



Synthesis, characterization, *in vitro* biocompatibility, and antimicrobial activity of gold, silver and gold silver alloy nanoparticles prepared from *Lansium domesticum* fruit peel extract

Shiv Shankar^a, Lily Jaiswal^a, R.S.L. Aparna^b, R.G.S.V Prasad^{b,*}

^a School of Applied Sciences, RMIT University, Melbourne 3001, Australia

^b Faculty of Pharmaceutical Sciences, Asian Metropolitan University, Kuala Lumpur 43200, Malaysia

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ABSTRACT

A cost-effective and eco-friendly method has been developed to form colloidal solutions of gold (AuNPs), silver (AgNPs), and gold–silver–alloy (Au–Ag–NPs) nanoparticles using *Lansium domesticum* (LD) fruit peel extract as a combined reducing and capping agent for the first time. The synthesized nanoparticles were characterized by various physico-chemical techniques. AgNPs and Au–Ag–NPs demonstrated potential antimicrobial activity. All these nanoparticles showed significant biocompatibility on C2C12 cell line. In addition, cellular and LDH activities supported our biocompatibility results. The outcomes of this study indicate that, these nanoparticles could be effectively utilized in pharmaceutical, biotechnological and biomedical applications.

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1. Introduction

Metal oxide nanoparticles are gaining considerable attention in the field of biomedicine [1]. Green and eco-friendly synthesis methods are very crucial for sustained environment [2]. *Lansium domesticum* (LD), a tropical fruit plant commonly known as longkong, belongs to a family Meliaceae which is native to Southeast Asian countries [3]. LD fruit peel contains several types of triterpenoids such as lansionic acid, 3 β -hydroxyonocera-8(26),14-dien-21-one, and 21 α -hydroxyonocera-8(26),14-dien-3-one, triterpene glycosides (lansiosides A, B, and C) and other organic compounds like linsic acid and methyl ester [4]. These triterpenoids are strong reducing agents which could reduce metal ions to nanoparticles and stabilize them by acting as capping agents [5].

In view of above properties, the aqueous LD fruit peel extract was used for the synthesis of gold, silver and gold–silver alloy nanoparticles at room temperature for the first time in the present study.

2. Materials and methods

All chemicals were procured from Sigma Chemicals, USA, unless otherwise stated. LD fruit peels were obtained from local

market of Kuala Lumpur, Malaysia. Ten grams of fruit peels were boiled in 100 mL double distilled water at 80 °C for 12 h, filtered, and stored at 4 °C. For synthesis of gold (AuNPs) and silver nanoparticles (AgNPs), 2 mL LD fruit peel extract was added to 18 mL aqueous solution (1.0 mM) of HAuCl₄ and AgNO₃, respectively. For synthesis of Au–Ag–NPs, 2 mL of LD fruit peel extract was added in premixed aqueous solution of AuHCl₄ (0.5 mM) and AgNO₃ (0.5 mM). The bioreduction of metals ions was monitored by measuring the absorbance of the sample periodically using UV/Vis spectrophotometer (Perkins Elmer LAMBDA 25). Fourier transform infrared (FTIR) (Spectrum one Perkin) Elmer spectra were obtained for the prepared nanoparticles. Zeta potential and particle size were measured by Zeta PALS-zeta potential analyzer (Brookhaven Instruments Corporation). Morphology of nanoparticles was determined by transmission electron microscopy (TEM) using JEOL-2010 instrument operated at accelerating voltage of 200 kV. The stability of prepared nanoparticles was assessed by measuring UV/Vis spectrum and zeta potential at specific time intervals up to 6 months. Antimicrobial assay of the synthesized nanoparticles was performed using a modified broth microdilution method [6]. Cytotoxicity was evaluated on C2C12 cells by MTT method. Cellular activity was measured by Almar Blue assay described previously [7]. Total DNA was measured by previously described method [7]. LDH leakage was estimated using LDH-Cytotoxic Test Wako kit (Wako Pure Chemical Industry, Osaka, Japan).

* Corresponding author. Tel.: +66 83894 3435.

E-mail address: gunnaeswara79@gmail.com (R.G.S. Prasad).

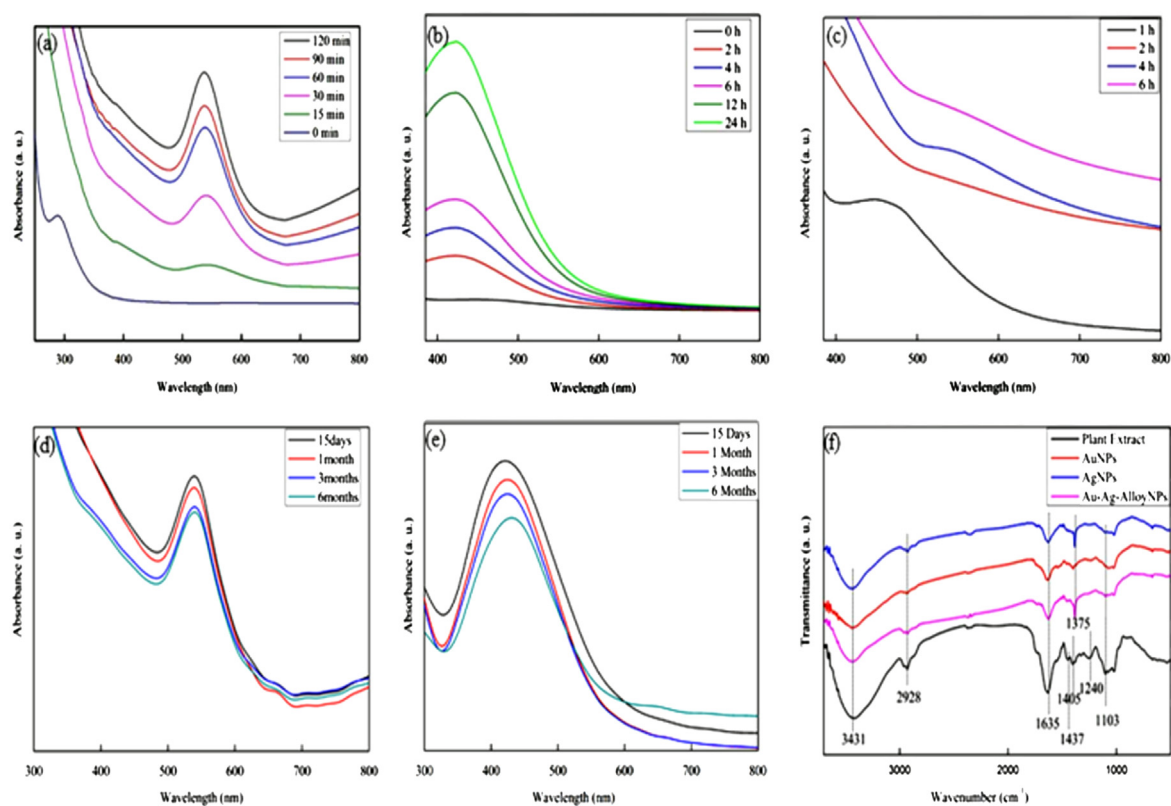


Fig. 1. UV-Visible spectra of (a) AuNPs, (b) AuNPs, and (c) Au-Ag-NPs with reference to time; (d) AuNPs stability, (e) AgNPs stability; and (f) FTIR spectra of nanoparticles.

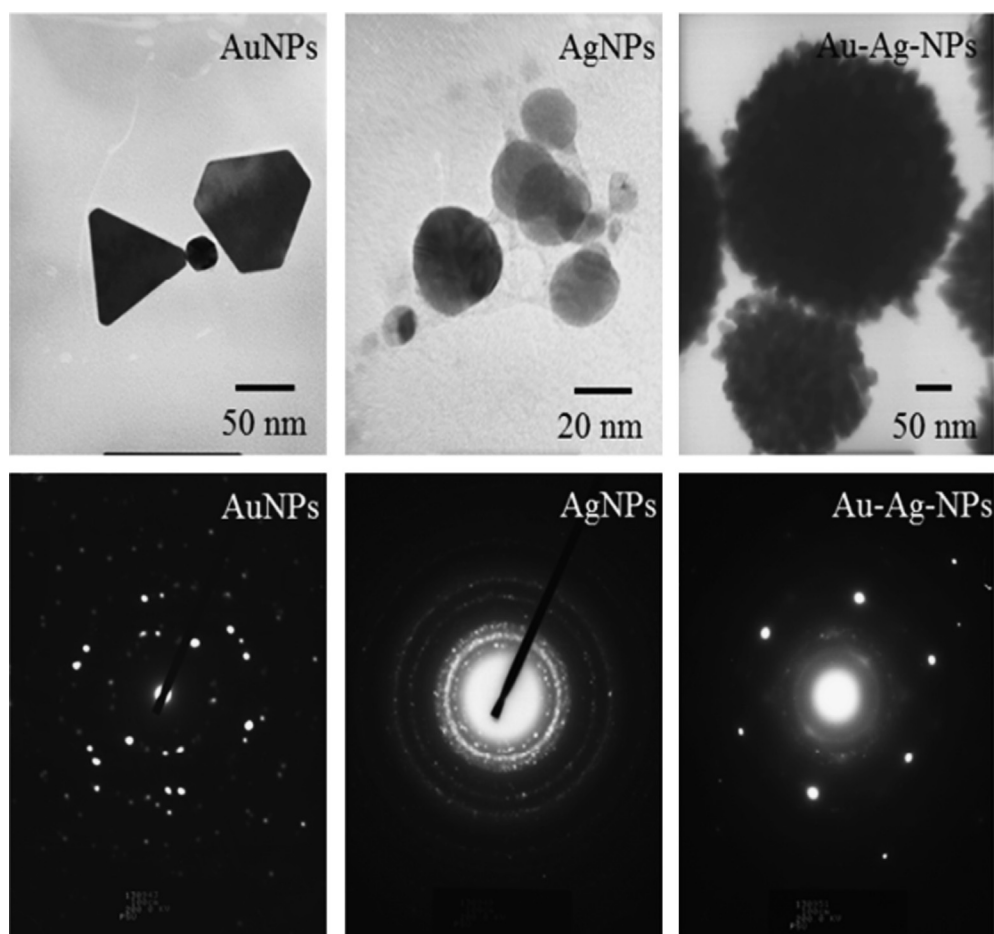


Fig. 2. TEM images of AuNPs, AgNPs, and Au-Ag-NPs (above) and SAED patterns of the respective nanoparticles (below).

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