



## Phytosynthesis of silver nanoparticles using *Otostegia persica*

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### ABSTRACT

In this study we researched about the synthesis of silver nanoparticle by the aqueous extract of *Otostegia persica*. In the first the results of HPLC was showed extracts of *Otostegia persica* contains poly phenols compound such as sinapic acid, caffeic acid, trans-feralic, gallic acid, p-coumaric acid and vanillin that sinapic acid, caffeic acid, trans-feralic are significant compound. Therefore, in this research, we have attempted to synthesize nanoparticles by using the aqueous extract of the *Otostegia persica*, which contains compounds such as sinapic acid, caffeic acid, trans-feralic acid, gallic acid, p-coumaric acid and vanillin. In this study, it was found that the aqueous extract of *Otostegia persica* is able to synthesis silver nanoparticles. In this research, after the reaction of solutions with each other, the first step was the color change from green to brown. Based on previous research, the reaction mixture changes color by adding different concentrations of metal ions. These color changes are caused by the stimulation of surface plasmon vibrations in silver nanoparticles, so the change in the color of the reactive mixture indicates the synthesis of silver nanoparticles. The aqueous extract of *Otostegia persica* was used as a stabilizer or capping agent and reducing agent to reduce  $Ag^+$  to metallic silver. The phenolic compounds in the *Otostegia persica* extract have the ability to react with silver ions in silver nitrate solution and exchange electrons and reduce silver ion ( $Ag^+$ ) to neutral silver ( $Ag^0$ ) in nano dimensions. Then we tried to optimize the research and the various components were optimization such as the time, pH, the concentration of extract and silver nitrate. Finally, the volume of the extract was analyzed and by using UV device, we proved the formation of silver nanoparticles and was observed a peak in the area of 734 nm. The results were showed that in the concentration of 1 mM from silver nitrate and the temperature of 22 C and pH=8 are the optimal conditions for the formation of silver nanoparticles. Then were sampled from the silver nanoparticles, the average size of silver particles and the structure of

nanoparticles were determined by using TEM device and the size of nanoparticle it was found 34 nm and its shape was observed as a sphere. Then we using FTIR and XRD for proved the formation of silver nanoparticles and we proved the existence of silver nanoparticles. Therefore, in this study, it was found that using polyphenolic compounds in the aqueous extract of *Otostegia persica* as a natural, harmless, inexpensive and with antioxidant and reducing properties can be used for the synthesis of metal nanoparticles, including silver nanoparticles that these silver nanoparticles are very important in the medical and pharmaceutical industries. The general conclusion from this research is the high value and importance of medicinal plants in the green synthesis of nanoparticle, which is a suitable alternative instead of using harmful chemicals, including the *Otostegia persica*, which has the ability to be planted and harvested in areas has different varieties of Iran and the plant is rich in secondary compounds, including polyphenolic compounds with high reductive and antioxidant properties, which is a suitable option for synthesis nanoparticles with appropriate shape and size.

**Keywords:** Green synthesise, *Otostegia persica*, Plant extract, Silver nanoparticles, Silver nitrate.

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