Foods 2024 Conference

The 5th International Electronic Conference on Foods

28–30 October 2024 | Online

MDPI

# Evaluation of the effect of grinding type and enzyme-assisted extraction on okara protein concentrate properties.

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## INTRODUCTION & AIM

Okara is a protein-rich byproduct from soymilk production. It has little market value, so it is usually used as animal feed or discarded. The growing consumption of soy-based products has led to the search for more sustainable soy processing with greater profits. The process of obtaining soymilk (Figure 1) includes a step (Step 2) of grinding in cold or hot water in which the cell walls are broken. Grinding in this work was done with a hot hammer mill (H, water at 90ºC) and with a cold disc mill (D, water at room temperature).


**Figure 1.** Soymilk production process

However, during the grinding step some cells are not damaged. Enzymatic-assisted pretreatment (EAP) could improve protein extraction by breaking down these cells. **The aim of this work was to evaluate the effects of the grinding type and the EAP on the extraction yield, thermal behavior and protein solubility of concentrates obtained from okara.**

## METHOD

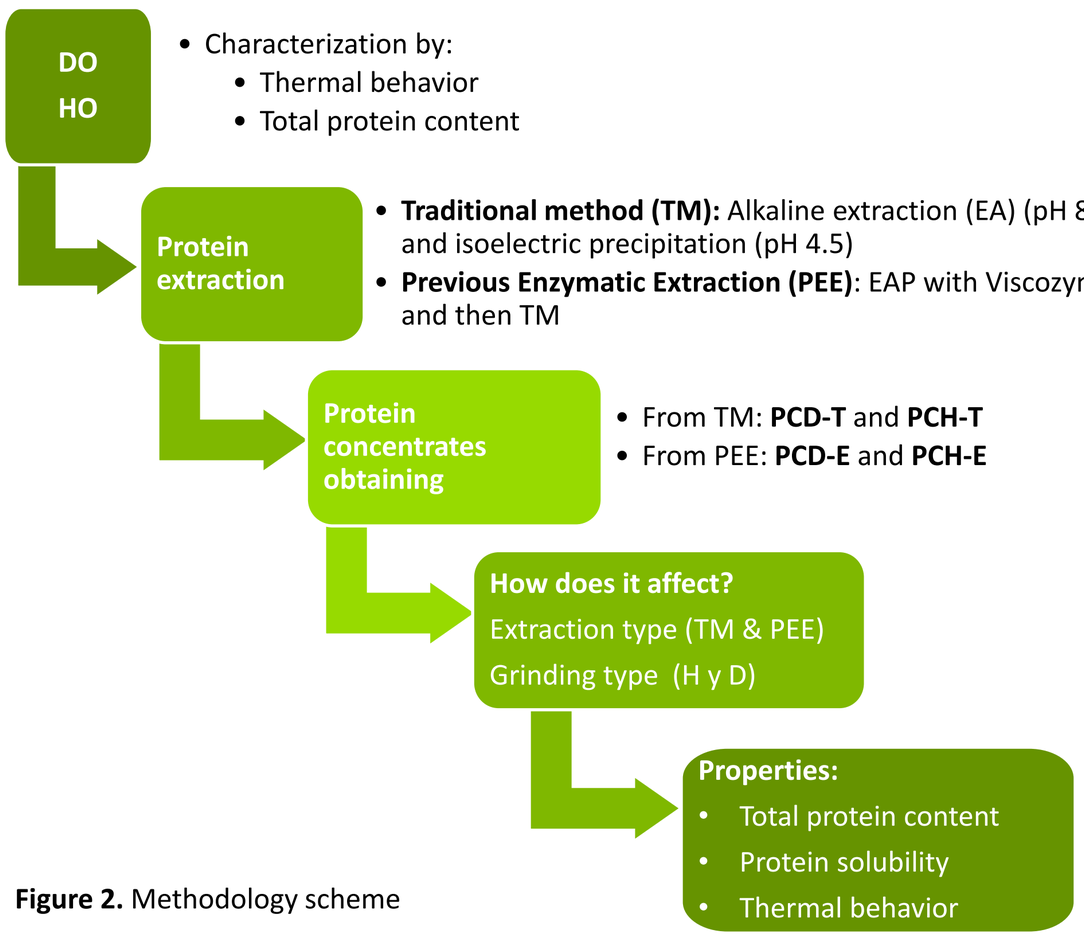



**Figure 2.** Methodology scheme

HO: okara from hammer milling with hot water
DO: okara from disc milling with room temperature water
PCD-T and PCH-T: Protein concentrate obtained by TM from OD and OH, respectively.
PCD-E and PCH-E: Protein concentrate obtained by PEE from OD and OH, respectively.

- Total protein content was determined by the Kjeldahl method (Nx6.25)
- Thermal behavior was determined by DSC.
- Protein solubility of the concentrates was quantified by the BCA method in a pH range of 2.5-11.5.
- Analysis of variance and Tukey's test were used to identify pairwise differences between means using the statistical program Infostat 2020e Version. Significance was determined at $p < 0.05$. All determinations were made at least in triplicate.

## RESULTS & DISCUSSION

**Table 1.** Protein contents of okara and concentrates, extraction yield (g concentrate extracted x 100 /g okara sample) and protein yield (g protein in the concentrate x 100 /g protein in the okara sample).

| Sample | Okara protein content (%)* | Enzymatic pre-treatment | Extraction yield (%) | Concentrate protein content (%)* | Protein yield (%) |
|---|---|---|---|---|---|
| HO | 36.7 | No | 3.9±0.4$^{a}$ | 58.1±0.2$^{a}$ | 2.3±0.2$^{a}$ |
| HO | 36.7 | Yes | 66.2±0.6$^{d}$ | 60.6±0.5$^{b}$ | 40.1±0.3$^{d}$ |
| DO | 29.3 | No | 16.6±0.4$^{b}$ | 61.3±0.1$^{c}$ | 10.2±0.3$^{b}$ |
| DO | 29.3 | Yes | 49.6±0.5$^{c}$ | 64.43±0.05$^{d}$ | 31.9±0.3$^{c}$ |

Averages with a common letter are not significantly different ($p > 0.05$). *Dry basis.

- Lower extractability in heat-treated samples (HO).
- Significant increase in extraction yield in enzymatically treated samples.

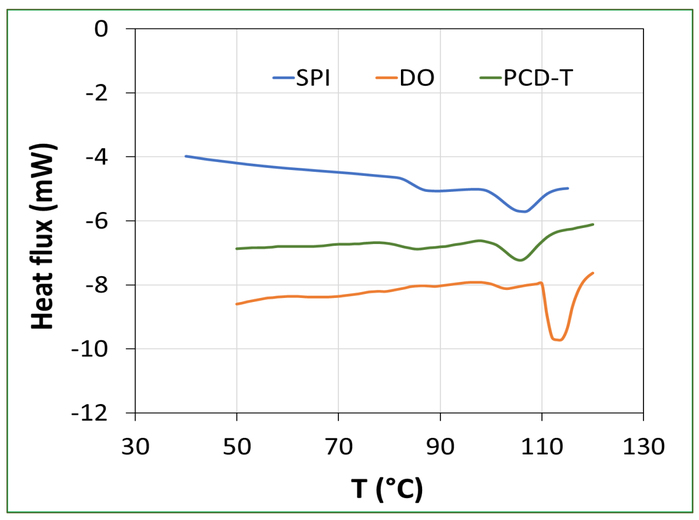
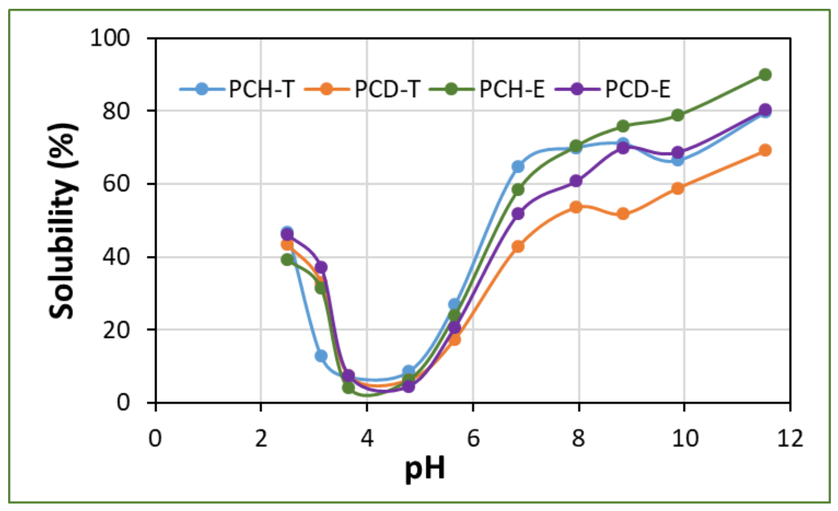



**Figure 3.** Thermograms of DO, PCD and a soy protein isolate (SPI)

- Thermal profiles of DO, PCD-T and PCD-E (not shown) were similar to that of SPI.
- Thermal profiles of HO, PCH-T and PCH-E didn't show endothermic peaks.
- Thermal treatment at 90ºC applied during soy processing (Figure 1, Step 4) with the hammer mill did not lead to the denaturation of okara proteins.

- The solubility curve of the concentrates presented a typical U shape, with the minimum close to pH 4.5.
- The samples from the hammer mill treatment exhibited greater solubility than those from the disc mill, despite being more denatured.




## CONCLUSION

- The milling method affects protein yield and the degree of native protein, with grinding using disc mill at room temperature being most effective.
- Enzymatic pre-treatment increases the protein yield.
- These results encourage the use of this by-product to obtain protein concentrates.

## FUTURE WORK

**Future Work:**

- Evaluation of the functional properties of the concentrates obtained by PEE: emulsifying properties, water and oil binding capacity, etc.
- Using the concentrates for food formulations.

**Acknowledgements:**

- CSIC (Comisión Sectorial de Investigación Científica-Sectoral Commission for Scientific Research, Universidad de la República)