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Study of surfactant and their use in drug delivery

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Abstract

The previous ten years has been observer to another stimulus in surfactant self-get together articles as specialists for drug conveyance that are an option to micellar, lamellar (liposome, niosome and transfersome) or microemulsion-based vehicles. The audit focuses on the utilization of polymeric micelles as drug transporters. Micellization of naturally dynamic substances is an overall peculiarity that expands the bioavailability of lipophilic medications and supplements. At present utilized low-sub-atomic weight drug surfactants have low harmfulness and high solubilisation power towards inadequately solvent drugs.

Keywords: surfactant, drug, polymeric micelles, lipophilic medications

Introduction

Different medication conveyance and medication focusing on frameworks are right now evolved or being worked on. Among drug transporters one can name dissolvable polymers, microparticles made of insoluble or biodegradable regular and engineered polymers, microcapsules, cells, cell apparitions, lipoproteins, lipo-somes, and micelles(1). Micelles as medication transporters can give a bunch of unsurpassable benefits - they can solubilize ineffectively dissolvable medications and in this way increment their bioavail-capacity, they can remain in the body (in the blood) long enough giving continuous amassing in the re-body areas with cracked vasculature. Surfactant phase structures have piqued the interest of pharmaceutical scientists over the years, either as drug vehicles/carriers or, more recently, as targetting systems. In the first case, the surfactant system plays no role in the biodistribution of the medication it transports, instead functioning just as a carrier. The surfactant system in the second case 'conveys' the drug to the desired (or target) site in the body and deposits it in some way. Targeting can take one of two forms; namely ‘passive’ targeting which relies on the natural biodistribution of the carrier, or ‘active’ targeting in which the carrier is in some way directed to the desired site, frequently by the use of targeting ligands expressed on the surface of the carrier. The micelle is designed in such a manner that the micelle's exposed outer surface in the aqueous environment is made up of components that aren't reactive with blood or tissue components.(2) Micelles can linger in the blood (tissues) for a long time without being identified by proteins and/or phagocytic cells due to this structural characteristic. This longevity is an extremely important feature of micelles as drug carriers.

Surfactant uses and development

Surfactants are commonly utilised in pharmaceutical formulations as wetting agents to aid in the dissolving and absorption of poorly soluble medicines. For this, reasonable and low molecular weight ionic surfactants, such as sodium lauryl sulphate, are utilised

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in concentrations that are safe for the intestinal mucosa. Previous research has found that ionic surfactants are considerably more damaging to biological membranes than non-ionic surfactants (3). Furthermore, lipophilic non-ionic surfactants dissolve poorly soluble moieties better than ionic surfactants. Non-ionic surfactants are thus more efficient in the dissolving of poorly soluble medicines than ionic surfactants. Non-ionic surfactants are highly effective emulsifiers for use in self-emulsifying medication delivery systems. Surfactants can be found in both natural and synthetic forms. Natural amphiphiles such as lipids and glycerol-based surfactants, are the major standard surfactants. Solans & Kunieda (4) state that they are an important component of the cell membrane. When animal and vegetable oils were mixed with alkaline salts, a soap-like substance was created, which might be useful in the treatment of skin diseases and for washing(5). Synthetic surfactants are being used in a variety of production processes and compositions (6).

A Pulmonary surfactant

A Pulmonary surfactant substance that covers the whole mammalian lung surface is referred to as pulmonary surfactant. It is synthesised by type II pneumocytes and secreted into the thin aqueous layer bordering the alveolar surface in the form of multilamellar structures, as previously stated (7). Its major goal is to keep the surface tension at the air–liquid interface below 2 mN/m, avoid pulmonary collapse during expiration, and limit the amount of labour required for inhalation. To keep breathing going, pulmonary surfactant is required. Surfactant deficiency or malfunction inhibits the alveoli from functioning properly, resulting in serious lung illnesses (8), such as Infant Respiratory Distress Syndrome (IRDS) or Acute Respiratory Distress Syndrome (ARDS), all of which are linked to lung damage. The phrase "polymeric carrier" refers to a polymer-based delivery system that may entrap and carry molecules of interest. They can be made of synthetic materials like polyesters or natural materials like alginate or chitosan (9,10). Synthetic polymers are favoured in principle because those originating from animal or vegetal sources may provide a risk of infection and immunogenicity.

Surfactant source

Bronchoalveolar lavage has been used in the majority of surfactant composition research (11). The same lipid and protein components are found in human and other mammalian species (12,13), albeit the amounts of different lipid classes vary somewhat, perhaps due to methodological differences. Many of the major lipids present in mammals can also be detected in the lungs of air-breathing shes (14), suggesting that 'pulmonary' surfactant has a long past.

Niosomes

Niosomes are an unique drug delivery technology that encapsulates the medication in a vesicle. Niosomes are vesicles that are made up of a bilayer of non-ionic surface active substances. The niosomes are very tiny and microscopic. In the same way as liposomes are formed up of a bilayer, niosomes are also. In the case of niosomes, however, the bilayer is made up of non-ionic surface active molecules rather than phospholipids, as in the case of liposomes. Most surface active chemicals produce micellar structures when submerged in water, however certain surfactants can produce bilayer vesicles, which are niosomes.

Depending on the method used to prepare them, niosomes can be unilamellar or multilamellar. The niosome is composed of a surfactant membrane with hydrophilic ends facing each other on the outside and interior of the vesicle, and hydrophobic chains facing each other within the membrane.(15) The majority of anticancer medications have serious adverse effects. Niosomes have the ability to change metabolism, extend medication circulation and half-life, and thereby reduce pharmacological adverse effects.(16)Niosomes cause a slower rate of tumour development and greater plasma levels, as well as longer clearance.

Advantages of Niosomes (17-20)

- Use of niosomes in cosmetics was first done by L'Oreal as they offered the following advantages
- The vesicle suspension being water based offers greater patient compliance over oil based systems.

- Since the structure of the niosome offers place to accommodate hydrophilic, lipophilic as well as amphiphilic drug moieties, they can be used for a variety of drugs.
- The characteristics such as size, lamellarity etc. of the vesicle can be varied depending on the requirement.
- The vesicles can act as a depot to release the drug slowly and offer a controlled release.

Application of Niosomes (21-24)

- It's used to target drugs.
- It is used to treat anti-neoplastic diseases such as cancer.
- Sodium stibogluconate is used to treat Leishmaniasis, which includes both dermal and mucocutaneous infections.
- It serves as a vehicle for the delivery of peptide drugs.
- It's utilised to research immune responses.
- Niosomes as Hemoglobin Transporters
- Niosome-based transdermal drug delivery systems
- It's employed in the delivery of ophthalmic drugs.

Surfactant-Templated Mesoporous Silica Nanoparticles

As anticancer drug delivery methods, three kinds of surfactant-templated mesoporous silica nanoparticles (Surf@MSNs) with diameters of 150–660 nm were produced. High drug (surfactant) loading capacities, prolonged drug (surfactant) release patterns, and high and long-term anticancer effectiveness are all features of the Surf@MSNs.(25)

It is well known that mesoporous silica nanoparticles (MSNs) possess some excellent properties such as facile multifunctionalization, excellent biocompatibility and biodegradability, high specific surface area and pore volume, tunable pore structures and excellent physicochemical stability (26-29). Because of its rising uses in nanomedicine and biotechnology, mesoporous silica nanoparticles (MSNs) have got a lot of attention (30-33). Materials like MSN which are having high surface area and good pore volume have been studied as one of the important application in area of drug delivery devices.

MSNs materials were synthesised by using following procedure which was previously published with some modifications in literature.(34-35) .

Briefly, the structure directing agent, PMES, (0.213 g, 0.5 mmol) was dissolved in 100 mL of nanopure water which was stirred vigorously at 80 0C for one hour. After that, APTMS was added slowly dropwise into above solution which was later followed by the addition of TEOS (1 mL, 4.5 mmol) at the rate of 20 mL/h. Structural properties of MSNs were modified by using different molar ratios of APTMS and PMES.

Conclusion

Lipid and surfactant based drug delivery systems are promising approach for improving bio-availability of poorly soluble drug compound. Niosomes have been proven to be useful in the delivery of anti-infective agents, anti-cancer agents, anti-inflammatory agents and fairly recently as vaccine adjuvants.

In choosing a suitable drug to be delivered by niosomes, it should be borne in mind that niosomes encapsulating hydrophobic drugs and macromolecules are more stable than niosomes encapsulating low molecular weight drugs.

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