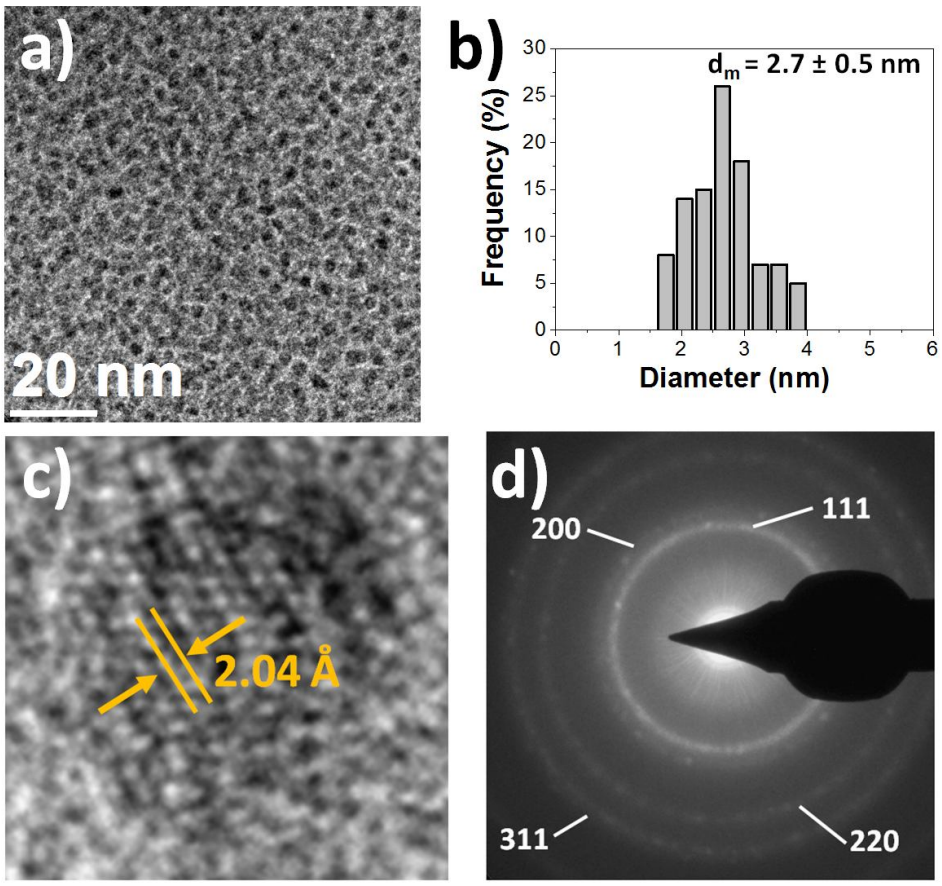

Figure 1. a) Conventional TEM image of silver nanoparticles synthesized using nectar honey. b) Particle size distribution of the same sample. c) HRTEM image of a silver nanoparticle. d) SAED pattern obtained for the area observed in part (a).