Journal of Nutrition and Dietetics

Extended Abstract Open Access

Green Synthesis and Characterization of Platinum Nanoparticles using Sapindus Mukorossi Gaertn Fruit Pericarp

M. NARESH KUMAR

Raghu Institute of Technology, India

Abstract

Synthesis of platinum nanoparticles (Pt-NPs) was accomplished by a green procedure employing aqueous solutions of Sapindus mukorossi Gaertn fruit pericarp. The size of nanoparticles obtained is in range of 2-19 nm which is achieved by the reduction of platinum ions with the aqueous extract of Sapindus mukorossi Gaertn Fruit pericarp. The resulted platinum nanoparticles are highly crystalline face-centered cubic (fcc) structures. The resulting platinum nanoparticles might be stabilized through the interactions of carboxylic groups in saponins and the carbonyl groups in flavonoids present in the soap-nut shells. TEM, XRD, SEM with EDS were used to study the morphology, distribution, crystallinity and size of the platinum nanoparticles. The results showed that platinum nanoparticles formed with cubic phase. This biogenesis is straight-forward, amenable for big scale industrial production and technical applications.

Keywords

Platinum nanoparticles, Sapindus mukorossi Gaertn, Green synthesis

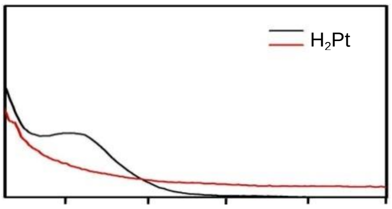
Introduction

Recently, research methodologies are implementing to develop easy, amicable and low cost green methods for the production of nanomaterials. Nanoparticles from noble metals are playing a vital role in the fields of bioelectronics, pharmaceuticals and organic catalysis. The metal constituted platinum compound cis-diamminodichloro-platinum (II) (cis- platinum) is a drug for treating cancer. The potential applications of platinum nanoparticles have been developed in the fields of hydrogen storage and fuel cells materials. They also showed excellent catalytic activity than bulk materials. Platinum nanoparticles also exhibited efficient catalytic activity in the development of fuel cells as proton-membrane exchangers.

Platinum nanoparticles can be prepared by several methods such as reduction of ethanol, water-in-oil microemulsion, polyol synthesis, supercritical fluid, ambient pressure drying method, sputtering methods, sonoelectrochemical method and microwave irradiated method. Nevertheless, these conditions are hampering the industrial preparation of platinum nanoparticles in terms of requiring expensive instruments and uses of toxic reagents.

Therefore, the use of biological materials such as plant materials and microorganisms are the best alternative approaches for the above mention approaches for platinum nanoparticlessynthesis in industrial preparation procedures. Instead the use of plant materials in place of microorganisms has more advantages including the elimination of elaborative processes and maintenance of cell cultures. In literature, a few methods have been reported for platinum nanoparticles preparation such as Dipyros kaki leaf extract, Cacumen platycladi extract and herbal Bidens tripartitus extract.

The aqueous extract of Soap nuts (Sapindus mukorossi Gaertn. fruit pericarp) mainly constituted with saponins (natural surfactants), flavonoids and carbohydrates. An ancient people of Asia and America have long been using soap nuts for washing. Usually, commercial available detergents release carcino- genic toxins into the environment during production, therefore, the best alternative to avoid this is to use soap nuts for the production of detergents due to its biodegradable properties. Hence, soap nuts are considered and used commercially in detergents, cosmetics, and other products. In addition, soap-nuts have some medicinal characteristic properties such as anti-inflammatory and antimicrobial activities. Recently, green synthesis of nanoparticles using of soap nuts is increasing in the field of nanotechnology to develop cost effective. In order to develop a greener and more economic protocol for the fabrication of platinum nanoparticles, we used an aqueous solution of Sapindus mukorossi Gaertn. Fruit pericarp extract as reducing and stabilizing agent. In view of these facts, herein, we report a biological, eco-friendly and economic procedure for preparation of platinum nanoparticles by thermal treatment in presence of aqueous solution of Sapindus mukorossi Gaertn. Fruit pericarp extract as reducing and stabilizing agent. A systematic characterized with UV-visible spectroscopy, transmission electron microscopy and X-ray diffraction techniques. The possible bioreduction of platinum precursor mechanism also has been discussed.



Experiment

Soap nut shells were procured from agricultural fields in India. Hexachloroplatinic acid (H2PtCl6) was purchased from Sigma-Aldrich (USA). The organic free water was collected from Marine department, Andhra University, Visakhapatnam, India.

The obtained platinum nanoparticles were characterized by using transmission electron microscope (TEM), X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FT-IR). TEM, selected area electron diffraction pattern (SAED) and energy dispersive X-ray (EDX) data were obtained on XPERT- PRO at room temperature, using CuK□ radiation □ = 1.5406 Å over a wide range of Bragg angles (30º □ 2q □ 85º). For TEM analysis, a few drops of platinum nanoparticles samples dispersion onto the carbon coated copper TEM grid and dried overnight. The FT-IR spectra were recorded on Schimadzu FTIR with the samples as KBr pellets.

Procedure

To prepare platinum nanoparticles, 10 mL of 0.01M H2PtCl6 solution was added to 10 mL filtrate of 50 % w/v of aqueous extract of Sapindus mukorossi Gaertn. fruit pericarp. The tightly sealed bottle was kept in preheated oven at 100 ºC for 10 h. The bio-reduction of H2PtCl6 is confirmed by the slow colour change to a stable black blue colour.

Results and Discussion

The formation of platinum nanoparticles was confirmed by conversion of yellow colour of platinum reduced solutions to black colour colloidal sample. It reveals that an aqueous soap nuts solution reduces Pt(IV) ions into Pt(0) nanoparticles at 100 ºC under the reaction period of 10 h.

UV-visible studies were performed to identify the formation of platinum nanostructures using an aqueous soap nuts solution. Fig. 1 displays the UV-visible spectra of H2PtCl6 and reduced platinum sample obtained by an aqueous soap nuts solution. The peaks at 259 nm correspond to H2PtCl6 as shown.

Due to thermal treatment in the presence of aqueous soapnut solution, the peak corresponding to H2PtCl6 disappeared, which indicates the reduction of Pt(IV) ions into Pt(0) nanoparticles