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Polymeric matrices for targetted delivery of mangiferin

Roman O. Shaikenov[1], Vladislava I. Klimshina [1], Svetlana N. Morozkina [1], Petr P. Snetkov [1]

1. Institute of Advanced Data Transfer Systems, ITMO University, Kronverkskiy Prospekt, 49, bldg. A, Saint-Petersburg 197101, Russia

INTRODUCTION & AIM

Mangiferin is a biologically active substance, a polyphenol extracted from the Mangifera indica plant. Mangiferin has antiviral, antitumour, anti-inflammatory, anti-viral and other properties, so it can potentially be used in medicine as an effective drug.

Mangiferin is also interesting as an alternative antibacterial agent. The use of antibiotics in agriculture is restricted worldwide. Therefore, mangiferin has the potential to replace traditional drugs.

However, one of the problems in the use of mangiferin is its poor water solubility and low bioavailability. Drug delivery matrices could be one of the potential approaches to solve these problems. Such matrices have been found to enhance drug bioavailability and stability and significantly decrease side effects. A wide variety of delivery systems with mangiferin have been developed in recent years.

These include polymer nanospheres, lipid nanoparticles, self-assembled protein particles and other matrices. Each of them has its unique properties and can be applied against a specific disease and for a specific way of administration of mangiferin into the body. Some matrices have a prolonged action, some release the drug immediately.

The collection of data on drug delivery systems will facilitate their study and enable the development of new matrices. In this brief review, we have compiled information about the main systems with mangiferin and their properties.

MANGIFERIN DELIVERY SUSTEMS

The most used materials for creating nanoparticles are polymers. For example, Anan Athipornchai et al made polymer nanospheres: a core of carrageenan with mangiferin surrounded by a chitosan shell (Figure 1). At 25 ℃, the spheres with the highest mangiferin content (10% by weight of carrageenan) released up to 90% mangiferin within 2 hours. The nanospheres had moderate antibacterial activity, but were nontoxic to eukaryotic cells in the in vitro test. The authors developed the nanospheres for seafood preservation, but they believe the spheres could also be used as drug delivery systems [1].

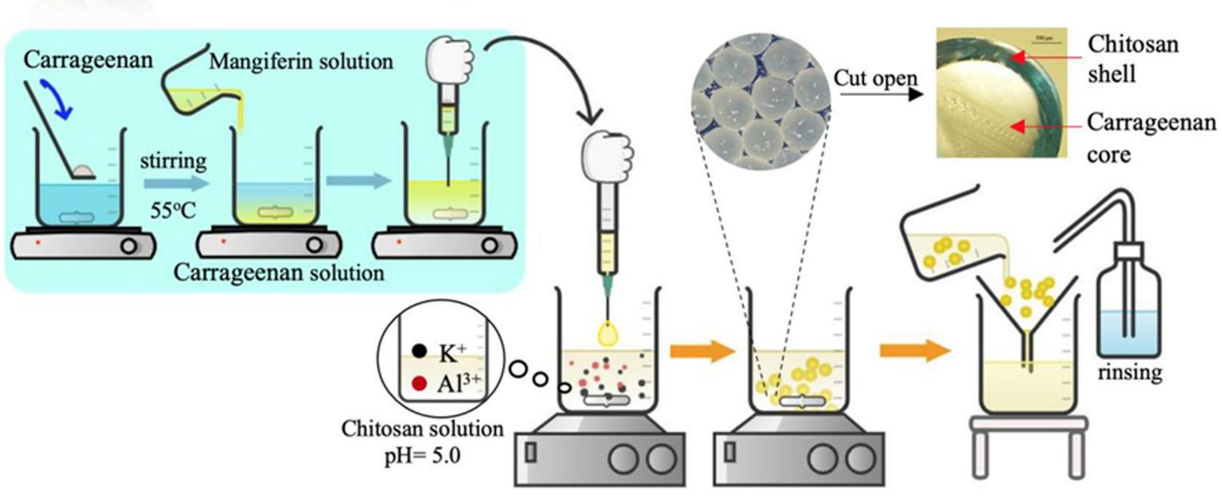
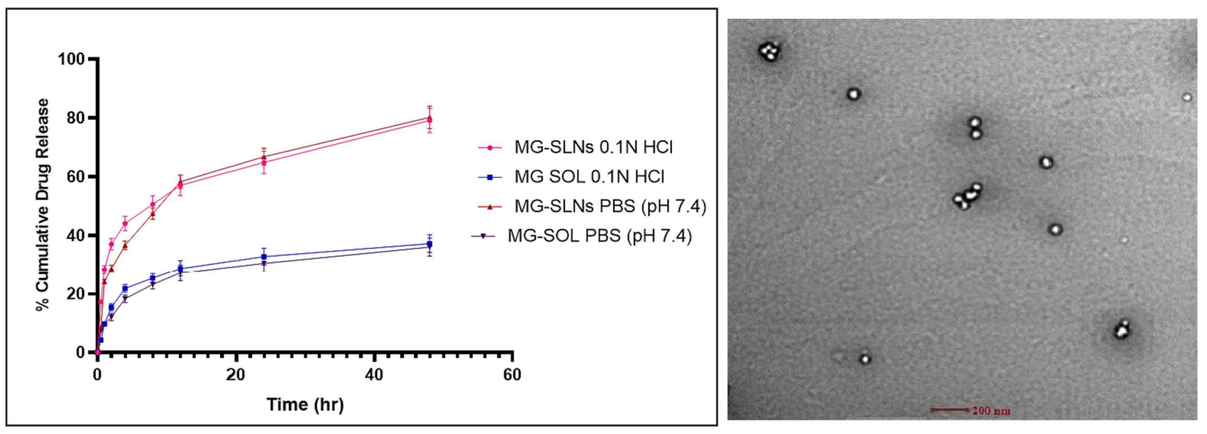


Figure 1. Preparation of carrageenan/chitosan spheres with mangiferin. Reproduced from [1] with permission from Elsevier, 2024.

In addition, lipid-based nanoparticles are often used in the synthesis of delivery systems. These substances have high bioavailability and affinity with body tissues. Thus, Ahmed I. Foudah et al synthesised solid lipid nanoparticles with mangiferin using microemulsion technique and ultrasound.

Labrafil M 2130 CS was chosen as the solid lipid and Tween 80 was chosen as the surfactant. The synthesised spheres ranged in size from 38.97 to 181.42 nm in diameter and had high capture efficiency of mangiferin, with the larger the particle size, the higher the capture efficiency (Figure 2). The nanoparticles had significant antioxidant effects comparable to ascorbic acid, and in vivo in mice also showed strong antidiabetic properties. In addition, it was found that encapsulation in nanoparticles enhanced the properties of mangiferin and allowed it to penetrate deeper into tissues [2].



(a) **(b)**

Figure 2. (a) Release kinetics of mangiferin solid lipid nanoparticles (MG-SLNs) and mangiferin solution (MG-SOL) in 0.1 N HCl and PBS media. (b) TEM image of MG-SLNs. Reproduced from [2] with permission from Elsevier, 2024

Moreover, emulsions and gels are being developed for external application. Cui Meng et al synthesised a protein-based matrix. They used the self-assembled peptide RADA16-I (Figure 3). The hydrogel was prepared by adding a suspension of nanoparticles in PBS. Mangiferin was released from the matrices intensely within 6 hours, then released smoothly up to 48 hours. Moreover, the higher the concentration of mangiferin in the hydrogel was, the less mangiferin was released into the medium [3].

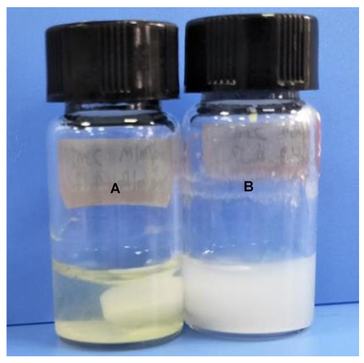


Figure 3. (a) Mangiferin with pure water. (B) Mangiferin with RADA16-I. Reproduced from [3] with permission from Taylor & Francis, 2024

CONCLUSION

Newly developed mangiferin delivery systems have the potential to become drugs against bacterial infections, inflammation and cancer. The matrices have significant advantages over properties of pure mangiferin. However, there are still several challenges. Matrices can affect the properties of mangiferin, reducing its effectiveness or altering its effects. In addition, more research is needed in this field to develop precise matrix formulations that will be suitable for each specific treatment method and target.

FUTURE WORK / REFERENCES

This research was funded by the Russian Science Foundation, project number 24-23-00269. Link to information about the project: https://rscf.ru/en/project/24-23-00269/.

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