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# Influence of organic acids on a non-conventional starch from *Corypha umbraculifera* L. to improve its functionality and resistant starch content

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# INTRODUCTION


- Starch is a naturally occurring polymer with an extended application in food and non-food industries owing to its technological properties, biodegradability, and safety (Aaliya et al. 2021).

- On the basis of the rate of in-vitro starch digestibility, starch can be categorized into resistant starch (RS), slowly digestible starch (SDS), and rapidly digestible starch (RDS).

- The RS is the starch that cannot be hydrolyzed in the small intestine within 120 min and is converted into short-chain fatty acids by colon microflora. RS is similar to dietary fiber and helps control or prevent diabetes and other degenerative diseases (Shaikh et al. 2019).

- The RS content of starch is increased by treatments such as hydrothermal, chemical and enzymatic treatments.

# TALIPOT PALM

- **Scientific name**: *Corypha umbraculifera* L.
- It is a tropical monocarpic palm belonging to the family of ***Aracaceae***.
- **Geography**: inhabit in moist climate and native to semi-wild coastal plains of south western India, Sri Lanka, Malaysia and Myanmar (Navaf et al. 2020).
- The stem pith of the mature talipot palm is a store house of the abundant amount of light brown coloured starch.
- About 100-250 kg of edible starch can be procured from the stem of a fully matured palm before its flowering and fruiting.

TALIPOT PALM

# OBJECTIVES

- To extract and isolate talipot starch from talipot palm stem.
- To modify and characterize starch by esterification with two food-grade organic acids, lactic acid and acetic acid.

# MATERIALS AND METHODS

**PHASE - 1**

Isolation of talipot starch (Navaf et al. 2020)

TALIPOT PALM STARCH

**PHASE - 2**

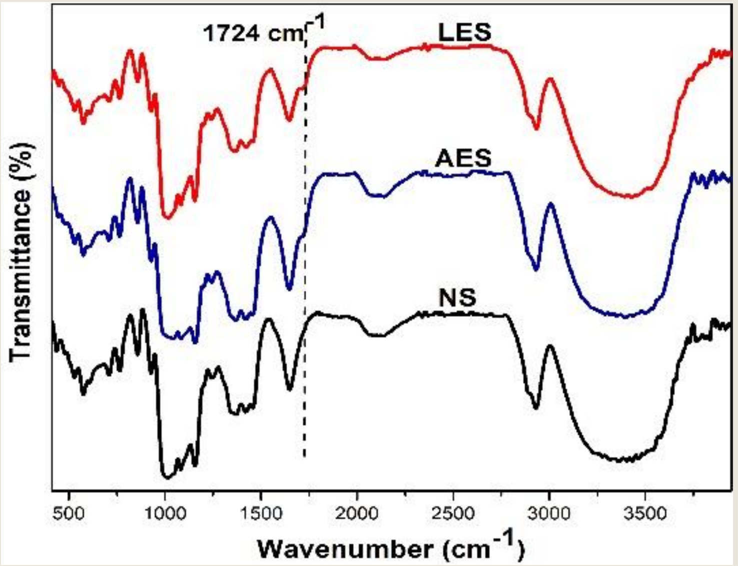
Modification of starch (Esterification)
Lactic acid and acetic acid (Shaikh et al. 2019)

**PHASE - 3**

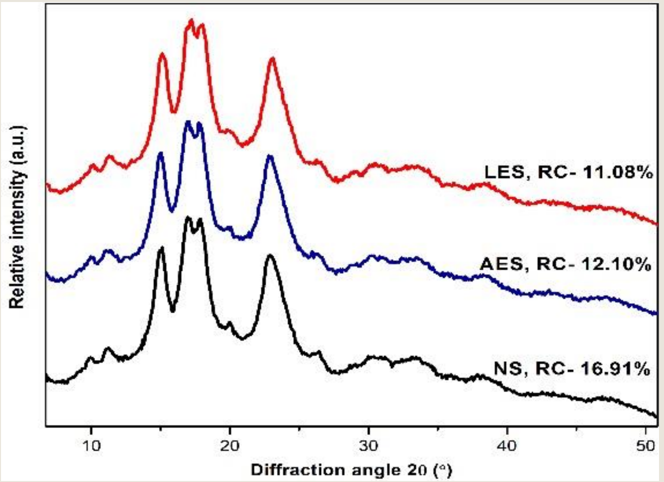
- FT-IR
- XRD and relative Crystallinity
- Amylose content (Williams et al., 1970)
- Swelling index (Sudheesh et al. 2020)
- In vitro digestibility (Englyst et al. 1992)
- Pasting properties (RVA) (George et al. 2021)
- Thermal Properties (DSC) (George et al. 2021)

# RESULTS AND DISCUSSION

## FT-IR and XRD analysis




A new peak in the modified starches was observed at 1724 $cm^{-1}$ representing C=O stretching group and it confirms the esterification modification by two organic acids.




Talipot starch possessed A-type crystallinity comprising a minor peak at an angle (2θ) 11.2° and major peaks 15.1°, 17.2°, 18.1°, 23.2°.

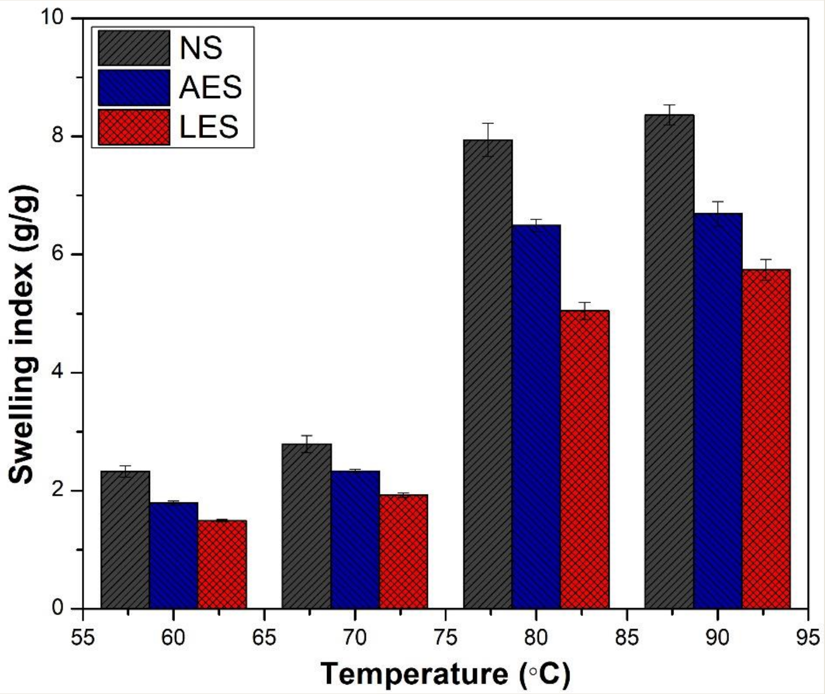
The crystalline pattern did not change with organic acid treatment; however peaks intensity and relative crystallinity showed a significant reduction ($p \leq 0.05$)

# Amylose content and swelling index

| Samples | Degree of substitution (%) | Amylose content (%) |
|---|---|---|
| NS | - | 28.13 ± 0.07[c] |
| AES | 0.091± 0.05[a] | 25.14 ± 0.18[b] |
| LES | 0.107± 0.10[b] | 23.99 ± 0.12[a] |

Values articulated are mean of triplicate ± SD. Values within the same column with different superscript letters are significantly different at $p \leq 0.05$, as determined by Duncan's multiple range test.

- The organic acids attack the easily accessible amorphous region of the granule and hydrolyze the glycosidic linkages, thereby reducing the molecular weight of chains and amylose content.




- Starch degradation due to partial acid hydrolysis of amylose and amylopectin in both crystalline and amorphous regions reduces the swelling index of modified talipot starches.

# *In vitro* digestibility

| Samples | RDS (%) | SDS (%) | RS (%) |
|---|---|---|---|
| NS | 29.45 ± 0.35[c] | 33.84 ± 0.14[a] | 36.71 ± 0.02[a] |
| AES | 22.66 ± 0.64[b] | 36.12 ± 0.23[b] | 41.22 ± 0.11[b] |
| LES | 17.28 ± 0.21[a] | 38.02 ± 0.71[c] | 44.70 ± 0.54[c] |

Values articulated are mean of triplicate ± SD. Values within the same column with different superscript letters are significantly different at $p \leq 0.05$, as determined by Duncan's multiple range test.

- ❑ When treated with organic acids, the hydroxyl groups in all positions of starch were substituted with the ester group to form bulky chains. This reaction enhanced stearic hindrance, which resists starch's enzymatic hydrolysis to increase the RS contents.

- ❑ **Esterified talipot starch with organic acids can be used in the preparation of low-glycemic index foods.**

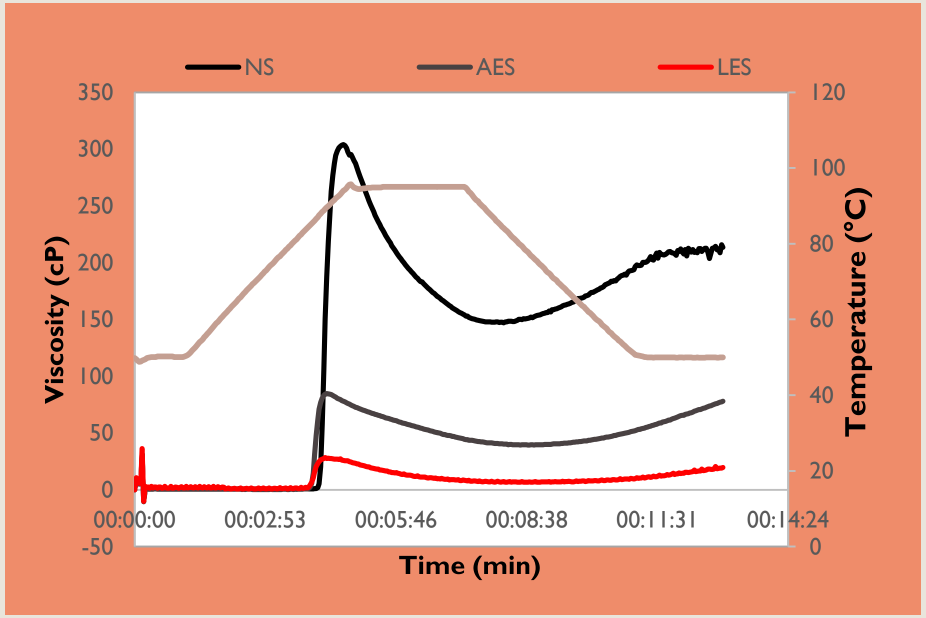
# Thermal properties by DSC

| Samples | $T_o$ (°C) | $T_p$ (°C) | $T_c$ (°C) | ΔH (J/g) |
|---|---|---|---|---|
| NS | $79.70 \pm 0.10^c$ | $82.31 \pm 0.03^c$ | $87.51 \pm 0.20^c$ | $11.29 \pm 0.05^c$ |
| AES | $71.05 \pm 0.11^b$ | $75.89 \pm 0.12^b$ | $82.12 \pm 0.17^b$ | $6.72 \pm 0.04^b$ |
| LES | $66.52 \pm 0.21^a$ | $72.64 \pm 0.15^a$ | $80.23 \pm 0.08^a$ | $5.87 \pm 0.20^a$ |

Values articulated are mean of triplicate ± SD. Values within the same column with different superscript letters are significantly different at $p \leq 0.05$, as determined by Duncan's multiple range test.

- The crystalline structure of the starch molecules inside the granules was affected by the organic acids and increases the amorphous region. Hence less energy and temperature are required for melting the crystalline structure of starch.

# Pasting properties by RVA




RVA viscogram of native and organic acid treated talipot starches.

Organic acid treated talipot starches with low pasting viscosity can be utilized as a texturizer in dairy and baked products.

- The reduction in RC and swelling power reduced the pasting viscosity of the organic acid treated talipot starches. The decrease in pasting viscosity of starch samples results from decreased swelling due to partial depolymerization of amylopectin or amylose in the amorphous regions of starch granules.
- The significant reduction in FV and SBV indicated reduced rate of retrogradation tendency of starch by the depolymerization action of acetic acid and lactic acid on talipot starches.

# CONCLUSION

- The talipot starch is a non-conventional source of starch and can be used as an alternative to commercially exploited starches which are of comparatively starch low yield.
- Esterification with lactic acid showed a higher impact on starch depolymerization and RS formation than acetic acid.
- Esterified talipot starch with organic acids is suitable for the preparation of low-glycemic index foods.
- Organic acid treated talipot starches with low pasting viscosity and low retrogradation tendency can be utilized as a texturizer in dairy and baked products.

# REFERENCES


1) Aaliya, B.; Sunooj, K.V.; Lackner, M. Biopolymer composites : a review. Int. J. Biobased Plast. 2021, 3, 40–84. https://doi.org/10.1080/24759651.2021.1881214.
2) Shaikh, F.; Ali, T.M.; Mustafa, G.; Hasnain, A. Comparative study on effects of citric and lactic acid treatment on morphological, functional, resistant starch fraction and glycemic index of corn and sorghum starches. Int. J. Biol. Macromol. 2019, 135, 314–327. https://doi.org/10.1016/j.ijbiomac.2019.05.115.
3) Navaf, M.; Sunooj, K.V.; Aaliya, B.; Sudheesh, C.; George, J. Physico-chemical, functional, morphological, thermal properties and digestibility of Talipot palm (Corypha umbraculifera L.) flour and starch grown in Malabar region of South India. J. Food Meas. Charact. 2020, 1–13. https://doi.org/10.1007/s11694-020-00408-1.
4) Williams, P.C.; Kuzina, F.D.; Hlynka, I. Rapid colorimetric procedure for estimating the amylose content of starches and flours. Cereal Chem. 1970, 47, 411–420.
5) Sudheesh, C.; Sunooj, K.V.; Bhavani, B.; Aaliya, B.; Navaf, M.; Akhila, P.P.; Sabu, S.; Sasidharan, A.; Sinha, K.S.; Kumar, S.; Sajeevkumar, V.A.; George, J. Energetic neutral atoms assisted development of kithul (Caryota urens) starch–lauric acid complexes : A characterisation study. Carbohydr. Polym. 2020, 250, 116991. https://doi.org/10.1016/j.carbpol.2020.116991.
6) Englyst, H.N.; Kingman, S.M.; Cummings, J.H. Classification and measurement of nutritionally important starch fractions. Eur. J. Clin. Nutr. 1992, 46, S33-50.
7) George, J.; Nair, S.G.; Kumar, R.; Semwal, A.D.; Sudheesh, C.; Basheer, A.; Sunooj, K.V. A new insight into the effect of starch nanocrystals in the retrogradation properties of starch. Food Hydrocoll. Heal. 2021, 1, 100009. https://doi.org/10.1016/j.fhfh.2021.100009.

# Thank you