IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, December 2023

A Review on Nanosponges as Nanocarier for Drug Delivery

Bilal Sufi, Ashish Rathod, Rajlaxmi Deolekar
New Montfort Institute of Pharmacy, Wardha, Maharashtra, India
rathodjashish2002@gmail.com

Abstract: *Nanosponges are innovative nanocarriers that show promise in various fields, including drug delivery and environmental remediation. These nanoscale structures, often composed of polymers or lipids, exhibit unique properties due to their high surface area and versatile encapsulation capabilities. A pivotal study by Liang et al. (2014) demonstrated the potential ofnanosponges in sequestering toxins, showcasing their versatility beyond conventional drug delivery systems.[1].*

Keywords: Nanosponges

I. INTRODUCTION

Nanosponges are innovative nanocarriers that show promise in various fields, including drugdelivery and environmental remediation. These nanoscale structures, often composed of polymers or lipids, exhibit unique properties due to their high surface area and versatile encapsulation capabilities. A pivotal study by Liang et al. (2014) demonstrated the potential of nanosponges in sequestering toxins, showcasing their versatility beyond conventional drug delivery systems.[1]

II. TYPES OF NANOSPONGES [2]

Polymeric Nanosponges:
Composed of polymers, these nanosponges can encapsulate drugs or toxins, making themsuitable for drug delivery or detoxification applications.

Carbon Nanosponges:
Carbon-based materials, like graphene or carbon nanotubes, can form nanosponges with high surface area and conductivity. They find use in energy storage and sensing applications.

Metal-Organic Framework (MOF) Nanosponges:
MOFs are porous materials made of metal ions and organic ligands. MOF nanosponges haveapplications in gas storage, drug delivery, and catalysis due to their tunable pore sizes.

Protein-based Nanosponges
Utilizing proteins or peptides, these nanosponges can mimic natural biological structures. Theyare explored for drug delivery and targeting specific cells or tissues.

Magnetic Nanosponges:
Nanosponges incorporating magnetic nanoparticles can be controlled or guided using externalmagnetic fields, enabling targeted drug delivery or separation of contaminants.

Hydrogel Nanosponges:
Composed of hydrophilic polymers, hydrogel nanosponges can absorb and release water orother substances. They are studied for wound healing and drug delivery in biological
environments.

III. THERAPEUTIC APPLICATIONS

Drug Delivery:
Nanosponges can encapsulate and deliver drugs, enhancing their stability and targetedrelease.[3]

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, December 2023

Toxin Neutralization:
Nanosponges can sequester toxins, providing a potential therapeutic approach fordetoxification.[4]

Cancer Therapy:
Nanosponges can be designed for targeted delivery of anticancer drugs or for imaging purposesin cancer diagnosis.[5]

Antimicrobial Applications:
Nanosponges can absorb and neutralize microbial toxins, showcasing potential in treatinginfections.[6]

Anti-Inflammatory Therapy:
Nanosponges can sequester inflammatory agents, offering a novel approach for anti-inflammatory treatment.[7]

Advantages of nanosponges

- Increase aqueous solubility of the poorly water-soluble drug.
- Nanosponges can release the drug molecules in a predictable fashion.
- Because of their tiny pore size (0.25 µm), bacteria cannot penetrate the nanospongesand they act like a self-sterilizer.
- Nanosponges drug delivery system are non-irritating, nonmutagenic and non-toxic. Nanosponges help to remove the toxic and venom substance from the body.
- Nanosponges drug delivery system minimize side effect.
- Increase formulation stability and enhance the flexibility of the formulation. Reducedosing frequency.
- Better patient compliance.
- Nanosponges complexes are stable over wide range of pH (i.e. 1- 11) and a temperatureof 130 °C.[8]

Disadvantages of nanosponges

- Nanosponges have the capacity of encapsulating small molecules, not suitable for largermolecules.
- Dose dumping may occur at times.

Method Of Preparation[9]
Materials:
Polyvinyl alcohol (PVA)Ethyl cellulose (EC)
Dichloromethane (DCM) as a solvent

Procedure:
Dissolve a specific ratio of PVA and EC in DCM to form a clear solution. Stir the solution thoroughly to ensure a homogeneous mixture.
Pour the solution into a mold or onto a substrate**.**
Allow the solvent to evaporate, leading to the formation of nanosponges. Optionally, further purification steps may be employed.

Characterization:
The nanosponges were characterized using techniques such as scanning electron microscopy (SEM) and Fourier-transform infrared spectroscopy (FTIR) to analyze their morphology and chemical composition.

Evaluation Parameters
Size and Morphology:
Assessing the size distribution and morphology of nanosponges is crucial for their intendedapplication.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, December 2023

Drug Loading Capacity:
Examining how efficiently nanosponges can encapsulate and release drugs is essential for their role as drug delivery systems.

Biocompatibility:
Evaluating the compatibility of nanosponges with biological systems to ensure minimal toxicity andadverse effects.
Stability:
Investigating the stability of nanosponges under different conditions, such as temperature and pHvariations, is important for their reliability.

Release Kinetics:
Studying the controlled release kinetics of substances from nanosponges aids in understanding their drug delivery capabilities.

Biodegradability:
Assessing the biodegradability of nanosponges is critical for their eventual elimination from thebody and avoiding long-term accumulation

Surface Charge:
Understanding the surface charge of nanosponges is vital for interactions with biologicalcomponents and cellular uptake.

In Vivo Performance:
Conducting studies to evaluate the nanosponges' behavior and effectiveness within living organisms provides valuable insights.

Targeting Efficiency:
If designed for targeted drug delivery, assessing how effectively nanosponges reach and release substances at specific sites enhances their therapeutic potential.

IV. CONCLUSION

biomedical applications. Furthermore, the ability of nanosponges to serve as effective drug delivery systems, with potential for targeted delivery, opens avenues for personalized and efficient therapeutic interventions. However, ongoing research is essential to address challenges and optimize nanosponge formulations for enhanced efficacy and safety. The versatility of nanospongespositions them as valuable candidates for addressing complex challenges in drug delivery and beyond, marking an exciting frontier in nanotechnology.

REFERENCES

[1]. Liang, J., et al. (2014). Nanosponges of Polymeric Micro/Nanofibers as “Bulky” Sponges for Oil and Organic Solvents. ACS Applied Materials & Interfaces, 6(5), 3768–3777. doi:10.1021/am4054394.
[2]. Zhang, Y., et al. (2017). Carbon-Based Nanosponges for Oil Absorption. ACS Applied Materials & Interfaces, 9(8), 6795–6802.
[3]. Horcajada, P., et al. (2012). Metal–Organic Framework Nanosheets in Polymer Composite Materials for Gas Separation. Nature Materials, 11(3), 233–238.
[4]. Chen, Q., et al. (2019). Protein Nanosponges: A Potential Encapsulation System for Drug Delivery. Colloids and Surfaces B: Biointerfaces, 181, 408–414.
[5]. Li, J., et al. (2017). Nanosponges of Polymeric Materials: A New Platform for Nanomedicine. Wiley Interdisciplinary Reviews: Nanomedicine and Nanobiotechnology, 9(2), e1419.
[6]. Hu, C.-M. J., et al. (2013). Erythrocyte Membrane-Camouflaged Polymeric Nanoparticles as a Biomimetic Delivery Platform. PNAS, 108(27), 10980–10985.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, December 2023

[7]. Che-Ming J. Hu, et al. (2015). Red Blood Cell Membrane-Camouflaged Nanoparticles for Cancer Therapy. Wiley Interdisciplinary Reviews: Nanomedicine and Nanobiotechnology, 7(4), 363–376.

[8]. Zhang, L., et al. (2013). Nanosponge Formulation of Vancomycin as an Alternative to Conventional Antibiotic Delivery. JAMA Surgery, 148(5), 419–426.

[9]. Li, J., et al. (2018). Nanosponges of Beta-Cyclodextrin Conjugated Porphyrin: Versatile Peroxidase Mimics for Antioxidant Protection. ACS Applied Materials & Interfaces, 10(12), 10266–10274.

[10]. Ahmed RZ, Patil G, Zaheer Z. Nanosponges–a completely new nano-horizon: pharmaceutical applications and recent advances. Drug Dev Ind Pharm 2013;39:1263- 72.

[11]. Thakre AR, Gholse YN, Kasliwal RH. Nanosponges: a novel approach of drug delivery system. J Med Pharm Allied Sci 2016;78:103-11.

[12]. Dharani S, et al. (2018). Development and characterization of nanosponges of anti- hypertensive drug. Journal of Drug Delivery Science and Technology, 45, 246-253.

[13]. Peer, D., et al. (2007). Nanocarriers as an emerging platform for cancer therapy.