Effects of pre-roasting on structural and functional properties of pea proteins

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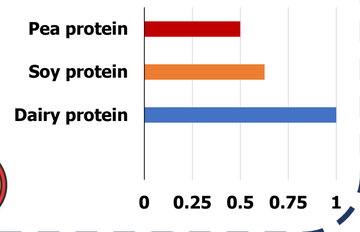
Introduction

Why pea protein

- Dairy protein and soy protein alternatives
- Sustainable
- Hypoallergenic
- Non-transgenic
- Low-cost



Why roast

- Non-chemical modification method
- Easy to scale up
- Heat-induced protein conformation alteration has the potential to improve protein solubility and functionality

Aim

This study aims to investigate the effects of pre-roasting on the extraction efficiency and functionalities (solubility and emulsifying) of pea proteins for their potential application in plant-based milk formulations.

Methodology

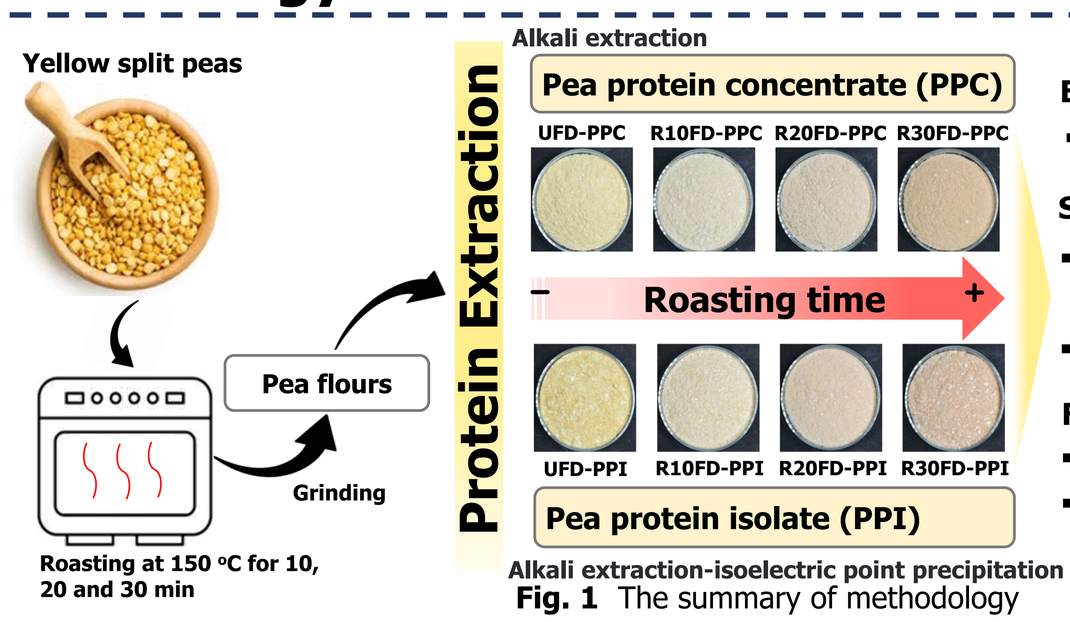


Fig. 1 The summary of methodology

Extraction efficiency
- Protein yield

Structural properties
- Surface hydrophobicity (H_o)-Tertiary structure
- Particle size

Functional properties
- Solubility
- Emulsifying properties

Abbreviation

U: unroasted
R: roasted
R10, R20, R30: pea seeds roasted at 150 °C for 10, 20 and 30 min, respectively
FD: freeze drying

Results

Protein yield

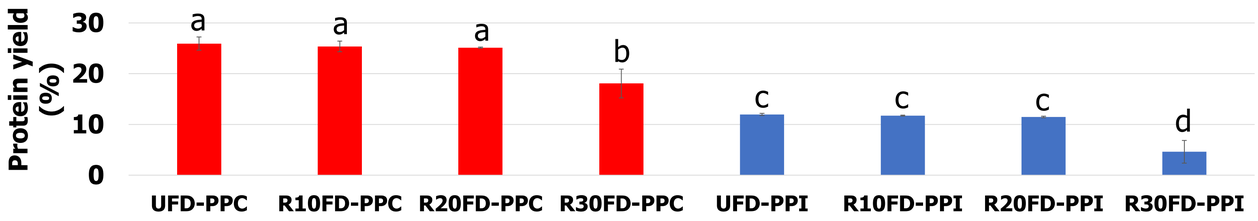
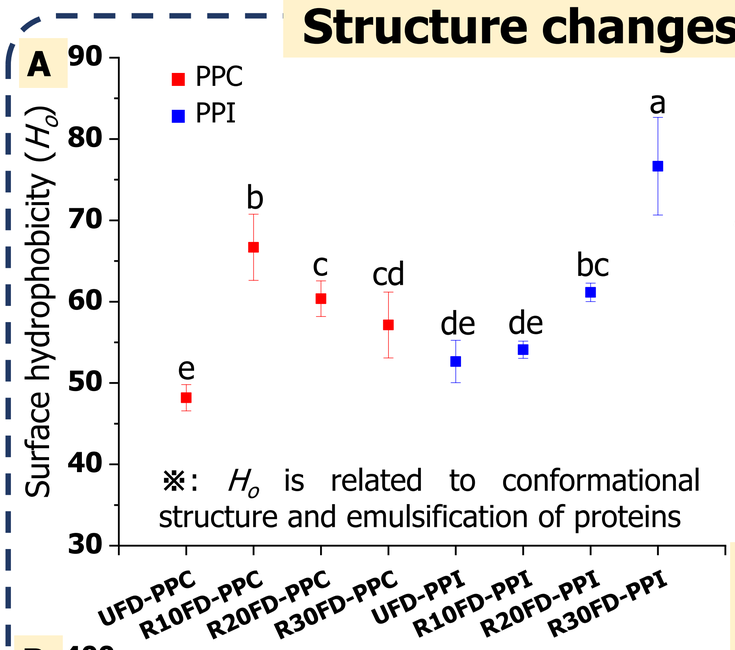
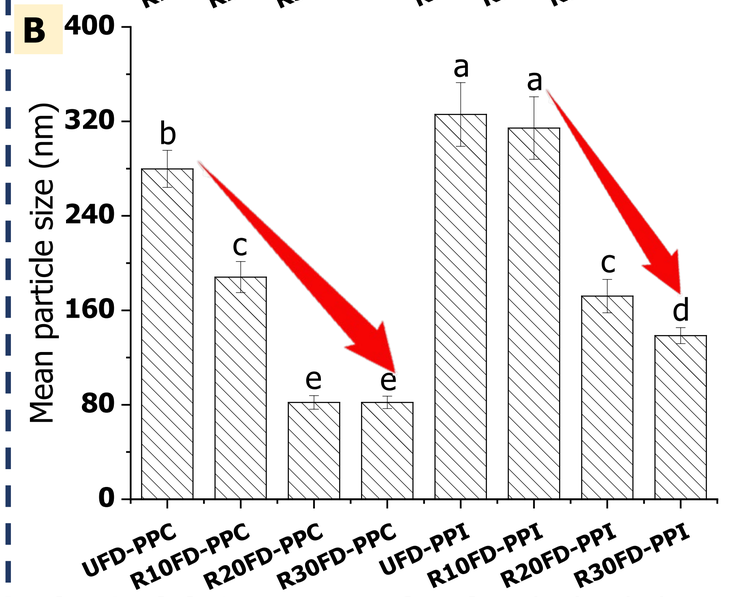


Fig. 2 The protein yield (%) of PPC and PPI with different pre-roasting times

The shorter roasting times (10 and 20 min) at 150 °C retained the yields of PPC (~25%) and PPI (~12%). A longer duration of pre-roasting (30 min) significantly reduced the extraction efficiency of both PPC and PPI.

Structure changes





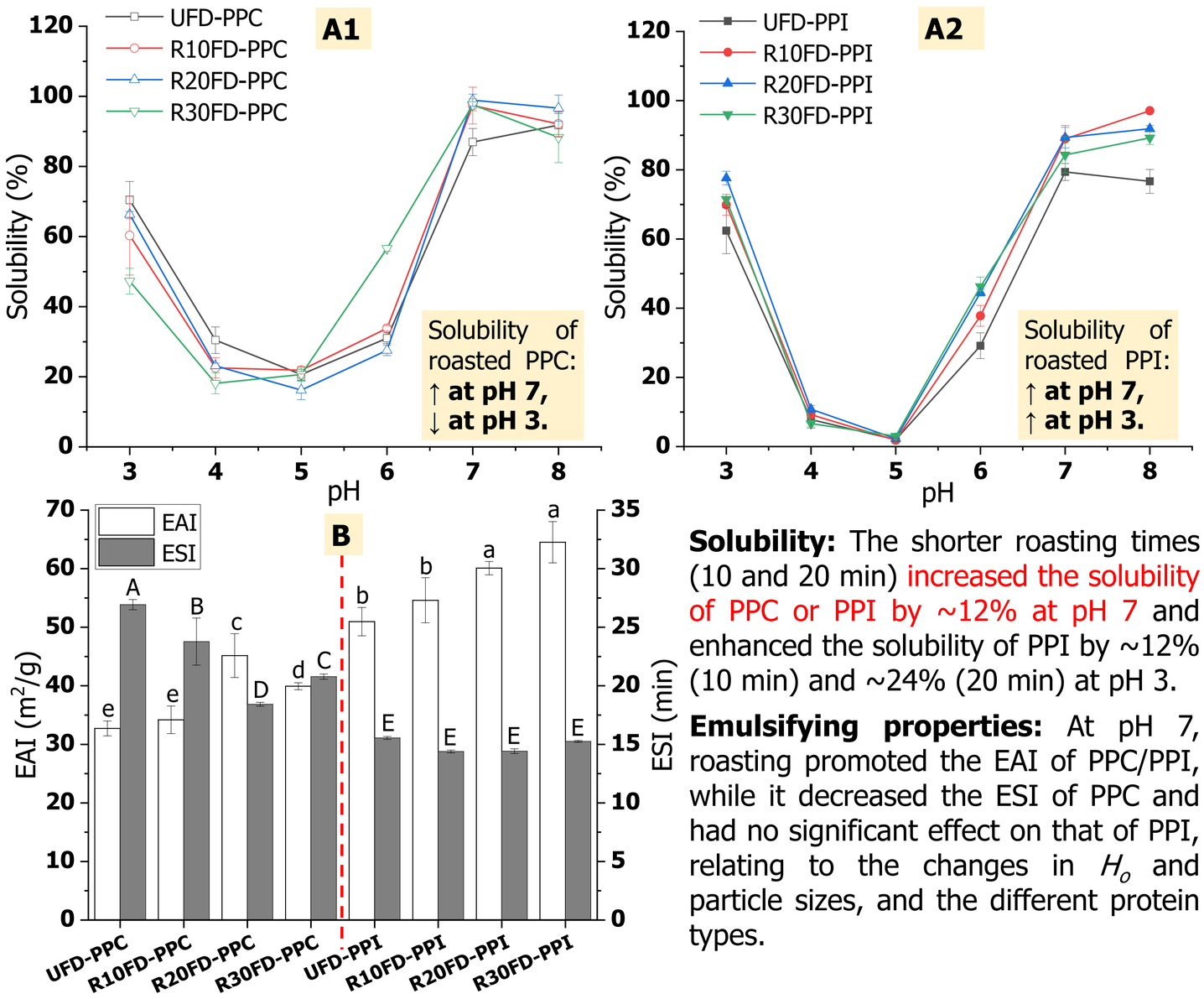
H_o: Roasted pea proteins > Unroasted pea proteins, PPI: Roasting time ↑ → H_o ↑

Jointly affect the solubility and emulsifying performance

Mean particle size:
PPI > PPC;
Roasting time ↑ → Particle size ↓

Fig. 3 **(A)** Comparison of surface hydrophobicity (H_o) of PPC and PPI with different pre-roasting times. **(B)** Effect of roasting on the mean particle size of pea protein solutions at pH 7. Different letters show significant differences ($P < 0.05$).

Functionality changes



Solubility: The shorter roasting times (10 and 20 min) increased the solubility of PPC or PPI by ~12% at pH 7 and enhanced the solubility of PPI by ~12% (10 min) and ~24% (20 min) at pH 3.

Emulsifying properties: At pH 7, roasting promoted the EAI of PPC/PPI, while it decreased the ESI of PPC and had no significant effect on that of PPI, relating to the changes in H_o and particle sizes, and the different protein types.

Fig. 4 **(A)** pH-dependence of pea protein solubility at pH 3-8: **(A1)** PPC and **(A2)** PPI. **(B)** Emulsion ability index (**EAI**) and emulsion stability index (**ESI**) at pH 7 of pea proteins with different pre-roasting times. Different letters show significant differences ($P < 0.05$).

Conclusions

- Short-term roasting (10 or 20 min) at 150 °C prior to extraction enables to **improve solubility** and **retain yield** of pea proteins.
- Pre-roasting significantly **reduced the particle sizes** and **affected the tertiary structure** (surface hydrophobicity) of pea proteins, which further influenced the **solubility** and **emulsification performance** of pea proteins.
- Pre-roasting enhanced the emulsifying ability index and has the potential to be used as ingredients for **plant-based milk production**.

Reference

Lao, Y., Ye, Q., Wang, Y., Vongsvivut, J., Selomulya, C. (2023). Quantifying the effects of pre-roasting on structural and functional properties of yellow pea proteins, Food Research International, 172, 113180.

Acknowledgement

This research was supported by ARC Discovery grant (DP200100642). The authors would like to acknowledge the XRF Laboratory, Mark Wainwright Analytical Centre.