ORGANOGELES: A NOVEL DRUG DELIVERY SYSTEMS

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ABSTRACT

Topical gel drug administration is a localized drug delivery system to deliver drug anywhere in the body through ophthalmic, rectal, vaginal and skin as topical routes. Skin is one of the most extensive and readily accessible organs on human body for topical administration and is main route of topical drug delivery system. Topical application of drugs offers potential advantages of delivering the drug directly to the site of action and acting for an extended period of time. An Organogel contains drugs are administered topically in order to achieve optimal cutaneous and percutaneous drug delivery because of various advantages such as ease of administration, non-invasive, better tolerance and compliance, local enhanced transdermal delivery, avoidance of local gastrointestinal toxicity, avoidance of first pass metabolism. The organogels may be regarded as bi-continuous systems consisting of gelators and apolar solvent, which may or may not contain water-molecules entrapped within the self-assembled structures of the gelator. Organogels are prepared by Fluid filled method, Hydration method, Soild-fiber method. Organogels are generally estimated for various parameters such as pH, Rheology, Spreadibility, Viscosity etc. Lecithin organogels (LO₅) are thermodynamically stable, clear, viscoelastic and biocompatible. In the last decade, interest in physical organogels has grown rapidly with the discovery and synthesis of a very large number of diverse molecules, which can gel organic solvents at low concentrations. In the pharmaceutical field, organogels can be used for drug and vaccine delivery via different administration routes. Organogels present very interesting advantages as drug delivery formulations, amongst their ease of preparation and administration.

KEYWORD: Organogel, Topical, Percutaneous, Pharmaceutical.
INTRODUCTION

Topical administration of drugs has recently gained an importance because of various advantages such as ease of administration, painless, better compliance, superior transdermal delivery, prevention of local gastrointestinal toxicity, first pass metabolism is avoid [K.D Patil et al., 2011]. There are various kinds of formulation systems and strategies have been evolved to provide a vehicle to deliver the medicament into the skin layer (cutaneous delivery) or through the skin and into systemic circulation (percutaneous absorption) and to target the skin [R. Stationwala et al., 2011]. The topical delivery has been attempted and made successful using a number of lipid based systems viz., vesicular systems, lipid microsphere, lipid nanoparticles, lipid emulsion, polymeric gels. In a recent development, organogels (phospholipids in conjunction with some other additives) has been shown to provide a very promising topical drug delivery vehicle [S. Sahoo et al., 2011]. Organogel is a semisolid formulation; it can be non crystalline, non glassy thermoreversible solid material which has an immobilized external apolar phase. The organogels can be considered as bi-continuous systems consisting of gelators and apolar solvent, which may or may not contain water-molecules entrapped within the self-assembled structures of the gelator [Y.Yang et al., 2008]. Organogels, when topically applied, are also referred to as lipogels and oleogels. Organogels can be distinguished from hydrogels by their predominantly organic continuous phase and can then be further subdivided based on the nature of the gelling molecule [A. Vintiloiu et al., 2008]. Organogels are obtaining more popularity because of the ease of application and better absorption through the skin layers. Various advantages of organogel are ease of preparation, cost reduction due to less number of ingredients, longer shelf life, thermodynamically stable. Since it consists of both hydrophobic and hydrophilic components, both hydrophobic and hydrophilic drugs can be incorporated. Organic solvents used in organogel formulation could be of natural origin, e.g. sunflower oil, mustard oil, etc. When compared to other lipid based carrier systems, it will prove to be better in terms of efficacy, feasibility and shelf life [S. Sahoo et al., 2011]. Thermodynamic stable nature of the organogels has been attributed to the spontaneous formation of fibrous structure by virtue of which the organogels reside in a low energy state. Organogels are also sensitive to the presence of moisture which has also been explored to develop controlled delivery systems. In one of the study [J. Varshosaz et al., 2013] transdermal nanoemulsion of metoprolol using lecithin as organogelator was developed. Three commercially available types of lecithin (200,100p, and170), tree short chain alcohol (n-butanol,isopropylalcohol, and n-propanol), and isopropyl myristate (IPM) were used as surfactant, cosurfactant, and oil phase,
respectively. The aqueous phase was composed of metoprolol tartrate. The prepared o/w nanoemulsions of metoprolol showed high flux and permeability through the skin. In another study [S.Y Raut et al., 2010] transdermal drug delivery system for zidovudine was developed. Non ionic surfactants based organogels were formulated and evaluated for their physicochemical properties and in vitro release. The mechanism of drug release in the study followed diffusion controlled zero order kinetics. Stability studies of non ionic surfactant based organogels proved that there were no significant change in physical stability, syneresis, drug content, pH, viscosity and diffusivity.

Organogels Possess Several Advantages Listed Below: [N.K Mujawar et al., 2014]

a) Ease of preparation  
b) Cost reduction  
c) Longer shelf life  
d) Short half life drug used  
e) Avoid first pass metabolism  
f) Organogels are moisture insensitive  
g) More stable than other types of gel  
h) Drug penetration through the skin can be enhanced.

Limitations of Organogels: [S. Ravi et al., 2014]  
a) Should be stored in a proper condition.  
b) The organogel has greasy property  
c) Less stable to temperature.

Mechanism of Gel Permeation into Skin  
Skin is made up of several layers of different types of tissue, which is protective in nature [T. Sreedevi et al., 2012]. The 3 main skin layers include: Epidermis, Dermis and Hypodermis. There are two possible mechanisms such as:

1. In stratum corneum the permeation of the gel into the skin occurs by diffusion through lipid intercellular matrix [S. Ravi et al., 2014].  
2. Gel provides a slight disorganization of the skin allowing the permeation of the gel and the active drug through the stratum corneum.
Table 1: Types of Organogels

<table>
<thead>
<tr>
<th>Sr. no</th>
<th>Types</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>Lecithin organogels</td>
<td>Lecithin is a phospholipid, extracted from various plants and animal tissues apart from the egg yolk. Lecithin organogels have been used as carriers for hydrophilic and hydrophobic drug molecules. [S.Sahoo et al., 2011]</td>
</tr>
<tr>
<td>2.</td>
<td>Sorbitan monosterate organogels</td>
<td>Sorbitan monosterate organogels are opaque, thermo reversible, semi-solids whose microstructure consists of surfactant tubules dispersed in the organic continuous phase. Sorbitan monosterate (Span 60) and Sorbitan mono-palmitate (Span 40) have been found to gel a number of organic solvents at low concentrations. [S Murdan, 2011]</td>
</tr>
<tr>
<td>3.</td>
<td>Micro/Nano-emulsion based organogels</td>
<td>Micro-emulsions are dispersions of two immiscible liquids which are thermodynamically unstable systems. The use of a micro emulsion gel as vehicle may enhance transdermal penetration by various mechanism. [S Ravi et al., 2014]</td>
</tr>
<tr>
<td>4.</td>
<td>Poly (ethylene) organogels</td>
<td>The polyethylene organogels are colorless in nature. These organogels have been extensively used as ointment bases. Poly (ethylene) was also used in the formulation of 5-iodo-2'-De-oxyuridine for the treatment of oral herpes simplex lesions. [S.Sahoo et al., 2011]</td>
</tr>
<tr>
<td>5.</td>
<td>Pluronic Lecithin Organogel (PLO)</td>
<td>PLO is a soy lecithin-based organogels. PLO may or may not contain sorbic acid in both the phases, which acts as a preservative. It occurs as yellow colored, odorless and opaque gel which is quickly absorbed from the skin. [S.Sahoo et al., 2011]</td>
</tr>
<tr>
<td>6.</td>
<td>Eudragit organogels</td>
<td>Eudragit organogels are really mixtures of Eudragit (L or S) and polyhydric alcohols, such as glycerol, propylene glycol and liquid polyethylene glycol, containing high concentrations of Eudragit [S Murdan, 2005].</td>
</tr>
<tr>
<td>7.</td>
<td>Fatty acid derived sorbitan Organogels</td>
<td>These gelators are hydrophobic non-ionic molecules having surface active properties and have the ability to immobilize various solvents like isopropyl myristate and vegetable oils. These gelators form solid-fiber matrix when the heated solution of gelator in apolar solvent is cooled down. The formation of the gel has been attributed to the formation of toroidal reverse micelles as the temperature is lowered. [S.Sahoo et al., 2011]</td>
</tr>
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</table>
Method of Preparation

1. **Fluid-filled Fiber Mechanism**

Firstly surfactants and co-surfactants mixtures were dissolved in apolar solvent that leads to formation of reverse micelles. After the addition of water, tubular reverse micelles were formed. Elongated tubular reverse micelle get entangled to form a 3-dimensional network [S.Sahoo et al., 2011].

2. **Solid Fiber Mechanism**

Apolar solvent and solid organogelator were heated and after cooling to room temperature, there was the formation of precipitates as fibers for organogelators, which undergo physical interactions amongst each other thereby forming a 3-dimensional network structure, which immobilizes apolar solvent [S.Sahoo et al., 2011].

3. **Hydration Method**

In this method gel may be prepared by directly hydrating the inorganic chemical, which produces dispersed phase of the dispersion. In addition of water vehicle, other agent as propylene glycol, propyle gallate and hydroxyl propyl cellulose may be used to enhance gel formation [N.K Mujawar et al., 2014].

4. **Cold Method**

Lecithin solution was prepared by first dissolving lecithin in an organic solvent with the aid of magnetic stirrer. The oil phase is prepared by mixing lecithin and organic solvent, the mixture is allowed to stand overnight to ensure complete dissolution. The aqueous phase is prepared by adding pluronic to ice water; the mixture is agitated to ensure complete dissolution. The prepared pluronic lecithin organogel, the oil phase is mixed with aqueous phase of pluronic using a high shear mixing method by magnetic stirrer. The oil surfactant mixture was heated at 60°C to obtain a clear solution which on cooling forms organogels [K.D Patil et al., 2011].
Fig. 2: Steps involved in the preparation of organogels.

Gel forming Compounds

A. Natural Polymer

The natural polymers like protein, enzymes, muscle fibers, polysaccharides and gummy exudates are used effectively in formulating the various types of pharmaceutical products. For example: Xanthan gum, pectin, tragacanth, guar gum, chitosan, carrageenan etc.

Xanthan Gum

It is occur as a cream- or white-colored, odorless, free flowing, and fine powder. The production of Xanthan gum is done by fermentation of carbohydrates with xanthomonas compestries and purified. It is also called as corn sugar. It is used for various purposes in oral and topical pharmaceutical formulation like, cosmetics, foods as a suspending and stabilizing agent further use is thickner and emulsifying agent. Xanthum gum is nontoxic and it is mostly compatible with other pharmaceutical ingredients [S. Shanmugam et al., 2005].

Chitosan

Chitosan is obtained from chitin by deacetylation process. Shell fish also contain chitosan. Chitin is isolated from the exoskeleton of crustaceans such as crabs, krill and shrimps. It
gives no reaction for cellulose or lignin. It is a novel drug carrier material and it improves the dissolution rate of controlled release matrix tablet. The additional uses of chitosan are as coating agent, gel former and to induce desirable properties such as mucoadhesion and permeation enhancement to improve the oral bioavailability of drugs [S. Shanmugam et al., 2005].

**Carrageenan**
Carrageenan is obtained from red sea weeds by extraction with water or aqueous alkali and recovered by alcoholic precipitation, drum drying or freezing. It is widely used as dissolution rate retarding polymer in sustained release dosage form in many pharmaceutical industries. In food industries it is used in milk product, ice cream, chocolate and jams etc. It is also used in a variety of nonparenteral dosage forms, including suspensions, emulsions, gels, creams, lotions, eye drops, suppositories, tablets, and capsules [S. Shanmugam et al., 2005].

**Tragacanth**
Tragacanth is white to yellowish in color, odorless and dull mucilaginous taste. It occurs as flattened, lamellated, frequently curved fragments. It may also be obtained in a powdered form. It is used as an emulsifying and suspending agent in a variety of pharmaceutical formulations. It is used in creams, gels, and emulsions [R.C Rowe et al., 2009]. The cross linked tragacanth exhibits superior swelling action and can be used as potential disintegrant [S. Shanmugam et al., 2005].

**Pectin**
Pectin is a high-molecular-weight; it’s consisting primarily of chains of galacturonic acid units linked as 1, 4-a-glucosides. It occurs as a coarse or fine, yellowish-white in color, odorless powder that has a mucilaginous taste. It has been used as an adsorbent and bulk-forming agent, and is used in the preparations which are used for the management of diarrhea, constipation, and obesity. It has also been used as an emulsion stabilizer [R.C Rowe et al., 2009].

**B. Acrylic Polymers**
Acrylics are polyesters based on acrylic acid. It is formed from the polymerization of an alkyl acrylate ester. They are widely used in the surface coating industry as well as being used in sheet form because of the exceptional clarity and durability of the process.
Carbomers are synthetic high-molecular-weight polymers of acrylic acid that are crosslinked with either allyl sucrose or allyl ethers of pentaerythritol. It is used as bioadhesive material, controlled-release agent, emulsifying agent, emulsion stabilizer, rheology modifier, stabilizing agent, suspending agent and tablet binder. Carbomers are also used in cosmetics. Carbomer formulations have therapeutically proved efficacious in improving symptoms of moderate-to-severe dry eye syndrome [R.C Rowe et al., 2009].

C. Cellulose Derivatives
Cellulose derivatives are obtained by the amination of hydroxyl ethyl cellulose with two different etherification agents, diethyl epoxy propylamine and diethyl amine hydrochloride. Water soluble cationic cellulose derivatives show sensitivity to pH and ionic strength variations. They could find application in drug or gene delivery system. They have potential to be used for controlled delivery of drugs of acidic character [J.Liesiene et al., 2012].
1. Carboxy methyl cellulose
2. Methyl cellulose
3. Other cellulose.

D. Surfactant
Non-ionic surfactants such as spans and tweens offer many advantages over ionic surfactants including increased stability, flexibility in formulation and more compatibility. Certain spans and tweens are also highly effective solubilisers, dispersing agents and wetting aids.

Span-Sorbitan Esters
Sorbitan esters occur as cream- to amber-colored liquids or solids with a characteristic odor and taste. Sorbitan diesters are a series of mixtures of partial esters of sorbitol and its monoanhydride with fatty acids. Sorbitan esters are widely used in cosmetics, food products, and pharmaceutical formulations as lipophilic nonionic surfactants. Sorbitan esters produce stable water-in-oil emulsions and microemulsions, when they are used as alone but they are frequently used in combination with varying proportions of a polysorbate to produce water-in-oil or oil-in-water emulsions and also in self-emulsifying drug delivery systems for poorly soluble compounds. [R.C Rowe et al., 2009]

Tween-Polyethoxylated Sorbitan Esters
Polysorbates have a characteristic odor and bitter in taste. Tweens are ethoxylated spans. Tweens are hydrophilic in nature and are soluble or dispersible in water and dilute solutions
of electrolytes. The solubility of Tweens increases in aqueous solution with the degree of ethoxylolation. Polysorbates consist 20 units of oxyethylene are hydrophilic nonionic surfactant. The use of polysorbates is mostly as emulsifying agent and in the preparation of stable o/w pharmaceutical emulsions, further use of poysorbates are solubilizing agent in the production of oral and parenteral suspensions, also used widely in cosmetics and food products. [R.C Rowe et al., 2009]

**Properties of Organogel**

1. **Visco-elasticity**
   The organogels behave like a solid on low shear rates and starts flowing on high shear rates due to weakening of physical interacting point of fiber matrix. They follow Maxwell model of visco-elasticity.

2. **Non-Birefringence**
   Under the polarized light organogels appears as a dark matrix, due to their isotropic nature. They don’t allow polarized light to pass through its matrix. This property of organogel is known as Non-Birefringence.

3. **Thermo-reversibility**
   When organogels are heated above critical temperature, it loses its solid matrix and start flowing, and then on cooling they regain their positions. This is because of the presence of the thermal energy in between the organogels.

4. **Thermo-stability**
   Organogels are thermo-stable in nature. Gelators can undergo self assembly under suitable conditions which are used to form organogels. As they undergo self assembly, it results in the decrease of total free energy of the system and hence the low energy thermo-stable organogels system formed.

5. **Opacity**
   Organogels can be transparent or opaque in nature, depending on the composition of the organogels. The lecithin organogels are transparent in nature while the sorbitan monostearate organogels are opaque in nature.
6. Chirality effects
The low molecular weight gelators affect the growth and the stability of the solid fibre networks because of the presence of chilarity but chirality does not have any effect on fluid-fiber gelators. The chiral centers within the gelators help in the formation of a compact molecular packing, which is suitable for thermodynamic and kinetic stability to the organogels system.

7. Biocompatibility
Organogels are found to be biocompatible in nature. [S. Jha et al., 2013]

Characterization of Organogels
1) Structural Features
An efficient characterization methodology for any organogel system begins with its structural elucidation. Due to the isotropic nature and the optical clarity of LOs spectroscopic techniques, like nuclear magnetic resonance (NMR) spectroscopy, and Fourier transformed infrared (FTIR) spectroscopy is possible. Various techniques have been employed to find the nature of binding forces responsible for association of monomers to form self-assembled structures, and FTIR spectroscopy has been found to be successful in establishing the hydrogen bonding as one of the major driving forces for the self-assembly of organogelator molecules in the organic solvents. Recently, small-angle X-ray scattering and atomic force microscopy have become important tools in determining the molecular arrangement of long range structures such as LOs, together with the absolute quantities such as diameter, length, or topology in gels. The direct visualization of the gel in its native state is possible using AFM, which allows observing the microstructures of the fibrous network throughout the gel mass. It also provides structural details on the larger length scale.

2) Rheological Behavior
These systems follow Maxwell’s rheological behavior on addition of the polar solvent but prior to gelling exhibit Newtonian behavior. It has been reported that the Maxwell’s rheology model holds good for systems with 3-dimensional temporal network of entangled micelles. The visco-elastic property of the organogels can be managed by modifying the formulation components, which extensively influence the structural stability and rheological behavior.
3) Phase Transition Temperatures
The organogel phase behavior can vary on changing temperature conditions. The nature of microstructures which forms gelling cross linked network can be closely viewed by the Phase transition temperature. It helps in optimizing the organogel composition. The microstructural homogeneity of the prepared organogel system also shows by the phase transition temperature. Hot stage microscopy and high sensitivity differential scanning calorimetry techniques can be used for the purpose of phase transition temperature.

4) Water Content
Nastruzzi and Gambri have determined the water content in LO\textsubscript{5}. They have proposed near-infrared spectroscopy as a simple, rapid and non destructive technique. The water loss by the evaporation can lead to subsequent decrease in the viscosity of the organogel and thus affecting the stability of the gel. Due to the presence of H-O-H stretching overtones, water shows a strong absorption peak at 1918nm. They have easily detectable and experimental. In addition, this method has also been proposed to be useful to identify phase separation (syneresis) in the prepared organogel formulations. [R. Kumar et al., 2005]

Evaluation parameter’s for Organogels

1) pH
Digital pH meter can be used for determining pH of the formulated organogels.

2) Physical appearance
Colour, homo-genecity, consistency, appearance and texture can be observed for prepared organogels.

3) Drug-polymer compatibility studies
The drug and polymer compatibility studies can be carried out by using Fourier Transform Infrared Spectrophotometer (Shimadzu FT-IR 8400-S) in the range of 400-4000cm\textsuperscript{-1} by KBr disc method.

4) Rheology
The organogels rheological properties can be determined by using a Brookefield’s viscometer (Model DV II+).
5) Drug content determination
UU-Visible spectrophotometer is used for the estimation of drug content. Amount equivalent to 25 mg of drug was taken and dissolved in 25 ml of methanol. Further dilutions were made using citro-phosphate buffer pH 5.5.

6) Spreadability
The spreadability of formulated organogels can be evaluated using a fabricated spreadability apparatus which consisted of two glass plates. Sample to be determined is placed on the lower plate and the upper plate is placed on the top of the sample. Then force is applied by adding increasing weight slowly for one minute into the pan connected to the upper plate. Each sample is tested for at least three reading and their mean values are calculated. [S.Abraham et al., 2013] Spreadability is measured as:

\[S = \frac{M \times L}{T}\]

Where, M= weight to be taken, L= length of the slide, T= time taken

Factor Affecting Organogels
1) Organic Solvent
The addition of polar solvent into the spherical lecithin micelles may cause an increase in cross-sectional area of the lecithin polar region, in which the solvent is arranged. A non-aqueous solvent is not particularly partial as long as it replaces water of the bacterial cellulose hydrogel completely without destroying its shape. E.g. Polyethylene glycol, Dimethylether.

2) Phase Transition Temperature (PTT)
It shows the nature of microstructures that form the gelling cross linked network. Hot stage microscopy and high sensitivity differential scanning calorimetry are the accurate and sensitive techniques for determining PTT.

3) Salt addition
Salt may magnetize part of water of hydration of the polymer allowing more formation of inter molecular secondary bond.

4) Temperature
The cause of temperature depends on the chemistry of the polymer and its mechanism of interaction with the medium. If the temperature is reduced when the gel is in the solution
form, the degree of hydration also reduced and gelation occurs. Formation of gel results from the cross linking of the chemicals, often cannot be liquid by dilution or temperature changes.

5) Molecular Weight

Low molecular weight polymers involve a high concentration to build up viscosity and to set to gel possibly.

6) Surfactants

Gel features can be varied by adjusting the proportion and concentration of the ingredients. Poloxamer 407 is a polyoxyethylene that function as a surfactant.

7) Physicochemical Properties

Charge: the presence of charged groups on a polymer favors mucoadhesion.

Solubility: mucoadhesives swell on contact with moisture, increasing the mobility of polymer molecules at the interface and exposing more sites for bond formation.

Molecular weight/ spatial configuration: It favors change in entanglement and interaction after the polymer and mucins have interpenetrated. [S.Gupta et al., 2011]

Applications of Organogels in Drug Delivery

The interest on the organogels based products has exponentially grown in the last decade.

The use of the organogels as a drug delivery vehicle was quite limited even in the recent past as most organogels were prepared using components which are regarded as non biocompatible.

Pretereral Delivery: L-alanine based injectable insitu forming organogels may be used for the delivery of labile macromolecular bioactive agents. The half life of the Sorbitan monosterate organogels is very short at the injection site. This may be approved to the diffusion of water molecules within the gelled structure which results in the subsequent interruption of the networked structure due to the emulsification of the gel surface. Development of a sorbitan monosterate based organoge showed prolonged delivery of a model antigen and radiolabelled bovine serum albumin after intramuscular administration of the probable use of the formulation as depot according to a study. These insitu forming organogels may be used for sustained delivery of bioactive agents after the same is being administered within the body. [V. Peter et al., 2014]
**Oral Delivery:** Sorbitan monostearate system is the example of the oral organogel formulations.\(^21\) Ibuprofen and non steroidal anti-inflammatory drug is incorporated within the gelled structure. *In-vivo* studies in rats showed that the organogels may be used as controlled delivery vehicle for oral delivery of lipophillic compounds [V. Peter et al., 2014]. After organ transplantation Cyclosporine A, used as powerful immunosuppressant. Cyclosporine A is incorporated in organogels varying in nature from highly hydrophobic to more hydrophilic systems. [S. Debnath et al., 2014]

**Transdermal Delivery:** Lecithin based organogels have also been tried as a matrix for transdermal delivery system because of its ability to improve the transport rate of the bioactive agents apart from its proven long term biocompatibility and low irritability potential. The aromatic tetra-amidines loaded in lecithin organogel they reduce the tumor cell growth in nude mice xenografted with the highly tumorigenic cell line FH06T1-1 by transdermal administrations. The methyl nicotinate incorporated within lecithin gel showed almost complete percutaneous absorption in experimental human models in a short period of time, which was characterized by the induction of erythema. The iontophoretic delivery system which uses MBG\(_5\) release the bioactive agents at higher rates when compared to passive diffusion [V. Peter et al., 2014]

**Topical Drug Delivery:** Therapeutic compounds of different chemical and physicochemical conditions such as muscle relaxants, steroids hormones, analgesics, antiemetic, and cardio vascular agents have been incorporated in the organogel with some encouraging results.

i) *Cosmetic:* well used in the cosmetic and personal care markets.

ii) *Ophthalmic:* Drug product resembled normal lachrymal turnover causes rapid clearance of solution and suspension dosage forms.

iii) *Ointments:* It is of various advantages like good acceptability, formation of a protecting film over the cornea, protection from conjuctival adhesion.

Methazolamide unproductive as an ophthalmic solution has been incorporated into carbomer and poloxamer gels for treatment of Glaucoma. [T.Garg et al., 2011]

**Dermal Drug Delivery:** The muscle relaxants administered in lecithin –Isopropyl myristate organogel is shown to provide immediate relief of pain resulting from bruxism (tooth grinding) and tooth clenching. Organogel have also been found to be an excellent matrix for the delivery of macromolecule with a molecular weight of 33000 Daltons. Phospholipids organogel containing anti-inflammatory macromolecule bromelain (15%) along with
capsaicin (0.025%) has been found to be effective anti-inflammatory composition. When this type of organogels are directly applied at the site of inflammation, it has been found to be useful in treating a variety of inflammatory indications. Subcutaneously-injected in situ-forming organogels prepared from L-alanine derivatives in safflower oil were used in the long term delivery of leuprolide, a luteinizing releasing hormone agonist used in prostate cancer. [S. Debnath et al., 2014]

**Table 2: Details of patents on organogels.**

<table>
<thead>
<tr>
<th>Name of topic</th>
<th>Patent number</th>
<th>Patent filling date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organogel compositions comprising alkylated benzimidazolones [T Litvin et al., 2012]</td>
<td>CA 2794445A1</td>
<td>Nov.2.2012</td>
</tr>
<tr>
<td>Organogel structured with 12-has and a selected polymer[D Makeiff et al., 2012]</td>
<td>WO 2013068345A2</td>
<td>Nov.6.2012</td>
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**REFERENCE**


