

# Advancing Science and Technology through Multidisciplinary Innovation toward the Future



**Dr. T. SOMANATHAN**

**Mrs. J. MONISHA**

**Mrs. P. GOWTHAMI**

**Dr. G.K. ABINAYA ISHWARYA**



**SRR**

Publicizing Research

ISBN 978-819871346-9



9 788198 713469

# **Advancing Science and Technology through Multidisciplinary Innovation toward the Future**

**AUGUST 2025**

**Dr. T. SOMANATHAN**

**Professor, Department of Chemistry, School of Basic Sciences  
Vels Institute of Science, Technology & Advanced Studies  
Chennai, India**

**Mrs. J. MONISHA**

**Assistant Professor, Department of Pharmaceutics  
Vels Institute of Science, Technology & Advanced Studies  
Chennai, India**

**Mrs. P. GOWTHAMI**

**Assistant Professor, PG Department of Chemistry  
Shrimathi Devkunvar Nanalal Bhatt  
Vaishnav College for Women  
Chennai, India**

**Dr. G K ABINAYA ISHWARYA**

**Assistant Professor, Department of Civil Engineering  
Vels Institute of Science, Technology & Advanced Studies,  
Chennai, India**

August 2025

ISBN: 978-81-987134-6-9



© Copyrights reserved by Authors and Publishers

*Despite our best efforts, there is still a risk that some errors and omissions might occur unintentionally.*

*Without the prior consent of the authors and publishers, no part of this publication may be duplicated in any form or by any means, whether electronically, by photocopying, or otherwise.*

*The opinions and findings expressed in the individual chapters are those of the authors and the book's editors, not the publishers.*

*Cover page images attributed from [www.freepik.com](http://www.freepik.com).*

Published By



**SCIENTIFIC RESEARCH REPORTS**  
(A Book Publisher, approved by Govt. of India)

I Floor, S S Nagar, Chennai - 600 087,  
Tamil Nadu, India.

[editors@srrbooks.in](mailto:editors@srrbooks.in), [contact@srrbooks.in](mailto:contact@srrbooks.in)  
[www.srrbooks.in](http://www.srrbooks.in)

## PREFACE

The advancement of science and technology has always been a driving force in shaping societies, economies, and cultures across the globe. In the 21st century, this momentum has gained unprecedented speed, fueled by multidisciplinary research and innovation. The present volume, *Advancing Science and Technology through Multidisciplinary Innovation toward the Future*, is a testimony to the diverse, yet interconnected, fields of inquiry that are addressing contemporary challenges while envisioning a sustainable future.

This book brings together contributions from researchers, academicians, and practitioners across domains such as pharmacology, nanotechnology, biomedical engineering, artificial intelligence, material science, and literary studies. Each chapter reflects a unique perspective on innovation, rooted in its discipline yet extending beyond disciplinary boundaries to create synergies that are essential for holistic development. From drug discovery and biomedical devices to sustainable construction materials and advanced alloys, the research presented here demonstrates how science and technology can serve as a bridge between theoretical exploration and practical application.

What makes this volume distinctive is its conscious engagement with global goals—health and well-being, sustainability, inclusivity, and technological empowerment. By integrating modern approaches such as artificial intelligence in healthcare, green nanotechnology in material sciences, and ergonomic rehabilitation devices for enhanced quality of life, the book underscores the role of innovation as a catalyst for social transformation. Simultaneously, the literary explorations remind us that human values, cultural narratives, and

gender perspectives remain central in balancing technological progress with ethical and societal considerations. The collective effort represented here is not merely a compilation of research findings but an invitation to think across boundaries. It encourages readers to see science and technology not in isolation, but as part of an ecosystem where knowledge flows freely, challenges inspire creativity, and collaboration drives solutions.

We believe this book will serve as an inspiration for scholars, students, and professionals to further the dialogue between disciplines, to innovate responsibly, and to harness knowledge for building a future that is both technologically advanced and human-centered. We would like to extend our sincere thanks to our publisher, **Scientific Research Reports, Chennai**, India, for their dedicated efforts in preparing this book, which provides enriched content.

*Wishes and Regards,*

**Dr. T. Somanathan**

Department of Chemistry, Vels Institute of Science, Technology & Advanced Studies (VISTAS), Chennai, India.

**Mrs. Monisha. J**

Department of Pharmaceutics, Vels Institute of Science, Technology & Advanced Studies (VISTAS), Chennai, India.

**Mrs. P.Gowthami**

PG Department of Chemistry, Shrimathi Devkunvar Nanalal Bhatt Vaishnav College for Women, Chennai, India.

**Dr. Abinaya Ishwarya G K**

Department of Civil Engineering, Vels Institute of Science, Technology & Advanced Studies (VISTAS), Chennai, India

## CONTENTS

Chapter No	Chapter Titles	Page No
1	Genus Suaeda: Advances in Pharmacology and Clinical Applications Supporting SDG 3 – Good Health and Well-being  Jeslin D, M. Vijey Aanandhi, M. K. Vijayalakshmi	1-16
2	Green Synthesis of Selenium Nanoparticles using Leaf Extract of Mukia maderasapatana and Deciphering its Biomedical Properties  Philip Gladys Thilagavathy, Boopathy Usharani	17-27
3	Self-Micro Emulsifying Drug Delivery Systems (SMEDDS) for Phytopharmaceuticals  Sahaya Merlin S, V. Jayashree	28-36
4	Drug Repurposing: A Modern Approach to Drug Discovery  Priyadharshini R, V. Jayashree	37-46
5	Artificial Intelligence in Pharmacy: The Future of Drug Design  Ijas Ahamed M, V. Jayashree	47-56
6	Gastro-retentive Floating System for Controlled Release: A Natural Polymer Approach  Monisha. J, Keerthana. J, Madhumitha. V	57-66

## Chapter 2

# Green Synthesis of Selenium Nanoparticles using leaf extract of *Mukia maderasapatana* and deciphering its biomedical properties

**Philip Gladys Thilagavathy<sup>a</sup>, Boopathy Usharani<sup>b\*</sup>**

<sup>a</sup> *Research Scholar, Department of Biochemistry, Vels Institute of Sciences, Technology and Advanced Studies, Chennai, India.*

<sup>b</sup> *Head of the Department, Department of Biochemistry, Vels Institute of Sciences, Technology and Advanced Studies, Chennai, India.*

*\*Corresponding Author: usharani.sls@velsuniv.ac.in*

---

### Abstract

Selenium nanoparticles (SeNPs) are tiny particulates, which possess the ability for assimilation by biological systems, and have garnered attraction among researchers due to its exceptional biological properties and potential therapeutic functionalities. In the present study, SeNPs were synthesized via an effective and eco-friendly technique using leaf extract of *Mukia maderasapatana*. Then SeNPs were characterized by various analytical techniques. UV-Vis spectroscopy showed absorption peak at 265 nm. Biomolecules acts as stabilizers for synthesized SeNPs. Alcoholic group, nitro compounds, aromatic compounds in SeNPs is revealed by the O-H bond, N-O bond and C-C bond by FTIR analysis. SEM analysis showed dimensions of synthesized SeNPs ranging from 73.24 nm to 187.6 nm. EDX analysis highlights the elemental composition of SeNPs as (13.75%) of Selenium, (69.27%) of oxygen and (16.98%) of sodium, and XRD spectroscopy revealed the crystalline structure of SeNPs. The antioxidant potential of SeNPs via in vitro assays like NO,

ISBN 978-819871346-9



ABTS, FRAP and H<sub>2</sub>O<sub>2</sub> showed higher inhibition as 86.71%, 89.18%, 87.54%, and 89.9% at a concentration of 50 µg/ml. Antiinflammatory effects of SeNPs demonstrated a noteworthy inhibition of Bovine Serum Albumin, Egg Albumin denaturation as 78% and 77%, also in membrane stabilization with increase in the concentrations of SeNPs it stabilizes the cellular membranes. Brine shrimp lethality assay performed to assess the cytotoxicity effects of SeNPs and recorded the 50% of survival at 80 µg/mL of concentration, and thereby validated its biosafety profile and potential therapeutic index. Collectively, this investigation highlights the multifunctional capabilities of SeNPs as promising candidates for applications in the biomedical field.

*Keywords: Selenium nanoparticles; Mukia maderaspatana; green synthesis; antioxidant; anti-inflammatory; Cytotoxicity*

## **1. Introduction**

In recent years, nanotechnology has emerged as an innovative discipline with multifaceted applications across a spectrum of scientific fields, notably in the medicine domain [1]. Nanoparticles are defined as particles that exhibit dimensions in the range of 10<sup>-9</sup> meters, and those nanoparticles formed from metallic elements are referred to as metallic nanoparticles. These nanoparticles exhibit a wide variety of applications in diverse domains, such as biotechnology, medicine, cosmetics and others. It also possesses numerous beneficial properties relevant to health and diagnosis. Due to their distinctive characteristics and properties that are dependent upon their size, metallic nanoparticles have garnered substantial focus from scientists [2]. The synthesis of nanoparticles via the utilization of plant sources or their derivatives is known as green synthesis, and this method is recognized for its safety, economic

feasibility, and environmental sustainability. It dispenses the obligation for toxic chemicals or reducing agents; instead the extract of plant serves as a reducing agent. The plant extract promotes the metal ion reduction; leading to the nanoparticle formation. Nanoparticles synthesized via sustainable eco-friendly methodologies exhibits a diverse range of beneficial properties, including antioxidant, antimicrobial and antitumor activities [3]. Selenium (Se) is categorized as a metalloid, manifesting features to both metals and non-metals. It has been confirmed that selenium serves as an integral dietary micronutrient vital for the optimal physiological efficacy of the human body. It includes a diverse collection of important medical applications [2]. Previous studies have revealed that selenium plays an essential function in the diverse disease prevention, including cystic fibrosis, cardiovascular disorders, and stress-related conditions [4].

In biological systems, selenium is an essential trace element, exhibiting specific functions in numerous health-related processes. In various allotropic forms selenium exhibits which includes both amorphous and crystalline configurations, and It is considered as a remarkable material due to its chemical versatility for the synthesis of nanoparticles [1]. Selenium nanoparticles (SeNPs) exhibits enhanced bioactivity and lower in toxicity in contrast to various sources of selenium such as selenate and selenomethionine. Recently, SeNPs have drawn significant academic attention as a vital research area due to their tiny size and remarkable physical and chemical properties, with an enhanced focus on their synthesis methods, features, and potential uses in the life sciences stream [5]. Hence, the green synthesis of SeNPs has garnered considerable interests of the researchers about their potential uses in the

ISBN 978-819871346-9



biomedical field. The biosynthetic process for SeNPs is recognized for its safe, non-toxic and environmentally friendly aspects. Moreover, owing to the organic compounds residing on their surfaces biosynthesized SeNPs shown greater stability which effectively deter the nanoparticles aggregation over time [6].

Oxidative stress refers to the presence of entities known as free radicals and reactive oxygen species (ROS), which are generated during standard physiological processes but can become harmful when not adequately neutralized by endogenous defense mechanisms. Indeed, oxidative stress arises from a dysregulation between the production of reactive oxygen species and the capacity of endogenous antioxidant systems to mitigate their effects. ROS serve as principal agents that trigger oxidation and induce oxidative stress, which is implicated in a myriad of diseases and pathological conditions. An excessive accumulation of ROS is detrimental, as it instigates biomolecular oxidation that culminates in cellular apoptosis and the manifestation of oxidative stress. Furthermore, oxidative stress incites inadvertent activation of enzymes and leads to oxidative damage within the cellular environment [7].

This ROS facilitates the oxidative impairment of macromolecules, leading to the onset of various diseases. Human possesses an intrinsic protective mechanism designed to inhibit the generation of free radicals. These protective systems may be compromised under certain pathological states, necessitating the introduction of antioxidant supplements to stave off the production of free radicals. Antioxidants engage with the oxidation process via radical scavenging and chelating activities, thereby mitigating the oxidative damage instigated by free radicals. A variety of synthetic compounds, including butylated hydroxyanisole and butylated hydroxytoluene,

are commercially accessible; however, these compounds are associated with numerous adverse effects in both humans and animals. Conversely, plant-derived constituents such as flavonoids, tannins, proanthocyanidins, and phenolic compounds exhibit robust antioxidant properties [8].

Inflammation constitutes a cellular and tissue response to injury triggered by a multitude of factors, including infectious agents, chemical substances, thermal exposure, and mechanical trauma [9]. The management of inflammation predominantly involves the utilization of both steroidal and nonsteroidal anti-inflammatory pharmacological agents. Within the domain of biomedicine, especially concerning anti-inflammatory therapies, the integration of nanotechnology has been extensively explored and thoroughly established [10]. A significant proportion of anti-inflammatory pharmaceuticals function as potential inhibitors of the cyclooxygenase (COX) pathway, which is integral to the metabolism of arachidonic acid, subsequently leading to the synthesis of prostaglandins, acknowledged as the key mediators of the inflammatory process. The suppression of prostaglandin biosynthesis is critical for the effective management of inflammation. Consequently, the administration of analgesic and anti-inflammatory compounds is deemed necessary for therapeutic intervention. The presently accessible anti-inflammatory pharmacological agents pose significant hazards to human health, particularly in terms of their toxicity and the probability of relapse of the disorder after the discontinuation of treatment. The traditional system of plant-based medicine plays a crucial role in healthcare, with numerous plant extracts and their isolated constituents recognized as potent anti-inflammatory agents [9]. Recently, the utilization of medicinal plants

has been investigated to formulate nanoparticles (NPs), aimed at enhancing therapeutic efficacy while mitigating adverse effects [10]. One of the most extensive and heterogeneous groups of flora, comprising both domesticated and wild species is Cucurbitaceae family. The species belonging to this family are generally regarded as “Cucurbits” and are valued for their significant contributions of vital dietary macromolecules. Furthermore, it is extensively used in Ayurvedic systems and in modern medical practices to solve a multitude of health-related issues [11].

*Mukia maderaspatana* is commonly referred as Madras pea pumpkin, a medicinal species generally found in tropical and subtropical zones [12]. Leaves are generally utilized for various applications among the different parts of the plant. Within the Indian cultural milieu, traditional practitioners employ various plant materials in several forms such as decoctions, extracts, juices and salads to tackle a wide range of health challenges [13]. Nonetheless, existing literature regarding the antioxidant and cytotoxic properties of *M. maderaspatana* remains notably sparse. Taking into account the previously highlighted insights and reinforced by the scientific corpus, the current research marks the pioneering systematic investigation into the cytotoxic potential of selenium nanoparticles synthesized from *M. maderaspatana*, alongside a comprehensive exploration of its antioxidant and anti-inflammatory activities.

Table 1: Elemental composition of synthesized SeNPs

<b>Element Line</b>	<b>Weight %</b>	<b>Weight Error %</b>	<b>Atom %</b>
O K	42.88	± 1.33	69.27
Na K	15.10	± 0.90	16.98
Se K	Nil	Nil	Nil
Se L	42.02	± 1.26	13.75
Total	100.00		100.00

## 2. Figures

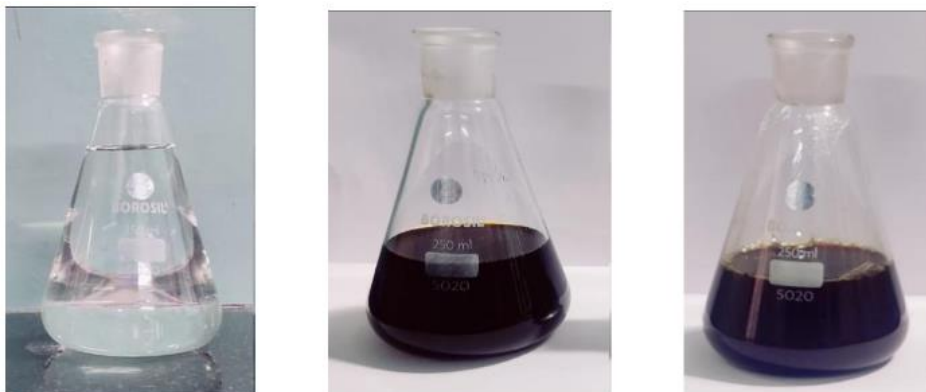


Figure. 1: Biosynthesis of Selenium Nanoparticles. a. Sodium selenite, b. *Mukia maderaspatana* extract, c. SeNPs formed

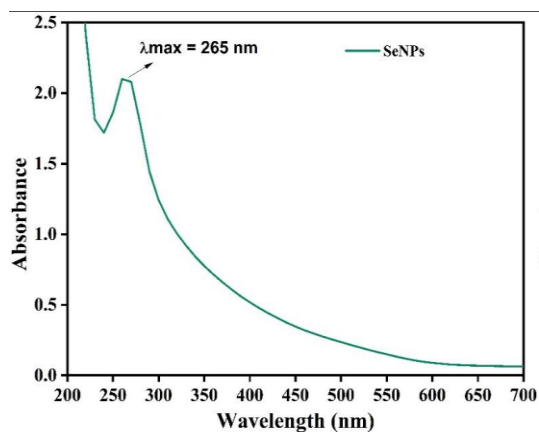


Figure. 2: UV-visible spectrum of SeNPs

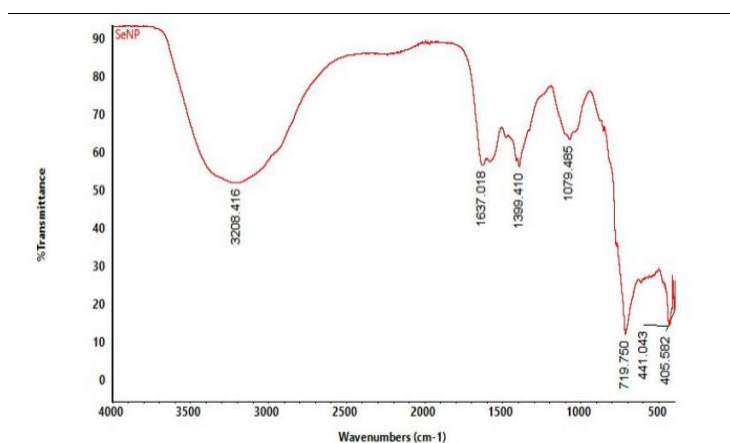


Figure. 3: FT-IR spectrum of SeNPs

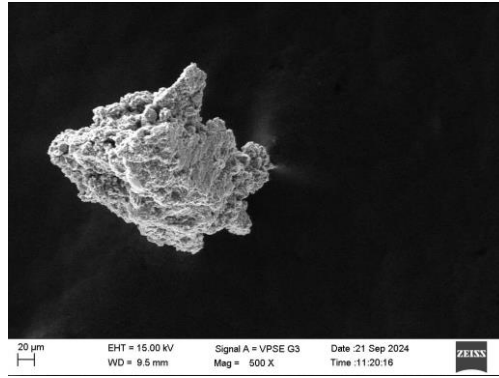


Fig.4. SEM analysis of SeNPs

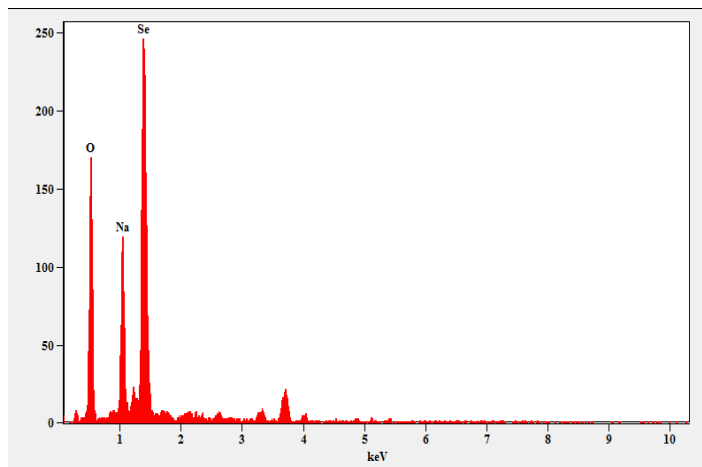


Fig.5. EDX spectrum of SeNPs

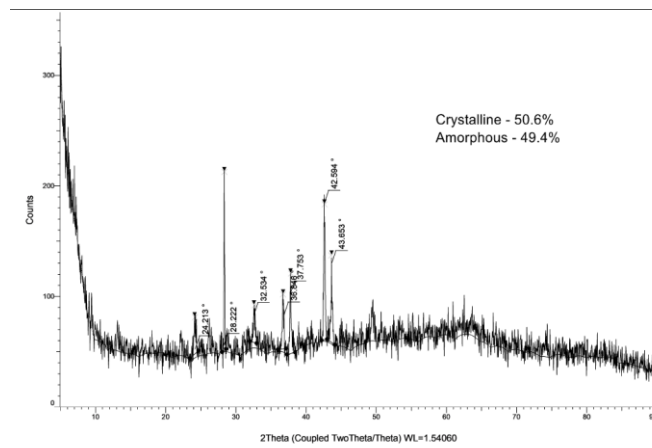


Fig. 6. XRD pattern of SeNPs

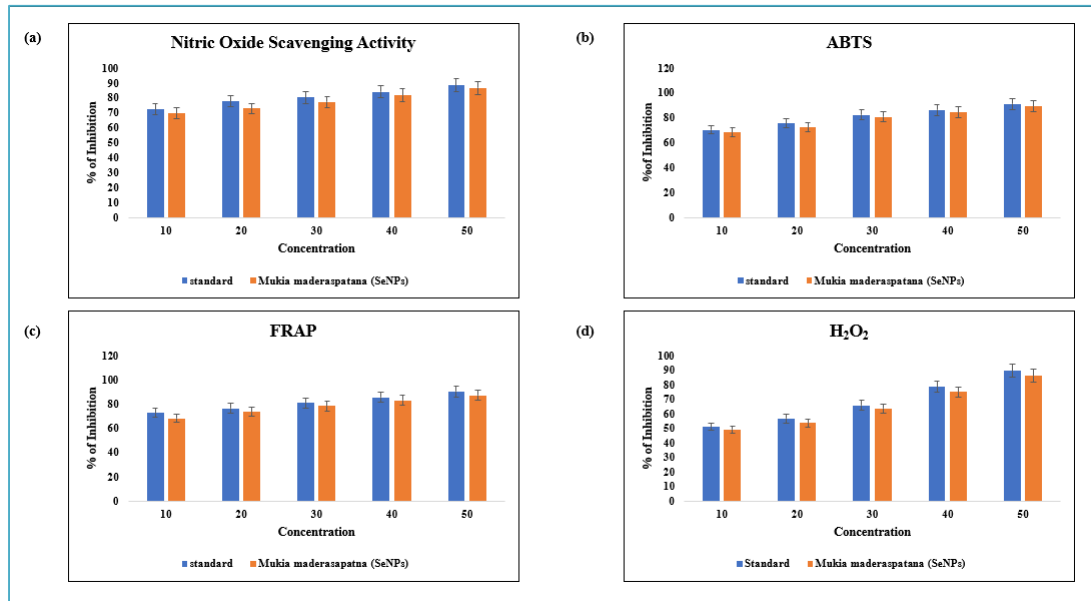


Fig. 7. In vitro Antioxidant assays – (a) Nitric Oxide Scavenging Activity, (b) ABTS scavenging activity, (c) Ferric reducing antioxidant power assay, (d) Hydrogen peroxide scavenging activity

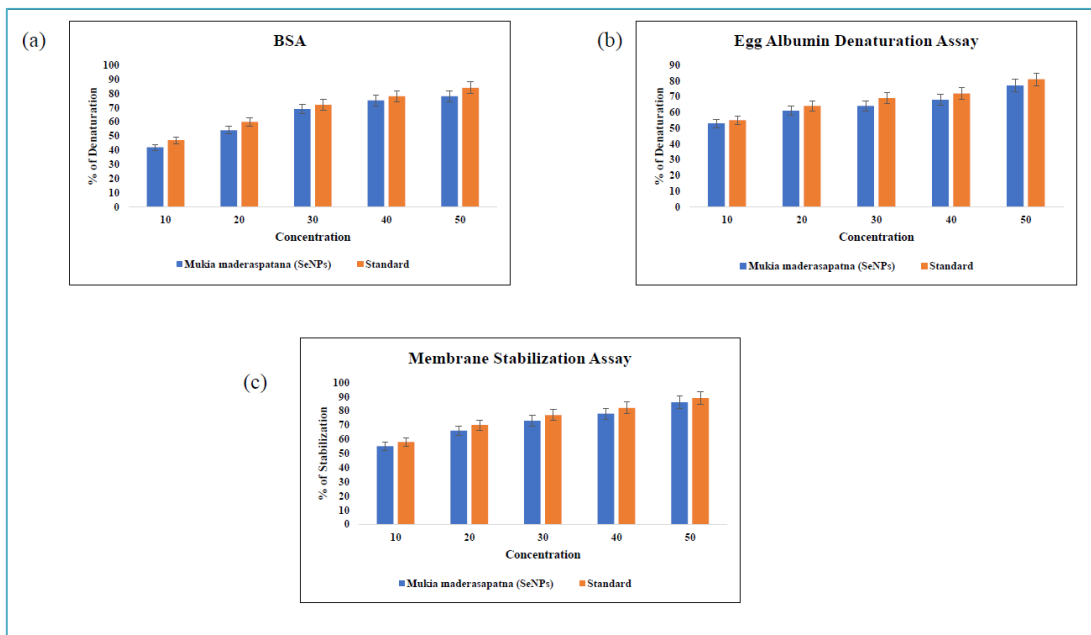


Fig.8. In vitro Anti-inflammatory assays – (a) Bovine Serum Albumin (BSA) Denaturation Assay, (b) Egg Albumin Denaturation Assay, (c) Membrane Stabilization Assay

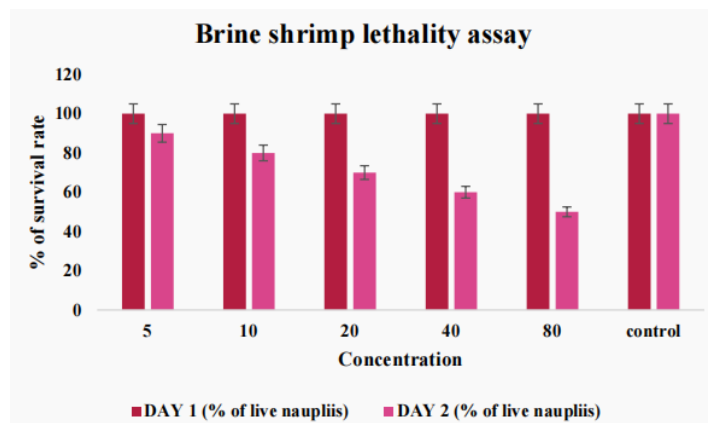


Fig. 9. Brine shrimp lethality assay

## References

- [1] D. Ravi, B. Gunasekar, V. Kaliyaperumal, and S. Babu, "Recent advances in antimicrobial activity of green synthesized selenium nanoparticles," *OpenNano*, vol. 20, p. 100219, 2024, doi: 10.1016/j.onano.2024.100219.
- [2] N. Sani-E-Zahra, M. S. Iqbal, K. Abbas, and M. I. Qadir, "Synthesis, characterization and evaluation of biological properties of selenium nanoparticles from *Solanum lycopersicum*," *Arab. J. Chem.*, vol. 15, no. 7, p. 103901, 2022, doi: 10.1016/j.arabjc.2022.103901.
- [3] A. K. Mittal, Y. Chisti, and U. C. Banerjee, "Synthesis of metallic nanoparticles using plant extracts," *Biotechnol. Adv.*, vol. 31, no. 2, pp. 346–356, 2013, doi: 10.1016/j.biotechadv.2013.01.003.
- [4] S. Skalickova, V. Milosavljevic, K. Cihalova, P. Horcky, L. Richtera, and V. Adam, "Selenium nanoparticles as a nutritional supplement," *Nutrition*, vol. 33, pp. 83–90, 2016, doi: 10.1016/j.nut.2016.05.001.
- [5] X. Yang *et al.*, "Preparation, characterization, and antioxidant and antiapoptotic activities of biosynthesized nano-selenium by yak-derived *Bacillus cereus* and chitosan-encapsulated chemically synthesized nano-selenium," *Int. J. Biol. Macromol.*, vol. 242, p. 124708, 2023, doi: 10.1016/j.ijbiomac.2023.124708.
- [6] Z. Keshtmand, E. Khademian, P. P. Jafroodi, M. S. Abtahi, and M. T. Yarakhi, "Green synthesis of selenium nanoparticles using *Artemisia chamaemelifolia*: Toxicity effects through regulation of gene expression for

cancer cells and bacteria,” *Nano Struct. Nano Objects*, vol. 36, p. 101049, 2023, doi: 10.1016/j.nanoso.2023.101049.

[7] S. Satpathy, L. L. Panigrahi, P. Samal, K. K. Sahoo, and M. Arakha, “Biogenic synthesis of selenium nanoparticles from *Nyctanthes arbor-tristis* L. and evaluation of their antimicrobial, antioxidant and photocatalytic efficacy,” *Heliyon*, vol. 10, no. 12, p. e32499, 2024, doi: 10.1016/j.heliyon.2024.e32499.

[8] A. B. Olaoye, S. S. Owoeye, and J. S. Nwobegu, “Facile green synthesis of plant-mediated selenium nanoparticles (SeNPs) using *Moringa oleifera* leaf and bark extract for targeting  $\alpha$ -amylase and  $\alpha$ -glucosidase enzymes in diabetes management,” *Hybrid Adv.*, vol. 7, p. 100281, 2024, doi: 10.1016/j.hybadv.2024.100281.

[9] B. Sahoo, L. L. Panigrahi, S. Jena, S. Jha, and M. Arakha, “Oxidative stress generated due to photocatalytic activity of biosynthesized selenium nanoparticles triggers cytoplasmic leakage leading to bacterial cell death,” *RSC Adv.*, vol. 13, no. 17, pp. 11406–11414, 2023, doi: 10.1039/D3RA00571B.

[10] S. Vasanthakumar, M. Manikandan, and M. Arumugam, “Green synthesis, characterization and functional validation of bio-transformed selenium nanoparticles,” *Biochem. Biophys. Rep.*, vol. 39, p. 101760, 2024, doi: 10.1016/j.bbrep.2024.101760.

[11] L. Asadpour, M. A. Bandari, and R. S. Masouleh, “Amikacin-loaded selenium nanoparticles improved antibacterial and antibiofilm activity of amikacin against bovine mastitis-causing *Staphylococcus aureus*,” *Heliyon*, vol. 11, no. 1, p. e41103, 2024, doi: 10.1016/j.heliyon.2024.e41103.

[12] K. Kamala, K. Santhosh, T. Pavithra, and P. Sivaperumal, “Therapeutic potential of selenium nanoparticles synthesized by mangrove plants: Combatting oral pathogens and exploring additional biological properties,” *J. Trace Elem. Min.*, vol. 9, p. 100167, 2024, doi: 10.1016/j.jtemin.2024.100167.

[13] S. S. Magalhães, M. A. Segundo, S. Reis, and J. L. Lima, “Methodological aspects about *in vitro* evaluation of antioxidant properties,” *Anal. Chim. Acta*, vol. 613, no. 1, pp. 1–19, 2008, doi: 10.1016/j.aca.2008.02.047.