Available online on 15.06.2026 at http://ajprd.com

Asian Journal of Pharmaceutical Research and Development

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Review Article

Ethosomes in Nanomedicine: A Comprehensive Review of Formulation Strategies and Therapeutic Applications

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A B S T R A C T

Ethosomes are novel lipid vesicular carriers that enhance drug delivery through the skin. Due to their high ethanol content, they offer improved flexibility and permeability, enabling drugs with diverse physicochemical properties to reach both superficial and deep skin layers.Introduced in 1996, ethosomes have been extensively investigated and modified, resulting in the development of new generations with optimized compositions. These systems can be incorporated into formulations such as gels, patches, and lotions, and are prepared using several innovative methods.Both preclinical studies and clinical trials confirm the efficiency of ethosomes in dermal and transdermal drug delivery. Compared with conventional liposomes, ethosomes demonstrate superior skin penetration and therapeutic effectiveness, making them a promising platform for future pharmaceutical applications.

Keywords: Ethosomes, nanoparticles, transdermal drug delivery, therapeutic applications.

A R T I C L E I N F O: Received 12 Jan. 2026; Review Complete 22 April, 2026; Accepted 14 May. 2026; Available online 15 June. 2026

Cite this article as:
Patel TG, Gohil SB, Rao SM, Patel PN, Pandya BD, Shah KP, Saluja AK, Diwakar SA, Ethosomes in Nanomedicine: A Comprehensive Review of Formulation Strategies and Therapeutic Applications, Asian Journal of Pharmaceutical Research and Development. 2026; 14(3):-454-461, DOI: **http://dx.doi.org/10.22270/ajprd.v14i3.1810**

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INTRODUCTION:

A drug delivery system is a formulation or a device that enables the introduction of a therapeutic substance into the body that improves its efficacy and safety by controlling the rate, time, and place of release of drugs into the body. The superior mode for the drug delivery is intravenous(IV) infusion which is continuously used as it follows "Bypass Metabolism."To enhance thepotencyof modern-day drug delivery system, the concept of Nanoparticles as a vehicle is introduced.[1]

A nanoparticle is a microscopic particle with at least one dimension measuring between 1 and 100 nanometers. These particles exhibit unique physical and chemical properties, often differing from their bulk material counterparts, due to their small size and high surface area and this finds its remarkable importance as in the form of Ethosomes.[2]

Ethosomes are composed of phospholipids, high ethanol concentration, and water. The high ethanol concentration is responsible for fluidizing the skin lipid bilayer structure and consequently, when incorporated into a vesicle it improves the vesicles' permeability across the Stratum corneum.[3]

1. **Classical Ethosomes:**Classical ethosomes are a variation of classical liposomes, consisting of phospholipids, high ethanol concentrations of up to 45% w/w, and water. Classical ethosomes for transdermal drug delivery were stated to be superior to classical liposomes because they were smaller and had negative potential for greater efficiency without clogging.[7]
2. **Binary ethosomes:** Binary ethosomes were introduced by Zhou et al. We were created essentially by adding a different form of alcohol to the classical ethosomes.[7]
3. **Transethosomes:**Transethosomes are the latest generation of ethosomal systems and were first recorded

in 2012 by Song et al. This ethosomal system includes the basic components of classical ethosomes and an additional compound such as a penetration enhancer or an edge activator (surfactant) in its formula.[7]

Advantages:[8,9]

1. Ethosome enhance permeation of drugs through skin for dermal, transdermal and intracellular delivery.
2. Deliver various molecules with differentphysicochemical properties, hydrophilic and lipophilic molecules, peptides, proteins and othermacromolecules.
3. The components of the ethosomes are generally recognized as safe (GRAS), non-toxic and approved for pharmaceutical and cosmetic use.
4. Ethosomal drug delivery system can be applied widely in pharmaceutical, biotechnology, veterinary, cosmetic & Nutraceutical fields.
5. High patient compliance: The ethosomal drug is delivered in a semi-solid form (gel or cream) with highpatient compliance ensuing.

Disadvantages:[10, 11]

1. Limited yield of products.
2. If shell locking fails, the ethosomes may agglomerate and disintegrate when transferred into the water.
3. Product loss when switching from organic to water media.

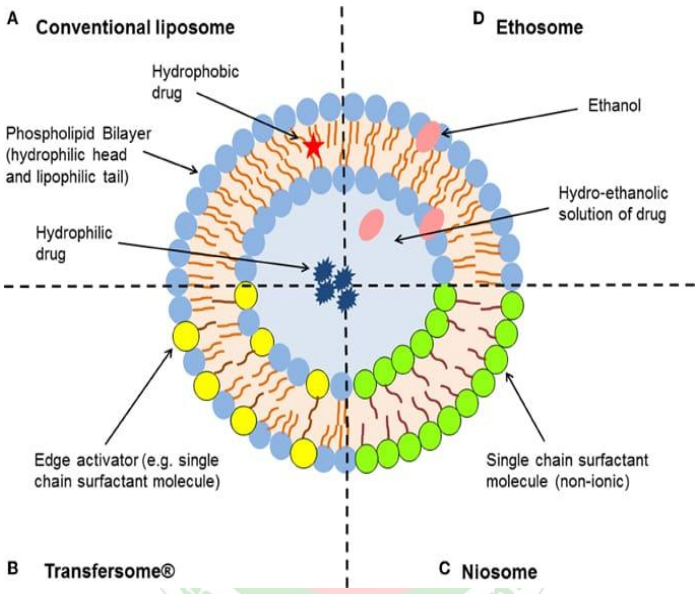

Figure 1: Structure of Conventional liposome, Transferosome, Niosome, Ethosome[4]

Classification of Ethosomes:

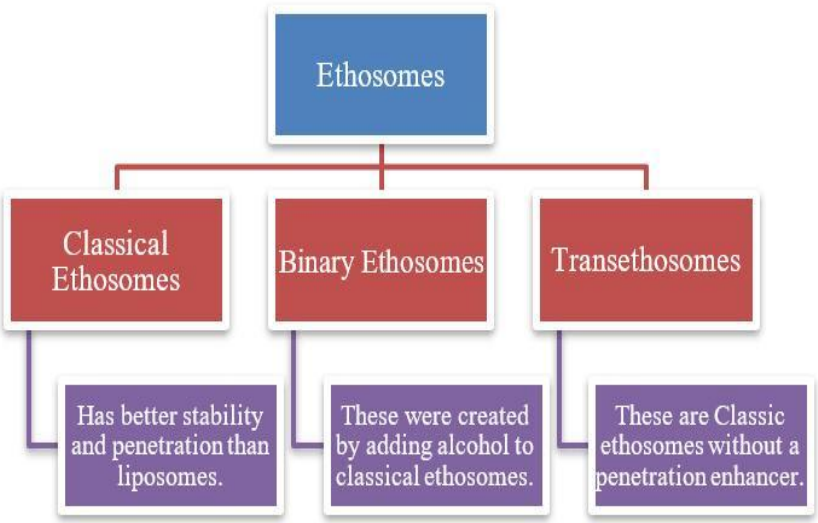

Figure 2 (a): Classification of Ethosomes[5]

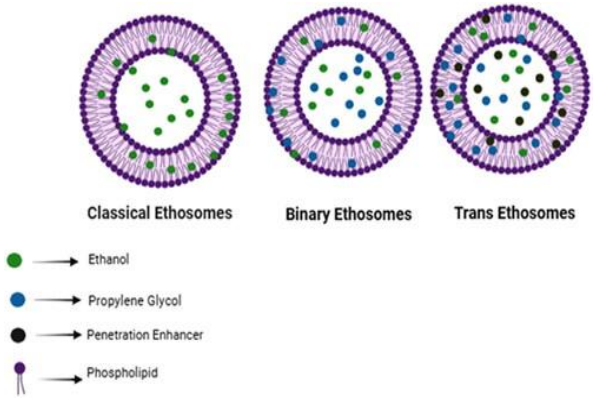

Figure 2 (b): Types of Ethosomes[6]

METHOD OF PREPARATION:

Preparation of ethosomes grounds on quick and easy scale up techniques without requiring any complex pilot-andindustrial-level instruments.Ethosome preparation includes two simple "cold" and "hot" methods.[12]

1. **Cold method:** This is one of the most commonly used ethosomes preparation methods, consisting of two basic and simple setups. In the first setup, phospholipid and other lipid material is dissolved by intense stirring in ethanol at room temperature with the use of mixer such as Hei Dolph mixer with continuous addition of polyols such as propylene glycol etc. With constant stirring followed by heating at 30°C in water bath. In the second setup, water is to be heated at 30°C in a separate vessel, both mixtures (obtained from first and second setup) are to be blended together following 5 minutes stirring in a covered vessel. Using sonication or extrusion process, the vesicle size of ethosomal formulation can be reduced to desire extend. Finally, the formulation is stored under refrigeration.[12]
2. **Hot method:** This method consists of dispersion of phospholipid in water by heating in a water bath at 40°C until a formation of a colloidal solution. In a separate vessel, ethanol and propylene glycol are mixed and heated to 40°C. If both mixtures exceed 40°C the aqueous phase is added to the organic phase. Depending on their hydrophilic / hydrophobic properties the drug is dissolved in water or ethanol. Using probe sonication or extrusion process, the vesicle size of ethosomal formulation can be diminished to the extent of desire.[12]
3. **Classic mechanical dispersion method:**Dissolve phospholipid in an organic solvent, or in a round bottom flask (RBF) mixture of organic solvents. Using a rotary vacuum evaporator above lipid transition temperature to remove the organic solvent to create a thin lipid film on the RBF wall; Traces of the solvent should be separated from the accumulated lipid film by leaving overnight in vacuum. Hydrate the lipid film with the drug's hydro ethanol solution by spinning the flask with or without periodic sonication at the correct temperature and eventually cool the resulting ethosomal suspension at room temperature. The formulation should be stored under refrigeration.[12]
4. **The ethanol injection–sonication method:**In this process, the organic phase containing the dissolved phospholipid in ethanol is injected into the aqueous phase using a 200-flow syringe system38 µl / min, then homogenized for 5 minutes with an ultrasonic probe.[12]

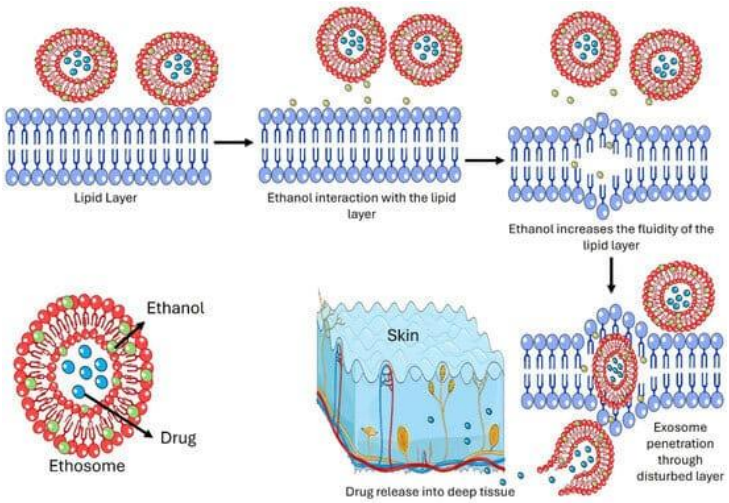

Figure 3: Ethosomes as Drug Delivery System[13]

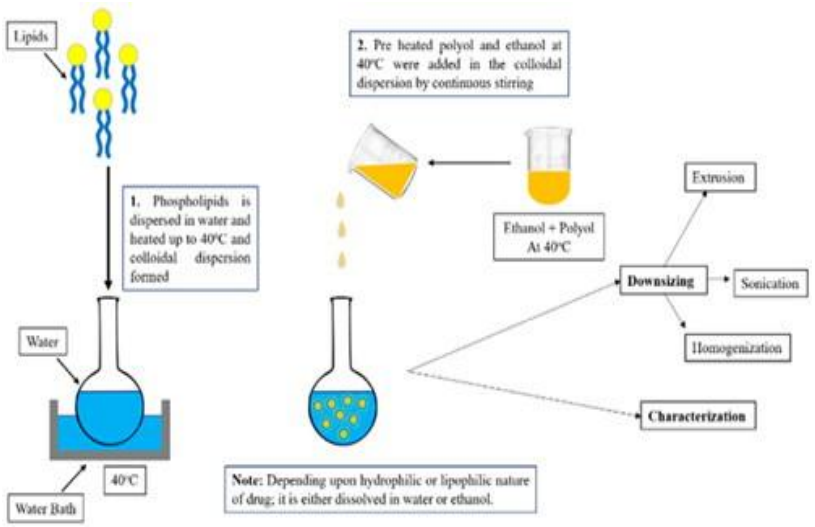

Figure 4: Method for Preparation of Ethosomes[14]

COMPOSITION OF ETHOSOMES:

Ethanol: Ethanol is an efficient penetration enhancer. It plays an important role in ethosomal systems by giving the vesicles special dimensional characteristics size, zeta potential, stability, prevention of clogging and increased permeability of the skin. Concentrations of ethanol in ethosomal systems have been reported to be from 10% to 50%.Many researchers concluded that when the concentration of ethanol is increased, the size of the ethosomes would decrease. Increasing ethanol concentration above the optimum amount, however, would cause the bilayer to be leaky, leading to a small increase in vesicular size and a significant decrease in the efficacy of trapping, and would solubilize the vesicles by further raising the ethanol concentration.[15]

Phospholipid: Phospholipid from different sources were used in formulation of the ethosomal scheme. The selection of phospholipid type and concentration for formulation are important factors during the production of ethosomal system since they will affect the scale, the effectiveness of the trapping, Zeta Potential vesicular properties, stability, and penetration. In general, in an ethosomal formulation, the concentration range of phospholipids is 0.5% to 5%. Rising phospholipid concentration can increase vesicular size marginally or moderately, but will greatly improve the efficiency of trapping. The relationship, however, is only valid until.

Cholesterol: Cholesterol is a stable steroid molecule, and its integration into ethosomal structures increasesmedication stability and clogging effectiveness. This avoids leakage and decreases permeability of the vesicles and vesicular fusion. Generally, it is used at a concentration of 3% but in some formulations, it was used up to 70% of the total phospholipid concentration in the formulation. Several studies have recorded that the vesicular size of ethosomal systems increased with cholesterol.[15]

Dicetyl phosphate: Dicetyl phosphate is widely used to avoid vesicle aggregation and to improve formulation stability. It is used at concentrations between 8% and 20% of the total phospholipid concentration in the ethosomal formulation. However; the impact of dicetyl phosphate on other properties of the ethosomal system remain uncertain.[15]

Stearyl amine: Stearylamine is a positive-charge agent. The addition of stearylamine to the ethosomal formulation caused a great increase in vesicular size and decrease in entrapment. Stearylamine readily penetrates the skin because of its lower molecular weight about 296.5 dalton.Other alcohols Along with ethanol, certain alcohols such as polypropylene glycol and isopropyl alcohol are also used in the preparation of binary ethosomes. efficiency, and change in the zeta potential charge from negative to positive which lead to aggregation of the vesicles within 1 week.[16]

Polypropylene glycol: Propylene glycol is a widely used penetration enhancer. This is used at a concentration range of 5% to 20% in the preparation of binary ethosomes and has been found to influence the ethosomal properties of size, trapping capacity, permeation and stability. Polypropylene glycol integration into ethosomal systems will result in more reduction of particle size relative to systems withoutpolypropylene glycol. A substantial reduction in particle size was achieved from 103.7 nm to 76.3nm when the polypropylene glycol concentration raises from 0% to 20 % v/v. It is suggested that polypropylene glycolenhances ethosomes stability by increasing the viscosity and anti-hydrolysis property.[16]

Isopropyl alcohol: Dave et al studied the influence of isopropyl alcohol on the entrapment efficiency and skin permeation of a diclofenac-loaded ethosomal system. Three types of formulations have been prepared: classical ethosomes containing 40% ethanol, binary ethosomes containing approximately 20% isopropyl alcohol and 20% ethanol, and a vesicular system containing 40% isopropyl alcohol. The vesicular device containing 40% isopropyl alcohol was found to have higher trapping performance (95 %) than the binary ethosomes (83.8 %).

Edge activators or penetration enhancer: The selection of a proper edge activator or penetration enhancer is a critical step in the formulation of Transethosomes, as they

have profound effects on the properties of the ethosomal system.[16]

Tweens and spans: In the ethosomal scheme, Tween 80 is used at concentrations of 10% to 50% of the total phospholipid concentration. It has been stated that Tween 80 has been integrated in ethosomal systems to minimize vesicular size and improve the stability of the system and skinpermeation properties. Mainly due to its solubilizing properties and the prevention of vesicle fusion, the impact of Tween 80 on the ethosomal system. Tween 20 formed an unstable formulation.Spans 80, 60, and 40 did not manage to generate homogeneous and stable transethosomes. Only Span 20 was used successfully in the preparation of transethosomes of caffeine and vitamin E. Oleic acid Oleic acid affects vesicular scale and elasticity, zetapotential, and skinpermeating properties menthol by increasing stratum corneum fluidity.L-Menthol was applied to transethosomes of ascorbic acid at a concentration of 5 % as a penetration enhancer.[16]

Cremophor: Cremophor is the brand name of a range of non-ionic polyethoxylated detergents. Cremophor EL-35 was used in an ethosomal system of testosterone propionate at concentrations of 0.5% to 1.5% w/w. Reducing vesicular size and increasing the drug's solubility and efficacy in trapping was found.Skin-penetrating and cell-entering peptide (SPACE) is a skin-penetration enhancer discovered by phage display and shown to deliver short RNAand streptavidin to the skin after direct chemical conjugation. This penetration enhancer was incorporated in transethosomes for the delivery of hyaluronic acid.[17]

Sodium dodecyl sulfate: Sodium dodecyl sulfate is an anionic surfactant and has been used at a concentration of 0.8% w/v in the preparation of transethosomes of ketoconazole and imiquimod.The results showed that sodium dodecyl sulfate significantly reduced the size, increased the entrapment efficiency and the zeta potential and enhanced the in vitro and in vivo skin-permeation properties of ethosomal system.[17]

EVALUATION OF ETHOSOMES:

1. **Vesicle skin interaction study**: There are different visualization strategies such as, for assessing the process of improved Vesicle skin permeation of ethosomal formulations.Transmission electron microscopy, eosinhematoxyl staining, fluorescence microscopy, and laser microscopy, confocal scanning was used. Such visualization methods also provided a better understanding about modulation of the structure and vesicle penetration pathways when used in combination. It was only to the upper layer of skin (stratum corneum) that traditional liposome penetrated.Deep penetration of liposomes free from alcohol was nearly negligible. In comparison, the ethosomal carrier was used to observe improved distribution of Rhodamine in terms of depth and quantity (dermis-layer).[18]

   Filter membrane: Vesicle interaction study by scanning interaction Electron microscopy This requires adding vesicle suspension (0.2 ml) to filter membranes with a 50 nm pore size, and positioning them in diffusion cells. The upper side of the filter was exposed to the air, whereas the lower side was in contact with phosphate buffer saline solution, (having pH6.5). The filters were removed after 1 hour and were prepared for scanning electron microscope studies by fixation at 4°C in Karnovsky's fixative overnight followed by dehydration with graded ethanol solutions (30%, 50%, 70%, 90%, 95%, and 100% v/v in water).[18]

2. **Skin permeation studies:** The hair of test animals (rats) was carefully cut short (< 2 mm) with a pair of scissors, and a scalpel separated the abdominal skin from the underlying connective tissue. For any adhering fat and/or subcutaneous tissue, the excised skin was put on aluminum foil, and the dermal side of the skin was gently teased off. The effective diffusion cell and receptor cell volume permeation area was 1.0 cm^2 and 10 ml, respectively. The temperature was kept to 32°C. The receptor compartment contained saline solution with phosphate buffer (10 ml pH 6.5). It placed excised skin between the donor and the receptor compartment. Applied to the epidermal surface of the skin was ethosomal formulation (1.0 ml). Samples (0.5 ml) were taken at 1, 2, 4, 8, 12, 16, 20,and 24hours of time intervals via the sampling port of the diffusion cell and analyzed using a high-performance liquid chromatography assay.[18]

3. **Stability study:**The stability of the vesicles was determined by the vesicles being held at 4°C.The vesicle size, zeta potential, and trapping efficiency were calculated after 180 days using the method previously stateduptake. [18]

4. **Drug absorption study:**The absorption of drugs into MT-2 cells (1,1106 cells / ml) took place in 24-well plates (Corning Inc) where 100 µl RPMI medium was applied. In phosphate buffer saline solution (pH7.4), ethosomal formulation, or advertised formulation, cells were incubated with 100 µl of the drug solution, and then drug absorption was calculated by HPLC assay analysis of the drug material.[18]

5. **High Performance Liquid Chromatography (HPLC) assay**: During in vitro skin permeation experiments and in MT-2 cell, the amount of drug permeated in the receptor compartment was determined by HPLC assay using methanol: distilled water: acetonitrile mixture (70:20:10) as a mobile step.[18]

6. **Statistical analysis:** The statistical significance of all the produced data was evaluated using ANOVA followed by student t-test range testing. Using the PRISM program, a confidence limit $p<0.5$ was set for interpreting the result.[18]

7. **Vesicle size and size distribution:**It is determined by dynamic light scattering, photon correlation spectroscopy, or Malvern Zetasizer. The size typically ranges from tens of nanometres to microns. The size affects skin penetration and stability.[19]

8. **Vesicle shape and morphology:**It can be visualized by Transmission Electron Microscopyand Scanning Electron Microscopy.Ethosomes are generally spherical and may be unilamellar or multilamellar. Morphology confirms vesicle formation and structural integrity.[19]

9. **Zeta potential:** It can be measured by zeta potential analysers.It indicates surface charge and predicts physical stability (colloidal stability) due to electrostatic repulsion. It is typically negative due to ethanol and phospholipid content; values above ±20 mV suggests good stability.[19]

10. **Entrapment efficiency (drug loading):** It is determined by separating free drug from vesicle-entrapped drug via ultracentrifugation or dialysis. It is quantified by UV-visible spectroscopy or High-Performance Liquid Chromatography (HPLC).It is critical in assessing the capacity to incorporate drug molecules effectively.[19]

11. **Transition temperature (phase behaviour):** It is analyzed by Differential Scanning Calorimetry (DSC). It indicates lipid bilayer phase transition temperature. The important for understanding vesicle membrane fluidity and stability at physiological conditions.[19]

12. **Surface tension Measurement:** It can be evaluated using methods like the Du Nouy ring tensiometer. It reflects surface activity of vesicular dispersions, influencing skin permeation.[19]

13. **Stability studies:** The Physical stability (size, morphology, zeta potential) assessed over time under different storage conditions. It is monitored via DLS, TEM, and visual inspection for aggregation or precipitation.[19]

14. **14.In-vitro skin permeation and penetration studies:** It can be performed using Franz diffusion cells with excised skin or synthetic membranes. It evaluates drug release profile, permeation rate, and skin deposition.The confocallaser scanning microscopyor fluorescence labelling used to visualize skin penetration.[19]

15. **Drug Content and Compatibility:**Drug content uniformity assessed via UV spectroscopy or HPLC.The compatibility studies can be determined by Fourier Transform Infrared Spectroscopy (FTIR)which ensures no interaction among drug and excipient.[19]

APPLICATIONS OF ETHOSOMES:

Ethosomes, the high ethanol derived vesicles are capable of penetrating deeper layers of the skin and thus tend to be vesicles of choice for transdermal drug delivery via the skin of hydrophilic and impermeable drugs.[20]

1. **Hormone delivery:** Oral hormone delivery is related to numerous issues, such as high first-pass metabolism, poor oral bioavailability and many dose-dependent side effects. In addition, oral hormonal preparations which depend heavily on patient compliance with these side effects. The risk of treatment failure is known to rise with every missed pill. Touitou et al. Revealed ability of ethosomes in hormonal delivery by performing a comparative analysis of transdermal delivery of testosterone loaded ethosomes (Testosome), as compared to transdermal testosterone patch (Testoderm patch, Alza) through rabbit pinna skin, which showed approximately 30-times higher skin permeation of testosterone from ethosomal formulation. For ethosomal formulation, the volume of drug deposited was substantiallyhigher for Testosome and Testoderm, respectively. The area under the curveand Cmax of testosterone significantly improved after the application of Testosome as compared to Testoderm. Thus, both in vitro and in vivo studies have shown increased skin permeation and testosterone bioavailability from ethosomal formulation.[20]

2. **Transcellular delivery:** Transcellular delivery Ethosomes have been shown to be an effective penetration enhancer and carrier device for the transcellular delivery of various therapeutic agents in active clinical trials. In contrast, almost no fluorescence was observed when integrated in a hydroethanolic solution or classic liposomes. After 3 min of incubation, the intracellular existence of each of the three tested probes was evident.[20]

3. **Pilosebaceous targeting:** The percutaneous drug delivery of hair follicles and sebaceous glands is increasingly recognized as potentially significant elements. The interest in pilosebaceous units was directed to their use as depots for localized therapy, particularly for the treatment of follicle-related disorders such as acne or alopecia. In addition, extensive attention has also been paid to using the follicles as transportation shunts for systemic drug delivery.[20]

4. **Delivery of anti-parkinsonism agent:** Dayan and Touitou prepared ethosomal formulations of the psychoactive drug trihexyphenidyl hydrochloride (THP) and contrasted their delivery from traditional liposomal formulations. THP is an antagonist of M1 muscarinic receptors and used to treat Parkinson's disease. The transdermal flux value of THP from ethosomes via the nude mouse skin was 87, 51 and 4.5 times higher than that of liposome, phosphate buffer, and hydro ethanol solution, respectively. After application of ethosomes, the amount of THP remaining in the skin at the end of 18 hr was substantially higher than after application of liposome or hydroethanolic (control) solution. Such findings revealed a greater potential for skin permeation of ethosomal-THP formulation and its use to help treat Parkinson disease.[21]

5. **Topical delivery of DNA:** A lot of environmental pathogens are trying to get into the body through the skin and skin has developed into an outstanding defensive barrier that is both immunologically active and capable of expressing the gene. The important use of ethosomes on the basis of the above facts is to use them for the topical delivery of DNA molecules to

express genes in skin cells. It has been proposed that ethosomes may be used as carriers for applications for gene therapy that require transient gene expression. The findings also suggested the ability to use ethosomes for successful transdermal immunization. Therefore, improved ethosomal skin permeation capacity opens the possibility of using these dosage types to deliver immunizing agents.[21]

6. **Delivery of anti-arthritis drug:**Topical delivery of anti-arthritis medication is a better alternative for site-specific delivery and overcomes traditional oral therapy-related problems. Cannabidiol (CBD) is a drug candidate recently discovered to treat rheumatoid arthritis. His oral administration is associated with a variety of issues such as low bioavailability, first pass metabolism, and degradation of GIT. Significantly increased in CBD-ethosomal formulation biological anti-inflammatory activity was observed when examined by the carrageenan mediated rat paw edema model. Thus, it was concluded that encapsulation of CBD in ethosomes greatly increased its permeation of the skin,its accumulation and thus its biological activities.[21]
7. **Delivery of antibiotics:**Topical antibiotic delivery is a safer option to improve the therapeutic efficacy of those drugs. Conventional oral therapy and other side effects cause many allergic reactions. Conventional outer formulations have poor permeability to deep layers of skin and subdermal tissues. Ethosomes can get around this issue by delivering sufficiently antibiotic into deeper layers of skin. Ethosomal preparations penetrate easily through the epidermis and carry substantial amounts of drugs into the deeper layer of the skin and kill infection at its core. The ethosomal preparations shows that antibiotic ethosomal formulation could be highly effective and would solve the problems associated with traditional therapy.[21]
8. **Delivery of problematic drug molecules:**It is difficult to transmit large biogenic molecules such as peptides or proteins orally, because they are fully degraded in the GI tract.Non-invasive protein delivery is a safer choice for addressing the oral delivery problems. Researchers have been investigating the effect of ethosomal insulin delivery in normal and diabetic SDI rats on reducing blood glucose levels in vivo. The result showed that insulin administered from this patch in both normal and diabetic rats induced a substantial decrease (up to 60 %) in blood glucose. At the other hand, an injection of insulin from a control formulation does not reduce the blood glucose.[22]
9. **Cosmeceutical application of ethosomes:**The benefit of applying ethosomes in cosmeceuticals is not only to enhance cosmetic chemicals' stability and decrease skin irritation from irritating cosmetic chemicals, but also to enhance transdermal permeation, particularly in elastic types. Furthermore, the compositions and sizes of the vesicles are the key considerations that need to be addressed in order to achieve these benefits of the elastic vesicles for cosmeceuticals.[22]

MARKETED PRODUCTS OF ETHOSOMES:[23]

From 2000, the ethosomes technology began to commercialize.

Marketed Products[23, 24]

Sr. No.	Name of Product	Uses	Manufacturer
1	Cellutight EF	Topical cellulite creamcontains a powerful combination of ingredients to increase metabolism and break down fat.	Hampdem Health,USA
2	Decorin cream	Anti-aging creamtreatingrepairing and delaying the visible aging signs of the skinincluding wrinklelines,saggingage spotsloss of elasticity and hyper pigmentation	Genome Cosmetics,Pennsylvania,US
3	Nanominox	First minoxidil containing productwhich uses ethosomes. It contains 4% minoxidilwell-known hair growth promoter that must be metabolized by sulfation to the active compound.	Sinere,Germany
4	Noicellex	Topical anti-cellulite cream	NovelTherapeuticTechnologies,Israel
5	Skin Genuity	Powerful cellulite buster,reduces orange peel	Physonics,Nottingham,UK
6	Supravir cream	For the treatment of herpes virus	Trima,Israel

CONCLUSION:

Ethosomes constitute a novel and highly versatile vesicular drug delivery platform distinguished by their remarkable ability to traverse the skin barrier and enhance the bioavailability of diverse therapeutic agents. Their unique composition of phospholipids, ethanol, and water imparts superior stability, deformability, and permeability, enabling efficient encapsulation and transport of both hydrophilic and lipophilic molecules. By addressing the limitations of conventional transdermal systems, ethosomes offer significant advantages including enhanced patient compliance, broad applicability across

pharmaceutical, cosmetic, and biotechnological domains, and demonstrated clinical efficacy, as evidenced by existing marketed formulations. Despite challenges such as product yield and stability constraints, ethosomes remain a promising and forward-looking technology with immense potential to revolutionize transdermal and targeted drug delivery in the future.

REFERENCES:

1. Pawar P, Kalamkar R, Jain A, Amberkar S, "Ethosomes: A Novel Tool for Herbal Drug Delivery", *International Journal of Pharmacy& Pharmaceutical Research*, **2015**, 3 (4): 191–202.
2. Udapurkar P, Kamble S, Biyani K, "Ethosomes: Novel Vesicular Carriers for Enhancing Transdermal Drug Delivery", *International Journal of Pharmaceutical and Chemical Sciences*, **2015**, 4 (1), 1–15.
3. Patrekar P, Inamdar S, Mali S, Mujib M, Ahir A, Hosmani A, "Ethosomes as novel drug delivery system: A Review", *The Pharma Innovation Journal*,**2015**, 4, (9): 10–21.
4. Abdulbaqi I, Darwis Y, Khan N, Khan R, "Ethosomal nanocarriers: the impact of constituents and formulation techniques on ethosomal properties, in-vivo studies, and clinical trials", *International Journal of Nanomedicine*, **2016**, 11, 2279–2304.
5. Aggarwal D, Nautiyal U, "Ethosomes: A review", *International Journal of Pharmaceutical and Medicinal Research*, **2016**, 4 (4): 354–363.
6. Touitoua E, Dayana N, Bergelsonb L, Godina B, Eliaza M, "Ethosomes:novel vesicular carriers for enhanced delivery: characterization and skin penetration properties", *Journal of Controlled Release*, **2000**, 65: 403–418.
7. Khogta S, Patel J, Barve K, Londhe V, "Herbal Nano formulations for Topical Delivery", *Journal of Herbal Medicine*, **2019**, 10, 1–28.
8. Govind G, Madhavi A, "Review of Herbal Drug Formulations and Its Evolutions, Mintage", *Journal of Pharmaceutical & Medical Sciences*, **2019**, 8 (1): 1–5.
9. Pandey V, Golhani D, Shukla R, "Ethosomes: versatile vesicular carriers for efficient transdermal delivery of therapeutic agents", *Drug Delivery*, 2019, 22 (8): 988–1002.
10. Niua X,Zhanga D, Biana Q, Fengc X, Lid H, Raoe Y, Shenf Y, Gengf F, Yuana A, Yinga X, Gaoa J, "Mechanism investigation of ethosomes transdermal permeation",*International Journal of Pharmaceutics*, 2019, 100–127.
11. Kulkarni S, Mishra KP, Sharma SB and Jain S, "Ethosomes: A Promising Way for Transdermal Drug Delivery", *International Journal of Pharmaceutical Sciences and Research*, **2015**, 6 (9): 3663–3670.
12. Touitou E, Godin B, "Ethosomes for skin delivery", *Journal of Drug Delivery Sciences and Technology*, **2007**, 17 (5): 303–308.
13. Verma S, Utreja P, "Vesicular nanocarrier based treatment of skin fungal infections: Potential and emerging trends in nanoscale pharmacotherapy", *Asian Journal of Pharmaceutical Sciences*, **2019**, 14:117–129.
14. Chourasia M, Kang L, Chan S, "Nanosized ethosomes bearing ketoprofen for improved transdermal delivery", *International Journal of Pharmacy and Pharmaceutical Sciences*, **2011**, 1: 60–67.
15. Song C, Balakrishnan P, Shim C, Chung S, Chong S, Kim D, "A novel vesicular carrier, transethosomes, for enhanced skin delivery of voriconazole: Characterization and in-vitro&in-vivo evaluation", *Colloids and Surfaces B: Biointerfaces*, **2012**, 92:299–304.
16. Chaturvedi M, Kumar M, Sinhal A and Saifi A, Recent development in novel drug delivery systems of herbal drugs, International Journal of Green Pharmacy, 2011, 87–94.
17. Parmar P, Mishra A, Pathak A, "Preparation and Evaluation of Ethosomal Gel of Clotrimazole for Fungal Infection by Mechanical Dispersion Method", *Current Research in Pharmaceutical Sciences*, **2016**, 6 (2): 45–49.
18. Sakdiseta P, Amnuaikitb T, Pichayakornb W, Pinsuwanb S, "Formulation development of ethosomes containing indomethacin for transdermal delivery", *Journal of Drug Delivery Science and Technology*, **2019**, 52: 760–768.
19. Dhiman A, Singh D, Fatima K, Zia G, "Development of Rutin Ethosomes for Enhanced Skin Permeation", *International Journal of Traditional Medicine and Applications*, **2019**, 1, (1): 4–10.
20. Dave V, Kumar D, Lewis S, Paliwal S, "Ethosome for Enhanced Transdermal Drug Delivery of Aceclofenac", *International Journal of Drug Delivery*, **2010**, 2: 81–92.
21. Kumar P, Patel A, Prasad R, Gautam S, "Formulation and Evaluation of Ethosome for Econazole Nitrate a Model Drug to Enhanced Transdermal Delivery", *International Journal of Pharmaceutics & Drug Analysis*, **2016**, 4 (3): 140–146.
22. Safeeruddin M, Manognya J, Sravani H, Rajeshwardutt K, Shruthi B, Ravali G, "Etodolac Loaded Ethosomes: Design and In-vitro Characterization", *World Journal of Pharmacy and Pharmaceutical Sciences*, **2016**, 6 (5): 896–903.
23. Ibrahim T, Abdallah M, El-Megrab N, El-Nahas H, "Transdermal ethosomal gel nanocarriers: apromising strategy for enhancement of antihypertensive effect of carvedilol",*Journal of liposomal research*, **2014**, 1 (2): 223–236.
24. Rahul G, Maheshwari S, Rakesh K, Tekade G,Piyoosh A, Sharma H, Darwhekar G, Tyagi A, Patel R, Jain D, "Ethosomes and ultradeformable liposomes for transdermal delivery of clotrimazole: A comparative assessment", *Saudi Pharmaceutical Journal*, **2012**, 20: 161–170.