Foods 2021
The 2nd International Electronic Conference on Foods
Future Foods and Food Technologies for a Sustainable World
15–30 OCTOBER 2021 | ONLINE

Rheological Characterization of Whey Protein-Stabilized Red Palm Oil (RPO) Emulsions

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Introduction

TOCOLS
(*i.e.*, tocotrienols, tocopherols)
250-1000ppm

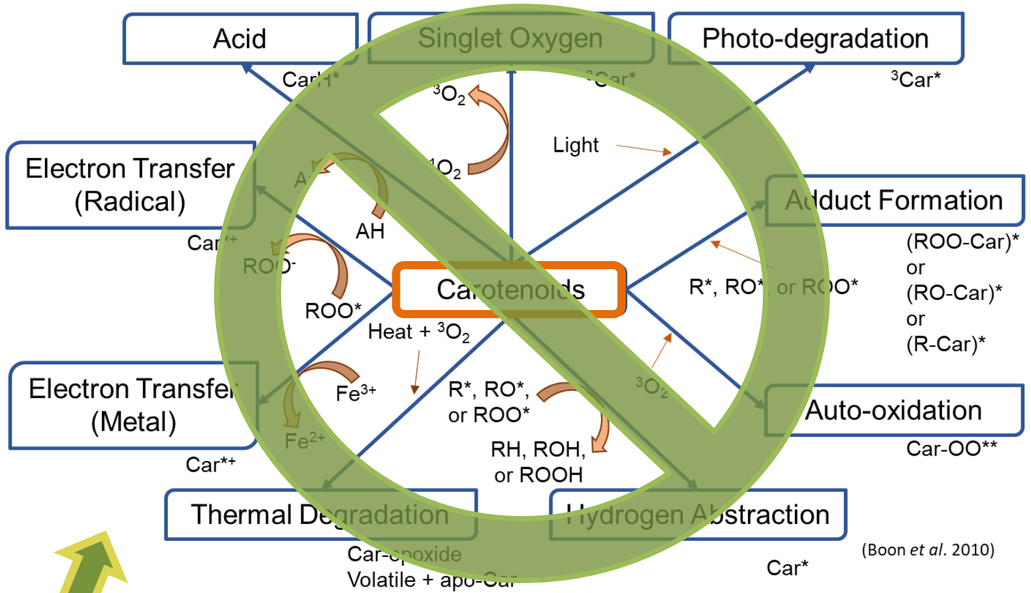
SQUALENE
28-80 ppm

COENZYME Q_{10}
100-360 ppm

PHYTOSTEROLS
200-400 ppm

Nagendran et al. 2000; Kumar and Krishna 2014;
Silou et al. 2017; Ayu 2015

CAROTENOIDS
(*i.e.*, α-carotene, β-carotene)
500-700 ppm



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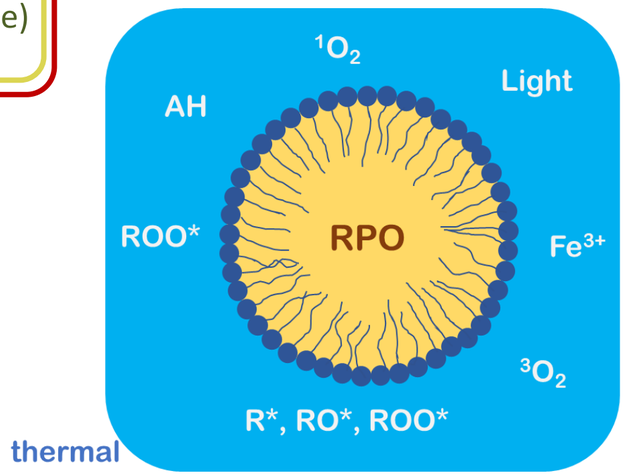

Armetha et al. 2021

Stability?
≅
Physical properties

Rheology

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Objective

to investigate the rheological properties of the whey protein-stabilized RPO emulsions as affected by the type and concentration of whey proteins.

- flow behavior
- apparent viscosity
- viscoelastic properties
- linear viscoelastic range limit of the emulsions

Materials

- Red Palm Oil (IOPRI, Medan, Indonesia)

- WPC75, WPC80, WPI90 (Glanbia Nutritionals, USA)
- Deionized water (Hach)
- Sodium Azide (Merck KGaA)

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Methods

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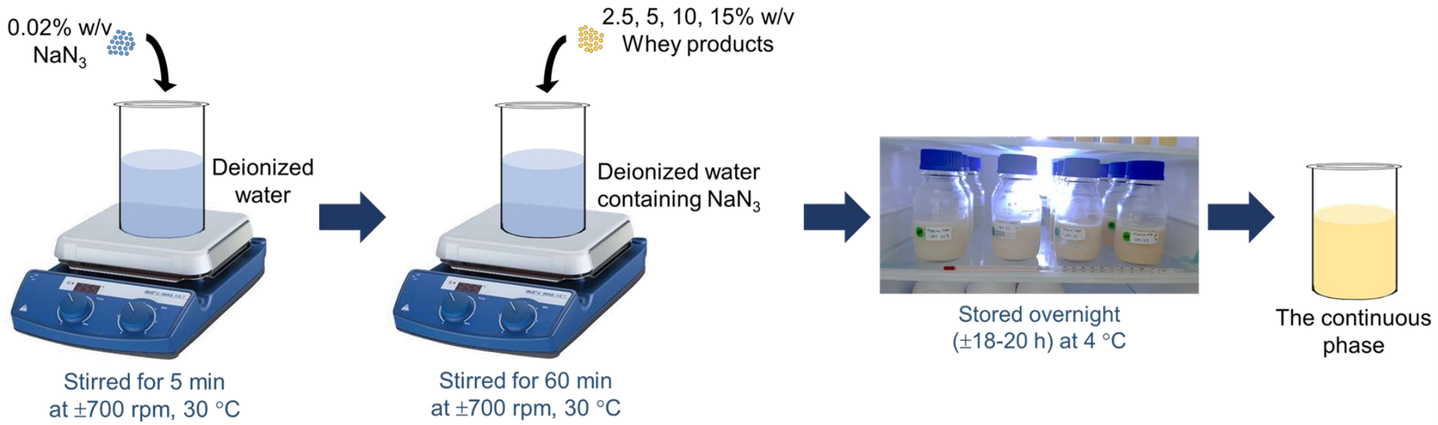
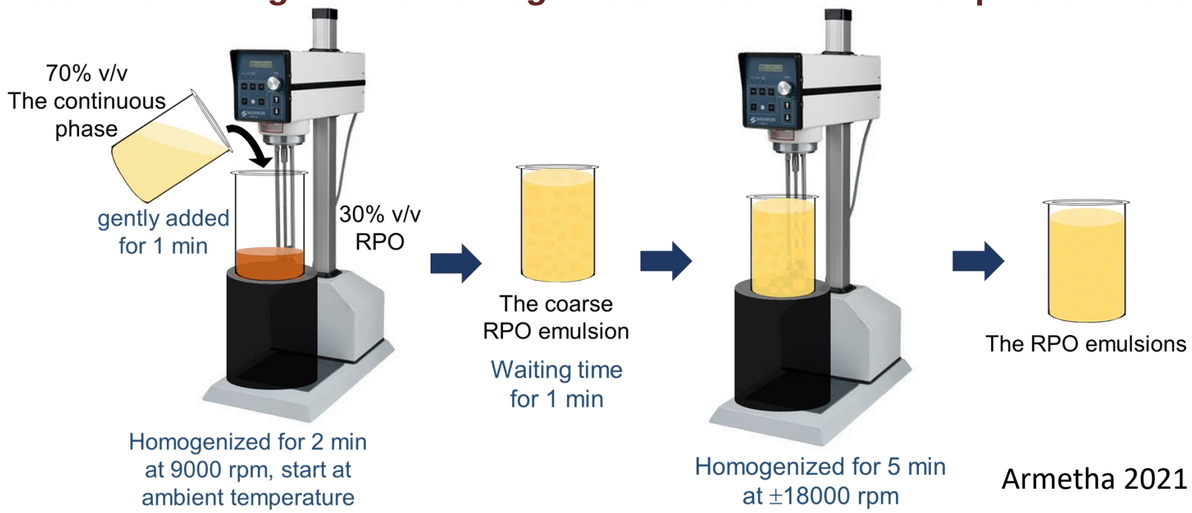
1. Preparation of continuous phase



2. Emulsification: *high-shear homogenization* combined with phase inversion



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Rheological Analysis

Modular Compact Rheometer (MCR) 92
Anton Paar, GmBH

Sample amount/analysis : 1 mL
Probe: *cone-plate* CP 50-1°
Gap = 0.1 mm, T = 25 °C

- ***Flow behaviour***
  Method: ***shear sweep 10^{-1} to 10^{3} s^{-1}***
- ***Apparent viscosity (ηapp)***
  Method: ***shear sweep at 10^{2} s^{-1}***
- ***Dynamic Viscoelastic Properties***
  Method: ***amplitude sweep 10^{-1} to 10^{3} % from 1 Hz***

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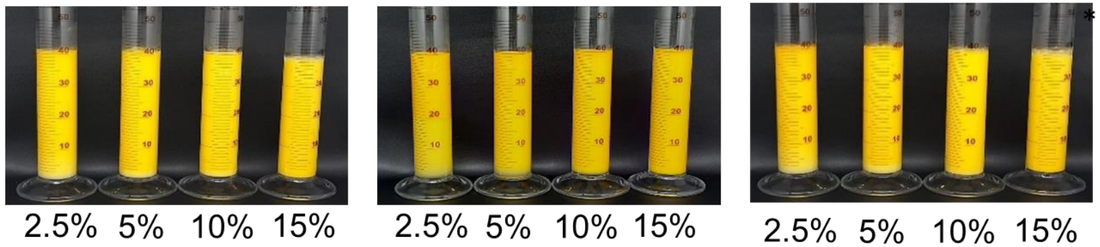
Important Findings



WPC80 **WPI90** **WPC75**

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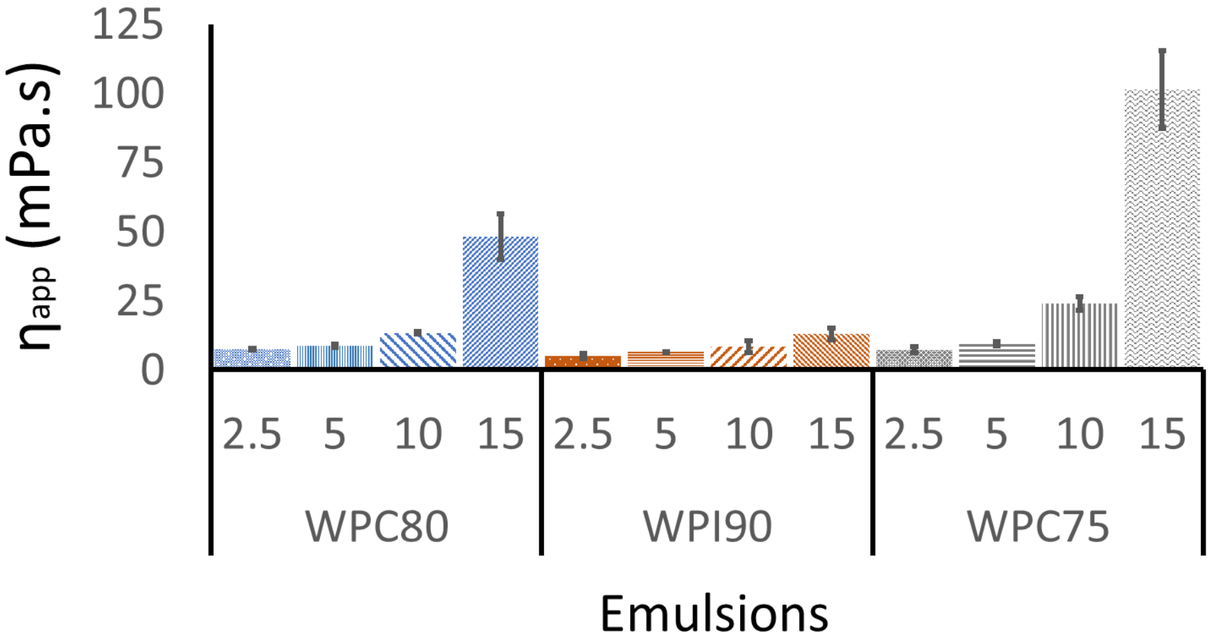

Flow Behaviour

- Casson fluids :

  all emulsion tested, except 15% WPC80 & 15% WPC75

- Hershel-Bulkley fluids :

  15% WPC80 & 15% WPC75

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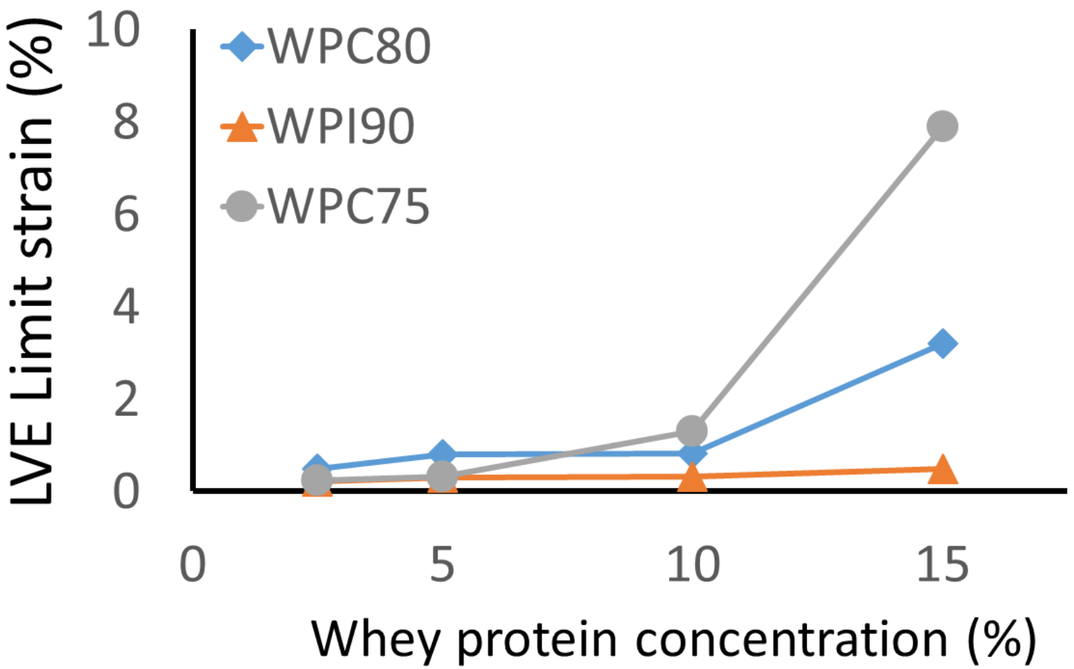
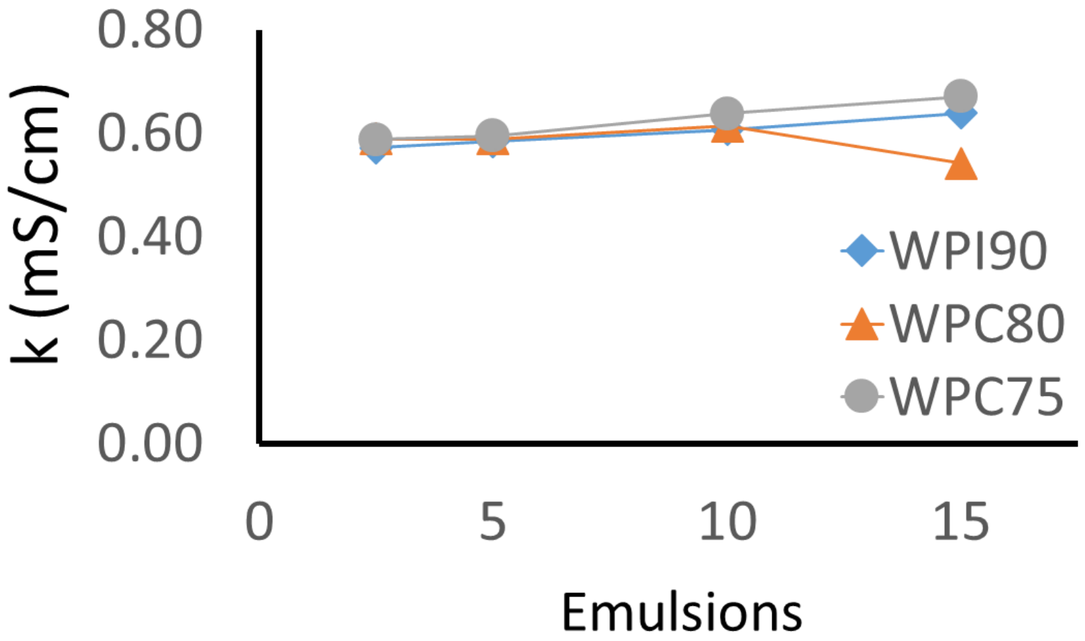
Important Findings

Viscoelastic Behaviour

- G'' >> G' = viscous





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Conclusions

Rheological properties of the whey protein-stabilized RPO emulsions was affected by the type and concentration of whey proteins.

- The flow behavior was varied for the certain type-concentration combination
  - ❖15% WPC80 and 15% WPC75-stabilized RPO emulsion was Hershel-Bulkley fluid, and the others were fitted to Casson fluid behavior
- apparent viscosity
  - ❖ higher with increasing whey protein concentration, WPI <<< WPC
- viscoelastic properties
  - ❖ viscous behaviour
- linear viscoelastic range limit of the emulsions
  - ❖higher with increasing whey protein concentration, WPI <<< WPC

15% WPC75-stabilized RPO emulsion

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Acknowledgement

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BEASISWA PMDSU

This research was funded by PMDSU scholarship grant from Directorate General of Higher Education, Ministry of Education and Culture, Republic of Indonesia

glanbia
for the supply of whey products

&

Anton Paar
for the access to analytical instrument

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Thank You

Best Regards,

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