Meenu Sreekumar et al /J. Pharm. Sci. & Res. Vol. 12(10), 2020, 1306-1308

ISSN:0975-1459
Journal of Pharmaceutical Sciences and Research
www.jpsr.pharmainfo.in

# Bigels: An Updated Review

**Meenu Sreekumar*, Mathan S, Sibi S Mathew, Shaiju S Dharan**
*Department of Pharmaceutics,*
*Ezhuthachan College of Pharmaceutical Sciences, Marayamuttom, Neyyatinkara,*
*Trivandrum-695124, Kerala, India.*

**Abstract**

Bigels are interesting innovative dual phase systems that have been recently proposed as a structured system for the delivery of active ingredients. Bigels, mixture of organogel and hydrogel in different proportion so it expresses merits of both phases (aqueous and oily phase) and these systems can overcome the demerits of both types of gels. Due to the combination of organogel and hydrogel, bigels shows some interesting characters like the capability to deliver both hydrophilic and lipophilic drugs, fastly spreadable, washable, hydration of stratum corneum, improve patient compliance and provide controlled drug delivery. The main objective of this review article is to provide a thorough insight in to the classification of bigels, advantages, disadvantages, preparation and characterization. Moreover, special focus is given to the applications of bigels as topical drug delivery system.

**Keywords:** Bigel, organogel, hydrogel, topical drug delivery

## INTRODUCTION

Gels are semisolid formulations which usually have two components, liquid and solid. Where liquid component is termed as solvent and the solid component is termed as gelling agent/ gelator. Gels are 3D networked systems which have a wide range of applications in pharmaceutical field.

Gels are classified in to 2 according to the nature of 3D network structures formed by the gelators: - polymer gels and particle gels. Polymer gels are formed due to the crosslinking of polymer molecules. Particle gels are formed by the colloidal particles aggregation. On the basis of polarity of solvent, gels are classified in to 2 types: - hydrogel and organogel. When the liquid solvent is polar it is called hydrogel and the liquid solvent is nonpolar it is termed as organogel. The hydrogels are 3D hydrophilic networks of homopolymeric or heteropolymeric chains and the cross-linked hydrogels have the ability to absorb huge amount of water without itself dissolving in it.Organogel is a solid like system in which organic liquid is entrapped inside a thermoreversibile 3D network. Organogels are very easy to prepare and its lipophilic nature will enhance the drug permeation through the stratum corneum. Organogel is oily in nature so it is difficult to remove when it is applied to the skin. Bigels are gels formed by the combination of two gels ie; organogel and hydrogel. Hydrogel helps in hydration of stratum corneum and organogel helps in increased penetration. Other benefits of bigels include easy washability, easy spreadability, and good contact period and bigels can overcome the disadvantages of both gels including the limited ability to cross the lipophilic barrier and low patient compliance for hydrogels and oily residues and stickness of organogel.

According to the distribution of two phases in bigels, these system is mainly classified in to 3 types:-

1. Hydrogel in organogel type
2. Organogel in hydrogel type
3. Bi- continuous/ matrix in matrix type [1,2,3]

**Advantages**

1. Bigels helps in enhanced hydration of stratum corneum
2. Bigels will accommodate both lipophilic and hydrophilic drugs
3. Bigels provide controlled drug delivery
4. Bigels gives good moisturizing effect to the skin
5. Bigels provide good spreadability
6. Bigels provide good washability [4,5,6]

**Disadvantage**

1. The main disadvantage of bigel is destabilization at high temperature, it means that this bigel system is not thermoreversibile [3]

## PREPARATION OF BIGEL

Bigels are prepared by mixing two gels ie., organogel and hydrogel, in different proportion with continuous stirring for a particular period of time at high shear rate/rpm to get a good homogeneous system. Hydrogels are prepared by the synthetic or the natural hydrophilic polymers which form a colloidal network of polymer chains in the water and the organogel products are increased due to the easy preparation and the long term stability.

During the preparation of bigel the temperature should be maintained during the mixing. Thermostability of the hydrogelators is very important during the method of mixing, otherwise degradation of the hydrogelators should occur.[3,7]

## CHARACTERIZATION

The important characterization of bigel system includes mechanical, structural, thermal, physical, rheological and electrical properties. Effect of many parameters in the mechanical properties of bigels includes organogel/hydrogel content, polymer structure (linear or branched) and polymer concentration. The content of organogel increases shows some significant impact on the cohesiveness, firmness, adhesiveness, stickiness, viscosity, and percent creep recovery of bigels .Likewise, when the hydrogel content increases the hardness of bigel also increases. The bigel systems includes branched polysaccharides, as water structuring agent, shows higher gel strength and better resistance to deformation. The leaching studies of bigels to find out the leaching of oil phase from the prepared formulations. The results showed

that the leaching from the bigels was very minute as compared to the emulgels. Final properties of the bigel system depend upon the structural distribution of each phase within the bigels and droplet size of the dispersed phase and the parameters can be measured by microscopic analysis.

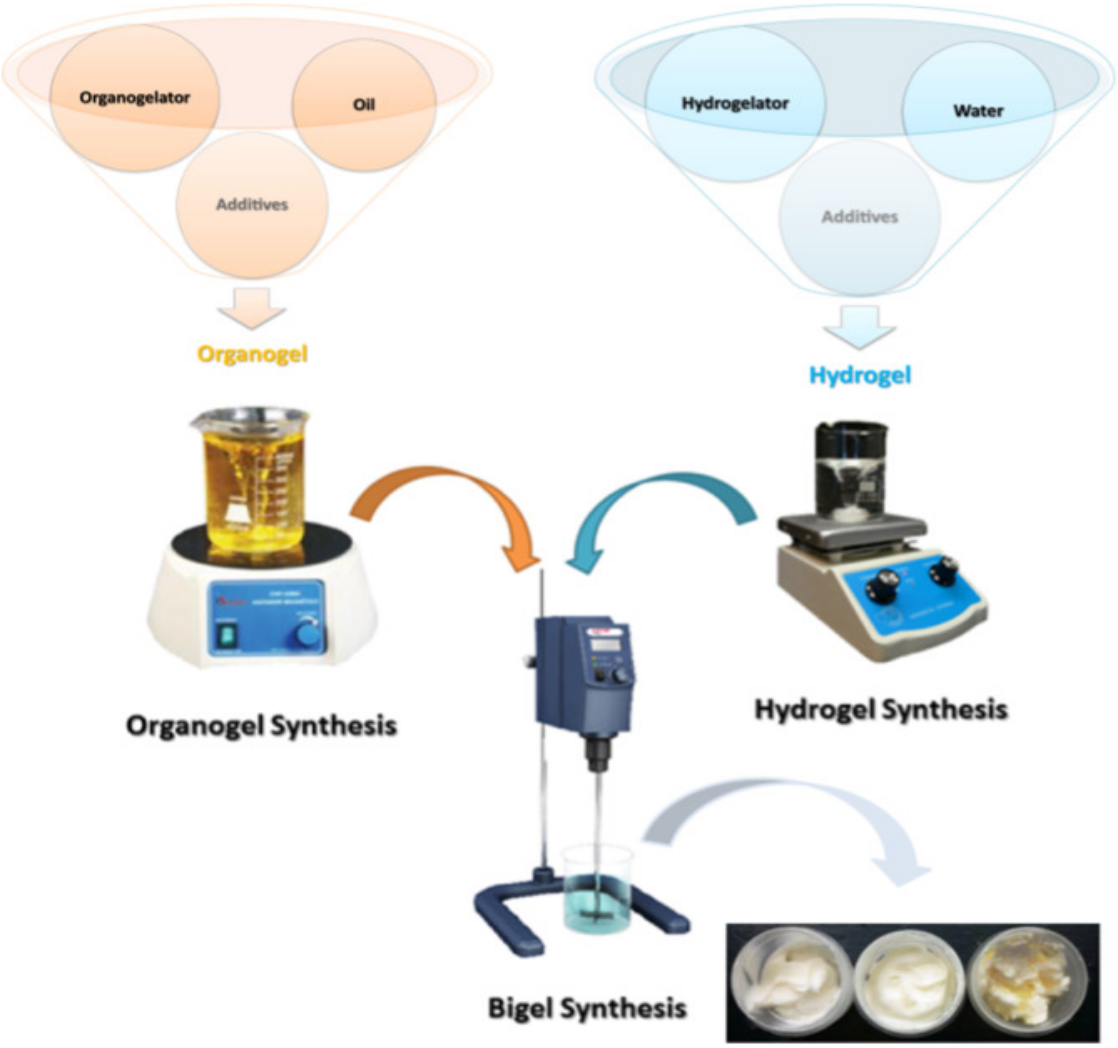
The effect of organogel content in the structural features of the bigel system have been reported in the literature. The small amount of organogel resulted in the heterogeneous continuous hydrogel matrix within the bigels which comprised of water droplets together with oil droplets while the interlinked organogel droplets in a complex system is formed by the higher organogel content. The increased organogel fraction can affects the polydispersity of droplets either in the enhancing or reducing manner depends on the constituents of the system.

The efficiency of a gelled systems for the commercial applications is directly linked with the rheological properties. The, dynamic rheological methods are useful in analyzing and optimizing the rheological properties of formulations and the rheological characterization of different bigel systems has been done by using strain controlled rheometer and stress controlled rheometer. Stress sweep tests of bigels shows that the critical stress, before which the moduli remain constant, for linear polysaccharides based bigels was 10Pa and for branched polysaccharides based bigels the value was 100Pa.

Sol-gel/gel-sol transition is a function of temperature and thermal stability. The thermal analysis of proteins/ sunflower oil based bigels shows that the broad endothermic peak, due to the evaporation of moisture was observed at higher temperature. Also these, bigel shows higher values of change in enthalpy (ΔH), associated with the evaporation of the water.

The thermal properties of organogel phase after it is put it in to a bigel system remained same as the pure organogel sample. Thermal stability of bigel systems is enhanced by increasing the organogel fraction or organogelators amount.

Electrical characterization is an important tool and this tool help to quantify the different parameters of the bigel formulations such as the electrical conductance, electrical resistance, impedance, etc and these different parameters are directly linked with their efficacy for the controlled delivery of the drugs. Electrical conductivity is also an important parameter in order to understand the distribution pattern of the individual phases within the multi-phase systems and the microenvironment of the systems. [1]



## APPLICATIONS IN TOPICAL DRUG DELIVERY

Drug delivery is a process to get the required therapeutic effects by incorporating and releasing active compounds from the formulation to the desired site of action. Skin is the largest organ of human body, it provides a layer of defense for our human body against microorganisms, heat, etc. A small number of active agents shows the properties to cross the barrier. Stratum corneum, viable epidermis and dermis are the three layers of skin through which the active agents can pass in to it. Transdermal/topical delivery helps in controlled drug delivery of active agents. The parameters which affect the permeation in to the skin includes blood flow rate, permeability of skin and the physicochemical properties of drugs. Topical delivery of drugs through the skin is very important due to some reasons: non-invasive, no need of trained persons, inability of drugs to pass through the metabolism, absence of problems related to intravenous therapy. Transdermal drug delivery has been widely used for many applications which includes the treatment of inflammation, itching, infection and also for the delivery of drugs in to the systemic circulation. Acacia gum based bigels shows highest drug release followed by the guar gum based bigels and then the xanthan gum based bigels. The lowest drug release from xanthan gum was displayed to the higher viscosity of xanthan gum based bigels. The branched polysaccharides based bigels showed small drug release as compared to the linear polysaccharides based bigels. Bigels shows high drug permeation than the hydrogel which has been attributed to the presence of fatty acids in fish oil. However, HPMC based bigels will shows the small drug permeation than the sodium alginate based bigels which was linked with the restricted release of drugs due to the presence of cellulose content present in the HPMC. High drug release rate from the hydrogel was attributed to the presence of aqueous phase and the smaller gel viscosity resulted in very easy permeation of hydrophilic drugs whereas the lowest drug release rate from the organogel shows the higher viscosity and lower surface activity. [3,8,9,10]

## REFERENCES


1. Ahmad S, Ujala F, Tanveer I. Key characteristics and modelling of bigel systems: A review. Materials Science & Engineering C 97(2019): 932- 53.
2. Shibayama M, Tanaka T. Phase transition and related phenomena of polymer gels. Ad Polym Sci 1993: 1-62.
3. Ahmad S, Francesca RL, Domenico G. Bigels: A unique class of materials for drug delivery applications. Soft materials 2018: 1-30.
4. Narayana CR, Arjun M, Sandeep DS. Design and evaluation of bigels containing flurbiprofen. Research J. Pharm. and Tech. 2018; 11(1): 143-52.
5. Velichka A, Petya P, George SG, Vencislava TT. Ketoprofen-loaded polymer carriers in bigel formulation: an approach to enhancing drug photostability in topical application forms. International Journal of Nanomedicine.2017; 12 6221-38.
6. Velichka YA, Petya TP, Elisaveta GA, Teodora DD. Carbopol hydrogel/ sorbitan monosterate- almond oil based organogel biphasic formulations: preparation and characterization of the bigels. Trop J Res. 2017; 16(7): 1455-63.
7. Mohmoud MI, Salma AH, Mahmoud MM. Organogels, hydrogels and bigels as transdermal delivery systems for diltiazem hydrochloride. Asian Journal of Pharmaceutical Sciences. 2013; 8: 48-57.
8. Sagiri SS, Behara B, Rafanan R. Organogels as matrices for controlled drug delivery: A review on the current state. Soft Mater. 2014; 12(1): 47-72.
9. Kamaly N, Yameen B. Degradable controlled release polymers and polymeric nanoparticles: Mechanisms of controlling drug release. Chem Rev. 116(4): 2602-63.
10. Fang JY, Hwang TL, Fang CL. In vitro and in vivo evaluations of the efficacy and safety of skin permeation enhancers using flurbiprofen as a model drug. Int J Pharm. 2003; 255(1-2): 153-166.