



## Biosynthesis and Characterization of Silver Nanoparticles from the Lemon Leaves Extract

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**Abstract.** The synthesis and characterization of Ag nanoparticles from *Citrus limonum* (lemon leaves) collected the Eastern Black Sea region was investigated in this study. A household microwave system device was used for microwave extraction of lemon leaves samples. The extract was prepared by taking 10g of dried lemon leaves. 10 g of sample was shaken in 100 mL of water for 90 min and extracted in a household microwave device at 4 minutes, 600 W. Ag nanoparticles were synthesized that the obtained aqueous solution was taken in different volumes by mixing 1 mM and 5mM AgNO<sub>3</sub> solution. The colloid solution was subjected to microwave in an oven 1, 3, 5, 10, 15, 20 and 30 minutes at 90, 180, 360 W. Then production of AgNPs, the mixture was watched by UV-Vis spectroscopy (Shimadzu UVP-1240 spectrophotometer) measurements at different wavelengths (300 – 800 nm) for SPR of silver nanoparticles. The transition from yellow to a dark brown, shows the synthesis of silver nanoparticles.

**Keywords:** Lemon leaves, Microwave Assisted Extraction, Silver nanoparticul, UV-Visible.

## Limon Yaprakları Ekstraktından Ag Nanopartiküllerin Biyosentezi ve Karakterizasyonu

**Özet.** Bu çalışmada, Doğu Karadeniz Bölgesinde toplanan limon yapraklarından (*Citrus limonum*) Ag nanopartiküllerin sentezi ve karakterizasyonu araştırılmıştır. Limon yaprağı örneklerinin mikrodalga ekstraksiyonu için bir ev mikrodalga sistemi cihazı kullanıldı. 10 g kurutulmuş limon yaprağı alınarak ekstrakt hazırlandı. Oda sıcaklığında, 10 g numune 100 mL suda 90 dakika çalkalandı ve bir ev mikrodalga cihazında, 600 W gücünde 4 dakika ekstrakte edildi, elde edilen sulu çözeltiden farklı hacimler alınarak 100 mL AgNO<sub>3</sub>(1, 5 mM) çözeltisi ile karıştırılır ve karışım, 90, 180, 360 W gücünde 1, 3, 5, 10, 15, 20 ve 30 dakika boyunca mikrodalgaya maruz bırakılarak Ag nanopartikülleri sentezlendi. Daha sonra üretilen AgNP'lerin kolloid çözeltisi, AgNP'lerin yüzey plazmon rezonansı (SPR) için UV-Vis spektroskopisi ile (Shimadzu UVP-1240 spektrofotometre) farklı dalga boylarında (300 - 800 nm) ölçümleriyle izlendi. Sarıdan koyu kahverengiye renk değişimi gümüş nanopartiküllerin sentezini gösterir.

**Anahtar Kelimeler:** Limon yaprakları, Mikrodalga Destekli Ekstraksiyon, Gümüş nanopartikül, UV-Görünür.

### 1. INTRODUCTION

In recent years, nanoparticle synthesis has received great attention owing to their unequalled properties and potential applications [1]. Silver nanoparticles have been synthesized by diverse physical and chemical methods [2]. When the physical methods are costly, chemical methods

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utilize toxic and hazardous chemicals which constitute significant threat to the environment and the synthesized silver nanoparticles can have reverse effects in biomedical applications due to the toxic chemicals adsorbed on their surface. The synthesis of metal nanoparticles in general and silver nanoparticles in particular exhibits a promise with potential applications in cosmetics, dermatology, pharmacology but also in catalysis and nanotechnology in general [3-5]. Especially progressive and under big expansion is the topic of green synthesis of silver nanoparticles utilizing readily available capping agents and reducing agents taken from plants and thus from renewable sources. Chemical synthesis have been shown to be simple and alternatively from green synthesis methods using either biological microorganisms or plant extracts [6].

The purpose of the work was to produce the AgNPs by exerting lemon leaves extracts which were operated in microwave assisted extraction. Microwave force is a good means for fast reduction of silver ions to silver nanoparticles at various circumstances, for example different extract volume, AgNO<sub>3</sub> concentrations, reaction time. Characterization of silver nanoparticles was using UV-Vis spectroscopy. The reaction mixture changed brown and displayed UV-Visible spectra characteristic of silver nanoparticles.

## 2. MATERIAL AND METHODS

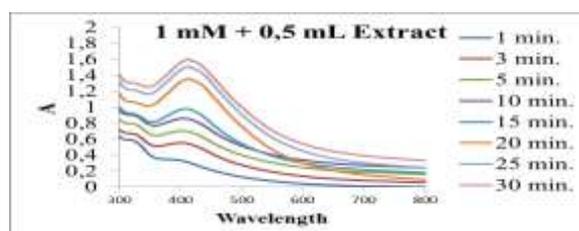
### 2.1. Preparation of tea extract

Fresh leaves of *Citrus limonum* (lemon leaves) were collected from the Eastern Black Sea region (Trabzon, Turkey). Then, the clean and fresh *Citrus limonum* leaves were dried in an airy environment and cut into small pieces. The extract was prepared by taking 10g of dried citrus limonum leaves. 10 g of dried citrus limonum leaves and 100 mL distilled water were placed flask and then were shaken for 90 min at room temperature. After shaking, the flask was transferred in a household microwave device. Extraction was carried out under a controlled 600 W microwave power for 4 min irradiation time. After extraction, the leaf extract filtrate was

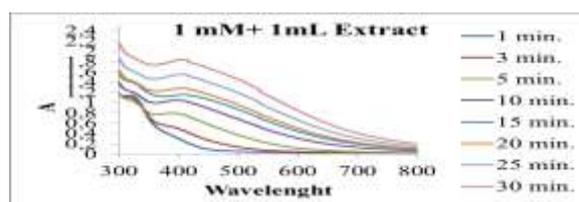
obtained by filtrating the solution through Whatman filter paper no.1. The extract is used as a reducing and stabilizing agent for the preparation of silver nanoparticles [7].

### 2.2. Production and characterization of AgNP

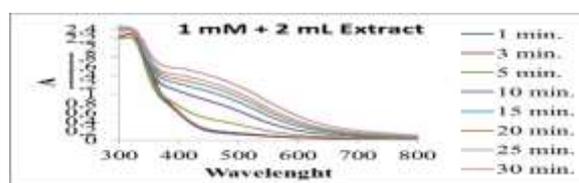
Metal nanoparticles were synthesized by adding aqueous solution of Ag NO<sub>3</sub> to lemon leaf extract. 0,5, 1, 2 mL samples of Lemon leaves solution was added to 100 mL of AgNO<sub>3</sub> solution (1mM and 5 mM) in this syntheses. After the mixture was subjected to microwave in an oven 1, 3, 5, 10, 15, 20 and 30 minutes at 90, 180, 360 W. Subsequently the production of AgNPs colloid solution was watched by UV-Vis spectroscopy measurements at regular intervals of time. The UV spectral peaks for silver nanoparticles range from 400 to 480nm [8]. Absorption spectra were measured on a Shimadzu UVP-1240 spectrophotometer. Each method was repeated three times.



(a)



(b)

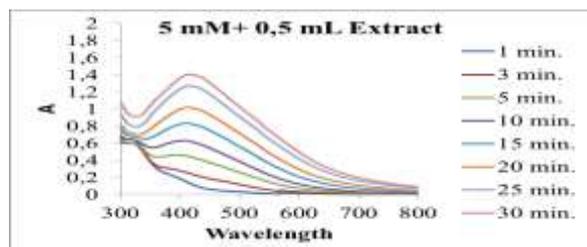


(c)

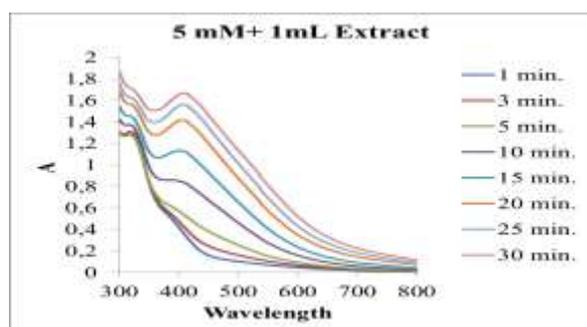
**Figure 1.**Uv-vis spectra of AgNPs obtained by using leaf extract of Lemon at various time (1 mM AgNO<sub>3</sub> and a)0,5 mL, b)1 mL c)2 mL Lemon leaf extract).

### 3. RESULTS AND DISCUSSION

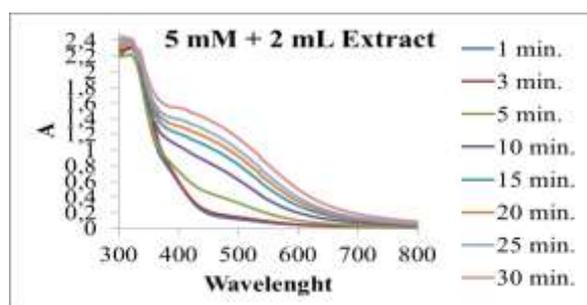
Silver nitrate ( $\text{AgNO}_3$ ) was used as sources of  $\text{Ag}^+$  ion required for that the produce of silver nanoparticles. The color of the solutions turned from yellow to dark brown is strong indication of Ag nanoparticle formation in the solution after treatment. SPR absorption spectra of silver nanoparticles produced from 1 mM (Fig.1) and 5 mM (Fig.2)  $\text{AgNO}_3$  concentration.



(a)



(b)



(c)

**Figure 2.** Uv-vis spectra of AgNPs obtained by using leaf extract of Lemon at various time (5 mM  $\text{AgNO}_3$  and a)0,5 mL, b)1 mL c)2 mL Lemon leaf extract).

Silver nanoparticles were successfully generated by extracts with 0,5 mL extract volume (Fig.1a and Fig.2a). It is clear that AgNPs were successfully produced with 0,5 mL lemon leaf extract that specific resonance band surveyed around 400-460 nm then by 15 minutes subject.

The band reached to maximum height after 30 minutes (Fig.1 and Fig.2).

Economical, simple and fast production of AgNP was achieved. Using lemon leaf infusion extracts produce stable silver nanoparticles.

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