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# "PRONIOSOMES AS NEXT-GENERATION DRUG CARRIERS: A REVIEW OF CURRENT INNOVATIONS"

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## ABSTRACT

The development of innovative drug delivery systems has revolutionized medication administration, improving targeted delivery, stability, and controlled release. Among these, proniosomes have emerged as a promising vesicular drug delivery system. Proniosomes are dry formulations composed of non-ionic surfactants, cholesterol, and carriers, which upon hydration form niosomes. These systems enhance drug bioavailability, reduce toxicity, and provide sustained release, making them superior to conventional dosage forms. This review explores the structure, components, types, preparation methods, characterization techniques, advantages, limitations, and clinical applications of proniosomes. Proniosomes offer enhanced stability, efficient drug encapsulation, and targeted delivery for various therapeutic applications, including anti-cancer, anti-infective, and transdermal drug delivery. Their potential in pharmaceutical research highlights their role as a next-generation drug carrier with significant advantages over traditional systems.

**KEYWORDS:** Proniosomes, Vesicular Drug Delivery, Controlled Release, Targeted Drug Delivery, Non-Ionic Surfactants, Transdermal Drug Delivery, Niosomes, Pharmaceutical Carriers.

## INTRODUCTION

The creation of innovative drug delivery methods has shown promise in controlling the body's medication release, whether it be spatially, temporally, or both. The control medication minimizes unpleasant side effects while acting at a predefined rate or staying

largely constant. Additionally, it targets drug activity by employing carriers to transport the drug to certain target cell types, or it localizes drug action by placing control release mechanisms in or next to sick tissue or organs. In order to provide regulated and targeted medication delivery, a number of innovative drug delivery systems are currently available for different routes of administration. One such mechanism is the incorporation of the medication into vesicular structures, which is thought to decrease toxicity and extend the drug's release into the systemic circulation. Numerous vesicular drug delivery methods have been created, including proliposomes and proniosomes, as well as vesicular systems like liposomes, niosomes, and transferosomes. Niosomes are non-ionic surfactant-based unilamellar or multilamellar vesicles that have the ability to ensnare hydrophobic and amphiphilic solutes. Niosomes have demonstrated benefits as drug carriers, including being a less expensive and chemically stable substitute for liposomes. However, they are linked to physical stability issues, including fusion, aggregation, sedimentation, and leakage during storage. The sophisticated niosomal formulation known as a proniosome has a surfactant and a carrier, which are hydrated before to use in the preparation. Aqueous noisome dispersion is created as a result of the hydration. Proniosomes reduce the niosomal formulation aggregation, leakage, and fusion issues.[1]

## PRONIOSOMES

Proniosomes are vesicles or vesicular drug delivery systems made of cholesterol, non-ionic surfactants, and other substances. Proniosomes are dry or anhydrous formulations made with carrier covered with a non-ionic surfactant. Because of their superior stability, suitable release pattern, and simplicity of packaging and transportation due to their dry nature, proniosomes are favoured over niosomes. Because they improve drug penetration and are biodegradable, non-toxic, amphiphilic, and capable of encapsulating both hydrophilic and lipophilic medicines, the surfactants used to make proniosomes serve as crucial carriers and ingredients in formulations.[2]

## STRUCTURE OF PRONIOSOMES

Microscopic lamellar formations are called proniosomes. These consist of cholesterol and non-ionic surfactant combined with hydration in aqueous medium. The surfactant molecule aligns itself such that the non-ionic surfactant's hydrophilic ends face outward. whereas the hydrophobic ends create the bilayer in the opposite manner. Although the bilayer of both liposomes and proniosomes is composed of non-ionic surface-active substances, the bilayer

of liposomes is composed of phospholipids. The preparation technique also affects whether a unilamellar or multilamellar proniosome forms.

The hydrophilic ends of the pro-niosome's surfactant bilayer are exposed on the outside and interior of the vesicles, while the hydrophobic chains (both) are oriented toward one another inside the bilayer. As a result, the proniosomes can contain both hydrophilic and hydrophobic medications.

Drugs that are hydrophilic are held inside the vesicle's confined area, whereas those that are hydrophobic are entrenched within the bilayer. Proniosomal gel can have a semisolid, translucent, or transparent gel structure. Due to the restricted presence of solvent, the resulting protostomes have a combination of liquid crystal phases, including lamellar, hexagonal, and cubic Here, the cubic phase is made up of a curved continuous lipid bilayer that extends to three dimensions, while the lamellar phase displayed sheets of surfactant structured in a bilayer and the hexagonal phase displayed a cylindrical compact structure formed in a hexagonal way.[3]

## COMPONENTS OF PRONIOSOMES

The essential and most common components for the delivery system are as follows.

**Surfactants:** Surfactants are typically organic molecules with amphiphilic properties that act as surface active agents. They serve as emulsifiers, permeability enhancers, wetting agents, and solubilizers, among other purposes. The most often utilized non-ionic surfactants for vesicle production include fatty acid esters, alkyl ethers, alkyl esters, and alkyl amides. HLB value, a reliable indication of any surfactant's capacity to form vesicles, should be used to guide surfactant selection. In addition to the surfactant's HLB values, the component's chemical structure and the key packing parameter also affect whether bilayer vesicles or micelles develop. A surfactant's HLB value is crucial for regulating drug entrapment in the vesicle it creates. Since Hydrophilic Lipophilic Balance is a reliable measure of any surfactant's capacity to produce vesicles, vesicle formation was shown to be consistent with HLB numbers between 4 and 8.[4]

**Carrier**: The carrier allows for flexibility in the ratio of surfactant to other components when utilized in the manufacture of proniosomes. Furthermore, it expands the surface area, which results in effective loading. The carriers should be free-flowing, non-toxic, and safe. They

should also have strong water solubility for easy hydration and poor solubility in the loaded mixed solution. The following is a list of frequently used carriers.[5,6]

a) Maltodextrin.

b) Sorbitol.

c) Spray dried lactose.

d) Glucose monohydrate.

e) Lactose monohydrate.

f) Sucrose stearate.

**Solvent and Aqueous Phase:** The size of the vesicles and the rate of drug penetration are significantly impacted by the alcohol employed in proniosomes. The sizes of the vesicles made from various alcohols vary, and they go like this: Propanol > Butanol > Isopropanol > Ethanol. To prepare proniosomes, an aqueous phase consisting of hot water, 0.1% glycerol, and phosphate buffer 7.4 is utilized.[7]

**Lecithin:** They are often referred to by their origin, such as egg lecithin from egg yolk and soy lecithin from soybeans. Lecithin contains phosphatidylcholine as a key component. It has several significant roles in the vesicular system, including.[9]

a) It improves permeability; b) It stops medication leaks. c) A higher Tc (phase transition temperature) increased the percentage of drug entrapment.

When comparing the two on the basis of their penetration capabilities, soy lecithin is a better option to choose because it contains unsaturated fatty acids, such as oleic and linoleic acid, while egg lecithin contains saturated fatty acids. However, soy lecithin forms larger vesicles than egg lecithin.[8]

**Cholestero**l It is a membrane additive, enhances the stability, fluidity, and permeability of lipid bilayers. It increases entrapment efficiency by acting as a "vesicular cement," stabilizing vesicles and preventing leakage. However, beyond a certain concentration, excess cholesterol competes with the drug for space within the bilayer, displacing the drug and destabilizing the vesicle, which decreases entrapment efficiency. Therefore, an optimal cholesterol concentration is crucial for balancing membrane stability and effective drug encapsulation.[8,10,11]

| Sr No. | Class | Example | Use |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | Surfactant | Span20, 40,60,80,85, Tween 20,40,80 | To increase drug flux rate across the skin |
| 2 | Cholesterol | Cholesterol | To prevent leakage after drug formulation |
| 3 | Lecithin | Soya lecithin, egg lecithin | Penetration enhance |
| 4 | Solvent | Chloroform, ethyl, methyl alcohol | Work as penetration enhancers |

**Fig.1 Components of Proniosomes.[12]**

**TYPES OF PRONIOSOMES.[13,14,15]**

1) Dry granular proniosomes: The dry granular proniosomes are classified into 2 types on the basis of method of preparation. These include

• Sorbitol based proniosomes: Proniosomes serve as the carrier in orbital base proniosomes, a dry formulation that is further coated with a non-ionic surfactant and transformed into niosomes in under one minute by adding hot water and stirring. These are typically created by spraying the sorbitol powder with a surfactant combination generated in an organic solvent, followed by the solvent's evaporation. The procedure must be repeated until the required surfactant coating is obtained since the sorbitol carrier dissolves in organic solvent. The size distribution of proniosomes depending on sorbitol is consistent. When the active substance is prone to hydrolysis, it can be helpful. Entrappment efficiency is reduced by the residual sorbitol to less than half of what is seen with sorbitol. This calls for a decrease in the final niosome suspension's carrier fraction. Since sorbitol dissolves in chloroform and other organic solvents, evaluating sorbitol particles presents a challenge. It is made using a process of gradual spraying.

• Maltodextrin based proniosomes

The quick slurry technique is used to prepare it. The amount of time needed to create proniosomes using the slurry approach is unaffected by the surfactant solution ratio. It is possible to use proniosomes with a high surface to carrier ratio. It is possible to make proniosomes with a high surface to carrier ratio.

It is rather easy to extract niosomes for drug administration from such proniosomes. A solid surfactant/sorbitol cake is produced via an analog technique with Sorbitol. Hollow-blown maltodextrin particles can be utilized for a notable increase in surface area since the shape of the maltodextrin is maintained. The rehydration process is more effective because of the

thinner surface coating caused by the larger surface area. This preparation may be used to deliver therapeutic molecules that are both hydrophobic and amphiphilic.

2) Liquid crystalline proniosomes

There are three ways that lipophilic surfactant chains might change into the disordered liquid state known as the lyotropic liquid crystalline state (neat phase) when the surfactant molecule is kept in contact with water. These three methods include raising the Kraft temperature (Tc), adding a solvent that breaks down lipids, and using both solvent and temperature. Bilayers are layered on top of one another in the intervening aqueous layer in the neat phase, sometimes referred to as the lamellar phase. Under a polarized microscope, this kind of structure produces thread-like birefrigerant structure and characteristic x-ray diffraction. At greater concentrations, the lamellar crystalline phase transforms into niosomes. Proniosomal gel and liquid crystalline proniosomes serve as reservoirs for transdermal medication administration.

Liquid crystalline proniosomes display a number of advantages.

1) Stability

2) High entrapment efficiency

3) As a penetration enhancer

4) Easy to scale up as no lengthy process is involved; moreover it avoids the use of pharmaceutically unacceptable additives.

## METHOD OF PREPARATION

There are 3 types of preparation

**1) Slurry method.**

**2) Slow spray coating method.**

**3) Coacervation phase separation method**

**1) Slurry method:** Maltodextrin is often used as a carrier and solvents to make a slurry in a round-bottom flask. A round-bottom flask containing a carrier (lecithin, maltodextrin) should be used to evaporate the solvent flask connected to the rotary evaporator to 50–60 rpm at 45–47 °C in order to find the free-flowing powder of proteinoids applied vacuum for during slurry. After lowering the pressure by 600 mm Hg, the dry formulation was discovered; it was then stored in a securely sealed container under refrigeration.[16,17].

Steps Involved.

1. Preparation of Surfactant-Lipid Mixture: Mix the surfactant and lipid in a specific ratio.
2. Addition of Water: Gradually add water to the surfactant-lipid mixture under constant stirring.
3. Formation of Slurry: Continue stirring until a uniform slurry is formed.

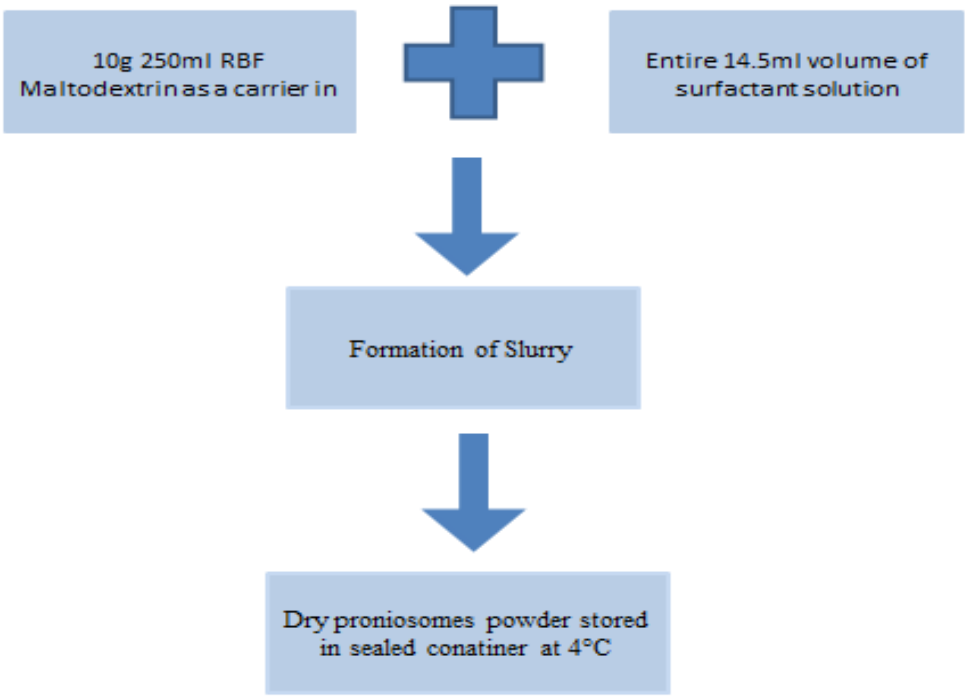


**Fig. 2 Slurry Method.**

4. Addition of API: Add the API to the slurry and mix well.
5. Drying: Dry the slurry to obtain a dry powder (Proniosomes).
6. Reconstitution: Reconstitute the Proniosomes with water to form a gel-like structure.

**Advantages of slurry method**

a) Maltodextrin like polysaccharide which is easily soluble in water and it is used as carrier material in formulation; they were easily coated by simply adding surfactant in organic solvent to dry maltodextrin.

b) Due to uniform coating on the carrier it protect the active ingredient and the surfactants from hydrolysis and oxidation.

c) The higher surface area results in thinner surfactant coating which makes the rehydration process efficient**.**

**2) Slow spray coating method:** In this method, the surfactant is added to an organic solvent and sprayed onto carrier. Then the solvent is evaporated. This process is repeated until the desired surfactant loading is achieved, because the carrier is soluble in the organic solvent. As the carrier dissolved, hydration of this coating allows the formation of multilamellar vesicles.[18,19] These niosomes have uniform size distribution and similar to those produced by conventional methods. A 100 ml round bottom flask containing desired amount of carrier can be attached to rotary flash evaporator. A mixture of surfactant and cholesterol should be prepared and introduced into round bottom flask on rotary evaporator by sequential spraying of aliquots onto carrier's surface. The evaporator has to be evacuated and rotating flask can be rotated in water bath under vacuum at 65-70 o C for 15-20 min. This process has to be prepared until all of the surfactant solution had been applied. The evaporation should be continued until the powder becomes completely dry.[13,20,21]

**Advantages of Slow spray coating method**

a) Uniform Thickness: Slow spray coating allows for a more uniform thickness of the coating material, resulting in a consistent finish.

b) Improved Adhesion: The slow spray coating process allows for better adhesion of the coating material to the substrate, resulting in a stronger bond and improved durability.

c) Enhanced Finish Quality: Slow spray coating enables the creation of high-quality finishes with minimal defects, such as orange peel or uneven texture.

**3) Coacervation phase separation method**

Proniosomal gel is commonly prepared using this technique. Alcohol (0.5 ml) is added to a clean, dry, wide-mouthed glass vial with a 5.0 ml capacity that contains precisely weighed amounts of surfactant, fat, and medication. After warming, a glass rod is used to thoroughly mix all the contents. The glass bottle's open end is sealed with a cap to stop solvent loss, and it is heated over a water bath at 60 to 70°C for approximately five minutes, or until the surfactant combination is fully dissolved. Then, using a water bath, the aqueous phase (0.1% glycerol solution) is added and heated until a clear solution forms, which, when cooled, transforms into proniosomal gel. Diagrammatic depiction as displayed in figure 3.[22,23]

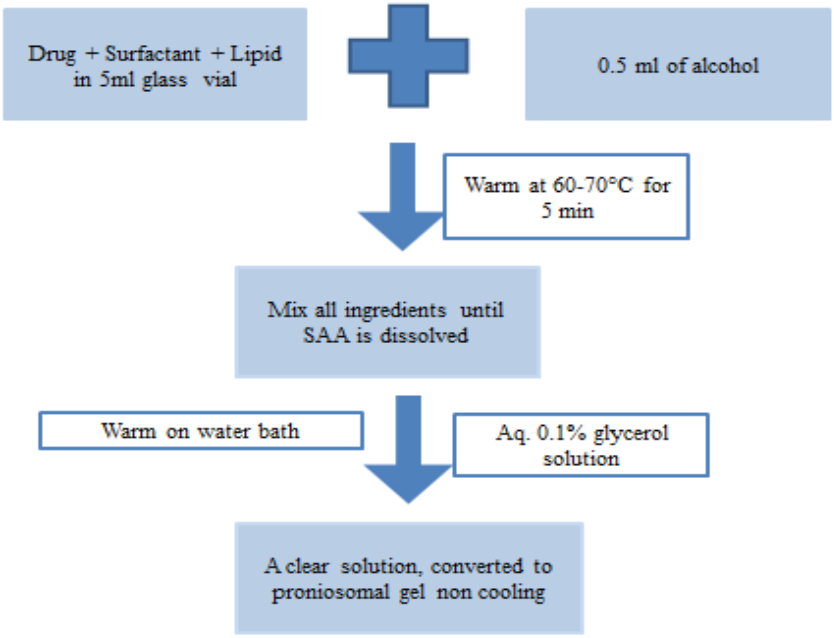


**Fig. 3 Coacervation phase separation method.**

**Advantages of Coacervation phase separation method**

a) Method is simple and without time consumable so it does require any specialized equipment.

b) Specially adopted for gel preparation

c) Small quantities or small dose formulation can be prepared on lab scale.

## CHARACTERIZATION OF PRONIOSOMES.[24]

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

- Measurement of angle of repose
- Scanning electron microscopy (SEM)
- Optical microscopy
- Measurement of vesicle size
- Drug content
- Entrapment efficiency
- In-vivo release studies
- Stability studies.

**Measurement of angle of repose**

The cylinder and funnel methods were used to measure the dried proniosomes angle of repose.

**Funnel method**

The proniosomal powder was placed into a funnel that was secured in place so that the funnel's outlet opening was 10 cm above the surface. The powder flowed out the funnel to create a cone on the surface, and by measuring the cone's height and base diameter, the angle of repose was further determined.

**Cylinder method**

A cylinder that was set so that the cylinder's exit orifice was 10 cm above the surface level was filled with the proniosome powder. The powder formed a cone on the surface of the cylinder as it poured downward. By taking measurements of the cone's height and base diameter, the angle of repose was further computed.[25].

Angle of repose is calculated by the below equation $\theta = \text{Tan-1} \times (h/r)$

**Scanning electron microscopy (SEM)**

One of the most crucial factors is the size of the proniosome particles. SEM was used to examine the size distribution and surface appearance of proniosomes. The proniosomal powder was applied to a double-sided tape that was attached to aluminium stubs. A scanning electron microscope's vacuum chamber (XL 30 ESEM with EDAX, Philips, Netherlands) held the aluminium stub. A gaseous secondary electron detector (working pressure of 0.8 Torr, acceleration voltage of 30.00 KV) XL 30 (Philips, Netherlands) was used to observe the morphological characterization of the samples.[26]

**Optical microscopy**

The niosomes were examined under a microscope (Medilux-207RII, Kyowa-G etner, Ambala, India) after being placed on glass slides. After adequate dilution, the microscope's ×1200 magnification is employed for morphological inspection. A digital single lens reflex (SLR) camera was used to take a photomicrograph of the preparation from the microscope.[26]

**Measurement of vesicle size**

The same medium that was utilized to prepare the vesicle dispersions was used to dilute them roughly 100 times. A particle size analyzer was used to measure the size of the vesicles. The device consists of a small volume sample holding cell and a multi-element detector with a He-Ne laser beam at 632.8 nm that is focussed with a minimum power of 5Mw using a

Fourier lens (R-5). Prior to measuring the vesicle size, the samples were agitated using a stirrer.[27]

**Drug content**

100 mg of plasmiosomes were added to a normal volumetric flask. After 15 minutes of shaking, 50 millilitres of methanol were used to lyse them. Methanol was used to dilute the solution to 100 millilitres. Then, using saline phosphate buffer at a certain pH, 10 ml of this solution was diluted to 100 ml. Following the withdrawal of aliquots, absorbance was measured at a certain wavelength, and the calibration curve was used to further determine the drug content.[28]

**Entrapment efficiency**

Extensive dialysis and centrifugation were used to separate the unentrapped medication from the niosomal solution. A dialysis tube with an osmotic cellulose membrane firmly fastened to one side was filled with the theniosomal suspension. The dialysis tube was then submerged in 100 millilitres of saline buffer at a certain pH, which was agitated using a magnetic stirrer. Via an osmotic cellulose membrane, the unentrapped medication and the niosomal suspension were separated into the medium. Following six hours of intensive dialysis, optical density readings were recorded, and the UV spectrophotometric approach was used to estimate the amount of medication entrapped.[29]

The formula was used to calculate entrapment efficiency.

$$\text{Entrapment efficiency} = \frac{\text{Amount of entrapped drug} * 100}{\text{Total amount of drug}}$$

**In vivo release studies**

Several methods, including the Franz diffusion cell, Keshary-Chien diffusion cell, cellophane dialyzing membrane, United States Pharmacopeia (USP) dissolution apparatus Type-1, and spectator molecular porous membrane tubing, were used to assess the drug's release from the proniosomal formulations. One or more of the following processes may be involved in drug release from proniosome-derived niosomal vesicles: drug diffusion from a bilayered membrane, desorption from the vesicle surface, or a combination of desorption and diffusion mechanisms.[30]

**Stability studies**

The produced proniosomes were stored for one to three months at different temperatures, including room temperature (25° ± 0.5°C), refrigerator temperature (2°-8°C), and high temperature (45° ± 0.5°C), in order to conduct stability experiments. Periodically, the average vesicle diameter changes and drug content were observed.

According to international climatic zones and conditions, stability tests for the dry proniosome powders intended for reconstitution should be conducted for accelerated stability at 40°C/75% relative humidity, according to standards from the International Conference on Harmonization (ICH) (WHO, 1996). nations in zones I and II have a temperature of 25°C and 60% relative humidity (RH) for long-term stability studies, while nations in zones III and IV have a temperature of 30°C and 65% RH. A product's appearance, color, assay, particle matter, sterility, pyrogenicity, and pH preservative content should all be assessed.[30]

**ADVANTAGES OF PRONIOSOMES.[31]**

1. The phospholipids and non-ionic surfactants in periosomes can both serve as drug diffusion aids and penetration enhancers.
2. Proniosomes offer many benefits, including easier distribution, storage, transportation, and dosing.
3. They stay clear of issues with physical stability, aggregation, fusion, and leakage that are related to either aqueous noisome dispersion.
4. Proniosomes also prevent issues with liposomes, such as oxidation or hydrolysis-induced disintegration and sedimentation, aggregation, or fusion while being stored.
5. Proniosomes may improve the skin barrier's pace of recovery in addition to providing a viable medication delivery method.

**DISADVANTAFES OF PRONIOSOMES.[31]**

1. Physical Stability Issues: Proniosomes can be physically unstable, leading to changes in their structure and composition over time, which can affect their performance.
2. Limited Shelf Life: Proniosomes typically have a limited shelf life due to their susceptibility to degradation, aggregation, or fusion, which can reduce their effectiveness.
3. Difficulty in Scaling Up: Scaling up the production of proniosomes can be challenging due to the complexity of the formulation process and the need for precise control over factors such as temperature, pH, and concentration.

4. High Production Costs: The production of proniosomes can be expensive due to the use of specialized equipment, high-quality ingredients, and complex formulation processes.
5. Limited Understanding of In Vivo Behaviour: There is still limited understanding of how proniosomes behave in the body, which can make it difficult to predict their performance and optimize their design for specific applications.

## CLINICAL APPLICATION OF PRONIOSOMES.[32]

### 1. Anti-neoplastic treatment

Because proniosomes induce significant side effects and prolong the drug's circulation and half-life, they can change the metabolism of antineoplastic drugs and reduce their negative effects.

### 2. Leishmaniasis disease

Using the medication to treat leishmaniasis in the form of proniosomes. This demonstrates both increased treatment efficacy and the administration of bigger dosages of the medication without producing adverse effects.

### 3. Immune response studies

Because proniosome vesicles have higher stability, lower toxicity, and immunological selectivity, they are utilized in immune response research.

### 4. Treatment of cardiac disorders

In cardiac disorders, such as hypertension, a proniosomal carrier is employed. To enhance medication delivery over a prolonged length of time.

### 5. Carriers for haemoglobin

Because proniosomes are oxygen-permeable vesicles, they can be employed as carriers of haemoglobin within the body, especially in anaemic individuals.

### 6. Drug targeting

Drugs can target the reticuloendothelial system with proniosomes. For instance, a medication that targets liver parasite infections.

### 7. Antibacterial therapy

Used in antibiotic therapy to improve the physical stability and stop phospholipid oxidation when an antibacterial medication is being stored.

### 8. Cosmetic formulation

Niosomes and liposomes are used as carriers for the delivery of active ingredients in a wide variety of cosmetic treatments that are now on the market. Unacceptable organic solvents were used in the manufacturing of liposomes, and even trace amounts of these solvents can damage skin. Proniosomes have been shown to be just as effective as liposomes and noisomes, however they are superior to them due to their handling, storage, and transportation. Therapeutic agents such as hydrating, nourishing, anti-aging, anti-wrinkle, cleaning, and sunscreen particles can be used to include into proniosomal carrier systems.

**Some of The Current Research Work Carried Out A Proniosomes as Drug Delivery.**

| Sr. No | Drug | Category | Method of preparation | Purpose/Reason | Reference |
|---|---|---|---|---|---|
| 1 | Tolnaftate | Antifungal | Coacervation phase separation method | To enhance systemic absorption and lengthen the duration of effect | [33] |
| 2 | Celecoxib | Anti-inflammatory, analgesic, anti- pyretic | Modified coacervation method | To improve bioavailability and decrease first pass metabolism | [34] |
| 3 | Risperidone | Anti-psychotic drug | Coacervation phase separation method | To improve bioavailability due to its limited oral systemic absorption | [35] |
| 4 | Isoniazid | Anti-tubercular drug. Anti-bacterial | Coacervation phase separation method | To improve therapeutic efficacy and reduces side effects | [36] |
| 5 | Ritonavir | Anti-viral, HIV treatment | Modified coacervation method | To increase formulation stability and maintain medication release | [37] |
| 6 | Olmesartan medoximil | Anti-hypertensive | Slurry method | Because they are poorly soluble in water, they should be taken orally to increase their bioavailability (26%). | [38] |
| 7 | Glimepiride | Hypo-glycemic activity | Coacervation phase separation metho | To improve its therapeutic efficacy | [39] |
| 8 | Cefuroxime - axeti | Anti-biotic (2nd generation) | Slurry method | To enhance bioavailability | [40] |
| 9 | Carvedilol | Anti-hypertensive (b-blocker) | Coacervation phase separation method | To increase bioavailability and entrapment efficiency | [41] |
| 10 | Clotrimazole | Anti-fungal (imidazole) | Coacervation phase separation method | To enhance solubility | [42] |

**Fig. 4 Proniosomes as Drug Delivery.**

## CONCLUSION

Proniosomes are a novel, tremendous drug delivery system for anti-cancer, anti-infective, and topical routes. They're extensively used in dermatology to treat skin disorders like melanoma, psoriasis, and bacterial and fungal infections.

Proniosomes are osmotically active, offering enhanced stability and reduced drug toxicity compared to other vesicular systems. Proniosomal gel formulations provide better comfort, controlled release, and sustained release of hydrophobic and hydrophilic drugs. They exhibit desirable skin penetration and entrapment efficiency, making them suitable for drug targeting. Proniosomes have good physicochemical properties, ensuring ease of industrial manufacturing, handling, and storage. Proniosomes are a promising drug delivery system for the future, overcoming drawbacks of conventional dosage forms. They enable controlled, targeted, transdermal, ocular, and sustained delivery. Transdermal delivery via proniosomes produces non-toxicity and enhanced penetration. Ophthalmic delivery improves bioavailability, residence time, and contact time. Dry proniosomes are convenient, easy to handle, and can be formulated into capsules, beads, or tablets. Proniosomes ensure effective, intended therapy and represent a promising drug delivery module. Derived from niosomes, proniosomes are more stable during sterilization and storage. They're considered better candidates for drug delivery due to factors like cost and stability. Proniosomes can encapsulate lipophilic and hydrophilic drug molecules, delivering high concentrations of active agents. Various types of drug deliveries are possible, including targeting, ophthalmic, topical, parenteral, and vaccine delivery. Research continues to explore the potential of proniosomes in drug delivery. With their advantages and benefits, proniosomes are poised to revolutionize the field of pharmaceuticals. Proniosomes offer a novel approach to drug delivery, providing satisfactory treatment compared to conventional systems. Their unique properties make them an attractive option for various therapeutic applications. As research advances, proniosomes are likely to play a significant role in the development of new drug delivery systems. Their potential to improve treatment outcomes and patient comfort makes them an exciting area of study.

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