Advancements in Legume Processing: A Comprehensive Review of Non-Conventional and Emerging Technologies

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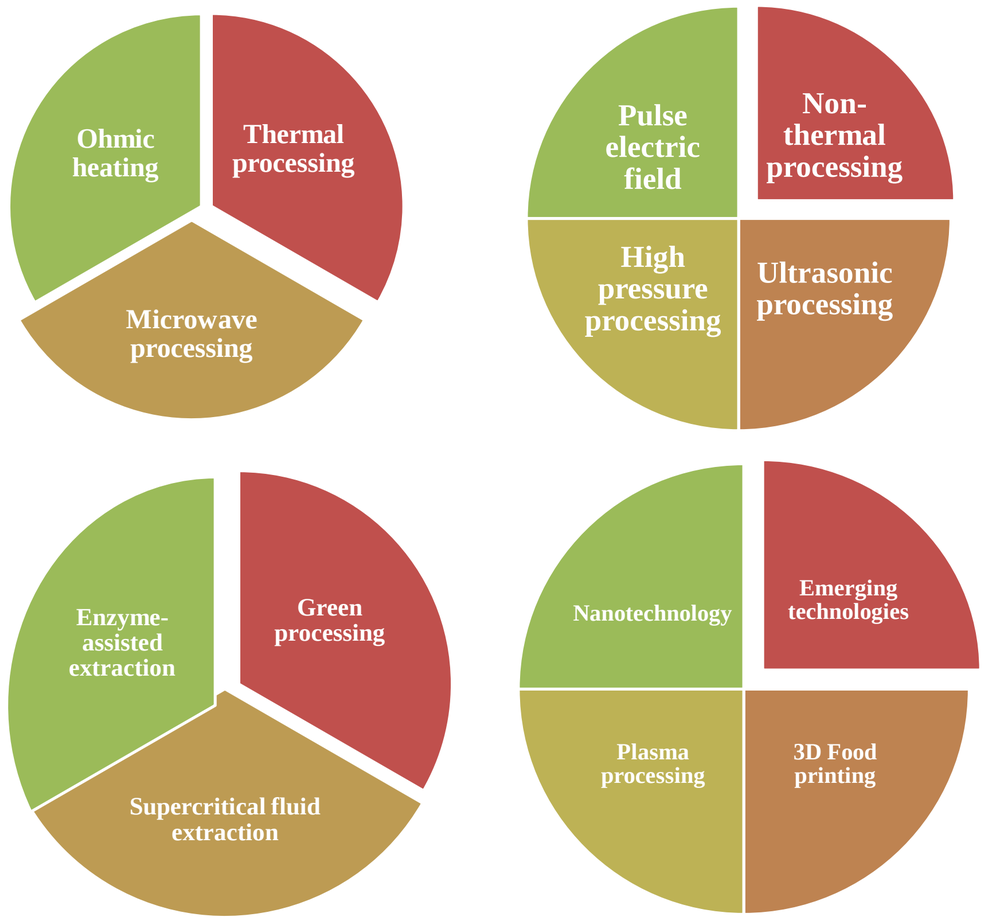
INTRODUCTION

- Legumes (Leguminosae family) → lentils, beans, peanuts
- Essential nutrients → protein, low glycemic index carbohydrates, dietary fibre, minerals (calcium, iron, phosphorus), and vitamins (thiamine, riboflavin, and folates).
- Thermal processing (steaming and boiling) → impact on the nutritional quality and functionality
- Challenges in the utilization of traditional thermal methods necessitate a novel non-thermal method
- Novel Processing methods include high-pressure processing, ohmic heating, enzyme-assisted extraction, supercritical fluid extraction, ultrasound processing, and plasma processing.
- Improvement of nutritional value, digestibility, and functional properties of legumes while minimizing nutrient losses

EFFECTS ON LEGUMES

Legumes	Processing methods	Effect of processing
Peas, chickpeas, lentils	Ultrasound processing	• Improved emulsification properties • Enhanced protein digestibility • Reduced cooking time
Lentils, chickpeas	High-pressure processing	• Modified volatile profile • Improved bioactivity • Increased hydration capacity • Retained vitamins and antioxidants
Peas, Lentils	Microwave processing	• Enhanced starch and protein digestibility • Improved water absorption • Reduced antinutritional factors like tannins
Faba beans	Pulse electric field	• Starch content reduction • Increased free glucose and protein • Improved extraction of phenolic components
Lentils	Ohmic heating	• Reduction in antinutritional factors • Faster cooking • Retention of flavour and aroma
Legumes (general)	Supercritical fluid extraction	• Enhanced extraction of oils and bioactive components • Improved solubility of proteins
Chickpeas, lentils	3D Food printing	• Creation of customized nutrient-rich foods • Enhanced control over texture and shape • Potential for fortified products
Legumes (general)	Nanotechnology	• Encapsulation of nutrients for controlled release • Improved bioavailability of minerals and vitamins • Extended shelf life
Chickpeas, Peas	Enzyme-Assisted Processing	• Breakdown of oligosaccharides (e.g., raffinose) • Enhanced release of bioactive peptides • Reduced flatulence-causing agents
Peas	Cold Plasma Treatment	• Microbial decontamination • Increased seed germination rates • Reduced pesticide residues

NON– CONVENTIONAL PROCESSING



FUTURE WORK

Integrating non conventional processing techniques into legume processing will pave the way for a more sustainable, nutritious, and versatile food future.

CONCLUSIONS

- Adoption of non-conventional technologies (ultrasound, pulsed electric fields, and cold plasma) → efficient and sustainable alternatives to traditional legume processing. and overall product quality
- Key functional and sensory properties are preserved, ensuring better taste, texture, and nutritional value.
- Such innovations support the development of nutritious legume-based foods, aligning with sustainable agriculture.
- These technologies reduce energy consumption, processing time, and chemical inputs, promoting eco-friendly food production and enhancing protein extraction, bioavailability .

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