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Antioxidant Activity of Silver Nanoparticles Synthesized Using Vetiveria zizanioides-In Vitro Study

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ABSTRACT

Introduction: Nanotechnology has a wide range of biomedical applications and nanoparticles can be devised to possess unique composition and functionalities, which can provide novel tools and techniques in biomedical research. Nanotechnology is one of the rapidly developing sciences in the past few years. Nanoparticles are materials that have all their dimensions in the Nano scale and measured in nanometres. The size-dependent physicochemical properties of nanoparticles promote their application in many products but the same unique properties also can lead to physiological responses in living systems by interaction with these materials.

Aim: The aim of the present study is to synthesize silver nanoparticles from aqueous extract of Vetiveria zizanioides plant and to evaluate its antioxidant potential.

Materials and methods: Plant extract of Vetiveria zizanioides was prepared and filtered by Whatman No 1 filter paper. Silver nitrate was added to the plant extract and kept in a magnetic stirrer for nanoparticle synthesis. The synthesized nanoparticle was preliminarily analysed using UV visible spectroscopy. Finally the left over solution was taken to calculate antioxidant activity.

Results and discussion: Antioxidant activity was calculated by DPPH method and the percentage of inhibition of silver nanoparticles synthesised from Vetiveria zizanioides was 46.9% for 10µL, 56.9% for 20µL, 61.5% for 30µL, 67.3% for 40µL and 72.4% for 50µL. Hence maximum inhibition was observed at 50µL that is at higher concentration

Conclusion: We can conclude that silver nanoparticles synthesised from Vetiveria zizanioides are a potent antioxidant agent. Since it shows a good activity in free radical scavenging, silver nanoparticles can be used in a clinical therapeutic application.

Key words: Antioxidant activity, Silver nanoparticles, *Vetiveria zizanioides*, DPPH assay, Innovative technique, Green synthesis

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INTRODUCTION

Nanotechnology has a wide range of biomedical applications and nanoparticles can be devised to possess unique composition and functionalities, which can provide novel tools and techniques in biomedical research [1]. In recent years, nanotechnology has been one of the most rapidly developing fields, with more studies reported on it [2–4]. Nanoparticles are materials that have all their dimensions in the Nano scale and measured in nanometres [5]. Nanoparticles can be used in medicine due to its increased interaction with microbes and has less side effects than drugs by reducing damage to healthy cells. The size-dependent physicochemical properties of nanoparticles promote their application in many products but the same unique properties also can lead to physiological responses in living systems by interaction with these materials [6]. Due to its superior physical, chemical, and biological properties, silver nanoparticles have recently gained a lot of attention [7]. Their superiority derives primarily from the scale, shape, composition, crystallinity, and arrangement of silver nanoparticles relative to their bulk types [8]. Efforts are being made to explore their attractive properties and utilize them in practical applications, such as anti-bacterial and anti-cancer therapeutics [9–12], diagnostics and optoelectronics [13], water disinfection [14], and other clinical/pharmaceutical applications [15].

Vetiveria zizanioides is an evergreen, perennial herb, having an appearance similar to lemongrass is found throughout the plains and lower hills of India, particularly

on the riverbanks and in rich marshy soil [16]. *Vetiveria zizanioides* can prevent soil erosion and is also helpful in rehabilitating metal-polluted soil [17]. Traditionally, the plant is used for aromatherapy, for stress, anxiety, nervous tension and insomnia [18]. *Vetiveria zizanioides* has been cultivated for many industrial applications, including the production of the commercially and medicinally valued volatile oil that can be obtained from its root [19]. Vetiver oil is commonly used as a odour contributor in the perfumery industry, cosmetics, soaps and used as a flavour agent in the food industry [20]. The essential oil of its root also appears to possess antioxidant activity [21].

One of the main contributing factors in the pathogenesis of many chronic disorders is oxidative stress [22]. Oxidative stress is a condition that happens when the balance between a cell's antioxidative defence and oxidants is disturbed by the presence of excessive oxidants. Free radicals and other reactive oxygen species are important factors in the ageing process [23]. As a result of the mitochondria's production of ATP, free radicals are generated when cells use oxygen to generate energy. Antioxidants fundamentally inhibit free radical propagation in biological systems [24,25]. The antioxidant capacity can be measured in medicinal plants or other materials for characterisation of the property [26–28]. Antioxidant activity of silver nanoparticles synthesised from aqueous extract of *Vetiveria zizanioides* plant has not yet been investigated. Our team has extensive knowledge and research experience that has translated into high quality publications [29–49]. The aim of the present study is to synthesize silver nanoparticles from aqueous extract of *Vetiveria zizanioides* plant and to evaluate its antioxidant potential.

MATERIAL AND METHOD

Extract preparation

In the present study, 1gm of *Vetiveria zizanioides* was added in 100 ml of distilled water and boiled for 10-15 minutes at 70 degree Celsius. After boiling, the plant extract was filtered by Whatman No 1 filter paper. 60 ml of 20 milli molar silver nitrate was prepared in 250 ml of conical flask; 40 ml of filtered plant extract was mixed to it and kept in a magnetic stirrer for nanoparticle synthesis. Colour change was observed after nanoparticle synthesis (figure 1&2). The synthesized nanoparticle was preliminarily analysed using UV visible spectroscopy. Prior to the final step, the nanoparticle solution was centrifuged at 8000 rpm to prepare nanoparticle pellet powder; it was dried in a hot air oven at 80 degree Celsius. The dried powder was sent for characterisation. Finally the left over solution was taken to evaluate its antioxidant activity. All the results were taken photographs and recorded in the excel sheets.

Figure 1: Figure represents the colour change observed after nanoparticle synthesis.

Antioxidant assay-DPPH method

DPPH assay was used to test the antioxidant activity of biogenic synthesized silver nanoparticles. Diverse concentrations (2-10 µg/ml) of *Vetiveria zizanioides* plant extract interceded silver nanoparticles were mixed with 1 ml of 0.1 mm DPPH in methanol and 450 µl of 50 mm Tris HCl buffer (pH 7.4) and incubated for 30 minutes. Later, the reduction in the quantity of DPPH free radicals was assessed dependent on the absorbance at 517 nm. BHT was employed as control. The percentage of inhibition was determined from the following equation,

% inhibition=Absorbance of control- Absorbance of test sample X 100/Absorbance of control

RESULTS

The percentage of inhibition of silver nanoparticles synthesised from *Vetiveria zizanioides* was 46.9% for 10µL, 56.9% for 20µL, 61.5% for 30µL, 67.3% for 40µL and 72.4% for 50µL. The percentage of inhibition of the standard was 76.56% for 10µL, 78.52% for 20µL, 85.63% for 30µL, 88.68% for 40µL and 93.15% for 50µL. Hence maximum inhibition was observed at 50µL that is at higher concentration (Table 1)(Figure 2). The silver nanoparticles synthesised from *Vetiveria zizanioides* have good antioxidant activity and are comparable to the standard.

Table 1: The table represents the antioxidant activity of silver nanoparticles synthesised from *Vetiveria zizanioides* compared to the standard.

No.	Concentration	Standard- % of Inhibition	Silver nanoparticles-% of Inhibition
1	10µL	76.56	46.9
2	20µL	78.52	56.9
3	30µL	85.63	61.5
4	40µL	88.68	67.3
5	50µL	93.15	72.4

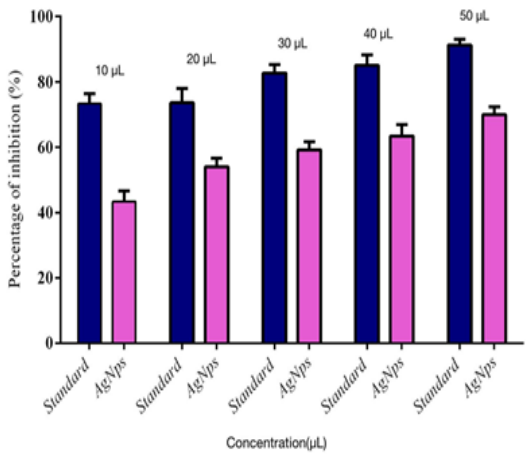

Figure 2: The graph represents the antioxidant activity of silver nanoparticles synthesised from *Vetiveria zizanioides* **by calculating the percentage of inhibition at different concentrations compared to the standard. Blue colour represents the silver nanoparticles synthesised from** *Vetiveria zizanioides***. Orange colour represents the standard. Maximum inhibition was observed at 50µL that is at higher concentration.**

DISCUSSION

Previous research works have reported on the various activities exhibited by the nanoparticles synthesised from natural sources such as cytotoxic and antimicrobial activity [50–52]. In a study, silver nanoparticles were synthesized from aqueous leaf extract of Cestrum nocturnum and its antioxidant and antibacterial activities were tested. The bacteriostatic and bactericidal activity of silver nanoparticles against 3 bacteria Escherichia coli, Enterococcus faecalis, and Salmonella typhi was determined using bacterial growth inhibition method. The results confirmed that the silver nanoparticles have more antioxidant activity as compared to vitamin C. Antioxidant and antibacterial activity of silver nanoparticles is due to the presence of bioactive molecules on the surface.

Silver nanoparticles were synthesised in a study, using an aqueous extract of the Nepeta deflersiana plant. Human cervical cancer cells were used to test the anticancer activity of silver nanoparticles synthesised from Nepeta deflersiana. The cytotoxic reaction was found to be concentration dependent. According to the results, there was also a substantial rise in ROS and lipid peroxidation, as well as a decline in MMP and glutathione levels. Biosynthesised silver nanoparticles caused cell death in HeLa cells, implying that silver nanoparticles have anticancer capacity. As a result, they can be used to treat the cervical cancer cells [53].

In future, silver nanoparticles biosynthesised from *Vetiveria zizanioides* can be assessed for its anticancer, anti-inflammatory, antifungal and antibacterial activity. The study's limitation was that it was conducted in vitro, so it cannot be assumed that the results of antioxidant activity could be translated into clinical effectiveness.

CONCLUSION

The silver nanoparticles biosynthesised from *Vetiveria zizanioides* have good antioxidant activity. We can conclude that silver nanoparticles are a potent antioxidant agent. Since it shows a good activity in free radical scavenging, further studies can be done on silver nanoparticles of its clinical therapeutic application.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest in the present study.

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