

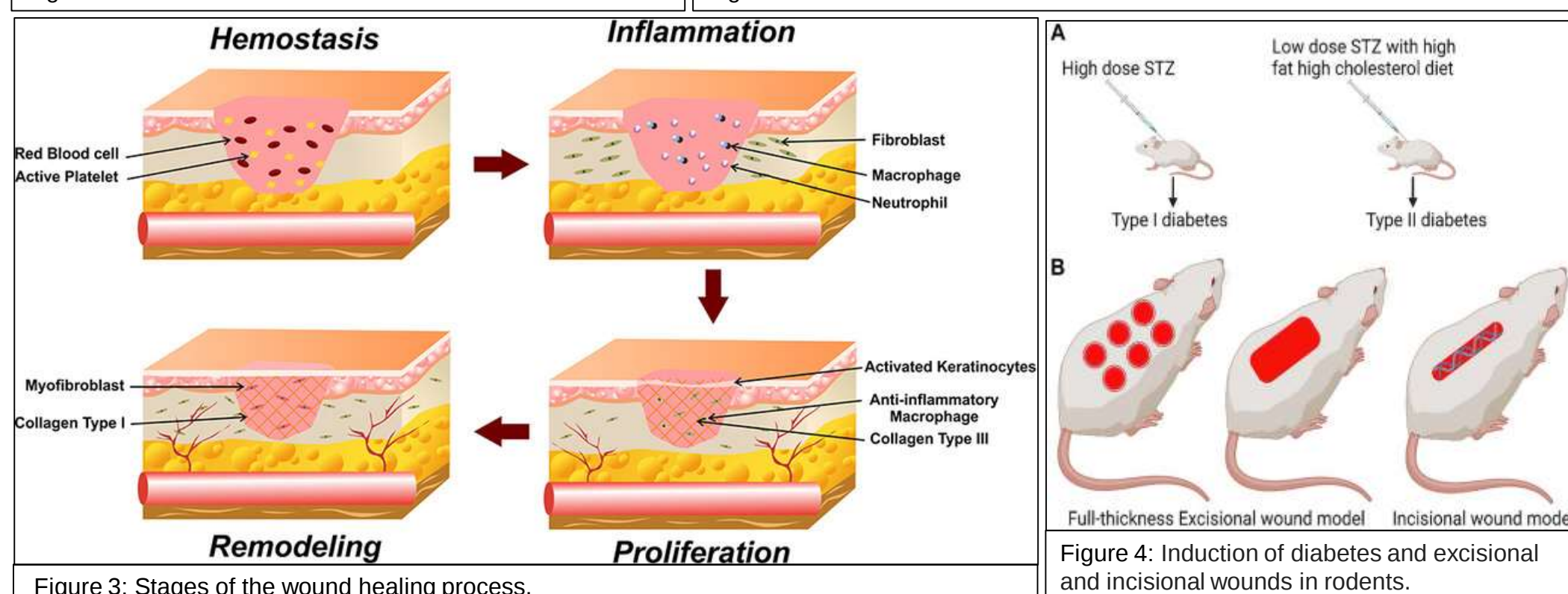
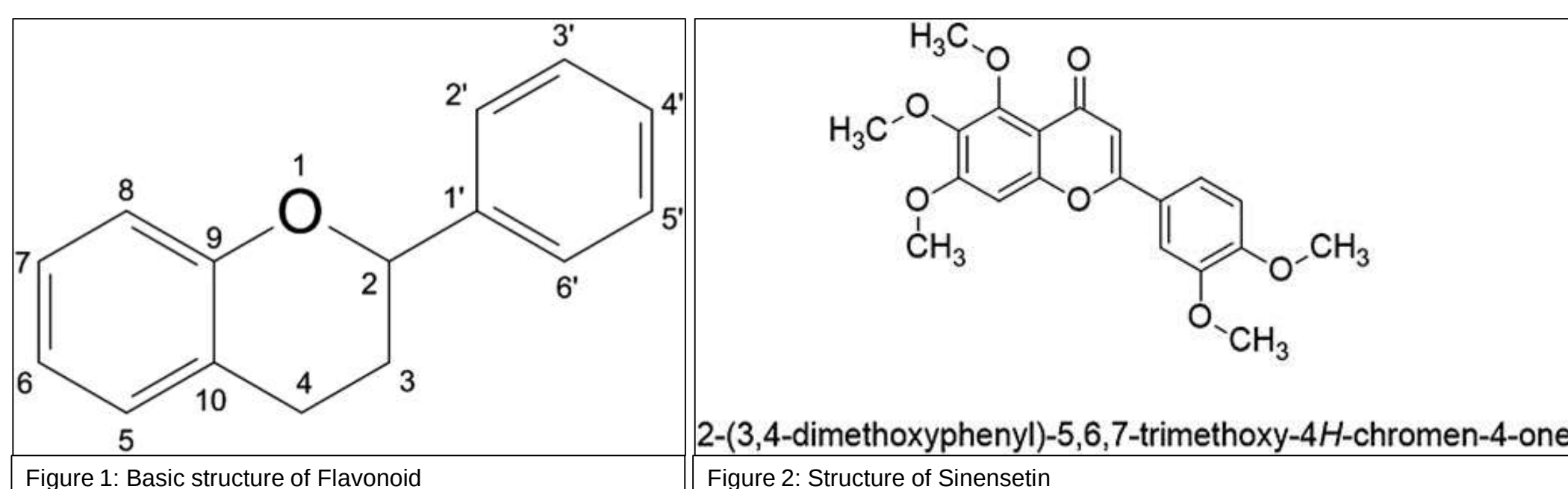
Quality by design (QbD) driven development of sinensetin embedded hydrogel for diabetic wound healing applications.

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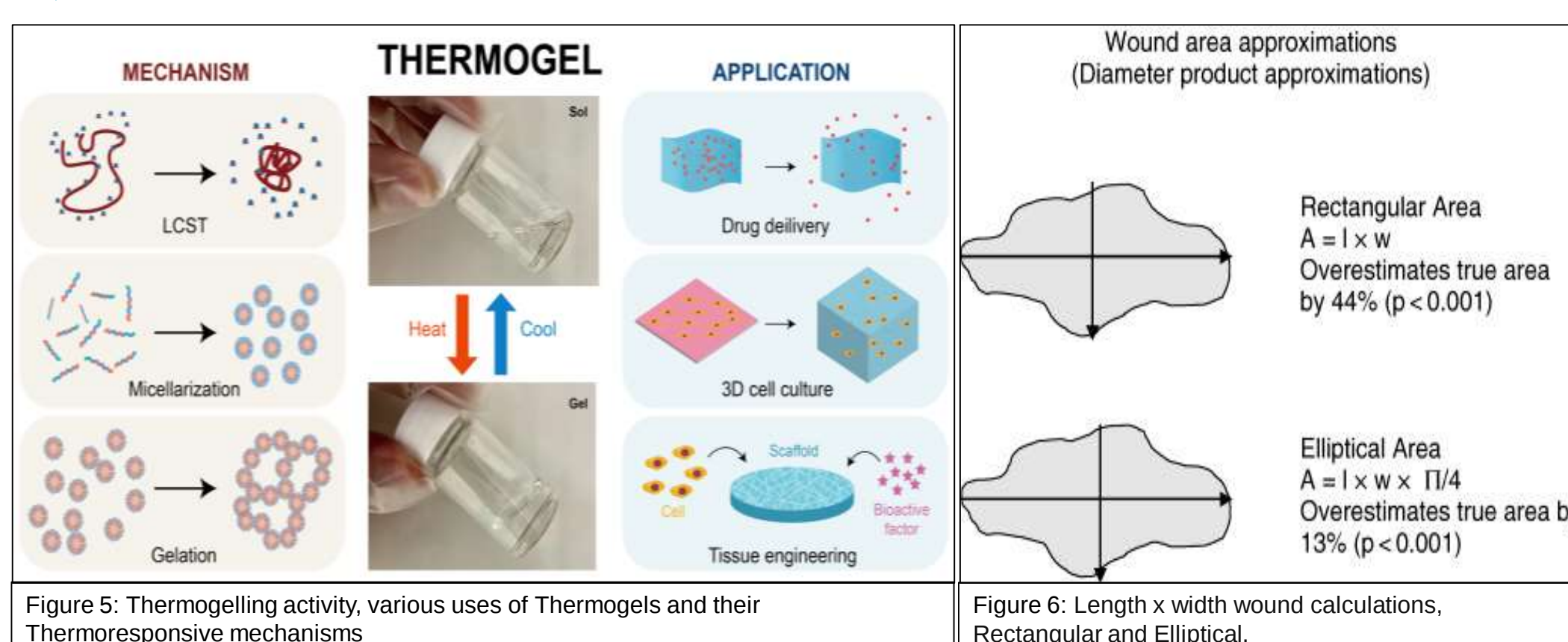
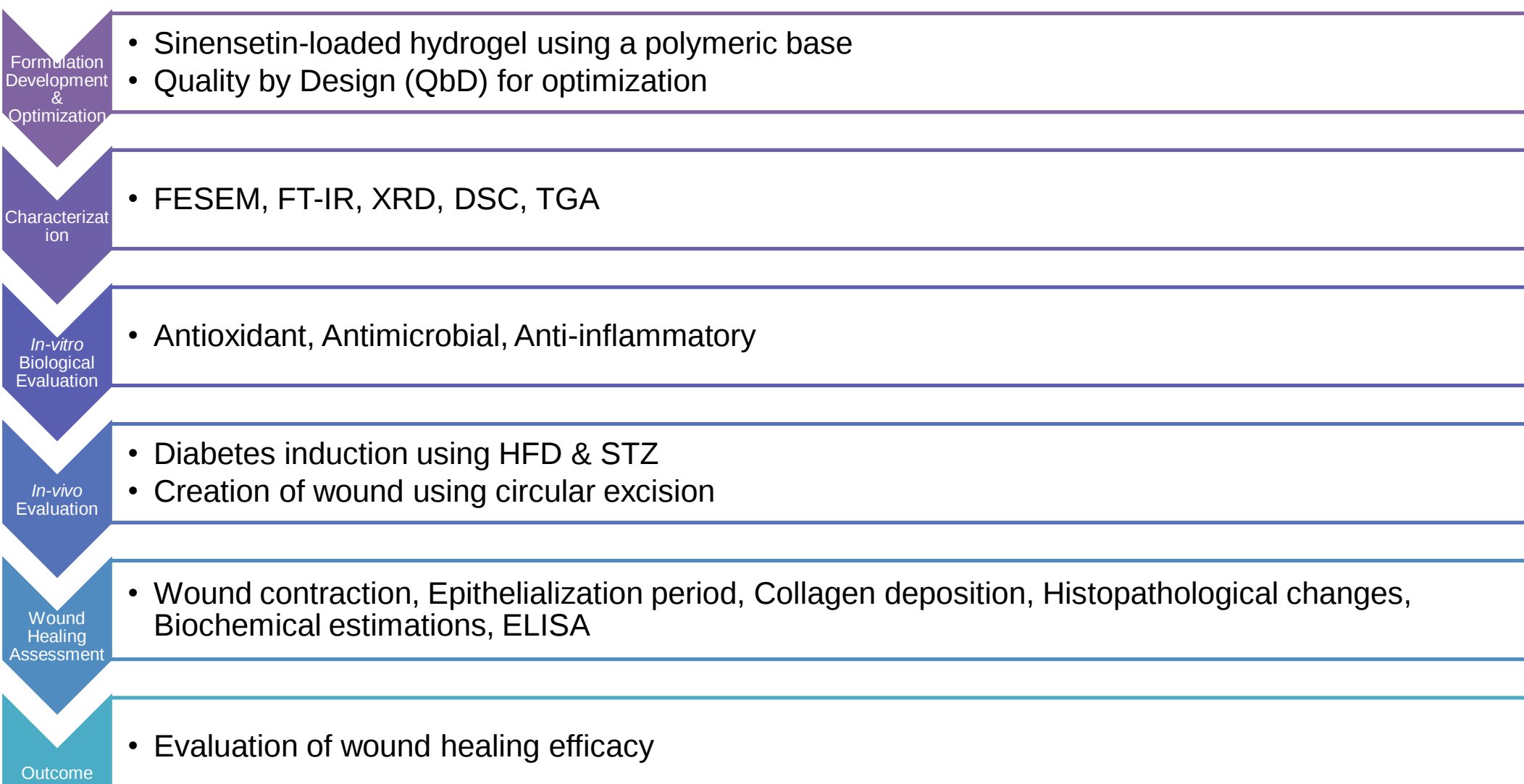
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INTRODUCTION & AIM

- ❖ Sinensetin is a polymethoxylated flavone found in *Orthosiphon aristatus* (Cat's whiskers) and citrus peels, has antioxidant, anti-inflammatory, and antimicrobial properties.
- ❖ The study focuses on developing and optimizing a sinensetin-loaded hydrogel using a Quality by Design (QbD) approach to achieve controlled release and better wound penetration.
- ❖ Hydrogels are an advanced targeted drug delivery system enhances drug stability, bioavailability, thermosensitivity and controlled release of drugs
- ❖ Diabetic wounds are a major complication of diabetes mellitus, often marked by delayed healing, chronic inflammation, poor angiogenesis, and a high risk of infection.



METHOD



DISCUSSION

- ❖ The proposed study aims to provide a deeper understanding of how sinensetin, can enhance diabetic wound healing when formulated in a hydrogel base.
- ❖ Diabetic wounds are difficult to manage due to chronic inflammation, oxidative stress, and microbial invasion, which together delay tissue regeneration.
- ❖ By incorporating sinensetin into a hydrogel, the formulation is anticipated to deliver the drug directly to the wound site in a sustained and localized manner, improving its therapeutic performance while minimizing systemic exposure.
- ❖ Through the Quality by Design (QbD) approach, the formulation process will be scientifically optimized, ensuring reproducibility and consistency in critical quality attributes such as viscosity, pH, and drug entrapment.
- ❖ Based on the reported pharmacological properties of sinensetin, the hydrogel is expected to exhibit strong antioxidant, antimicrobial, and anti-inflammatory effects in vitro, contributing to reduced oxidative stress and infection at the wound site.
- ❖ In the diabetic animal model, these effects may collectively accelerate wound contraction, angiogenesis, and ECM remodelling.
- ❖ Histological analysis will help confirm tissue regeneration, while cytokine assays will clarify the involvement of molecular pathways in the healing process.

CONCLUSION

This study aims to establish sinensetin-loaded hydrogel as a novel and effective approach for diabetic wound management. By combining the multifunctional pharmacological properties of sinensetin with a biocompatible, thermoresponsive hydrogel, the formulation is expected to provide localized, sustained drug delivery that enhances tissue repair while minimizing systemic exposure. The QbD-guided optimization ensures consistency in critical quality attributes, supporting reproducible therapeutic outcomes. Antioxidant, anti-inflammatory, and antimicrobial effects of sinensetin are anticipated to accelerate wound contraction, angiogenesis, and extracellular matrix remodelling in diabetic models. Overall, the findings are expected to highlight a promising bridge between natural product research and advanced wound care solutions.

REFERENCES

- Tawade M, Chopade J, Thomas A, Shirode D. Fractionation, HPLC-MS assisted phytochemical profiling, quantification, and evaluation of the chronic wound healing potential of ethanolic extract of *Ardisia solanacea* (Poir.) Roxb. *Pharmacological Research-Natural Products*. 2025 Mar 1;6:100182.
- Singla RK, Dubey AK, Garg A, Sharma RK, Fiorino M, Ameen SM, Haddad MA, Al-Hiary M. Natural polyphenols: Chemical classification, definition of classes, subcategories, and structures. *Journal of AOAC International*. 2019 Sep 1;102(5):1397-400.
- Kusnadi K, Herdiana Y, Rochima E, Putra ON, Mohd Gazzali A, Muchtaridi M. Collagen-based nanoparticles as drug delivery system in wound healing applications. *International Journal of Nanomedicine*. 2024 Dec 31:11321-41.
- Quazi A, Patwekar M, Patwekar F, Mezni A, Ahmad I, Islam F. Evaluation of wound healing activity (excision wound model) of ointment prepared from infusion extract of polyherbal tea bag formulation in diabetes-induced rats. *Evidence-Based Complementary and Alternative Medicine*. 2022;2022(1):1372199.