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## **IMPORTANCE OF NANOEMULGEL FORMATION FROM MEDICINAL PLANTS OF TURKMENISTAN**

***Abstract:** The importance of nanoemulgel formation from medicinal plants in Turkmenistan is a growing area of research, particularly for its potential in enhancing drug delivery systems and therapeutic effectiveness. Nanoemulgels are a combination of nanoemulsions and gels, which provide numerous advantages in drug formulations, such as increased bioavailability, stability, and controlled release of bioactive compounds. Medicinal plants native to Turkmenistan, with their rich diversity, offer significant potential in developing these advanced pharmaceutical formulations. This article explores the formation of nanoemulgels from medicinal plants of Turkmenistan.*

***Ключевые слова:** nanoemulgel, medicinal plants, Turkmenistan, drug delivery systems, bioavailability, pharmaceutical formulations, nanoemulsions, therapeutic effectiveness*

Turkmenistan is home to a diverse array of medicinal plants, many of which have been used for centuries to treat various ailments. These plants contain bioactive compounds that exhibit significant therapeutic properties, such as anti-inflammatory, antimicrobial, and antioxidant activities. However, the poor solubility and bioavailability of these compounds often limit their effectiveness when used in traditional forms of medicine.

To overcome these challenges, modern pharmaceutical technologies such as nanoemulgel formation are being explored. Nanoemulgels combine the properties of nanoemulsions (ultrafine emulsions) and gels, offering an innovative approach to improving the delivery and absorption of medicinal plant-derived compounds. This paper examines the importance of nanoemulgel formation from medicinal plants of Turkmenistan, with a focus on their potential applications in enhancing drug delivery systems.

### **Medicinal Plants of Turkmenistan and Their Bioactive Compounds**

Turkmenistan's rich flora is home to numerous medicinal plants, including species like *Artemisia*, *Crocus*, *Ziziphora*, *Ferula*, and *Nigella sativa*. These plants contain various bioactive compounds, such as essential oils, alkaloids, flavonoids, and terpenes, which are known for their medicinal properties.

However, the active compounds in these plants often face challenges when administered in their natural form, including poor solubility in water, rapid degradation in the digestive tract, and low bioavailability. To overcome these challenges, nanoemulgels offer a promising solution by enhancing the solubility, stability, and controlled release of these compounds.

### **Nanoemulgel Formation and Mechanism**

A nanoemulgel is a hybrid formulation that combines a nanoemulsion with a gel matrix. Nanoemulsions are colloidal dispersions of oil and water, stabilized by surfactants, with droplet sizes typically less than 100 nm. The gel component in the nanoemulgel system provides a thickened structure, which enhances the physical stability and controlled release of the drug.

The combination of the two forms results in a stable, highly bioavailable drug delivery system that can improve the therapeutic efficacy of medicinal plant extracts. The small droplet size of the nanoemulsion increases the surface

area for absorption, while the gel matrix ensures prolonged release of the active compounds, making the treatment more effective.

## **Advantages of Nanoemulgels for Medicinal Plants**

### ***Enhanced Bioavailability***

The nanoemulsion component of nanoemulgels enhances the solubility and bioavailability of hydrophobic compounds found in medicinal plants. By reducing the particle size, the surface area for absorption is increased, enabling better penetration through biological membranes and faster absorption into the bloodstream.

### ***Controlled Release of Active Compounds***

The gel component in nanoemulgels ensures a controlled release of the active compounds. This allows for sustained therapeutic effects over time and reduces the need for frequent administration, improving patient compliance.

### ***Stability and Protection of Active Compounds***

The encapsulation of medicinal plant extracts in nanoemulsions within a gel matrix offers increased stability, protecting the bioactive compounds from degradation due to environmental factors such as light, heat, and oxygen. This stability is crucial for maintaining the efficacy of the medicinal compounds.

### ***Targeted Drug Delivery***

Nanoemulgels also offer the potential for targeted drug delivery. By modifying the composition of the nanoemulsion and the gel, it is possible to direct the release of the active compounds to specific sites in the body, such as inflamed tissues or tumor sites, thereby enhancing the therapeutic effect.

## Challenges in Nanoemulgel Formation

While nanoemulgels show great promise, several challenges must be addressed in their development and use. These challenges include:

- **Stability of the Formulation:** Achieving long-term stability of nanoemulgels, especially in terms of preventing phase separation, is a significant challenge in the formulation process.
- **Scaling Up Production:** Although nanoemulgel formulations have been successfully developed in laboratory settings, scaling up production to an industrial level is often challenging due to the complexity of the preparation and the need for precise control over particle size and distribution.
- **Toxicity and Safety:** The use of surfactants and other excipients in nanoemulgels raises concerns about their potential toxicity, especially with prolonged use. Ensuring the safety of these formulations is essential for their clinical application.

## Future Prospects

Despite the challenges, the future of nanoemulgel technology in the pharmaceutical industry looks promising, particularly for medicinal plants of Turkmenistan. Advances in nanotechnology, such as the use of biodegradable surfactants and plant-based gels, may lead to more sustainable and safer formulations.

Future research should focus on optimizing nanoemulgel formulations, improving their stability and bioavailability, and evaluating their therapeutic potential in clinical trials. Additionally, collaborations between pharmaceutical companies and research institutions could accelerate the development of nanoemulgels as a novel drug delivery system for medicinal plant-based therapies.

## Conclusion

The formation of nanoemulgels from medicinal plants of Turkmenistan presents a promising avenue for enhancing drug delivery systems. By improving the bioavailability, stability, and controlled release of bioactive compounds, nanoemulgels offer significant therapeutic potential in the treatment of various diseases. With continued research and technological advancements, nanoemulgels could become a valuable tool in modern medicine, particularly in harnessing the medicinal properties of Turkmenistan's diverse plant species.

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