Engineered HPMC/Starch Hydrogels for pH Independent Drug Release

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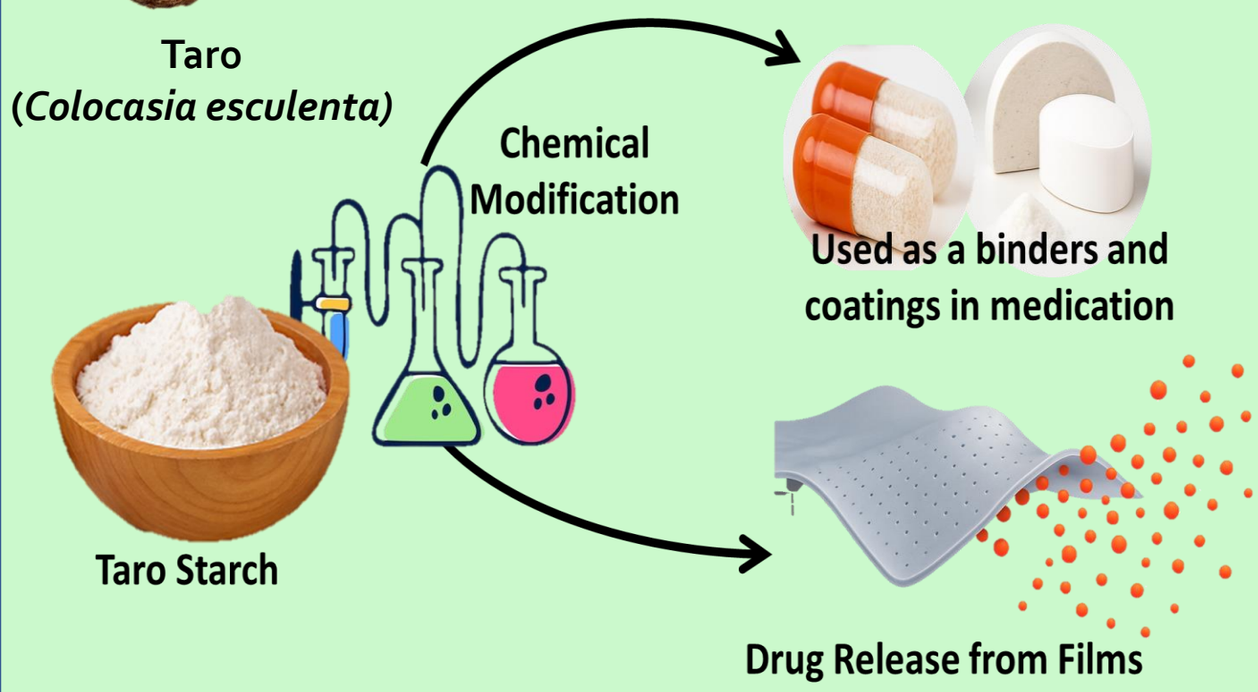
Introduction

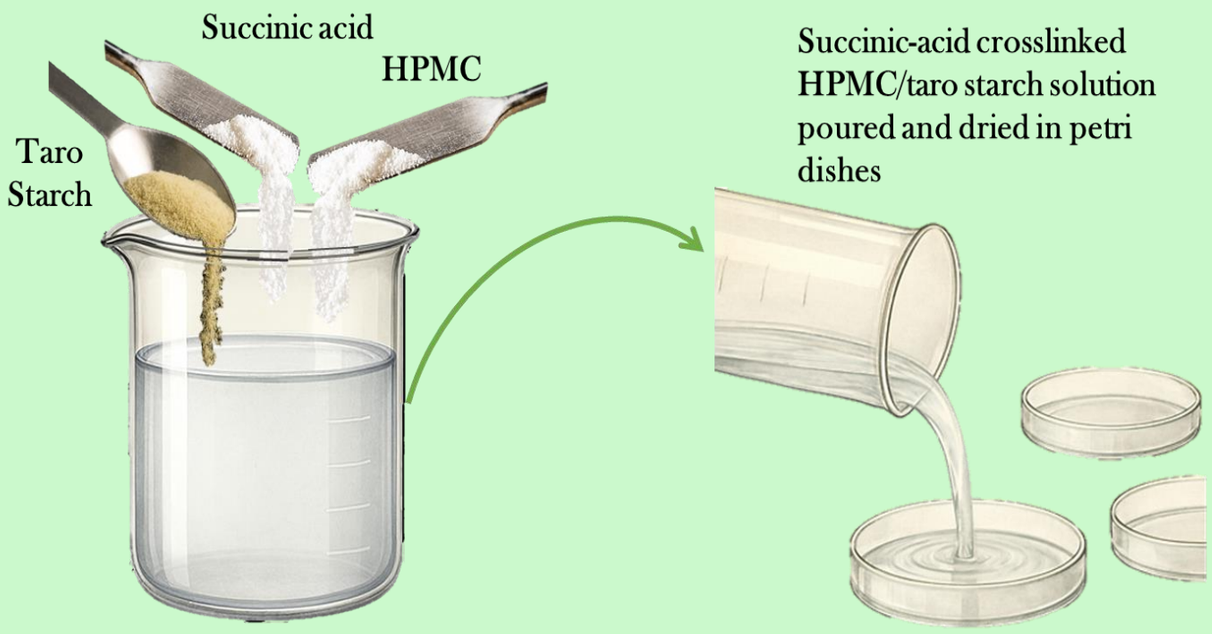
- Starch from taro (*Colocasia esculenta)* is a readily available, renewable and low-cost biopolymer widely found in tropical countries, known for its excellent gel-forming properties[1].
- Small starch granules, high digestibility, hypoallergenic nature, biocompatible and biodegradable properties make taro starch suitable for use in pharmaceutics.



- Some weaknesses of taro starch are weaker gel strength and limited mechanical stability, which necessitates blending it with polymers improve its functional performance.
- Hydroxypropyl methylcellulose (HPMC) is a semi-synthetic polymer widely used in pharmaceutical formulations for controlled drug release.
- Succinic acid (SA) mediated crosslinking produces a stronger, more stable polymer network suitable for controlled drug release and moisture-resistant pharmaceutical formulations.
- The aim of this study was to develop hydrogel using taro starch from two cultivars—*Uroni Vonu* (UV) (high amylopectin) and *Vavai Dina* (VD) (high amylose) blended with HPMC for the delivery of quetiapine fumarate (QF), a model drug.

Methodology

- Starch from two native varieties of taro; UV and VD were extracted using the sedimentation method.
- Taro starch was blended with HPMC at 80:20 and 60:40 (HPMC:Starch) ratios. SA was incorporated as both a crosslinker and acidifier.
- Swelling behaviour and drug release kinetics from the hydrogel were assessed in gastric fluid (GF) (pH 1.2), intestinal fluid (IF) (pH 6.8) and distilled water (DW) (pH 7).



Results & Discussion

- Crosslinked HPMC/taro starch hydrogel (film) displayed looser, highly porous structures compared to uncrosslinked blends.

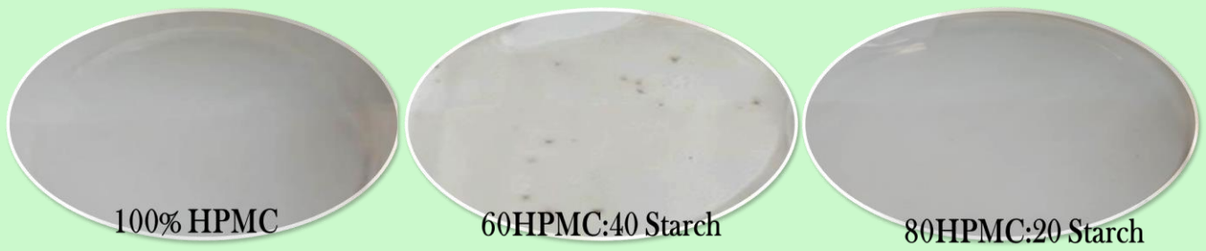


Table 1: The total starch content in the two varieties of taro

Taro Variety	Total Starch (%)	Amylose Content(%)
UV	74.22 ± 1.24	22.34 ± 0.64
VD	70.74 ± 0.51	32.16 ± 0.90

- All hydrogels showed pH-independent swelling, with slightly greater uptake in amylopectin-rich formulations.

Table 2: The amount of drug released per 10 mg of prepared sample at the end of one hour

Sample	DW(mg)	GF (mg)	IF (mg)
100% HPMC	0.50	1.35	0.51
60HPMC:40UV Starch	0.52	1.20	0.55
80HPMC:20UV Starch	0.53	1.35	0.50
60HPMC:40UV Starch/SA	1.00	1.16	1.01
80HPMC:20UV Starch/SA	1.13	1.54	1.15
60HPMC:40VD Starch	0.50	1.20	0.55
80HPMC:20VD Starch	0.52	1.35	0.46
60HPMC:40VD Starch/SA	1.01	1.14	1.08
80HPMC:20VD Starch/SA	1.20	1.50	1.23

- In vitro drug release kinetics revealed that the uncrosslinked hydrogels exhibited pH dependent behavior best fitting the Hixson Crowell model in IF and DW.
- The hydrogels in acidic media (GF) and those that were crosslinked with succinic acid demonstrated pH independent release profile, attributed to the maintenance of an acidic microenvironment within the hydrogel matrix and followed the Korsmeyer Peppas release model.
- This hydrogel has the potential to improve the therapeutic performance of weakly basic drugs by achieving consistent, sustained and pH independent release throughout the gastrointestinal tract.

Conclusion

SA-crosslinked HPMC/taro starch hydrogels offered a promising platform for pH-independent delivery of QF. Release kinetics in both GF and crosslinked films followed the Korsmeyer–Peppas model due to the acidic environments externally in the media and internally via SA's microenvironment. While, uncrosslinked formulations exhibited pH dependent release following Hixson–Crowell kinetics.

References

[1] Nand, A. V., Charan, R. P., Rohindra, D., & Khurma, J. R. (2008). Isolation and properties of starch from some local cultivars of cassava and taro in Fiji. South Pacific Journal of Natural Science, 26, 45-48.

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