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Green Synthesis of Gold Nanoparticles Using Latex of *Jacaratia Mexicana*

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Abstract: In recent years, green synthesis of gold nanoparticles (AuNPs) has gained much interest because of its importance in medicine and industry, harnessing the endemic flora of each region favors the reduction of costs for this synthesis method that uses biological material from plants as a reducing agent and stabilizer. In this work we report a method for biosynthesis of AuNPs using latex obtained from the fruit of *Jacaratia mexicana*, which is an endemic plant of Mexico. Gold nanoparticles were obtained from the reduction process of aqueous gold ions exposed to latex of *Jacaratia Mexicana*. Gold nanoparticles were characterized by UV–vis spectroscopy and shown distinct peak ranged from 545 to 560nm depending on the concentrations of the latex and gold ions.

Key words: *Jacaratia mexicana*, green synthesis, gold nanoparticles, latex.

INTRODUCTION

The synthesis of nanomaterials represents a fundamental aspect in research, development and nanotechnology applications, because of their fascinating properties and important applications that are complementary or superior to their bulk counterparts[1]. Gold nanoparticles (AuNPs) in particular are of significant importance due to their unique characteristics such as low toxicity, biocompatibility, antimicrobial activity, optoelectronic, biosensing and catalytic properties[2-5]. The explorations of natural resources (plants) are most promising and eco-friendly alternatives compared to physical or chemical nanoparticles synthesis process[6]. ''Green chemistry'' is a branch of chemistry related to design, development and implementation of chemical products and process minimizing and/or eliminating the use and generation of substances hazardous to human health and the environment[7]. For the synthesis of metal nanoparticles by reduction of the corresponding metal ion salt solutions, three main factors are considered in green chemistry: solvent choice, the use of environmentally benign reducing agent and the use of non-toxic capping agent for stabilization of nanoparticles[8]. The formation of metal nanoparticles is caused by a chemical reaction in the presence of reducing agent via ''green'' synthesis. There has been an increasing interest in identifying environmentally friendly and multifunctional materials for the synthesis of metal nanoparticles.

Biosynthesis of noble metal nanoparticles using plant based extracts has taken great scientific interest because they can act as reducing agents as well as capping agents following an environmentally friendly, sustainable and cost-effective process.

The literature review shows that have realized the synthesis of gold nanoparticles Au-NPs using Citrus sinensis (orange), Prunus persica (peach), Carica papaya (papaya), Citrus limon (lemon) [9,10], the different components of plant biomolecules have both capping and reductive activity, and are mainly responsible for the reduction of silver and gold ions, resulting in more biocompatible nanoparticles[11]. Within the main advantages of using this methodology is its low cost and speed for the synthesis nanoparticles.

Our plant study the *Jacaratia mexicana* belongs to the family of Caricaceae, with four genera and eight species, is a tree of wide distribution in Mexico, found in tropical deciduous forest (figure 1), measuring more than 10 meters high, with annual fruit and has latex in stems and fruits (figure 2), these are fleshy, its rind is green with red, elongated, pentagonal nuances, 13-18 cm long, is used in the manufacture of food and sweets, and it has been reported that species sharing the same family have synthesized metal NPs[11-15]

Figure 1: Distribution of *Jacaratia mexicana* in Mexico

The aim of the study has been observe the properties of latex *Jacaratia mexicana* as a reducing and stabilizing agent for the synthesis of gold nanoparticles in aqueous solution, which is an endemic species of Mexico belongs to the family Caricaceae (figure 2). It is reported the synthesis of metal nanoparticles with plants of this family[11-15]. The gold nanoparticles were characterized by UV-visible spectroscopy.

METHODS

Jacaratia mexicana fruits were obtained from Yautepec Morelos. For sample preparation, crude latex was obtained by cutting the fruits of *Jacaratia*. Milky white latex was stored at −20 ◦C until use. $HAuCl_4$ analytical grade was purchased from Sigma–Aldrich.

All the aqueous solutions were prepared using deionized water. In a typical reaction procedure, crude latex was diluted to 100ml using de-ionized water for obtained 1% of this. Latex solution was mixed at different ratio (9:1, 7:3, 5:5, 3:7, 1:9 v:v) with 1×10^{-3}M aqueous $HAuCl_4$ solution.

The mixture was stirring at 300rpm for 4 h in orbital stirring. UV–vis absorption spectra were measured using Thermo Scientific Evolution 600 spectrophotometer.

a) b)

Figure 2: a) Tree and b) fruit of *Jacaratia mexicana*

RESULTS

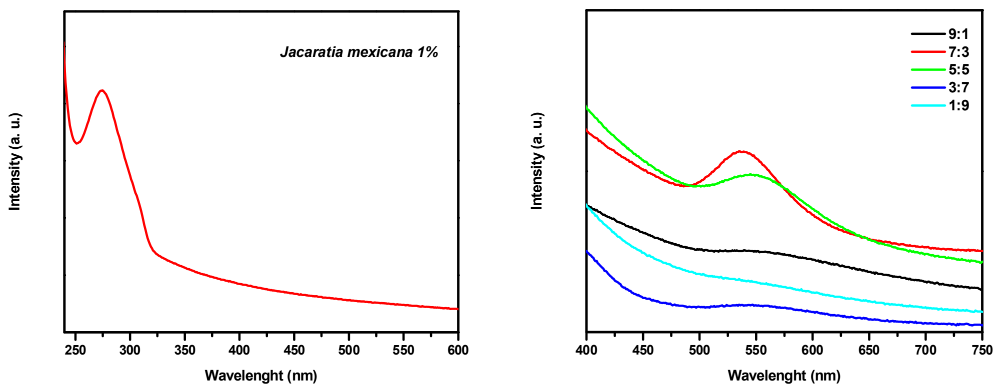
The primary detection of synthesized gold nanoparticles was carried out in the reaction mixture by observing the color change at pink-ruby red after (Figure 3) 4 hr of reaction due to gold nanoparticles production at different concentrations[16]. These color changes occur due to excitation of surface plasmon vibrations of gold nanoparticles.

As illustrated in figure 4a and 4b, the Uv-Vis spectra recorded of latex of *Jacaratia mexicana* and the generation of gold nanoparticles. The surface Plasmon peak located at 542nm which is characteristic of the formation of spherical gold nanoparticles[17] approximate size of 70 nm .

Observe that the SPR band is broad showing the formation of particles with broad size distribution, which indicates polydispersed nanoparticles.

a) b)

Figure 3: Different concentration the latex of *Jacaratia mexicana* before (a) and after (b) 4 hours of treatment $HAuCl_4$ (1mM)



a) b)

Figure 4: Spectra of a) Latex of *Jacaratia mexicana* and b) Synthesis of nanoparticles of gold

CONCLUSIONS

This is the first report showing that latex obtained of *Jacaratia mexicana* can be used as a reducing agent and stabilizer for the biochemical synthesis of gold nanoparticles, representing a green, cheap and eco-friendly method. Gold nanoparticles synthesized by the above method are quite stable and without visible changes even after a month if the nanoparticle solutions are kept in light proof condition.

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