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"Green synthesis of nanoparticles by using *Nigella sativa* (Kalonji) of methanolic and water extracts as reducing and stabilizing agents"

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Abstract

Nanoparticles can be synthesized from various physical, chemical and biosynthetic methods. Synthetic methods are considered harmful and hazardous due to the pollution. The use of harmful chemicals is avoided in biosynthesis of nanoparticles, green synthesis of nanoparticles provide enhanced efficiency as compared to the other methods. Green synthesis establishes the pollution free and environmentally friendly approach. In this study the nanoparticles were formed from methanolic and water extracts of *Nigella sativa* (Kalonji). Nanoparticles of metals and metal oxides fabricated from plant-extract based methods possess amazing physiochemical and biological properties due to the unique morphologies, stability and controlled geometry. The synthesized nanoparticles were confirmed by using different characterization techniques such as SEM and UV-Visible spectroscopy

Introduction

Humans are continuously motivated for making their lives prosperous and easy through invention and innovation. Nanoscience is an emerging field which provides solution to our global problems. In nanoscience our perspective is to look at matter and its interactions with energy, chemicals and biological systems and leads to the great interest in autonomous movement of objects at nanoscale. Nanotechnology has its roots deepinto fields like chemistry, biology and physics. Nanoparticles include the particles having sizes from 1-100 nm at least in one dimension. 'Nano' word is derived from Greek word 'nanos' meaning "tiny or dwarf" (Min Chung etal., 2016). There are two categories of nanoparticles: inorganic nanoparticles and organic nanoparticles. Inorganic nanoparticles comprise metallic nanoparticles (like Au, Cu, Al, Ag, Zn), semi-conductor nanoparticles (like ZnS, ZnO2, CdS) and magnetic nanoparticles (like Co, Ni, Fe), whilst organic nanoparticles include carbon nanoparticles (carbon nanotubes, nanowires, quantum dots) (Nadiyah M. A. and Mohammad. M. H., 2021). Nanotechnology includes the synthesis, development, modification and applications of nanoparticles. Nanoparticles can be synthesized by using noble metals such as platinium, sodium, zinc etc. using various chemical and physical methods (Khan, Faryad, et al., 2022).But these methods are often considered as hazardous to environment. Green-biosynthetic methods are used for the fabrication of nanoparticle using biological systems such as yeast, fungi, bacteria and plant extracts. Plant extract based green synthesis of nanoparticles is considered as eco-friendly, cost-effective and it does not involve any harsh and extreme conditions like high temperature, high pressure and release of toxic substances. The biological fabrication of nanoparticles is considered beneficial use of waste materials, high efficiency, and ease of formation of nanoparticles, eco-friendliness and cost-effectiveness. (Sikiru, Surajudeen, et al., 2022).

Medicinal herbs have been used for the treatment of variety of diseases and ailments from pre-historic times, as these herbs contain the Phyto-chemicals required for the particular disease. Phyto-chemicals are the focus of researchers because of their beneficial effects for human health including anti-carcinogenic, anti-atherogenic, antiulcer, anti-inflammatory, immune modulating, antimicrobial and analgesic effects. The search for plant based antioxidants has greatly increased due to its importance. (Rao U S M etal., 2016).

Objectives

Plant based synthesis of nanoparticles is considered as much "cleaner and greener" as it is valid of any toxic chemicals. Plant based fabrication of nanoparticles is gaining our research is mainly focus on the synthesis under moderate popularity as it is cost effective, involves easy sampling, does not require expensive instrumentation and extreme physical conditions.

The chief objective of this research is to attempt synthesis of metal and metal oxide nanoparticles by using extract of *Nigella sativa* in order to produce nanoparticles of varying sizes and afterwards these particles will be subjected for their screening to find out their physiochemical and biological properties. The part of of our research is mainly focus on the synthesis under moderate laboratory conditions, characterization of synthesized nanoparticles and their evaluation against in-vitro biological assay will be carried out from reputed research institute.

Methodology

The seeds of *Nigella sativa* were washed thoroughly twice with distilled water to remove any impurities present on the seeds. It was dried under sun light for three weeks. After the complete removal of moisture, the seeds were ground separately by electric grinder until it was completely converted into finely powdered form. The powder will be soaked in methanol and water separately to yield methanolic and water extract.

Synthesis of nanoparticles:

Salts solutions of specific concentrations of the desire metal and metal oxides were prepared in de-ionized water. The aqueous solutions of salts were allowed to stand for 24 hours in order to protect from sunlight. After 24 hours of soaking both the methanolic and water extracts were mixed separately with salt solution through dropping funnel with constant stirring at room temperature on magnetic stirrer plate. After completion of reaction the solution was centrifuged for a while and nanoparticles were collected and dried

Results

The silver nanoparticles were fabricated and confirmed from SEM, most of the silver nanoparticles were found ranging between 70 nm to 100 nm. (Figure-1)

The formation of silver nanoparticles was further confirmed by UV-visible spectroscopy. The maximum absorption of silver nanoparticles were found between 415-440nm. The absorption range of silver nanoparticle was according to the reported absorption range of silver nanoparticles. (Jardón-Romero E etal., 2022) (Figure-2)

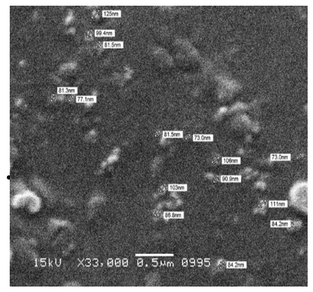

Figure-1: SEM of synthesized silver nanoparticles

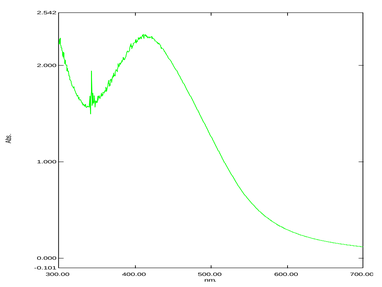

Figure-2: UV-visible spectroscopy of synthesized silver nanoparticles

Conclusion

The flavanoids and phenolics contents present in plant extracts were responsible for different biological properties, which were ultimately used for the treatment of many chronic and acute diseases. These nanoparticles can be further used to target the modified cells which can be the basis of many life threatening diseases. Utilization of these plant wastes for the synthesis of nanoparticles can a step towards revolution of mankind. In the current study we synthesized silver nanoparticles by using methanolic and water extracts of *Nigella sativa.*

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