Clinical Case Reports and Studies
2026 Volume 13, Issue 3
DOI: 10.59657/2837-2565.brs.26.336

BioRes Scientia
Value your Research

Research Article

Open Access

Eco-Friendly Synthesis of Silver Nanoparticles from Dragon Fruit (Selenicereus undatus) Peel and Assessment of Anti-inflammatory, Anti-bacterial, and Anti-diabetic Activities

J Bagyalakshmi*, T Ajeethkumar

Department of Pharmaceutics, Sri Ramakrishna Institute of Paramedical Sciences, College of Pharmacy, Tamil Nadu, Coimbatore-44, India.

**Corresponding author: J Bagyalakshmi.*

Abstract

This study uses the aqueous peel extract of *Selenicereus undatus* (dragon fruit) as a natural reducing and stabilizing agent to create silver nanoparticles (AgNPs) in an environmentally friendly and economical manner. The phytochemicals in the peel reduced 1 mM $AgNO_3$ as part of the green synthesis process, as demonstrated spectroscopically by a surface plasmon resonance peak in the UV–visible range and visually by a shift in color from pale yellow to brown. The peel extract's phytochemical screening identified alkaloids, flavonoids, tannins, phenols, terpenoids, steroids, saponins, and glycosides, all of which aided in the stability and production of nanoparticles. The anti-inflammatory, antibacterial, and antidiabetic properties of the synthesized AgNPs were assessed in relation to those of their crude extract equivalents and conventional reference medications. AgNPs had better anti-inflammatory action (IC_{50} = 102.54 µg/mL) in protein denaturation tests than the peel extract (IC_{50} = 125.9 µg/mL). AgNPs considerably outperformed the extract in antibacterial testing, producing inhibition zones of 17 mm against Staphylococcus aureus and 15 mm against Escherichia coli, respectively. AgNPs' increased antidiabetic potential (IC_{50} = 75.16 µg/mL) in comparison to the extract (IC_{50} = 113.31 µg/mL) was further demonstrated by α-Amylase inhibition experiments. These findings suggest that the synergistic interaction between silver and bioactive phytochemicals gives the green-synthesized AgNPs their higher pharmacological effect. All things considered, S. undatus peel-mediated AgNPs offer a viable and durable platform for creating multipurpose nanotherapeutics that target metabolic diseases, microbial infections, and inflammation.

Keywords: selenicereus undatus; silver nanoparticles; anti-inflammatory; anti-bacterial; anti-diabetic activity

Introduction

Silver nanoparticles are extensively researched nanostructures that range in size from 1 to 100 nanometers. They are primarily utilized in novel and enhanced biomedical applications like protective coatings, medication delivery, tissue scaffolding, and wound dressings. Silver nanoparticle surface functionalization creates a lot of opportunities. [citation] Silver is frequently utilized in the form of silver nitrate because of its antimicrobial characteristics. Furthermore, microorganisms are more exposed due to the larger surface area of silver nanoparticles, which increases their effectiveness over free silver [1]. Silver nanoparticles (AgNPs) are being more and more used in a variety of industries, including food, medicine, consumer products, and healthcare, due to their unique physical and chemical characteristics, which include high yield, solubility, and stability. Biological activity, optical, electrical, thermal, and great electrical conductivity are some of these attributes. Because of these special characteristics, they are utilized in a wide range of products, including consumer goods, antibacterial agents, coatings for medical devices, optical sensors, and cosmetics; in the food and pharmaceutical industries; in orthopaedics, diagnostics, and drug delivery; and, ultimately, they improve the anticancer drugs' capacity to kill tumours [2,3,4].

Synthesis of Silver Nanoparticles

Synthesis of silver nanoparticles using physical methods

There are two types of physical methods: "top-down" and "bottom-up." The "top-down" method uses mechanical milling processes to reduce bigger materials into smaller particles. The challenge of attaining the appropriate particle size and shape is a significant disadvantage of this approach. The defects created in the lattice parameters during the milling process lead the samples' magnetic characteristics to deviate from those of ordinary particles of the same size. By chemically combining smaller ions in a liquid or gaseous phase, the "bottom-up" technique creates nanoparticles [5,14].

Synthesis of Silver nanoparticles using chemical methods

Silver nanoparticles are created chemically using organic solvents or water. Metal precursors, reducing agents, and stabilizing/capping agents are typically the three primary ingredients in this process. Two steps are typically involved in the creation of silver nanoparticles: nucleation and growth. There are two general approaches for creating silver nanomaterials: "top-down" and "bottom-up." Bulk metals are mechanically ground using the "top-down" process, and then colloidal protective agents are used for stability. Sono-decomposition, chemical reduction, and electrochemical techniques are examples of "bottom-up" techniques. Unlike physical procedures, which have a lesser yield, chemical methods have a high yield, which is one of their main advantages. Many of the aforementioned techniques are somewhat costly, though. Furthermore, the chemicals utilized to create AgNPs such as 2-mercaptoethanol, thio-glycerol, citrate, and borohydride are hazardous and toxic [6,7].

Plant name-Selenicereus undatus

Scientific classification

Kingdom: Plantae
Subkingdom: Tracheobionta
Super division: Spermatophyta
Division: Magnoliophyta
Class: Magnoliopsida
Subclass: Caryophyllidae
Order: Caryophyllales
Family: Cactaceae
Genus: *Selenicereus* (formerly *Hylocereus*)
Species: *Selenicereus undatus* (Haw.) D.R. Hunt [8,23].

Vernacular class:

English: Dragon Fruit / Night-blooming Cactus
Hindi: Kamalam
Gujarati: Kamalam
Marathi: Kamalam
Bengali: Dragon phol
Tamil: Kamalam pazham / Pitaya
Telugu: Kamalam Pandu / Pitaya Pandu
Sanskrit: Not traditionally documented due to non-native origin [24].

Materials and methods

Plant Collection and processing

The peel was collected from the local market and authenticated in Coimbatore city. This process involves collecting leaves from the fresh and healthy fruit of *Selenicereus undatus*. The peel is then separated from the fruit and any impurities. This is an important step because any impurities in the peel can affect the quality of the final extract. This was then stored in an airtight container.

Extraction preparation

The fresh peel of the dragon fruit was cut into small pieces. After weighing, 10g of the pieces were taken. These were boiled in 100ml of water for 1hour and then allowed to cool. The mixture was filtered, and the resulting filtrate was collected for further use in experiments [9].

Phytochemical Analysis

Test for Alkaloids (Wagner's Test)

1ml of the extract was treated with Wagner's reagent. The formation of a brown-red precipitate indicated the presence of alkaloids [10].

Tests for Flavonoids

1ml of the extract was added to a test tube, followed by three or four drops of sodium hydroxide. A deep yellow color appeared, which gradually turned colorless when a few drops of dilute HCl were added, indicating the presence of flavonoids.

Tests for Phenolic Compounds (Ferric Chloride Test)

2ml of the extract and 1ml of methanol were added to a test tube. 2 drops of ferric chloride were added, and the appearance of a yellowish-green color indicated the presence of phenolic compounds [10].

Tests for Steroids (Liebermann Burchard Test)

2ml of the plant extract were added to a test tube, followed by three drops of concentrated HCl and 1ml of Liebermann Burchard solution. The formation of a blue-green ring indicated the presence of steroids.

Tests for Saponins (Foam Test)

2ml of the extract and 5ml of distilled water were added to a test tube. A few drops of KOH were added, and the mixture was shaken vigorously for five minutes. The formation of a constant foam within ten minutes indicated the presence of saponins [13].

Tests for Proteins (Biuret Test)

1ml of the plant extract was mixed with an equal amount of 40% NaOH solution and two drops of 1% copper sulphate solution. The appearance of a violet color indicated the presence of proteins [10].

Tests for Tannins (Ferric Chloride Test)

2ml of the extract were added to a test tube, followed by three or four drops of ferric chloride solution. The formation of a dark blue or greenish-black color indicated the presence of tannins.

Tests for Terpenoids (Salkowski Test)

2ml of the extract were mixed with 2ml of chloroform and 3 ml of concentrated sulphuric acid. The formation of a reddish-brown color indicated the presence of terpenoids [11].

Tests for Glycosides (Ferric Chloride Test)

2ml of the extract were mixed with 2ml of glacial acetic acid containing a few drops of ferric chloride solution. The formation of a brown colour ring indicated the presence of glycosides.

Green Synthesis of Silver Nanoparticles

1mg of the extract was weighed and diluted to 10 ml with water.

Preparation of 1mM Silver Nitrate Aqueous Solution

A 1 mM solution of silver nitrate was made by dissolving 0.017 grams of silver nitrate in 100 ml of distilled water. For later usage, the solution was kept in an amber-coloured bottle [12,13,1].

Synthesis of Silver Nanoparticles

100 ml of 1 mM aqueous $AgNO_3$ was mixed with an aliquot (1 ml, 3 ml, and 5 ml) of the aqueous plant extract. For half an hour, the reaction mixtures were continuously stirred at 120 rpm on a magnetic stirrer. In order to identify the development of silver nanoparticles, which are characterized by a colloidal brown color, the color change of the mixes was observed. Double beam UV-visible spectroscopy was used to measure the SPR band position throughout a range of wavelengths from 300 to 800 nm in order to characterize the nanoparticles [14,1].

Separation of Silver Nanoparticles

AgNPs were finally taken out of the reaction mixture. The reaction mixture was then divided into two equal portions and put into a sterile, previously weighed 10ml centrifuge tube. An Eppendorf centrifuge tube containing the produced nanoparticles was centrifuged for 30 minutes at 10,000 rpm. Following centrifugation, distilled water was used to purify the suspended pellet. To extract the AgNPs, the purified pellets were subsequently dried for 24 hours at 60 °C. The final powder was removed for additional analysis. Pharmacological activity of *Selenicereus undatus* peel extract and green synthesized *Selenicereus undatus* peel extract silver nanoparticles [15,2].

Pharmacological Activity

Anti-inflammation

The peel of the dragon fruit, *Selenicereus undatus,* is full of phytochemicals with a potent antioxidant capacity that support anti-inflammatory actions, including flavonoids, phenolic acids, vitamin C, and betalains, particularly betacyanins. By lowering oxidative stress, these substances inhibit inflammatory signaling cascades, including NF-αB activation and the downstream production of NOS and COX-2, which are frequently seen in *in-vitro* models. Peel extracts scavenge reactive oxygen species and lower oxidative damage markers (like lipid peroxidation) in cell-based and biochemical studies. This is correlated with activated immune cells producing less proinflammatory cytokines like TNF-α and IL-6. Several studies show that methanolic or aqueous peel extracts reduce inflammatory responses in some *ex-vivo* experiments and standard *in -vitro* models (such LPS-stimulated macrophages), indicating both direct radical scavenging and signalling pathway modification. Preparations of fermented or phenolic-enriched peels frequently exhibit higher activity, suggesting that potency is significantly influenced by the extraction technique and chemical profile. Therefore, the combined effects of antioxidants and polyphenols, which both neutralize radicals and suppress the expression of pro-inflammatory genes, provide a plausible explanation for the peel's anti-inflammatory properties. The data consistently support the peel as a source of chemicals capable of influencing early inflammatory responses and justify future mechanistic and *in-vivo* investigation, even though the majority of the evidence is *in-vitro* (DPPH, NO inhibition, cytokine tests). All things considered, *Selenicereus undatus* peel is a promising botanical anti-inflammatory candidate whose action is mostly mediated by the inhibition of important inflammatory mediators induced by antioxidants [16].

Anti-bacterial

A combination of phenolics, flavonoids, tannins, and organic acids found in dragon fruit peel have antibacterial properties that work against both Gram-positive and Gram-negative bacteria. Red and white pitaya peel extracts have demonstrated detectable zones of inhibition and MIC reductions against organisms like *Staphylococcus aureus, Escherichia coli, Pseudomonas spp.*, and *Bacillus spp.* in agar-diffusion and broth microdilution studies. The activity of these extracts varies by solvent, concentration, and cultivar. Mechanistically, flavonoids and phenolic substances can inhibit bacterial enzymes, chelate vital metal ions, disrupt bacterial cell membranes, and prevent the formation of biofilms all of which lower virulence and survivability. Additionally, a number of studies demonstrate that peel extracts decrease biofilm biomass and bacterial adherence in model systems, which is advantageous for cosmetic or food preservation applications. Crucially, extracts enriched for bound polyphenols or betacyanins have greater antibacterial power, and bactericidal activity can be greatly increased by processing techniques like fermentation and solvent fractionation. Although they are rarely as effective as conventional antibiotics, crude peel extracts are appealing for supplementary applications due to their broad-spectrum activity, affordability, and food-grade origin (e.g., wound dressings, preservative blends, or as a capping/reducing agent in nanoparticle synthesis that itself boosts antimicrobial action). The peel's usage in the creation of green nanoparticles and topical preparations is justified by the overall evidence that it is a repeatable source of antimicrobial phytochemicals [17,14].

Anti-diabetic

Selenicereus undatus peel extracts have been shown in several *in-vitro* and some *ex-vivo* studies to inhibit the enzymes α-amylase and α-glucosidase, which break down carbohydrates, and to have antioxidant qualities that can shield pancreatic β-cells from oxidative damage. These two complementary mechanisms are important for glycaemic control. In conventional colorimetric tests, phenolic fractions and bound polyphenol extracts from the peel exhibit strong enzyme inhibition, frequently with inhibition percentages high enough to be compared to plant-derived antidiabetic leads; fermentation or fractionation also tends to increase inhibitory potency. Furthermore, antioxidant activity (DPPH, reducing power, total antioxidant capacity) provides an indirect antidiabetic benefit by lowering oxidative stress, which is a factor in β-cell malfunction and insulin resistance. While robust in vivo glycaemic efficacy in animal models is less frequently reported and seems to depend on dose/formulation, some studies also report that whole fruit or peel extracts modulate glucose uptake in cell models and alleviate postprandial glucose spikes in starch-agar diffusion type assays. Together, the betalains, flavonoids, and phenolic acids that make up the peel's bioactive profile offer tenable biochemical foundations for the indirect antioxidative defence of glucose-regulatory tissues as well as direct enzyme inhibition. If the effects are confirmed in carefully monitored in vivo trials, these data encourage the development of peel-derived fractions or formulated extracts (including their inclusion into nanoparticles/nanoemulgels) for supplementary glycaemic-control techniques [18,12].

Pharmacological activity for a green synthesis selenicereus undatus peel extract silver nanoparticle

Anti-inflammatory activity

The *in-vitro* protein denaturation inhibition experiment was used to assess the anti-inflammatory properties of *Selenicereus undatus* peel extract and its green-synthesised silver nanoparticles (AgNPs), with diclofenac sodium acting as the reference. With an IC_{50} value of 82.8 µg/mL and an 85% inhibition at 500 µg/mL, diclofenac demonstrated strong inhibition. The crude peel extract demonstrated modest anti-inflammatory action, with an IC_{50} of 125.9 µg/mL and a 79.11 percent inhibition at 500 µg/mL. Remarkably, the AgNPs formulation performed better, resulting in an 82.53 percent inhibition at 500 µg/mL and a lower IC_{50} of 102.54 µg/mL. AgNPs' larger surface reactivity and nanoscale size are responsible for the increased activity, which may help them interact more effectively with biological targets and protein substrates. A dose-dependent response across concentrations validates the assay's stability and dependability. The results show that adding S. undatus phytoconstituents to silver nanoparticles increases their anti-inflammatory effectiveness. This is probably because the phenolic and flavonoid chemicals in the peel extract have synergistic antioxidant and protein-stabilizing properties. According to these findings, AgNPs produced from *S. undatus* have a great deal of promise as natural anti-inflammatory agents on par with prescription medications.

Antibacterial activity

The antibacterial activity of Selenicereus undatus peel extract and its AgNPs was tested against Gram-positive *Staphylococcus aureus* and Gram-negative *Escherichia coli* using the agar well diffusion method, with benzoyl peroxide (2 µg/mL) as the reference. At 200 µg/mL, the peel extract alone showed moderate inhibitory zones of 3 mm against E. coli and 10 mm against S. aureus. At the same dose, however, the

AgNP formulation produced zones of 17 mm and 15 mm, respectively, indicating significantly increased inhibition. The increased surface area, continuous release of silver ions, and smaller particle size all contribute to the improved antibacterial activity by denature proteins, break microbial membranes, and disturb cellular respiration. The findings provide a distinct dose-dependent response, demonstrating the AgNPs markedly superior efficacy over the crude extract. Its potential use in topical antimicrobial formulations and wound-healing applications is supported by the synergistic combination of silver nanoparticles and bioactive phytochemicals from S. undatus, which creates a strong antibacterial system effective against both Gram-positive and Gram-negative pathogen [20].

Anti-Diabetic activity (α-amylase inhibition)

Using Acarbose as a reference standard, the antidiabetic effectiveness of *Selenicereus undatus* peel extract and its AgNP formulation was evaluated using the *in-vitro* α-amylase inhibition assay. At 500 µg/mL, acarbose showed 85.63 percent inhibition with an IC_{50} of 87.28 µg/mL. In contrast to the AgNPs, which exhibited superior activity with 81.12% inhibition and a lower IC_{50} value of 75.16 µg/mL, the peel extract had noteworthy inhibitory action, attaining 78.53% inhibition with an IC_{50} of 113.31 µg/mL. The increased surface area of the nanoparticles, which allows for higher contact with α-amylase active sites, and the inclusion of phenolic and flavonoid chemicals, which are known to regulate carbohydrate metabolism, may be the cause of the heightened inhibition seen for the AgNPs. The enhanced effectiveness also suggests a potential synergy between the AgNPs metallic core and phytochemical capping agents. These results suggest that *S. undatus* based AgNPs have promising enzyme inhibitory ability, making them viable natural α-amylase inhibitors for managing type 2 diabetes mellitus and postprandial hyperglycaemia [13].

Conclusion

The current study effectively illustrated an environmentally acceptable method of producing silver nanoparticles by employing *Selenicereus undatus* (Haw.) D.R. Hunt peel extract as a natural stabilizing and reducing agent. Characterization verified that stable AgNPs with higher biological activity were formed in comparison to the crude extract. The green-synthesised nanoparticles shown strong anti-inflammatory, antibacterial, and antidiabetic properties; they were significantly better than the unaltered extract and as effective as common medications like acarbose, diclofenac, and benzoyl peroxide. Silver ions and the phytoconstituents of dragon fruit peel, primarily phenolics, flavonoids, and betalains, work in concert to produce these effects, which include potent antioxidant, enzyme-modulating, and membrane-disruptive qualities. The findings demonstrate the potential use of S. undatus peel in topical, antibacterial, and metabolic disease treatments, and also confirm its value as a source for green nanotechnology-based therapies. For upcoming drug development, further mechanistic and in vivo research is necessary to examine its pharmacological efficacy and safety.

References

1. Bagyalakshmi J, Sowmiyadevi B. (2024). Characterization and evaluation of green synthesized silver nanoparticles using *Moringa oleifera* leaf extract and its antihypertensive activity. *Annals of Clinical and Medical Case Reports, 13*(16):1-9.
2. Bagyalakshmi J, Navaneethkrishnan C, Priya K. (2024). Formulation and evaluation of soap film incorporated with green synthesized *Azadirachta indica* silver nanoparticles. *Nanoparticle, 5*(1):13.
3. Saraf S. (2010). Applications of novel drug delivery system for herbal formulations. *Fitoterapia, 81*(7):680-689.
4. Titus D, Samuel E.J, Roopan S.M. (2019). Nanoparticle characterization techniques. In *Green synthesis, characterization and applications of nanoparticles* (303-319). Elsevier.
5. Kolahalam, L. A., Kasi Viswanath, I. V., Diwakar, B. S., Govindh, B., Reddy, V., & Murthy, Y. L. N. (2019). Review on nanomaterials: Synthesis and applications. *Materials Today: Proceedings*. Elsevier.
6. Forough M, Farhadi K. (2010). Biological and green synthesis of silver nanoparticles. *Turki Jou of Enginee and Environmental Sciences, 34*:281-287.
7. Patel B.M, Kuchekar A.B, Pawar S.R. (2021). Emulgel approach to formulation development: A review. *Biosciences, Biotechnology Research Asia, 18*(3):459–465.
8. Betancur G, J.A, Muriel R, S.B, González J.E.P. (2020). Morphological characterization of the red dragon fruit—*Selenicereus undatus* (Haw.) D. R. Hunt—under growing conditions in the municipality of San Jerónimo (Antioquia,

Colombia). *Revista Facultad Nacional de Agronomía Medellín, 73*(1):9019–9027.

9. Phongtongpasuk S, Poadang S, Yongvanich N. (2016). Environmentally friendly method for synthesis of silver nanoparticles from dragon fruit peel extract and their antibacterial activities. *Energy Procedia, 89*, 239–247.
10. Yuniarsih N, Lenterani I. (2021). Formulation and physical stability test of facial gel wash dragon fruit (*Hylocereus polyrhizus*) peel extract. *IOP Conference Series: Materials Science and Engineering, 1071*(1):012012.
11. Suhartomi K.N, Gulo K.N, Saragih A.D, Martinus A.R, Ikhtiari R. (2020). Antioxidant properties of sweet orange peels in several fractions of methanolic extract. In *Proceedings of the International Conference on Health Informatics and Medical Application Technology.* 1:371-378.
12. Bagyalakshmi J, Bavya C. (2023). Preparation, characterization, and pharmacokinetic interactions study of green synthesized silver nanoparticles of *Pterocarpus marsupium* with antidiabetic drug. *International Journal of Research in Pharmacy and Pharmaceutical Sciences, 3*(1):1-20.
13. Bagyalakshmi J, Priya B, Bavya C. (2022). Evaluation of antidiabetic activity of aqueous extract of bark of *Pterocarpus marsupium* silver nanoparticles against streptozotocin and nicotinamide induced type 2 diabetes in rats. *Biomedical Jour of Scientific & Technical Research, 43*(1):34254-34268.
14. Bagyalakshmi J, Prathiksha M. (n.d.). *Green synthesis of* Citrus sinensis *peel (orange peel) extract silver nanoparticle and its various pharmacological activities*.
15. Gowda S, Sriram S. (n.d.). *Dragon fruit peel extract mediated green synthesis of silver nanoparticles and their antifungal activity against* Colletotrichum *truncatum causing anthracnose in chilli*.
16. Eid A.M, El-Enshasy H.A, Aziz R, Elmarzugi N.A. (2014). Preparation, characterization and anti-inflammatory activity of *Swietenia macrophylla* nanoemulgel. *Nanomedicine & Nanotechnology, 5*:1-10.
17. Vanaja M, Paulkumar K, Gnanajobitha G, Rajeshkumar S, Malarkodi C, Annadurai G. (2014). Herbal plant synthesis of antibacterial silver nanoparticles by *Solanum trilobatum* and its characterization. *International Journal of Metals*, 692461.
18. Bagyalakshmi J, Sivakumaran S.S, Priya K, Swathika R. (2023). Green synthesis and characterization of silver nanoparticles using *Cassia fistula* and assessment of its in vitro anti-diabetic activity. *Global Journal of Allergy, 9*(1):001-011.
19. Nishikito D.F, Borges A.C, Laurindo L.F, Otoboni A.M, Direito R, Goulart R.D, Nicolau C.C, Fiorini A.M, Sinatora R.V, Barbalho S.M. (2023). Anti-inflammatory, antioxidant, and other health effects of dragon fruit and potential delivery systems for its bioactive compounds. *Pharmaceutics, 15*(1):159.
20. Usharani S, Devi B.R. (2019). Synthesis of silver nanoparticles using orange peel extracts and their antibacterial activity. *World Journal of Pharmaceutical Research, 8*(10):854-869.
21. Hnawate R.M, Deore P. (2017). Nanoparticle-novel drug delivery system: A review. *International Journal of Current Research and Review, 5*(5):9–23.
22. Raza K, Kumar M, Kumar P, Malik R, Sharma G, Kaur M, Katare O.P. (2014). Topical delivery of aceclofenac: Challenges and promises of novel drug delivery systems. *BioM Rese Intern*, 406731.
23. Zaman, Q. U., Hussain, M. A., Khan, L. U., Cui, J. P., Hui, L., Khan, D., Lv, W., & Wang, H. F. (2023). Genome-wide identification and expression pattern of the GRAS gene family in pitaya (*Selenicereus undatus* L.). *Biology, 12*(1):11.
24. Khokha A. A, Hui L, Khan D, Hussain M.A, Lv W, Zaman Q.U, Wang H.F. (2023). Comprehensive characterization of SBP genes revealed their role under multifactorial stress combinations in dragon fruit. *Plant Stress, 10*:100294.

Cite this article: Bagyalakshmi J., Ajeethkumar T. (2026). Eco-Friendly Synthesis of Silver Nanoparticles from Dragon Fruit (Selenicereus undatus) Peel and Assessment of Anti-inflammatory, Anti-bacterial, and Anti-diabetic Activities, *Clinical Case Reports and Studies*, BioRes Scientia Publishers. 13(3):1-6. DOI: 10.59657/2837-2565.brs.26.336

Copyright: © 2026 J Bagyalakshmi, this is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Article History: **Received:** August 12, 2026 | **Accepted:** September 04, 2026 | **Published:** September 11, 2026