Review Article **CODEN: IJRPJK** **ISSN: 2319 – 9563**

International Journal of Research in Pharmaceutical and Nano Sciences

Journal homepage: www.ijrpns.com

https://doi.org/10.36673/IJRPNS.2020.v09.i05.A29

A REVIEW ON NIOSOMES

Prashant P. Jadhav*[1]

[1*]Department of Pharmaceutics, Gourishankar Education Society's Satara College of Pharmacy, Satara, Maharashtra, India.

ABSTRACT

Niosome are non-ionic surfactant vesicles got on hydration of manufactured nonionic surfactants, with or without fuse of cholesterol or their lipids. They are vesicular frameworks like liposomes that can be utilized as transporters of amphiphilic and lipophilic medications. Baneful are promising vehicle for sedate conveyance and being non-ionic and Niosomes are biodegradable, biocompatible non- immunogenic and display adaptability in their basic portrayal. Niosomes have been broadly assessed for controlled discharge and focused on conveyance for the treatment of malignancy, viral contaminations what's more, other microbial maladies. Niosomes can ensnare both hydrophilic and lipophilic medications and can delay the dissemination of the ensnared tranquilize in body. Exemplification of medication in vesicular framework can be anticipated to delay the presence of medication in the foundational flow and upgrade entrance into target tissue, maybe lessen poisonousness if specific take-up can be accomplished. This audit article centers around the points of interest, Disadvantages, arrangement strategies, factors influencing, portrayals, *in vitro* strategies, medicate discharge energy and utilizations of baneful.

KEYWORDS

Niosome, Composition, Methods of preparation, Evaluation and Application.

Author for Correspondence:

Prashant P. Jadhav,
Department of Pharmaceutics,
Gourishankar Education Society's Satara College of Pharmacy, Satara, Maharashtra, India.

Email: prashantjadhav01061997@gmail.com

INTRODUCTION

Paul Ehrlich, in 1909, started the advancement for focused conveyance when he conceived a medication conveyance system that would target legitimately to ailing cell. Medication focusing on can be characterized as the capacity to coordinate a helpful specialist explicitly to wanted site of activity with almost no connection with non target tissue. In pernicious, the vesicles framing amphiphile is a non-ionic surfactant, for example, Span-60 which is

generally settled by expansion of cholesterol and modest quantity of anionic surfactant, for example, dicetyl phosphate. The principal report of non-ionic surfactant vesicles originated from the corrective applications conceived by L'Oreal. The idea of fusing the medication into pernicious for a superior focusing of the medication at fitting tissue goal is broadly acknowledged by analysts and academicians. Different sorts of medication conveyances can be conceivable utilizing niosomes like focusing on, ophthalmic, skin, parental and so forth[1,2].

Definitions

A niosome is a non-ionic surfactant-based liposome. Niosomes are framed for the most part by cholesterol consolidation as an excipient. Different excipients can likewise be utilized. Niosomes have more entering ability than the past arrangements of emulsions. They are fundamentally practically like liposomes in having a bilayer, notwithstanding, the materials used to get ready niosomes make them progressively steady and in this manner niosomes offer more favorable circumstances over liposomes. The sizes of niosomes are minute and abide nanometric scale. The molecule size extents from 10nm-100nm[1].

Structure of niosome

A commonplace niosome vesicle would comprise of a vesicle shaping amphiphile for example a non-ionic surfactant, for example, Span-60, which is generally balanced out by the expansion of cholesterol and a limited quantity of anionic surfactant, for example, dicetyl phosphate, which likewise helps in settling the vesicle. [Figure No.1][1].

Advatages

- They are osmotically dynamic and stable.
- They increment the steadiness of the ensnared sedate
- Handling and capacity of surfactants don't require any uncommon conditions
- Can increment the oral bioavailability of medications
- Can upgrade the skin infiltration of medications
- They can be utilized for oral, parenteral too effective.
- The surfactants are biodegradable, biocompatible and non-immunogenic.
- Improve the helpful execution of the medication by shielding it from the organic condition and limiting impacts to target cells, subsequently decreasing the freedom of the medication[3-6].

Disadvantages

- Physical insecurity
- Aggregation
- Fusion
- Leaking of captured tranquilize
- Hydrolysis of typified drugs which constraining the timeframe of realistic usability of the scattering[3-7].

TYPES OF NIOSOMES

Bola surfactant containing niosomes

The surfactant use in Bola surfactant containing niosomes are made of omega hexadecylbis (1-aza-18 crown-6) (bola surfactant): length 80/cholesterol in 2:3:1molar proportion.

Proniosomes

Proniosomes is produced using the transporter and surfactant blend. After the hydration of proniosomes, Niosomes are created.

Aspasomes

Aspasomes is created utilizing the blend of acorbylpalmitate, cholesterol and incredibly charged lipid diacetyl phosphate prompts the course of action of vesicles. Aspasomes are first hydrated with water/liquid course of action and a short time later it is exposed to sonication to get the niosomes. Aspasomes can be used to manufacture the transdermal immersion of drugs. Aspasomes have in like manner been used to lessen dissipate brought about by responsive oxygen species as it has intrinsic cell support property.

Niosomes in carbopolgel

Niosomes were set up from medication, ranges and cholesterol then it is joined in carbopol-934 gel

(1%w/w) base containing propylene glycol (10% w/w) and glycerol (30% w/w).

Vesicles in water and oil system (v/w/o)

In this technique, the fluid niosomes into an oil stage outline vesicle in water in oil emulsion (v/w/o). This can be set up by extension of niosomes suspension figured from mix of sorbitol monostearate, cholesterol and solulan C24 (Poly-24-Oxyethylene cholesteryl ether) to oil stage at 60^{o}C. This result in the arrangement of vesicle in water in oil (v/w/o) emulsion which by cooling to room temperature structures vesicle in water in oil gel (v/w/o gel). The v/w/o gel along these lines acquired can capture proteins/proteinous drugs and furthermore shield it from enzymatic corruption after oral organization and controlled discharge.

Niosomes of hydroxyl propyl methyl cellulose

In this sort, a base containing 10% glycerin of hydroxyl propyl methyl cellulose was first arranged and afterward niosomes were fused in it.

Deformable niosomes

The blend of non-ionic surfactants, ethanol and water shapes the deformable niosomes. These are littler vesicles and effectively go through the pores of layer corneum, which prompts increment infiltration productivity. It very well may be utilized in effective planning.

The niosomes are likewise characterized by the number and size of bilayer which is as per the following,

Multi Lamellar Vesicles (MLV)

Multilamellar vesicles are the most generally utilized niosomes. It comprises of various bilayer. The surmised size of vesicles is 0.5-10µm distance across. It is easy to make and are precisely steady upon capacity for significant stretches.

Large Unilamellar Vesicles (LUV)

These are the huge unilamellar vesicles which having a high fluid/lipid compartment proportion, with the goal that bigger volumes of bio-dynamic materials can be ensnared.

Small Unilamellar Vesicles (SUV)

These little unilamellar vesicles are generally arranged from multilamellar vesicles by sonication strategy, French press and expulsion technique[8].

FORMULATION/ COMPOSITION OF NIOSOMES

Two component utilized in niosome readiness are,

Cholesterol

Non-ionic surfactants

Cholesterol is a steroid subordinate, which is utilized to give unbending nature and legitimate shape, adaptation to niosome structure.

Non-ionic Surfactants are commonly utilized for the planning of niosomes (Table No.1).

Example

Tweens (20, 40, 60, 80)

Ranges (Span 60, 40, 20, 85, 80)

Brijs (Brij 30, 35, 52, 58, 72, 76).

DIFFERENT TYPES OF NON-IONIC SURFACTANTS[2-9]

Methods of preparation[10-16]

Ether injection

In this technique, slow infusion of surfactant: cholesterol (150micro.mol.) in 20ml ether through a 14 cloth needle (25ml/min.) in preheated 4ml fluid stage kept up at 600c. The ether arrangement was vanished utilizing rotational evaporator, after dissipation of the natural dissolvable it structures single layered vesicles.

Sonication

Niosomes utilizing sonication strategy were set up by Baillie, *et al*, 1986. In this technique, surfactant: cholesterol (150micro.mol.) blend was scattered in 2ml watery stage in vial. The scattering is exposed to test sonication for 3 min. at 600c. This technique included the arrangement of MLVs which are exposed to ultrasonic vibration. Sonicator is two sort Probe and Bath sonicator. Test sonicator is use when test volume is little and Bath sonicator is use when test volume is enormous.

Hand shaking method

In this strategy, surfactant: cholesterol (150micro.mol.) blend was broken down in 10ml diethylether in RBF. The ether is vanished under vacuum at room temperature in rotating dissipated. Upon hydration the surfactant grows and is stripped off the help in to a film. Swollen amphiphiles in the end overlay to frame vesicles. The fluid volume

entangled in vesicles gives off an impression of being little which 5-10% is.

Extrution method

In this technique, niosomes were readied utilizing C16G2, a synthetically characterized non - ionic surfactant by expulsion through a polycarbonate film. These examinations not just show the impact of number of expulsion on vesicles size yet additionally the impact of size on epitome of medication.

Reverse phase evaporation method

In this technique, surfactant is broken down in chloroform and included into the 0.25 volume phosphate saline cushion arrangement is emulsified to get w/o emulsion. The blend is then requested and thusly chloroform is vanished under decrease pressure. The lipid or surfactant frames a gel first and in this way hydrates to shape vesicles.

Bubble method

It is novel method for the one stage readiness of liposomes and niosomes without the utilization of natural solvents. It comprises of round-bottomed flagon with three necks put in water shower to control the temperature. Water-cooled reflux and thermometer is situated in the first and second neck and nitrogen gracefully through the third neck. Cholesterol and surfactant are scattered together in this cradle (pH 7.4) at 70^{o}C. A persistent stream of nitrogen gas bubbles is created and presented through the scattering and produce a niosomes.

Micro fluidization method

Micro fluidization is a current procedure to design unilamellar vesicles of portrayed gauge flow. In view of lowered fly standard, in this system two fluidized streams interface at ultrahigh speeds, in accurately portrayed littler scope channels inside the connection chamber. The impingement of slender fluid sheet along a typical front is organized to such an extent that the vitality provided to the framework stays inside the zone of niosomes development. The result is a progressively conspicuous consistency, littler size and better reproducibility of niosomes molded.

Separation of unentrapped drug

The expulsion of unentrapped solute from the vesicles should be possible by different strategies, for example, dialysis, gel filtration and centrifugation.

Dialysis

Dialysis is one of most significant strategy utilized for expulsion of unentrapped tranquilize from vesicles. In this procedure, the watery niosomal scattering is dialyzed in dialysis tubing against phosphate cradle or ordinary saline or glucose arrangement.

Gel Filtration

In this strategy, the unentrapped tranquilize is evacuated by gel filtration of niosomal scattering through a Sephadex-G-50 section and elution with phosphate cradled saline or ordinary saline.

Centrifugation

The niosomal suspension is centrifuged and the supernatant is isolated. The pellet is washed and afterward resuspended to acquire a niosomal suspension free from unentrapped sedate.

EVALUATION[17-21]

Measurment of Angle of repose

The angle of repose of dry niosomes powder was estimated by a funnel method. The niosomes powder was filled a channel which was fixed at a position with the goal that the 13mm outlet opening of the pipe is 5cm over a level dark surface. The powder streams down from the channel to frame a cone on a superficial level and the edge of rest was then determined by estimating the stature of the cone and the breadth of its base.

Filtering electron microscopy

Molecule size of niosomes is significant trademark. The surface morphology (roundness, perfection and development of totals) and the size conveyance of niosomes were concentrated by Scanning Electron Microscopy (SEM). Niosomes were sprinkled on to the twofold sided tape that was fastened on aluminum hits. The aluminum stub was set in the vacuum office of an examining electron magnifying instrument. The examples were watched for

morphological portrayal utilizing a vaporous auxiliary electron identifier.

Optical Microscopy

The niosomes were mounted on glass slides and saw under a with an amplification of 1200X for morphological perception after appropriate weakening. The photomicrograph of the arrangement likewise acquired from the magnifying lens by utilizing an advanced SLR camera.

Estimation of vesicle size

The vesicle scatterings were weakened around multiple times in a similar medium utilized for their arrangement. Vesicle size was estimated on a molecule size analyzer The device comprises of a He-Nelaser light emission nm centered with a base intensity of 5Mw utilizing a Fourier focal point [R-5] to a point at the focal point of multielement finder and a little volume test holding cell (Su cell). The example was mixed utilizing a stirrer before deciding the vesicle size. Hu C. what's more, Rhodes 7 out of 1999 detailed that the normal molecule size of niosomes determined niosomes is around 6μm while that of customary niosomes is about 14μm.

Capture proficiency

Capture proficiency of the niosomal scattering in should be possible by isolating the unentrapped sedate by dialysis centrifugation or gel filtration as depicted above and the medication remained captured in niosomes is controlled by complete vesicle interruption utilizing half n-propanol or 0.1% Triton X-100 and investigating the resultant arrangement by fitting test technique for the medication. Where, the adjustment in the vesicle size can be dictated by osmotic examinations. Niosomes plans are hatched with hypotonic, isotonic, hypertonic answers for 3 hours. At that point the adjustments in the size of vesicles in the details are seen under optical microscopy

$$Percentage\ entrapment = \frac{\text{Total Drug} - \text{Diffused Drug}}{\text{Total Drug}} \times 100$$

Security examines

To decide the solidness of niosomes, the upgraded bunch was put away in hermetically sealed fixed vials at various temperatures. Surface qualities and rate medicate held in niosomes furthermore, niosomes got from proniosomes were chosen as boundaries for assessment of the steadiness, since flimsiness of the plan would reflect in tranquilize spillage and a reduction. In the rate medicate held. The niosomes were test at normal time frames (0, 1, 2 and 3months), watched for shading change, surface qualities and tried for the rate medicate held.

APPLICATION[8-22-26]

Niosome as a transporter for hemoglobin

Niosomal suspension shows a noticeable range too imposable onto that of free hemoglobin so can be utilized as a bearer for hemoglobin. Vesicles are likewise porous to oxygen and hemoglobin separation bend can be adjusted comparatively to non-exemplified hemoglobin.

Niosomes as medication transporters

Niosomes have in like manner been used as transporters for iobitridol, a suggestive administrator used for X-beam imaging. Skin niosomes may fill in as solubilization network, as a local station for kept up appearance of dermally unique blends, as passageway enhancers, or as rate-confining layer deterrent for the change of essential ingestion of drugs.

Ophthalmic medication conveyance

It is hard to accomplish brilliant bioavailability of medication from visual measurement structure like ophthalmic arrangement, suspension and balm because of tear creation, impermeability of corneal epithelium, non-profitable retention and transient habitation time. Yet, to accomplish great bioavailability of medication niosomal vesicular frameworks have been proposed. Carter, *et al.* announced that different dosing with sodium stibogluconate stacked niosomes was seen as successful against parasites in the liver, spleen and bone marrow when contrasted with straightforward arrangement of sodium stibogluconate.

Conveyance of peptide drugs

Yoshida, *et al*, examined the steadiness of peptide expanded by niosomes. In Yoshida, *et al*, for oral conveyance of 9-desglycinamide, 8-arginine

vasopressin captured in niosomes in an *in-vitro* intestinal circle model and detailed that the solidness of peptide expanded by niosomes.

Transdermal conveyance of medications by niosomes

In transdermal course of conveyance, when medication is fused in niosomes entrance of medication through skin is improved.

Neoplasia

The anthracyclic anti-microbial, for example, Doxorubicin which shows wide range hostile to tumor movement, creates a portion depend ant irreversible cardio harmful impact. This medication expanded the life expectancy and diminished the pace of multiplication of sarcoma when controlled by niosomal conveyance into mice bearing S-180 tumor.

Use in considering safe reaction

In light of their immunological selectivity, low threat and progressively critical strength; niosomes are being used to consider the possibility of the invulnerable response induced by antigens. Nonionic surfactant vesicles have obviously displayed their ability to function as adjuvant after parenteral association with different unmistakable antigens and peptides.

Calming operators

Niosomal plan of Diclofenac sodium with 70% cholesterol shows more prominent enemy of inflammator action as contrast with free medication. Niosomal definition of Nimesulide and Flurbiprofen shows more noteworthy calming action when contrasted with free medication. Sharma, *et al*, (2009) was created range 60 niosomal oral suspension of fluconazole in the treatment of parasitic disease. It is compelling as contrast with container and tablets.

Leishmaniasis

Niosomes can be used for centering of drug in the treatment of diseases in which the debasing living thing lives in the organ of reticulo-endothelial system. Leishmaniasis is such a disease in which parasite assaults cells of liver and spleen.

Immunological application

Niosomes have been utilized for contemplating the idea of the insusceptible reaction incited by antigens. Brewer and Alexander have revealed niosomes as strong adjuvant as far as immunological selectivity, low poisonousness and security.

Niosomes in quality conveyance

Novel niosome itemizing considering the 2, 3-di (tetradecyloxy) propan-1-amine cationic lipid, getting together with squalene and polysorbate 80 to evaluate the transfection efficiency in rat retinas. Lipoplexes at 15/1 extent were 200nm in measure, 25m V in zeta potential and showed roundabout morphology. At this extent, it was seen that niosomes solidified and made sure about the DNA from enzymatic handling.

CURRENT STATUS[27]

Niosomes are vesicles like liposomes, yet comprised of non-ionic surfactants and like liposomes. They can ensnare hydrophilic just as lipophilic medications. They have preferable soundness over liposomes and consequently have more noteworthy enthusiasm for mechanical appropriation. The non-ionic surfactant frameworks make niosomes innately target-explicit to tumor, liver and cerebrum. They have been accounted for to be helpful as focusing on frameworks of medications for treatment of malignant growth and in treatment of microbial maladies caused especially by infection and parasites. Tumor focusing of Methotrexate in mice model have been profoundly effective. Different medications, for example, sodium stibogluconate, doxorubicin, etoposide, utilized foundationally and certain dermal restorative specialists, for example, 5-dihydrotestosterone, triamcinolone acetonide and so forth have been seen as of improved viability when figured as niosomes. Since no uncommon taking care of/stockpiling safeguards are required for niosomes, their business abuse would be simpler. They are biodegradable and decrease fundamental poisonousness of different antitumor and antimicrobial operators by restricting the

medication to explicit locales of activity. Likewise, being surfactant in piece, they have a capacity to trick body's phagocytic barrier instrument and go about as covertness sedate transporters making their powerful dissemination time longer than the medication given Inc ordinary structures.

FUTURE POINTS OF VIEW[9]

Niosomes speak to a promising medication conveyance atom. There is a ton of degree to embody poisonous enemy of malignancy drugs, hostile to infective medications, enemies of AIDS drugs, mitigating drugs, against viral medications, and so forth in niosomes and to utilize them as promising medication bearers to accomplish better bioavailability and focusing on properties and for diminishing the harmfulness and symptoms of the medications. The ionic medication transporters are moderately poisonous and inadmissible through niosomal bearers are more secure. Dealing with and capacity of niosomes require no extraordinary conditions.

Table No.1: Different Types of Non-Ionic Surfactants

S.No	Type of Non-Ionic Surfactant	Example
1	Fatty alcohol	Cetyl alcohol, stearyl alcohol, cetostearyl alcohol, oleylaocohol.
2	Ethers	Brij, Decyl glucoside, Lauryl glucoside, Octyl glucoside, Triton X-100
3	Esters	Glyceryl laurate, Polysorbates, Spans
4	Block copolymers	Poloxamers

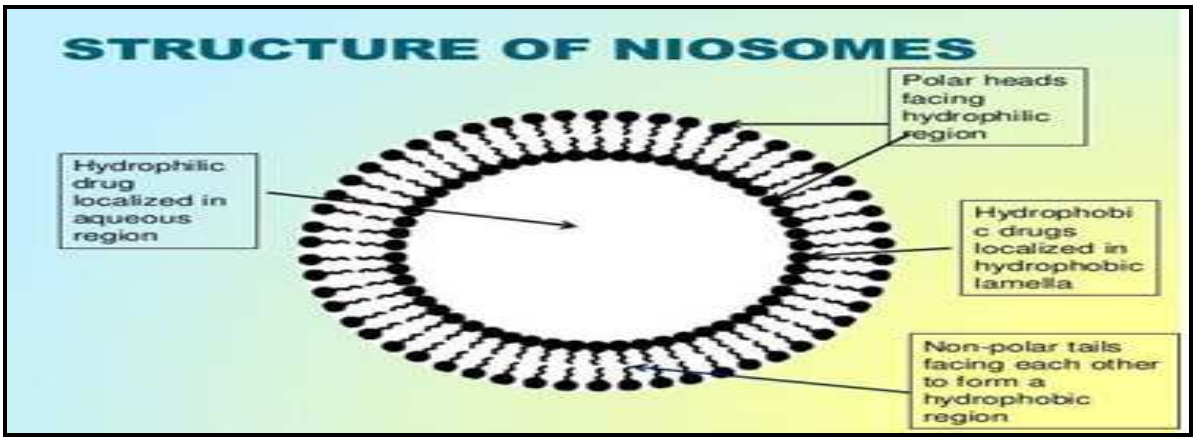

Figure No.1: Structure of Niosome

CONCLUSION

Niosome are well preffered drug delivery system over liposome. Niosome are more stable and economic. Also noisome have good targeted drug delivery. Drug delivery potential of niosome can be enhance by novel concepts like proniosomes, discomes and aspasome. Niosomesare better candidates for drug delivery over liposomes due to various factors like cost, stability etc. Targeting, ophthalmic, topical, parentral type of drug deliveries can be possible using niosomes.

ACKNOWLEDGEMENT

The authors wish to express their sincere gratitude to Department of Pharmaceutics, Gourishankar Education Society's Satara College of Pharmacy, Satara, Maharashtra, India for providing necessary facilities to carry out this research work.

CONFLICT OF INTEREST

We declare that we have no conflict of interest.

REFERENCES

1. Arunachalam A, Jeganath S, Yamini K and Tharangini K. Niosomes: A novel drug delivery system. *International Journal of Novel Trends in Pharmaceutical Sciences,* 2(1), 2012, 25-31.
2. Madhav N V S and Saini A. Niosomes: A novel drug delivery system, *International Journal of Research in Pharmacy and Chemistry,* 1(3), 2011, 498-511.
3. Biju S S, Talegaonkar S, Misra P R, Khar R K. Vesicular systems: An overview, *Indian J. Pharm. Sci,* 68(2), 2006, 141-153.
4. Ijeoma F, Uchegbu, Suresh P, Vyas. Non-ionic surfactant based vesicles (niosomes) in drug delivery, *Int. J. Pharm,* 72, 1998, 33-70.
5. Malhotra M, Jain N K. Niosomes as Drug Carriers, *Indian Drugs,* 31(3), 1994, 81-866.
6. Alsarra A, Bosela A, Ahmed S M, Mahrous G M. Proniosomes as a drug carrier for transdermal delivery of ketorolac, *Eur. J. Pharm and Biopharm,* 2(1), 2004, 1-6.
7. Hu C, Rhodes D G. Proniosomes: a novel drug carrier preparation, *Int. J. Pharm,* 185(1), 1999, 23-35.
8. Pande V V, Pawar S S and Pagar O B. Review on niosomes, *Austin Pharmacol Pharm,* 3(2), 2018, 1-7.
9. Rajera R, Nagpal K, Singh S K and Mishra D N. Niosomes: A controlled and novel drug delivery system, *Biological and Pharmaceutical Bulletin,* 34(7), 2011, 945-953.
10. Yoshida H, Lehr C M, Kok W, Junginger H E, Verhoef J C, Bouwistra J A. Niosomes for oral delivery of peptide drugs, *J. Control Rel,* 21(1-3), 992, 145-153.
11. Satturwar P M, Fulzele S V, Nande V S, Khandare J N. Formulation and evaluation of ketoconazole niosomes, *Indian J. Pharm,* 64(2), 2002, 155-158.
12. Vyas S P, Khar R K. Niosomes Targeted and controlled drug delivery, 2008, 249-279.
13. Gibaldi M and Perrier D. Pharmacokinetics, Inc, *Marcel Dekker, New York,* 2nd Edition, 1982, 127-134.
14. Namdeo A, Jain N K. Niosomal delivery of 5-fluorouracil, *J. Microencapsul,* 16(6), 1999, 731-740.
15. Bhaskaran S, Panigrahi L. Formulation and evaluation of niosomes using different nonionic surfactant, *Ind J Pharm Sci,* 63, 2002, 1-6.
16. Balasubramanian A. Formulation and *In-vivo* evaluation of niosome encapsulated daunorubicin hydrochloride, *Drug Dev and Ind. Pharm,* 3(2), 2002, 1181-1184.
17. Schreier H. Liposomes and niosomes as topical drug carriers: dermal and transdermal delivery, *J. Controlled Release,* 30, 1985, 863-868.
18. Buckton G, Harwood. Interfacial phenomena in drug delivery and targeting academic publishers, *Switzerland,* 1995, 154-155.
19. Hunter C A, Dolan T F, Coombs G H, Baillie A J. Vesicular systems (niosomes and liposomes) for delivery of sodium

stibogluconatein experimental murine visceral leishmaniasis, *J. Pharm. Pharmacol,* 40(3), 1998, 161-165.

20. Bairwa N K, Choudhary Deepika. Proniosome: A review, *Asian Journal of Biochemical and Pharmaceutical Research,* 2(1), 2011, 690-694.
21. Suzuki K, Sokan K. The application of liposome's to cosmetics, *Cosmetic and Toiletries,* 105, 1990, 65-78.
22. Khandare J N, Madhavi G, Tamhankar B M. Niosomes novel drug delivery system, *The Eastern Pharmacist,* 37, 1994, 61-64.
23. Baillie A J, Florence A T, Hume L R, Muirhead G T, Rogerson A. The preparation and properties of niosomes non-ionic surfactant vesicles, *J. Pharm. Pharmacol,* 37(12), 1985, 863-868.
24. http//en.wikipedia.org/wiki/Niosomes, Structure of Niosomes.
25. Rogerson A, Cummings J, Willmott N, Florence A T. The distribution of doxorubicin in mice following administration in niosomes, *J. Pharm. Pharmacol,* 40(5), 1988, 337-342.
26. Blazek-Walsh A I and Rhodes D G. SEM imaging predicts quality of niosomes from maltodextrin-based proniosomes, *Pharm. Res,* 18(5), 2001, 656-661.
27. Mandal S C and Mandal M. Current status and future prospects of new drug delivery system, *Pharm Times,* 42(4), 2010, 6-13.
28. Kaur D and Kumar S. Niosomes: present scenario and future aspects, *Journal of Drug Delivery and Therapeutics,* 8(5), 2018, 35-43.
29. Yoshioka T, Stermberg B, Florence A T. Preparation and properties of vesicles (niosomes) of sorbitan monoesters (Span 20, 40, 60 and 80) and a sorbitantriester (Span 85), *Int. J Pharm,* 105(1), 1994, 1-6.
30. Biswal S, Murthy P N, Sahu J, Sahoo P, Amir F. *Intern Jour of Pharmace Scie and Nanotech,* 1(1), 2008, 1-8.

Please cite this article in press as: Prashant P. Jadhav. A review on niosomes, *International Journal of Research in Pharmaceutical and Nano Sciences,* 9(5), 2020, 273-281.