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# Green Synthesis of Silver Nanorods using Aqueous Seed Extract of Nigella Sativa and Study of its Antidiabetic Activity

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**ABSTRACT**

Silver nanoparticles have attracted considerable interest due to its potential applications in display technologies, thermoelectric and electronic devices, optoelectronic devices and biomedicine. In this study, silver nanorods are successfully prepared from $AgNO_3$ using Nigella sativa seed extract as a reducing agent. Metallic nanorods are traditionally synthesized by wet chemical techniques, where the chemicals used are quite often toxic and flammable. In the present study, we describe a cost effective and eco-friendly technique for green synthesis of silver nanorods from 1mM $AgNO_3$ solution through the seed extract of Nigella sativa as reducing as well as capping agent. Nanorods are characterized using UV–Vis absorption spectroscopy, FTIR, and SEM. SEM analysis showed uniformly sized nanorods. The nanorods are studied for its antidiabetic property on animal models.



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## INTRODUCTION

Silver nanorods are morphology of nano scale objects in nanobiotechnology. They are produced by direct chemical synthesis and range in size from 1-100nm and they are cubical and cuboidal in shape. They are larger in size than silver nanoparticles and have unique optical, electrical, and thermal properties and also synthesized from semiconducting material. They have many applications in display technologies, electrical fields and also in Mircoelectrical mechanical systems (MEMS) (Antariksh Saxena, R.M., 2010).

Green synthesis also called sustainable chemistry is one of the methods for producing silver nanorods. Green synthesis of nanoparticles is an eco-friendly approach which might pave the way for researchers across the globe to explore the potential of different herbs in order to synthesize nanoparticles (Babu, 2010). This method involves the use of plants which help in faster production of nanords. Also green chemistry seeks to reduce the negative impact of chemistry on the environment by preventing pollution at its source and using fewer natural resources. Silver nanoparticles have been reported to be synthesized from various parts of herbal plants such as *Piper longum (*Justin Packia Jacob, S., 2012*), Piper nigram (*Justin Packia Jacob, S., 2013*), Plumeria rubra (*Hana Sarah Haseeb, S., Justin Packia Jacob, 2014).

Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin, and/or when the body cannot effectively use the insulin it produces. Diabetes Mellitus is a metabolic disease worldwide. Various plants have shown management and treatment of diabetes mellitus (Ikram, Hussain, 2014). The black seeds or "black cumin" of *Nigella Sativa* (Ranunculacea) are used as chemical remedies and also as traditional Pharmacological medications for treatment of diabetes mellitus (Shabnam Javed, 2012).

## MATERIALS AND METHODS

*Nigella sativa* seeds were collected, ground, boiled and filtered to an aqueous solution. Silver nitrate solution was prepared in 1mM concentration. Synthesis and optimization process involves taking seed extracts in different volumes (1ml, 3ml, and 5ml) and adding to 40ml of silver nitrate solution. The mixture solutions were taken separately and kept under different conditions like sunlight and microwave exposure. The colour change was observed on formation of silver nanoparticles.

The silver nanoparticles were characterized using ultraviolet-visible spectroscopy method and the dimensions and size of the nanoparticles were noted

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using Scanning Electron Microscope. The presence of different compounds that are responsible for the production of silver nanorods were observed using (FTIR) Fourier Transform Infrared Spectroscopy.

Then further experimentations were done to study the Antidiabetic properties of *Nigella sativa* using animal models. The animal model used was Swiss Albino mice. The mice were taken and weighed at an average weight of 25-50gms. The mice were divided into five groups where each group comprised of five mice. In (group-1) the mice were given saline and were checked for its Blood glucose level and weight. In (group-2) the mice were fed with silver nanorods in normal conditions and tested for blood glucose level and body weight. In (group-3) the mice were given Alloxan which stops the insulin production by destroying the insulin producing cell so the glucose level is increased. In (group-4) the mice were fed with alloxan and the synthesized nanorods. In (group-5) the mice were fed with alloxan and a positive control Merformin and tested for its blood glucose level and body weight (Aftab Ahmad, 2014; Raju, S., K. Hemamalini, 2012).

## RESULTS AND DISCUSSION

The colour change from pale yellow to tan-brownish colour (Fig 1) was observed, this shows the presence of silver nanoparticles. The colour change is due to the optical property called surface plasmon resonance. Then the maximum absorbance was determined by scanning the solution between the range 400-480nm. Maximum absorbance or Plasmon resonance peak was observed at 446nm (Fig 2) which confirms the presence of siver nanoparticles.

### 3.1 *Sem Analysis:*

SEM analysis was done to check the dimensions and shape of the nanoparticles. In Fig 3 it is seen that the average size was found to be 77.7nm and the length and width were noted to be 1.09 micrometer and 239nm respectively.

### *3.2 Ftir Analysis :*

The FTIR spectroscopy results (Fig 4) shows the compounds responsible for the production of silver nanorods. FTIR spectroscopy, scanned at a range 500-4000cm-$^{1}$ of resolution to ensure the formation of silver nanoparticles. Bands are observed at 3420, 2920, 1630, 1380, 1020 and 583 cm-$^{1}$. The bands at 3420 and 2920 cm-$^{1}$ showed that reduction of silver ions in NPs. The band at 1630 cm-$^{1}$ showed the N-H bonding vibrate of amides. The band in seed extract at 1630 to 1380 cm-$^{1}$ after the bio reduction of AgNP's indicated the C=C stretching mode in the aromatic compounds which confirmed the presence of aromatic compounds like flavonoids.

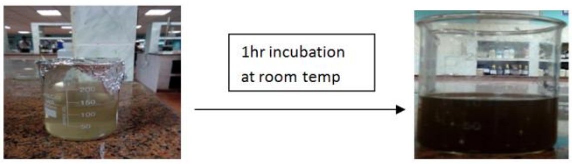


**Fig. 1:** Change of colour from light yellow to dark brown on exposure to sunlight.

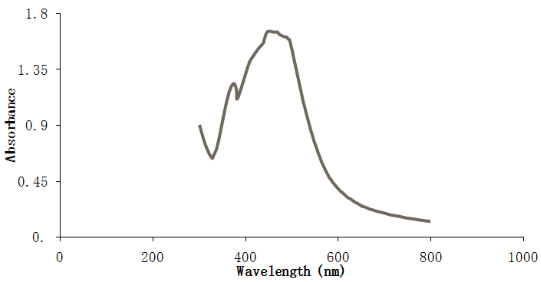


**Fig. 2:** UV spectrum of the AgNPs synthesized.

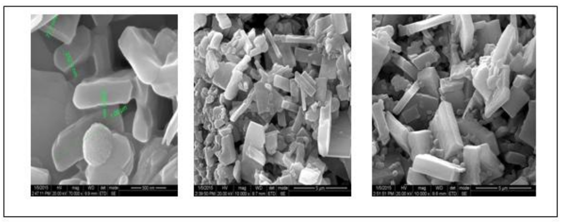

**Fig 3:** SEM image of silver nanorods synthesized using ***Nigella Sativa.***

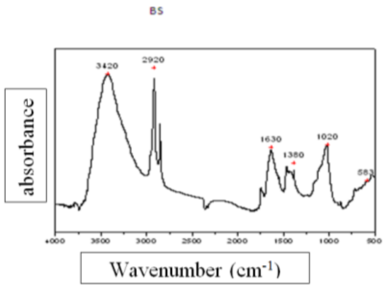


**Fig. 4:** FTIR spectra of silver nanorods synthesized using *Nigella Sativa*.

The results of anti-diabetic activity done using animal models are shown below

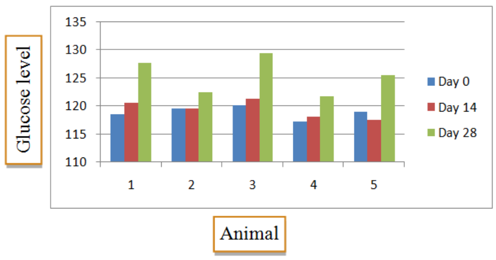


**Fig. 5:** Goup 1 (normal).

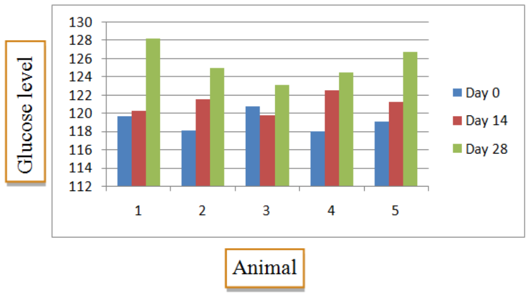


**Fig. 6:** Group 2 (NORMAL + SILVER NANORODS).

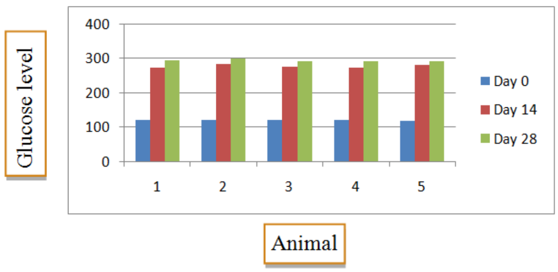


**Fig. 7:** Group 3(Alloxan).

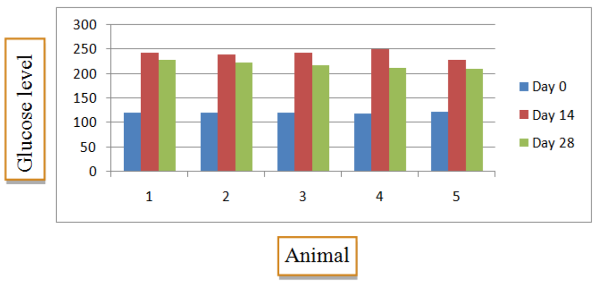


**Fig. 8:** Group 4(Alloxan+ SILVER NANORODS).

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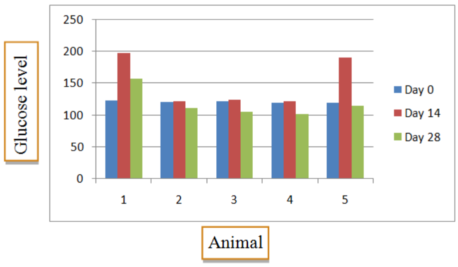


**Fig. 9:** Group 5 (MERFORMIN + SILVER NANORODS).

**4, *Conclusion:***

In conclusion plant mediated synthesis of silver nanorods is simple, rapid and ecofriendly technique. Ag nanorods biosynthesized using *Nigella sativa* seeds were characterized using SEM, UV-VIS and FTIR spectroscopic techniques. The SEM result indictaed the presence of well dimensioned silver nanorods of average diameter 77.7nm. The reduction of silver ions and stabilization of the silver nanorods was due to the participation of plant metabolites. FTIR result shows that flavanoids were responsible for the bioreduction of silver ions. Flavanoids are a group of chemical compounds that confer antimalarial, antibacterial, antidiabetic, antitumor property to the plant. Hence it can be inferred that the antidiabetic activity of the biosynthesized nanorods is due to the quassinoids present. Antidiabetic property of the biosynthesized nanorods were tested on animal models and the test gave positive results. Due to this property, the biosynthesized nanorods prove to be a potential candidate for medical applications.

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