



Formulation and Evaluation on "Herbal Nanogel "

Harshavardhan S. Bhosale, Rutuja R Shah

Anandi Pharmacy College Kalambe Tarf Kale, Kolhapur, India.

Received: 2025-2-02

Revised: 2025-2-15

Accepted: 2025-2-21

Abstract:

Increasing research interest has been focused on controlled as well as sustained drug delivery using natural and biocompatible constituents in recent years. This review paper will highlight on the methodology of Nanogel. Drug loading, release mechanisms, and their application in industry for herbal medicine. The term "Nanogel define as a hydrogel nanoparticle with a network of cross-linked hydrophilic polymers. Nanogel ere nanoparticles made up of cross-linked polymer that swell in a suitable solvent. They can be administered by various routes such as oral, nasal, parenteral, pulmonary intra-ocular etc. This study examined the most recent advancements in Nanogel production and drug delivery. Phytochemistry is a discipline of chemistry that studies herbal compounds. Herbal substances have aided in the development of innovative remedies for a wide range of illnesses. Several of these compounds are forbidden from being used in medications due to broad medical characteristics and pharmacokinetics.

Keywords: Herbal medicine, Nanogel, basic methodology, drug Loading techniques.

INTRODUCTION:

Herbal medicines that are those with working ingredients made from plant parts, like leaves, roots or flowers. Herbal medicine is a special and remarkable form of traditional medicine in which the traditional mean in this case known as the herbalist. Specializes in the use of herbs to treat various ailments. Herbal medicine is often defined as "the therapeutic practices that are alive for many years, before the event and spread of recent medicines", This branch of other medicines that medicinal plants for therapy is applied as herbal medicine which exploits medicinal plants for therapy is applied as herbal medicine which is mostly researched by many researchers.

Nanogel have emerged as suitable vehicle for delivering and releasing medications to patients in recent years as one of the many dimensions of Nano medicine the junction of nanotechnology, medicine, and pharmaceuticals. Nanogel are cross-linked polymer networks that are nanoscale in size and capable of absorbing enormous amounts of water. Nanogel are hydrogels with a size of nanometres or less. A hydrogel is a polymer-based that is made by connecting polymer chains to form a macromolecular network. Hydrogels can be made in a variety of ways but all require the creation of polymeric monomers, which must then be polymerized with functional cross-linker molecules to form a 'not-like polymer structure. Pharmaceuticals can be loaded into the pores and then released flatter through the pores. Nanogel, on the other hand, are essentially hydrogels but on a 20 200 nm scale. Emulsion polymerization is used to make the vast majority of Nanogel. Patients can be given Nanogel orally, pulmonary, nasally, parentally, or intra-ocularly. The medications are released from the Nanogel in a variety of ways, but the mechanism including activation by external stimulation alters internal properties. Due to this physical change, which causes the polymer network to swell or compress, the medicinal is delivered to the desired area. Depending on the release mechanism used, this stimulation could come from the body's immediate surroundings or an external stimulus source. A certain change in temperature within a specific volume are the most common internal-external components that produce a physical change (also known as the volume phase transition temperature). On the other hand, light is the most common external stimulation.

Importance of Nanogel

- Less amount of drag is required.
- Provide protection from biodegradation of drug molecule inside the body system.
- Size of Nanogel can be adjustable according to delivery mechanism.



- Reduced the toxicity of drugs.
- Nanogel are able to cross physiological barrier of skin also the blood brain barrier.
- Nanogel with loaded drug delivered inside the body without any side effects and also can be applied topically.
- Easy for scale up and friendly formulation route.
- Appropriate for many of bioactive compounds like proteins, antibodies, peptides etc.
- Enhance permeation capability.
- Improved ability to access areas that is not accessible by hydrogel, upon intravenous administration.

Properties of Nanogel

- **Biocompatibility and Degradability:** Nanogel based drug delivery system is highly biocompatible and biodegradable, due to this characteristic it is highly suitable for the patients.
- **Swelling Property in Aqueous Media:** The most beneficial features of Nanogel is their rapid swelling/de-swelling characteristics.
- **Higher Drug Loading Capacity:** Drug loading capacities of Nanogel depend on the functional group present in the polymeric unit. These functional groups have an effect drug carrying and drug releasing properties, and some functional groups have the potential to conjugate with drugs/antibiotics for targeting for application.
- **Particle Size:** Nanogel ranges in size of 200nm in diameter and therefore effect avoiding the rapid renal exclusion but are enough to avoid the uptake by the endothelial system.
- **Solubility:** Nanogel are able to soluble hydrophobic drugs and diagnostic agents in core or network of gel.
- **Electro mobility:** Nanogel could be prepared without employing energy or harsh condition such as sonication or homogenization, which is critical for encapsulating bio-macromolecules.
- **Colloidal Stability:** Nanogel have better stability over the surfactant micelle concentrations, slower rate of dissociation, and longer retention of loaded drugs.

Nanocarrier as drug release mechanism :

A nanocarrier is a type of nanomaterial that is used to convey another chemical, such as a medicine. Archetypes such as micelles, polymeric systems, carbon-based materials, and liposomes are often utilized as medicinal application in nanocarrier. 19% Nanocarrier are now being researched medication delivery, and their particular properties suggest that they could be useful in chemotherapy. Nanomaterial can enter the body by a variety of routes, including the respiratory system, the skin, the digestive tract, and medication injection, before being transported to organs and may exert severe biological effects such as inflammatory responses, oxidative stress, and DNA damage. As NPs possess an ability to load and deliver an amazing spectrum of drugs to almost any organ of the body, delivering focused, regulated, as well as prolonged therapeutic effects, they have become an important subject of drug delivery studies. Examples of Nanogel are reported for drug delivery applications including both hydrophobic and hydrophilic agents, and even oligodeoxynucleotides.

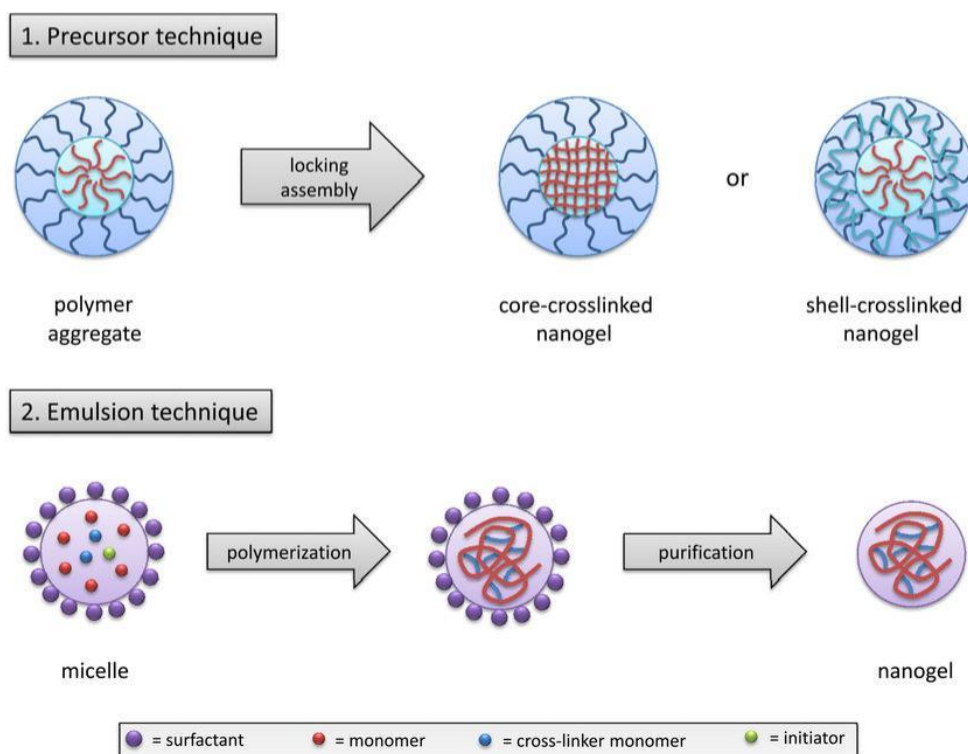
Basic methodology of Nanogel :

Basic method of preparation of Nanogel Method used for synthesis of Nanogel are listed as follows:

- Biopolymer synthesis system
- Water in oil (W/O) heterogeneous emulsion method
- Inverse Nano emulsion method

- Reverse micellar method.
- Membrane emulsification method
- Heterogeneous free radical polymerization method
- Conversion of microscopic gel technique

1. Chemical cross-linking method



Cross linked polymer method :

A cross-linked polymer Nanogel is formed when polymer chains are interconnected through covalent bonds (chemical cross-linking) or non-covalent interactions (physical cross-linking) to create a three-dimensional network on a nanoscale, resulting in a stable, swollen gel-like structure with the ability to encapsulate various molecules within its matrix; essentially, it's a tiny, cross-linked polymer gel particle.

Key points about cross-linked polymer Nanogel formation:

- Polymer selection:

The choice of polymer is crucial, as it determines the nanogel's properties like hydrophobicity, biocompatibility, and responsiveness to stimuli.

- Cross-linking agents:

To create the network, a cross-linking agent is added, which can be a molecule with multiple reactive functional groups that can form bonds with the polymer chains.

Emulsion technique :

W/O emulsion methods involve generally two steps: emulsification of aqueous droplets of water-soluble biopolymers in continuous of phase with an aid of oil-soluble surfactants and cross linking of biopolymers with water-soluble cross linkers.



Application of Nanogel:

Applications including drug delivery, Bioimaging, and water decontamination.

- Drug delivery

1. Cancer therapy: Nanogel can target cancer cells and reduce uptake into healthy cells.
2. Neurological diseases: Nanogel can treat central nervous system disorders and neurodegenerative diseases.
3. Diabetes: Nanogel can be used to treat diabetes.
4. Anti-inflammatory therapy: Nanogel can be used to treat inflammatory diseases.
5. Anaesthetic drugs: Nanogel can be used to deliver anaesthetic drugs.
6. Wound healing: Nanogel can be used to treat wounds.
7. Bone regeneration: Nanogel can be used to regenerate bone.
8. Psoriasis: Nanogel can be used to treat psoriasis.

- Bioimaging

Contrast agents: Nanogel can be used to entrap contrast agents for imaging.

Nanoparticles: Nanogel can be used to encapsulate gold and silver nanoparticles for imaging.

- Other applications

1. Water decontamination: Nanogel can be used to decontaminate water.
2. Catalysis: Nanogel can be used for catalysis.
3. Nanogel can be customized to respond to environmental stimuli, which can improve their precision and Efficacy.

CONCLUSIONS

Nanogel formulation is a versatile platform for enhancing herbal drug properties. Due to its flexibility and versatility Nanogel have several opportunities in herbal formulations as a drug carrier. Herbal Nanogel transform natural products into the most suitable drugs for the treatment of many diseases, such as cancer, skin diseases, diabetes, etc. Chitin, chitosan, PLGA, PEG and other polymers are generally used in the synthesis of cross-linked herbal Nanogel. These cross-linked Nanogel have excellent potential in delivering drugs through the transdermal route. Compared with oral drugs, this has less side effects on patients' compliance with herbal medicines. Although many natural medicinal products have been developed, not all of these products are safe. Some are highly toxic, can interact with conventional drugs and have adverse side effects. For herbal products to be accepted in modern. Medical systems, the quality of herbal products needs to be evaluated. Herbal Nanogel formulations are currently expected in the pharmaceutical industry and can give the required synergistic effects at low drug concentrations and almost no side effects. In general, herbal Nanogel products can be a practical new drug carrier system.

REFERENCES:

1. Pallvai M. Chaudhari and Aarti V. Paithankar, "Herbal Nanogel Formulation: A Novel Approach", Journal of Science and Technology, Vol. 05, Issue 05, Sep-October 2020, pp149-Page 26 AJPS 2022, 09 (02), 19-27
2. Viswanathan B, Salim M, Subhramani A, Sruthi. Historic review on modern herbal nanogel formulation and delivery methods. International journal of pharmacy and pharmaceutical sciences 2018;10(10):1-1
3. AL, Magbool F. Elamin I, Shayoub M. Nanogel a pharmaceutical carrier-review article. Scholars journal of applied medical sciences 2017; 5(11F): 4730-4736.
4. Iordana Neamtu, Alina Gabriela Rusu, Alina Diaconu, Loredana Elena Nita and Aurica P. Chiriac. Basic concepts and recent advances in nanogels carriers in medical applications. Drug delivery 2017, 24(1):539-557.



5. Kamboj VP. Herbal medicine. *Curr Sci* 2000, 78:35-8. 3
6. Vickers A, Zollman C. ABC of complementary medicine: herbal medicine. *Rr Meal* 1999; 319:1050-3.
7. Yadav D, Suri S, Choudhary AA, Sikender M, Hernant, and Beg NM, et al. Novel approach: herbal remedies and natural products in pharmaceutical science as nano drug delivery systems. *Int J Pharm Tech* 2011,3:3092-116
8. Ansari SH, Farha 1, Sameem M. Influence of nanotechnology on herbal drugs: a review. *J. Adv Pharm Technol Res* 2012;3:142-6.
9. Bonifacio BV, Silva PB, Rams MAS, Negri KMS, Bauab TM, Chorilli M. Nanotechnology-based drug delivery systems and herbal medicines: a review. *Int J Nanomed* 2013;9:1-15
10. Rajesh B. Das S. Dharnajit P. Pavani M. Formulation design and optimization of herbal gel containing albizia lebbeck bark extract. *Int J Pharm Pharm Sei* 2014;6:111-4.
11. Karanth H. Murthy RS. Nanotechnology in brain targeting. *Int J Pharm Sci Nanotechnol.*2008;1(1):10-24 12.
12. Vinogradov SV. Nanogels in the race for drug delivery. *Nanomedicine.* 2010 Feb 11;5(2):165.
13. Sultana F. Manirujjaman, Imran-Ul-Haque M. Arafat M, Sharmin S. An overview of nanogel delivery system. *J Appl Pharm Sci* 2013;3:595-1
14. Jain N, Jain R. Thakur N. Gupta BP. Jain DK, Banveer J. Jain S. Nanotechnology: a safe ffective drug delivery system. *Asian J. Pharm. Clin. Res.* 2010;3(3).
15. Olina M, Asadian Birjand M. Balach M., Hashemi, M., Mokditarzadeh, A., Abnous, K., and Ramezam, M. (2018) Recent advances in co-delivery systems based on polymeric nanoparticle for cancer treatment. *Artif. Cells Nanomed. Biotechnol.* 46, 1095-1110. doi:10.1080/21691401.2017. 1376675
16. Bonificio BV, da Silva PB, dus Santos Ramos MA. Negri KM5, Baab TM. Chorilli M. Nanotechnology-based drug delivery systems and herbal medicines a review. *Nanomed* 2014,9:1
17. Anatomy, Skin (Imegumenti, Epidermis Yousef H. Alhajj M, Sharma S November 14, 2022
18. Holloway, A review of the effects of ageing integrity wound healing. *Br J Community Nurs.* 2019 Mar 01:24(Sup3):\$28-833. [PubMed]
19. Bany HW, Novel mechanisms and devices to enable successful transdermal deng delivery. *European Journal of Pharma Science* 2001:14(2):101-14.
20. Swati Talele, Preetam Nikam, Braja Ghosh, Chaitali Deore, Ashwini Jaybhave et al. (2017) A Research Article on Nanogel as Topical Promising Drug Delivery for Diclofenac sodium. *Indian 3 of Pharmaceutical Education and Research* 51(45): 580-597
21. Saurabh Tiwari, Shweta Singh, Pushpendra Kamar Tripathi, Chetan Kamar Dubey (2015) A Review Nanogel Drug Delivery System. *Asian J. Res Pharm. Sci.* 5(4):253-255
22. Pachana Sultura, Manirujjaman, Md. Leean-Ul-Haque, Mohammad Arafat, Sanjida Sharmin (2013) An Overview of Nagel Drug Delivery

How to cite this article:

Harshavardhan S. Bhosale et al. *Jcpr.Human*, 2025; Vol. 21 (2): 13-17

Conflict of Interest Statement:

The authors have no conflicts of interest to declare.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.