



Review on Transferosomes and Transferosomal Gels

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Authors' contributions

This work was carried out in collaboration between both authors. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Transdermal drug delivery systems (TDDS), which are self-administrable and non-invasive, can improve bioavailability and patient compliance by bypassing first-pass metabolism. Vesicular-based TDDS have attracted a lot of attention in recent years because they're designed for controlled, efficient, and targeted drug delivery. One of these delivery technologies, transferosomal-based formulations, has grown in popularity due to its ability to achieve all of the desired criteria and quality qualities. Transferosomes combine the characteristics of liposomes and niosomes because they contain both liposomes (phospholipids and cholesterol) and niosomes as components (nonionic surfactants; edge activators). as a result, they are referred to as the first generation of elastic liposomes. However transdermal drug delivery is difficult due to the presence of the skin's protective barrier, transferosomal drug delivery overcomes all obstacles due to its unique characteristics, such as its ultradeformable vesicular nature. The benefits, limitations, modes of penetration, formulations, production and assessment methodologies, and pharmaceutical uses of transferosomal drug delivery systems are discussed in this paper.

Conclusion: Transferosomes have several importance over other vesicular systems, including greater deformability, greater penetration power across skin, the ability to deliver systemic drugs, and higher stability.

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1. INTRODUCTION

Due to the presence of first pass effect or medication interactions with other components of Gastro Intestinal tract (GIT) before absorption, an efficacious, successful therapy with no undesirable effects may not be possible in the majority of situations. Patient compliance is poor with these types of therapies. As a result, improved drug delivery methods have been studied in recent years in order to achieve the benefits of conventional treatment while avoiding the drawbacks. One promising method for avoiding pre-systemic metabolism and contact is the use of peptides. The presence of a skin barrier, on the other hand, restricts or amplifies the relaxed penetration of various molecules when they are applied as creams, gels, or ointments. As a result, new carrier or vesicular-based TDDS are needed to increase molecule penetrability through the skin barrier [1].

2. NOVEL DRUG DELIVERY SYSTEMS.

These drug delivery methods have risen in popularity and became pioneers in recent years because they provide significant benefits in terms of reduced dose frequency, improved bioavailability, site specificity, and reduced adverse effects. Many experiments around the world have strongly advocated NDDSs as a developing and promising strategy to combat major illnesses using the results of such in vitro, ex vivo, and in vivo research [2].

3. DIFFERENT HYBRIDS OF VESICLES

3.1 Liposomes

The Liposomes are known as phospholipid vesicles comprising of one or more concentric lipid dual layers enfolding discrete aqueous spaces. The special character of liposomal systems to entrap both lipophilic and hydrophilic compounds allows various range of drugs to be enclosed by the vesicles [3].

3.2 Niosomes

The niosomes are a types of vesicles which are made up of non-ionic surfactants, which contains both hydrophobic matter (tails) and hydrophilic matter (heads), these acts healing tank for delivery of drug in organized manner to increase the bioavailability [4].

3.3 Pharmacosomes

These are said to be colloidal dispersions of drugs that bound covalently to lipids and occur as ultrafine vesicular, micellar or hexagonal arrangements depending on the chemical assembly of drug-lipid complex. The term pharmacosome was obtained by linking a drug (pharmakon) to a carrier (soma). So these are known as pharmacosomes [5].

3.4 Ethosomes

Ethosomes are lipid based carriers reported firstly by Touitou et al. these are bilayer moieties like liposomes but differ from them in view composition as cholesterol is replaced in ethosomes with high concentrations of ethanol and these are prepared by thin film hydration technique or by addition of aqueous phase in designed manner [6].

3.5 Colloidosomes

Colloidosomes are different class of microcapsules. Where it's shell holds coagulated colloid particles at interface of emulsions. These particles arrange among themselves on exterior portion of droplets in order to lessen the total interfacial energy forming colloidosomes [7].

3.6 Herbosomes

The name herbosome itself is saying that herb means plant part and some is a cell like. Many compounds from plant origin are polar in nature. Because of cellular lipid structure and high molecular size of polar compounds phytoconstituents couldn't absorb while passive diffusion. Severely restricting the molecules to pass across the lipid rich biological membrane. The herbosomes or phytosomes had proven to be highly efficient in protection of pharmaceutically active herbal extracts against gastric secretions and gut bacteria [8].

3.7 Sphingosomes

Sphingosomes are nothing but concentric bilayer vesicles where aqueous phase is completely hided by a bilayer membrane mainly composed with natural or synthetic sphingolipids. Sphingosomes are liposomes composed of sphingolipids and cholesterol. Sphingosomes are

given in many routes they are intravenous, intramuscular, subcutaneous and intra-atrial. In some cases, even it administered through inhalation [9-10].

3.8 Cubosomes

Cubosomes are submicron nanoparticles of bicontinuous cubic liquid crystalline phase, and water in oil phase is separated by bilayer. These nanoparticles are self-assembled liquid crystal-like units of surfactants with appropriate ratio of water with microstructure and also possess solid like flow properties. They have major ratio of bilayer particle volume and huge breaking resistance [11]

4. TRANSFEROSOME

Transferosomes, even called as ultra-deformable vesicles for applying to skin holding a lipid bilayer with phospholipids and edge activator along with aqueous layer. Based on the lipophilicity the active substance is enclosed with in core or amongst the bilayer. In comparison to liposomes, transferosomes are having a great capacity to touch whole deeper areas of skin once applied topically [12].

The trademark Transferosome was registered by the German business IDEA AG and refers to a proprietary medicine delivery technology. The name translates to "carrying body" and is derived from the Latin word "transferre," which means "to carry across," and "some," which is a Greek word for "body." The transferosome is a synthetic vesicle that mimics the properties of exocytotic cell vesicles, making it ideal for controlled and potentially targeted medication delivery [13].

The structure of a transferosome is seen in Fig. 1. These are a complex aggregate that is extremely adaptive and stress resistant. The vesicle is both self-regulating and self-optimizing because of its local composition and bilayer shape independence. This enables transferosomes to efficiently traverse various transport barriers before acting as a drug carrier for non-invasive targeted medication administration and therapeutic agent sustained release [14].

The commonly used edge activator in this type of drug delivery system to increase flexibility are tween80, span80, sodium cholate, sodium deoxycholate etc. and the commonly employed phospholipids used for vesicle forming are soya phosphatidylcholine, Egg lecithin's and cholesterol etc. Examples of components of transferosomes are tabulated in Table 1 [15].

Structure of Transferosomes

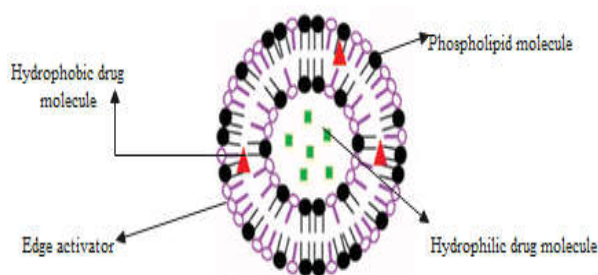


Fig. 1. Structure of transferosomes

Table 1. List of Transferosome

S. No.	Example	Class	Use
1	Egg Phosphatidyl Choline, Soya Phosphatidyl choline, dipalmitoylphosphatidyl choline	Phospholipids	Vesicles forming component
2	Ethanol, methanol, isopropyl alcohol, chloroform	Solvents	As a solvent
3	Sod. Cholate, Sod. Deoxycholate, Tween-80, Span 80, Tween 20	Surfactants	Vesicles forming component (Edge Activators)
4	Saline phosphate buffer (pH 6.4), Phosphate buffer pH 7.4	Buffering agent	As a hydrating medium
5	Rhodamine-123, Rhodamine –DHPE, Fluorescein –DHPE, Nile-red	Dye	For CSLM study

4.1 Advantages

- Transferosomal carriers are made up of both hydrophilic and hydrophobic units, making them the only drug delivery system capable of delivering therapeutic compounds in a wide range of solubility.
- Because of their ultra-deformability and elastic qualities, transferosomes can squeeze through skin barrier constrictions that are thin, such as 5-10 times smaller than vesicle size.
- High vesicle deformability allows medications to flow through the skin without causing significant vesicle loss, and can be employed for both topical and systemic therapy.
- Regardless of size, shape, molecular weight, or polarity, these carriers are highly adaptable and efficient in accommodating a range of agents.
- As these units are prepared with natural phospholipids and edge activators. These are biodegradable and biocompatible.
- Transferosomes are used to transfer proteins and peptides, insulin, corticosteroids, interferons, anaesthetics, NSAIDs, anti-tumor medications, and herbal remedies, among other active chemicals. Transferosomes are prime choice for obtaining a sustained drug release, as well as expectable and extended period of activity
- These have the ability to boost transdermal flow while also improving bioactive agent site selectivity.
- Scaling up is simple due to the tiny and simple production method.
- Bypassing first-pass metabolism, which is a major flaw in oral medication administration, resulting in improved drug bioavailability.
- The entrapment rate of transferosomes is quite high in the case of hydrophilic medicines, reaching nearly 90% in some cases.

4.2 Limitations of Transferosomes

- Because of their proclivity for oxidative stress, transferosome formulations are chemically unstable. When aqueous media is degassed and purged with inert gases such as nitrogen and argon, the oxidation of transferosomes is dramatically reduced.
- Another challenge of using transferosomes as drug delivery vehicles is obtaining the

purity of natural phospholipids, which is difficult to produce. As a result, synthetic phospholipids could be used as a substitute [1,16].

4.3 Mechanism of Action of Transferosomes

According to current research, transferosomes are drug delivery systems that can pass through undamaged skin. The lipid's interaction with water causes the lipid to attract water molecules, causing hydration, and the lipid vesicles to migrate to the water-rich concentration part. This change in water content across the stratum and epidermis of the skin increases the trans dermal osmotic gradient, allowing transferosomes to penetrate the skin. As a result of its self-optimizing deformability, once a transferosome reaches a pore, it can reversibly change its membrane role. Fig. 2 depicts the mechanism in visual form for easier comprehension. If transferosomes are applied to the skin under non-occlusive conditions, they can easily permeate the skin. To establish the trans-epidermal osmotic gradient across the skin, the skin must be non-occlusive. According to the literature, the Transferosomes' penetration mechanism is its moisture-seeking proclivity for deeper skin layers, also known as xerophobia (hydrotaxis). The moisture loss from the transferosomal formulation upon application to the skin causes this moisture seeking behaviour (non-occlusive state).

The natural transdermal water activity variation across the skin layers creates a powerful force that activates the Transferosomes, causing the widening of intercellular connections and the formation of transcutaneous channels with a diameter of 20-30nm. These pathways are created to allow ultra-deformable microscopic Transferosomes to pass through the epidermal layers furthermore, the osmotic gradient created by body heat evaporating moisture from the skin's superficial layers is used as a driving force to facilitate the flexible passage of therapeutic agents from the site of application to the specific area for local or system therapies in effective therapeutic concentrations with minimal systemic toxicity.

Transferosomes have a better penetration efficiency (through small skin pores) than traditional liposomes, but they have a similar bilayer structure that allows for the encapsulation of hydrophobic, hydrophilic, and amphiphilic

medicines. Transferosomes differ from liposomes in that their non-natural membranes are softer, more flexible, and ultra-deformable.

Transferosomes are supramolecular units made up of a bilayer of amphipathic agent (phospholipid), and adding a bilayer unstiffening agent improves the elasticity and penetrability of the bilayer (edge activator). Alcohol is present in high or low concentrations in the formulations of several transferosomes as penetration enhancers and as solvating cosolvents. Vesicles are self-regulating and self-optimizing due to the shape of the lipid bilayer and the interdependency of local composition. Transferosomes can effectively and easily bypass many transport barriers in the body due to the existence of this feature.

Ethanol has been suggested as a way to modify the polar head area of the lipid bilayer. Following penetration, ethanol increases the fluidity of the intercellular lipid matrix and, as a result, the density of the lipid lamellae decreases. Transferosomes can pass through the stratum corneum and reach the dermis and blood flow, among other places. The deformability of the transfersomal membrane, which can be linked to the vesicle compositions, determines their ability

to penetrate. As a result, the best vesicle compositions must be found by executing specially tailored experimental procedures for each medicinal drug in order to acquire the best carriers [17,18]. Mechanism of action of transferosomes is depicted as pictorial diagram in Fig. 2.

4.4 Methods to Prepare Transferosomes

4.4.1 Rotary Film evaporation method

Modified hand shaking method is another name for this approach. In this approach, API, lecithin, and edge activator are solubilized in a 1:1 mixture of chloroform and ethanol by manual shaking at a temperature higher than the lipid's transition temperature, and the resulting liquid is maintained for evaporation to remove the organic solvent. The thin lipid coating is left overnight to allow complete removal of the organic solvent. The film is then hydrated by rotating it at 60 RPM for 1 hour at room temperature with a pH 6.5 buffer. The leftover vesicles swell for 2 hours at room temperature. Small vesicles were made from leftover vesicles that had been sonicated at room temperature. Rotary Film Evaporation Method is given in Fig. 3 [19].

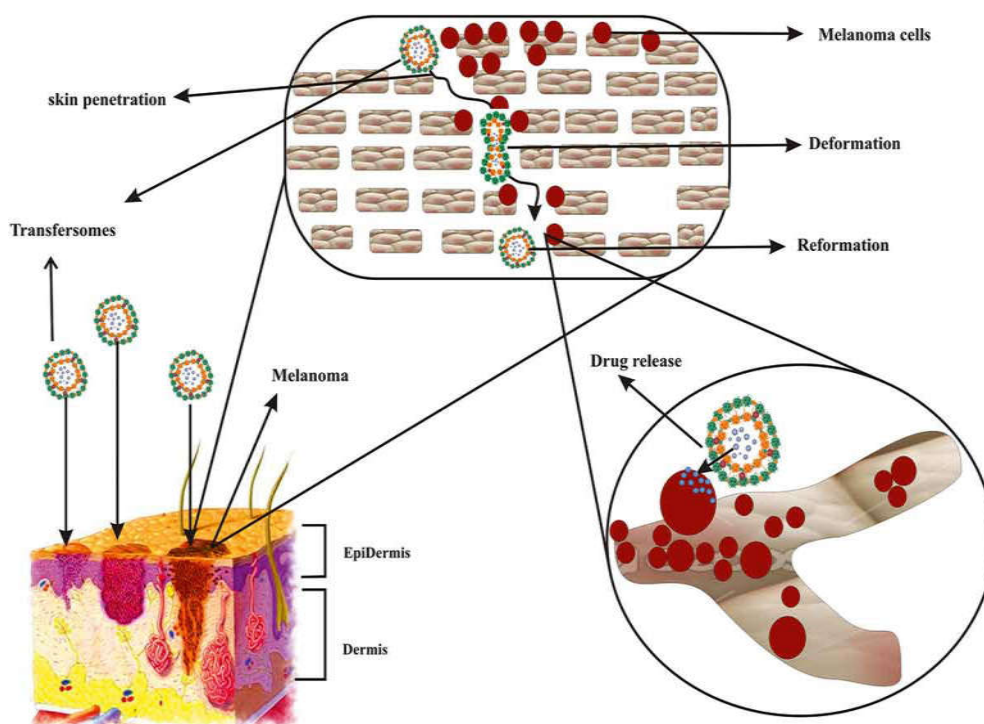


Fig. 2. Pictorial diagram of mechanism of action of transferosomes

4.4.2 Reverse phase evaporation method

This method is carried out as follows: lipids and organic solvents were combined together in a round bottomed flask under nitrogen purging aqueous media containing edge activators. Depending on the drug's solubility, it's mixed with either a lipophilic or a lipophobic media. After sonication, the prepared material is left for 30 minutes until it appears to be a homogeneous combination. Organic phase is eliminated when pressure is kept to a minimum. The substance

transforms into a viscous gel that creates vesicles [20]. This method is depicted in Fig. 4.

4.4.3 Vortex or sonication method

Edge activators and phospholipids are assorted by continuous swirling in order to disperse in phosphate buffer in this procedure. After forming a milky suspension, it is sonicated in a bath sonicator before being extruded through polycarbonate membranes. The process is shown in Fig. 5.

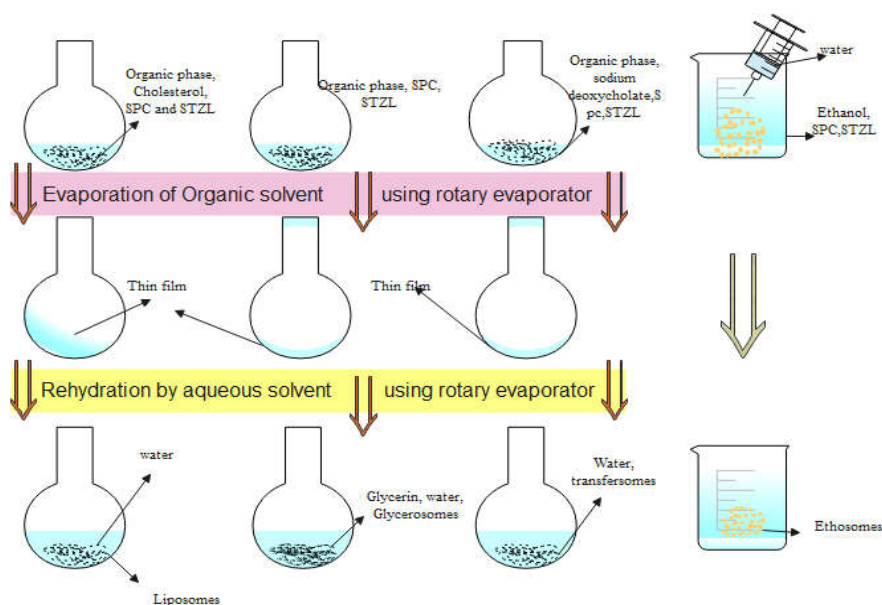


Fig. 3. Rotary film evaporation method

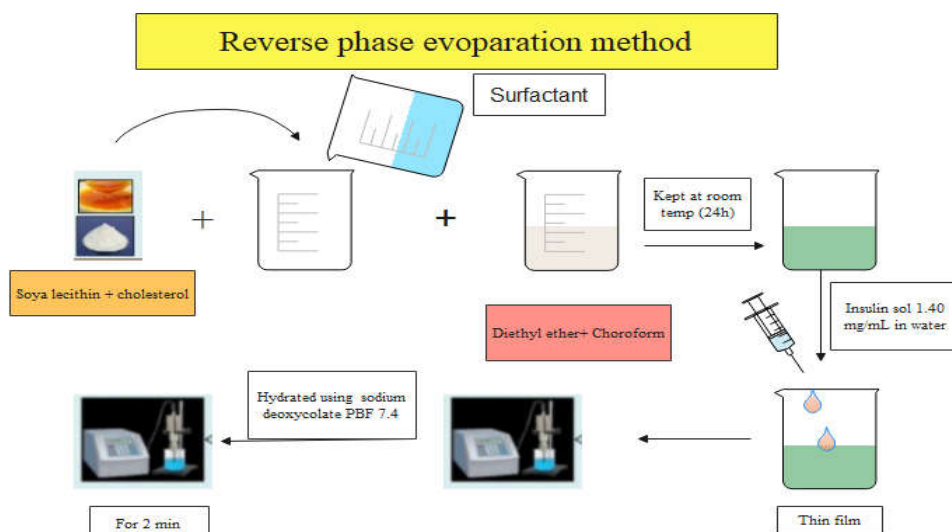


Fig. 4. Reverse phase evaporation method

4.4.4 Ethanol Injection Method

This method is more beneficial than others. The medication and water solution are warmed up at a consistent temperature with continuous agitation in this procedure. Phospholipids and edge activators are combined with an ethanolic solution in aqueous media and then reacted [21–24]. Method is illustrated in Fig. 6.

4.4.5 Freeze thaw method

This process involves freezing the created multi lamellar vesicles suspension and then transferring it to a tube and dipping it in a

nitrogen bath at -300 degrees Celsius for 30 seconds. After the suspension has frozen, it is treated to a high temperature in a water bath for 8-9 rounds [22–24]. Diagrammatic view of this method is given Fig. 7.

4.5 Procedural Characteristics Affecting Transferosomes Properties

A variety of procedural characteristics may alter the properties of transferosomes during the production of an optimum transferosomal formulation. The following parameters are involved in the production of transferosomes in general:

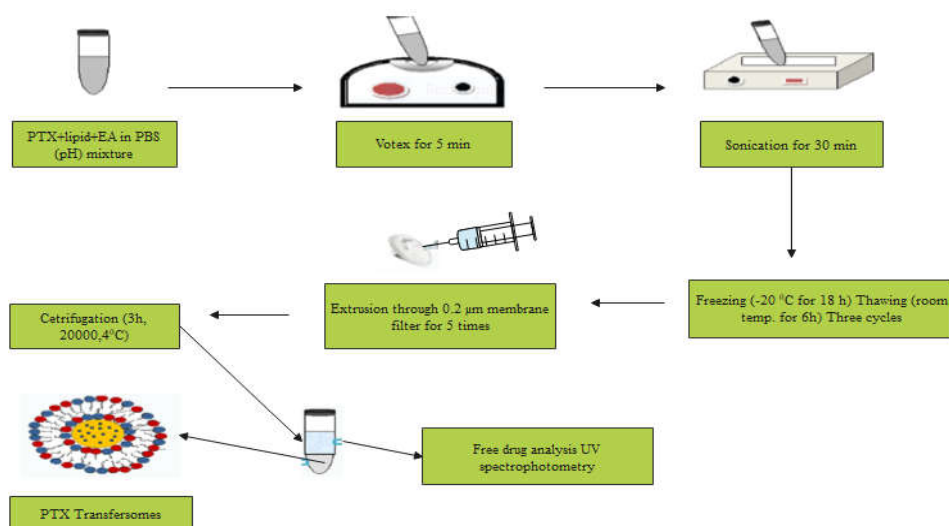


Fig. 5. Vortex or sonication method

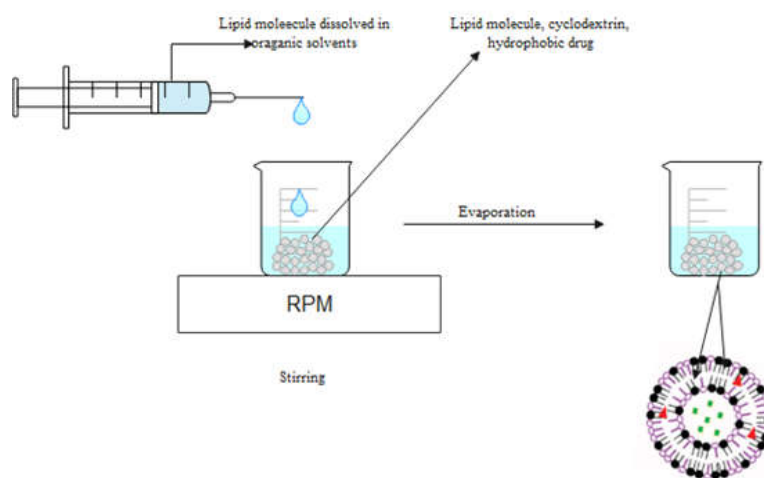


Fig. 6. Ethanol injection method

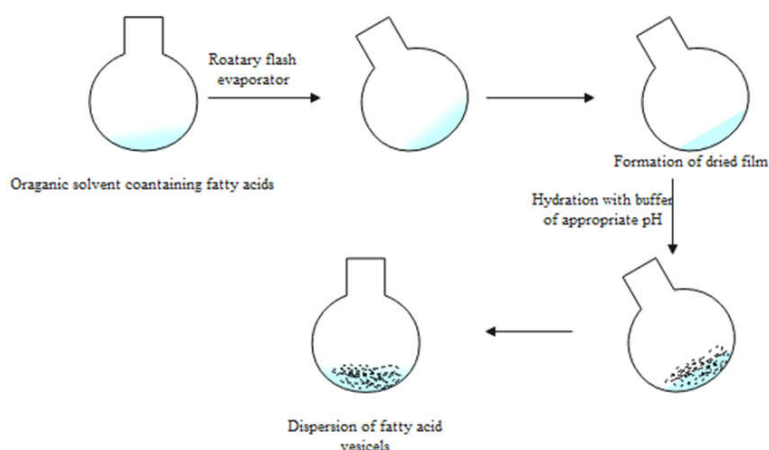


Fig. 7. Freeze thaw method

4.5.1 Effect of Phospholipid ratio to edge activator ratio

Due to the fact that the phospholipid: edge activator ratio has a significant impact on entrapment efficiency, vesicle size, and penetration ability, it should be accurate. In general, it has been suggested that EE could be reduced by using a surfactant with a higher concentration. This could be due to an increase in vesicular membrane permeability caused by the arrangement of surfactant molecules inside the vesicular lipid bilayer structure, which could result in pores within the vesicular membrane, increasing fluidity and allowing the entrapped medication to leak quickly.[16].

4.5.2 Effect of various solvents

Solvents like ethanol or methanol are employed. The solubility of all formulation components in the solvent, as well as their compatibility with the solvent, influence the solvent selection. To generate a good film-forming capability and greater stability after hydration, all excipients and medicines should ideally dissolve in solvent and achieve a clear transparent solution [25]. Solvents employed in formulation can also act as penetration enhancers, increasing drug flux through membranes. Ethanol was employed in many experiments to increase the transit of estradiol, hydrocortisone, 5-fluorouracil, and levonorgestrel through rat skin, according to Williams and Barry [26].

4.5.3 Effect of hydration Medium

Water or a saline phosphate buffer is used as the medium (pH6.5-7). To create a balance between

biological qualities and biological uses, as well as the route of administration, the pH level of compositions must be suitable. The lipid bilayer of transferosomes is similar to the phospholipid layer of a cell membrane, and unionised medicines are last membrane-bound to the phospholipid bilayer and enter the cell via the intracellular route [27,28].

4.6 Characterization of Transferosomes

4.6.1 The zeta potential and particle size determination

The particle size and zeta potential will be assessed at 250 C using a dynamic light scattering instrument and particle size analysis. The produced sample is diluted with filtered water before being measured using a Malvern zeta sizer made in the United Kingdom.

4.6.2 Vesicle morphology

Transmission electron microscopy and phase contrast microscopy were used to visualize transferosome vesicles. The size and structure of vesicles can be used to determine the stability of vesicles throughout time [29].

4.6.3 Number of Vesicles per cubic mm

Unsonicated transferosome formulations are diluted five times with 0.9 percent Sodium chloride solution (NaCl). For additional investigation, an optical microscope and a hemocytometer are utilised. The following equation is used to count the transferosomes in 80 tiny squares: (Total number of transferosomes

counted x dilution factor x 4000)/Total number of squares counted = Total quantity of transferosomes per cubic mm [22].

4.6.4 Entrapment efficiency

It is expressed in terms of percent drug entrapment, and the untrapped drug can be separated first using the micro column centrifugation method. 0.1 percent Triton x-100 or 50 percent n-propanol are used to disrupt vesicles.

Entrapment efficiency = (Amount entrapped/Total amount absorbed) x 100

4.6.5 Drug content

The drug content can be calculated by using HPLC with UV detectors or Spectrophotometric methods [30].

4.6.6 Turbidity measurements

Measurement of turbidity can be done by using Nephelometer method.

4.6.7 Degree of deformability or permeability measurements

A permeability investigation will be used to characterise transferosomes. Pure water is utilised as a control for the deformability investigation, and the formed transferosomes are delivered through a series of pores with known sizes ranging from 50nm to 400nm. Following the entry of each size, DLS measurements can be taken [13].

4.6.8 Penetration ability

Assessment of penetration capability of transferosomes can be performed by using Fluorescence Microscopy [31].

4.6.9 Occlusion effect

In the case of regular topical preparations, occlusion of the skin is considered favourable for drug permeation. Despite the fact that occlusion is hazardous to elastic vesicles. The fundamental driving mechanism for vesicle permeation through skin is hydrotaxis. It has an effect on hydration forces because it prevents water from evaporating from the skin.

4.6.10 Surface charge and charge density

Surface charge and charge density can be determined by zetasizer.

4.6.11 In-vitro drug release

Minicolumn centrifugation is used to measure the penetration rate, in which the suspension is incubated at 32°C and samples are obtained at different time intervals, with the free drug being extracted. Secondly, the volume of drug entrapped at Zero times is used to compute the quantity of drug released.

4.6.12 In-vitro skin permeation study

The skin of a goat is utilised in a phosphate buffer with a pH of 7.4. The hair on the skin is removed, and the skin is moisturised with regular saline. The cotton swab should be used to remove fat tissues. A modified franz diffusion cell with a 50 mL column and a receiver compartment effective area of 2.50 cm². Skin can be kept at a low temperature in IPA. with a 100rpm stirring speed and the stratum corneum towards the donor compartment A 1mL aliquot is drawn and replenished with fresh phosphate buffer on a regular basis. 17 [32].

4.7 Applications

- These are worthy transporter option to deliver the drug in to skin layers for treatment of dermal cancer [31].
- Delivery of drugs with high molecular weight through mucosal layers is possible
- Delivery of biologically active drugs and DNA using lipid vesicles.
- The ultra-deformable vesicles can be employed to overcome the drugs which are predicted to have GI side effects example, NSAIDs.
- These are employed in delivering the corticosteroids.
- Transferosomes can be used as carriers in delivery of interferons.
- To transport the peptides and as well as proteins transferosomes are good choice.
- Transcutaneous vaccines were shown better results in hepatitis B.
- These are applicable to deliver the herbal drugs, anticancer drugs and anesthetics few applications are written in Table2 [33].

Table 2. Different kinds of drugs and their inference

Name of drug	Inference
Insulin	Persuade medicinally important hypoglycemia with good efficiency and reproducibility
Capsaicin	Improved skin penetration
Ketoprofen	Improved permeation for anti-inflammatory activity
Norgesterol	Improved transdermal flux
Curcumin	improved penetration for anti-inflammatory activity
Colchicine	Escalation in skin penetration
Indinavir sulfate	Upgraded influx to fight against acquired immuno deficiency syndrome (AIDS)
Hydrocortisone	Biologically active at dose several times lower than currently used formulation.
Triamcinolone acetonide	Used for both local and systemic delivery.
Stavudine	Great in vitro skin delivery of Stavudine for antiretroviral action

5. TRANSFERSOMAL GEL

5.1 Preparation of Transferosomal Gel

Taking a one-unit equivalent dose of transferosomes and integrating them into a suitable gel basis or vehicle can produce the gel. If the amount of untrapped medication is greater than 10%, it can be removed before turning in the gel by centrifuging the transferosomes at 6000 rpm for 15-30 minutes and discarding the supernatant. Mechanical stirring at 25 rpm for five minutes is used to incorporate transferosomes into gel [20].

5.2 Evaluation of Transferosomal Gel

5.2.1 Determination of pH

The pH of the topical applications is evaluated by using a digital pH meter by immersing the glass electrode in formulation totally so as to cover the electrodes.

5.2.2 Spreadability

The spreadability of a gel can be determined using the gel's slip and drag characteristics. Spreadability is determined using modified equipment. The modified apparatus is made up of two glass slides, one of which is fastened to a wooden plate and the other of which is controlled by a hook. $S = m \times l / t$ is the formula used in this example. where S stands for spreadability, m for weight in the pan attached to the higher slide, t for time taken to travel a specific distance, and l for distance travelled. The spreadability is

calculated in triplicates, although average values are used in the end. While mass and length are maintained, time should be determined.

5.2.3 Drug content

For a gel formulation, the drug content must be processed by converting equivalent weight to one-unit dose and estimating the drug using appropriate analytical techniques. Because the gel is viscous, at least 6 samples should be calculated to assure consistent medication distribution inside the gel.

5.2.4 In-vitro diffusion study

An in-vitro drug release studies can be carried out using the Franz diffusion cell. The dialysis membrane is positioned between the receptor and donor compartments. The donor compartment is filled with transferosomes gel equivalent to one-unit dose, while the Phosphate buffer pH 7.4 is filled in receptor compartment. Throughout the trial, the diffusion cells should be stirred at 50 rpm at $32.0 \pm 0.5^\circ\text{C}$. Then required sample should be retrieved from the receiver compartment via the side tube at various time intervals and analysed for drug content using an appropriate analytical method.

5.2.5 Stability studies

Vesicle magnitude should be measured in enhanced transferosomes gel formulations that are submitted to accelerated stability tests under accelerated storage conditions. Diffusion behaviours at predetermined time points, zeta potential [34–38].

6. REVIEW OF WORK DONE ON TRANSFEROSOMES

Mbah CC et al. Reported {2015} The development of NIPRD-AF1 Transfersomal vesicular carrier system using phopholipon 90 H and various concentrations of a mixture of surfactants such as sorbitan monolaurate, SLS, and Tween 80, as well as boosting excipients through solvent evaporation. The AF1 ointment formulation was made using the fusion procedure and the British pharmacopoeia standard. When comparing Transfersomal AF1 to the ointment AF1 formulation, it was discovered that Transfersomal AF1 had better penetration [39].

Shabana Syeda et al. Formulated and evaluated of the Diclofenac sodium transfersomes for transdermal drug administration. These were made utilizing a thin film hydration process with a ratio of surfactants (Span 20,60, and 80) and lecithin in the organic phase. It was determined that span 60 was the ideal surfactant for the manufacture of diclofenac sodium transfersomes due to its high entrapment efficiency and stability [40].

Maged K El Sayyad et al. Formulated the Transdermal drug delivery of sildenafil citrate was improved by encapsulating it in nano-sized ultra-deformable vesicles called transfersomes. Using a thin sonication approach and thin film hydration, sildenafil citrate loaded transfersomes were created using non-ionic and ionic edge activators in various ratios. Sildenafil citrate was effectively synthesised in transfersomes, which enhanced its transdermal penetration when compared to the drug's suspension [41].

Mahmood S et al., reported the nano transfersomes vesicles of raloxifene HCL using phopholipon 90 G, sorbitan 80, and a rotary evaporation method to provide the lipid vesicles with the desired range of particle size, PDI, Zeta potential, and ex vivo flux for essential transdermal permeation and stability of the formulation. When used transdermally, the developed transfersomal formulation of raloxifene HCL with sorbitan 80 produced improved outcomes [42].

Aparanjitha.R et al. performed investigations on Lisinopril dihydrate by using a film hydration process with different surfactants (span 80 and Tween 80), HPMC E 15, and soya lecithin, the drug was encapsulated into vesicles. A

transfersomal transdermal patch was made and tested. When compared to the formulation's oral bioavailability, the formulation's drug release was superior [43].

7. CONCLUSION

Transfersomes have several advantages over other vesicular systems, including greater deformability, greater penetration power across skin, the ability to deliver systemic drugs, and higher stability. Transfersomes are made up of hydrophilic and hydrophobic moieties and have a wide range of solubility. The developed transfersomal gel could be used to improve medicine delivery through the skin.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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