MICROWAVE AQUEOUS EXTRACTION OF SHRIMP SHELL PROTEINS

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Introduction

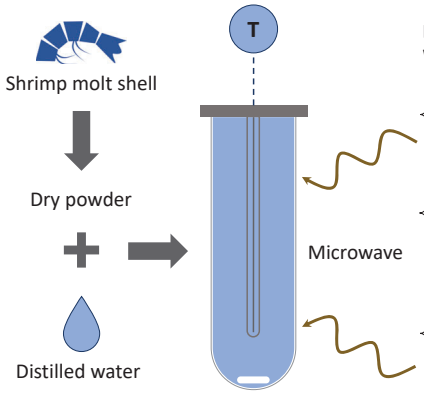
Shrimp production generates the exoskeleton as one of the waste products due to the molting process[1].

This shell can be valorized by the recovery of chitin, but it also has a high protein content (20-40%)[2] with interest to be isolated.

During the conventional chitin extraction process, proteins cannot be reused, due to the use of inorganic alkaline solvents[3].

This study aimed to use water as solvent for the extraction of proteins from shrimp molt shells by microwave assisted extraction.

Methods



Equipment: Anton Paar Monowave 300
Working volume: 20 mL

Fixed variable:
- Rotation speed: 1000 rpm
- Particle size ($D_{90\%}$) 483 ± 9 µm

Studied variables:
- Temperature (T): 175 and 225 °C
- Isothermal time (t): 0 and 10 min
- Solid-liquid ratio (S/F): 10, 20, and 40 mL/g

Response:
- Extraction yield (Gravimetric)
- Protein extraction (BCA method)
- Free amino acid extraction (Ninhydrin method)

Results

Table 1. Raw material characterization

Parameter	(g/100 g of dried shell)
Ash content	53.7 ± 0.5
Protein content	10.6 ± 0.4
Amino acid content	1.37 ± 0.12
Fatty acid content	3.8 ± 0.9
Chitin content	17.8 ± 0.7

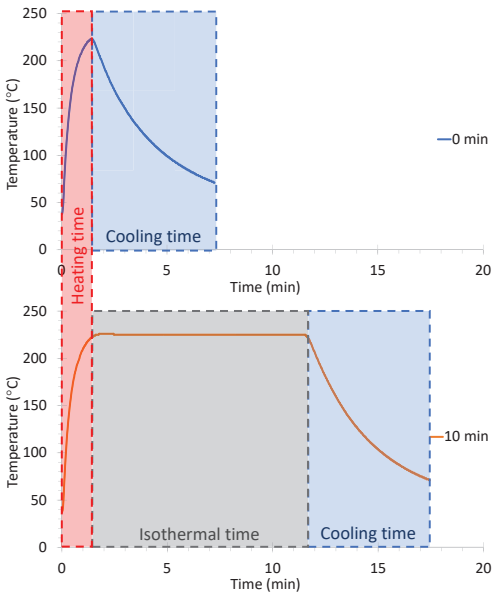
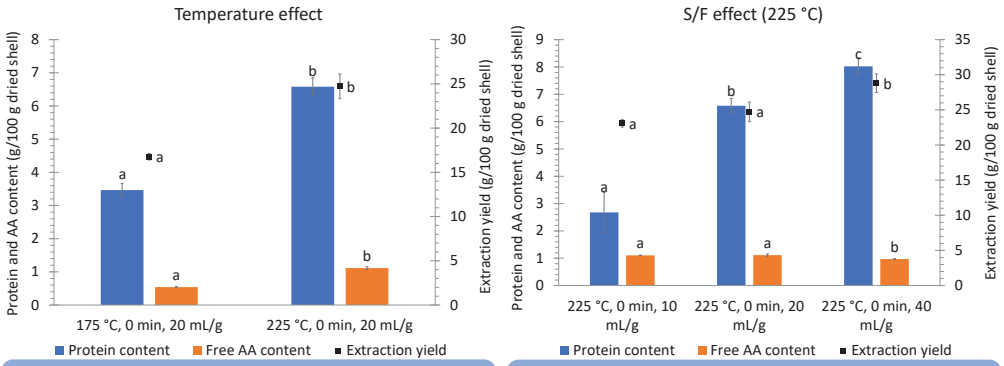
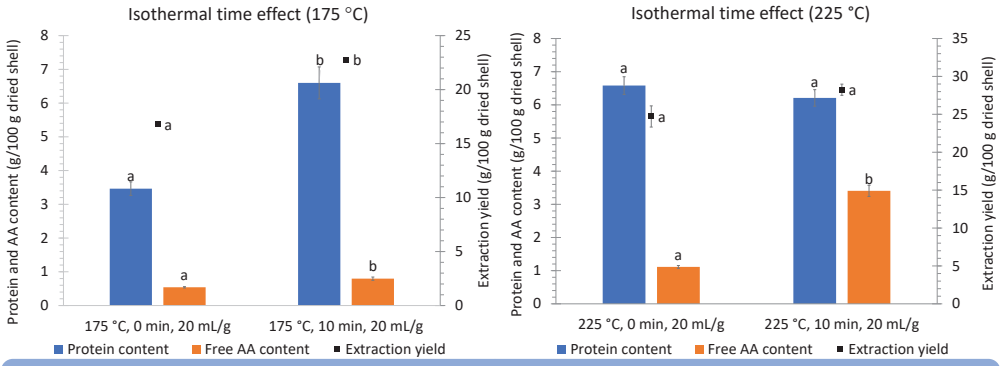


Fig. 1. Temperature profile



Low temperature: diminished protein extraction and the hydrolysis into amino acids.

High S/F: favored the extraction of proteins.



High Isothermal time: at low temperatures increases de extraction of proteins, with low increase in hydrolysis into amino acids, while at high temperature the hydrolysis into amino acids is promoted.

Fig. 2. Effect of the studied variables

Conclusions and On-going Work

Conclusions:
- A total protein extraction yield of approximately 80 wt% was obtained in relation to the initial amount of proteins in the raw material, using only water as the solvent.
- Temperature is a parameter that increases the content of extracted proteins but increases the content of amino acids.
- Isothermal time effect is modulated by the process temperature.
- S/F is a controlling parameter in the extraction of proteins and do not promote the complete hydrolysis of proteins.
- Highest protein extraction with low degradation: T = 225 °C, t = 0 min, and S/F = 40 mL/g (protein: 8.0 ± 0.3%, free AA: 0.97 ± 0.02%, and extraction yield: 28.8 ± 1.3%).

On-going work:
- These parameters (T: 170 - 230 °C, t: 0 - 12 min, and S/F: 20 - 60 mL/g) are being studied in a Box-Behnken experimental design for process optimization.

Reference: [1] N. Mezzomo, J. Martínez, M. Maraschin and S. R. S. Ferreira, Journal of Supercritical Fluids, 2013, 74, 22–33. [2] X. Hu, Z. Tian, X. Li, S. Wang, H. Pei, H. Sun and Z. Zhang, ACS Omega, 2020, 5, 19227–19235. [3] H. El Knidri, R. Belaabed, A. Addaou, A. Laajeb and A. Lahsini, Int J Biol Macromol, 2018, 120, 1181–1189.

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