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LIPOSOMES IN COSMETIC SCIENCE: A COMPREHENSIVE REVIEW OF APPLICATIONS AND BENEFITS

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Abstract
Targeted drug delivery in cosmetics and dermatology aims to maximize the efficacy and localization of active ingredients while overcoming the skin's natural barrier, particularly the stratum corneum. Lipid-based carriers such as liposomes offer a biocompatible, non-toxic, and effective strategy for enhancing dermal and transdermal delivery. Liposomes encapsulate both hydrophilic and lipophilic substances, facilitating controlled release, reduced systemic absorption, and improved skin hydration, protection, and repair. Various specialized liposomal systems—including transferosomes, niosomes, novasomes, marinosomes, ultrasomes, photosomes, ethosomes, phytosomes, yeast-based liposomes, sphingosomes, glycerosomes, oleosomes, catezomes, and invasomes—have been developed to address specific delivery challenges and skin concerns such as acne, dryness, UV damage, inflammation, and aging. These systems leverage diverse compositions and mechanisms to improve skin penetration, stability, bioavailability, and therapeutic outcomes. The continued evolution of liposomal technologies supports the development of advanced cosmeceuticals with enhanced performance, safety, and consumer acceptance.

INTRODUCTION

Targeted drug delivery implies selective and effective localization of pharmacology
At the same time, it implies maximizing access and ef ficacy to the active ingredient, the non-
targeted region, which is the given target of therapeut ic concentrations (1). The skin, though easily accessible, acts as a barrier to molecule penetration, limiting drug and cosmetic delivery. Cosmeceuticals—cosmetic products with bioactive ingredients—are more effective when they reach deeper skin layers. (2). Modern skincare must deliver active ingredients effectively, but the stratum corneum—a tightly packed barrier—limits penetration. Chemical enhancers can increase lipid fluidity to improve substance delivery through the skin.(3, 4) The stratum corneum offers the greatest resistance to penetration and is the rate-limiting step for percutaneous absorption(5) The stratum corneum's corneocytes are encased in dense, lamellar lipid crystals and cross-linked proteins, limiting drug uptake into cells. Consequently, most active ingredients diffuse through the lipid lamellae in the intercellular spaces.(6) For successful Dermal or Transdermal Release requires reversible crossing of the skin barrier. so many strategies overcome the barrier function of the stratum corneum, improved transport of active ingredients to the skin (7, 8).

Lipid-based carriers are vital for targeted drug delivery due to their biocompatibility, low toxicity, and ability to solubilize active ingredients. They are especially effective for topical use, offering safe, non-irritating, and controlled release and can be used as a penetration enhancer for encapsulated drugs excellent occlusion and hydration properties. (9)

LIPOSOMES

Liposomes are spherical vesicles with bilayer membranes that encapsulate hydrophilic drugs in their core and lipophilic substances within the bilayer. Their versatile structure makes them widely used in cosmetics for effective ingredient delivery. (10-12) These properties are used as solubilizers for sparingly soluble substances, dispersants, sustained release systems, the most obvious are encapsulated substances, stabilizers, preservatives, microencapsulation systems and microreactor delivery systems. It is non-toxic because it can be made entirely from naturally occurring substances, biodegradable and non-immunogenic (13-15) **Fig. 1**

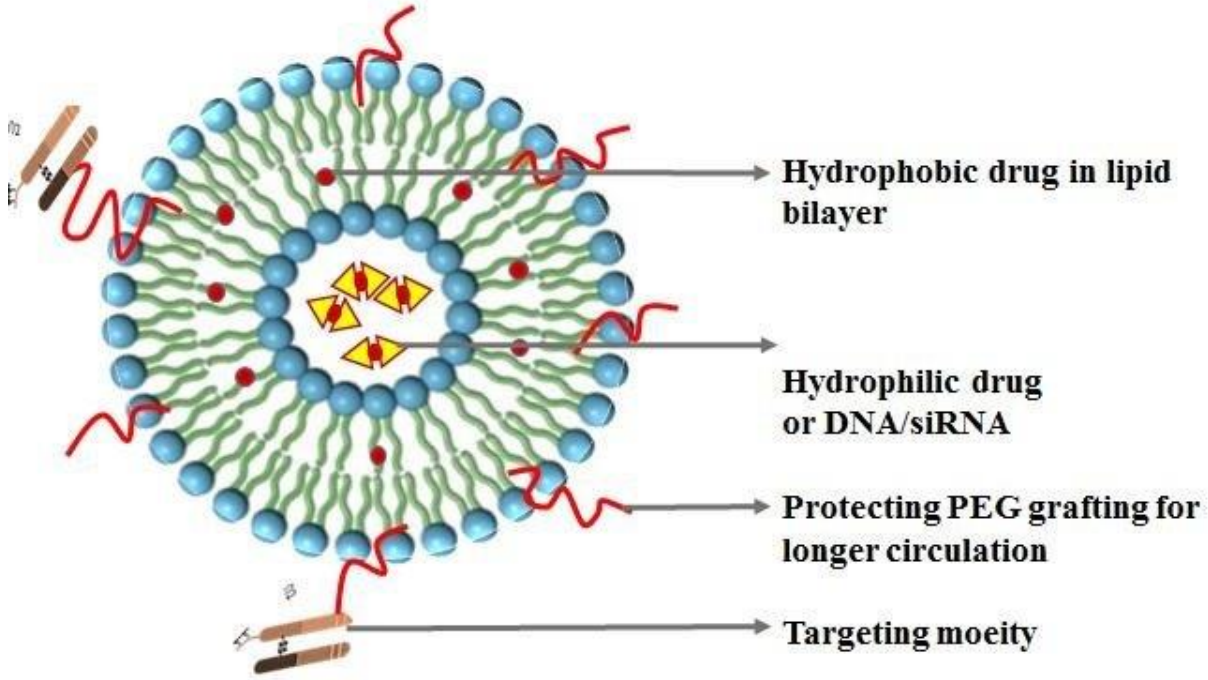

Fig. 1 Structure and Functional Components of a Liposome

Beneficial aspects of liposome

The major benefit of topical liposomes in dermatology are:

❖ to reduce serious side effects and incompatibilities that may arise from its drug localizing characteristics and thus avoiding systemic absorption

❖ to increase drug accumulation at the skin due to the mimic epidermis composition, which enables liposome substantivity with biological membranes

❖ nontoxic and biodegradable characteristics of liposomes

❖ easy to scale up for manufacturing (16)

❖ to encapsulate both water- and lipid-soluble active components (17)

❖ washing out may be delayed, which provides water resistant character(18)

❖ to moisturize and restore action of the constitutive skin lipids membranes

❖ to localize drug depots in the skin, resulting in sustained release of dramatically active compounds, so improving the therapeutic index of the drug at target site while reducing the toxicity profile to its minimum. (19) Besides its unique beneficials, liposomes show some disadvantages such as low stability, low encapsulation efficiency, high cost of manufacturing,

degradation by hydrolysis or oxidation, sedimentation, aggregation or fusion of liposomes during storage (20, 21)

Application of liposome as drug carrier in cosmetics
Skin inflammation
Liposomal cosmeceuticals enhance acne treatment by improving skin delivery, reducing side effects, and targeting bacteria like Propionibacterium acnes in sebum-rich follicles.(22). Liposomal formulations enhance the delivery and antibacterial effectiveness of lauric acid against Propionibacterium acnes, overcoming solubility issues and reducing irritation. Similarly, liposomal salicylic acid offers controlled release, lowering irritation and dosing frequency in acne treatment.(23)
Skin dryness
Hydration effects are of great interest to dermatologists, as skin hydration is considered a marker of health, just as dry skin is a sign of dysfunction. The penetration of active ingredients into human skin is highly dependent on skin moisture and can be affected by occlusive compound (24). The moisture content of skin is 10-20%.(25) Deficiencies in essential fatty acids, cholesterol, and ceramides lead to increased trans epidermal water transport (i.e., xerosis) in addition to skin dryness. (25)The use of occlusive agents prevents water from evaporating from the skin into the atmosphere, and water is retained in the skin.(26) Moisturizing products makeup, one of the largest and most important categories of skin care products. The function of humectants is to keep the stratum corneum hydrated. Dry skin loses its elasticity, becomes hard and brittle, and the skin becomes rough and scaly.(27) Many topical formulations of have an undesirable aesthetic appearance (such as petrolatum), increasing the need for new occlusive agent(28)liposomes show occlusive properties and can retain and increase the skin humidity and consequently restore the barrier functions of the skin. (29)Liposome formulations with higher egg phospholipid content enhance skin hydration and barrier function due to their superior occlusive effects.(30)

Protection from UV radiation
UV rays can cause many things, acute and chronic effects on the skin. Erythema is acute response of human skin to ultraviolet radiation. Long-term exposure of the skin to UV light causes photoaging and photo carcinogenesis, immunosuppression and mutations. (31) Studies show that over 90% of the epidermis is squamous cell carcinoma and 50% or more of basal cells. Carcinomas exhibit UV-induced mutations. (32) About the harmful effects of UV rays on the skin interest in light stabilizers such as sunscreen (33) Multilamellar liposomes enhance UV protection and SPF of octyl methoxycinnamate by improving skin retention and reducing deep layer penetration compared to conventional formulations. (34)

Free radical scavenger
Skin aging is driven by genetic, environmental, and hormonal factors, with free radicals from UV exposure, smoking, and alcohol playing a key role in extrinsic aging. (35) Antioxidants reduce free radical damage by scavenging them, thereby preventing destruction at the cellular level. (36) Liposomes enhance the skin penetration and stability of sodium ascorbyl phosphate, making them more effective than aqueous formulations for topical antioxidant delivery. (37).

Skin disorders
Neurodermatitis is a chronic relapsing inflammatory dermatitis. Non-communicable and pruritic skin diseases (38) Liposomal encapsulation of betamethasone dipropionate enhances its anti-inflammatory effects in atopic dermatitis, reducing erythema and scaling with fewer side effects, potentially improving the risk/benefit ratio over traditional gels. (39) Dipotassium glycyrrhizinate-loaded deformable liposomes enhance skin delivery and offer a stable, low-irritation option for treating dermatitis, opening new possibilities for advanced topical therapies.(40) Liposomal hydrogels of adenosyl cobalamin significantly enhance skin permeability and show protective effects, suggesting potential for treating inflammation and symptoms of atopic dermatitis. (41) Table 1

Table 1 Liposome-Mediated Delivery for Targeted Skin Treatment

Application Area	Condition/Concern	Active Ingredient(s)	Liposome Benefit	Reference(s)
Acne Treatment	Skin inflammation (Acne)	Benzoyl peroxide, Lauric acid, Salicylic acid	Enhances skin drug delivery and retention, boosts antibacterial efficacy, allows controlled release, and reduces irritation and systemic absorption.	(22, 23)
Skin Hydration	Skin dryness	(Empty liposomes), Egg phospholipids	Occlusive, boosts skin moisture, restores barrier, and offers superior hydration vs. reference products.	(22, 24-30)
UV Protection	Protection from UV radiation	Octyl methoxycinnamate, SAP (Sodium Ascorbyl Phosphate)	Smaller particles enhance SPF, retention, penetration, and UV blocking, depending on lipid makeup.	(31-33)
Free Radical Scavenging	Skin aging	SAP (Sodium Ascorbyl Phosphate)	Facilitates penetration of antioxidants through the stratum corneum.	(34-36)
Skin Disorders	Neurodermatitis	Betamethasone dipropionate (BDP)	May increase anti-inflammatory effects while potentially reducing anti-proliferative effects (linked to atrophy).	(37, 38)
Skin Disorders	Atopic Dermatitis	Dipotassium glycyrrhizinate, Adenosyl cobalamin (Vitamin B12 derivative)	Dipotassium glycyrrhizinate enhances skin permeability, while adenosyl cobalamin provides protective effects against inflammation and dermatitis symptoms.	(39, 40)

COSMETIC LIPOSOMAL TYPES

Cosmetic liposome may be divided into different types according to the composition and indication. **Fig. 3** We can use any one type depending on the formulation of cosmetic product. These types are: Table 2

Transferosome

Transferosomes are highly deformable, highly reactive and efficient liposomes. Currently for direct transdermal drug delivery. Regarding due to its small size (300-200 nm), it can easily penetrate the skin and pass through the stratum corneum of the skin. By using intracellular or transcellular pathways with the help of, it has two elongated elastic layers on its surface. Liposomes composed of phospholipids containing cholesterol Sodium cholate (Cholic acid salts) (11)

Niosome

Niosome are small vesicles composed of nonionic surfactants from alkyl or dialkyl polyglycerols ether class. In cosmetics and skin care, the use of niosome is very useful as they can bring about improvements. Increase product efficacy and penetration, increase bioavailability of poorly absorbed ingredients and increases the drug (11, 42, 43)

Novasomes

Novasomes are 0.1–1.0-micron non phospholipid oligolamellar lipid vesicles and represent a great diversity. A liposome or modified noisome synthesized by binding polyoxymethylene fatty acid monoester, cholesterol and free fatty acid in a ratio of 74:22:4. By imparting adhesion to skin and hair, it provides further superiority for use in cosmetics. This allows for sustained release and efficacy and texture of these cosmetics (44)

Marinosomes

These types are made from marine lipids extract containing a lot of eicosatetraenoic acid Docosahexaenoic acid, an omega-3 polyunsaturated fatty acid. It is metabolized by epidermal enzymes in

the skin and converted into anti-inflammatory and anti-proliferative metabolites that aid in many healings. Skin inflammation problem, toxicity test indicates that this category of liposomes is safe for skin and skin eye (43, 45)

Ultrasomes

Ultrasomes are a unique category of liposomes formed by entrapment of endonucleases extracted from Micrococcus luteus. Helps detect and speed UV skin damage up to 4 treatments. Ultrasomes also contain DNA and it suppresses the expression of several cytokines, including tumor necrosis factor-alpha and interleukins 1, 6, and 8, reducing the risk of skin cancer (46)

Photosome

Photosomes work by triggering photodegradation. An enzyme derived from the sea plant anacystinidurans. They are widely used in sunscreens to prevent light from damaging the DNA of cells, prevent immune system suppression, and reduce the risk of developing cancer. (46)

Ethosomes

Ethosomes, distinguished by high ethanol content, disrupt skin lipid layers to enhance cosmetic delivery more effectively than traditional liposomes.(47) An oxygen delivery system using liposomal vesicles with a perfluorocarbon core effectively transports oxygen to the skin by encapsulating hydrophobic oxygen gases.(47)

Phytosomes

They are advanced herbal supplements Liposomes prepared by mixing phospholipids and phospholipids plant extracts such as flavonoids, glycosides and terpenoids. Phytosomes improve the absorption of plant ingredients into the skin and are widely used in cosmetics. High lipid profile and improved skin penetration.(48) The phytosome delivery system uses a dual-layer phospholipid membrane to enhance the solubility, permeability, and stability of both polar and nonpolar compounds.(49)

Yeast-based liposomes

Liposomal vitamin C derived from yeast cells enhances skin oxygenation, repair, and fibroblast activation, significantly improving absorption and skin texture.(30)

Sphingosome

Sphingosomes, composed of skin-compatible ceramides, restore hydration and barrier function while enhancing topical and transdermal delivery in cosmetics.(50)

Glycerosome

Glycerosomes, enhanced with glycerin, deliver potent cosmetic actives and antioxidants to the skin, promoting healing and defense, with future use in antioxidant creams. (51) Glycerosomes, sized 80–110 nm with high glycerol content, offer enhanced skin penetration, safety, efficacy, and user-friendly topical drug delivery..(52)

Oleosomes

Oleosomes, natural oil-rich liposomes from plants, offer stable antioxidant delivery in skincare and food, with lubrication properties influencing texture, feel, and consumer acceptance.(53)

Catezome

Catezomes are cationic, non-phospholipid vesicles ideal for delivering diverse cosmeceuticals to hair and skin, especially when controlled or enhanced penetration is needed.. (30) Catezomes, with a cationic charge and tunable release, effectively deliver hydrophilic and hydrophobic actives like fragrances and sunscreens to the skin's surface.(54)

Invasomes

Compared to other traditional vesicles, invasomes are novel vesicular systems that significantly enhance the transdermal penetration of active drug molecules. Phospholipids, ethanol, and terpene, or a combination of terpenes, make up the structures of these vesicles. These elements had good penetration qualities and functioned as an appropriate transdermal penetrator.(55) **Fig. 2.**

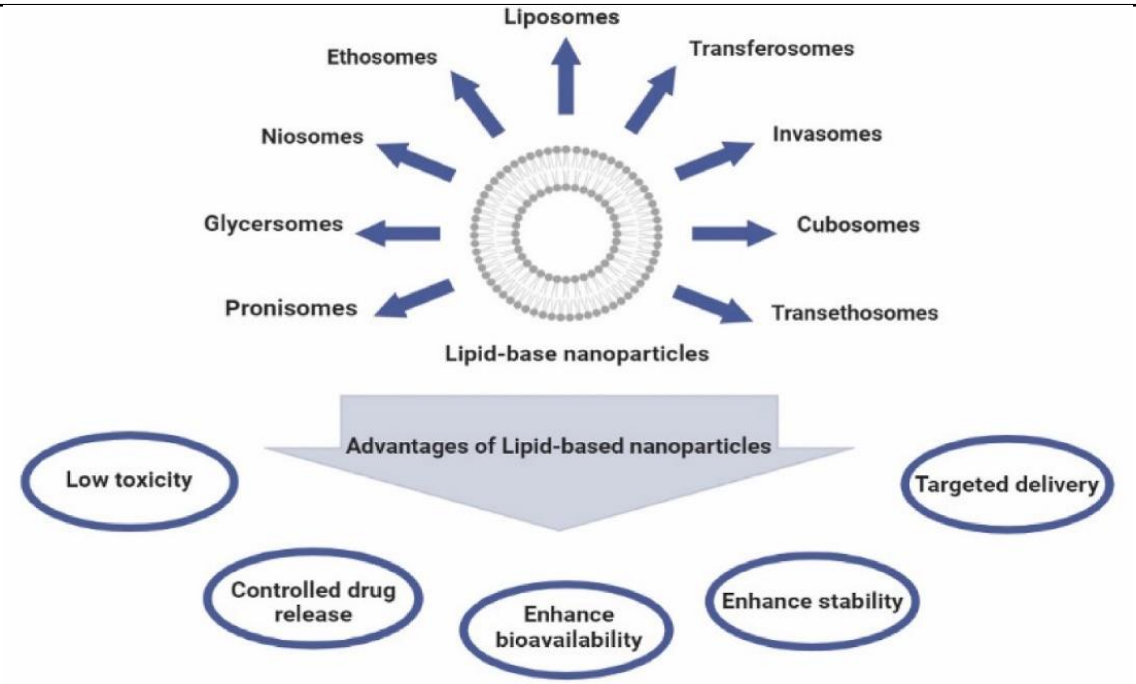

Fig. 2 Advantage of lipid-based nanoparticles

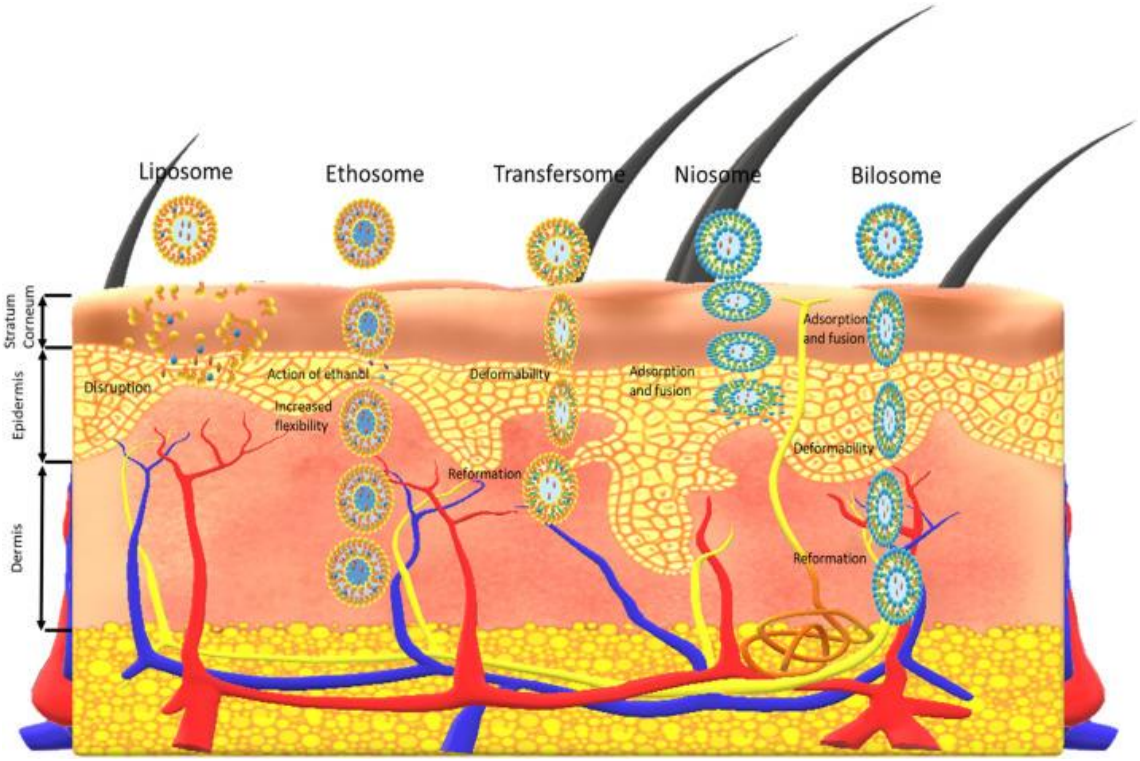

Fig. 3 Cosmetic Liposomal Types

TABLE 2 SPECIALIZED LIPOSOME SYSTEMS FOR ADVANCED COSMETIC APPLICATION				
Liposome Type	**Composition**	**Size Range (approx.)**	**Key Features**	**Cosmetic Applications**
Transferosome	Phospholipids, cholesterol, sodium cholate (cholic acid salts)	200-300 nm	Highly deformable, reactive, efficient for transdermal delivery, easily penetrates the stratum corneum via intracellular/transcellular pathways.	Direct transdermal drug delivery.
Niosome	Nonionic surfactants (alkyl or dialkyl polyglycerol ethers)	Small vesicles	Increases product efficacy and penetration, enhances bioavailability of poorly absorbed ingredients.	General cosmetic and skincare improvements, delivery of various active ingredients.
Novasome	Non-phospholipid oligolamellar lipid vesicles (polyoxymethylene fatty acid monoester, cholesterol, free fatty acid)	0.1-1.0 micron	Adhesion to skin and hair, sustained release, improved efficacy and texture.	Enhancing cosmetic efficacy, providing sustained release of active ingredients, improving product texture.
Marinosome	Marine lipid extract (eicosatetraenoic acid, docosahexaenoic acid - omega-3 fatty acids)	Not specified	Metabolized by epidermal enzymes into anti-inflammatory and anti-proliferative metabolites, safe for skin and eye.	Addressing skin inflammation.
Ultrasome	Liposomes entrapping endonucleases from Micrococcus luteus	Not specified	Detects and speeds up UV skin damage repair, contains DNA that suppresses pro-inflammatory cytokines, reducing skin cancer risk.	Sun damage repair, potential anti-inflammatory and anti-carcinogenic effects.
Photosome	Enzyme derived from the sea plant Anacystis nidulans	Not specified	Triggers photodegradation, used in sunscreens to prevent UV-induced DNA damage, immune suppression, and cancer risk.	Sunscreens and sun protection products.
Ethosome	Phosphatidylcholine, water, high concentration (20-50%) of ethanol	Soft, flexible	Non-invasive carrier, penetrates deep into skin layers or the entire body by disrupting skin's lipid bilayer. Offers superior delivery volume and depth.	Efficient delivery of cosmetics deep into the skin. Oxygen carrier vesicles (perfluorocarbon core) for skin oxygenation.

Phytosome	Liposomes with incorporated plant extracts (flavonoids, glycosides, terpenoids)	Not specified	Improves absorption of plant ingredients into the skin due to high lipid profile and enhanced penetration.	Delivery of herbal supplements and plant-based active ingredients in cosmetics.
Yeast-based liposome	Derivatives of yeast cells incorporating vitamin C	Not specified	Delivers vitamin C, aids in skin healing, calming, and oxygenation, activates dermal fibroblasts.	Skin healing, soothing, oxygenation, and improving skin texture and feel.
Sphingosome	Liposomes composed of ceramides	Not specified	Normalizes damaged or dehydrated skin by compensating for ceramide deficiencies, restores skin barrier function, high skin compatibility.	Products for dry, damaged, or dehydrated skin, restoring skin barrier function.
Glycerosome	Modified liposomes containing glycerin and phospholipids	80-110 nm (for quercetin type)	Delivers high-performance active ingredients, healing and beautifying properties, glycerin enhances skin penetration, non-toxic.	Delivery of various cosmetic active ingredients, particularly antioxidants, improving skin defense activity.
Oleosome	Natural liposomes from plant seeds/fruits (oils, vitamins, pigments)	Not specified	High stability, antioxidant properties, potential for controlled release, influences product spreadability and mouthfeel (in related applications).	Delivery of natural oils, vitamins, and pigments in personal care products, influencing texture and sensory properties.
Catezome	Non-phospholipid vesicles from fatty acid salts of amphipathic quaternary amines (cationic surface charge)	Not specified	Can load and release both hydrophilic and hydrophobic compounds (depending on ionic strength), retain ingredients on the skin surface due to cationic charge, low skin penetration.	Delivery of fragrances, sunscreens, and enzymes to the outermost layers of the skin.
Invasome	Phospholipids, ethanol, and terpene(s)	Not specified	Significantly enhances transdermal penetration of active drug molecules due to the combination of components.	Enhanced transdermal delivery of cosmetic ingredients.

REFERENCES

1. Abdel-Rashid RS, Helal DA, Alaa-Eldin AA, Abdel-Monem R. Polymeric versus lipid nanocapsules for miconazole nitrate enhanced topical delivery: in vitro and ex vivo evaluation. Drug Delivery. 2022;29(1):294-304.
2. Scioli Montoto S, Muraca G, Ruiz ME. Solid lipid nanoparticles for drug delivery: pharmacological and biopharmaceutical aspects. Frontiers in molecular biosciences. 2020;7:587997.
3. Schafer N, Balwierz R, Biernat P, Ochędzan-Siodłak W, Lipok J. Natural ingredients of transdermal drug delivery systems as permeation enhancers of active substances through the stratum corneum. Mol Pharm. 2023;20(7):3278-97.
4. Hmingthansanga V, Singh N, Banerjee S, Manickam S, Velayutham R, Natesan S. Improved topical drug delivery: Role of permeation enhancers and advanced approaches. Pharmaceutics. 2022;14(12):2818.

5. Yu Y-Q, Yang X, Wu X-F, Fan Y-B. Enhancing permeation of drug molecules across the skin via delivery in nanocarriers: novel strategies for effective transdermal applications. Frontiers in bioengineering and biotechnology. 2021;9:646554.
6. Liston LS, Rivas PL, Sakdiset P, See GL, Arce Jr F. Chemical permeation enhancers for topically-applied vitamin C and its derivatives: A systematic review. Cosmetics. 2022;9(4):85.
7. Higaki K, Nakayama K, Suyama T, Amnuaikit C, Ogawara K-i, Kimura T. Enhancement of topical delivery of drugs via direct penetration by reducing blood flow rate in skin. International journal of pharmaceutics. 2005;288(2):227-33.
8. Ghafourian T, Zandasrar P, Hamishekar H, Nokhodchi A. The effect of penetration enhancers on drug delivery through skin: a QSAR study. Journal of controlled release. 2004;99(1):113-25.
9. Müller R, Souto E, Alemieda AJ. Topical delivery of oily actives using solid lipid particles. Pharmaceutical Technology Europe. 2007;19(12).
10. Laouini A, Jaafar-Maalej C, Limayem-Blouza I, Sfar S, Charcosset C, Fessi H. Preparation, characterization and applications of liposomes: state of the art. Journal of colloid Science and Biotechnology. 2012;1(2):147-68.
11. Srinivas K. The current role of nanomaterials in cosmetics. J Chem Pharm Res. 2016;8(5):906-14.
12. Reva T, Vaseem A, Satyaprakash S. Md. khalid JA. Liposomes: The novel approach in cosmaceuticals. World J Pharm Pharm Sci. 2015;4(6):1616-40.
13. Lasic D. Application of Liposomes in medicine: A Review. Am Sci. 1992;80:20-31.
14. Lipowsky R. The conformation of membranes. Nature. 1991;349(6309):475-81.
15. Lasic DD. Liposomes: from physics to applications: Elsevier Science Limited; 1993.
16. Egbaria K, Weiner N. Liposomes as a topical drug delivery system. Advanced drug delivery reviews. 1990;5(3):287-300.
17. Ramachandran C, Niemiec SM, Weiner ND. Influence of Nonionic Liposomal Composition on Topical Delivery of Peptide Drugs into Pilosebaceous Units: An in Vivo Study Using the Hamster Ear Model. 1995.
18. skin Ddat, G Cevc - Expert opinion on investigational drugs -TF.
19. Kaur IP KM, Agrawal R. Role of novel delivery systems in developing topical antioxidants as therapeutics to combat photoageing. Ageing Res Rev 2007;6(4):271-88.
20. Jaspart S PG, Delattre L, et al. Solid lipid microparticles: formulation, preparation, characterisation, drug release and applications. Expert Opin Drug Deliv 2005;2(1):75-87.
21. Alsarra IA BA, Ahmed SM, et al. Proniosomes as a drug carrier for transdermal delivery of ketorolac. Eur J Pharm Biopharm 2005;59(3):485-90
22. Nakase K, Tashiro A, Yamada T, Ikoshi H, Noguchi N. Shiunko and Chuoko, topical Kampo medicines, inhibit the expression of gehA encoding the extracellular lipase in Cutibacterium acnes. The Journal of Dermatology. 2019;46(4):308-13.
23. Eroğlu İ, Aslan M, Yaman Ü, Gultekinoglu M, Çalamak S, Kart D, et al. Liposome-based combination therapy for acne treatment. Journal of liposome research. 2020;30(3):263-73.
24. Pham QD, Björklund S, Engblom J, Topgaard D, Sparr E. Chemical penetration enhancers in stratum corneum—Relation between molecular effects and barrier function. J Control Release. 2016;232:175-87.
25. Manvi H, Janhvi M, Reva T, Sayali M, Rutika G. Skin Aura: The Impact of Moisturizers on Maintaining Skin Hydration. International Journal of Trend in Scientific Research and Development. 2024;8(5):345-51.
26. Dhanani S, Shah M, Nair P. Occlusive therapy in dermatology. Indian J Dermatol Venereol Leprol. 2024;91(1):132-5.

27. Barnes TM, Mijaljica D, Townley JP, Spada F, Harrison IP. Vehicles for drug delivery and cosmetic moisturizers: Review and comparison. Pharmaceutics. 2021;13(12):2012.
28. Ainurofiq A, Haya AFFD, Safitri AN, Solihatin IZ, Nusriya SB, Nugroho TS. Characterization and application of moisturizer in skin treatment: A review: Moisturizer in Skin Treatment. Journal of Pakistan Association of Dermatologists. 2023;33(4):1602-13.
29. Jung S, Otberg N, Thiede G, Richter H, Sterry W, Panzner S, et al. Innovative liposomes as a transfollicular drug delivery system: penetration into porcine hair follicles. J Invest Dermatol. 2006;126(8):1728-32.
30. Ashtiani HA, Bishe P, Lashgari N-A, Nilforoushzadeh MA, Zare S. Liposomes in cosmetics. J Skin Stem Cell. 2016;3(3):e65815.
31. Nikolić S, Keck C, Anselmi C, Müller R. Skin photoprotection improvement: synergistic interaction between lipid nanoparticles and organic UV filters. Int J Pharm. 2011;414(1-2):276-84.
32. Ziegler A, Jonason AS, Leffellt DJ, Simon JA, Sharma HW, Kimmelman J, et al. Sunburn and p53 in the onset of skin cancer. Nature. 1994;372(6508):773-6.
33. Schneider SB. Global cosmetic regulations? A long way to go.... Global Regulatory Issues for the Cosmetics Industry: Elsevier; 2009. p. 189-233.
34. Golmohammadzadeh S, Jaafarixx M, Khalili N. Evaluation of liposomal and conventional formulations of octyl methoxycinnamate on human percutaneous absorption using the stripping method. Journal of cosmetic science. 2008;59(5):385-98.
35. Allemann IB, Baumann L. Antioxidants used in skin care formulations. Skin Therapy Lett. 2008;13(7):5-9.
36. Rivers J. The role of cosmeceuticals in antiaging therapy. Skin Therapy Lett. 2008;13(8):5-9.
37. Fočo A, Gašperlin M, Kristl J. Investigation of liposomes as carriers of sodium ascorbyl phosphate for cutaneous photoprotection. Int J Pharm. 2005;291(1-2):21-9.
38. De Benedetto A, Agnihothri R, McGirt LY, Bankova LG, Beck LA. Atopic dermatitis: a disease caused by innate immune defects? J Invest Dermatol. 2009;129(1):14-30.
39. Korting H, Zienicke H, Schäfer-Korting M, Braun-Falco O. Liposome encapsulation improves efficacy of betamethasone dipropionate in atopic eczema but not in psoriasis vulgaris. Eur J Clin Pharmacol. 1990;39:349-51.
40. Trotta M, Peira E, Debernardi F, Gallarate M. Elastic liposomes for skin delivery of dipotassium glycyrrhizinate. Int J Pharm. 2002;241(2):319-27.
41. Jung SH, Cho YS, Jun SS, Koo JS, Cheon HG, Shin BC. Topical application of liposomal cobalamin hydrogel for atopic dermatitis therapy. Die Pharmazie-An International Journal of Pharmaceutical Sciences. 2011;66(6):430-5.
42. Patravale VB, Mandawgade S. Novel cosmetic delivery systems: an application update. Int J Cosmet Sci. 2008;30(1):19-33.
43. Reva T, Vaseem A, Satyaprakash S, Khalid JM. Liposomes: the novel approach in cosmaceuticals. World Journal of Pharmacy and Pharmaceutical Sciences. 2015;4(6):1616-40.
44. Singh A, Malviya R, Sharma PK. Novasome-a breakthrough in pharmaceutical technology a review article. Adv Biol Res. 2011;5(4):184-9.
45. Karimi N, Ghanbarzadeh B, Hamishehkar H, KEYVANI F, Pezeshki A, Gholian MM. Phytosome and liposome: The beneficial encapsulation systems in drug delivery and food application. 2015.
46. Arora N, Agarwal S, Murthy R. Latest technology advances in cosmaceuticals. Int J Pharm Sci Drug Res. 2012;4(3):168-82.
47. Paiva-Santos AC, Silva AL, Guerra C, Peixoto D, Pereira-Silva M, Zeinali M, et al. Ethosomes as nanocarriers for the development of skin delivery formulations. Pharm Res. 2021;38(6):947-70.

48. Yang S, Liu L, Han J, Tang Y. Encapsulating plant ingredients for dermocosmetic application: An updated review of delivery systems and characterization techniques. Int J Cosmet Sci. 2020;42(1):16-28.
49. Susilawati Y, Chaerunisa AY, Purwaningsih H. Phytosome drug delivery system for natural cosmeceutical compounds: Whitening agent and skin antioxidant agent. J Adv Pharm Technol Res. 2021;12(4):327-34.
50. Yadav AR. Drug delivery reviews. World. 2023;1(1):19-25.
51. Ganesan P, Choi D-K. Current application of phytocompound-based nanocosmeceuticals for beauty and skin therapy. International journal of nanomedicine. 2016:1987-2007.
52. Sharma D, Rani A, Singh VD, Shah P, Sharma S, Kumar S. Glycerosomes: Novel nano-vesicles for efficient delivery of therapeutics. Recent Advances in Drug Delivery and Formulation: Formerly Recent Patents on Drug Delivery & Formulation. 2023;17(3):173-82.
53. Nikolaou F, Yang J, Ji L, Scholten E, Nikiforidis CV. The role of membrane components on the oleosome lubrication properties. J Colloid Interface Sci. 2024;657:695-704.
54. Moradi L, Javanmardi S, Abolmaali S, Mohammadi Samani S. Passive enhancement of transdermal drug delivery: lipid-based colloidal carriers as an emerging pharmaceutical technology platform. Trends in Pharmaceutical Sciences. 2019;5(1):25-40.
55. Jain S, Tripathi S, Tripathi PK. Invasomes: Potential vesicular systems for transdermal delivery of drug molecules. Journal of Drug Delivery Science and Technology. 2021;61:102166.