ENHANCED TRANSDERMAL PERMEATION OF DICLOFENAC SODIUM USING MANGO SEED KERNEL STARCH NANOPARTICLES

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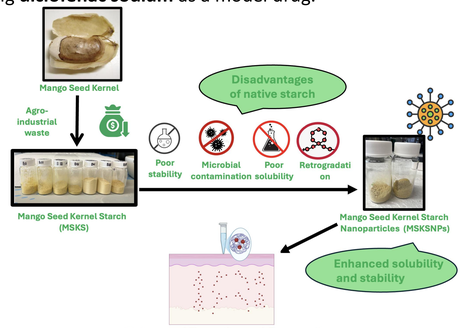
Purpose

- The purpose of this study was to prepare and characterize diclofenac-loaded nanoparticles obtained from **starch isolated from mango seed kernels (MSKS)** and evaluate the **transdermal permeation**.
- MSKS **extraction** was performed using an **alkaline method** followed by **freeze-drying**, and its physicochemical properties were compared with commercial corn starch. MSKS **nanoparticles (MSKSNPs)** were synthesized using **mild alkali hydrolysis** and **ultrasonication**, then characterized for physicochemical properties, *in- vitro* **transdermal permeation** using **diclofenac sodium** as a model drug.



Results

Sl. No	Drying method	Solid: solvent ratio	Sedimentation time (Hour)	% yield
1	Tray Dryer (40°C) for 6 hours	1:10	24	17.23±5.96
2	Tray Dryer (40°C) for 6 hours	1:10	48	20.2±3.24
3	Tray Dryer (40°C) for 6 hours	1:12	24	15.4±6.41
4	Air dry (RT 20°C) for 24 hours	1:12	24	18.6±2.32
5	Air dry (RT 20°C) for 24 hours	1:12	48	36.2±3.23
6	Freeze drying for 24 hours	1:10	48	20.2±2.15
7	Freeze drying for 24 hours	1:12	48	30.4±3.15
8	Freeze drying for 24 hours	1:14	48	67.7±5.20
9	Freeze drying for 24 hours	1:15	48	60.5±3.21

Table 1:Effect of process parameters on percentage yield.

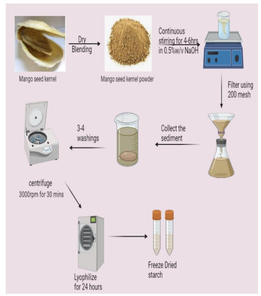
Sl. No.	Parameter	MSKS (Mean±SD)	Corn starch (Mean±SD)
1	Solubility (%)	17±2.8	14±3.2
2	pH	7.0±1.2	7.0±0.6
3	Moisture content (%)	7.4±0.8	11.8±1.2
4	Water Holding Capacity (%)	79.35±0.8	72.93±0.6
5	Swelling Power(g/g)	3.2±0.16	2.3±0.52
6	Gelatinization temperature(°C)	60±2.5	66.7
7.	Amylose/ Amylopectin content	0.35	0.33

Table 2:Physico-chemical properties of MSKS compared with corn starch.

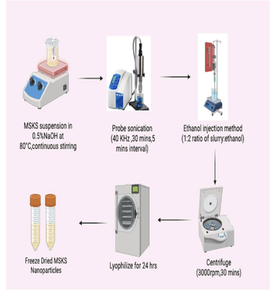
PSD	• 140±3.6 nm with a polydispersity index of 0.42±0.03.
FTIR	• Confirmed the chemical integrity of Starch.
TEM	• Confirmed the globular structure of MSKSNPs with particle sizes lower than 100nm.
XRD	• The degree of crystal size of diclofenac is reduced to 14 nm when compared with the pure drug, 33 nm.
%EE	• 82.34±5.2.

Table 3:Physico-chemical Characterization Of Mango Seed Kernel Starch Nanoparticles

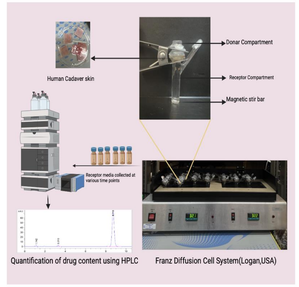
Methods and Materials



Extraction of starch from mango seed kernels by modified **Alkaline method**



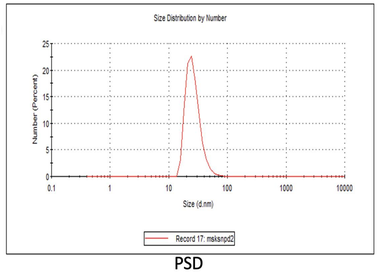
Preparation of MSKSNP'S nanoparticles by mild **alkaline hydrolysis** and and **ultrasonication** method.



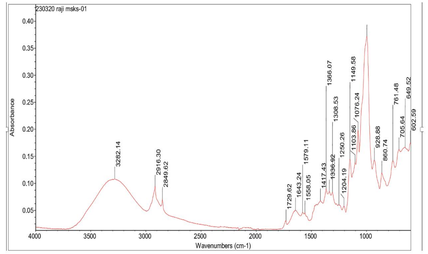
Invitro permeation testing using **Franz Diffusion Cell System**

Figure 1:Schematic Illustration of Isolation of Mango Seed Kernel Starch, Preparation of Mango Seed Kernel Starch Nanoparticles, and In-vitro Permeation Testing

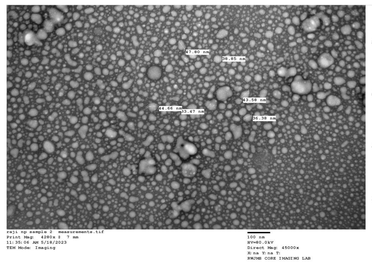
Results



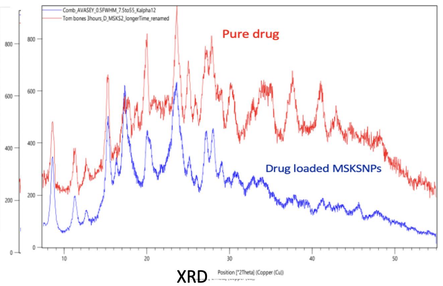
PSD



FTIR



TEM



XRD

Figure 2:Physico- chemical characterization of MSKSNPs

References

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2. Ahmad M, Gani A, Hassan I, Huang Q, Shabbir H. Production and characterization of starch nanoparticles by mild alkali hydrolysis and ultra-sonication process. Scientific Reports. 2020 Feb 26;10(1):1-1.
3. El-Naggar ME, El-Rafie MH, El-Sheikh MA, El-Feky GS, Hebeish A. Synthesis, characterization, release kinetics, and toxicity profile of drug-loaded starch nanoparticles. International journal of biological macromolecules. 2015 Nov 1; 81:718-29.

Results

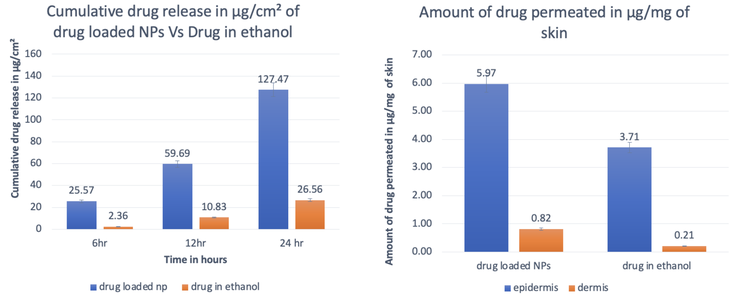

Figure 3: IVPT data of diclofenac Sodium loaded Mango Seed Kernel Starch Nanoparticles (MSKSNPs) as compared with control ethanolic diclofenac solution. Concentrations of the drug were 10mg/ml in both test and control samples (n=3). A) Cumulative drug release of drug-loaded nanoparticles vs ethanolic diclofenac solution for 6,12, and 24-hour time points. B) Amount of drug permeated in µg/mg of epidermis and dermis.

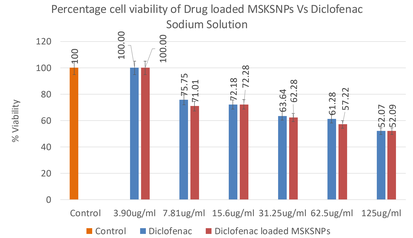

Figure 4: Percentage cell viability using Alamar Blue Assay of drug-loaded Mango Seed Kernel Starch Nanoparticles (MSKSNPs) and ethanolic solution of diclofenac sodium. The study was conducted in three replicates with three individual groups.

Conclusions

- Mango seed starch nanoparticles were successfully synthesized using mild alkali hydrolysis and ultrasonication.
- The method was **relatively simple** and took **less time** than acid hydrolysis. The MSKSNPs were found to be **more amorphous** compared to the native starch.
- These nanoparticles showed **enhanced transdermal permeation** compared with the ethanolic drug solution.

Future Directions

- The study will be expanded to include other BCS Class II drugs.
- Antioxidant and antimicrobial studies will be conducted on the nanoparticle formulations.

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