Can Cold Plasma Treatment Improve the Food Product Development Properties of Cricket Protein?

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Introduction

- The global population is expected to reach 9.1 billion by the year 2050, fueling the search for efficient and edible proteins (Cunha et al., 2025).
- Crickets (*Acheta domesticus*) are extremely valuable in terms of nutritional value. They not only contain significant amounts of proteins and fat, but also vitamins and minerals.
- Research has already been conducted on finding efficient methods of cricket protein extraction for high protein yields (Cunha et al., 2025).
- Despite this, further research is still needed to further adapt the qualities of cricket protein by increasing its digestibility and solubility to make it more suitable for product development.
- Novel technologies like cold plasma (CP) treatments may provide beneficial characteristic changes to create new market-friendly products (Pina-Pérez et al., 2021).
- Cold plasma induces structural and functional modifications in food proteins by generating reactive species that change protein conformation.
- It modifies the protein properties such as solubility, emulsification, digestibility, and bioactivity.

Objectives

- Extraction of protein isolates from defatted cricket flour
- Evaluate the modification of cricket proteins by cold plasma treatment.

Materials and Methods

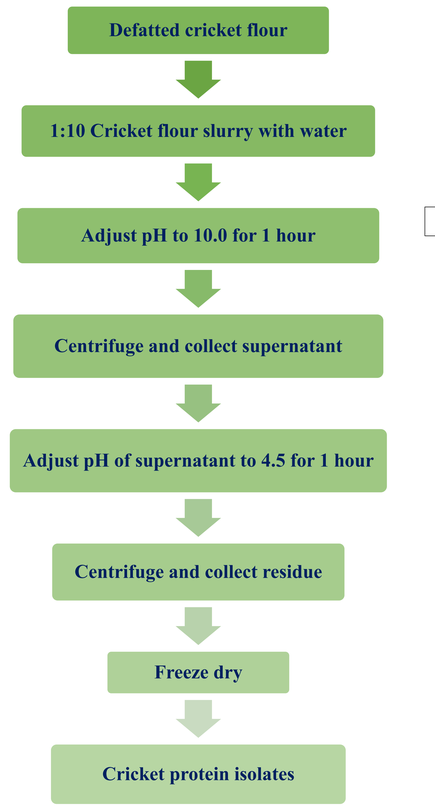
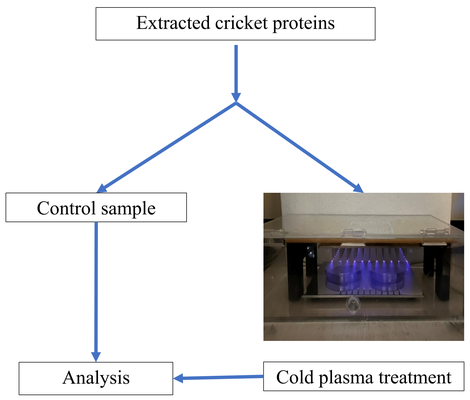


Figure 1: Extraction methodology of cricket proteins



Cold plasma treatment parameters
Voltage: 220 V
Discharge frequency: 1.8 kHz
Time of exposure: 15 minutes
Resonance frequency: 57.07 Hz

Figure 2: Experimental design

Characterization
Protein yield and purity, Solubility, Foaming and emulsification, Water and Oil Holding Capabilities, Digestibility, and Radical scavenging activities.

Results and Discussion

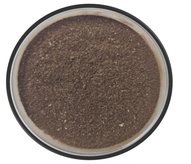


Figure 3: Extracted cricket proteins

Mass yield (%)	**7.00 ± 0.50 %**
Purity (%)	**79.90 ± 0.00%**
Protein extractability (%)	**43.04 ± 3.39%**

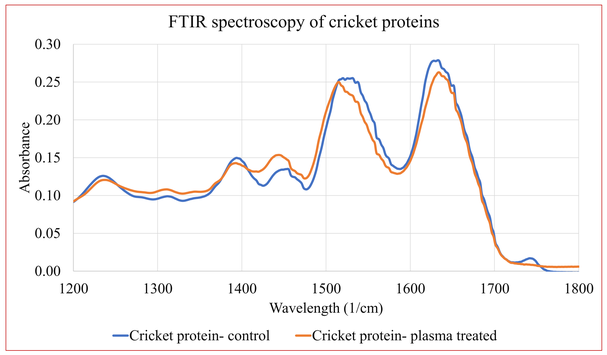


Figure 4: Secondary structure of cricket proteins

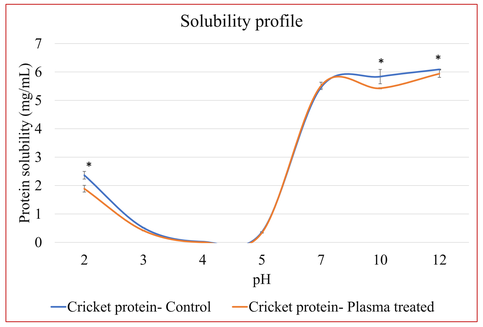


Figure 5: Protein solubility profile

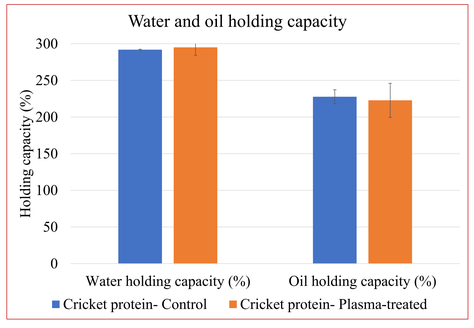


Figure 6: Water- and Oil-holding capacities

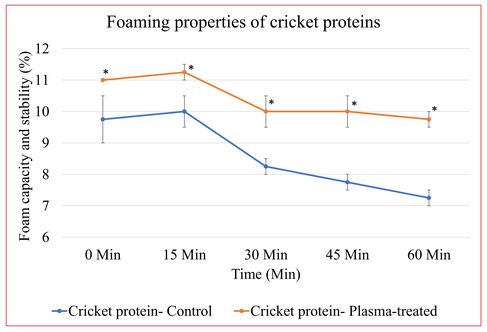


Figure 7: Foaming capacity and stability

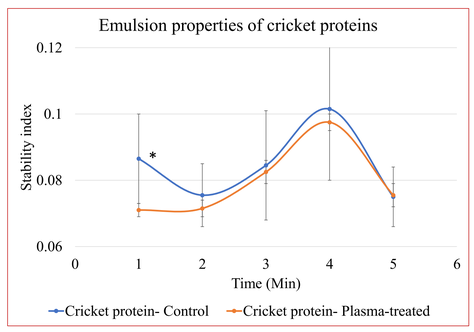


Figure 8: Emulsion capacity and stability

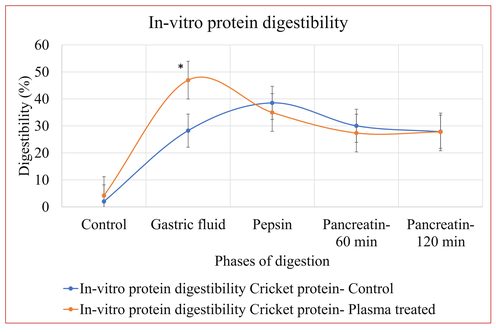


Figure 9: In-vitro protein digestibility

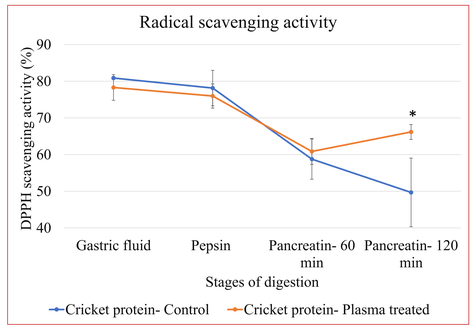


Figure 10: Radical scavenging activity of digestates

- The cricket protein isolates showed a higher purity of 79.9%, with 43% extractability.
- The secondary structure showed modifications in Amide II and α-helix regions predominantly.
- The solubility showed a significant decrease after plasma exposure in highly acidic and alkaline pH ranges..
- Both the control and plasma-treated proteins share similar water and oil holding capacity with no significant difference.
- The foaming properties showed a significant increase throughout the incubation period after plasma exposure..
- The emulsion activity was lower for plasma-treated proteins at 0 min but showed no significant difference during the incubation.
- The digestibility showed that plasma-treated cricket proteins had higher breakdown in the gastric phase.
- The radical scavenging activity of the digestates consistently reduced with each phase of digestion.
- Plasma-treated cricket proteins showed significantly higher scavenging activity at the end of digestion.

Conclusions

- Cold plasma exposure has modified the protein structure, improving foamability, digestibility, and antioxidant
- properties.
- However, the functional properties like solubility and emulsification do not show significant improvement.
- The secondary structural changes may be the reason for the modifications in the protein's functional and bioactive properties.

Future Work

- The cold plasma parameters need to be optimized to increase the functional and biological activities of the extracted cricket proteins.
- Further, the yield and extractability of the proteins may be improved by adapting any process intensification methods.

Acknowledgement

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