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FLOWER – BASED ECO – FRIENDLY SYNTHESIS OF NOBLE METALLIC NANOPARTICLES: A COMPREHENSIVE EXPERIMENTAL STUDY

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Introduction

There is a constant need for synthetic methods that help increase the environmental protection and the human health and, as a consequence, various unconventional routes are studied. The eco – friendly synthesis of noble metallic nanoparticles constitutes an important branch of nano-biotechnology, a specialized scientific domain of nanotechnology that reunites biological mechanisms with physical-chemical methods to obtain nanoparticles with unique properties. Plants are excellent precursors for large-scale synthesis of silver (AgNPs) and gold (AuNPs) nanoparticles and researchers worldwide are constantly developing new and improved preparation routes that enable a better control of the properties and applications of the resulted phyto – noble metallic nanoparticles. This research paper described the eco – friendly synthesis of AgNPs and AuNPs from flowers: *Convolvulus arvensis*, *Melilotus officinalis* and *Solidago virgaurea* with important benefits to human health. Both noble metallic nanoparticles were prepared from the flower's aqueous extracts under different temperature conditions (room temperature, 30^0 C and 50^0) and, also, preliminary experiments were carried out under microwave irradiation. The two noble metallic nanoparticles were characterized using known spectrophotometric techniques and by investigating the antioxidant and antimicrobial activity.

Materials and methods

All the flowers used in the present research experiments were purchased readily dried and used to prepare the corresponding aqueous extracts that were further mixed with either silver nitrate ($AgNO_3$) or tetrachloro auric acid ($HAuCl_4$) to eco – synthesize the noble metallic nanoparticles. The formation of AgNPs/AuNPs was investigated using ultra – violet visible (UV-Vis), Fourier transformed infrared spectroscopy (FTIR), dynamic light scattering (DLS) spectra and their antioxidant activity was determined using 2,2 diphenyl 1 - picrylhydrazyl (DPPH) assay. All the aqueous extracts were characterized using qualitative and quantitative assays.

Antimicrobial activity was evaluated using the disk-diffusion method with microbial inoculum sown on the surface of Petri dishes.

Results and conclusions

The qualitative screening for chemicals of the three aqueous flower extracts revealed the presence of saponins, carbohydrates, flavonoids, etc., highlighting their excellent capacity to green synthesize AgNPs and AuNPs. Quantitative spectrophotometric determinations revealed that total content of flavonoids (TCF) had the highest value in the case of *Melilotus officinalis* (789.533 mg/L), followed by *Convolvulus arvensis* (695.833 mg/L) and *Solidago* virgaurea (600.023 mg/L). UV – Vis spectra were recorded in the region of 250 – 800 nm, at different time intervals, in order to study the stability of both noble metallic nanoparticles in time. The results obtained at room temperature revealed a maximum at 435 nm (AgNPs - *Convolvulus arvensis*), 433 nm (AgNPs - *Melilotus officinalis*) and 441 nm (AgNPs - *Solidago virgaurea*, while for the corresponding AuNPs the maxima ranged from 525 nm (*Convolvulus arvensis*) to 544 nm (*Melilotus officinalis*). Fourier transformed infrared spectroscopy allowed a precise determination of the functional groups present in both aqueous extracts and noble metallic nanoparticles thereof: a strong band at 3287 cm^{-1}, representing the alkynes, was observed in all the samples. Antimicrobial tests showed that *E. coli* exhibited sensibility to both green synthesized AgNPs, whatever the temperature conditions used.

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