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Studies Of Silveroxide Nanoparticles From Orange Peel

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ABSTRACT

The current study was attempted to develop silver nanoparticles from orange peel extract designed for the management of lung cancer. Silver nanoparticles were prepared using orange peel extract and nanoparticles forming material in an organic solvent to form an effective solution. The nanoparticles were formed by the solvent evaporation method. Nanoparticles are extremely small units whose size is articulated in nano-meters 10^{-9}. To transport medications to the target region, nanoparticles (NP) play a crucial function and can conjugate with different pharmaceuticals in a variety of ways. The prepared silver nanoparticle were characterized by UV spectroscopy, FTIR, XRD, SEM and anti-cancer activity. Orange peel silver nanoparticles exhibit satisfactory parameters results which shows this nanoparticle can be used for anticancer activity and both the compounds have good compatibility and effectiveness in the cancer cells and sustainability for the growth of the cancer. Silver nanoparticles are one of the most prominent compounds for cancer activity.

KeyWords: AgO nanoparticles, ,UV, FTIR, XRD, Antibactrial Studies

1. INTRODUCTION

A nanoparticle, sometimes referred to as a nano-scale particle, with a dimension of one to one hundred nanometers (nm). In both directions, the word is also used to describe fibres and nanotubes with diameters of 100 nm or less, as well as bigger particles up to 500 nm in size. A typical term for metal particles smaller than 1 nm is "atom clusters." The biological manufacture of nanoparticles from waste plant extracts is now being explored, with some researchers working on it and testing for anticancer properties. The dimension vary from 1 to 100 nm closely resembles the mesoscale, or range of 1 to 1,000 nm, which is generally associated with the field of colloid science. The distinction is mainly conceptual for molecules less than 100 nm. A nanoparticle is a single nano-object that has three coordinate dimensions smaller than 100 nm. Both one-dimensional (nanofibres and nanotubes) and two-dimensional (nanodiscs and nanoplates) nanoobjects are defined in the ISO standard. However, a more expansive yet scientific interpretation was approved by the European Union Commission in 2011. Innovative synthesis techniques and the investigation of new biological resources for nanoparticle production are made possible by green synthesis approaches. New plant species, microbial strains, and bioactive chemicals that can be used in green synthesis methods are constantly being discovered by researchers[1] Microorganisms used in synthesis processes include bacteria, fungus, algae, and plant extracts[2]. The biomolecules found in these organisms can be utilised as capping, stabilising, and reducing agents when creating nanoparticles. These biomolecules include, for example, polyphenols, proteins, and polysaccharides[3] . Green synthesis is an environmentally safe and sustainable way to produce nanoparticles that could be used in a number of industries, including electronics; one of the most prized and extensively consumed fruits in the world is Citrus sinensis. From the tender age of childhood to the advanced age of old age, sweet consumption when it is ripe has appealed as patterned after many, creating high market demand and simultaneous increasing commodity value of the plant worldwide production of Citrus sinensis is projected to be 115 million tons per year [5]. Citrus sinensis bioactive components, including anthraquinone, tannins, terpenoids, lavonoids, and saponins, are among the main causes of its high production [6]. The Citrus sinensis peels contain many phytochemicals, they are rich in nutrients, and have been used in various pharmaceutical and food formulations [7]. The plant extract is commonly used to treat antioxidant, antitumor, antimicrobial, anti-in lammatory and gastroprotective[8].The remarkable surface area of nanoparticles about their volume amplifies their reactivity and lends them utility in medication administration[9]. Size Dependent Properties: The physical, chemical, and optical characteristics of nanoparticles can alter as they go closer to the nanoscale. A variety of disciplines, including materials science, electronics, and optics, make use of this size-dependent behavior[10]. Quantum Effects: Quantum effects become important at the nanoscale, resulting in distinctive optical, electrical, and magnetic properties[11]. For instance, the size-tunable fluorescence of quantum dots makes them useful in imaging and display technology. Orange peel, the outer, protective skin of an orange fruit, contains a diverse substance, including essential oils, flavonoids, vitamins, and dietary fiber[12].

2. EXPERIMENTAL METHODS

2.1 SYNTHESIS OF SILVER OXIDE NANO PARTICLES

About 2g of powdered peel were boiled in 200ml of distilled water for 30 minutes. The resulting orange color extract were cooled to room temperature and it can be double filtered by using what man filter paper to get the pure extract of orange peel. Then the extract was stored in a refrigerator in order to be used for further experiments. Initially, 10 ml of orange peel extract was mixed with 50 ml of 20% NaOH solution. Subsequently, 5 ml of this mixture was combined with 50 ml of distilled water in a 250 ml beaker. While stirring constantly, silver nitrate and ammonium carbonate solutions was added drop wise. There resulting suspension was stirred at 750 rpm for one hour at 24°C.Theprecipitate was then filtered and washed multiple times with ethanol and ammonia solution. Following this, the precipitates were dried in a vacuum for 12 hours. To complete the synthesis, the precipitates were calcinated in a hot air oven at 350°C for 5 hours. Finally, the silver oxide nanoparticles were collected and stored in a vacuum-sealed container.

2.2 CHARACTERISATION OF SILVER OXIDE NANO PARTICLES

2.2.1 UV-Visible Spectroscopy

The extract, AgO NPs were scanned in entire UV-Visible range (200-800nm) to assess the constituents present in leaf powder, AP extract, AgONPs. Ultraviolet-visible spectroscopy or Ultraviolet-visible spectrometer (UV-Vis) refers to the absorption spectroscopy in the UV-Visible spectral region. This means it uses light in the visible range directly affects the perceived colour of the chemicals involved. In this region of the electromagnetic spectrum, molecules undergo electronic transitions' spectroscopy is based on the interaction between light and the matter when the matter absorbs the light, it undergoes excitation and excitation, resulting in the production of a spectrum.

2.2.2 Fourier Transform Infra-red Spectroscopy (FTIR)

FTIR Spectroscopy of orange peel nano particles was analyzed to detect the presence of functional groups. Infra-red spectrophotometer-based methods perhaps the most effective technique for detecting functional groups in various compounds. The FTIR spectrum of orange peel extract were recorded by using BIORAD-FTS-7PC type FTIR spectrometer.. FTIR peaks were recorded for scans within the wavelength range 4000-650cm per sec.

2.2.3 X ray Diffraction Spectroscopy

X-ray diffraction analysis (XRD) is a technique used in materials science to determine the crystallographic structure of a material. XRD works by irradiating a material with incident X-rays and then measuring the intensities and scattering angles of the X-rays that leave the material. A primary use of XRD analysis is the identification of materials based on their diffraction pattern. As well as phase identification, XRD also yields information on how the actual structure deviates from the ideal one, owing to internal stresses and defects.

Crystals are regular arrays of atoms, whilst X-rays can be considered as waves of electro-magnetic radiation. Crystal atoms scatter incident X-rays, primarily through interaction with the atoms electrons. This phenomenon is known as elastic scattering; the electron is known as the scatterer. A regular array of scatterers produces a regular array of spherical waves. In the majority of directions these waves cancel each other out through destructive interference, however, they add constructively in a few specific directions, as determined by Bragg's law:

2.2.4 Anti – Bacterial Activity

Sample preparation

1 mg of AgO NPs samples were dissolved in 1 mL of ethanol, which is used as a stock and a required concentration of 25µl was standarded from it.

Agar Disc Diffusion Test

The Antibacterial screening of the Sample AgO NPs carried out by determining the zone of inhibition using the agar disc diffusion method (Bauer, 1996). The given samples were tested against pathogenic gram positive bacteria Stahylococcus aureus (MTCC- 3160) and gram negative bacteria Pseudomonas aeroginosa(MTCC-424).

Bacterial Inoculums Preparation

Inoculum of Stahylococcus aureus MTCC- 3160 and *Pseudomonas* aeroginosaMTCC-424 was prepared in a respective broth and kept for incubation at 37^{o} C for 18-24 hrs.

3. RESULT AND DISCUSSION

3.1 UV-Visible Spectral Studies

Figure 1 represents a UV-Visible (UV-Vis) absorption spectrum, which illustrates the absorbance of a sample across a range of wavelengths, typically from 200 to 800 nanometers.. The sharp decline in absorbance after 330 nm suggests that the sample does not absorb significantly in the visible region (400–700 nm), implying that the substance is likely colorless to the human eye. Beyond 400 nm, the absorbance remains low and relatively flat, with a slight rise near 800 nm that may be due to minor background noise or weak interactions. Overall, this spectrum suggests the presence of UV-active functional groups, such as aromatic rings or conjugated systems, but no significant visible light absorption.

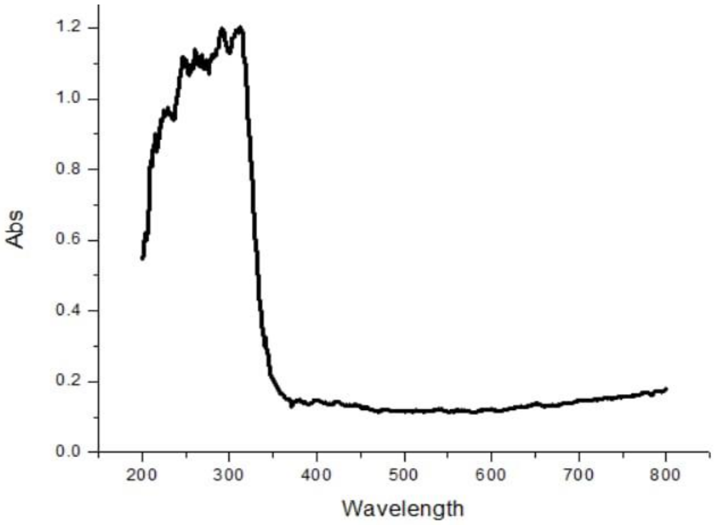

Figure .1 UV and Visible Spectral Studies of AgO NPs

3.2 Infrared Spectral Studies

Figure 2 represents Infrared (IR) spectrum, absorption of infrared radiation by a sample at different wave numbers. The x-axis denotes the wave number range from 4000 to 400 cm⁻¹, while the y-axis represents % transmittance (%T), where lower values indicate stronger absorption. The spectrum shows a broad and strong absorption around 3287.73 cm⁻¹, which is characteristic of O-H (hydroxyl) or N-H (amine) stretching vibrations, indicating the presence of alcohols, amines, or possibly water. A sharp peak at 1492.68 cm⁻¹ suggests C=C stretching, typical of aromatic rings. Peaks around 1042.59 cm⁻¹ and 786.63 cm⁻¹ correspond to C-O stretching (esters, ethers, or alcohols) and C-H bending (aromatics or alkanes), respectively. The presence of multiple peaks in the fingerprint region (below 1500 cm⁻¹) indicates a complex molecular structure. The detailed interpretation of this IR spectrum depends on the specific functional groups present in the compound, but overall, it suggests the presence of hydroxyl or amine groups, aromatic rings, and possibly ether or ester functionalities.

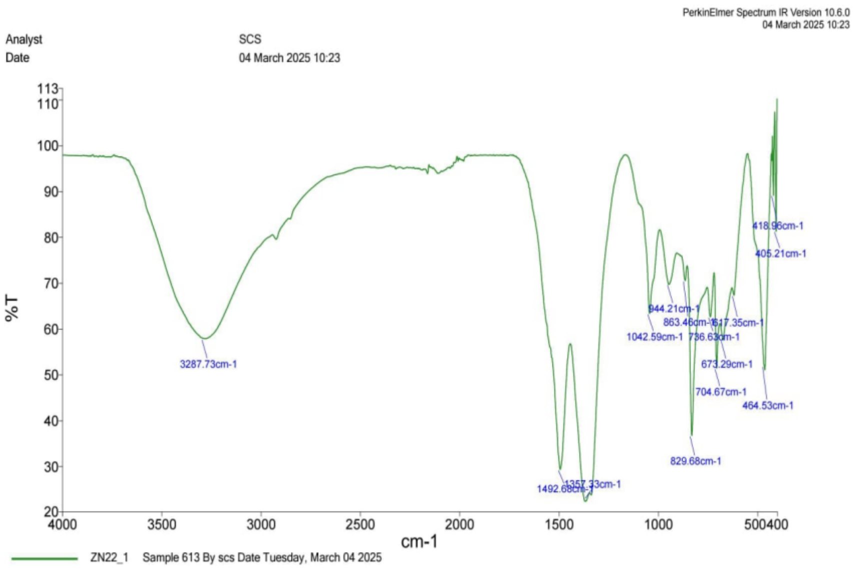

Figure .22 Infrared Spectral Studies of AgONPs

3.3 X-ray Diffraction Studies

This is an X-ray Diffraction (XRD) pattern, which provides information about the crystallographic structure, phase composition, and crystalline nature of a material. The x-axis represents the 2θ (Two-Theta) angles in degrees, while the y-axis shows the intensity (counts) of diffracted X-rays. The presence of sharp peaks at specific 2θ values indicates that the sample is crystalline. The most intense peaks at 13.927°, 27.970°, and 42.441° suggest strong diffraction from well-ordered planes, which are characteristic of a specific crystalline phase. By comparing these peak positions with standard reference databases (such as the JCPDS or ICDD), one can determine the material's identity. The presence of multiple peaks suggests either a single-phase material with complex symmetry or a multiphase mixture. The peak broadening, if present, can provide insights into crystallite size, with broader peaks indicating nano crystalline or amorphous components. Overall, this XRD pattern confirms that the analyzed sample exhibits high crystalline, and further phase identification can be achieved by comparing the peak positions with standard reference patterns. .

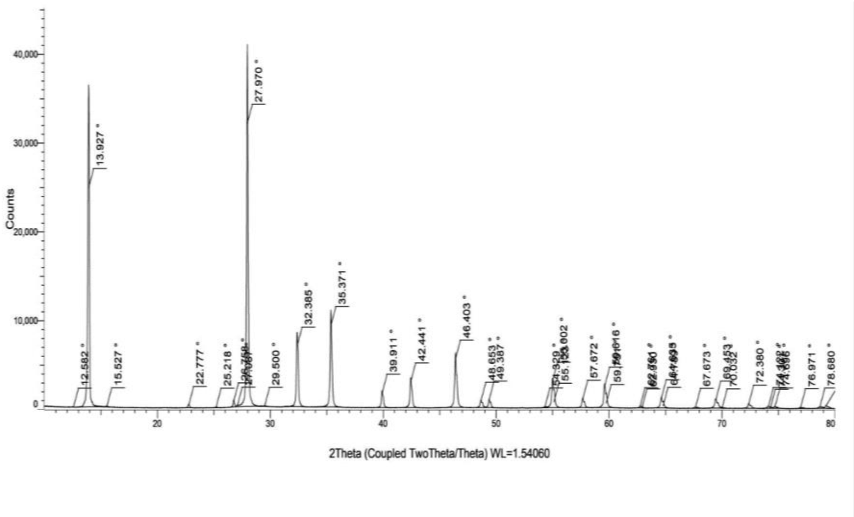

Figure. 3 X-ray Diffraction Studies of AgO NPs

3.4ANTI-BACTERIAL TEST

Disc diffusion Method

The medium was prepared by dissolving 38 g of Muller Hinton Agar (Hi Media) in 1000 ml of distilled water. The dissolved medium was autoclaved at 15 lbs pressure at 121 °C for 15 min (pH 7.3). The autoclaved medium was cooled and poured to the petriplates (25 ml/plate) and after solidification; the plate was swabbed with Stahylococcus aureus (MTCC- 3160) and Pseudomonas aeroginosa (MTCC-424). Finally, the sample AgO with 25µlwere loaded on a sterile disc and then placed on the surface of the swabbed plates. The plates were incubated at 37 °C for 24 hours. After the incubation, inhibition zones were examined and measured with transparent ruler in millimetres (including disc). The absence of zone inhibition was interpreted as the absence of activity .The activities are expressed as resistant, if the zone of inhibition was less than 7 mm, intermediate 8-10 mm and sensitive if more than 11 mm . Table 1 & figure 4 shows Anti-bacterial potential of AgO Nano particles.

Sample code (AgO)	Name of the Organism and concentration of sample Zone of inhibition (mm in diameter)	
	Stahylococcus aureus (G +ve)	*Pseudomonas aeroginosa* (G -ve)
PC	19	**20**
NC	-	**-**
CU14	12	**-**

Keywords: PC (Positive control) **(Streptomycin), NC** (Negative control),

Table 1:Anti-bacterial potential of AgONPs

Figure 4:Anti-bacterial potential of Sample AgONPs

4. CONCLUSION

In conclusion, the synthesis of silver oxide nanoparticles using orange peel extract has emerged as a promising area of research, offering a sustainable and eco-friendly alternative to traditional methods. The use of silver oxide nanoparticles reducing agent has been shown to produce silver oxide nanoparticles with unique properties, including antimicrobial, antioxidant, and photo catalytic activities. These nanoparticles have potential applications in various fields, including medicine, cosmetics, and environmental remediation. Further research is needed to fully explore the potential of silver oxide nanoparticles synthesized using orange peel, but the existing evidence suggests that this approach holds great promise for the development of novel,green technology-based applications. The antibacterial study demonstrated that the gram-negative (G^-) and gram-positive (G^+) bacteria are profound to the silver oxide nanoparticles.

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