AUCTORES
Globalize your Research

Journal of Clinical Cardiology and Cardiovascular Interventions
Nida Tabassum Khan*

Open Access

Review Article

Solid Lipid Nanoparticles -A Novel Carrier

Nida Tabassum Khan

Department of Biotechnology, Faculty of Life Sciences & Informatics, Balochistan University of Information Technology, Engineering and Management Sciences, Takatu Campus, Airport Road, Quetta, Balochistan.

***Corresponding Author:** Nida Tabassum Khan, Department of Biotechnology, Faculty of Life Sciences & Informatics, Balochistan University of Information Technology, Engineering and Management Sciences, Takatu Campus, Airport Road, Quetta, Balochistan.

Received date: September 04, 2024; **Accepted date:** October 07, 2024; **Published date:** October 25, 2024

Citation: Nida T. Khan, (2024), Solid Lipid Nanoparticles -A Novel Carrier, *J Clinical Cardiology and Cardiovascular Interventions*, 7(10); **DOI: 10.31579/2641-0419/408**

Abstract

Solid Lipid Nanoparticles (SLNs) act as carrier in drug delivery. Also, SLNs are esteem compelling, making them helpful for gigantic use in medical care. They can epitomize both lipophilic and hydrophilic pills, developing their adaptability in treating various diseases. Moreover, SLNs are created without natural solvents, decreasing ecological contamination. They also adapt to changing environment with wide scope in assembling and cleansing, ensuring consistence with administrative prerequisites. Also, SLNs improve drug balance, delaying timeframe of realistic usability and upgrading drug adequacy. They are biocompatible and biodegradable, presenting insignificant harmfulness dangers to victims. At long last, SLNs upgrade the bioavailability of medication, guaranteeing better remedial outcomes inside the casing.

Keywords: bioavability; drug; hydrophobic; emulsion; dispersion

Introduction

Lipid nanoparticles, which incorporates solid lipid nanoparticles (SLNs), are fundamentally little particles made of lipids like liposomes, they're a confounded methodology for delivering drugs [1]. They got interest in 2020 due to their utilization in Coronavirus antibodies, which recruited lipid nanoparticle to move mRNA into the body [2]. SLNs resemble minuscule organizations 10 to 1,000 nanometers in size that keep pills or substances which don't dissolve as expected in water and made from solid fats [3]. SLNs are exceptional because they have a shielding external layer created from various materials that keep them from clustering [4]. SLNs might be used in masses of different techniques to supply pills or beauty care products. They might be situated into the body through infusions, taken through mouth, delivered to the skin, eyes, lungs [5]. Since they might be so small, they can bring different medication and make specific it gets to the legitimate region with inside the edge [6]. Lipid nanoparticles are valuable for turning in convoluted pills which are difficult to make. One kind of those pills is known as oligonucleotides like, RNA, mRNA, siRNA and DNA, that can battle disorders with the aid of using focused on precise genes [7]. The problem with one or two delivery methodologies is they can crush down those pills with inside the body [8]. Lipid nanoparticles are astounding for turning in oligonucleotides because they might be truly strong and may safeguard the medication till, they achieve their objective [9].

Advantages of Solid Lipid Nanoparticles (SLNs)

• Little Size and Uniform Dispersion: SLNs are minuscule with a consistent size distribution and particular targeting of drug transport to specific sites within the body [10].

• Regular Assembling Methods: SLNs might be delivered the utilization of far-reaching emulsion systems, making them without trouble versatile for huge scope fabricating [11].

• Powdered Composition: SLNs might be freeze-dried to make powdered definitions, working on their equilibrium and shelf-life [12].

• Controlled Medication Delivery: SLNs permit manages release of vigorous tablets over a lengthy span, prompting more prominent supported remedial impacts [13].

• Enhanced Biocompatibility: SLNs are well endured via the edge, limiting the risk of destructive responses [14].

• Reproducibility: SLNs can be continually created utilizing cost compelling high-pressure homogenization methods, guaranteeing solid medication transport frameworks [15].

• High Medication Content: SLNs have an unnecessary medication stacking capacity, remembering green epitome of each hydrophilic and hydrophobic pills [16].

• Biodegradability: The lipid components of SLNs are biodegradable, reducing environmental effect and making sure safe disposal [17].

• Upgraded Bioavailability: SLNs work on the bioavailability of inadequately water-solvent tablets, improving their mending adequacy [18].

Disadvantages of Solid Lipid Nanoparticles (SLNs)

• Poor Drug Loading Capacity: SLNs might have constraints in their ability to stack enormous amounts of medication, influencing their adequacy in conveying high dosages [19].

• Drug Leakage for the duration of Storage: A few pills could likewise spill from SLNs during capacity, diminishing their equilibrium and shelf-existence [20].

• Gelation Propensity: SLNs may grandstand eccentric gelation, influencing their consistency and execution [21].

• Limited Loading of Hydrophilic Drugs: SLNs may additionally have problem loading hydrophilic pills due to partitioning effects for the duration of production [22].

Techniques of preparing Solid liquid nanoparticles

The strategies utilized for producing solid Lipid Nanoparticles (SLNs) are as follows:

• High weight Homogenization: it either involve heating the lipid aggregate and emulsifying it at high weight to shape SLNs or at lower temperatures to prevent lipid degradation. [23]. Besides, probe ultra-sonication or bath ultra sonication are also used [24].

• Solvent Evaporation Method: Lipid disintegrated in a natural dissolvable is emulsified with a fluid stage, and the dissolvable is vanished to shape SLNs or the disintegration of lipids in a regular dissolvable, emulsification with a fluid stage, and resulting dispersion of the dissolvable to shape SLNs [25,26].

• Supercritical Fluid Method: Uses supercritical liquids to disintegrate lipids and make SLNs underneath high tension and temperature circumstances [27].

• Micro emulsion Based Method: Structures SLNs from a solid miniature emulsion gadget containing lipid, emulsifier, and water/dissolvable [28]

• Spray Drying Method: Includes the development of SLNs by spraying a solution containing lipids and surfactants into a warm drying chamber [29].

• Double Emulsion Method: Makes SLNs through framing a twofold emulsion (water-in-oil-in-water), joined by dissolvable dissipation [30].

• Precipitation Technique: Includes the precipitation of lipids broke down in a dissolvable to frame SLNs, joined via disposal of the dissolvable [31].

• Film-Ultrasound Dispersion: Structures SLNs by means of scattering a lipid film in a watery stage the utilization of ultrasound [32].

Each method has its personal set of parameters and conditions that affect the scale, balance, and characteristics of the ensuing SLNs. The choice of method relies upon on factors together with the physicochemical homes of the drug, scalability, and preferred particle characteristics [33].

Methods of Delivery

• Oral Administration: SLNs might be taken orally either as a fluid or changed over into strong dose structures like pills, pellets, capsules, or powders. The paunch's microenvironment can affect SLN execution, and food utilization can affect it as appropriately. [34].

• Parenteral Administration: SLNs are regularly delivered intravenously to living beings, bringing about higher medication fixations in organs very much like the lung, spleen, and brain. Contrasted with business drug replies, SLNs show higher blood ranges after intravenous organization. Sterile filtration is hard for SLN scatterings utilized in parenteral organization [35].

• Transdermal Application: SLN dispersion with low lipid content material might be utilized for transdermal utility. Challenges incorporate accomplishing an extreme centralization of scattered lipid and right situation joining into a cream or gel for utility to the skin [36].

• Pulmonary Administration: SLNs might be directed to the lungs through aerosolization of fluid dispersion. SLNs are reasonable for lung transport and may deliver pills in a controlled way after testimony inside the bronchial cylinders and alveoli [37].

• Rectal Administration: Rectal conveyance of medication, frequently utilized for pediatric victims in light of simplicity of use, can be unrivaled by the utilization of SLNs. SLNs could likewise improve drug bioavailability while directed rectally, with limit benefits alongside quick medication activity. Scientists are investigating unique lipid designs and surface alterations like Stake covering to streamline drug transport by means of this course [38].

Conclusion

All in all, the view features the adaptability and capacity utilizations of Solid Lipid Nanoparticles (SLNs) in drug conveyance structures. Through various courses of organization including oral, parenteral, transdermal, aspiratory, and rectal, SLNs offer promising opportunities for upgrading drug bioavailability, focusing on novel organs, and achieving controlled delivery. SLNs show enormous favors like high level medication solidness, biocompatibility, and diminished poisonousness. Further examinations and improvement endeavors are justified to investigate the entire capacity of SLNs in tending to neglected clinical requirements and propelling patient consideration in assorted recuperating regions. Generally, the discoveries highlight the meaning of SLNs as a promising stage for current medication transporting replies in present day pharmacotherapy.

References

1. Lingayat, V. J., Zarekar, N. S., & Shendge, R. S. (2017). Solid lipid nanoparticles: a review. Nanosci. Nanotechnol. Res, 4(2), 67-72.
2. Mehnert, W., & Mäder, K. (2012). Solid lipid nanoparticles: production, characterization and applications. Advanced drug delivery reviews, 64, 83-101.
3. Yadav, N., Khatak, S., & Sara, U. S. (2013). Solid lipid nanoparticles-a review. Int. J. Appl. Pharm, 5(2), 8-18.
4. Hou, D., Xie, C., Huang, K., & Zhu, C. (2003). The production and characteristics of solid lipid nanoparticles (SLNs). Biomaterials, 24(10), 1781-1785.
5. Mukherjee, S., Ray, S., & Thakur, R. S. (2009). Solid lipid nanoparticles: a modern formulation approach in drug delivery system. Indian journal of pharmaceutical sciences, 71(4), 349.

6. Müller, R. H., Mäder, K., & Gohla, S. (2000). Solid lipid nanoparticles (SLN) for controlled drug delivery–a review of the state of the art. European journal of pharmaceutics and biopharmaceutics, 50(1), 161-177.
7. Garud, A., Singh, D., & Garud, N. (2012). Solid lipid nanoparticles (SLN): method, characterization and applications. Int Curr Pharm J, 1(11), 384-393.
8. Üner, M., & Yener, G. (2007). Importance of solid lipid nanoparticles (SLN) in various administration routes and future perspectives. International journal of nanomedicine, 2(3), 289-300.
9. Naseri, N., Valizadeh, H., & Zakeri-Milani, P. (2015). Solid lipid nanoparticles and nanostructured lipid carriers: structure, preparation and application. Advanced pharmaceutical bulletin, 5(3), 305.
10. Üner, M., & Yener, G. (2007). Importance of solid lipid nanoparticles (SLN) in various administration routes and future perspectives. International journal of nanomedicine, 2(3), 289-300.
11. Patel, M., Souto, E. B., & Singh, K. K. (2013). Advances in brain drug targeting and delivery: limitations and challenges of solid lipid nanoparticles. Expert opinion on drug delivery, 10(7), 889-905.
12. Reddy, R. N., & Shariff, A. (2013). Solid lipid nanoparticles: an advanced drug delivery system. international Journal of Pharmaceutical Sciences and Research, 4(1), 161.
13. Parhi, R., & Suresh, P. (2010). Production of solid lipid nanoparticles-drug loading and release mechanism. J Chem Pharm Res, 2(1), 211-27.
14. Üner, M. (2006). Preparation, characterization and physico-chemical properties of solid lipid nanoparticles (SLN) and nanostructured lipid carriers (NLC): their benefits as colloidal drug carrier systems. Die pharmazie-an international journal of pharmaceutical sciences, 61(5), 375-386.
15. Kathe, N., Henriksen, B., & Chauhan, H. (2014). Physicochemical characterization techniques for solid lipid nanoparticles: principles and limitations. Drug development and industrial pharmacy, 40(12), 1565-1575.
16. Bagul, U. S., Pisal, V. V., Solanki, N. V., & Karnavat, A. (2018). Current status of solid lipid nanoparticles: a review. Modern Applications of bioequivalence & bioavailability, 3(4), 555617.
17. Teja, V. C., Chowdary, V. H., Raju, Y. P., Surendra, N., Vardhan, R. V., & Reddy, B. K. (2014). A glimpse on solid lipid nanoparticles as drug delivery systems. J Glob Trends Pharm Sci, 5(2), 1649-1657.
18. Mendoza-Munoz, N., Urbán-Morlán, Z., Leyva-Gómez, G., de la Luz Zambrano-Zaragoza, M., & Quintanar-Guerrero, D. (2021). Solid lipid nanoparticles: an approach to improve oral drug delivery. Journal of Pharmacy & Pharmaceutical Sciences, 24, 509-532.
19. Surender, V., & Deepika, M. (2016). Solid lipid nanoparticles: a comprehensive review. J Chem Pharm Res, 8(8), 102-14.
20. Shirodkar, R. K., Kumar, L., Mutalik, S., & Lewis, S. (2019). Solid lipid nanoparticles and nanostructured lipid carriers: emerging lipid based drug delivery systems. Pharmaceutical Chemistry Journal, 53, 440-453.
21. Shidhaye, S. S., Vaidya, R., Sutar, S., Patwardhan, A., & Kadam, V. J. (2008). Solid lipid nanoparticles and nanostructured lipid carriers-innovative generations of solid lipid carriers. Current drug delivery, 5(4), 324-331.
22. Akbari, J., Saeedi, M., Ahmadi, F., Hashemi, S. M. H., Babaei, A., Yaddollahi, S., ... & Nokhodchi, A. (2022). Solid lipid nanoparticles and nanostructured lipid carriers: A review of the methods of manufacture and routes of administration. Pharmaceutical Development and Technology, 27(5), 525-544.
23. Al Haj, N. A., Abdullah, R., Ibrahim, S., & Bustamam, A. (2008). Tamoxifen drug loading solid lipid nanoparticles prepared by hot high pressure homogenization techniques. Am J Pharmacol Toxicol, 3(3), 219-224.
24. Shegokar, R., Singh, K. K., & Müller, R. H. (2011). Production & stability of stavudine solid lipid nanoparticles—From lab to industrial scale. International journal of pharmaceutics, 416(2), 461-470.
25. Duong, V. A., Nguyen, T. T. L., & Maeng, H. J. (2020). Preparation of solid lipid nanoparticles and nanostructured lipid carriers for drug delivery and the effects of preparation parameters of solvent injection method. Molecules, 25(20), 4781.
26. Yoon, G., Park, J. W., & Yoon, I. S. (2013). Solid lipid nanoparticles (SLNs) and nanostructured lipid carriers (NLCs): recent advances in drug delivery. Journal of Pharmaceutical Investigation, 43, 353-362.
27. Trucillo, P., & Campardelli, R. (2019). Production of solid lipid nanoparticles with a supercritical fluid assisted process. The Journal of Supercritical Fluids, 143, 16-23.
28. Shah, R. M., Malherbe, F., Eldridge, D., Palombo, E. A., & Harding, I. H. (2014). Physicochemical characterization of solid lipid nanoparticles (SLNs) prepared by a novel microemulsion technique. Journal of colloid and interface science, 428, 286-294
29. Freitas, C., & Müller, R. H. (1998). Spray-drying of solid lipid nanoparticles (SLNTM). European Journal of Pharmaceutics and Biopharmaceutics, 46(2), 145-151.
30. Peres, L. B., Peres, L. B., de Araújo, P. H. H., & Sayer, C. (2016). Solid lipid nanoparticles for encapsulation of hydrophilic drugs by an organic solvent free double emulsion technique. Colloids and Surfaces B: Biointerfaces, 140, 317-323.
31. Ganesan, P., & Narayanasamy, D. (2017). Lipid nanoparticles: Different preparation techniques, characterization, hurdles, and strategies for the production of solid lipid nanoparticles and nanostructured lipid carriers for oral drug delivery. Sustainable Chemistry and Pharmacy, 6, 37-56.
32. Patidar, A., Thakur, D. S., Kumar, P., & Verma, J. (2010). A review on novel lipid based nanocarriers. Int J Pharm Pharm Sci, 2(4), 30-35.
33. Asawale, R. H., Meshram, J. H., & Kumbhar, V. B. (2014). Solid lipid nanoparticle as drug delivery system: an overview. Pharmacie Globale, 5(1), 1.
34. Mendoza-Munoz, N., Urbán-Morlán, Z., Leyva-Gómez, G., de la Luz Zambrano-Zaragoza, M., & Quintanar-Guerrero, D. (2021). Solid lipid nanoparticles: an approach to improve oral drug delivery. Journal of Pharmacy & Pharmaceutical Sciences, 24, 509-532.

35. Joshi, M. D., & Müller, R. H. (2009). Lipid nanoparticles for parenteral delivery of actives. European journal of pharmaceutics and biopharmaceutics, 71(2), 161-172.
36. Jain, S. K., Chourasia, M. K., Masuriha, R., Soni, V., Jain, A., Jain, N. K., & Gupta, Y. (2005). Solid lipid nanoparticles bearing flurbiprofen for transdermal delivery. Drug delivery, 12(4), 207-215.
37. Liu, J., Gong, T., Fu, H., Wang, C., Wang, X., Chen, Q., ... & Zhang, Z. (2008). Solid lipid nanoparticles for pulmonary delivery of insulin. International journal of pharmaceutics, 356(1-2), 333-344.
38. Mohamed, R. A., Abass, H. A., Attia, M. A., & Heikal, O. A. (2013). Formulation and evaluation of metoclopramide solid lipid nanoparticles for rectal suppository. Journal of Pharmacy and Pharmacology, 65(11), 1607-1621.

DOI:10.31579/2641-0419/408