Food Processing and Protein Quality: Current Considerations

James D. House

Department of Food and Human Nutritional Sciences

University of Manitoba

Conflict of Interest Disclosure

- Have received funding from national and international granting agencies (e.g. NSERC) and industry, including commodity groups representing both plant and animal proteins
- Canadian patent re: sunflower tofu production
- Board of Trustees – IAFNS
- Advisory Committee – Canadian Nutrition Society

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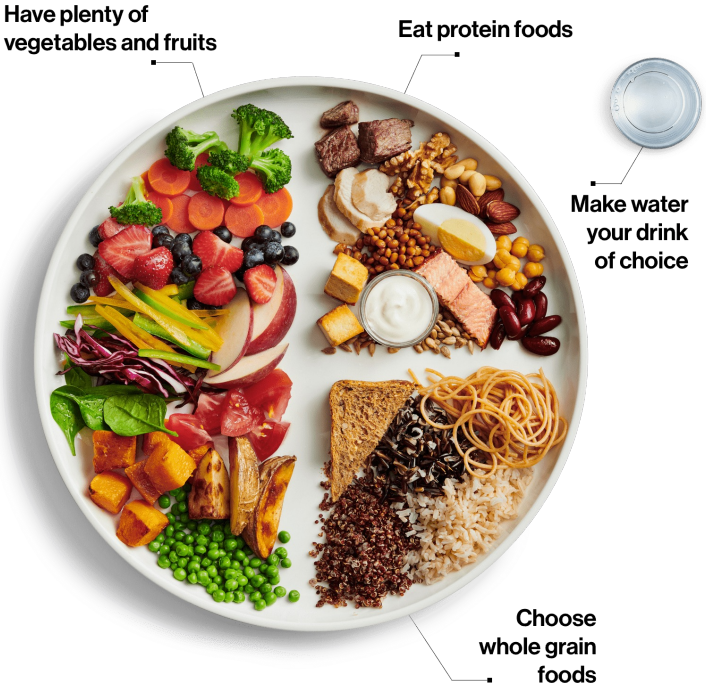
What are Protein Foods

Choose **Protein Foods** that come from Plants more often



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https://food-guide.canada.ca/en/

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Finding Plant-Based Proteins

- **Consumers are looking for plant proteins, but how do they find them?**
  - Nutrition Facts Table
  - Front of pack label claims
    - **Protein Content claims**
- **Protein content claims must be substantiated**
- **Can be difficult, especially for whole, plant-based protein sources**

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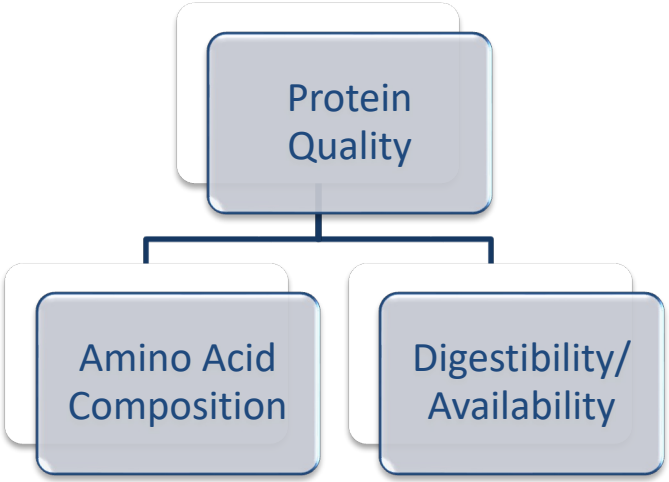
Background on Protein Content Claims

Jurisdiction	Basis for Protein Content Claims	Methodology	Criteria
U.S.A.	Protein Quality & Quantity	Protein Digestibility-Corrected Amino Acid Score **(PDCAAS)**	**PDCAAS Corrected Protein = 5.0 – 9.9 g = Good Source; 10.0 g or above = Excellent Source**
Canada	Protein Quality & Quantity	Protein Rating System based on the Protein Efficiency Ratio **(PER)**	**Protein Rating of 20 – 39.9 = Good Source; 40 or above = Excellent Source**
EU & UK	Protein Quantity	Expression of protein content relative to energy content	**12 – 19.9% of energy = Source of protein; 20% of energy or above = High Protein**
Australia/New Zealand	Protein Quantity	Expression of total protein content per serving	**10 g of protein = Good source**
FAO 2013 Proposal	Protein Quality & Quantity	Digestible Indispensable Amino Acid Score (DIAAS)	**Protein must exceed 5 grams per serving to qualify AND meet a DIAAS cut-off of 75 (proposed) for a source claim**

Fundamentals of Protein Quality

Amino Acid Score < 1.0 indicates that at least one amino acid is limiting

Pulses: Typically limiting in either Tryptophan or Sulphur Amino Acids
Cereals: Limiting in lysine



Plant-based proteins typically present with lower digestibility

- Encapsulating effect of cell wall
- Presence of protease inhibitors

How well does the amino acid pattern match human amino acid needs?

To what extent are the amino acids digested, absorbed and ultimately made available for metabolic demands?

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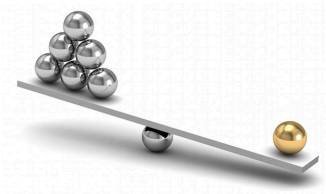
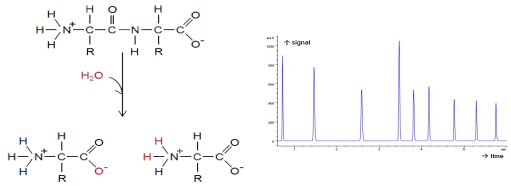
Methods Comparison

Technical Considerations

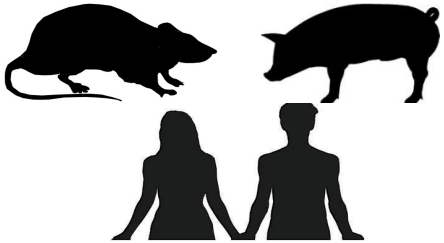
Quantity vs. Quality



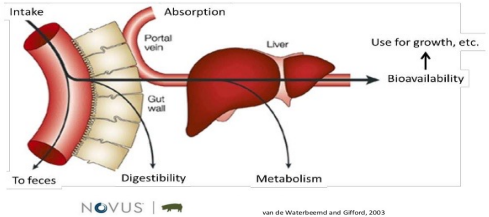
Analytical Issues



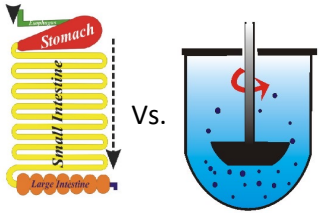
Choice of Species



Digestibility vs. Availability



in vivo vs. in vitro



The Numbers

Reference Pattern

Serving Size

Threshold Values

Conversion Factors

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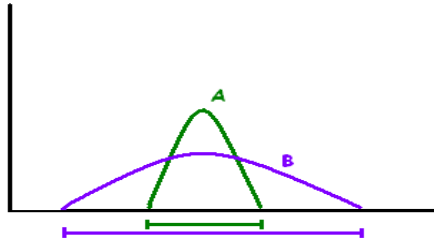
Methods Comparison

Other Considerations

Social License	Cost	Variability
		

- Breeding
- GMO

- Nutrition
- Climate

- Novel Processes
- Modifications

- Genetics (Plant/Animal)
- Environment
- Processing

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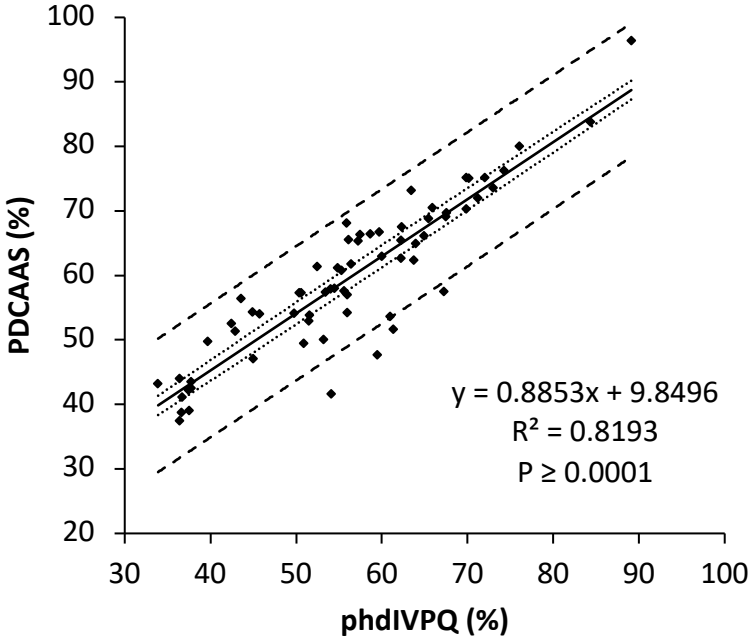
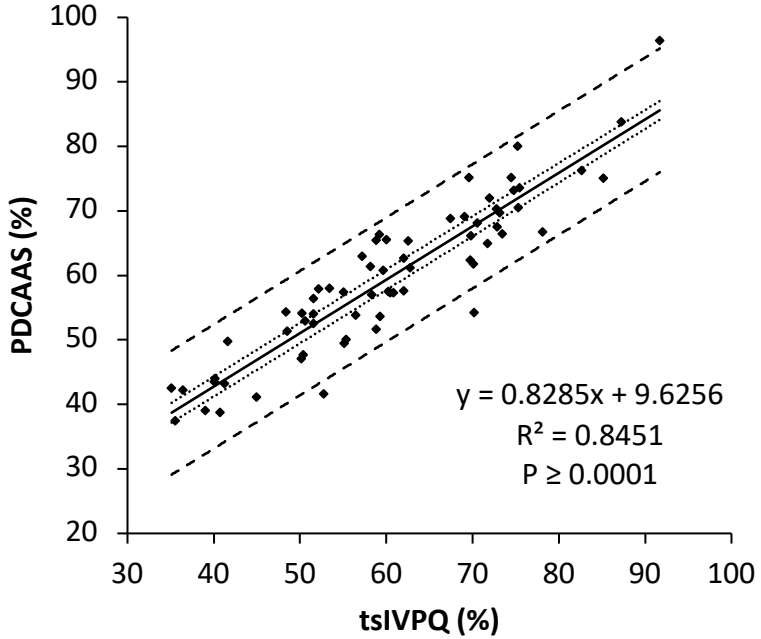
In Vitro PDCAAS

- pH-drop *in vitro* PDCAAS



- Two-Step *in vitro* PDCAAS



Franczyk, 2018

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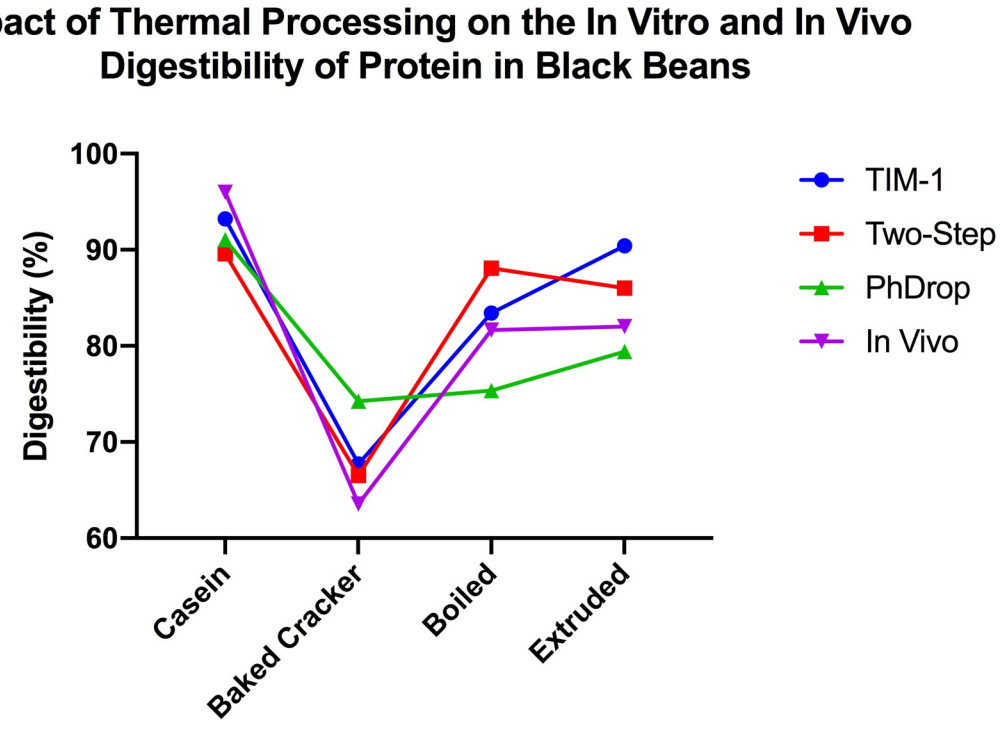
Dynamic In Vitro Digestion Systems



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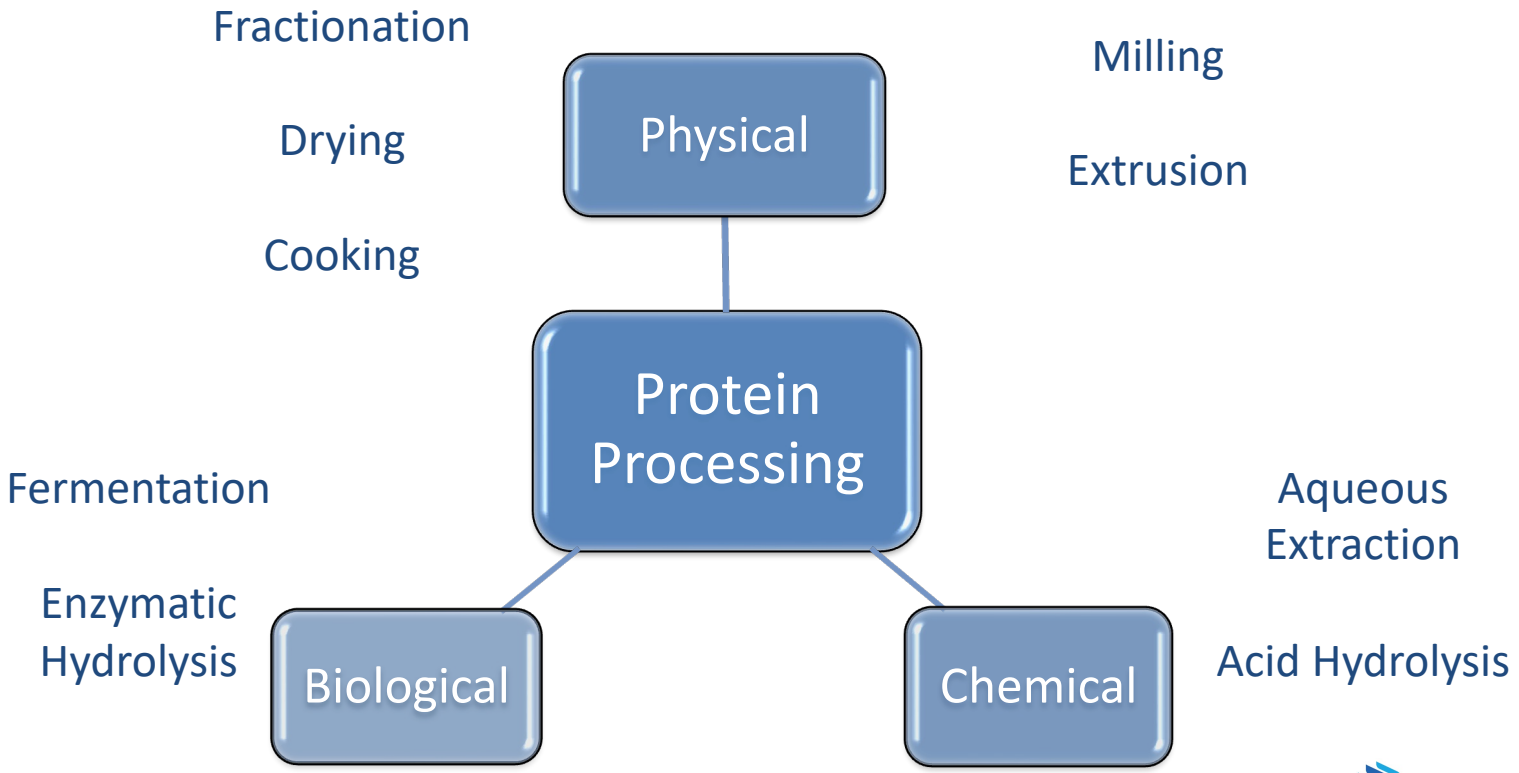
Impact of Processing on Plant Protein Quality



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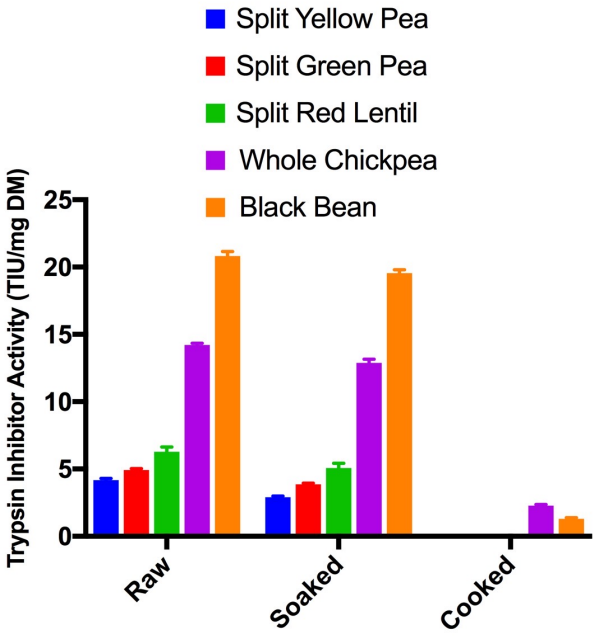
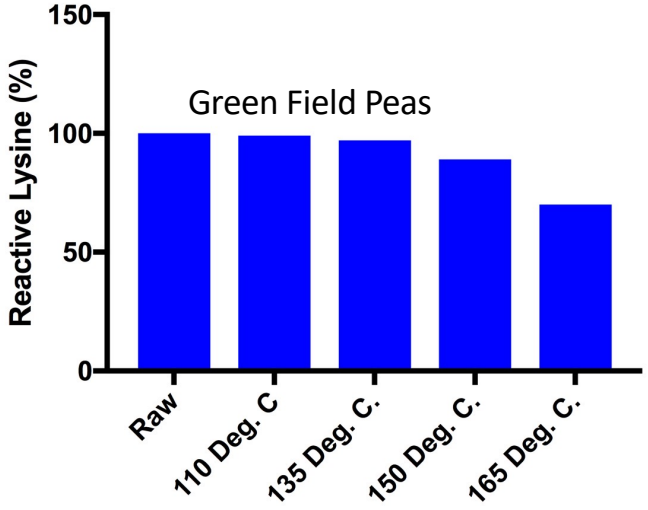
Impact of Thermal Processing on Protein Quality



Shi et al., 2017. J. Food Sci. Technol. 54: 1014-1022.



Van Barneveld et al., 1994. Brit. J. Nutr. 72: 221-241.

Balance is key!

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Summary

- North American regulatory frameworks require protein quality substantiation for content claims
- If protein quality is to be maintained as a criterion, need to better understand sources of variation (Genotype x Environment x Processing)
  - Amino Acid Content
  - Amino Acid Digestibility/Availability
- Methods need to reflect challenges with continued use of bioassays (ethics, costs, suitability, timeliness)