Journal of Advanced Zoology

ISSN: 0253-7214

*Volume **44** Special Issue**-2 Year 2023** Page **2197:2204***

Design and evaluation of *Moringa oleifera* loaded transferosome vesicles: *In vitro* characterization

Subhranshu Panda[1], Vivek Kulkarni[1], Santosh Jadhav[2], Umesh Jirole[3]

[1]*School of Pharmaceutical Sciences, Jaipur National University, Jaipur, India, 302017.*

[2]*Department of Pharmaceutical Chemistry, SVPM'S College of Pharmacy, Malegaon, Maharashtra, India, 413115.*

[3]*Ashokrao Mane Institute of Pharmaceutical Sciences and Research, Save Tal- Shahuwadi, Dist- Kolhapur, 416213*

Address for correspondence: vivekkulkarni1486@gmail.com

Article History
Received: 08July2023
Revised: 29 Aug 2023
Accepted: 02 Oct 2023

CCLicense
CC-BY-NC-SA 4.0

Abstract

Moringa oleifera herb is widely found in western ghat. The anticancer potential especially against breast cancer is proved by many scientific investigators. However poor skin permeability of active constituents limits the therapeutic use of this herbal active. Transfersomes are modified liposomes with improve skin permeation ability. Thus, extract loaded transfersomes were formulated to improve skin permeation of extract. The transfersomes are phospholipid based vesicles with edge activators. The edge activators increase skin permeation of transfersomes. The extract loaded transfersomes were fabricated using thin film hydration and assessed for vesicle size, microscopic imaging and thermal behavior. The transfersomes showed acceptable vesicle size and zeta potential. Thus, formulated transfersomes could be promising alternative for skin permeation enhancement of herbal active.

Keywords: Transfersomes, *Moringa oleifera*, Breast cancer, Phospholipid vesicles

Introduction

Plant extract or isolated therapeutically active phytoconstituents have long been used worldwide for treatment of various diseases as well as accepted by physicians and patients because of their fewer side effects. Therapeutic efficacy of herbs is widely reported and extensively explored in

the literature by ancient Indians (Kaur and Saraf 2011). Plant derived phytoactives based drug delivery systems are becoming more popular in the modern world for treating various diseases with lesser toxic impressions and better therapeutic potential. Modern herbal medicines developed on the basis of traditional ayurvedic knowledge. Nearly, 50% of modern herbal medicines are developed using isolated active phytoconstituents from various parts of herbs. In addition to this, most of the novel therapeutic molecules discover nowadays are developed using plant based lead molecules. However therapeutic effects of some herb based products are limited due to various constraints like limited solubility as well as stability in gastrointestinal tract (GIT), poor absorption across GIT linings, considerable first pass metabolism and limited oral bioavailability. These issues are well documented in the scientific literatures. In order to tackle limitations associated with conventional herb based products various scientific experts have utilized nanotechnology based approaches (Sansare et al. 2021).

The transdermal route of administration has aroused great interest in pharmaceutical research, as it eliminates many of the problems associated with the oral route of administration (Coma-cros et al. 2018). Several strategies have been used recently to increase transdermal bioactive transmission. These include electrophoresis, iontophoresis, chemical permeability enhancers, microneedles, sonophoresis, as well as vesicular systems like liposomes, niosomes, ethosomes and transfersomes. These strategies include promising transitions. A new patented vesicular systems successfully utilized to improve skin permeation of drugs is transfersomes. Transfersomes are elastic supramolecular lipid bundles containing phospholipid bilayer modified with edge activator. In simpler term these are newly modified liposomes consist of phospholipid bilayer modified with edge activator (single chain surfactant molecules) (Sansare et al. 2021).

Transfersomes are preferred to deliver transdermal drugs as vesicle phospholipids (Chaudhary et al. 2013; Sarwa et al. 2014). The phospholipid membrane of transfersomes is more flexible than standard liposomes which confer its suitability for transdermal drug delivery. The highly flexible membrane properties of transfersomes potentiate its permeation across stratum corneum. These are capable to undergo self-deformation and reformations while its transport across pore. Edge activators in phospholipid bilayer of transfersomes generates transepidermal osmotic gradient which potentiate its squeezing across layers of skin. The use of transfersomes for effective topical delivery of herbal extracts is recently investigated by various researchers. There have

been multiple previous attempts to encapsulate various bioactives in transfersomes (Avadhani et al. 2017; Sundralingam et al. 2020).

Thus, present study has initiated with aim to formulate *Moringa oleifera* extract loaded transfersomes and characterization of drug loaded transfersomes.

Material and methods

Materials

Moringa oleifera leaves powder purchased locally. Lipoid S-100 was gifted by Lipoid (Germany). Tween 20 were purchased from S.D. Fine Chemicals Ltd. (Mumbai, India). All other reagents, solvents and chemicals were analytical grade and purchased locally.

Methods

Preparation of Moringa oleifera extract loaded transfersomes

Moringa oleifera loaded transfersomes were fabricated using thin film hydration technique (Jyothi et al. 2021). Briefly Lipoid S-100 and Tween 80 were dissolved in chloroform. The resulting organic solvent mixture was then subjected to rotary evaporator at 58^0C, to form a thin film of phospholipid. The dry phospholipid film then hydrated with aqueous solution of *Moringa oleifera* leaves powder. The concentration of extract in the formulation was 0.1% w/w. The hydrated film was subjected heat-cool cycle by heating in water bath up to 58 ^{0}C and cooling to room temperature with vortexing.

Evaluation of Moringa oleifera extract loaded transfersomes

Particle size distribution

The photon correlation spectroscopy principle (Zetasizer Nano ZS, Malvern, UK) was utilized for assessment of particle size of designed transfersomes (Rai and Pandey 2017). Transfersomal dispersion was diluted with double distilled water and subjected to particle size assessment at 24 ^{0}C.

Zeta potential

The zeta potential of formulated transfersomes was measured using Zetasizer Nano ZS, Malvern, UK) (Guo et al. 2018). Transfersomal dispersion was diluted with double distilled water and filled in zeta potential cuvette. The resulting dispersion was subjected to particle size assessment at 24 ^{0}C.

Differential scanning calorimetry

Differential scanning calorimetry was used to assess thermal behavior of extract, phospholipid and formulated transfersomes. The Perkin-Elmer DSC was used to assess thermal behavior of samples. Briefly, 10 mg of each sample was placed in sample pan separately and sealed. The samples were then heated in the range of 30°C to 200°C (heating rate: 10°C/min) using nitrogen purging (rate: 20 mL/min) to record DSC thermograms.

Assessment of surface morphology of formulated transfersomes

Surface morphology of transfersomes was analyzed using scanning electron microscope. The samples were loaded on aluminium stub with carbon adhesive tape and on this about 1-1.5 minutes of sputtering had applied enough gold to conduct the SEM electrons to ground and prevent charging without noticeably altering the topography of sample. The samples were scanned separately at a voltage 20kV and the images were taken.

Results and discussion

Preparation of Moringa oleifera extract loaded transfersomes

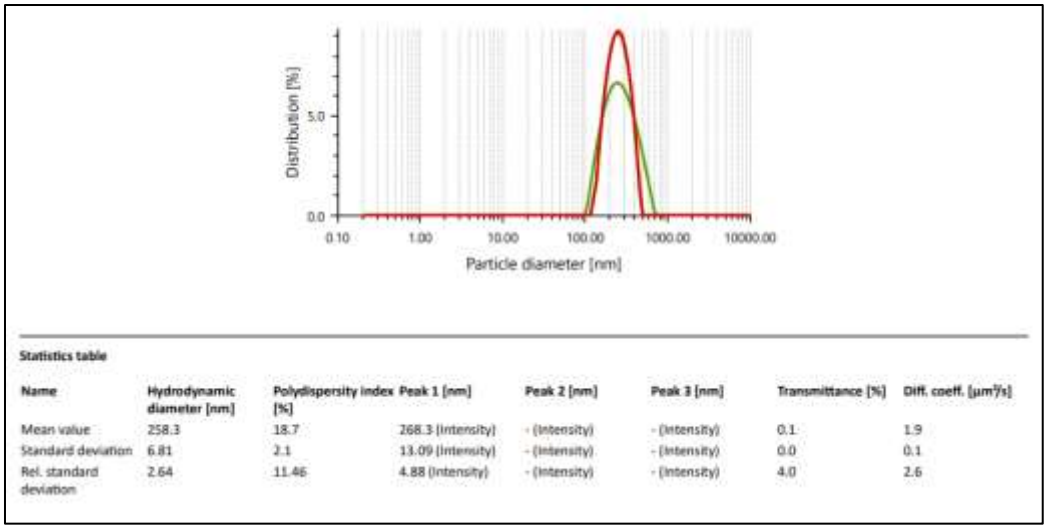
Moringa oleifera is well known herbal treatment for management of breast cancers. The anticancer potential of herb has been proved by many scientific investigators. However, poor skin permeability of active constituents limits the therapeutic use of extract. Thus, extract loaded transfersomes were formulated for improve skin permeation of extract. The extract loaded transfersomes were formulated using thin film hydration technique and evaluated for particle size, zeta potential, thermal behavior and surface morphology.

Evaluation of Moringa oleifera extract loaded transfersomes

The formulated extract loaded transfersomes were evaluated with respect to following characteristics.

Particle size distribution

The photon correlation spectroscopy principle (Zetasizer Nano ZS, Malvern, UK) was utilized for assessment of particle size of formulated transfersomes. The particle size distribution curve of transfersomes is highlighted in figure 1. The transfersomes revealed average particle size of 258.3 nm.



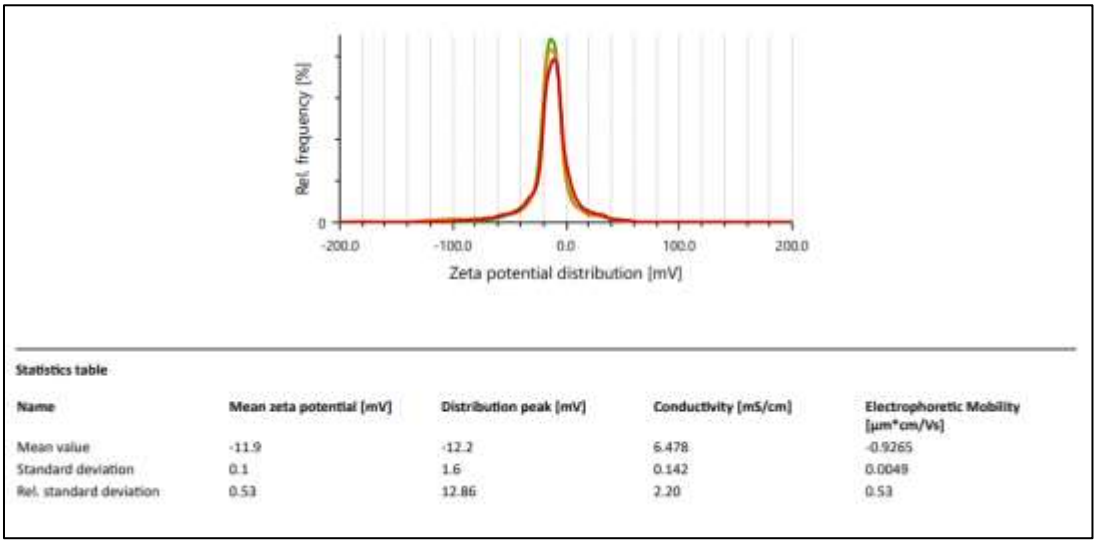
Statistics table

Name	Hydrodynamic diameter [nm]	Polydispersity index [%]	Peak 1 [nm]	Peak 2 [nm]	Peak 3 [nm]	Transmittance [%]	Diff. coeff. [µm²/s]
Mean value	258.3	18.7	268.3 (Intensity)	- (Intensity)	- (Intensity)	0.1	1.9
Standard deviation	6.81	2.1	13.09 (Intensity)	- (Intensity)	- (Intensity)	0.0	0.1
Rel. standard deviation	2.64	11.46	4.88 (Intensity)	- (Intensity)	- (Intensity)	4.0	2.6

Figure 1 Particle size distribution of formulated transfersomes

Zeta potential

The zeta potential of formulated transfersomes was measured using Zetasizer Nano ZS, Malvern, UK). The zeta potential of nanosystems indicates physical stability of nanocarrier based system. The high positive and negative value indicates better stabilization of nanocarrier through electrostatic repulsion. The zeta potential curve of transfersomes is highlighted in figure 2. The zeta potential was found to be -11.9 mV. The negative value of eta potential indicates good physical stability of transfersomes.



Statistics table

Name	Mean zeta potential [mV]	Distribution peak [mV]	Conductivity [mS/cm]	Electrophoretic Mobility [µm*cm/Vs]
Mean value	-11.9	-12.2	6.478	-0.9265
Standard deviation	0.1	1.6	0.142	0.0049
Rel. standard deviation	0.53	12.86	2.20	0.53

Figure 2 Zeta potential curve of formulated transfersomes

Differential scanning calorimetry

Differential scanning calorimetry was used to assess thermal behavior of extract, phospholipid and formulated transfersomes. The DSC thermograms of *Moringa oleifera* extract, phospholipid and transfersomes is highlighted in figure 3. The DSC thermograms of formulated transfersomes showed endotherms of both extract as well as phospholipid which indicates entrapment of active constituents of extract in transfersomal vesicles without any degradation.

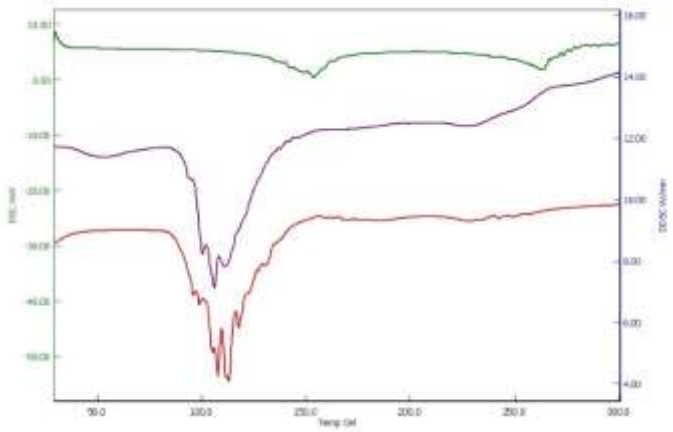


Figure 3 DSC thermograms of extract, phospholipid and formulated transfersomes

Assessment of surface morphology of formulated transfersomes

Surface morphology of transfersomes was analyzed using scanning electron microscope. The SEM image of transfersomes is represented in figure 4. The SEM image showed exactly spherical vesicles of transfersomes. The SEM imaging confirmed formation of extract loaded transfersomes in spherical shape.

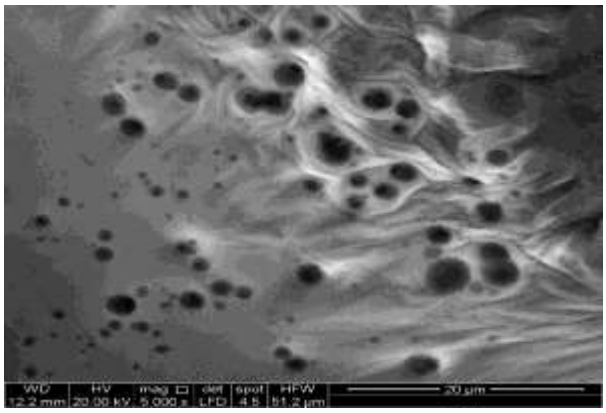


Figure 3 SEM image of formulated transfersomes

Conclusion

The poor skin permeability of active constituents limits the therapeutic use of extract. Thus, extract loaded transfersomes were formulated to improve skin permeation of extract. The transfersomes are phospholipid based vesicles with edge activators. The edge activators increase skin permeation of transfersomes. The extract loaded transfersomes were fabricated using thin film hydration and assessed for vesicle size, microscopic imaging and thermal behavior. The vesicle size and zeta potential were found to be 258.3 nm and -11.9 mV. The DSC confirmed loading of extract in transfersomes without chemical degradation. Thus, formulated transfersomes could be promising alternative for skin permeation enhancement of herbal active.

References

Avadhani KS, Manikkath J, Tiwari M, et al (2017) Skin delivery of epigallocatechin-3-gallate (EGCG) and hyaluronic acid loaded nano-transfersomes for antioxidant and anti-aging effects in UV radiation induced skin damage loaded nano-transfersomes for antioxidant and anti-aging effects. Drug Deliv 24:61–74. https://doi.org/http://dx.doi.org/10.1080/10717544.2016.1228718

Chaudhary H, Kohli K, Kumar V (2013) Nano-transfersomes as a novel carrier for transdermal delivery. Int J Pharm 454:367–380. https://doi.org/http://dx.doi.org/10.1016/j.ijpharm.2013.07.031

Coma-cros EM, Biosca A, Lantero E, et al (2018) Antimalarial Activity of Orally Administered Curcumin Incorporated in. Int J Mol Sci 19:1–11. https://doi.org/10.3390/ijms19051361

Guo C, Yin J, Chen D (2018) Co-encapsulation of curcumin and resveratrol into novel nutraceutical hyalurosomes nano-food delivery system based on oligo-hyaluronic acid-curcumin polymer. Carbohydr Polym 181:1033–1037. https://doi.org/10.1016/j.carbpol.2017.11.046

Jyothi SL, Krishna KL, Ameena Shirin VK, et al (2021) Drug delivery systems for the treatment of psoriasis: Current status and prospects. J Drug Deliv Sci Technol 62:102364. https://doi.org/10.1016/j.jddst.2021.102364

Kaur CD, Saraf S (2011) Topical vesicular formulations of Curcuma longa extract on

recuperating the ultraviolet radiation – damaged skin. J Cosmet Dermatol 10:260–265

Rai S, Pandey V (2017) Transfersomes as versatile and flexible nano-vesicular carriers in skin cancer therapy : the state of the art. Nano Rev Exp 8:1325708. https://doi.org/10.1080/20022727.2017.1325708

Sansare V, Gupta MK, Shrivastava B, et al (2021) Comprehensive review on use of phospholipid based vesicles for phytoactive delivery. J Liposome Res. https://doi.org/10.1080/08982104.2021.1968430

Sarwa KK, Mazumder B, Rudrapal M, Verma VK (2014) Potential of capsaicin-loaded transfersomes in arthritic rats. Drug Deliv 22:638–646. https://doi.org/10.3109/10717544.2013.871601

Sundralingam U, Chakravarthi S, Radhakrishnan AK (2020) E ffi cacy of Emu Oil Transfersomes for Local Transdermal Delivery of 4-OH Tamoxifen in the Treatment of Breast Cancer. Pharmaceutics 12:807. https://doi.org/10.3390/pharmaceutics12090807