WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.084
Volume 10, Issue 11, 443-450. Review Article ISSN 2277– 7105

A REVIEW ON NANONIOSOMES

Nasrina Abdin*, Bidisha Bordoloi, Toufikananda Rabha and Jagya Jyoti Dutta

Department of Pharmaceutics, Girijananda Chowdhury Institute of Pharmaceutical Science, Hatkhowapara, Azara, Guwahati, Assam, India, 781017.

Article Received on
26 June 2021,

Revised on 15 July 2021,
Accepted on 05 August 2021

DOI: 10.20959/wjpr202111-21361

***Corresponding Author**
Nasrina Abdin
Department of Pharmaceutics, Girijananda Chowdhury Institute of Pharmaceutical Science, Hatkhowapara, Azara, Guwahati, Assam, India, 781017.

ABSTRACT

Drug delivery systems are the formulations targeting for transport of a drug to the areadesired for the action within the body. The field of nanochemistry research has revealed a great advancement in the emerging of novel nanocarriers as potential drug delivery systems. The current review discusses about the most important features of niosomes like their types, the diverse preparation approaches, advantages, their stability, their uses, their therapeutic applications. The unique structure of niosome presents an effective novel drug delivery system (NDDS) with ability of loading both hydrophilic and lipophilic drugs. The low cost ofmanufacture, ingredients, stability, possibility of large-scale production, and the resultant ease of storing of niosomes have led to the exploitation of these nano carriers as substitutes toother micro and nano-encapsulation technologies. In past niosomes were used in cosmetics &it has applications on therapy of cancer, used as a carrier in haemoglobin, transport of the peptide drugs orally, in leishmaniasis, in cosmetics and as carrier in dermal drug delivery. Abundant research articles were published in scientific journals, reporting valuable results of individual case studies in this context. The present review describes preparation methods and recent studies on niosomal drug delivery systems and also gives up to date information regarding recent applications of niosomes in drug delivery.

KEYWORDS: Niosomes, hydrophilic drugs, production, drug delivery system.

INTRODUCTION

Nanoniosomes entrapped the hydrophilic drug in the core cavity and hydrophobic drugs in the non-polar region existing within the bilayer hence together hydrophilic and hydrophobic

drugs can be incorporated into niosomes.[1] The niosomes are ampiphillic in nature, the medicine is encapsulated in a vesicle, made by non-ionic surfactant, shown in Fig. 1. The niosomes size is a very small and microscopic.[2] Niosomes are generally considered as an alternative to liposomes since they lessen the disadvantages associated with liposomes.[3] They overcome the drawbacks related with liposomes like chemical instability. The key resolution of emerging niosomal system is biocompatibility, biodegradability, chemical stability, low production cost, easy storage and handling and low toxicity.[4,5] Niosomes are managed by several routes such as parenteral, oral, topical. Niosomes are used as a carrier to deliver different types of drugs such as synthetic and herbal, antigens, hormones and other bioactive compounds.[6,7,8]

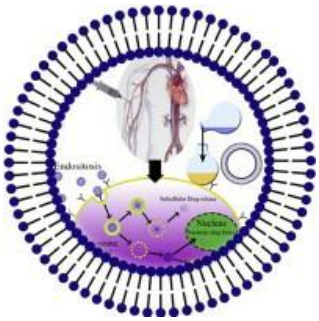

Figure 1: Structure of Niosome.

These are extensively employed as drug delivery systems, they are bilayered vesicles generally found by the self-assembly of cholesterol and nonionic surfactants, later by hydration in an aqueous medium.[9] Advantages of niosomes are biodegradability, bioavailability, biocompatibility, stability, low cost and diversity of available surfactants for their design.[10][11][12] Niosomes contain two major components, including cholesterol and non- ionic surfactants. Cholesterol provides rigidity and proper shape, while surfactants play a key role in the development of niosomes. The non-ionic surfactants hold a hydrophilic head (non- polar) and a hydrophobic tail. The families of Spans (Span 20, 40, 60, 80 and 85), Tweens (Tween 20, 40, 60, and 80), and Brij (Brij 30, 35, 52, 58, 72 and 76) are commonly used as non-ionic surfactants in the preparation of niosomes. Niosomes are frequently used for loading different types of drugs. For instance, paclitaxel[13], acyclovir[14] and enoxacin/gentamicin[15][16] are successfully loaded in niosomes as anticancer, antiviral and antibacterial agents, correspondingly.

Niosomes

Classification of Niosomes

Niosomes are classified by the number of size, bilayers and preparation method. Multilamellar-0.5 µm to 10 µm in diameter.

Large unilamellar-0.1µm to 1µm in diameterSmall unilamellar-25 to 500 nm in diameter.

Types of Niosomes[17,18]

Proniosomes

Proniosomes are made from the carrier and surfactant mixture. After the hydration of proniosomes, niosomes are produced.

Aspasomes

Aspasomes can be utilized to build the transdermal saturation of medications. Aspasomes have likewise been employed to diminish scatter, caused by reactive oxygen species as it has innate cell reinforcement property.

Niosomes in carbopolgel

Niosomes were obtained from drug, spans and cholesterol.

Deformable niosomes

These are smaller vesicles and easily pass through the pores of stratum corneum, which leads to elevated penetration efficiency. It can be used in topical preparation.[19,20]

The niosomes are also categorised affording to the number and size of bilayers.

i) Multi Lamellar Vesicles (MLV)

Multilamellar vesicles are the extensively used niosomes, it has a number of bilayers. It is simple to make and are mechanically stable upon storage for longer periods.

ii) Large Uni lamellar Vesicles (LUV)

These are having a high aqueous/lipid compartment ratio, so that larger volumes of bio-active materials can be entrapped.

iii) Small Uni lamellar Vesicles (SUV)

These are generally obtained from multilamellar vesicles by french press, sonication and extrusion method.

Methods of Preparation

Thin-Film Hydration Method

It is a simple and well-known technique. In this, the surfactants, cholesterol, and some additives like charged molecules are liquified in an organic solvent in a flask. Then organic solvent is separated using a rotary vacuum evaporator. A solution of drug is added and the dry film is hydrated above the transition temperature of the surfactant for quantified time with persistent shaking.[21,22]

Ether Injection Method

In this, the surfactants with additives are liquified in ether and inoculated gradually through a needle in a solution of drug maintained at a persistent temperature. The solvent is vanished using a rotary evaporator. During the vaporization the development of single layered vesicles will be seen.[23,24]

Reverse Phase Evaporation Method

Niosomal ingredients are liquified in ether and chloroform mixture and added to aqueous phase containing the drug. The subsequent blend is sonicated in order to form an emulsion and the organic phase is vanished. Large uni lamellar vesicles are formed during the evaporation of the organic solvent.[25,26]

Micro fluidization Method

In this the drug and the surfactant fluidized streams interact at ultrahigh velocities, in precisely defined micro channels inside the interaction chamber. The rapid impingement and the energy involved leads to development of niosomes.[27,28]

Stability of Niosomes

These are performed by the estimation of PDI, size, and zeta potential of niosomes. Storage conditions are critical for firmness and niosomes that stored at 4 °C have maintained their size, zeta potential, and stable structure. However, at 25 °C storage condition, zeta potential values were decreased from +40 to −20 mV. With a decrease in zeta potential values, aggregation occurred and therefore increase in size was observed at room temperature after 100 days.[29,30]

Advantages

Bioavailability improvement: The term bioavailability suggests to the part of a dosage that

is accessible at the site of activity in the body.[31]

- These are stable and osmotically active, also they elevate the stability of entrapped drug.
- No special conditions are required for handling and storage of surfactants.
- They improve oral bioavailability of poorly absorbed drugs and enhance skin penetration ofdrugs.

Niosomes offer numerous advantages as presented below.

(i) Niosomes are osmotically active, chemically stable and have long storage time compared to liposomes.

(ii) Their surface formation and modification are very easy because of the functional groupson their hydrophilic heads.

(iii) They have high compatibility with biological systems and low toxicity because of theirnon-ionic nature.

(iv) They can entrap lipophilic drugs into vesicular bilayer membranes and hydrophilic drugsin aqueous compartments.

(v) They are biodegradable and non-immunogenic.

(vi) Access to raw materials is convenient.

(vii) Niosomes can advance the therapeutic performance of the drug molecules by protecting the drug from biological environment, ensuing in improved availability and controlled drug delivery.

(viii) Niosomes exhibit a high patient compliance, because of the water-based suspension of niosomes.

(ix) The handling of surfactants requires no special precautions and conditions;

(x) Niosomes will upsurge the oral bioavailability and skin penetration of drugs;

(xi) The variable characteristics of the niosomes can be regulated.

(xii) Niosomes can improve absorption of some drugs across cell membranes, to localize in targeted tissues and to elude the reticuloendothelial system.[32,33,34]

Applications

Niosomes has its applications in various fields.

Niosome As Carrier In Dermal Drug Delivery

Niosomes were used for the dermatological purpose in 1975 in cosmetic industry. The first niosomal cosmetic product was launched by Lancome Niosome, an antiaging formulation. Topical formulations of niosomes which are developed recently are mentioned below.

As Carrier: Niosomes being the vesicles can easily permeate to oxygen and the haemoglobin dissociation curve is modified similarly to non-encapsulated haemoglobin. So, they are used as the carrier for haemoglobin.[35]

CONCLUSION

Niosomes have been proven to be useful controlled drug delivery systems for transdermal, parenteral, oral, and ophthalmic routes. They can be used to encapsulate anti-cancer agents, anti-inflammatory agents anti-infective agents and fairly newly as vaccine adjuvants. The present work deals with an up-to-date review on the anticancer drugs and niosomal drug delivery system. The potential of niosome can be enhanced by using novel preparations, loading and modification methods. Thus, these areas need further exploration and research so as to bring out commercially available niosomal preparations.

ACKNOWLEDGEMENT

The authors are thankful to the management of Girijananda Chowdhury Institute of Pharmaceutical Science, Guwahati, Assam, India, for providing necessary facilities to carry out the research work.

REFERENCES

1. Shakya V, Bansal BK. Niosomes: a novel trend in drug delivery Int. J. Res. Dev. Pharm. L. Sci, 2014; 3(4): 1036-1041.
2. Makeshwar K, Wasankar S. Niosomes: a novel drug delivery system. Asian J. Pharm. Res, 2013; 3: 16-20.
3. Punithavalli G, Vignesh M. Formulation of Niosomal Suspension with enhanced oral bioavailability of Diclofenac sodium. J. Global Trends Pharm. Sci, 2012; 3: 656-671.
4. Katare R, Gupta P, Mahor S, Rawat A, Khatri K, Katare Y, Panda A, Vyas S. Development of polysaccharide-capped niosomes for oral immunization of tetanus toxoid. Journal Drug Del. Sci. Tech, 2006; 16: 167-172.
5. Shahiwala A, Misra A. Studies in topical application of niosomally entrapped nimesulide. Journal of Pharm. Pharmaceut. Sci, 2002; 5: 220-225.
6. Bagheri A, Chu B, Yaakob H. Niosomal Drug Delivery Systems: Formulation, Preparation and Applications. World Appl. Sci. J, 2014; 32: 1671-1685.
7. Sudheer P, Kaushik K. Review on Niosomes-A Novel Approach for Drug Targeting. Journal of Pharmaceutical Research, 2015; 1-14.
8. Sunil kumar M. Niosomes as novel drug delivery system. International Research Journal

of Pharmaceutical and Applied Science, 2015; 5: 1-7.

9. Kumar A. Leishmania and leishmaniasis. New York: Springer; 2013.
10. Barakat HS, Kassem MA, El-Khordagui LK, et al. Vancomycin-eluting niosomes: a new approach to the inhibition of staphylococcal biofilm on abiotic surfaces. AAPS Pharm Sci Tech, 2014; 15: 1263-1274.
11. Guan L, Liu X, Xiao F, et al. Characterization of elastic niosomes prepared with various nonionic surfactants for lidocaine hydrochloride transdermal delivery. Nano sci Nano technol Lett, 2016; 8: 1033-1039.
12. Shaker DS, Shaker MA, Hanafy MS. Cellular uptake, cytotoxicity and *in-vivo* evaluation of tamoxifen citrate loaded niosomes. Int J Pharm, 2015; 493: 285-294.
13. Bayindir ZS, Yuksel N. Characterization of niosomes prepared with various nonionic surfactants for paclitaxel oral delivery. J Pharm Sci, 2010; 99(4): 2049-2060.
14. Mukherjee B, Patra B, Layek B, Mukherjee A. Sustained release of acyclovir from nano-liposomes and nano-niosomes: an *in vitro* study. Int J Nanomedicine, 2007; 2(2): 213-225.
15. Fang JY, Hong CT, Chiu WT, Wang YY. Effect of liposomes and niosomes on skin permeation of enoxacin. Int J Pharm, 2001; 219(1-2): 61-72.
16. Abdelbary G, El-gendy N. Niosome-encapsulated gentamicin for ophthalmic controlled delivery. AAPS Pharm Sci Tech, 2008; 9(3): 740-7.
17. Makeshwar K, Wasankar S. Niosomes: a novel drug delivery system. Asian J. Pharm. Res, 2013; 3: 16-20.
18. Verma A. A vital role of niosomes on Controlled and Novel Drug delivery. Indian Journal of Novel Drug Delivery, 2011; 3: 238-246.
19. Arul J, Shanmuganathan S, Nagalakshmi. An Overview on Niosome as Carrier in Dermal Drug Delivery. J. Pharm. Sci. Res, 2015; 7: 923-927.
20. Moghassemi S, Hadjizadeh A. Nano-niosomes as Nanoscale Drug Delivery Systems: An illustrated review. J. Controlled Release, 2014; 2: 22-36.
21. Bhaskaran S and Lakshmi PK. Comparative evaluation of niosome formulations prepared by different techniques. Acta Pharm. Sci, 2009; (51)1: 27-32.
22. Baillie AJ, Florence AT, Hume LR, Muirhead GT, and Rogerson A. The preparation and properties of niosomes non-ionic surfactant vesicles. The Journal of Pharmacy and Pharmacology, 1985; (37)12: 863-868.
23. Marwa A, Omaima S, Hanaa ELG, and Mohammed AS. Preparation and *in-vitro* evaluation of diclofenac sodium niosomal formulations. International Journal of

Pharmaceutical Sciences and Research, 2013; (4)5: 1757-1765.

24. Srinivas S, Kumar YA, Hemanth A, and Anitha M. Preparation and evaluation of niosomes containing aceclofenac. Digest Journal of Nanomaterials and Biostructures, 2010; (5)1: 249-254.
25. Moghassemi S, Parnian E, Hakamivala A, et al., Uptake and transport of insulin across intestinal membrane model using trimethyl chitosan coated insulin niosomes. Mater. Sci. Eng, 2015; (46): 333-340.
26. Kiwada H, Niimura H, Fujisaki Y, Yamada S, and Kato Y. Application of synthetic alkyl glycoside vesicles as drug carriers. Preparation and physical properties. Chem. Pharm. Bull, 1985; 33(2): 753-759.
27. Zidan AS, Rahman Z, and Khan MA. Product and process understanding of a novel pediatric anti-HIV tenofovir niosomes with a high-pressure homogenizer. Eur. J. Pharm. Sci, 2011; 44(1-2): 93-102.
28. Verma S, Singh SK, Syan N, Mathur P, Valecha V. Nanoparticle vesicular systems: a versatile tool for drug delivery. J. Chem. Pharm. Res, 2010; 2(2): 496-509.
29. Ojeda E, Puras G, Agirre M, Zarate J, Grijalvo S, Eritja R, Martinez-Navarrete, G, Soto-Sanchez, C, Diaz-Tahoces A, Aviles-Trigueros M, et al. The influence of the polar head-group of synthetic cationic lipids on the transfection efficiency mediated by niosomes in rat retina and brain. Biomaterials, 2016; 77: 267-279.
30. Ojeda E, Puras G, Agirre M, Zarate J, Grijalvo S, Pons R, Eritja R, Martinez-Navarrete, G, Soto-Sanchez, C, Fernandez E, et al. Niosomes based on synthetic cationic lipids for gene delivery: The influence of polar head-groups on the transfection efficiency in HEK-293, ARPE-19 and MSC-D1 cells. Org. Biomol. Chem, 2015; 13: 1068-1081.
31. Madhav N, Saini A. Niosomes: A Novel Drug Delivery System. Int. J. Res. Pharm. Chem, 2011; 1: 498-511.
32. Verma S, Singh SK, Syan N, Mathur P, Valecha V. Nanoparticle vesicular systems: a versatile tool for drug delivery. J. Chem. Pharm. Res, 2010; 2(2): 496-509.
33. A. Tarekegn, et al., Niosomes in targeted drug delivery: some recent advances, Int. J. Pharm. Sci. Res, 2010; 1(9): 1-8.
34. M. Carafa, E. Santucci, G. Lucania, Lidocaine-loaded non-ionic surfactant vesicles: characterization and in vitro permeation studies, Int. J. Pharm, 2002; (23): 21-32.
35. M.R. Mozafari (ed.), Nanomaterials and Nanosystems for Biomedical Applications, 67-81.