STUDY OF DIFFERENT TYPES OF LIQUID CRYSTALS AND THEIR APPLICATIONS

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ABSTRACT

Liquid crystals, also known as mesophase, are substances that flow like liquids yet have the well-ordered organisation properties of crystalline solids. Produced in two ways, that is, categorised into two sorts 1) Thermotropic LCs and 2) Lyotropic LCs are two types of LCs. Thermotropic LCs are formed by varying the temperature of a liquid, whereas Lyotropic LCs are formed by liquefying the molecule in multiple solvents. It also deals with the system's adequate large amplitude molecular movement, allowing molecules to swap sites and realign self-forming LC phases. Thermotropic LCs are frequently single-compound systems, whereas lyotropic LCs are always solutions that include both a solute and a solvent.The primary goal of this review article is to focus on Pharmaceutical Liquid Crystals (LCs) in terms of their necessity, objectives, applications, and benefits over alternative dosage forms, as well as their significance in recent advances in innovative systems. The goal of this review article is to provide detailed information about pharmaceutical LCs technology, including the most recent and innovative liquid crystal method development techniques.

Keywords: LCs -Liquid crystals Liquid crystals - Mesophase, Cubosomes

INTRODUCTION

F. Reinitzer discovered liquid crystals at the beginning for cholesterol in incentives. Examining biological LC materials is still of interest more than a century later. However, the emphasis has changed away from the research of general LC characteristics and toward more detailed themes such as their impact on molecular organisation crucial to biological activities. Liquid crystalline environments are carried by living cells [1]. Friedrich Reinitzerrecognised the discovery of a mid liquid crystalline state in 1888. While doing research on a cholesterol-based substance to determine the proper formula and molecular weight of cholesterol, he was struck by the fact that this matter appeared to have two melting temperatures. At 145.5°C, a solid crystal melts into a murky liquid that remained until 178.5°C, when the muddiness unexpectedly vanished, giving place to a clear translucent liquid. Mesophase liquid crystals act as a bridge between the crystalline solid state and the amorphous liquid state [2,3]. Liquid Crystals micro carriers exist as a transitional state between the solid and liquid states. It is commonly referred to as a mesomorphic state [4] Interior aqueous zones of reverse cubic phase colloidal particles provide some advantages in technical applications when compared to droplets of conventional oil-in-water emulsions (o/w) [5]. On the one hand, these surrounds perform a specific molecular arrangement on other solvated molecules and accumulations. The liquid crystal is the thermodynamically situated substance between the isotropic liquid and the crystalline phase.They have the flow qualities of a liquid while yet retaining some of the order of a crystal [6]. Liquid crystal can be considered a fourth state of matter after solid, liquid, and gas. As the name implies, liquid-crystal phases exist between the predictable crystal phase and the liquid phase. Typically, liquid-crystal molecules have anisotropic rod-like or disc-like shapes. The proclivity of molecules to support themselves with long-range direction is a distinguishing feature of liquid crystals [7].

Liquid crystals can flow like liquids, but their molecules are arranged and/or favoured in a crystal-like manner. These two generic groups of liquid crystals: thermotropic liquid crystals and lyotropics system are heavily impacted by solvents and many thermotropic liquid crystals exhibit a variety of phases as the temperature of the system is changed. As the temperature rises, a specific type of LC particle may exhibit a variety of smectic and nematic phases.

Thermotropic liquid crystal materials have a distinct molecular structure that is divided into two portions, referred to as the central core and side chain. The core part is a stiff body that gives the molecule structure anisotropy, while the side chain part is a flexible region that gives it mobility[8].

As a result, they retain anisotropic physical properties such as elastic behaviour, dielectric constant, refractive index, or viscosity, to name a few. However, while being partially ordered, LCs has liquid-like flow properties, making them anisotropic fluids. The liquid crystalline state can be moved in two fundamentally different ways, resulting in the two primary classes of LC, thermotropic phases and lyotropic phases. Cubosomes are nanoparticles with diameters ranging from 10-500nm [9]

TYPES OF LIQUID CRYSTALS

Thermotropic, lyotropic, and metallotropic phases can be found in liquid crystals. Organic molecules make up thermotropic and lyotropic LCs. When the temperature of thermotropicLcs is altered, the phase transition into the LC phase occurs. Lyotropic LCs exhibit phase transitions as a function of temperature and the concentration of LC molecules in a solvent (typically water). Metallotropic LCs comprises both organic and inorganic molecules, and their LC transition is regulated not only by temperature and concentration, but also by the inorganic/organic molecule ratio.

Liquid crystals can be found in the natural world as well as in technology applications. Liquid crystal displays are used in the majority of modern electronic displays. In living systems, lyotropic liquid-crystalline phases abound. Many proteins and cell membranes, for example, are LCs. Soap solutions and related detergents, as well as tobacco mosaic virus, are other well-known LC examples.

Liquid Crystal is of various types, some are:

1. Polymer Liquid Crystal
2. Polymer Dispersed Liquid Crystal
3. Polymer Stabilized Liquid Crystal
4. Lyotropic Liquid Crystal
5. Ferroelectric Liquid Crystal

Polymer Liquid Crystal

Polymers can obtain liquid crystallinity by dissolving them in a solvent (lyotropic liquid-crystal polymers) or heating them above their glass or melting transition points (thermotropic liquid-crystal polymers).Liquid-crystal polymers are available in two forms: melted/liquid and solid. The commercial aramid known as Kevlar is an example of lyotropic LCPs in solid form. This aramid's chemical structure is made up of linearly substituted aromatic rings connected by amide groups. Similarly, various thermotropic LCP series have been commercially developed by a number of businesses (e.g., Vectra).

In the 1980s, a large number of LCPs demonstrated order in the melt phase, similar to that of nonpolymeric liquid crystals. Because of the self-reinforcing qualities obtained from the macromolecular orientation in the mesophase, processing LCPs from liquid-crystal phases (or mesophases) results in fibres and injected materials with high mechanical properties.

LCPs may now be melt-processed at high rates on standard equipment with great mould detail replication. In fact, the ease with which LCPs may be formed is a significant competitive advantage over other polymers, as it compensates the high cost of raw materials. PLCs (polymer liquid crystals) are a type of material that combines the characteristics of polymers and liquid crystals. These "hybrids" exhibit the same mesophases as typical liquid crystals while retaining many of the polymer's beneficial and adaptable features.

Rod-like or disk-like components (called mesogens) must be inserted into the chains of ordinarily flexible polymers in order for them to display liquid crystal properties. The location of the mesogens has a significant impact on the sort of PLC that forms. Mesogens that are themselves part of a polymer's main chain create main-chain polymer liquid crystals, or MC-PLCs. Side chain polymer liquid crystals, or SC-PLCs, are generated when mesogens are joined to the polymer as side chains via a flexible "bridge" (called the spacer.)

The presence of long flexible spacers, a low molecular weight, and a regular alternation of stiff and flexible units throughout the main chain are all factors that influence polymer mesomorphism.

Polymer Dispersed Liquid Crystal

Polymer-dispersed liquid crystals (PDLCs) are a novel type of material with applications ranging from switchable windows to projection displays. The display industry is conducting substantial research into these materials, which are simply a combination of polymers and liquid crystals.

Liquid crystal droplets are spread in a solid polymer matrix to form PDLCs. The outcome is a polymer that looks like Swiss cheese, with liquid crystal droplets filling in the gaps. The material's unusual behaviour is due to these small droplets (a few microns in diameter for practical uses). The intensity of transmitted light can be varied by changing the orientation of liquid crystal molecules with an electric field.

Polymer Stabilized Liquid Crystal

The polymer stabilised liquid crystal (PSLC) film is a new electro-optical material created by dissolving a small amount of a bifunctionalphotoreactive monomer in a low molecular mass liquid crystal.Photopolymerization induced phase separation was used to make PSLC films using photoreactive biphenyl methacrylate monomers. The electro-optical characteristics of PSLC films were studied in relation to liquid crysta1 concentration, curing duration, monomer configurations, and alignment layer.

Lyotropic Liquid Crystal

Thermotropic and lyotropic liquid crystals are the two types of liquid crystals. The phase transitions of thermotropic liquid crystals are temperature-dependent, whereas those of lyotropic liquid crystals are temperature-dependent and concentration-dependent. In a mixture of myelin and water in 1850, the Lyotropic Liquid Crystal texture was discovered. Surfactants have two separate parts: a polar, frequently ionic, head and a nonpolar, generally hydrocarbon tail, which make up lyotropic liquid crystals. The head is attracted to water, or hydrophilic, and the tail is repelled by water, or hydrophobic, according to the "like dissolves like" rule. The molecules organise themselves when dissolved in high enough quantities so that the polar heads are in contact with a polar solvent and/or the nonpolar tails are in contact with a nonpolar solvent.

Lyotropic liquid crystals can be found in a variety of settings. When soaps and detergents react with water, they generate lyotropic liquid crystals. Cake batters may also contain liquid crystals in the kitchen.

Ferroelectric Liquid Crystal

The smectic C phase of liquid crystals was originally described in 1933. It wasn't until 1974 that it was understood that the term should be ferroelectric, implying that the phase is permanently polarised without the requirement for an electric field. This was discovered by Robert Meyer (Meyer, 1975), who later demonstrated it in a synthesized chiral smectic C material DOBAMBC.

The Surface Stabilized Ferroelectric Liquid Crystal (SSFLC) device was first proposed by Clark and Lagerwall in 1980. This was a significant step forward in the field of FLC applications. It also resulted in the widespread development of FLC chemistry. Direct-view displays and print bars were the first products introduced in 1989.

For small displays, FLCs have previously been developed. For a full-screen image, these displays can be magnified or projected. They can also be utilised in head-mounted displays, such as virtual reality displays. These monitors are extremely portable and allow for human interaction. The most straightforward technique to lower the system's weight is to reduce the size of the screen required. FLCs can also use reflecting illumination instead of large (and energy-intensive) backlighting devices. Because SSFLC devices have bistability, they are perfect for still photos when low energy consumption is a priority because no more power is required once the image is formed. Despite this, their switching time is quick enough to support the high frame rates required for video. The quick switching time also allows for full colour on each pixel, resulting in improved quality on a given display size.

APPLICATIONS OF DIFFERENT TYPES OF LIQUID CRYSTAL

Applications of Polymer Liquid Crystal

Applications for these materials range from the production of high-strength materials to their use in optical devices.

High Strength Fiber:
High-strength fibres are one use of polymer liquid crystals that has been successfully produced for industry. Kevlar, which is used to produce helmets and bullet-proof vests, is an example of how polymer liquid crystals can be employed in applications that require strong, light materials.

Optical Applications:
In the display sector, polymer liquid crystals are used. PLCs have slow "reaction times" when exposed to electric fields. That is, when a field is applied, it takes a considerable time for the molecules to align along it. This isn't a useful property to employ in displays when the screen needs to switch from one perspective to another quickly.

In poled polymeric slab waveguides, side chain polymer liquid crystals have good qualities for use in optically nonlinear devices such as optical waveguides and electro-optic modulators. More devices, such as optically-addressed spatial light modulators, tunable notch filters, optical amplifiers, and laser beam detectors, are likely to be made from PLCs in the future. Ferroelectric chiral smectic C phases have features that make them suitable for films used in nonlinear optics. PCLs are excellent for electrical and mechanical parts, food containers, and other applications needing chemical inertness and high strength because to their diverse qualities. Low relative dielectric constants, low dissipation factors, and commercial availability of laminates make PCL particularly appealing for microwave frequency devices. PCL is a kind of semiconductor that is utilised in microelectronic systems.

Energy-efficient displays can be made with a twisted nematic polymer liquid crystal cell. The display is selectively melted into the liquid crystal phase using a laser. The cell's orientation is then determined by passing a field through it, exactly like in a regular twisted nematic liquid crystal cell. The mesogens will be locked in that position when the polymer cools and hardens into a glass, and the field may be switched off.

Applications of Polymer Dispersed Liquid Crystal

PDLCs (polymer-dispersed liquid crystals) are a significant new class of materials having electro-optic applications such as flexible displays, large-area devices projection displays, electrically switchable windows, and so on. Polymer-dispersed liquid crystals have the potential to be used in a wide range of electro-optic applications, including displays and light shutters. The capacity of the nematic direction of the liquid crystal droplets to align under an electric stimulus is the basis for PDLC windows. A thin PDLC layer (approximately 25 microns thick) is deposited between clear plastic covers in a typical application. The plastic substrates are coated with a very thin coating of indium tin oxide, a conducting substance (ITO).

The dispersion of light through a PDLC window is principally determined by the difference in refractive index between droplets and their surroundings. When there is a high droplet density, the environment is primarily made up of other droplets, making the relative orientation of their directors a critical factor. The droplets are anisotropic, with an index of refraction parallel to the director that differs from that perpendicular to it.

Smart Glass also uses Polymer Dispersed Liquid Crystal. When applied to windows or skylights, smar glass, EGlass, or switchable glass, sometimes known as smart windows or switchable windows, refers to electrically switchable glass or glazing that alters light transmission capabilities when voltage is applied.

Certain varieties of smart glass can allow users to manage the amount of light and heat that passes through by changing from transparent to translucent at the touch of a button, partially blocking light while preserving a clear view of what's behind the window. At the flick of a switch, another sort of smart glass can provide seclusion. Electrochromic devices, suspended particle devices, Micro-Blinds, and liquid crystal devices are all examples of smart glass technology.

Applications of Polymer Stabilized Liquid Crystal

The helical structure of cholestrics leads to unusual optical properties.

1. ***Bistable Reflective Cholestric Liquid Crystal Displays:***

The property of selective reflection from the planar cholesteric texture in contrast to partial or full transmission through the focal conic and homeotropic textures provides opportunities for a variety of display applications when the pitch of the cholesteric material is in the visible wavelength range.

2. *Light Shutter:*
The choice of mode in light shutter applications is determined by the intended actions; however both modes display relatively little fluctuation in 'transmission across the visible wavelength spectrum and both has a wide viewing angle.

Reverse Mode Light Shutter: The cholesteric material changes to a focal conic texture when exposed to a mild electric field perpendicular to the windows. Because the index of refraction changes at the polydomain boundaries between focal conic regions, visible light is substantially scattered.A reverse mode cell with an applied electric field is shown in the diagram above (on-state). The liquid crystals scatter light in the focused conic texture. The black lines in the diagram show light rays entering and scattering across the cell.A reverse mode cell with no applied electric field is shown in the diagram above (off-state). Due to their long wavelength helical pitch, the liquid crystals are aligned in the planar pattern and transmit visible light. The blue wedges in the picture represent layers of liquid crystal planes and indicate their average director direction. Green is the colour of the schematic polymer network.

Normal Mode Light Shutter: Photopolymerization of normal mode cells occurs in the homeotropic texture created by a high electric field. The cell settles into the focused conic texture when the electric field is removed. The cell scatters light and is opaque in the absence of an electric field. The cell becomes transparent again when an electric field is applied.A typical cell without an electric field is seen in the diagram above (off- state). The liquid crystals scatter light in the focused conic texture. Thelight rays going through the cell are represented by the black lines.A typical cell with an electric field applied (on-state) is shown in the diagram above. In the homeotropic texture, the liquid crystals are aligned. The red wedges depict the average director orientation of layers of Jlanes in liquid crystals, whereas the blue represents the Polymer network conceptually.

3. *Polymer Walls in PSCTs :*

A bistable, polymer stabilised cholesteric texture is formed by dispersing photocurable monomers in a cholesteric liquid crystal mixture (PSCT). Polymer walls can have high polymer content without compromising the electro-optic properties. These walls are produced in the interpixel region of a pixel array.

4. *Photo Tuning:*

The planar state of PSCTs reflects light of a certain wavelength. For light at normal incidence, the wavelength is given by Bragg's reflection law, $\lambda = p * n$, where p is the pitch and n is the average refractive index. A change in the material's pitch length will result in a new wavelength of light being reflected. For this, a tunable chiral Material (TCM) can be utilised. It increases chirality and so decreases pitch when added to cholesteric formulations (initially the cholesteric formulation reflects red light and after the TCM is added it reflects blue). The tunable chiral dopant is polymerized by ultraviolet radiation, causing its concentration to decrease. The chirality of the mixture reduces as the concentration falls, but the pitch of the mixture increases. As a result of the extended UV exposure, the mixture's pitch increases more, and the reflected wavelength increases accordingly, according to Bragg's reflection law (the reflected wavelength can be increased back to the original wavelength, that of red light). Because of the concentration gradient caused by the variable concentration of TCM, bleeding or colour diffusion may occur over time. To keep the TCM in place and prevent colour diffusion, it might be linked to a polymer network. The higher the polymer concentration, the lower the reflectivity and colour brightness. TCMs with higher helical twisting power could be employed with less. By exposing pixels to different levels of UV light, TCMs allow a sequential array of the three primary hues to be created from the same cholesteric mixture. Selective masking and repeated UV exposure achieves the dual purpose of colour patterning of pixels and device stabilisation by modifying the chirality of the TCM and photopolymerizing the remaining monomer to produce the desired polymer network. Longitudinal stripes rather than pixels are shown in the figure below, and the required increase in UV exposure time is achieved by a series of two masks and exposures.

Applications of Lyotropic Liquid Crystal

Lyotropic liquid crystalline behavior is simple household soap. Soaps remove grime and oil better than pure water because the nonpolar insides of the micelles may dissolve nonpolar molecules that water cannot dissolve. A lyotropic liquid crystal can coat a medicine to prevent it from being degraded in the digestive tract. The medicine can then be given orally, and once inside the body, the liquid crystal breaks down and the drug is released. Stable hydrocarbon foam has been created using lyotropic liquid crystals. When lyotropic liquid crystal molecules transition from inverse micelles to lamellar sheets, the surface tension is reduced enough for foam to form. The hydrocarbon and the surfactant can dissolve in each other, but the surfactant cannot dissolve in water. Water can dissolve in the surfactant and mix into the liquid crystal. Many additional compounds are soluble in lyotropic liquid crystals as well. The medication hydrocortizone is one example.It is often taken in topical applications. Liquid crystals may become a primary solvent for topical medications.

Lyotropic Liquid Crystals are also extremely important in biological membranes.Membranes are made up largely of amphiphilic lipids like phospholipids and cholesterol, with a minor amount of glycolipids thrown in for good measure. The polar head compositions and hydrocarbon chain lengths of phospholipids vary, but almost all have two hydrocarbon tails, one saturated and one unsaturated. These tails are pliable, with the greatest range of motion found at the furthest distance from the poliir's head. The structures of phospholipids and cholesterol are depicted in the diagram below.

Proteins, which can be determined by hydrophobic interaction, are also found in the membrane. This would leave polar sections of proteins exposed to water on the exterior, either inside or outside, while nonpolar regions would remain separated on either side of the lipid bilayer.

The bilayer acts as a solvent for the proteins and allows them to make contact with certain polar heads that are required for effective protein function. The following illustration depicts a cell membrane (bottom right) with lipids in green and proteins scattered across the membrane in blue.

Applications of Ferro-electric Liquid Crystal

SSFLCs have a substantially faster switching time than other liquid crystal technologies. Shutters have a transition time of 70 microseconds. The obvious benefit is the faster transition from the white to the black states for video, and vice versa. The capacity to colour sequentially. This means that a colour is formed by quickly alternating the additive primary colours red, green, and blue. The eye combines the sequence into a single hue due to the quick switching time. If the switching time was not rapid enough, each pixel would have to be subdivided into red, green, and blue in order to form a colour. This would necessitate increasing the size of the display in order to obtain a less grainy colour image.

Ferroelectric materials' nonlinear properties can be exploited to create capacitors with tunable capacitance. A ferroelectric capacitor is typically made up of a pair of electrodes sandwiched between two layers of ferroelectric material. Ferroelectric permittivity is not only tunable, but it is also frequently very high in absolute value, especially at the phase transition temperature. Ferroelectric capacitors have a smaller physical size than dielectric (non-tunable) capacitors of similar capacitance as a result of this.

Ferroelectric materials' spontaneous polarisation results in a hysteresis effect that can be exploited as a memory function, and ferroelectric capacitors are used to manufacture ferroelectric RAM [4] for computers and RFID cards. Thin films of ferroelectric materials are commonly employed in these applications because the field required to alter the polarisation can be obtained with a low voltage. When employing thin films, however, special care must be paid to the interfaces, electrodes, and sample quality in order for devices to function reliably.

Due to symmetry considerations, ferroelectric materials must also be piezoelectric and pyroelectric. Ferroelectric capacitors are particularly helpful for sensor applications because of their combination of memory, piezoelectricity, and pyroelectricity. Medical ultrasound machines (the capacitors generate and listen for the ultrasound ping used to image the internal organs of a body), high-quality infrared cameras (the infrared image is projected onto a two-dimensional array of ferroelectric capacitors capable of detecting temperature differences as small as millionths of a degree Celsius), fire sensors, sonar, vibration sensors, and even fuel injectors on diesel engines all use ferroelectric capacitors.

The ferroelectric tunnel junction (FTJ), which consists of a contact made up of nanometer-thick ferroelectric film sandwiched between metal electrodes, is another current topic of attention. The ferroelectric layer is thin enough that electrons can tunnel through it. A giant electroresistance (GER) switching effect could be caused by piezoelectric and interfacial effects, as well as the depolarization field.

COMMON APPLICATIONS OF LIQUID CRYSTALS

Oral drug delivery

Liquid crystals solve the various obstacles associated with the oral delivery of several potential drugs, such as high molecular size, poor water solubility, and poor absorption. Large proteins have been used for local action in the gastrointestinal tract in a distinct application. Targeted and controlled release can be paired with liquid crystalline nanoparticle carriers. The particles are designed to process in situ at a predetermined rate, allowing for effective in vivo drug distribution from dosage form. Cubosome carriers can also be released at different absorption sites, such as the upper and lower intestine, which is crucial for medications with a restricted absorption window.

In topical and mucosal depositions

Cubic phases are more bio sticky in nature, making them suitable for topical and mucosal depositions, as well as medication distribution via dosage forms.

Controlled-Release Drug Delivery

The most commonly explored application by cubosomes investigators is controlled release of solubilized active compounds, and spectacular evaluations have occurred of attempted delivery applications as well as pharmacological active compounds that have been solubilized in bulk cubosomes and liquid crystals. Because of its smaller aperture size (5–10 nm), capacity to solubilize hydrophobic, hydrophilic, and amphiphilic particles, and biodegradability to simple enzyme action, cubic phase is appealing for controlled release. Cubic phase is highly bioadhesive and is expected to improve skin permeability, implying outstanding compatibility with mucosal deposition and topical and administration of active chemicals.

Intravenous drug delivery systems

Liquid crystals having internal liquid crystal structures of curved lipid membranes are utilised to solubilize, encapsulate, and distribute medications throughout the body. While liposomes and emulsions have found utility as intravenous carriers in pharmaceutical goods, liquid crystal nanoparticle shapes improved payloads of proteins, peptides, and many insoluble small compounds, and are the best carriers for injection or infusion of many actives.

Topical drug delivery systems

A different way of liquid crystal application is the topical delivery system. They are based on utilising the unique features of liquid crystals. Topical delivery systems are unique bio adhesive LC formulations intended to facilitate controlled and effective medicine delivery to buccal, ocular, vaginal, and other sites.

RECENT APPLICATION OF LIQUID CRYSTALS

Melanoma (cancer) therapy

Anticancer chemicals have recently been successfully encarporated in liquid crystals and studied physicochemically. This advantageous nano carrier's distinct structure suggests that it be used in the treatment of melanoma. A sizeable object passes through the tight connections that exist between the endothelial cell lining of the arteries. Passive targeting is heavily relied on a drug nano carrier's capacity to have a longer circulation lifespan, resulting in greater accumulation at the precise targeted spot. Circulation duration is determined by nanoparticle physicochemical properties (size, solubility, charge, biodegradability, shape, rigidity), which may be easily controlled in the majority of the specified delivery methods.

Drug delivery vehicle

Such novel materials have a wide range of applications, including medication delivery vehicles. The rapid development of the life sciences industry is expected to force hitherto "exotic" delivery vehicles and excipients into larger market locations, similar to personal care and consumer items. As a result, self-assembled surfactant phases have been thoroughly tested for compatibility with a wide range of medical active ingredients and applications.

Sustained release behaviour

A more recent patent achievement by refers to the use of liquid crystals in personal care product sectors such as hair care, skin care, cosmetics, and antiperspirants. A wide range of medications with varying physicochemical properties were introduced to liquid crystals, and their sustained release performance was also investigated. Cubosome residue particles were responsible for the sustained behaviour of cubosomes. Dispersion of monoglyceride-based cubosomes can be introduced for topical usage, as well as percutaneous or mucosal applications.

In treatment of viral diseases

Because of the microbicidal properties of monoglycerids, they can be utilised in intravaginal therapy of sexually transmitted illnesses caused by viruses (e.g., HSV, HIV) or bacteria (e.g. Neisseria genorrticae and Chlamydia trachomatis). Because of the structural similarities between the stratum corneum and the cubic phase structure, it is prudent to assume the construction of a mixture of stratum corneumlipids with cubosomalmonolein. This kind of interaction could lead to the formation of a cubosome goods yard in this layer, from which pharmaceuticals could be discharged in a controlled manner.

In topical and mucosal depositions

Cubic phases are most bioadhesive by nature, making them suitable for topical and mucosal depositions, as well as drug conveyance.

Controlled-Release Drug Delivery

Controlled release of solubilized active compounds is a popular use among LCs researchers, and excellent evaluations have occurred for delivery applications as well as pharmaceutical active components that have been solubilized in bulk cubic phase and LCs. Cubic phase is most suited for controlled release due to its extremely small pore size (5–10 nm), capacity to solubilize hydrophobic, hydrophilic, and amphiphilic compounds, and biodegradability via simple enzyme activity. Cubic phase is highly bioadhesive and acts as a skin penetration enhancer, implying that it is compatible with topical and mucosal admission and distribution of active substances.

CONCLUSION

The technique of forming a drug's liquid crystal can be useful and successful in delivering the medicine to the appropriate target. This approach can be used widely in topical medication administration since it has advantages such as smooth sensation and drug loading of incompatible molecules. Numerous patents are being filed in this LCs technology on a daily basis. It is a new drug loading technology that requires more attention before it can be used in actual scientific businesses to produce a quality consequence for society.

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