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Impact of different cross-linking agents on functional, rheological, and structural properties of talipot palm starch: A new source of stem starch

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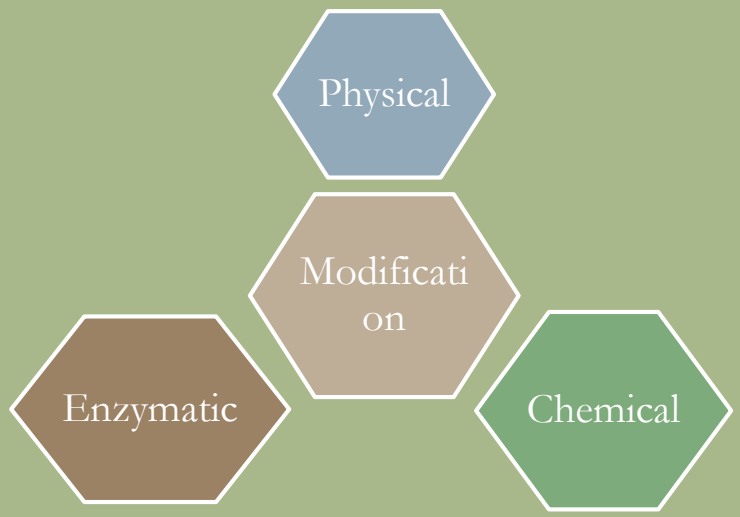
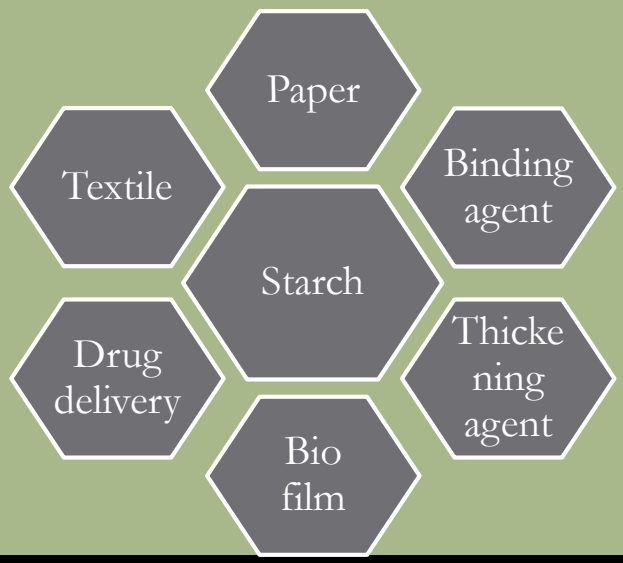
INTRODUCTION

- Starch is naturally abundant botanical biomaterial found in the plant kingdom
- Talipot palm (*Corypha umbraculifera L.*) is a non-conventional source of starch with a starch yield of 76%.

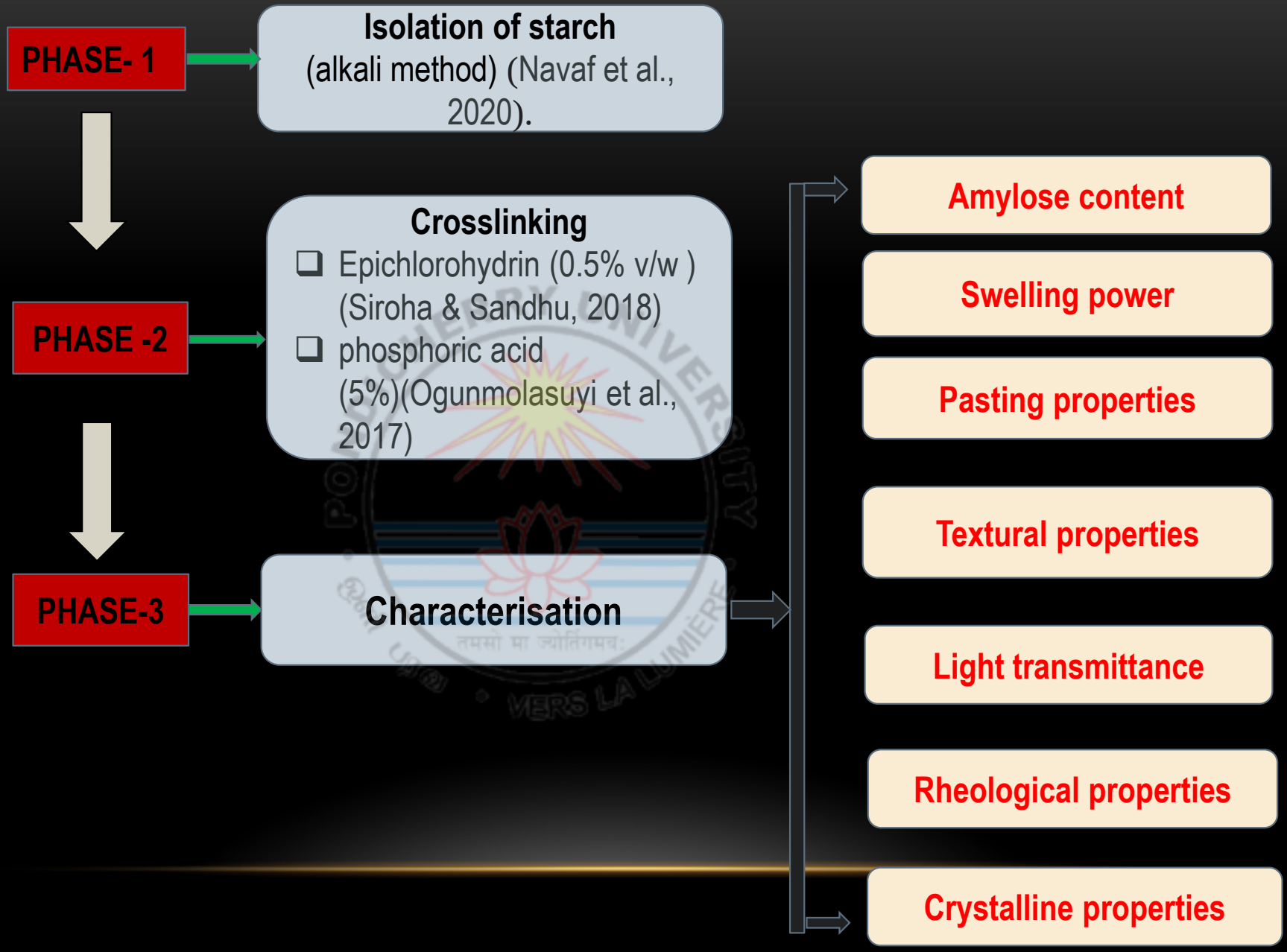




OBJECTIVES

- To isolate the starch from the flour obtained from the trunk of Talipot palm.
- To modify starch by using epichlorohydrin and phosphoric acid.
- Characterization of modified starches

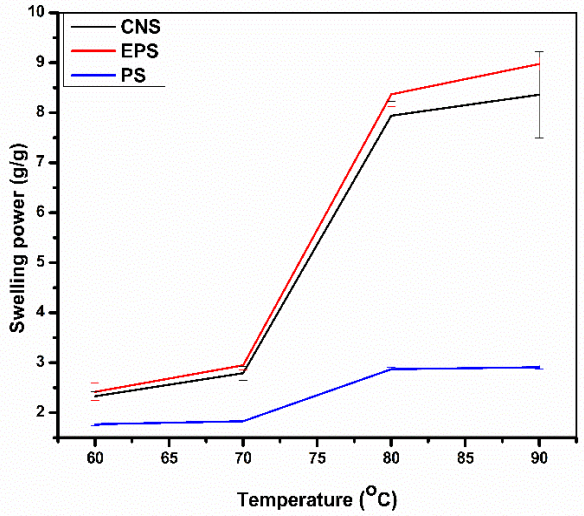
PLAN OF WORK


PHASE- 1
Isolation of starch
(alkali method) (Navaf et al., 2020).
PHASE -2
Crosslinking
Epichlorohydrin (0.5% v/w) (Siroha & Sandhu, 2018)
phosphoric acid (5%)(Ogunmolasuyi et al., 2017)
PHASE-3
Characterisation
Amylose content
Swelling power
Pasting properties
Textural properties
Light transmittance
Rheological properties
Crystalline properties

RESULT & DISCUSSION

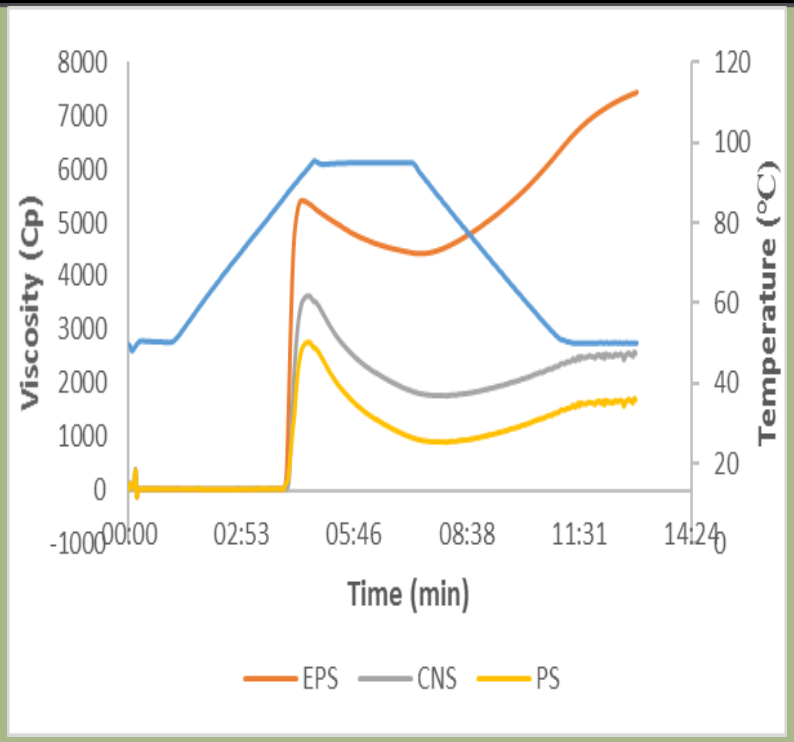
AMYLOSE CONTENT AND SWELLING POWER

Sample	Amylose (%)
CNS	26.13±0.71[a]
EPS	19.15±0.34[c]
PS	21.84±0.51[b]



- The formation of ester linkages between starch chains in CLS's causes a decrease in the amylose content
- The increased SP of EPS was due to the low degree of cross-linking, which may retain granule integrity and increase the amount of water entrapped in granules.
- The decreased SP of PS is maybe due to the hydrolysis of glycosidic bonds during phosphoric acid treatment

PASTING PROFILE



	CNS	EPS	PS
PV(cP)	3646	5408	2773
TV(cP)	1765	4417	892
BV(cP)	1881	991	1881
SV(cP)	797	3019	797
FV(cP)	2562	7436	1689

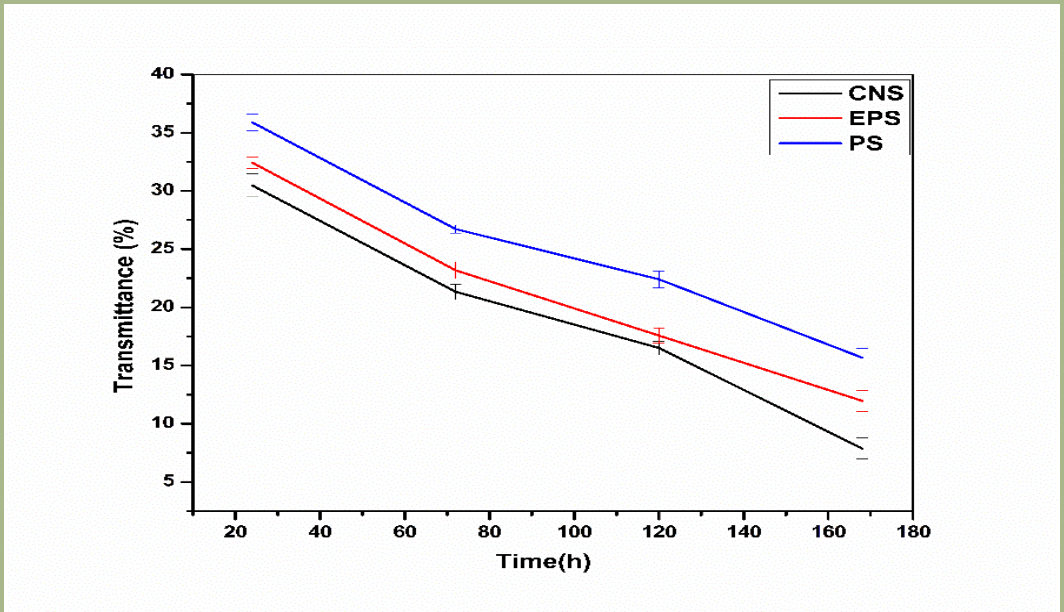
- The increased pasting profile of EPS is due to the lower degree of cross-linking.
- The decreased peak viscosity of PS may be due to lower swelling power caused by the hydrolysis of glycosidic linkages.
- EPS exhibited a higher setback viscosity, and thus have a strong gel.
- cross-linking with the phosphate group restricted the re-orientation of amylose and amylopectin, leading to the decreased setback and final viscosities

GEL TEXTURAL PROPERTIES

Sample	Hardness (N)	Springiness (mm)	Gumminess (Nmm)	Chewiness (Nmm)	Cohesiveness
CNS	45.54 ± 0.37^{b}	0.91 ± 0.02^{b}	23.36 ± 0.33^{b}	21.22 ± 0.22^{b}	0.52 ± 0.01^{a}
EPS	149.69 ± 1.34^{a}	0.97 ± 0.01^{a}	66.75 ± 0.63^{a}	63.73 ± 0.46^{a}	0.43 ± 0.00^{b}
PS	13.62 ± 0.10^{c}	0.87 ± 0.01^{b}	5.59 ± 0.48^{c}	5.18 ± 0.27^{c}	0.43 ± 0.01^{b}

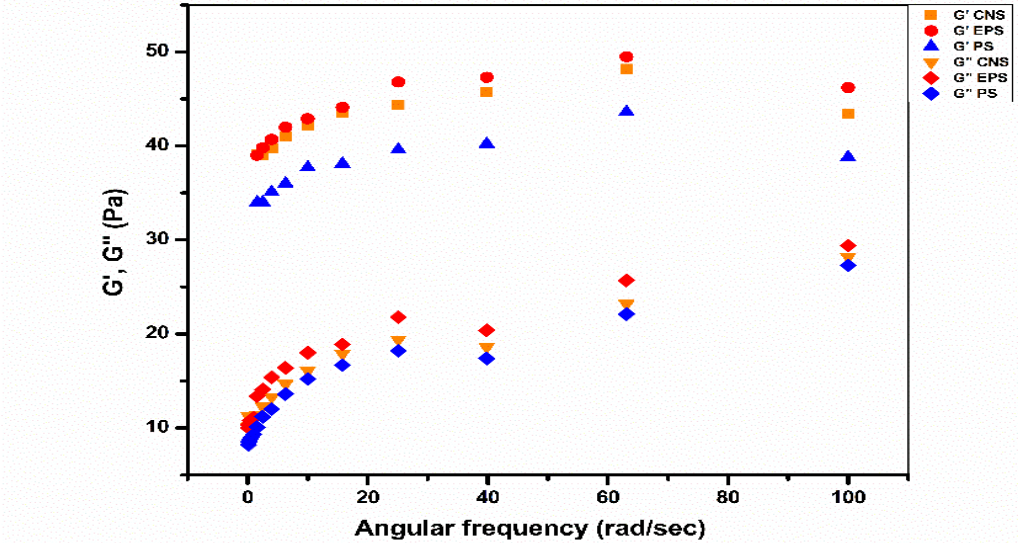
- The increased hardness of EPS may be due to the higher setback viscosity, resulting in higher re-orientation of starch molecules which form a strong gel.
- The lower gelation capacity and setback viscosity of PS limits the rate at which leached starch molecules reoriented, ending in the development of the weak gel during cold storage

LIGHT TRANSMITTANCE



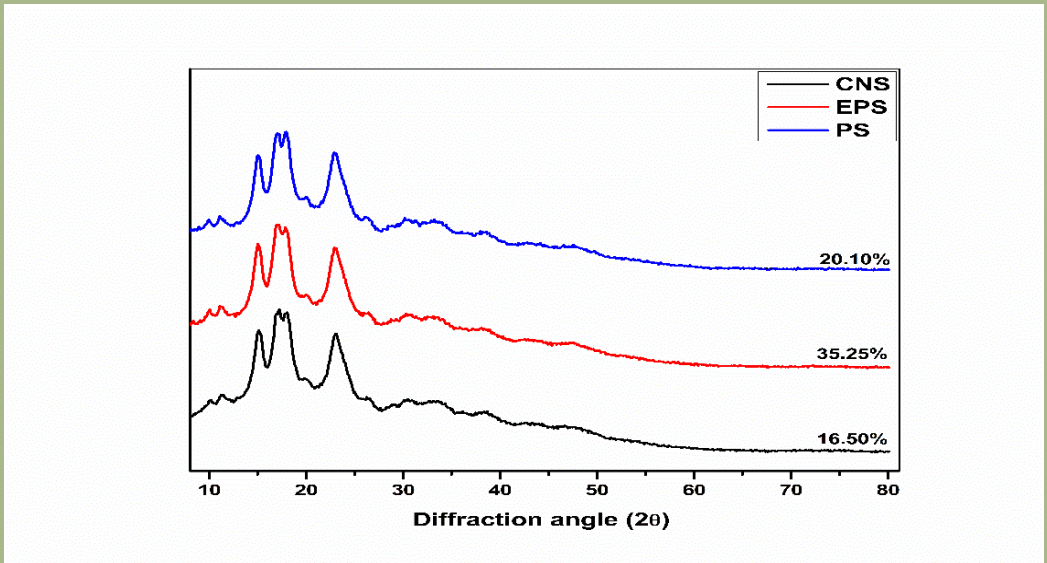
- The retrogradation rate, aggregate synthesis, and leaching of starch components, which causes turbidity to occur, are only a few of the variables that affect the light transmittance and paste clarity of starch gel during storage
- The increased light transmittance of EPS is due to high swelling power.
- The smaller, highly light-transparent molecules created by the hydrolysis of starch molecules may be the cause of improved light transmittance and paste clarity of PS

RHEOLOGICAL PROPERTIES



- The magnitude of G' and G" was significantly ($p \leq 0.05$) changed by cross-linking
- The increased G' and G" values of EPS is maybe due to the formation of rigid gel with high molecular integrity
- The decreased G' and G" values of PS starch are due to the restricted rate of retrogradation, which leads to the development of a weak gel.

STARCH CRYSTALLINITY



- All the diffractograms exhibited similar pattern characteristics of type A crystalline patterns with diffraction peaks at an angle of 15.1°, 17.2°, 18.1°, and 23.2°.
- The creation of a more ordered structure through cross-linking may be the cause of the enhanced RC value of EPS
- the increased RC value of PS could ascribe to the hydrolysis of the amorphous region and the formation of phosphate dieter bond, giving increased integrity

CONCLUSIONS

- Treatment of talipot starch with epichlorohydrin and phosphoric acid significantly changed the functional, pasting, textural, rheological, and structural properties.
- Treatment with epichlorohydrin improved the talipot starch's ability to swell and its pasting characteristics. However, it decreased in phosphoric acid-treated starch.
- Paste clarity of talipot starch was significantly improved in both EPS and PS
- Cross- linked talipot starches can be utilized for various food products like canned food, dairy products, etc.

Thank you....