

The Power of Pulses:

Capturing New Opportunities for Pulse Proteins through Innovations Along the Value Chain

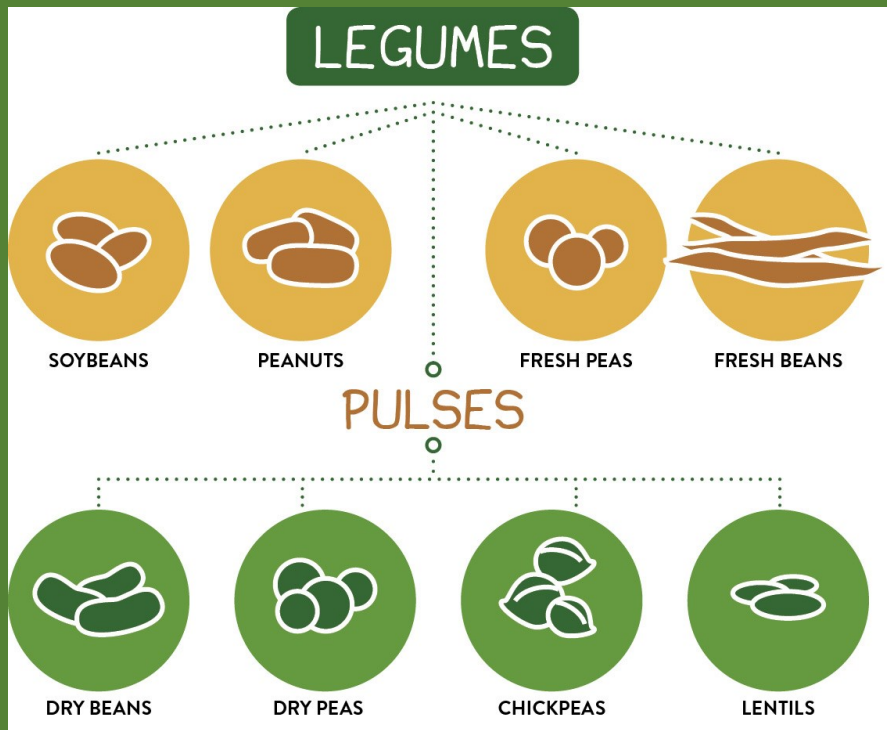
James D. House

Professor and Head
Department of Food and Human
Nutritional Sciences





Snapshot: Pulse Sector



- In 2016, Global pulse production was 82 M tonnes from 82 M hectares (FAOSTAT, 2018)
 - 62% for human consumption
- Canada produces approx. 8% of world production
 - Consume only 7% of what is produced
 - Export-focused



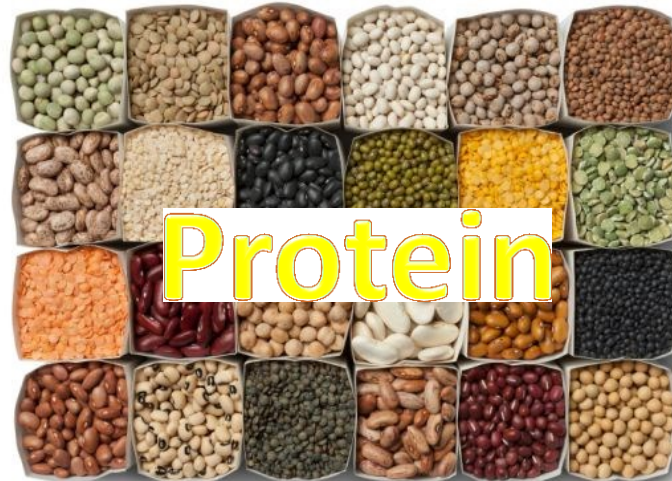
Traditional Pulse Utilization



Nutritional Value of Pulses



↑ Dietary Fibre
↑ Iron
↑ Folate
↑ Potassium
↑ Bioactives



↓ Fat
↓ Glycemic Index



Protein Sources in the Human Diet

Pasiakos et al., 2015. Nutrients 7: 7058-69.

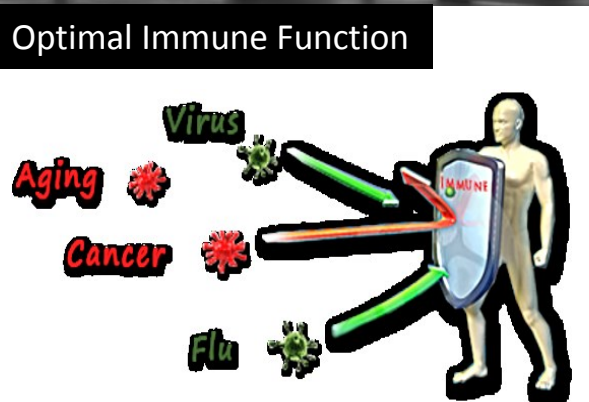


United States (NHANES 2007-2010)

- Consuming approx. 40 grams of protein per 1000 calories
 - 70% from Animals
 - 20% from dairy
 - 50% from meat, eggs, offal
 - 30% from Plants
 - 6% from breads and rolls
 - 2.5% from pasta
 - 1.3% from legumes, including pulses



Why Protein?

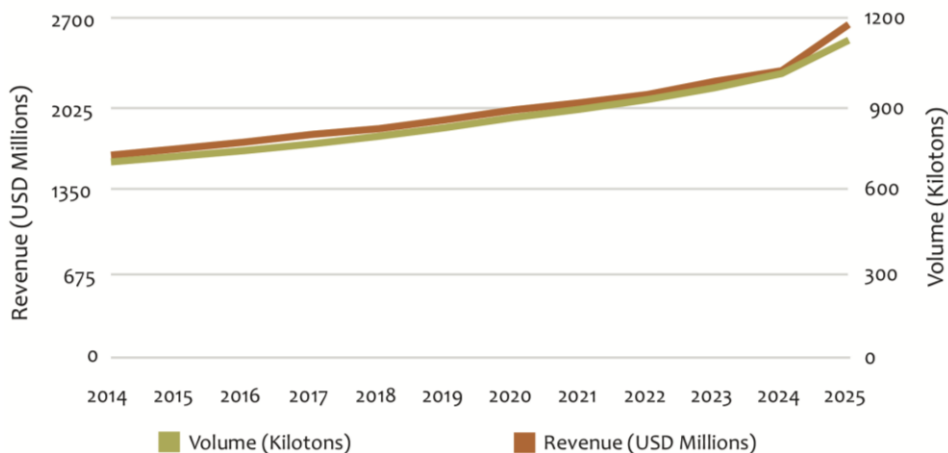




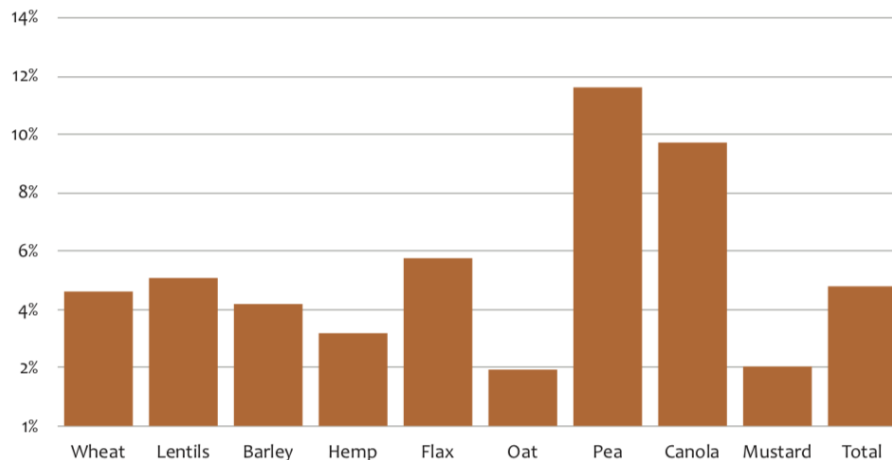
Global Protein Trends



Global Protein Ingredients Market Estimates and Forecast, 2014-2025



Global Plant Protein Ingredients Market, Compound Annual Growth Rate, 2016-2025 (USD Millions)



Source: Protein Industries Canada; Unleashing the potential of Canadian crops.
Accessed: www.proteinindustriescanada.ca



Pulse Protein: *Capturing New Opportunities*



Opportunities

- Plant-based proteins
- Sustainability
 - Nitrogen fixation
 - Water usage
- “Snackification” & Novel Beverages
 - Protein functionality

Challenges

- Supply chain
 - Genetics
- Knowledge
 - Optimal processing
- Protein quality
 - Functional
 - Nutritional
- Sensory attributes



Communicating Protein Messages



Nutrition Facts Panel

- Crude Protein Content
- % Daily Value (in US)

Claims

- Origin Claims
- Composition Claims
- Symbols
- Nutrient Content Claims
 - Source → Excellent Source
 - Comparative Claims

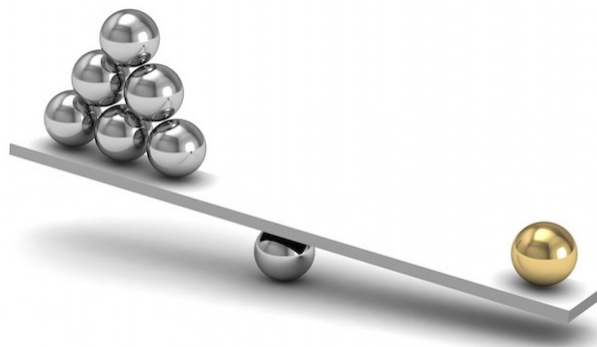
Kidney Beans, Organic		
12/15 oz		
Nutrition Facts		
Serving Size	1/2 cup (130g)	
Servings Per Container	About 3.5	
Amount Per Serving		
Calories 100	Calories from fat 0	
% Daily Value*		
Total Fat 0g		0%
Saturated Fat 0g		0%
Trans Fat 0g		
Sodium 15mg		0%
Potassium 440mg		12%
Total Carbohydrate 18g		6%
Dietary Fiber 10g		40%
Sugars <1g		
Protein 8g		16%

High in Protein

Excellent Source of Protein



What Evidence is Needed to Support Nutrient Content Claims?



Quantity

vs.

Quality




- Nitrogen Content
- Nitrogen Conversion Factor
 - Per Weight or Volume basis
 - Per % Energy basis

- Amino Acid Composition
- Digestibility/Availability of Amino Acids for Metabolic Work



What Evidence is Needed to Support Nutrient Content Claims?



Jurisdiction	Basis for Protein Content Claims	Methodology
	Protein Quality & Quantity	Protein Rating System based on the Protein Efficiency Ratio (PER)
	Protein Quality & Quantity	Protein Digestibility-Corrected Amino Acid Score (PDCAAS)
	Protein Quantity	Expression of protein content relative to energy content

Proposed Method: Digestible Indispensable Amino Acid Score (**DIAAS**)

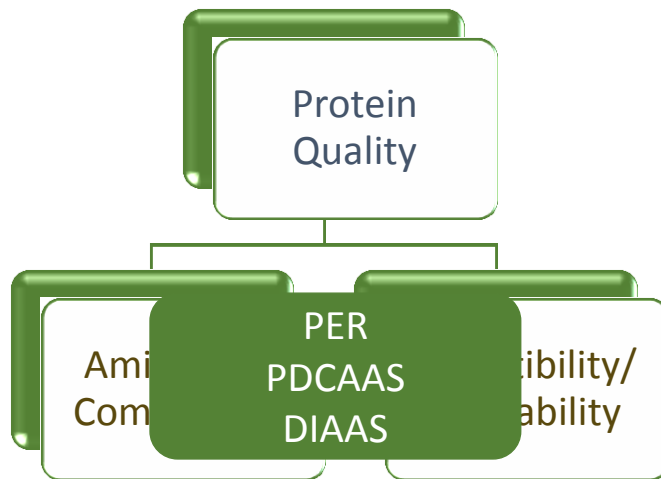


What Evidence is Needed to Support Nutrient Content Claims?



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

Pulses: Typically limiting in either Tryptophan or Sulphur Amino Acids



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?



Pulse Protein: *Capturing New Opportunities*



Nutritional Quality

Plant
Genetics

Processing

Agronomy

Blending

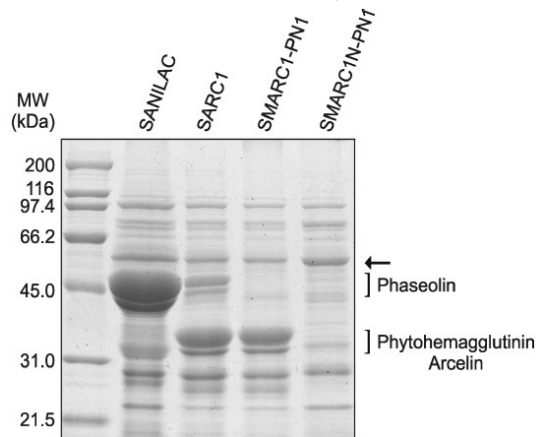


Pulse Protein: *Capturing New Opportunities*



Plant Genetics

- Traditional breeding of Navy Beans led to alterations in seed storage proteins, shifting AA patterns (Taylor et al., 2008)
- Increase Sulphur AA



line	Cys ^b	Met
SARC1	20.8	15.1
SMARC1-PN1	25.0	18.3
SMARC1N-PN1	35.0	17.0

- SAA increased up to ~40%



Pulse Protein: *Capturing New Opportunities*



Agronomy: Impact of S Fertility on Pea Composition

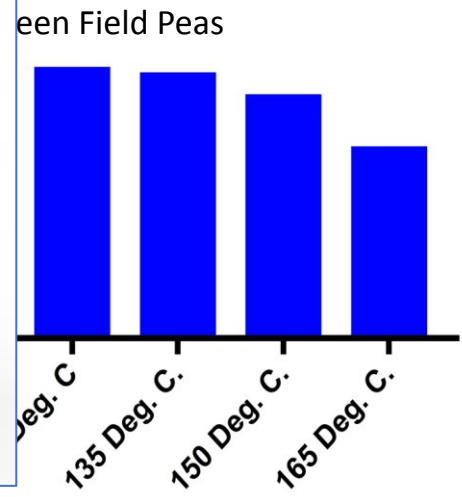
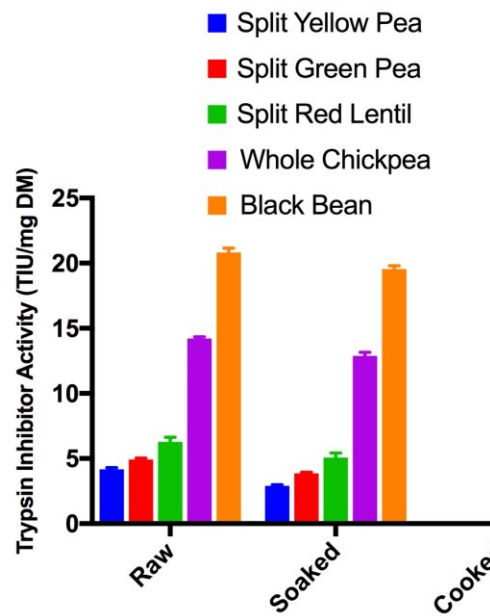
Sulphur Treatment (g/pot)	DM (g/pot)	N (%)	S (%)	Total Sulphur Amino Acids (g/16gN)	Biological Value
0	46	4.03	1.17	1.98	65.5
0.15	58	4.13	1.28	2.00	65.7
0.5	54	4.09	1.49	--	--
1.0	52	4.04	1.49	2.18	67.8
2.0	44	4.02	1.60	--	--



Pulse Protein: *Capturing New Opportunities*



Processing - Thermal





Pulse Protein: *Capturing New Opportunities*



Processing - Extrusion



Collaborative Program:

- University of Manitoba
- Canadian International Grains Institute
- Food Development Centre (Manitoba)
- Agriculture and Agri-Food Canada

Ingredient	Processing Conditions	AAS	%TPD	PDCAAS
Pinto Bean Flour	Native	--	--	--
	Extrusion	0.73	84.80	0.62
	Simulated Baked Cracker	0.70	59.95	0.42

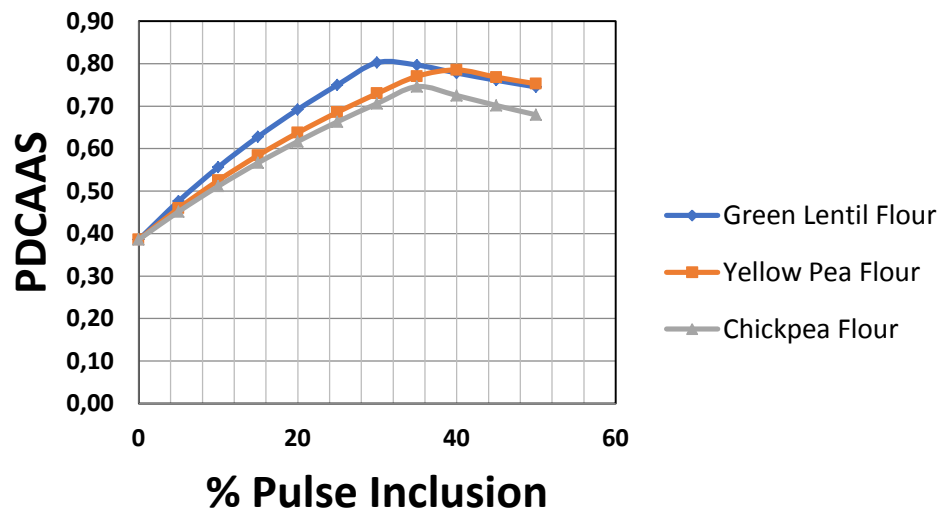


Pulse Protein: *Capturing New Opportunities*



Blending

The Impact of Adding Pulse Flour to Wheat
Flour on PDCAAS Values



Key Considerations:

- Ideal “partners”
 - Allergen
 - Clean label
- Functionality
- Sensory Attributes
- Cost
- Availability



Pulse Protein: *Capturing New Opportunities*



Blending

Product	Type	RACC	g CP per RACC	PDCAAS	g PDCAAS-corrected CP per RACC	Claim
Bagel						
18968	Plain, wheat	55.00	5.61	0.30	1.68	No claim
	70:30 Wheat:Lentil	55.00	7.59	0.80	6.07	Good Source
	70:30 Wheat: Pea	55.00	7.44	0.73	5.43	Good Source
Bread						
18041	Pita, wheat	50.00	4.55	0.30	1.37	No Claim
	70:30 Wheat:Lentil	50.00	6.15	0.80	4.92	No Claim
18064	Sliced, wheat	50.00	5.20	0.30	1.56	No Claim
	70:30 Wheat:Lentil	50.00	7.03	0.80	5.63	Good Source
	70:30 Wheat: Pea	50.00	6.90	0.73	5.04	Good Source



Pulse Protein: *Capturing New Opportunities*



Blending

Product	Type	RACC	g CP per RACC	PDCAAS	g PDCAAS-corrected CP per RACC	Claim
Pasta						
20120	Spaghetti, wheat	55.00	7.17	0.30	2.15	No Claim
	70:30 Wheat:Lentil	55.00	9.70	0.80	7.76	Good Source
	70:30 Wheat:Pea	55.00	9.51	0.73	6.95	Good Source
Snacks						
19047	Pretzels, wheat	30.00	2.99	0.30	0.90	No Claim
	70:30 Wheat:Lentil	30.00	4.04	0.80	3.23	No Claim
	50:50 Wheat:Lentil	30.00	4.74	0.75	3.55	No Claim

Product #s refer to USDA Nutrient Database entries

RACC

Claim

Reference amount customarily consumed (g)

10-19.9% of Daily Reference Value (50 g) = Good Source

20% or > of Daily Reference Value (50 g) = Excellent Source



Pulse Protein: *Capturing New Opportunities*



Processing: Creating New Plant-Based Products



Challenge for Extrusion:

Create high protein puffed snacks
based on pulses

Potential Solution:

Gas-assisted extrusion technology
(Filiz Koksel: Tuesday @ 11 am)



Pulse Protein: *Capturing New Opportunities*



Processing: Creating New Plant-Based Products





Pulse Protein: *New Opportunities*



The Protein Highway
<http://proteinhwy.tlg.ca>



The Protein Supercluster
<https://www.proteinindustriescanada.ca>



Gracias!



UNIVERSITY
OF MANITOBA