

Comparison study on biosynthesis of silver nanoparticles using fresh and hot air oven dried *IMPERATA CYLINDRICA* leaf

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Abstract: The perennial rhizomatous grass; *Imperata cylindrica* (*I. cylindrica*) has been reported rich in various phytochemicals. In present study, silver nanoparticles were synthesized from aqueous leaf extract of *I. cylindrica* at two different leaf conditions; fresh leaves and hot-air oven dried leaves. Biosynthesized silver nanoparticles were characterized by UV-visible spectroscopy, field emission scanning electron microscopy (FESEM) and Fourier transform infrared spectroscopy (FTIR). Maximum absorption was recorded between 400 nm to 500 nm. FESEM analysis revealed that the silver nanoparticles predominantly form spherical shapes. The particles sizes were ranging from 22-37 nm. The elemental composition of the synthesized silver nanoparticles was confirmed by using energy dispersive X-ray spectroscopy (EDX) analysis. Fourier transform infrared spectroscopy (FTIR) confirmed the reducing and stabilizing actions came from biomolecules associated with *I. cylindrica* leaf extract. Thus in this investigation, an environmentally safe method to synthesized silver nanoparticles using local plant extract was successfully established.

1. Introduction

Cogon grass is a perennial grass that can be found commonly thrives around areas where disturbed by human activities (figure 1). This plant is native in Southeast Asia, the Philippines, China, and Japan [1] and has been listed as one of the most problematic weeds in the world [2]. Unlike other several types grass species, this perennial rhizomatous grass (division of *Magnoliophytai*; class *Liliopsida*, order *Cyperales*, family *Poaceace*/*Gramineae* and genus *Imperata* Cirillo) is not suitable for forage. This is due to the sharp edge of mature leaves. Apart planted as soil erosion control in some places, this plant was also claimed to have medicinal value. Studied conducted by previous researchers [3] confirm the presence of tannins, alkaloids, saponins and flavonoids in *I. cylindrica* leaf extract. These compounds are claim to have potential for the reduction of ionic into bulk metallic nanoparticles formation [4].

Metallic nanoparticles such as silver have many applications in various areas such as medicine, biology, material science, physics and chemistry [5]. Silver nanoparticles is a fascinating noble due to their unique properties which include good electrical conductivity, chemical stability, catalytic and antibacterial activity [6]. In addition silver possess minimal risk of toxicity towards humans making it a popular choice



to be incorporated in health industry, food storage, textile, coatings and several environmental applications. With the emergence of silver nanoparticles in various applications, the development of environmental friendly synthesis is a promising field to be explored in order to cater the increasing demand.



Figure 1. Image of *Imperata cylindrica*.

The use of plant extracts to synthesis nanoparticles is often termed as ‘green synthesis’ method. This type synthesis procedure reduces or eliminated the use and/or generation of hazardous substances [7]. Silver nanoparticles have been previously synthesized using leaf extract of *Hibiscus cannabius*, *Pimenta dioica*, *Anacardium occidentale*, *Hibiscus rosa sinensis* and *Azadirachta indica* [8]–[12]. Although generally *I. cylindrica* has the power of reducing silver ions to silver nanoparticles, the selection between dry or fresh plant extract can affect the properties of synthesized silver nanoparticles. Hence, the present investigation was carried out to study the effect of oven drying leaf before extraction on optical and morphological properties of biosynthesized nanoparticles.

2. Experimental Procedures

2.1. Plant Material Preparation

Fresh *I. cylindrica* leaves were collected from Universiti Teknologi MARA Shah Alam, Selangor, Malaysia. Taxonomy identification were carried out by Forest Research Institute Malaysia (Sample no. PID 200916-17). Two type of leaves samples were used for this experiment; fresh and oven dried leaves. The green reducing agents were prepared by cutting the leaves of *I. cylindrica* before washing it thoroughly using tap water and followed by distilled water. Leaves specimen were oven dried at 80°C before finely grounded using dry mill of conventional food processor. The powder was screened through 100 mesh sieve to eliminate coarse particles. The aqueous leaves extract of the specimen was prepared by dissolving 5 g of leaf powder in 200 ml distilled water. The mixture was boiled at 60 °C for 30 min. The aqueous leaves extract of fresh leaf specimen was prepared by heating 20 g of fresh leaves together with 100 ml distilled water at 60 °C for 30 min. The extract from both type of leaves were filtered to be use in the experiment.

2.2. Biosynthesis of Silver Nanoparticles

The silver nanoparticles from both types of *I. cylindrica* leaves extract was synthesized by adding 10 ml of the aqueous leaves extract into 90 ml of 5 mM aqueous AgNO₃. The mixture was stirred for 5 min at 150 rpm before heated using water bath at 60 °C for 10 min. Appearance of brown colour marks the formation of silver nanoparticles.

2.3. Characterization of Biosynthesized Silver Nanoparticles

The formation of silver nanoparticles was monitored by recording SPR bands of both samples using a UV-visible double beam spectrophotometer (Perkin Elmer, Lambda 35 UV/Vis System) operated in 700 -300 nm range at a resolution 1 nm. Morphological properties and elemental composition of the silver nanoparticles were acquired by field emission scanning microscope (FESEM) SUPRA-40 VP together with energy dispersive X-ray (EDX) unit. The EDX analysis was carried out to analyse the elemental composition of the synthesized nanoparticles.

3. Results and Discussion

3.1. Biosynthesis of Silver Nanoparticles

The present study deals with the synthesis of silver nanoparticles using aqueous leaf extract of *I. cylindrica* as green reducing and stabilizing agent. Comparison study between the reducing ability of two variations of leaf extracts (fresh and dried leaves) were observed. The formations of nanoparticles were identified by colour changing from light yellow to dark brown [13]. The colour changes in reaction mixture was known due to surface plasmon resonance (SPR) phenomenon [7]. The time taken for leaves and hot-air oven dried leaves to mediate synthesis process was 30 minutes.

3.2. Uv-visible Spectroscopic Studies

Preliminary characterization was carried out using Uv-visible spectrophotometer at absorption wavelength of 300- 700 nm (figure 2). The colloidal solution of silver nanoparticles synthesized from dried leaves extract exhibited strong absorption at 448 nm which confirm the formation of Ag nanoparticles [14]. Silver nanoparticles synthesized from fresh leaves extract gave low intensity and broad absorption spectrum at 437 nm. The appearance of bands at lower wavelength mark smaller particles size [10] which was later confirmed by FESEM images. The SPR bands as reported by previous study [15] are influenced by the size, shape, morphology, composition and dielectric environment of the synthesized nanoparticles.

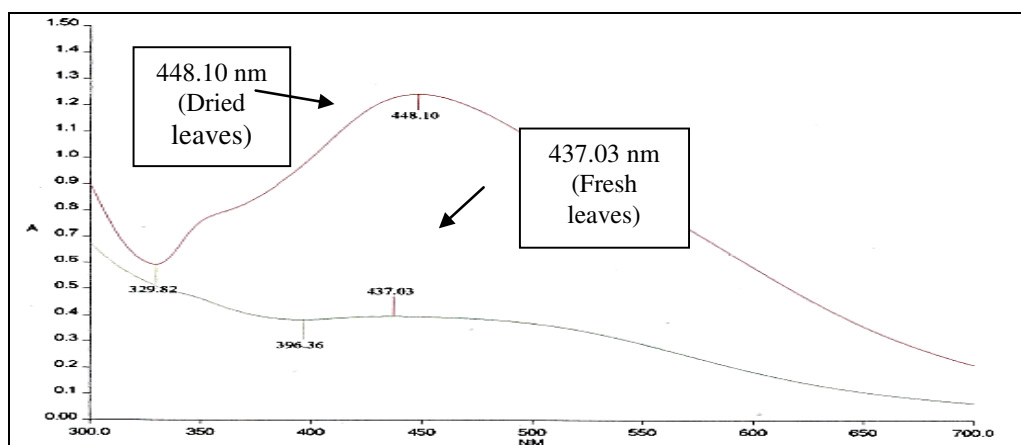


Figure 2. UV- vis absorption spectrum of silver nanoparticles (5 mM) from fresh and dried leaf extract.

3.3. FESEM Studies

Morphology and size of both samples were identified from FESEM images. The particles from both samples were predominately spherical shape (figure 3). Fresh leaf results in nanoparticles size ranging from 22 to 35 nm with least agglomeration. Silver nanoparticles synthesized from oven dried leaf have slightly larger particles with size ranging from 27 to 37 nm. The particles also exhibit some agglomeration

and lack of shape uniformity. Agglomeration of nanoparticles typically took place due to the insufficient capping agent in the leaf extract during synthesis of nanoparticles [16]. According to previous study [17], the quantity and type of flavonoid groups changed according thermo stability during leaf drying and extract preparation. Consequently, the stabilizing and capping behaviour of the plant extract were also altered. These might cause the differences in particles morphology and size of biosynthesized silver nanoparticles.

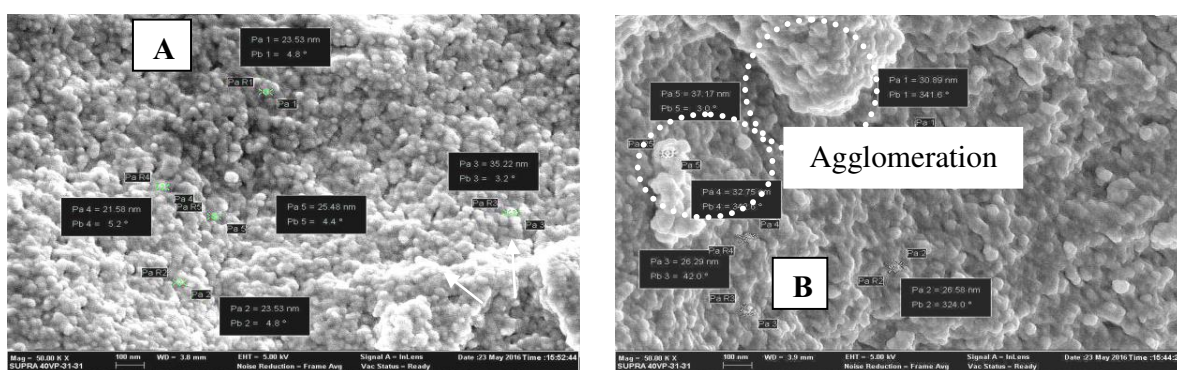
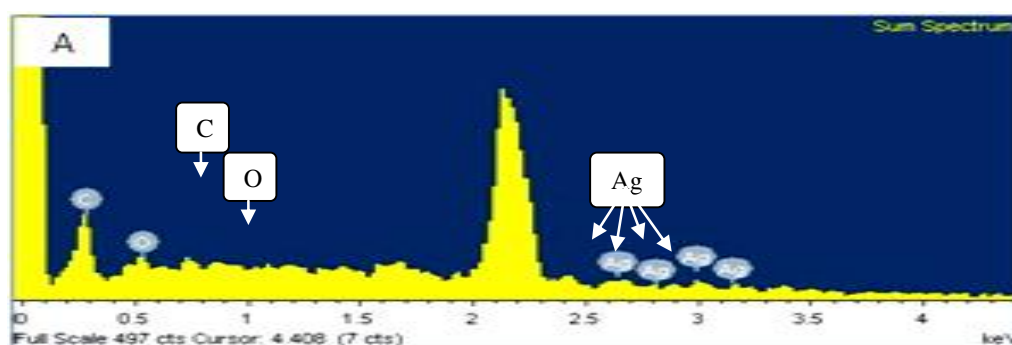


Figure 3. Micrograph (magnification of 50 k) of silver nanoparticles synthesized from (A) fresh leaves and (B) hot-air oven dried leaves.

3.4. EDX Spectroscopy Study

The presence of silver was confirmed from the Ag peaks obtained from the EDX spectrum (figure 4 (A) & (B)). The signal for silver was obtained at the energy of 3 keV indicates that the silver has been correctly identified [18]. Elemental composition of nanoparticles synthesized from both type of leaf extract was presented in figure 4(C). About 71.42 % and 75 % of silver was detected in both sample of nanoparticles synthesized from fresh leaf and hot-air oven dried leaf respectively.



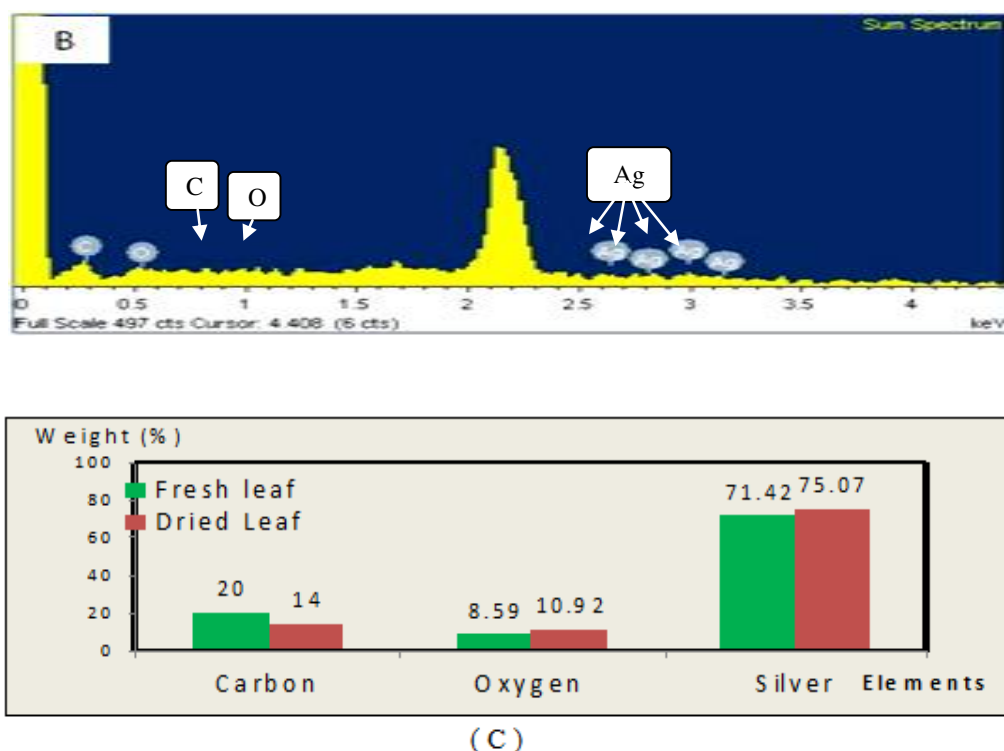


Figure 4. EDX result showing the presence of silver nanoparticles and bioorganic components of (A) fresh leaves and (B) oven dried leaves. (C) Elemental composition of nanoparticles synthesized from both plant extract.

4. Conclusion

In conclusion, this study successfully demonstrated the use of oven dried and fresh *I. cylindrica* leaf as silver particle size reducing and stabilizing agent. In UV-visible spectroscopy analysis, silver nanoparticles synthesized from hot-air oven dried leaf gave sharper and more prominent peak (448 nm) compared to fresh leaf. FESEM analysis revealed fresh leaf extract produced spherical silver nanoparticles with less agglomeration and smaller particle size range (22 to 35 nm). Silver nanoparticles synthesized from dried leaves showed more agglomeration with particle size ranging from 27 to 38. EDX analysis has correctly identified formation of silver as the result of biosynthesis in both samples. From this study it can be recognized that drying plant materials for synthesizing nanoparticles may affect the capping abilities and cause particles to agglomerate. A lot work need to be carried out in future to understand the synthesis mechanism hence improving the morphology of biosynthesized nanoparticles.

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