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Phyto-assisted Synthesis and Assessment of Anti-Inflammatory and Antioxidant Properties of Selenium Nanoparticles Prepared Using Banana Stem Extracts-An In-vitro Study

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ABSTRACT

Toxic chemicals are used in traditional nanoparticle synthesis processes, resulting in environmental toxicity. As a result, we must switch to "green synthesis." Previous studies have shown that selenium nanoparticles reinforced with banana stem extract have excellent antimicrobial properties. As a result, this research was carried out to determine the anti-inflammatory and antioxidant properties of selenium. Since selenium induces cell wall lysis due to intracellular material leakage, it is an excellent antimicrobial agent and was chosen to make a nanoparticle.

Aim: Aim of the study was phyto assisted preparation of nano selenium from banana stem cell and evaluation of its anti-inflammatory and antioxidant properties.

Material and methods: Anti-inflammatory and antioxidant properties of the nanoparticle were assessed using Bovine Serum Albumin (BSA) and DPPH Assay respectively at 10 µL, 20 µL, 30 µL, 40µL, 50 µL.

Results: Values for anti-inflammatory property of nanoparticles were higher than the standard values at 40µL, 50 µL concentrations. Percentage of inhibition was highest at 40 µL (86%) and 50 µL (84.6%). The values for antioxidant property of nanoparticles were found to be higher than the standard values at concentrations except at 40µL, 50 µL. Percentage of inhibition was highest at 20 µL (86.2%)

Conclusion: Within the limits of the study, it can be concluded that selenium nanoparticles have exceptional anti-inflammatory and antioxidant properties and further can be incorporated in dental material or can be used to coat suture materials to improve their properties.

Key words: Selenium, Characterisation, Green synthesis, Nanoparticle, Anti-inflammatory, Antioxidant properties

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INTRODUCTION

Nanotechnology is a relatively modern technology that has ushered in a new era in research. In recent years, nanoparticles have received a lot of attention in the scientific community. Optics, electronics, biomedical, and materials sciences1 have all benefited from this technology [1]. Some of the highlighted advantages of nanoparticles in recent years include potent antimicrobial, anticancer, antioxidant agents, drug, and gene delivery, and so on [1-4]. Nanotechnology is concerned with nanoparticles, which are atomic or molecular aggregates with a scale of less than 100 nanometres. There are essential elements that have had their atomic and molecular properties modified [5].

Chemical reduction, laser ablation, solvothermal, inert gas condensation, sol-gel process is some of the traditional methods used to make selenium nanoparticles. Even though traditional physical and chemical methods take less time to synthesise large quantities of nanoparticles, toxic chemicals are needed as capping agents to maintain stability, resulting in environmental toxicity [6]. Green synthesis, which avoids the use of toxic chemicals in the synthesis process, has several advantages in terms of environmental friendliness and usability for biomedical applications [6,7]. Since it does not involve complex processes such as intracellular synthesis and several purification measures, or the maintenance of microbial cell cultures, the use of agricultural wastes or plants and

their parts [8] has emerged as an alternative to chemical synthetic procedures.

Because of their nontoxicity, biocompatibility, and drug and bactericidal activity, selenium nanoparticles (SeNP) are superior [9]. The contact killing property of selenium has been extensively researched in recent years. Increased bacterial intracellular oxidative stress in the bacterial cell wall due to ion release from the selenium surface results in bacterial cell lysis, according to studies [1]. Due to the high incidence of oxide layer formation on the nanoparticle surface, which results in reduced antibacterial property [10], the synthesis of selenium nanoparticles is highly technique responsive.

The objective of this study was to use banana fruit extract to synthesize selenium nanoparticles and to evaluate its anti-inflammatory and antioxidant properties as its excellent potency against oral aerobes was already proven in the previous studies. Also, the nano composite showed minimal cytotoxic effects [2].

MATERIAL AND METHODS

Preparation of banana extract

Freshly picked organic banana fruits were thoroughly washed in distilled water several times. Using a sterile knife, the fruit was sliced into small pieces and ground into small particles using a mortar and pestle. 1 molar solution of banana extract was made by combining 1 gram of banana pulp with 100 ml distilled water.

Synthesis of Se nanoparticle

As described in the previous steps, nanocomposite synthesis was accomplished by mixing

100 ml of 1M selenium nanoparticle solutions. An orbital shaker was used to stir the nanoparticle solution overnight, followed by a magnetic heated stirrer, before colour shift was detected. Hourly UV-vis spectrometric readings were taken to track the selenium nano composite synthesis. After centrifuging the resulting mixture, selenium nanoparticles were obtained [11].

Anti-inflammatory activity

Test group

10 µL, 20 µL, 30 µL, 40 µL and 50 µL of the nanocomposite solution was taken in 5 test tubes respectively. To each test tube 2 ml of 1% Bovine Serum Albumin (BSA) was added. 390 µL, 380 µL, 370 µL, 360 µL and 350 µL of distilled water was added to the test tube containing 10 µL, 20 µL, 30 µL, 40 µL and 50 µL of nanoparticles respectively.

Control group

2 mL of Dimethyl Sulphoxide (DMSO) was added to 2 mL of BSA solution.

Standard group

10 µL, 20 µL, 30 µL, 40 µL and 50 µL of Diclofenac Sodium was taken in 5 test tubes respectively. To each test tube 2 mL of 1% Bovine Serum Albumin (BSA) was added. The test tubes were incubated at room temperature for 10 minutes. Then they were incubated in a water bath at 55°C for around 10 minutes. Absorbance was measured at 660 nm in the UV Spectrophotometer.

% Inhibition was calculated using the following formula:

% of inhibition=$(Control\ OD - Sample\ OD \div) Sample\ OD$ x 100

RESULTS

Anti-inflammatory assay showed the following values at the end of the study:

Anti-inflammatory property of nanoparticles was higher than the standard values at 40µL, 50 µL concentrations. Percentage of inhibition was highest at 40 µL (86%) and 50 µL (84.6%).

Antioxidant test showed the following values for the nanocomposite: The values for antioxidant property of nanoparticles were found to be higher than the standard values at concentrations except at 40µL, 50 µL. Percentage of inhibition was highest at 20 µL (86.2%).

DISCUSSION

One of the most pressing challenges in modern medicine is the development of effective drug delivery mechanisms that can increase the therapeutic profile and efficacy of therapeutic agents. The development of a variety of new drug delivery systems has been aided by advances in nanoscience and nanotechnology, which have enabled the synthesis of new nanomaterials.

Nanoparticle synthesis has advanced rapidly in recent years, relative to the early part of the century [12]. The nanoparticles were previously synthesised using traditional methods. Even though traditional physical and chemical methods take less time to synthesise large quantities of nanoparticles, toxic chemicals are needed as capping agents to maintain stability [7].

Since hazardous substances were used, these approaches resulted in environmental toxicity. To prevent the use of such hazardous chemicals, the Green Synthesis process was proposed and is now commonly used all over the world. It is both an environmentally friendly and cost-effective method [13]. As a result, we conducted this research to assess the cytotoxicity of selenium nanoparticles reinforced with banana extract. In previous research, the antibacterial properties of the same were found to be excellent against oral microbes.

Banana extract has been shown in studies to be an excellent antioxidant, scavenging reactive oxygen species, and protecting antioxidant enzymes like SOD, which are important for cellular defence.

Selenium has long been recognised for its antibacterial properties. Selenium nanoparticles serve as antioxidants

by inhibiting chain reactions, peroxide decomposition, transition metal ion catalyst attachment, radical scavenging operation, and continued hydrogen abstraction [13,14]. The ability to absorb, neutralise, or quench singlet and triplet oxygen are only a few of the important factors that contribute to antioxidant activity. Selenium is an excellent antioxidant and anti-inflammatory and thus was used in this study and even showed promising results.

CONCLUSION

Within the limits of this study, it can be concluded that selenium nanoparticles have exceptional anti-inflammatory and antioxidant properties. With a possibility to be included in the dental materials to improve the properties.

CONFLICT OF INTEREST

The author declares that there are no conflicting interests.

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