



Proniosomal Gel: A novel drug delivery

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Abstract

Different types of drug delivery systems are intended to deliver therapeutic agents to the appropriate site of interest to get desired pharmacological effect. In the field of drug delivery, the advancement of nanotechnology helps to develop novel dosage forms like proniosomes. They are dry formulation of water-soluble carrier particles that are coated with surfactant. They are rehydrated to form niosomal dispersion immediately before use on agitation in hot aqueous media within minutes. Proniosomes are physically stable during the storage and transport. Drug encapsulated in the vesicular structure of proniosomes prolong the existence of drug in the systematic circulation and enhances the penetration into target tissue and reduce toxicity. This article reviews provesicular drug delivery systems with a focus on composition, preparation, the mechanism of drug delivery, encapsulation of the drug into provesicles and characterization techniques.

Keywords: Provesicles, proniosomes, novel drug delivery, non-ionic surfactant, transdermal drug delivery, toxicity

Introduction

In recent times, no single drug delivery system fulfils all the criteria, but attempts have been made through novel approaches. Many novel approaches emerged covering various routes of administration, to achieve either controlled or targeted delivery. The prime aim of novel drug delivery is maintenance of the constant and effective drug level in the body and minimizing the side-effects and it also localizes the drug action by targeting the drug delivery by using drug carriers. Drug delivery systems using colloidal particulate carriers such as liposomes or niosomes have distinct advantages over conventional dosage forms because the particles can act as drug-containing reservoirs. The use of non-ionic surfactant vesicles as drug carrier systems has distinct advantages over conventional dosage. They can increase the drug efficacy, reduce drug side effects, increase the drug solubility, and develop an effective topical delivery

Proniosomes improve effectivity, scale back or eliminate adverse effects and enhance therapeutic actions of medicine. They are accustomed to avoid gastrointestinal tract (GIT) incompatibility, pre-systemic metabolism, and unwanted adverse effects related to oral delivery. Additionally, they maintain therapeutic levels of drug for an extended time, decrease the frequency of administration and improve patient compliance.

Delivery of drugs using colloidal particulate carriers such as Proniosomes are dry, free-flowing preparation coated with a surfactant. To form a multi-lamellar niosome, Proniosomes are rehydrated directly within minutes by transient agitation. Niosome suspension is appropriate for giving medication by different routes. They are promising candidates for industrial application as they can transport, distribute, store and process easily. So, Proniosomes can be another option to liposomal and other vesicular drug delivery systems for the entrapment of each polar and non-polar medication.² Proniosomes improve effectivity, scale back or eliminate adverse effects and enhance therapeutic actions of medicine.

Pros

Proniosomes does not demand any unique environments for storage conditions. They are substantially stable in comparison to niosomes and elementary to handle, store and transport. Proniosomes is dimensionally identical. Also, proniosomal preparations avoid inappropriate solvents.

Proniosomes offered enhanced bioavailability with lesser side effects and encapsulated with water-soluble and lipid-soluble drugs. Proniosomes is the harmonious carrier with the ideal property of decomposable, compatible with the skin. Proniosomes is a flexible drug delivery system formulated with a broad range of drugs and a potential number of active constituents

Structure

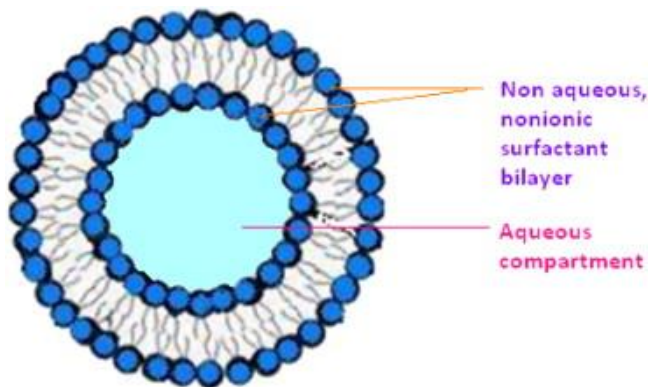


Fig 1: Structure of proniosomes

Proniosomes are microscopic lamellar structures. They combine a non-ionic surfactant of the alkyl or dialkyl polyglycerol ether class and cholesterol followed by hydration in aqueous media. The surfactant molecule directs themselves such that the hydrophilic ends of the non-ionic surfactant orient outward, while the hydrophobic ends are in the opposite direction to form the bilayer. Surfactant especially non-ionic surfactant is the key structural component in the preparation of Proniosomes. These surfactants do not have any charge as they possess a polar head and non-polar tail. So, their stability, toxicity as well as compatibility is higher than other surfactants. The non-ionic surfactants have wetting and emulsifying effects by which they improve the solubility and permeability of drugs. HLB value is very important for the selection of surfactants and HLB Value between 4 and 8 is compatible with vesicle formation by Proniosomes. It is difficult for hydrophilic surfactants to achieve a high concentration because of the high liquid solubility of hydrophilic surfactants. Therefore, aggregation and conglutination to form proniosomal lamellar structure would be absent.

Drug transport through the skin

The research study carried out on the transdermal application of pro-vesicles, the results are inconsistent. The variables that affect the vesicle skin interactions are not evident, but entrust the remarkable part of evaluating the effectiveness of drug transport through the skin. If a drug loaded in proniosomes for the release of the drug, it should be hydrated to form niosomes. Thermodynamic activity between the vesicles and corneum drives the permeation of fat-soluble drugs through the corneum. The above interaction encompasses structural modifications in the legitimate character of the skin.

Components and its effect on proniosomes

Proniosomal gel comprises various ingredients such as surfactants, phosphatidylcholine, cholesterol, alcohol and aqueous phase.

1. Surfactants: Non-ionic surfactants are the best choice

of surfactants for the preparation of proniosomes and since it possesses the ability to enhance solubility, which helps in increasing the bioavailability of less water-soluble drugs

- 2. Phosphatidylcholine:** Phosphatidylcholine is a phospholipid and it extracted from lecithin. The frequently utilized lecithin is the soya lecithin, a source of soya beans and the egg lecithin source of egg yolk. The solubility of lecithin is generally low in the water. In aqueous solution, lecithin can form liposomes, micelles or lamellar arrangements being dependent on hydration and temperature. In the preparation of proniosomal gel, lecithin acts as a permeation enhancer and it intensifies the portion of drug entrapment properties to the elevated phase transition temperature.
- 3. Cholesterol:** Cholesterol is an essential component in the preparation of proniosomes. Cholesterol imparts stability and permeability to the vesicles. The quantity of drugs entrapped in the proniosomes depends on the concentration of cholesterol utilized and higher transition temperature of span 60.
- 4. Solvents:** The choice of solvents is also a crucial factor, which significantly impacts the vesicle size and drug permeation. The literature study showed that, based on the phase separation and solubility of alcohol in water, the size of vesicles increases in the following order ethanol>propanol>butanol>isopropanol.
- 5. Aqueous phase:** The extensively used aqueous phases in the formulation of proniosomes are hot water, 0.1 % glycerol and phosphate buffer pH 7.4. The pH of the aqueous phase is a critical factor that defines the entrapment of drugs.

Proniosomal drug delivery through different routes

- 1. Oral routes:** The oral route of drug administration is the most preferred route for drug delivery. But bioavailability of the orally administered drug is sometimes affected by first-pass metabolism, instability in the gastric environment, low permeability through the intestinal epithelium. In some cases, absorption of the drug may alter due to the presence of food. So, to improve the bioavailability of the oral drug, different nanocarriers are engaged. Oral Proniosomes are one of them that can solve the limitations of the conventional oral dosage form.
- 2. Ocular routes:** Proniosomes are one of the promising methods in ocular drug delivery. In this route, proniosomal gels in the ocular route provide several advantages like extended and sustained action, enhanced corneal residence time, prevent enzymatic degradation of drugs in tears, and ultimately improve ocular bioavailability.
- 3. Pulmonary routes:** With the aid of the pulmonary route, we can easily treat respiratory diseases than other delivery methods. Through this route, drugs can be applied directly within the lungs. Drug-loaded particles like liposomes dispensed through aerosol, can easily distribute to bronchi and lungs and prolong the release of the drug. Liposomal delivery also has minimum systemic side effects due to localized action to the lungs. But liposomes may be degraded by oxidation or hydrolysis. so, the proniosomes can be an option to overcome the limitations of the liposome.
- 4. Vaginal routes:** Vaginal drug delivery is one of the

favourable routes to target the disease associated with women's health issues. It offers both the local and systemic delivery of drugs. Usually, different categories of drugs like antibiotics, antifungal, antiprotozoal, antiviral, lab or-inducing agents, spermicidal agents, steroids, etc. are delivered through the vaginal route.⁴³ Proniosomal gel has very good mucoadhesive properties and provides a constant release pattern, which is very useful for vaginal drug delivery.

5. **Parenteral routes:** In parenteral drug delivery, targeted and sustained drug release at a predetermined rate can be achieved due to remarkable advancement in pharmaceutical technology.
6. **Dermal and transdermal routes:** The dermal route is employed for local action only to treat different types of skin disease. This route can avoid systemic effects and therefore offers fewer side effects. On the other hand, through transdermal delivery, we can deliver drugs for systemic action. But in both the dermal and transdermal drug delivery, the skin prevents the penetration of drugs. The vesicular drug delivery can be utilized to overcome the problem.
7. **Intranasal routes:** The nasal drug delivery method has some limitations like mucociliary clearance, degradation of drugs by the enzyme. Vesicular drug delivery systems can circumvent these limitations.

Cosmeceuticals application of Proniosomes

Cosmeceutical is generally used to refer to skincare products that contain active ingredients that are beneficial to improving skin's appearance and promoting healthy skin. Moisturizers and serums containing ingredients like vitamin C, niacinamide, retinol, peptides, growth factors, and botanicals can all be used in this regard. Cosmeceuticals are also recommended for patients with acne, rosacea, eczema, and other skin conditions where they are commonly used in combination with prescription medications.

Types of Proniosomes

According to the type of carrier and method of preparation of proniosomes they are of two types.

1. Sorbitol based proniosomes
2. Maltodextrin based proniosomes

Preparation of Proniosomes

The proniosomes consist of a number of ingredients such as the non-ionic surfactant, cholesterol or lecithin being the main ingredient. Some of the methods, which were reported for the preparation of proniosomes are as follows:

1. Hand shaking method
2. Slurry method
3. Slow spray coating method

Characterization of Proniosomes

Evaluation studies are further carried out for the prepared proniosomes in order to find out the

1. Measurement of angle of repose
2. Scanning electron microscopy (SEM)
3. Optical microscopy
4. Measurement of vesicle size
5. Drug content
6. Entrapment efficiency
7. In-vivo release studies
8. Stability studies

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