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(Review Article)

Niosomes NDDS: An Overview

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Abstract

Niosomes are self-assembled, non-ionic surfactant-based vesicles that serve as an advanced drug delivery system (DDS), enhancing bioavailability, stability, and controlled release of therapeutic agents. Composed of non-ionic surfactants, cholesterol, and water, they offer a cost-effective and stable alternative to liposomes. Structurally similar to liposomes, niosomes encapsulate both hydrophilic drugs in their aqueous core and lipophilic drugs within their lipid bilayer. The biocompatibility, ease of formulation, and potential for targeted drug delivery make niosomes suitable for various pharmaceutical applications. Surfactants like Span and Tween, combined with cholesterol, stabilize the bilayer, preventing leakage and enhancing vesicle rigidity. Their ability to cross biological barriers such as the skin, gastrointestinal tract, and blood-brain barrier allows for versatile administration routes. Niosomes can be prepared using methods like the thin-film hydration method, reverse phase evaporation, microfluidics, and emulsion-based techniques, each influencing size, drug encapsulation efficiency, and release profile. The drug release can be tailored by adjusting the surfactant-to-cholesterol ratio, surfactant type, and incorporating stabilizers or targeting ligands. Overall, niosomes provide controlled, sustained, and site-specific drug delivery, reducing dosing frequency and improving patient compliance.

Keywords: Niosomes, drug delivery system, non-ionic surfactants, cholesterol, lipophilic drugs, hydrophilic drugs, controlled release, bioavailability, targeted delivery, Span, Tween, vesicular system.

INTRODUCTION

Throughout the course of recent many years, the field of medication conveyance has advanced altogether, with a rising spotlight on creating frameworks that improve the bioavailability, solidness, and remedial adequacy of medications. Among these imaginative frameworks, vesicular medication conveyance frameworks, especially liposomes, have acquired unmistakable quality because of their capacity to typify both hydrophilic and lipophilic medications, offering controlled and designated discharge. Be that as it may, notwithstanding their benefits, liposomes are related with a few restrictions, including high creation costs, dependability issues, and concerns in regards to their immunogenicity and harmfulness. To beat these constraints, niosomes, which are non-ionic surfactant vesicles, have arisen as a promising other option.

Niosomes are colloidal, bi-layered vesicles framed from non-ionic surfactants, frequently in blend with different parts like cholesterol and stabilizers. These vesicles show properties like liposomes however with upgraded soundness, biocompatibility, and lower creation costs. The utilization of non-ionic surfactants considers more prominent adaptability in definition, offering the potential for a great many applications, from drugs to beauty care products.

This article gives a nitty gritty prologue to niosomes, their construction, readiness strategies, portrayal methods, and their applications in drug conveyance. Besides, the paper examines the difficulties and future possibilities of niosomes with regards to arising patterns in drug and clinical examination.

Niosome Design and Arrangement

The expression "niosomes" is gotten from "nios" (signifying "like" in Greek) and "some" (alluding to vesicular design), basically alluding to vesicles framed from non-ionic surfactants. Like liposomes, niosomes are circular vesicles comprising of at least one bilayer films that can embody both hydrophobic and hydrophilic substances. The bilayer structure is principally made out of non-ionic surfactants, for example, Ranges and Tweens, which are amphiphilic atoms, having both hydrophobic and hydrophilic districts.

Non-Ionic Surfactants

The center parts of niosomes are non-ionic surfactants, which vary from the phospholipids utilized in liposomes. These surfactants assume a basic part in shaping the bilayer construction of the Niosome. Usually involved surfactants in Niosome plans include Range (Sorbian esters): These are ordinarily used to frame the bilayer construction of niosomes. They are hydrophobic, which helps in settling the bilayer.

Tween (Poly oxyethylene subsidiaries of Sorbian esters): These are more hydrophilic and help in shaping the outer layer of the Niosome and working on the steadiness of the vesicle. Cholesterol: Cholesterol is frequently integrated into Niosome details to upgrade film strength by lessening the ease of the bilayer, in this way working on the niosomes protection from outer anxieties like temperature changes. These surfactants can shape vesicles that epitomize both hydrophilic and hydrophobic medications, making niosomes flexible transporters for a large number of drug specialists.

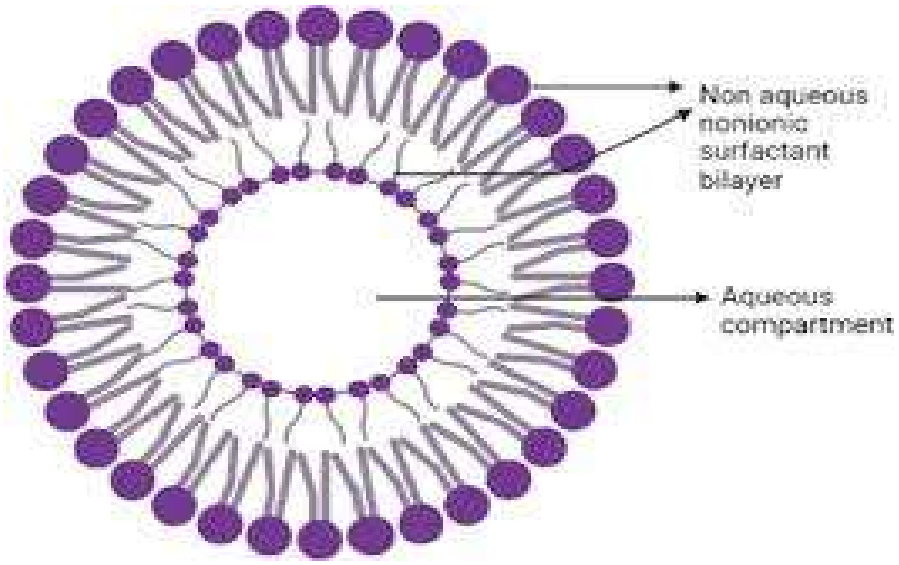

Figure 1: Structure of Niosomes

The development of niosomes relies upon the cooperation between the surfactant atoms and the watery stage. The surfactants self-gather into bilayer structures when presented to fluid media under proper circumstances. The surfactants orchestrate themselves so the hydrophilic head bunches face the water stage, and the hydrophobic tail bunches arrange towards within, away from the water.

Contingent upon the technique utilized, niosomes can be framed with various sizes, going from 50 nm to a few microns. The size of the vesicle and the organization of the surfactants are key factors that impact the epitome proficiency, discharge profile, and solidness of the Niosome.

Techniques for Arrangement

A few techniques can be utilized to get ready niosomes, each with its own benefits and limits. The decision of arrangement strategy relies upon variables, for example, the size and conveyance of niosomes, epitome effectiveness, and the particular utilization of the Niosome detailing.

Dainty Film Hydration Technique: The dainty film hydration strategy is one of the most normally involved procedures for planning niosomes. In this strategy, a combination of non-ionic surfactants and different lipids (e.g., cholesterol) is broken up in a natural dissolvable like chloroform or methanol. The dissolvable is then vanished under diminished strain to frame a slender film on the mass of the holder. The slim film is in this manner hydrated with a watery arrangement, which prompts the development of niosomes. This technique considers the embodiment of both hydrophilic and hydrophobic medications.

Micro fluidization: Micro fluidization includes passing a pre-framed surfactant arrangement through a high-pressure homogenizer under controlled conditions. The high shear powers created during this cycle break the surfactant atoms into more modest vesicles, bringing about the arrangement of niosomes. This technique is especially valuable for creating uniform-sized vesicles.

Ether Infusion Strategy: In this strategy, an answer of non-ionic surfactants broke down in ether is infused into a watery arrangement under consistent mixing. As the ether dissipates, surfactant atoms self-collect into vesicles. This strategy is frequently utilized for embodying hydrophobic medications however can be restricted by the unpredictability of ether and the potential for harmfulness.

Converse Stage Vanishing Strategy: This procedure includes dissolving surfactants in a natural dissolvable and afterward adding a watery stage containing the medication. The blend is then exposed to vanishing under diminished pressure, prompting the arrangement of vesicles. The converse stage vanishing technique is especially valuable for getting ready enormous vesicles with high epitome efficiencies.

Portrayal of Niosomes

After arrangement, niosomes should be described to evaluate their size, morphology, exemplification productivity, discharge conduct, and steadiness. A few methods are accessible to describe niosomes:

Molecule Endlessly Size Circulation: Dynamic Light Dissipating (DLS) and Filtering Electron Microscopy (SEM) are normally utilized strategies to quantify the endlessly size dispersion of niosomes. DLS gives data on the normal size and polydispersity record, while SEM offers high-goal pictures of the Niosome morphology.

Embodiment Effectiveness: Embodiment productivity alludes to the level of the medication effectively typified in the niosomes comparative with the aggregate sum of medication utilized in the detailing. This still up in the air by isolating the free medication from the medication stacked niosomes and estimating how much medication held in the vesicles, frequently utilizing procedures like UV-Vis spectroscopy or Elite Execution Fluid Chromatography (HPLC).

In vitro delivery studies: In vitro discharge studies are fundamental to comprehend the delivery profile of medications from niosomes. These examinations are normally led in cushion arrangements at physiological pH and temperature, utilizing dialysis packs or dispersion cells to quantify how much medication delivered over the long haul.

Solidness Studies: Soundness studies are urgent to assess the timeframe of realistic usability of niosomes under different natural circumstances, including temperature, dampness, and light openness. Procedures like freeze-defrost cycles, centrifugation, and capacity at various temperatures are utilized to survey the soundness of the niosomes after some time.

Uses of Niosomes

Niosomes have tracked down assorted applications across a few fields, including drugs, beauty care products, and biomedicine. Their capacity to exemplify both hydrophilic and hydrophobic medications, further develop drug solvency, and give controlled discharge makes them an appealing choice for different restorative and non-helpful applications.

Drug Applications: Drug Conveyance: Niosomes are especially favorable in the conveyance of inadequately solvent medications, as they can improve dissolvability and bioavailability. They can be utilized for both foundational and restricted drug conveyance, including oral, transdermal, and intravenous courses.

Designated Medication Conveyance: Niosomes can be functionalized with focusing on ligands (e.g., antibodies or peptides) to guide the medication to explicit tissues or cells, working on remedial viability and diminishing aftereffects.

Controlled Delivery: By controlling the structure of niosomes, it is feasible to accomplish controlled or supported arrival of the embodied medication, in this manner working on the pharmacokinetic profile and lessening the recurrence of organization.

Restorative Applications: Niosomes are likewise broadly utilized in the corrective business, fundamentally for embodying dynamic fixings like nutrients, cell reinforcements, and hostile to maturing specialists. The capacity of niosomes to infiltrate the skin and convey dynamic fixings proficiently has made them a fundamental part of many healthy skin items.

Immunization Conveyance: Niosomes have been investigated as transporters for antibody conveyance because of their capacity to embody antigens and shield them from corruption. The controlled delivery properties of niosomes can be especially gainful in immunization definitions that require.

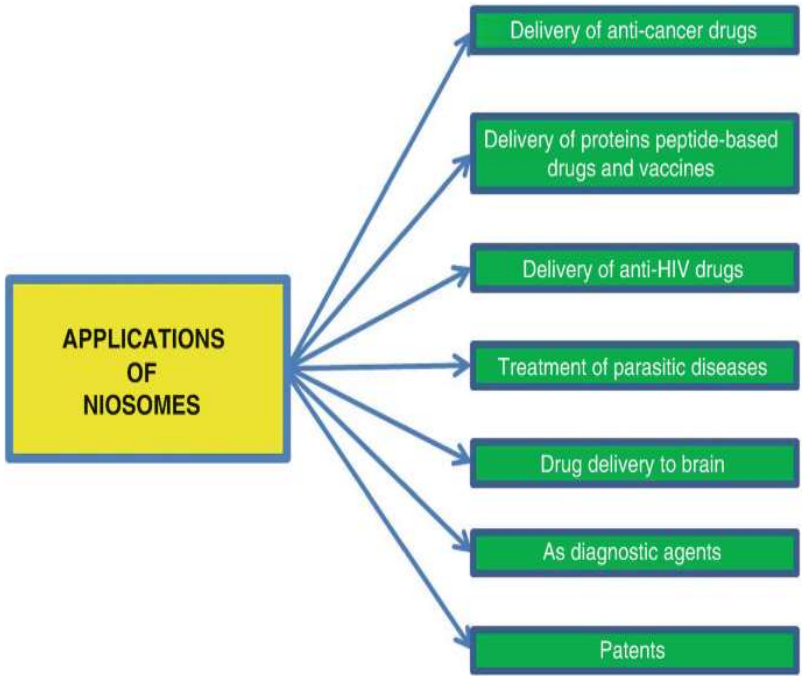

Figure 2: Application of Niosomes

Advantages of Niosomes

Niosomes have emerged as a promising alternative to liposomes for drug delivery due to their distinct advantages. These benefits make niosomes particularly attractive for a variety of applications, including pharmaceutical, cosmetic, and biomedical fields.

Stability: One of the primary advantages of niosomes over liposomes is their enhanced stability. Niosomes are formed using non-ionic surfactants, which are generally more stable than the phospholipids used in liposomes. Phospholipids, especially those derived from natural sources, are prone to oxidation and hydrolysis, making liposomes less stable in certain conditions such as temperature fluctuations, light exposure, and pH variations. In contrast, niosomes exhibit better stability under these conditions, particularly in terms of shelf-life and resistance to physical disruption.

Additionally, the incorporation of cholesterol or other stabilizing agents into Niosome formulations can further enhance membrane rigidity and stability. This allows niosomes to remain intact during storage, transportation, and after administration, reducing the likelihood of premature drug release.

Cost-Effectiveness: Niosomes are significantly more cost-effective than liposomes. The non-ionic surfactants used to form niosomes are generally cheaper than phospholipids, which are a major component of liposomes. This reduction in material costs translates into lower production expenses for Niosome-based drug delivery systems. Additionally, the simpler preparation methods for niosomes, such as the thin-film hydration technique, can further reduce manufacturing costs compared to liposome production, which often requires more specialized equipment and more complex procedures.

Versatility in Composition: Niosomes offer greater flexibility in formulation compared to liposomes. While liposomes primarily consist of phospholipids, niosomes are made from non-ionic surfactants, which can vary widely in terms of their chemical structure, hydrophilicity, and hydrophobicity. This versatility allows formulators to optimize the properties of niosomes, such as the size, charge, and drug release profile, for specific applications. Additionally, non-ionic surfactants can be combined with other stabilizing agents like cholesterol or hydrophilic polymers to further enhance Niosome performance.

Ability to Encapsulate Both Hydrophilic and Hydrophobic Drugs: Like liposomes, niosomes can encapsulate a wide range of both hydrophilic and hydrophobic drugs. The non-ionic surfactants used in niosomes are amphiphilic, which means they have both hydrophobic tails and hydrophilic head groups. This dual functionality enables niosomes to encapsulate drugs that are either water-soluble (hydrophilic) or fat-soluble (lipophilic). As a result, niosomes are versatile drug delivery carriers capable of improving the bioavailability and solubility of a variety of therapeutic agents, including poorly water-soluble drugs.

Improved Drug Bioavailability: Niosomes can enhance the bioavailability of encapsulated drugs by improving their solubility, stability, and absorption. This is especially beneficial for drugs with poor solubility in water. By encapsulating the drug within the Niosome, the drug is protected from degradation in the gastrointestinal tract, which may lead to enhanced absorption and better bioavailability. Niosomes can also be used to modify the release kinetics of drugs, allowing for controlled or sustained release, which further improves therapeutic outcomes.

Targeted and Controlled Drug Delivery: Niosomes can be modified to achieve targeted drug delivery. This can be accomplished by functionalizing the surface of the niosomes with specific ligands such as antibodies, peptides, or other molecules that target receptors on the surface of specific cells or tissues. For example, niosomes can be designed to target cancer cells, improving the specificity and efficacy of chemotherapy while reducing systemic side effects.

Furthermore, niosomes can be engineered to provide controlled or sustained release of the encapsulated drug. By adjusting the composition of the surfactants or adding stabilizers, the release rate of the drug can be controlled, ensuring that the drug is released over an extended period rather than all at once. This controlled release helps maintain therapeutic drug concentrations over time and reduces the need for frequent dosing.

Biocompatibility and Non-Toxicity: Niosomes are composed of non-ionic surfactants, which are generally recognized as safe (GRAS) by regulatory authorities like the U.S. FDA. These surfactants are less likely to cause toxicity or adverse immune reactions compared to other materials used in drug delivery systems. Additionally, the biocompatibility of niosomes makes them suitable for a wide range of medical and pharmaceutical applications, including intravenous administration.

Since niosomes do not rely on phospholipids (which may be derived from animal or plant sources), they can also be considered a more “universal” carrier, free from concerns about immunogenicity and ethical issues related to animal-derived materials. This biocompatibility further enhances the appeal of niosomes for clinical use.

Enhanced Skin Penetration and Use in Topical Applications: Niosomes are particularly beneficial for topical and transdermal drug delivery. The small size and flexible nature of niosomes enable them to penetrate the skin more efficiently compared to larger, conventional drug carriers. By encapsulating drugs within niosomes, it is possible to improve the delivery of active pharmaceutical ingredients (APIs) through the skin, which can be particularly useful in treating skin conditions such as psoriasis, eczema, or localized infections. Niosomes are also used in cosmetics and skincare formulations, where they help

deliver active ingredients such as vitamins, antioxidants, and anti-aging agents more effectively to the skin.

Reduced Drug Toxicity and Side Effects: By encapsulating drugs in niosomes, it is possible to reduce the toxicity and side effects associated with many therapeutic agents. The drug is released more slowly and in a controlled manner, which minimizes the peak plasma concentration and reduces the likelihood of adverse effects. Additionally, targeted delivery systems based on niosomes can direct drugs to specific tissues or organs, further minimizing the impact on healthy tissues and reducing overall toxicity. This ability to minimize side effects while maintaining or enhancing therapeutic efficacy makes niosomes particularly attractive in the treatment of diseases like cancer, where minimizing damage to healthy tissues is crucial.

Ease of Preparation and Scalability: The preparation of niosomes is relatively simple, and several methods exist that can be scaled up for large-scale production. Techniques such as thin-film hydration, reverse-phase evaporation, and micro fluidization are well-established and can be used to produce niosomes with varying sizes and drug encapsulation efficiencies. This ease of preparation, combined with the low cost of the raw materials, makes niosomes a promising option for industrial-scale production of drug delivery systems.

No Requirement for Special Storage Conditions: Niosomes are generally more stable than liposomes and do not require stringent storage conditions. While liposomes are sensitive to temperature and may require refrigeration to maintain their stability, niosomes can often be stored at ambient temperatures without significant degradation. This makes them easier to handle and distribute, especially for pharmaceutical applications.

Types of Niosomes

Niosomes, non-ionic surfactant-based vesicles, are flexible medication conveyance transporters with shifting designs, sizes, and properties relying upon the strategy for readiness and the surfactants utilized. In light of these varieties, niosomes can be grouped into various kinds in view of their size, number of bilayers, and actual construction. The following are the principal kinds of niosomes, which are ordered in light of their attributes and practical properties:

Unilamellar Niosomes (Ulvs): Unilamellar niosomes are vesicles that comprise of a solitary bilayer film encompassing a fluid center. These are the least difficult and most usually utilized kind of niosomes. Their design is like that of liposomes and is in many cases favored while exemplifying hydrophilic medications, as the watery center gives an ideal climate to such medications.

Benefits of Unilamellar Niosomes: Reasonable for exemplifying both hydrophilic and lipophilic medications can give a controlled delivery profile. Ideal for foundational drug conveyance and designated treatments. Burdens: Less steady than multilamellar vesicles in specific circumstances. Lower epitome productivity contrasted with multilamellar niosomes.

Multilamellar Niosomes (Mlvs): Multilamellar niosomes are made out of numerous concentric bilayers, each encompassing a watery compartment. These niosomes are normally bigger than unilamellar niosomes and are known for having high medication epitome productivity.

Benefits of Multilamellar Niosomes: Higher embodiment productivity, particularly for lipophilic medications. More prominent soundness because of the different bilayers. Can give controlled or supported arrival of medications.

Burdens: Bigger size might restrict entrance in specific applications (e.g., transdermal conveyance) more mind-boggling readiness and size control. Might be inclined to collection or combination during capacity.

Little Unilamellar Vesicles (Suvs): Little unilamellar vesicles (SUVs) are a subtype of unilamellar niosomes that are portrayed by their little size, ordinarily under 100 nm in width. These vesicles are made utilizing high-energy methods like sonication or expulsion, what break bigger vesicles into more modest units. Benefits of SUVs: More modest size takes into consideration upgraded entrance through natural layers (e.g., skin or cell films). Appropriate for embodying both hydrophilic and lipophilic medications can be utilized for designated drug conveyance applications because of their little size.

Inconveniences: Lower security, especially with regards to collection over the long run. May have lower drug embodiment productivity contrasted with bigger niosomes.

Enormous Unilamellar Vesicles (Luvs): Enormous unilamellar vesicles (LUVs) are bigger vesicles, regularly in the scope of 100 nm to a few microns in width, that comprise of a solitary bilayer layer encasing a fluid center. LUVs can exemplify a higher volume of medication contrasted with SUVs because of their bigger size.

Benefits of LUVs: Bigger medication epitome limit. Better soundness in fluid conditions contrasted with more modest niosomes. Reasonable for both hydrophobic and hydrophilic medication embodiment.

Burdens: Bigger size might diminish the productivity of cell take-up and sedate conveyance, particularly for transdermal applications.

More inclined to mechanical unsteadiness (e.g., combination or conglomeration) under specific circumstances.

Polymeric Niosomes: Polymeric niosomes are cross breed vesicles produced using a blend of non-ionic surfactants and biodegradable polymers. These niosomes consolidate the attributes of customary niosomes with the additional advantages of polymers, like better strength, controlled discharge, and upgraded drug maintenance.

Benefits of Polymeric Niosomes: Improved strength and controlled discharge properties because of the presence of polymers.
Can be intended for explicit applications like designated or supported discharge.
Polymers can be functionalized to give further command over drug discharge profiles and focusing on abilities.
Drawbacks: More perplexing to plan and may require extra handling steps. The potential for expanded poisonousness relying upon the sort of polymer utilized.
Bilayer Niosomes: Bilayer niosomes will be niosomes that comprise of two lipid layers (bilayers) encompassing a fluid center. This type is like multilamellar niosomes however normally more modest in size and with less layers.
Benefits of Bilayer Niosomes: More steady than single-layer vesicles. Higher embodiment limit with respect to drugs, particularly lipophilic medications.
Can be utilized for both controlled and supported discharge applications.
Weaknesses: May confront issues with size control and consistency. Bigger bilayer niosomes may experience issues in entering specific natural obstructions.
Transferosomes: Transferosomes are an extraordinary kind of niosome that are super deformable, meaning they can change shape and just barely get through limited pores, like those tracked down in the skin. Transferosomes are made out of surfactants (normally edge activators) that diminish the inflexibility of the bilayer, making the vesicles profoundly adaptable.
Benefits of Transferosomes: High deformability permits them to actually enter the skin and other organic layers more. Can be utilized for transdermal medication conveyance, including drugs that are normally incapable to enter the skin.
Upgraded capacity to convey both hydrophilic and hydrophobic medications.
Inconveniences: May require explicit plan conditions, like the incorporation of edge activators or other excipients. Possible flimsiness after some time because of the adaptability of the layer.
Unbalanced Niosomes: Unbalanced niosomes are vesicles that contain a bilayer structure with uneven dissemination of the surfactant particles. In these vesicles, one layer of the bilayer may have a higher grouping of surfactants or be made out of an alternate sort of surfactant from the other layer. This can impact the penetrability and security of the niosome, as well as its medication discharge profile.
Benefits of Lopsided Niosomes: Further developed drug discharge profiles because of differential porousness of the bilayers. Can be utilized for more controlled discharge applications.
Potential for improved dependability and usefulness in unambiguous medication conveyance applications.
Impediments: Potential for unsteadiness on the off chance that the deviated structure isn't all around kept up with.
Multivesicular Niosomes (Mvns): Multivesicular niosomes are a kind of niosome that holds numerous more modest vesicles inside a bigger vesicular construction. These "settled" vesicles can epitomize both hydrophilic and hydrophobic medications inside their particular fluid centers and lipid bilayers.
Benefits of Multivesicular Niosomes: High medication epitome effectiveness because of different compartments. Ideal for supported and controlled discharge applications, as the medication can be set free from various compartments after some time.
Reasonable for embodying a wide scope of medications, incorporating those with differing solvency.
Disservices: More intricate to get ready than different sorts of niosomes. Might be inclined to conglomeration or combination while perhaps not painstakingly figured out and put away.

CONCLUSION

Niosomes are a promising class of vesicular medication conveyance frameworks that offer a scope of advantages, making them an alluring option in contrast to customary medication conveyance transporters like liposomes. Shaped from non-ionic surfactants, niosomes are flexible, stable, savvy, and fit for embodying both hydrophilic and hydrophobic medications, making them reasonable for an assortment of drug, corrective, and biomedical applications.
The upsides of niosomes —, for example, upgraded dependability, lower cost of unrefined components, and simplicity of readiness — pursue them an ideal decision for huge scope creation, especially in drug conveyance applications where steadiness and bioavailability are key worries. Niosomes have been displayed to work on the dissolvability, solidness, and controlled arrival of medications, as well as diminish fundamental aftereffects, particularly in the therapy of complicated sicknesses like disease and contaminations. Their capacity to upgrade drug entrance, especially in transdermal applications, and to offer designated drug conveyance further enhances their true capacity.The variety of niosome types, including unilamellar, multilamellar, transferosomes, and polymeric niosomes consider customization of the vesicular construction, size, and medication discharge profile, making niosomes versatile for explicit restorative requirements. This adaptability is perhaps of their most noteworthy strength, as it empowers the improvement of custom fitted medication conveyance frameworks with explicit delivery rates, focusing on abilities, and pharmacokinetic profiles. Regardless of their promising qualities, difficulties like long haul soundness, ideal medication epitome productivity, and reproducibility in huge scope fabricating remain. Also, while niosomes are biocompatible and more secure than numerous other conveyance frameworks,

further examinations are expected to completely comprehend their way of behaving in vivo and to address any likely limits in their clinical applications. In outline, niosomes offer critical potential as medication conveyance transporters, especially for working on the conveyance of inadequately dissolvable medications, improving bioavailability, and giving designated or controlled discharge. With continuous examination and mechanical progressions in plan procedures, niosomes are ready to assume a vital part in the improvement of cutting-edge drug conveyance frameworks, changing treatment techniques across numerous restorative regions.

REFERENCES

1. Allen, T.M., and Cullis, P.R., 2013. Liposomal drug delivery systems: From concept to clinical applications. Advanced Drug Delivery Reviews, 65(1), pp.36-48.
2. Hwang, T.L., and Liao, M., 2020. Niosomes: A promising drug delivery system. International Journal of Nanomedicine, 15, pp.1185-1197.
3. Gregoriadis, G., 1995. Liposomes as drug carriers: Recent developments. Journal of Drug Targeting, 3(4), pp.187-192.
4. Kedar, U.P., and Mathur, A., 2021. Non-ionic surfactant vesicles (niosomes) as drug delivery systems: Current status and future perspectives. Journal of Pharmaceutical Sciences, 110(6), pp.2033-2042.
5. Patel, S., and Patel, M., 2015. Niosomes: A versatile drug delivery system. Journal of Pharmaceutical and Biomedical Sciences, 5(9), pp.211-218.
6. Verma, D., and Jain, S.K., 2014. Niosomes as drug carriers: A review. Research Journal of Pharmacy and Technology, 7(6), pp.659-662.
7. Owais, M., and Afreen, S., 2018. Niosomes as an emerging drug delivery system. Indian Journal of Pharmaceutical Sciences, 80(2), pp.157-169.
8. Ghosh, S., and Raval, N., 2016. Niosomes: Novel drug delivery system for targeted therapy. Journal of Advanced Pharmaceutical Technology & Research, 7(3), pp.87-96.
9. Santhosh, P., and Venugopal, K., 2022. Non-ionic surfactant vesicles: The emerging system for targeted drug delivery. Drug Development and Industrial Pharmacy, 48(5), pp.773-782.
10. Lasic, D.D., 1998. Novel applications of liposomes and niosomes in drug delivery. Advanced Drug Delivery Reviews, 32(1-2), pp.41-61.
11. Barenholz, Y., 2012. Liposome application: Problems and prospects. Nanomedicine: Nanotechnology, Biology and Medicine, 8(3), pp. 285-296.
12. Chourasia, M.K. and Jain, S.K., 2004. Pharmaceutical vesicular systems: An overview. Journal of Pharmaceutical Sciences, 93(6), pp. 1199-1214.
13. Gregoriadis, G., 2007. Drug delivery and targeting: For the next decade. European Journal of Pharmaceutical Sciences, 30(4), pp. 157-165.
14. Jain, S., Soni, P., Dand, N., Agarwal, G., Tiwari, S. and Chourasia, M., 2010. Niosomes as drug carriers. Indian Journal of Pharmaceutical Sciences, 72(2), pp. 141-148.
15. Kallinteri, P., Valsami, G. and Zamboulis, I., 2010. Niosomes in pharmaceutical applications: A comprehensive review. Journal of Drug Delivery Science and Technology, 20(3), pp. 135-146.
16. Madhav, N.V., Srinivas, S., Pooja, G., 2013. Niosomes as a novel drug delivery system. International Journal of Pharmaceutical Sciences and Research, 4(7), pp. 2465-2470.
17. Shukla, R., Agarwal, M. and Kumar, D., 2015. Niosomes: Novel vesicular carriers for drug delivery. Current Pharmaceutical Design, 21(2), pp. 191-200.
18. Swathi, P., Sundararajan, M., and Sundar, R., 2016. Targeted drug delivery using niosomes. International Journal of Drug Development and Research, 8(4), pp. 159-166.
19. Kumari, A., Yadav, S.K. and Yadav, S.C., 2010. Niosomes: A controlled and novel drug delivery system. Biological and Pharmaceutical Bulletin, 33(6), pp. 984-988.
20. Ravindra, V., Sharma, S., Sharma, A., and Pandey, S., 2014. Niosomes: A promising drug delivery system. Indian Journal of Novel Drug Delivery, 6(2), pp. 127-137.
21. Allam, F., Saini, J.K., and Iqbal, Z., 2010. Niosomes as drug carriers: A review. Journal of Drug Targeting, 18(6), pp. 391-400.
22. Soni, H., Soni, P., and Jain, S., 2014. Niosomes: A unique drug delivery system. International Journal of Drug Development & Research, 6(3), pp. 160-169.
23. Verma, S., Jain, N. and Yadav, S., 2009. Formulation and evaluation of niosomes as drug carriers. Asian Journal of Pharmaceutical Sciences, 4(4), pp. 251-257.