International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Characterization and Formulation Loaded Silver Nanowire from *Jatropha Gossypiifolia* Stem Extract

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Abstract: ***Introduction: Silver nanowires are extensively studied in the current research using because of its high conductivity, transparency and stability. Objective: The objective of the contemporary research is to describe the most recent synthesis strategies in prepare and evaluate Ag nanowire of Jatropha gossypiifolia stem extract for high-aspect-ratio. Method: Preparation of AgNWs from Jatropha gossypiifolia stem extract were successfully synthesized by a green method and AgNWs were evaluated by in-vitro anticancer activity. Result: AgNWs are thoroughly studied in the recent research because of their exceptional phytochemical and biological capabilities. Aqueous silver ions were shown to be decreased in solution when exposed to a Jatropha gossypiifolia extract, which resulted in the creation of silver nanowire within 4 hours at 50^{0}C. A UV-visible, FTIR, particle size, zeta potential, and SEM spectrophotometer are used to characterize silver nanowires. Additionally, it was discovered that the diameters of the synthesized AgNWs ranged from 50 nm to 204 nm, with particle sizes of up to 748.3 nm. The colloidal suspension's zeta potential was discovered to be -27.3 mV. The AgNWs generated silver nanowires and demonstrated in-vitro anticancer efficacy against MCF-7 cells. Conclusion: AgNWs are a promising alternative to traditional materials for transparent electrodes. Therefore, silver nanowires have great potential application in optoelectronic devices and their cytotoxicity will be evaluated in our future work for nanomedicine applications.***

Keywords: *Jatropha gossypiifolia*, Successive Extraction, Silver Nanowire, Characterization, Anticancer activity.

1. Introduction

Cancer is series of disorders which is distinguished by the unregulated development and division of abnormal cells. The cancer is developed by different internal factors such as inherited mutations, hormones and immune conditions as well as external factors such as consumption of tobacco, some hazardous chemicals, radiation and infectious agents etc.[1] Cancer is a term that refers to a group of disorders defined by abnormal cell growth and the ability to invade or spread to other parts of the body. Conversely, benign tumors do not spread to other parts of the body. Lumps, irregular bleeding, prolonged coughing, weight loss, and changes in bowel habits are among the signs and symptoms. These signs could be cancer, but they could also be something else.[2] Humans are affected by about 100 different types of cancer.[3] Breast and colon cancers are two of the most common malignancies in Western nations, with a lot of research being done to avoid them.[4]

One-dimensional (1D) metal nanomaterials have attracted wide spread research interest due to their unique electrical, magnetic, optical, thermal and catalytic properties. Consequently, such nanomaterials have become promising candidates for a wide range of applications in optoelectronics, nanoelectronics, nanophotonics and micromechanics because of their exceptional density of states and high aspect ratio. [5]

In particular, silver (Ag) has the highest electrical and thermal conductivities of all metals, and its 1D form, referred to as Ag nanowires (AgNWs), has huge potential for practical applicability in a range of technologies. Over the years, numerous AgNW synthesis protocols have been proposed, including the use of soft and hard templates and a range of wet-chemical techniques like hydrothermal, solvothermal and polyol-based synthesis. [6, 7]

The plant part selected for the present study is *J. gossypiifolia L.* stem (Family: Euphorbiaceae) and was collected from Ahmednagar. The family contains 172 identified species. Euphorbiaceae is the largest family among the Angiosperms. It is placed in the order, “Geraniales”. Euphorbiaceae family is rich in secondary metabolites such as alkaloids, cyanogenic glycosides, diterpenes, glucosinolates, tannins and triterpenes. Jatropha is a Greek word in which “jatros” means doctor and “trophe” means food [8]. It is a bushy, gregarious shrub, up to 1.8m in height. The plant has traditional uses such as emetic, emmengogue, blood purifier, anti-coagulant, antibacterial, anticancer, antiulcer. The plant is known to possess various medicinal and pesticidal properties. Ethnobotanical uses of *J. gossypiifolia* have been reported for cancer, diarrhea, dysentery, skin diseases (leprosy), arthritis, ulcer, gum infections and wound healing.[9]

2. Material and Method

2.1 Material

Silver nitrate (99.9%) was acquired from Rajarambapu college of pharmacy, kasegaon, sodium hydroxide (NaOH) (80%), and sodium borohydride (NaBH4) (97%), was purchased from college. All chemicals were used without future purification. Double deionized water was used throughout the analysis.

2.2 Method

2.2.1. Preparation of *Jatropha gossypiifolia L.* Stem Extract (Successive extraction)

Jatropha gossypiifolia L. stem were collected washed and shallow dry. *Jatropha gossypiifolia L.* stem were powdered using a grinder and powder of 0.40 micron was collected using specific sieves. 50 gm of powder was packed in the thimble of muslin cloth in the extractor. Mouth of the extractor was fitted to bulb type condenser and neck was packed with sealing wax. Heating was continued with continuous flow of water through the condenser. For all the extractions temperatures was kept nearer to the boiling range of the respective solvent. Extraction cycle was observed continuously for Eighteen (18) cycles till completion of extraction. Solvent was recovered by distillation and extract heating mental. Finally dried extract were weighted and preserved in the air tight containers. Percent extract were calculated. Soxhlet apparatus was used for continuous extraction of the powdered crude drug. The material was packed in the apparatus and allowed to get extracted with hot solvent that continuously percolates from top to bottom. Condensed fresh solvent percolates every time through the powder and is the major advantages with these techniques.[10]

2.2.2. Synthesis of Silver nanowires[11]

In order to prepare Ag-NWs, *Jatropha gossypiifolia L.* stem extract (5ml) was added into the aqueous solution of AgNO3 (1Mm/10mL) under standard conditions. The mixture was constantly stirred at 50^0 C with continuous irradiation of UV-light of 265nm four hours. The colour changes from greenish to light green ppt and finally orange indicated after filtration followed by oven drying at 50^0 C for 30min (Figure 1A, B).

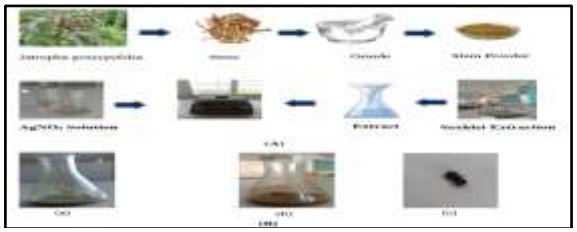

Figure 1: Fig. 1: (A). Step-wise representation for the formation of silver-Nanowires (AgNWs) by using *Jatropha gossypiifolia* stem extract under UV-irradition. (B). Extract + AgNO3 solution (a), Orange colored Ag-NWs (b), Ag-NWs Powder (c)

3. Charaterization of Ag Nanowire

The UV-Vis spectra of our reaction mixture provide qualitative insights on the nanowire yield of our synthesis. The fabrication of AgNWs was preliminarily established by recording the absorbance in UV/Vis spectra ata range of 300–800 nm. Fourier Transformation Infrared Spectroscopy (FTIR) was used to characterize the nanoparticles using the powder sample by ATR in the range of 400–4000 cm^{-1}. Particle range analysis of the formulated silver nanowire was performed using a HORIBA particle size analysis. Scanning electron microscope (SEM) is a type of electron silver nanowire used to produced images of a sample by scanning the surface of sample with a focused beam of electron. The electron interest with atoms in the sample and producing various signals that contain information about the sample's surface topography and composition. SEM can achieve resolution better than 1 nm.

4. Result and Discussion:

4.1 UV-Visible Analysis of Ag-NWs:

UV visible spectroscopy is a convenient and preliminary method for the characterization of nanomaterials. It is clear from spectra that there is no peak in *Jatropha gossypiifolia* stem extract solution which illustrates the absence of Ag-NWs. But after mixing $AgNO_3$ solution with extract, a change in color to yellowish-brown represented the reduction of silver ion and a peak appeared at around 415.0 nm due to surface plasma resonance that confirmed the synthesis of nanowires.

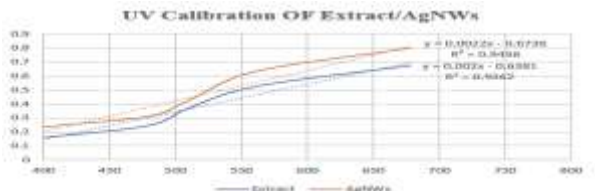

Figure 2: UV spectral analysis of Jatropha gossypiifolia stem extract

4.2. FTIR Studies Of AG NWs:

FTIR analysis of *jatropha gossypifolia leaves* extract and Ag-NWs was conducted to find out the functional groups accountable for the reduction and capping of silver ions.

Table 1: IR interpretation of reduced AgNWs

Sr. No	*Peak Observed [cm^{-1}]*	*Functional group*
1.	*2535.93*	C-SH stretching
2.	2838.7	C-H aliphatic
3.	3309.25	O-H stretching
4.	1697.05	C=O stretching
5.	3243.68	C-NH2 stretching
6.	3394.1	N-H stretching

4.3. Particle Size Determination of developed Silver nanowire preparation:

The mean particle size range in prepared Silver nanowire was observed to be length 48.3 nm and diameters ranging

from 50 to 204 nm which was found to be correct for the formulation. Which was the particle size in figure no. 4.

Figure 4: Graphical Presentation of particle size of AgNWs

4.4. Zeta Potential Determination of AgNWs:

The prepared AgNWs were assessed by measuring zeta potential. The value was obtained at -27.3 mV. The result of zeta potential is shown in figure no. 5.

Figure 5: Determination of Zeta Potential of AgNWs

4.5. Formation mechanism of silver nanowires:

In Order to have a good insight into the growth mechanism of AgNWs, we investigated their shape evolution by sampling from the solution at different stages.

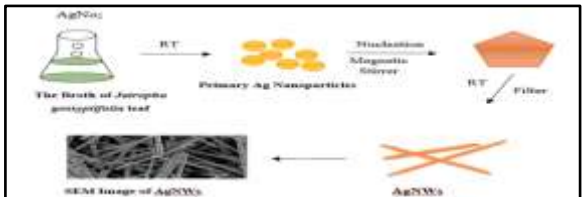

Figure 6: Formation Mechanism of Silver Nanowire (AgNWs)

4.6. *In-vitro* anticancer activity by MTT Assay:

The cytotoxicity activity of Extract and AgNWs against MCF-7 compared with 5-fluorouracil (standard drug). The MCF-7 assay study was work on the inhibition of cell proliferation. The % viability noted to be 80%, 58.38% and 56.68% for 500µg/ml of 5-fluorouracil, JG extract and JG AgNWs against MCF-7 respectively.

Table 2: % Inhibition against MCF-7 cell line

Sr. No	*Concentration (µg/ml)*	*Percentage (%) Inhibition*		
		Standard Drug	JG Extract	JG AgNWS
1	100	87%	65.24%	63.47%
2	200	86%	62.79%	61.16%
3	300	84%	60.28%	59.47%
4	400	83%	59.19%	57.30%
5	500	80%	58.38%	56.68%

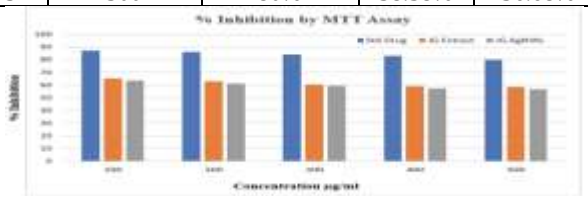

Figure 7: Graphically representation of % Inhibition against MCF-7 cell line

5. Conclusion

The Ag-Nw were successfully fabricated using $AgNO_3$ as a precursor and *jatropha gossypiifolia* stem extract under continuous irradiation of UV light. Hence, *Jatropha gossypiifolia* stem extract can be used for the synthesis of AG-NWs. The recent years, the eco-friendly method has been widely used for AgNWs synthesis with good control over nanowire morphology. While method possesses various advantages like simplicity and scalability. The characterization of the AgNWs is a fundamental process to evaluate their properties and to obtain information on composition, structure and morphology. The addition AgNWs exhibited cytotoxic action on some human cell lines (breast MCF-7) cell line.Therefore, silver nanowires have great potential application in optoelectronic devices and their cytotoxicity will be evaluated in our future work for nanomedicine applications.

6. Future Perspective

Future research in the area green synthesis of AgNWs is expected to emphasize large-scale extractAgNWs can be synthesised in huge quantities consistently at high yields to significantly lower costs.Additionally, the main objective will be to utilise green synthesis to produce a low-toxicity, biodegradable solvent using water. The majority of current methods for creating chemical nanoparticles from metal salts use harsh chemicals, surfactants, and additives.

Acknowledgment
The authors express their thanks to Dr. Girish G. Potdar Yashwantrao Chavan College Science, Karad for authentication of the plant material. The authors are thankful to Dr. Shrinivas Mohite. Principle and Management of Rajarambapu College of Pharmacy, Kasegaon, for providing the facilities necessary to carry out this research work.

Conflicts of Interest:
The authors report no conflicts of interest.

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