

# Protein Quality & Canadian Pulses

## *Finding the Right Balance*

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| Human Ecology

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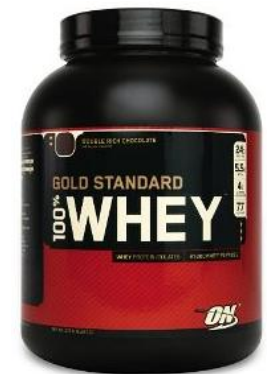
Human Nutritional Sciences

# Outline

- Definition of Protein Quality
- Protein Quality of Cooked Canadian Pulses
- Pending Regulatory Changes
- Take Home Messages

# Protein Nutrition in Context

- What is protein?
  - %Nitrogen x 6.25 → **Crude Protein**
  - Polymer of amino acids with defined structural presentation (Primary, Secondary, etc....)
  - Macronutrient that provides energy, indispensable amino acids and dispensable nitrogen
- Need to reflect on all of these parameters when considering nutrition!



# Definition of Protein Quality

- **Amino acid composition**
  - Indispensable amino acid pattern relative to needs of the target population
  - Sufficient dispensable amino acids to meet overall N requirement
- **Digestibility/Availability**
  - to what extent are the amino acids digested, absorbed and ultimately made available for biological processes
- All methods to define Protein Quality are based on some combination of these factors

# Assessment of Protein Quality

- **Established Methods**
  - Biological Value
  - Protein Rating
    - Protein Efficiency Ratio
  - Amino Acid (Chemical) Score
  - Digestibility-Corrected Score
    - Fecal
    - Ileal
  - Metabolic Availability

# Assessment of Protein Quality

## Protein Rating

- Based on:
  - Protein Efficiency Ratio determination
    - Weight gain/Protein intake over 28 days
  - Adjustments relative to reference protein (Casein)
    - Adj. PER of Casein = 2.5
  - Amount of protein in a “reasonable daily intake”
    - Note: This is not the same as “Representative Serving”

**Protein Rating = Adj. PER x Protein in Reasonable Daily Intake**

# Assessment of Protein Quality

## Amino Acid Score

- Defines the relative deficiencies in amino acids for a given protein
- Specific for
  - A given age, stage or gender
  - A specific protein source

- **Calculation:**

Amino Acid in Protein Source (mg/g protein)

Amino Acid Requirement (mg/g protein)

- Calculate for all AA
- Lowest number = score = limiting amino acid acid

# Assessment of Protein Quality

## **PDCAAS**

- Established (Official) method for determining protein quality in US and many other countries (not Canada)

$$\text{PDCAAS} = \text{AAS} \times \text{TPD}\%$$

- Where
  - AAS = Amino Acid Score
  - TPD% = True protein digestibility
    - Determined by measuring fecal nitrogen digestibility



How Does Health Canada  
Define Protein Quality?

# Protein Content Claims

- **Protein Rating**

- Official method of Health Canada

- F0-40 : The Determination of Protein Rating

- Established in “Food and Drug Regulations”

The screenshot displays the Justice Laws Website interface. At the top, there is a navigation bar with the Government of Canada logo and the text "Government of Canada" and "Gouvernement du Canada". To the right, it says "Canada.gc.ca | Services | Departments | Français". Below this is a blue header with a red maple leaf logo and the text "Justice Laws Website" and "Canada". A search bar is visible on the right side of the header. The main content area shows the breadcrumb trail: "Home > Laws Website Home > Consolidated Regulations > C.R.C., c. 870 - Table of Contents > C.R.C., c. 870". The title of the page is "Food and Drug Regulations (C.R.C., c. 870)". Below the title, there are links for "Full Document: HTML | XML [4419 KB] | PDF [4286 KB]" and a note that "Regulations are current to 2013-01-27 and last amended on 2013-01-04. Previous Versions". The main heading is "Food and Drug Regulations" followed by "C.R.C., c. 870" and "FOOD AND DRUGS ACT". Below this, it says "Regulations Respecting Food and Drugs". The structure is divided into "PART A", "ADMINISTRATION", and "GENERAL". Under "GENERAL", there are three sub-sections: "A.01.001. These Regulations may be cited as the Food and Drug Regulations.", "A.01.002. These Regulations, where applicable, prescribe the standards of composition, strength, potency, purity, quality or other property of the article of food or drug to which they refer.", and "A.01.003. [Repealed, SOR/94-289, s. 1]".

# Protein Content Claims

## Protein Content Claims

Protein Rating	Claim
20.0 - 39.9	Source of Protein
40 or >	Excellent Source of Protein

# Case Study

## Protein Quality of Canadian Pulses



# Increasing Pulse Consumption

- Focus on permissible claims on pulses
  - Origin claims “Product of Canada”
  - Health Claims
    - Disease Risk Reduction Claims
    - Function Claims
    - Nutrient Function Claims
    - General Health Claims
  - Nutrient Content Claims

# Pulses & Canada's Food Guide

*Recommended Number of Food Guide Servings per Day*

	Children			Teens		Adults			
	2-3	4-8	9-13	14-18		19-50		51+	
	Sex Girls and Boys			Females	Males	Females	Males	Females	Males
<b>Vegetables and Fruit</b>	4	5	6	7	8	7-8	8-10	7	7
<b>Grain Products</b>	3	4	6	6	7	6-7	8	6	7
<b>Milk and Alternatives</b>	2	2	3-4	3-4	3-4	2	2	3	3
<b>Meat and Alternatives</b>	1	1	1-2	2	3	2	3	2	3



# Nutrient Content Claims & Pulses

- In order to better position pulses within the “Meat & Alternatives” group, need to emphasize value of the dietary protein
- Challenge:
  - Lack of data to support protein quality of cooked pulses
    - Existing PER estimates too low
      - Preparation methods indeterminate
    - Limited data (if any) on Canadian pulses

# Protein Quality of Cooked Canadian Pulses

- Assess the protein quality of cooked Canadian pulses via:
  - **Protein Rating (Adjusted PER)**
  - **PDCAAS**
- Establish data in support of protein content claims for cooked Canadian pulses
  - **Assist consumers in making choices re: meat alternatives**



# Protein Quality of Cooked Canadian Pulses

- 9 aggregate Canadian pulse samples from the 2010 crop year were collected:

*Black Beans*

*Kabuli Chickpeas*

*Navy Beans*

*Pinto Beans*

*Red Kidney Beans*

*Split Green Peas*

*Split Red Lentils*

*Split Yellow Peas*

*Whole Green Lentils*



- Samples were cooked according to methods developed by the Canadian International Grains Institute

# Protein Quality of Cooked Canadian Pulses

- Protein Rating (Adjusted PER) determined using weanling rats
  - Casein as reference
  - 28 day feeding period
- Determination of
  - Amino acid composition
  - True protein digestibility



# Protein Quality of Cooked Canadian Pulses

	Adj. PER	Crude Protein (g/250 mL Serving)	Protein Rating (250 mL serving)
Red Kidney Beans	1.55	15.47	23.98
Navy Beans	1.51	16.84	25.43
Whole Green Lentils	1.30	14.07	18.29
Split Red Lentils	0.98	18.68	18.31
Split Yellow Peas	1.42	14.09	20.01
Split Green Peas	0.86	15.31	13.17
Black Beans	1.61	15.25	24.55
Chickpeas	2.32	13.12	30.44
Pinto Beans	1.64	14.19	23.27
Casein	2.50		

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Pinto Beans	1.64	14.19	23.27
Casein	2.50		

Highlighted cells qualify for "Source of Protein" claim in Canada

# Protein Quality of Cooked Canadian Pulses

## Amino Acid Scores

	HIS	ILE	LEU	LYS	MET+ CYS	PHE+ TYR	THR	TRP	VAL
Black Beans	1.61	1.49	1.34	1.30	0.76	1.46	1.54	0.95	1.40
Chickpeas	1.54	1.63	1.28	1.27	1.08	1.49	1.19	0.61	1.39
Navy Beans	1.44	1.37	1.20	1.20	0.88	1.36	1.32	0.83	1.33
Pinto Beans	1.55	1.42	1.27	1.26	0.85	1.38	1.37	0.77	1.31
Red Kidney Beans	1.46	1.17	1.14	1.16	0.70	1.25	1.29	0.83	1.15
Split Green Peas	1.31	1.19	1.13	1.22	0.59	1.21	1.13	0.89	1.13
Split Red Lentils	1.42	1.42	1.27	1.29	0.59	1.37	1.23	0.80	1.32
Split Yellow Peas	1.26	1.38	1.10	1.25	0.90	1.21	1.11	0.73	1.25
Whole Green Lentils	1.41	1.37	1.23	1.40	0.71	1.35	1.24	0.72	1.25

# Protein Quality of Cooked Canadian Pulses

## Amino Acid Scores

	MET+ CYS	TRP
Black Beans	0.76	
Chickpeas		0.61
Navy Beans		0.83
Pinto Beans		0.77
Red Kidney Beans	0.70	
Split Green Peas	0.59	
Split Red Lentils	0.59	
Split Yellow Peas		0.73
Whole Green Lentils	0.71	

# Protein Quality of Cooked Canadian Pulses

	Protein (CP) (g/100 g)	PDCAAS	Reference Serving (g)	Corrected CP per Serving	%Daily Reference Value
Red Kidney Beans	8.27	0.549	90.00	4.09	8.17
Navy Beans	8.76	0.667	90.00	5.26	10.52
Whole Green Lentils	6.72	0.628	90.00	3.80	7.60
Split Red Lentils	7.30	0.538	90.00	3.54	7.07
Split Yellow Peas	6.81	0.643	90.00	3.94	7.87
Split Green Peas	7.39	0.500	90.00	3.33	6.65
Black Beans	8.39	0.534	90.00	4.03	8.07
Chickpeas	7.57	0.519	90.00	3.53	7.07
Pinto Beans	7.85	0.590	90.00	4.17	8.33
Casein	86.78	1.000			

Daily Reference Value = 50 g Protein  
 %DRV > 10 = Good Source of Protein

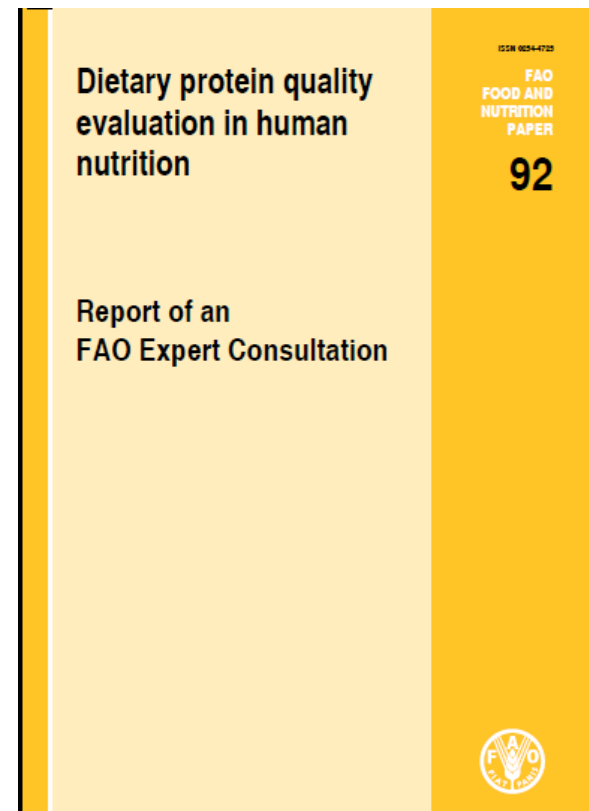
# Protein Content Claim for Pulses

- Based on new PER/Protein Rating data
  - CFIA updated Table 6-13 in 2012 to recognize new PER data
- PDCAAS data used in support of protein content claims in the US
  - Values sensitive to
    - Reference serving size
    - Digestibility values
    - Protein and AA composition



# Pending Changes

- Use of the Protein Rating method has been challenged for decades
- Health Canada will consider new approaches but waiting on the publication of new FAO report



Released January, 2013

# Pending Changes

- **Recommends moving to *DIAAS***
  - Digestible Indispensable Amino Acid Score
- **Advances from PDCAAS method**
  - Uses different reference AA pattern
    - AA requirement pattern of 6 month olds
  - Uses ileal digestibility instead of fecal digestibility
  - Bases final DIAAS value on lowest score

# PDCAAS vs. DIAAS

	%Daily Reference Value		
	DIAAS Values	DIAAS Method	PDCAAS Method
Red Kidney Beans	51.02	8.43	8.17
Navy Beans	65.25	11.43	10.52
Whole Green Lentils	58.19	7.82	7.60
Split Red Lentils	50.19	7.32	7.07
Split Yellow Peas	73.91	10.07	7.87
Split Green Peas	46.63	6.89	6.65
Black Beans	49.40	8.30	8.07
Chickpeas	66.46	10.06	7.07
Pinto Beans	60.84	9.55	8.33

Recommendation that no protein < 75 should qualify for source claims

# Impact of Pending Changes

- Adoption of DIAAS as is will remove potential for numerous plant-based foods to qualify for protein claims
- Recommendations need to be reviewed and commented
- Consider blends of proteins
  - Pulse:Cereal blends
  - AA profile critical

# Creating Balance – *Considering AA Profile Alone*

Protein	LYS	SAA	THR	TRP
	<i>mg/g Protein</i>			
Reference Pattern (1985)	<b>58</b>	<b>25</b>	<b>34</b>	<b>11</b>
Split Yellow Pea	72	22	39	8.0
Wheat	24	30	26	11.8
Oats	41	48	34	13.7
25 Pea:75 Wheat	36	28	29	10.9
50 Pea:50 Wheat	48	26	32	9.9
60 Pea:40 Wheat	53	25	33	9.6
75 Pea:25 Wheat	60	24	35	9.0
25 Pea:75 Oat	49	41	35	12.3
50 Pea:50 Oat	57	35	36	10.9
60 Pea:40 Oat	60	33	36	10.3
75 Pea:25 Oat	64	29	37	9.5

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# Finding the Right Balance

- Blends of pulses with cereals leads to complementation of amino acid profiles
- Need data on ileal digestibility of amino acids in order to determine DIAAS values
  - Likely AA pattern will be the most important driver of DIAAS value for blends
  - Unless digestibility negatively impacted by processing or anti-nutritive factors

Questions?