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PHYSICOCHEMICAL PROPERTIES AND STORAGE STABILITY OF OSA TARO AND POTATO MODIFIED STARCH STABILISED PICKERING EMULSIONS IN CHOCOLATE SPREAD FORMULATION

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INTRODUCTION & OBJECTIVE

- Chocolate spread, made up of an aqueous phase dispersed in a continuous fat phase (intrinsically immiscible), requires emulsifiers for spreadability and stability to prevent oil separation.
- Pickering emulsions stabilised by solid particles as an alternative to conventional emulsifiers due to their stability and eco-friendliness.
- Modified starches offer non-toxic, biodegradable and versatile options to stabilise emulsions.

Objective:

- To investigate the physicochemical properties and storage stability of native and OSA derived from taro and potato starch to stabilise Pickering emulsions in chocolate spread formulation.

METHOD

Isolation of native taro and potato starch

OSA Modification of taro and potato starch

Characterization of native and OSA starch granules

- Scanning Electron Microscopy (SEM)
- Differential Scanning Calorimeter (DSC)
- Fourier Transform Infrared Spectroscopy (FTIR-ATR)

Preparation of chocolate spread formulation using different type of starch

- Chocolate: Oil: Water: Starch = 50:30:15:5

Characterization of chocolate spread

- Water Activity
- pH
- Droplet Size Measurement
- Rheological Measurement
- Texture
- Colour
- Storage Stabilization of Chocolate Spread
- Accelerated Centrifugal Test
- Blooming Index

Statistical analysis

CONCLUSION

- OSA helps in enhancement of emulsifying capacity of potato starch. All chocolate spread-based Pickering emulsions made with different starch types showed shear-thinning behavior and elastic-like properties (G' > G"). Both NT and OT starch demonstrated effective stabilization in chocolate spread-based Pickering emulsions compared to both NP and OP.

FUTURE WORK / REFERENCES

- Investigate the potential of OSA-modified potato starch in enhancing the emulsifying capacity for chocolate spread-based Pickering emulsions, focusing on its ability to encapsulate bioactive and act as a solid barrier for improved stability. This could lead to functional foods with enhanced nutritional properties and better emulsion stability.

RESULTS & DISCUSSION

Characterization of starch granule

Starch sample	Starch granules size (µm)	Tp (°C)	△ H (J/g)
Native Potato	53.37 ± 21.37[a]	64.51	2.43
OSA Potato	34.67 ± 10.76[b]	64.93	0.67
Native Taro	-	-	-
OSA Taro	-	-	-

*Values are expressed in mean ± standard deviation for three replication (n=3).
*Values with the same letters in the same column are not significantly different at $p<0.05$.

Table 1: Granules size and gelatinization properties of NP, OP, NT, and OT starch.

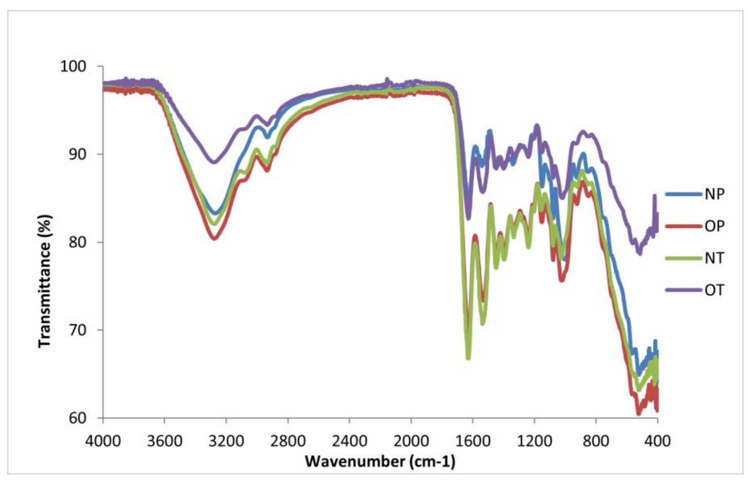

Fig. 1: FTIR spectra of NP, OP, NT, and OT starch.

Physicochemical and storage stability (chocolate spread-based Pickering emulsion)

- The droplet size of OP starch chocolate spread-based Pickering emulsions shows the smallest droplet size (30.80 ± 5.45 µm).
- All chocolate spread-based Pickering emulsions shows:
  - High emulsion stability, which is > 72.53%.
  - Shear-thinning behaviour, when the viscosity is reduced, and shear rate (1/s) increased.
  - Storage modulus G' > Loss modulus G", indicating elastic-like behaviour.
- OT starch chocolate spread-based emulsions show the highest value of firmness and spreadability in texture analysis.
- Colour analysis:
  - Lightness : L* (NP<OP<NT<OT)
  - Redness : a* (NT<OT<OP<NP)
  - Yellowness : b* (NT<OT<OP<NP)
- Blooming Index:
  - White index Value at Day 28 of observation shows that NP>OP>OT>NT

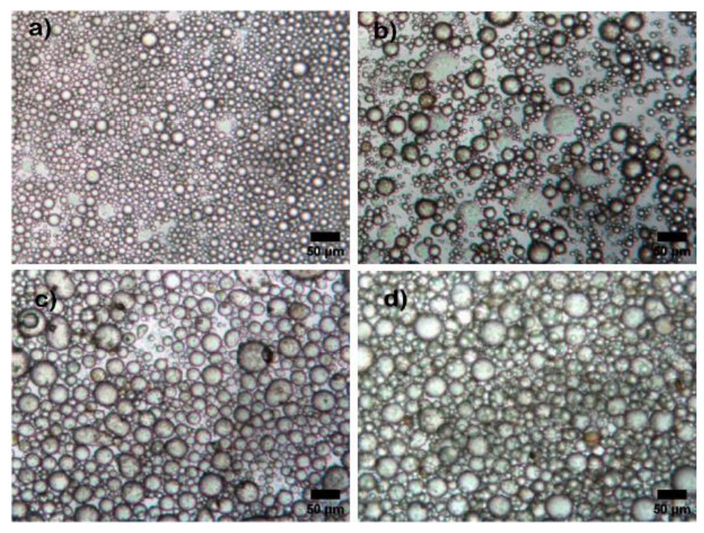

Fig. 2: Microscopy images of chocolate spread-based Pickering emulsions formulated with (a) NT, (b) OT, (c) NP, and (d) OP.

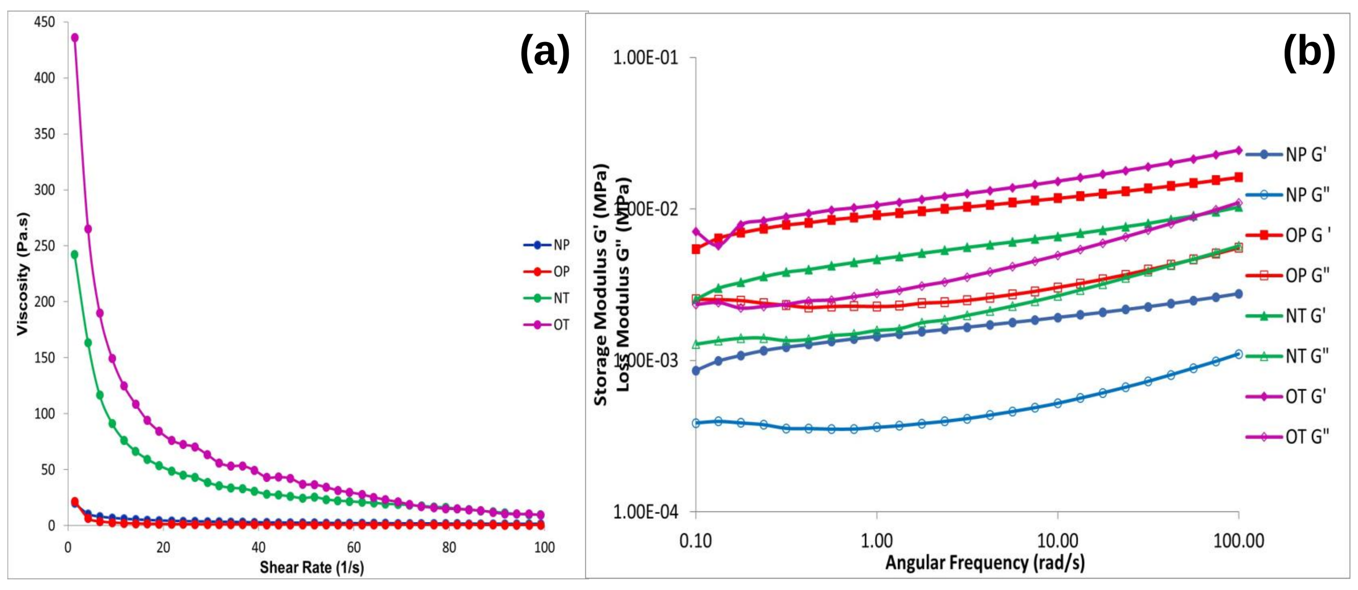

Fig. 3: Rheological behavior of chocolate spread-based Pickering emulsions stabilised by NT, OT, NP, and OP starches, where; (a) viscosity, and (b) viscoelastic behavior.

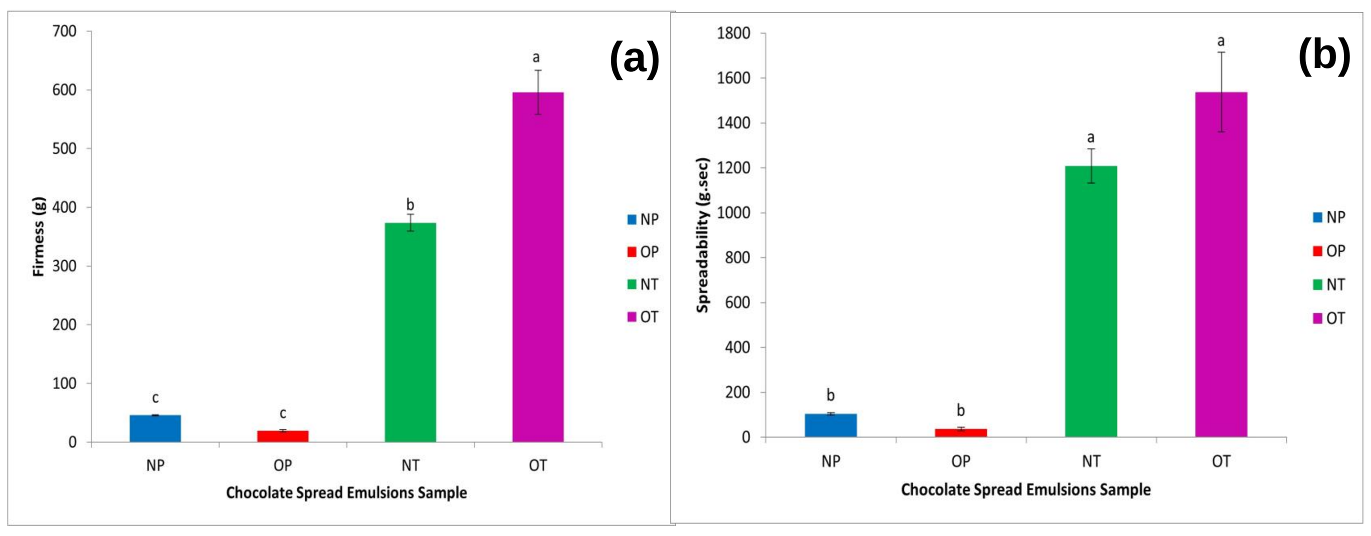

Fig. 4: Texture analysis on chocolate spread-based Pickering emulsions stabilised by NT, OT, NP, and OP starches, where; (a) firmness, and (b) spreadability.

Property of chocolate spread emulsion	Native potato	OSA potato	Native taro	OSA taro
Water activity	0.85 ± 0.00[a]	0.81 ± 0.01[c]	0.84 ± 0.00[b]	0.84 ± 0.00[b]
pH	5.96 ± 0.03[d]	6.25 ± 0.01[c]	6.60 ± 0.01[a]	6.48 ± 0.03[b]
Droplet size (µm)	50.08 ± 8.73[a]	30.80 ± 5.45[c]	35.38 ± 4.71[b]	34.58 ± 6.08[b]
Emulsion stability (%)	83.37 ± 4.71[a]	72.53 ± 1.56[a]	82.97 ± 11.42[a]	81.37 ± 7.34[a]

*Values are expressed in mean ± standard deviation for three replication (n=3).
*Values with the same letters in the same row are not significantly different at $p<0.05$.

Table 2: Property (water activity, pH, droplet size, and emulsion stability) of chocolate spread-based Pickering emulsions stabilised by NT, OT, NP, and OP starches.

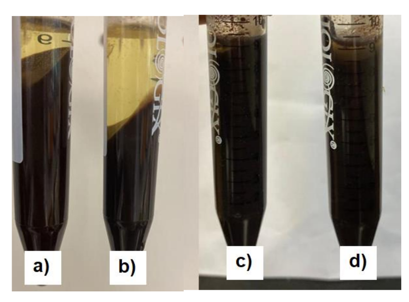

Fig. 5: Visual appearance of chocolate spread-based Pickering emulsions stabilized by (a) NT, (b) OT, (c) NP, and (d) OP after centrifugation at 3,800 rpm for 10 minutes.

Abbreviation: Native taro (NT); OSA Taro (OT); Native potato (NP); OSA Potato (OP)