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Ufasomes: Rising Technology For Delivery of Drugs

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ABSTRACT

In a vesicular drug delivery system, one or more concentric bilayers of amphiphilic molecules cover an aqueous compartment. They are an excellent distribution method for targeted medication administration because of their ability to localise drug activity to the area or organ of function. The vesicular drug delivery system maintains the drug activity at a constant rate. As a consequence, the body's opioid frequency is maintained while unfavourable side effects are reduced. Unsaturated fatty acid vesicles are known as ufasomes. With a pH range of 7 to 9, they're pH-controlled suspensions of closed lipid bilayers made up of fatty acids and their ionised species (soap). Fatty acid vesicles are often made using the lipid film hydration technique. Oleic acid is the most significant fatty acid utilised as a primary component in the production of ufasomes. This study discusses the advantages, disadvantages, possible development, and categorization of ufasomes.

Key Words: Ufasome, Vesicular Drug Delivery System, Fatty Acid Vesicles, Development, Characterization, Applications

INTRODUCTION [1]

When an evaporated film is mechanically agitated in the presence of a buffer solution, ufasomes form, which are vesicles made up of long-chain unsaturated fatty acids. Colloidal suspensions of fatty acids and their ionised forms are known as fatty acid vesicles. It's an efficient way of getting medications to the infection site, resulting in reduced opioid toxicity and adverse effects. The creation of vesicular systems, such as liposomes, has been studied as a technique to localise drugs at their sites of action and increase the penetration of biologically active components into tissues. Liposomes are made up mostly of phospholipids. Pure manufactured phospholipids are not yet accessible in substantial quantities, and natural phospholipids are chemically varied. The availability of fatty acids is ufasomes' primary advantage over liposomes. Unsaturated fatty acids like oleic acid and linoleic acid, as well as saturated fatty acids like octanoic acid and decanoic acid, may form fatty acid vesicles.

The skin is a well-known route for delivering bioactive chemicals to specific locations. However, since it acts as a physical barrier between the body and the outside environment, opioid penetration via this channel is challenging. In the top layers of the skin, the stratum corneum, which comprises of corneocytes surrounded by lipid areas, serves as the main physical protection. A number of penetration enhancers may be employed to ensure effective and efficient topical medication delivery. The basic purpose of injecting drugs into the skin to treat skin problems is to produce local outcomes at or around the injection site. Traditional formulations such as creams, gels, and ointments suffer from dermatopharmacotherapy (limited local activity). A variety of ways have been investigated to increase the penetration of the bioactive moiety into the skin and further localise the therapy at the site of action, including the formation of vesicular structures such as niosomes, liposomes, and ufasomes.

Ufasome is a novel way to improve opioid absorption through the skin. Unsaturated fatty acids like linoleic and oleic acids are employed as natural permeation enhancers in the production of ufasomes. Surfactants are often used with fatty acids to improve skin flexibility and medication transport through the skin membrane. For a long period, ufasomes increased drug retention qualities within the cell membrane of skin cells.

The ufasomes are fatty acid vesicles. Membrane fatty acid hydrocarbon tails are oriented towards the membrane interior, whereas carboxyl groups are in contact with water, generating

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a bilayer structure. Ufasomes are soapy suspensions of closed lipid bilayers, mostly fatty acids. They usually stay between 7 and 9 on the pH scale.

ADVANTAGES [2]

1. Increases the amount of time a medicine spends in systemic circulation while lowering toxicity.
2. Because the drug is delivered directly to the source, it may be absorbed selectively.
3. Improves bioavailability, particularly for poorly soluble medicines.
4. Hydrophilic or lipophilic medicines may be incorporated into ufasomes.
5. Delays the removal of fast metabolizable substances, acting as a continuous release mechanism.
6. The chemical will immediately penetrate if administered topically.
7. Ufasomes are less expensive than liposomes and niosomes because fatty acids are widely available.
8. The entrapment quality of the medication is satisfactory.

GENERALIZED WAY OF FORMATION [3]

Only non-oxidized components are utilised in the production of ufasome. The stock solutions of oleic and linoleic acids in chloroform containing 10% oleic and linoleic acids are produced and treated at 20°C. In most cases, 0.02 ml of the stock solvent is evaporated in a test tube using a water pump, then dried with a nitrogen spray. The fatty acid layer is entirely broken up in 0.2 ml of 0.1 M tris-hydroxymethyl aminomethane buffer, pH 8–9, after strong spinning on a vortex blender. This process produces ufasome suspensions that are stable for at least 24 hours. Particles are created using an ultrasonic generator with a titanium microtip in several researches. A stream of nitrogen is employed to expel air from the buffer during irradiation, and the suspension is blanketed with the gas. An ice bath aids in maintaining a steady temperature.

METHODS OF PREPARATION [4]

Thin Film Hydration Method

In this mechanism, vesicle formation happens in a narrow pH range. In a flask with a circular rim, fatty acid is mixed with an organic solvent. This method demands a high concentration of fatty acids. Before the organic solvent has completely evaporated, the liquid is evaporated. Finally, a thin fatty acid layer is formed and hydrated using a pH-appropriate buffer.

By Addition of Alcohol

In this procedure, adding an alcohol with the same chain length as the fatty acid leads in the formation of fatty acid vesicles. The key advantage of this technology is that the fatty acid vesicles are stable throughout a wide pH range. The formation of vesicles may be enhanced in the presence of pre-added fatty acid vesicles and liposomes. Because this procedure takes a long time to complete, this saves time.

Autopoetic Process

When an aqueous fatty acid solution is added to a water-buffered solution, fatty acid vesicles form due to the random pH transition. There is a chance that vesicles will form when half of the carboxylic acids in a fatty acid ionize. The hydrocarbon chain creates a bilayer arrangement opposing the aqueous compartment, which reduces the amount of water it comes into contact with.

KEY ISSUES IN MANUFACTURING OF UFASOMES [5]

Selection of fatty acid

12 to 22 carbon fatty acids seem to be ideal for the production of stable ufasomes, based on studies of natural membrane phospholipids and information from pressure region measurements on fatty acid surface films. In truth, the bulk of the study was focused on C-18 acids since they showed the greatest promise in early experiments. Only oleic acid (cis-9-octadecenoic acid) and linoleic acid (cis-9,12-octadecenoic acid) formed membranes, allowing ufasomes to meet these criteria. Palmitic acid is tolerated up to 33% by weight in an oleic acid membrane, whereas stearic acid is tolerated up to 5% by weight. The preparations were unaffected by charging the membrane with modest quantities of oleic, linoleic, or stearic acid amides. Oleic acid remained uncontaminated by peroxides for at least 6 weeks, although linoleic acid generated considerable peroxide within 2–3 weeks, according to stability studies.

Addition of cholesterol

In lipid vesicles, cholesterol has the rare ability to alter membrane fluidity, elasticity, and permeability. It basically fills in the gaps left by the incomplete packing of other lipid molecules. The capacity of vesicles to hold solute quickly decreases in the presence of increasing cholesterol concentrations. Furthermore, at whatever cholesterol content, there is no increase in membrane impermeability. Researchers compared glucose leakage from ufasomes with 17 percent cholesterol included by weight to leakage from spheres with 17 percent cholesterol incorporated by weight. Glucose leakage from vesicles with 17 percent additional cholesterol was greater than glucose leakage from cholesterol-free oleic and linoleic acid ufasomes, according to their results.

pH

Only in a certain pH range (7–9), when nearly half of the carboxylic groups are ionised, can fatty acid vesicles form. Below this range, fatty acids form unstructured precipitates, but beyond this range, they are excessively soluble. A titration curve of the oleic acid/oleate technique will identify three zones for micelle, vesicle, and oil droplet production at an 80 mM total concentration. At higher pH, micelles (which have a larger ratio of ionized to protonated molecules) are the major aggregation species, while oil droplets develop at lower pH. Fatty acid vesicle systems are significantly easier to distinguish at concentrations just slightly higher than the critical vesiculation concentration, or CVC, at which vesicle production is seen. At the necessary vesiculation concentration, monomers and nonvesicular aggregates form a bilayer structure, generating colloidal vesicle suspensions. It's also worth mentioning that diluting a fatty acid micellar solution to neutral pH causes the vesicles to form in a random pattern with a wide size variation.

Selection of buffer

A typical ufasome preparation buffer is tris hydroxymethyl aminomethane. On the other hand, spheres are formed by borate, glycine-hydroxide, and bicarbonate solutions. The buffer used is determined by the kind of solute to be included. For example, ufasomes made in bicarbonate did not entrap glucose in vesicles, whilst borate preparations could not be examined for retention owing to the formation of a glucose buffer complex. Because the appropriate weight of buffer for tris must match the weight of fatty acid used to shape membranes, 0.1 ml of 0.1 M tris at pH 8 is required to produce ufasomes from 1 milligramme of fatty acid.

Electrolyte

Most electrolytes prevent the formation of ufasomes. After stabilizing the spheres in the necessary buffer, they may be exposed to phosphate or chloride solutions while keeping the occluded glucose.

Peroxidation

Peroxidation disrupts the natural bilayer structure of fatty acid molecules, which is the principal effect of peroxidation on ufasome membranes. The inside of the hydrophobic membrane is deformed by peroxidation of a bulky hydrophilic group, allowing water-soluble molecules to transit more freely. The manner of preparation may have a big impact on the degree of fatty acid peroxidation. Peroxidation did not develop during the few time required for hand vortexing. Linoleic acid oxidized at 0.1 percent per minute in air-saturated buffers when exposed to 30-W irradiations during a more severe ultrasonic re-suspension. Because the maximum exposure duration was 3 minutes, this technique could not accomplish substantial oxidation of even oxidation prone linoleic acid. However, butylated hydroxytoluene, nitroxide radicals, and alpha-tocopherol were shown to be resistant to linoleic acid membrane peroxidation by Hicks and Gebicki.

Divalent cations

Enzymatic and non-enzymatic catalytic mechanisms are involved in lipid peroxidation (LPO). Nonenzymatic lipid peroxidation depends strongly on transition metal ions. Just a few metals that experience a valency shift requiring a single electron transfer will catalyze quick peroxidation in unsaturated lipids. Lipid peroxidation has been shown to be influenced by non-variable valence state metals such as magnesium, calcium, and zinc, which cannot participate in redox-coupled homolysis. Calcium ions have a biphasic influence on LPO, which implies that they may both activate and suppress the enzyme. Researchers looked at calcium's biphasic activity in liposomes and ufasomes. In the presence of ascorbate or hydroperoxide, as well as Fe^{2+}, LPO was induced in liposomes and ufasomes. Ca^{2+} induced LPO in lipid by interfering with negatively charged lipid groups (phosphate groups of lecithin, carboxyl groups of linolenic acid), displacing bound Fe^{2+} ions and the concentration of free Fe^{2+} ions, which engage directly in LPO catalysis, at low concentrations (10^{-6}-10^{-5}). Ca^{2+} based inhibitory activity was dependent on its association with superoxide anion radicals at high concentrations (10^{-3}). Other cations with large charge density are also capable of releasing Fe^{2+} ions attached to negatively charged groups of lipids and reacting with superoxide free radicals, but it's not only Ca2+ ions that have this biphasic effect on LPO. In the absence of Ca^{2+} ions, it was discovered that adding La^{3+} ions to linolenic acid ufasomes at a concentration equivalent to Fe^{2+} ions stimulated LPO. On the combined activity of equimolar concentrations of Ca^{2+} and La^{3+} (when their overall concentration surpassed that of Fe^{3+}), an impact of inhibition of linolenic acid peroxidation was detected.

CHARACTERIZATION OF UFASOME [6]

Particle Size and Size Distribution

A particle size analyzer is utilized at a fixed angle of 90 degrees and at 25 degrees Celsius to measure the average diameter and size distribution of ufasome suspensions using Photon Correlation Spectroscopy. After being diluted with phosphate buffer, the suspensions were passed over a polycarbonate membrane (pH 7.4). This is done to decrease particulate matter interference till sizing.

Shape and Surface Morphology

The morphological features of sphericity and accumulation of drug-loaded ufasomal dispersion may be studied using

transmission electron microscopy (TEM). On a carbon film-covered copper grid that has been negatively stained with 1 percent phosphotungstic acid, one drop of the selected ufasomal dispersion may be tested. The sample is then allowed to dry at room temperature for 10 minutes before being TEM inspected.

Differential Scanning Calorimetry

Scanning in Differential Mode, the physical state of the material inside the oleic acid vesicles is investigated using calorimetry. The vesicles were scanned at a rate of 2°C/min in a conventional aluminum pan.

Entrapment Efficiency

The drug's entrapment efficacy may be calculated by ultracentrifugation at 25000 rpm for 3 hours at 4°C. The entrapment effectiveness of the supernatant may be measured using UV spectroscopy. The following equation can be used to calculate the volume of the entrapped drug as a percentage:

Entrapment efficiency (%) = (Amount of drug added initially - Amount of drug determined in the filtrate spectrophotometrically) / Amount of drug added initially × 100

In Vitro Drug Release

The goal of this study is to evaluate the drug's ufasome release rate and kinetics. This might be done using Franz diffusion cells. The Franz diffusion cell has two compartments: a donor compartment and a receptor compartment. These two compartments are separated by a polycarbonate membrane with a pore size of 50 nm. The donor compartment held 1 mL of ufasomal dispersion, whereas the receptor compartment contained PBS, pH 7.4, maintained at 37°C and swirled at a constant pace using a magnetic stirrer. At regular intervals, aliquots of samples are collected and replaced with equivalent quantities of fresh PBS (pH 7.4).

pH-Dependent Stability

The influence of pH on stability and drug release activity was examined by incubating optimised vesicular dispersion with buffers of pH 8.5, 7.4, 6.5, and 5.5. The samples are collected at predefined intervals and centrifuged for 30 minutes at 14,000 rpm. The free medicine generated may be tested using the supernatant. The following method can be used to measure the volume of drug that has been leached:

% Drug diffused = Amount of free drug / Total drug × 100

DYNAMIC NATURE OF UFASOMES [7]

One of the most notable properties of fatty acid vesicles is their complicated existence, which is due to the fact that they are made up of single-chain amphiphiles. Fatty acid vesicles differ from traditional vesicles made of double-chain amphiphiles and micelles made of single-chain surfactants due to their dynamic properties. The fact that the protonation/ionization ratio of the terminal carboxylic acid may be altered to form a variety of fatty acid aggregates. The kinetics of ufasome formation are being studied by scientists. To investigate the formation kinetics of micelles and vesicles from a saturated fatty acid/soap monomer solution, researchers utilised a cellulose acetate membrane to dilute fatty acid/soap monomers. The rate of reaching equilibrium was investigated starting with an asymmetric distribution of fatty acid/soap molecules between two chambers separated by the dialysis membrane, one containing aggregation (micelles or vesicles) and the other containing just the buffer solution. Micelles developed in the diffusate chamber, and fatty acid and soap concentrations in both chambers were same. The achievement of balance in the case of vesicles, on the other hand, was significantly hampered (the concentration in the diffusate increased very slowly after the solution was saturated with monomers). The number of amphiphiles in vesicles is usually much higher than in micelles. Creating fatty acid vesicles has a far greater energy barrier than forming fatty acid (soap) micelles, according to the results of dialysis research using fatty acid vesicles. A basic way of creating fatty acid vesicles is to add an alkaline soap solution to an intermediate pH buffer solution. As a condensed solution of sodium oleate micelles is introduced to a pH 8.5 buffered solution, oleic acid/sodium oleate vesicles develop spontaneously when the pH lowers from about 10.5 to 8.5, causing partial protonation of the oleate molecules. The size and lamellarity of the vesicles generated are polydisperse. When alkaline micelles are introduced to buffered vesicles, fatty acid vesicles develop spontaneously.

STABILITY CONSIDERATION IN UFASOME FORMULATION [8]

The reduction of the fatty acid-water system's free energy is critical for the long-term survival of ufasome membranes. The membrane does not develop spontaneously because the acids begin a separate stage at pH 8. However, under the correct circumstances, even mild mechanical agitation is sufficient to trigger bilayer formation. A major portion of the energy freed in this phase is due to the increased entropy of water caused by the hydrophobic interactions of the directed hydrocarbon chains. The tempting contact is reversed by mutual repulsions of the ionised carboxyl head groups in the bilayer. Electrolytic dissociation lowers the fatty acid films' resiliency, which might lead to rupture. By reducing the degree of head group dissociation, establishing stable complexes between protonated and ionized carboxyl headgroups, or decreasing the degree of head group dissociation, screening counter ions minimize charge repulsion. Any of these processes might be involved in the stability of

the ufasome membrane. Lowering the pH at the particle surface minimizes lateral charge repulsions, which is good for membrane stability. Reduced ionization improves membrane stability in many circumstances. To begin with, protonated molecules, unlike anions, are essentially insoluble in water. Second, lateral head group repulsion is decreased; when the second charge is removed from a film of densely packed head groups, the average space between them increases by roughly 40%, halving coulombic repulsions. Third, protonated acid molecules (AH) and anions (A^-) form a series of tightly bonded complexes, with the 1:1 complex being the most common. The energy for binding is made up of free energy changes caused by hydrophobic contacts, the entropy of demixing connected with dimer formation, and a free energy decrease caused by the creation of hydrogen bonds between protonated and ionized carboxyl groups. Studies of interactions in dicarboxylic acids have shown that very strong hydrogen bonds form between COOH and COO groups due to the presence of a negative charge near the hydrogen implicated in bonding. The stability of ufasome membranes is caused by head group hydrogen bonding with water, complex formation of ionized and neutral acid molecules, and hydration of dissociated carboxyl groups. The same dispersion and hydrophobic interactions that bring micelles and membrane interior areas together also maintain fatty acid hydrocarbon regions together.

MICROSCOPIC STUDIES [9]

The arrangement of biological membrane components such as fatty acids and phospholipids was revealed by electron microscopy of sectioned vesicular structures. However, it was widely assumed that the necessary fixing and staining required strong chemicals, which might cause deformation of these delicate structures, leading to loss of definition and the fabrication of objects. To alleviate such concerns, less abrasive procedures might be utilised. One of the most successful approaches for dealing with natural components is freeze-fracture. The procedure of detecting birefringence is significantly gentler. Negatively stained specimens used to study the structure of the ufasome did not survive the preparing stages, according to electron microscopy. Both efforts to use neutralised potassium phosphotungstate to stain ufasomes for electron microscopy failed to produce specimens with any interior structure.

Freeze fracturing and etching

The ufasome suspension is then equilibrated with 17 percent glycerol for 10 minutes before being frozen. The ufasome suspensions are then immediately frozen in copper helmets with Freon before being kept under liquid nitrogen. In a Balzers microtome, fracturing takes occur at 110°C and 2×10^{-6} Torr pressure. For etching, the temperature is raised to 100°C for 1 minute. Following cutting, a layer of platinum and carbon is deposited at a 45° angle on the fracture face, with a thickness of 3 nm. Floating replicas off the metal helmet into water, which is then combined with methanol until the solution is 80 percent alcohol, is the most effective method to wash them. In 30 minutes, both fatty acid indications were gone. The copies are then examined using a Hitachi HS8 electron microscope. According to the researchers, the appearance of ufasomes made from oleic or linoleic acids did not differ. Due to the high amount of water in ufasome preparations, ice made up a large part of the freeze broken face, which had an uneven surface. Etching the surface, particularly if the ufasomes had been pre-equilibrated in glycerol, resulting in a clear separation between the ice and the particle surface. The fatty acids' visible exterior and interior surfaces are smooth, but the underlying ice is usually granular. The space between the membranes is also rough, indicating that it was formerly full of water.

Birefringence

The variance in birefringent particle frequency might be explained by the high range of inter-membrane lengths reported in ufasomes. In multi-lamellar particles, the intrinsic variable of the different forms of birefringence is generally positive or negative in sign. A positive "sign" component is produced by perpendicular alignment of lipid molecules to the membrane surface, while a negative "form" component is produced by parallel alignment of nearby membranes. As the distance between neighboring membranes widens, the amount of birefringence decreases. Freeze-etched ufasome preparations demonstrated that irregular multi-membrane particles or huge water-filled spheres are much more typical than symmetrical particles with strong birefringence.

RECENT INNOVATIONS IN CONVENTIONAL UFASOMES [10]

Because of concerns concerning carboxylic acid vesicles' colloidal stability, ufasome applications in medication delivery are mostly unexplored. Several recent studies, however, have shown that employing novel types of fatty acids or blended structures of various surfactants may improve medication dispersion.

New Type of Fatty Acids

Between pH 8.5 and 9, the fatty acid cis-4,7,10,13,16,19-docosahexaenoic acid (DHA) self-assembles into vesicles.

Extension of The pH Range

A limited pH range is typically appropriate for the production of fatty acid vesicles since about half of the carboxylic acid must be ionized. However, by using the following unique ways, the pH spectrum may be expanded.

a) ***Amphiphilic additives, such as linear alcohols or a surfactant containing a sulfate or sulfonate head group***

Vesicles are made using decanoic acid and decanoate type combinations at a pH of 6.4 to 7.8, while the pH for vesicle production may be decreased to at least 4.3 by adding sodium dodecylbenzene sulfonate (SDBS).

b) ***Alter the scale of the hydrophilic head group of fatty acids synthetically***

It has been shown that fatty acids having an oligo (ethylene oxide) unit intercalated between the hydrocarbon chain and the carboxylate head group increase vesicle stability at lower pH. A large polar community has two effects: it decreases the phase transfer temperature and the pH range in which vesicles may form.

Insensitivity toward Divalent Cation

Divalent cations like Mg^{2+} and Ca^{2+} cause vesicle precipitation even at low concentrations. To stabilize fatty acid vesicles in the presence of ionic solutes, fatty acid glycerol esters may be added.

Enhancement of Stability by Cross-linking Fatty Acid Molecules by Chemical Bonds

A fatty acid (soap) containing a polymerizable moiety (e.g., sodium 11-acrylamidoundecanoate: SAU) may be utilized to increase the consistency. It was revealed that polymeric SAU vesicles may self-assemble into vesicular aggregates and are stable at high temperatures.

Mixture of Fatty Acid Vesicle and Surfactant-Based Vesicles

A model framework for mixed vesicles is tetradecyltrimethylammonium hydroxide (TTAOH) and fatty acids. When about equal quantities of TTAOH and fatty acid were mixed, unilamellar, and multilamellar vesicles were formed.

APPLICATION OF UFASOMES [11]

Drug-loaded ufasomes may be used to administer a variety of medicinal medicines transdermally. Transdermal distribution has been employed for anti-inflammatory, anti-fungal, anti-osteoarthritic, anti-cancer, and other drugs loaded in ufasomes.

Anti-fungal Drugs

To overcome the drawbacks of conventional formulations, such as allergic responses and limited penetration capability, novel formulations such as niosomes, liposomes, ethosomes, microemulsions, and micelles have been developed for transdermal distribution of these drugs. Ufasomes are more advanced gadgets that were created expressly for this purpose. The drug released from the ufasomal dispersion was maintained, according to an *in-vitro* drug release study. In-vivo testing confirmed a five-day drug release from ufasomes. This shows that, unlike other commercially available formulations, it is suitable for long-term treatment.

Anti-cancer Drugs

5-fluorouracil (5-FU) has been approved by the US Food and Drug Administration for use as a topical treatment for basal cell carcinoma (BCC). The marketed formulation has been linked to itchiness, eczema, redness, and a lack of skin penetration. Ufasomes are utilized to decrease side effects since the drug is encapsulated inside the vesicles. They have the ability to boost opioid penetration while also delaying the release of drugs. In the refrigerator, the fatty acid vesicles remained mostly intact. According to *ex-vivo* skin penetration studies, the fatty acid vesicles entered the stratum corneum and stored the material in the epidermal layer of the skin.

Anti-inflammatory Drugs

The initial step of treatment for rheumatoid arthritis (RA) is the use of non-steroidal anti-inflammatory drugs (NSAIDs). To prevent or reduce joint damage, slow-acting disease-modifying antirheumatic medications (DMARDs) have lately been suggested for the early treatment of RA. The amount of medication penetrated through rat skin was three to four times more when fatty vesicles were employed instead of plain drug solution or carbopol gel. A skin penetration experiment shows that up to 50% of the injected amount is detected in the skin when fatty acid vesicles are utilized. As a consequence, using this technique may aid in the reduction of RA inflammation. The transdermal penetration was found to be 4.7 times larger when fatty acid vesicular gel was coupled to pure medication gel. There was a considerable reduction in edoema when the fatty acid vesicular gel was connected to the same amount of commercial product. As a consequence, fatty acid vesicles-based medicine gels may be more effective than commercially available gels in treating inflammation.

Anti-osteoarthritic drugs

Collagen and proteoglycans are necessary for joint regeneration and the formation of synovial fluid, which lubricates the joints. Supplementing with glucosamine encourages the body to produce them. As a result, glucosamine has long been advised for osteoarthritis treatment. As a consequence, to control osteoarthritis, glucosamine sulfate fatty vesicles are packed and dispersed in carbopol gel for topical administration. The medication concentration in the vesicle-based gel was found to be six-times greater in rodents than in the standard carbopol gel. The drug was also routinely published on a fatty acid vesicle gel. As a result, this formulation might be employed as a depot treatment for osteoarthritis.

CONCLUSION

Ufasomes are fatty acid-based suspensions of closed lipid bilayers with a pH range confined to a specified range. In ufasomes, fatty acid molecules' hydrocarbon tails are oriented against the membrane interior, while the carboxyl groups are in contact with water. Factors such as fatty acid selection, cholesterol amount, buffer, pH variation, and others influence the stability of ufasome formulation. Ufasomes have a lot of therapeutic potential and may be utilized to treat a variety of skin conditions. Swelling, itching, and other allergic responses on the skin may be reduced since the drug is released in a regulated or extended manner. Fatty acid vesicles have also been demonstrated to be especially helpful in the treatment of skin problems in circumstances such as AIDS due to the medication's regulated release. Ufasomes are a preferable option to liposomes for topical drug administration because of their reduced cost, faster penetration capacity, and robust entrapment performance.

CONFLICTS OF INTEREST

No conflict of interest is declared.

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