
Assessing Protein Quality in Food: Navigating Regulations and Sources

James D. House

Department of Human Nutritional Sciences

University of Manitoba

Winnipeg, MB, Canada



UNIVERSITY
OF MANITOBA

Disclosure Statement

- **Current Grants & Contracts**

- Agriculture and Agri-Food Canada Growing Forward 2 – Private:Public Partnership with:
 - Pulse Grower Associations and processing industries
 - Cereal Grower Associations and agronomic industries
- Natural Sciences and Engineering Research Council of Canada (NSERC)
 - Discovery Grant, Connect Grant
- Industry Contracts and Technical Services Agreements related to Protein Quality Assessment of foods and food ingredients
- Egg Farmers of Canada
- Manitoba Egg Farmers
- MITACS Canada

- **Current Participation on Advisory Boards and Grant Review Panels**

- Danone Canada
- ILSI North America – Canadian Advisory Council
- AOAC International Editorial Board

- **No financial interests in agri-food/nutrition companies**

Outline

- **Communicating Protein Messages**
- **Protein Quality: Supporting Protein Content Claims**
- **Current and Proposed Approaches to Measuring Protein Quality**
 - *Challenges and Opportunities*
- **Protein Quality Workshop – Overview of Key Findings**

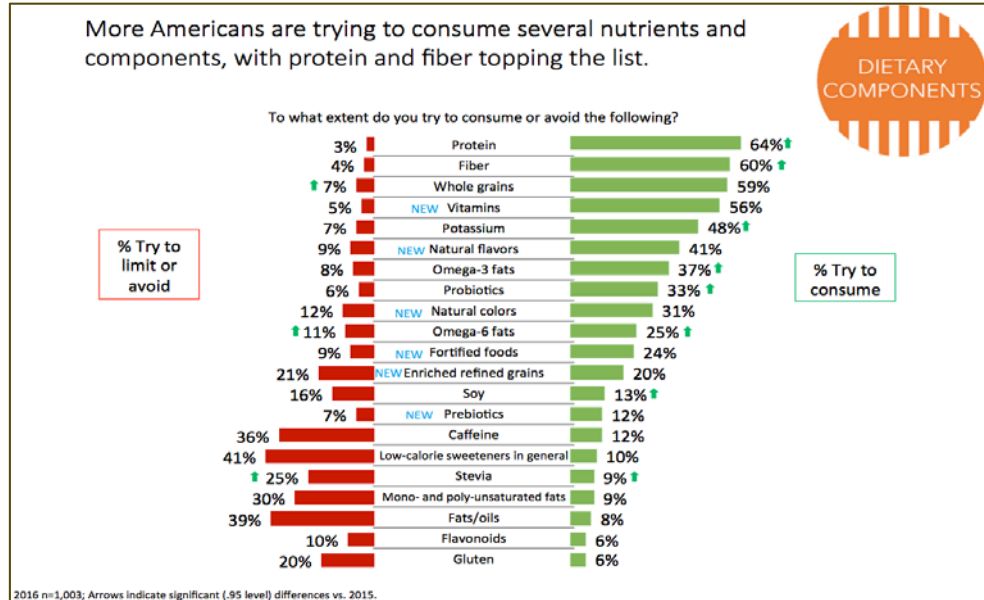
Consumers are Seeking Protein



10 Key Trends in Food, Nutrition & Health 2016

<http://www.new-nutrition.com>

More Americans are trying to consume several nutrients and components, with protein and fiber topping the list.



- 64% of respondents try to consume protein
 - More prevalent in women and those with higher incomes

Communicating Food Protein Messages

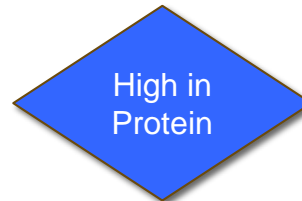
• Nutrition Facts Panel

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

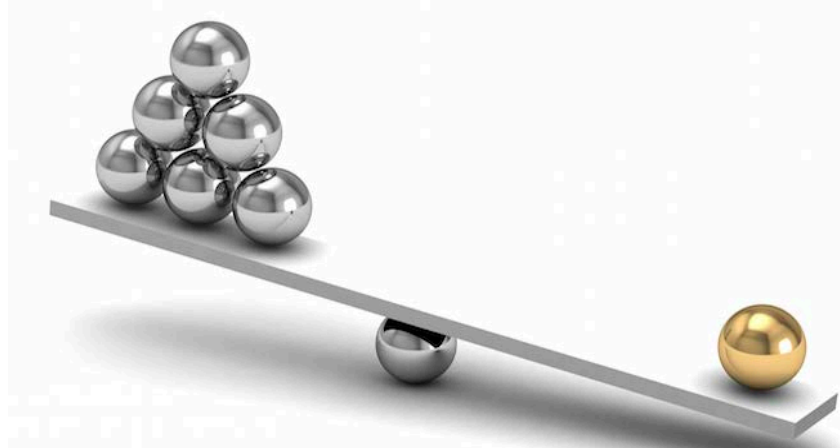
Nutrition Facts	
Valeur nutritive	
Per 1 bowl (300 g) / Pour 1 bol (300 g)	
Amount	% Daily Value
Teneur	% valeur quotidienne
Calories / Calories 440	
Fat / Lipides 19 g	29 %
Saturated / Saturés 4 g	
+ Trans / Trans 0.2 g	21 %
Cholesterol / Cholestérol 35 mg	
Sodium / Sodium 860 mg	36 %
Carbohydrate / Glucides 53 g	18 %
Fibre / Fibres 4 g	16 %
Sugars / Sucres 6 g	
Protein / Protéines 15 g	
Vitamin A / Vitamine A	45 %
Vitamin C / Vitamine C	4 %
Calcium / Calcium	20 %
Iron / Fer	20 %

• Claims

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



What Evidence is Needed to Support 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

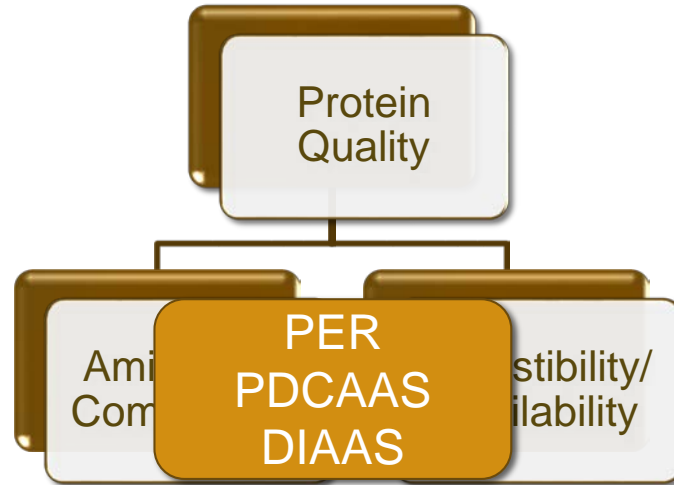
What Evidence is Needed to Support Content Claims?

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**)

Establishing Evidence for Protein Content Claims

Protein Quality Assessment



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?

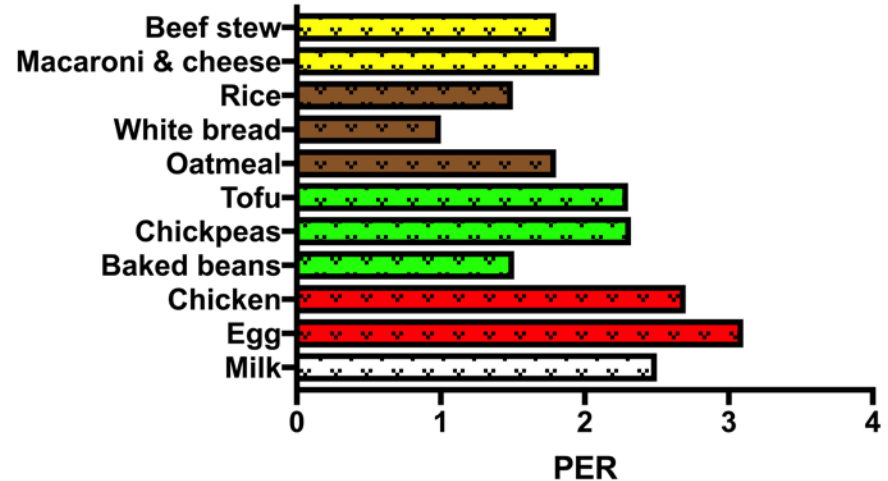


The Protein Rating Approach



- Based on Protein Efficiency Ratio
 - Rat bioassay
 - Weight gain/Protein intake over 28 days
- Adjustments relative to reference protein (Casein)
 - Adj. PER of Casein = 2.5
- Protein Rating = PER x Protein Contained in Reasonable Daily Intake
 - 20 ->39.9 = Source of Protein
 - 40 and above = Excellent Source of Protein

PER Values of Common Foods



Eggs
Protein Rating = 100 g x 12.63% x 3.1
= **39.2 (Good Source)**



The Protein Rating Approach



Advantages

- Simple
- Provides a summative biological response to protein intake

Disadvantages

- Rodent bioassay → not reflective of human amino acid needs
- Ethical constraints
- Limited data available
 - 47 entries in the CFIA PER table
 - 184,022 foods in USDA Food Composition Databases
- Non-additive
 - Limits predictions for new food products



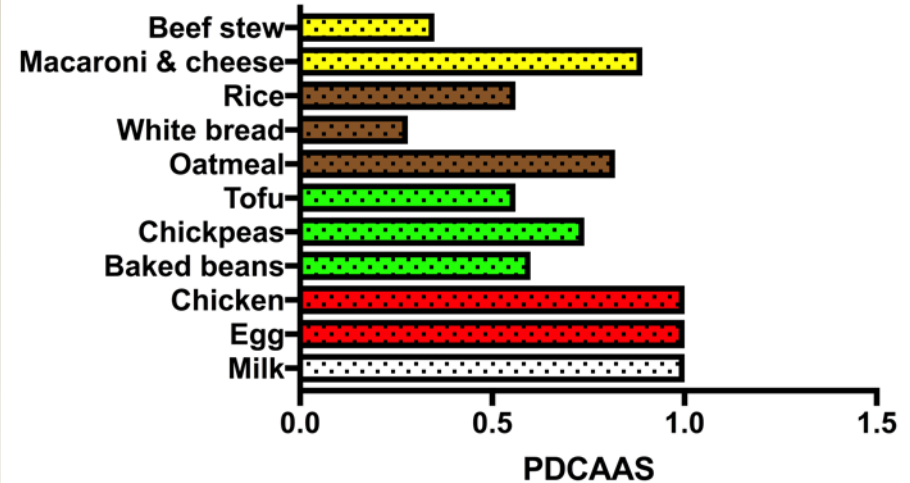
The PDCAAS Approach



Product of:

- Amino Acid Score (AAS)
 - AA in food/AA in reference pattern
 - mg/g protein
 - Reference pattern of 2-5 yr old school children (1991)
- True Fecal Protein Digestibility (TFPD)
 - Fecal N output/Dietary N input
 - Corrected for endogenous losses

PDCAAS Values of Common Foods





The PDCAAS Approach



Protein Content Claims

- PDCAAS x Protein content of “RACC”
 - Representative amount customarily consumed
- Compare to Daily Value (50 g)
 - 5 – 9.9 g = Good Source
 - 10 g or greater = Excellent Source

Eggs

$$50 \text{ g} \times 12.63\% \times 1.0 = \mathbf{6.32 \text{ (Good Source)}}$$



The PDCAAS Approach



Advantages

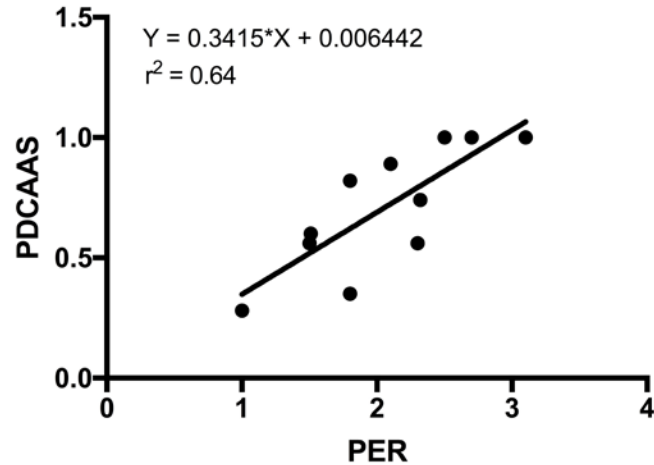
- Simple
- Robust AA datasets
- Additive
 - Permits calculations of PDCAAS values of mixtures

Disadvantages

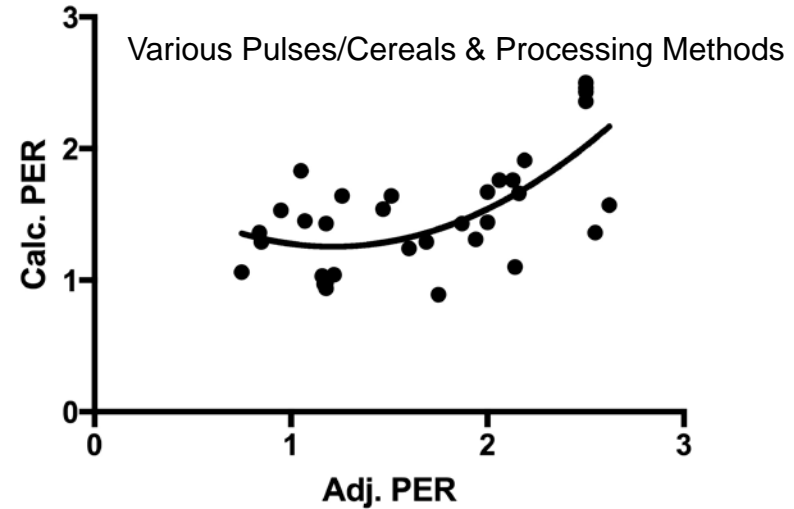
- Rodent bioassay → not reflective of human amino acid needs
- Fecal protein digestibility
 - Impact of gut microbiota
- Ethical constraints
- Truncation of values > 1.00

PER vs. PDCAAS

PER vs. PDCAAS

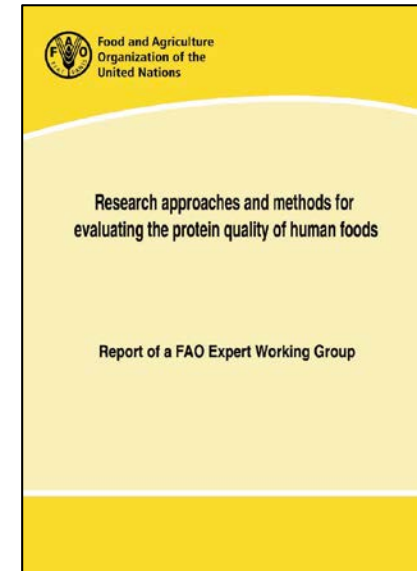
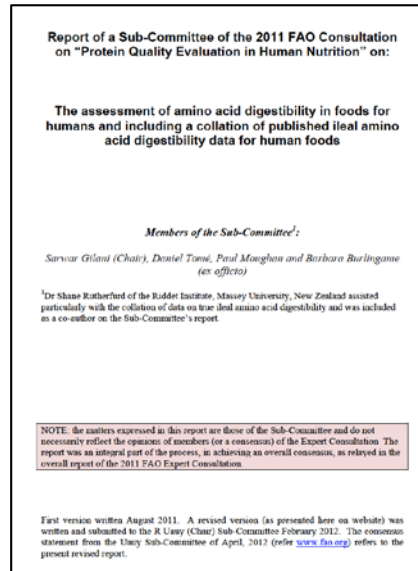
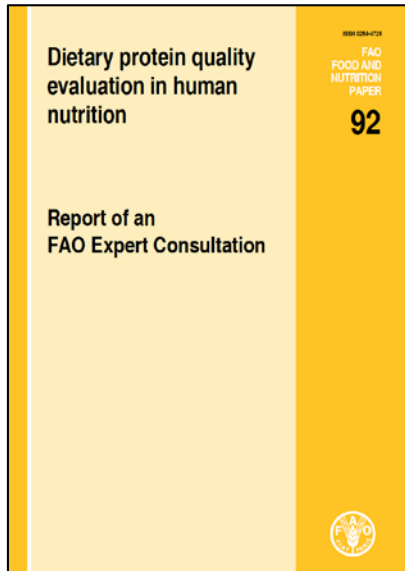


Calculated vs. Measured Adjusted PER Values



Quadratic Fit; $R^2 = 0.442$

The DIAAS Approach



Proposed Approach – Has yet to be adopted by any jurisdiction

The DIAAS Approach

Proposed Approach

- AA treated as individual nutrients
- Uses ileal digestibility values
- Scores >1.00 are not truncated

Advantages

- Should be more reflective of the ability of a food to provide available protein

Disadvantages

- Bioassay
 - Ethical constraints
- Multiple analyses required for one DIAAS value

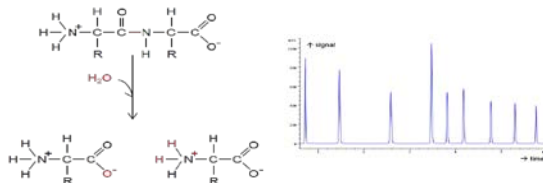
Methods Comparison

Technical Considerations

Quantity vs. Quality



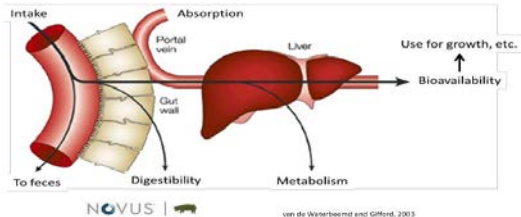
Analytical Issues



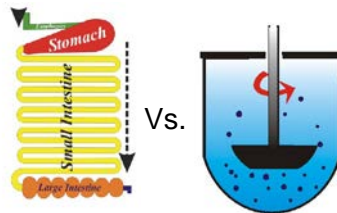
Choice of Species



Digestibility vs. Availability



in vivo vs. in vitro

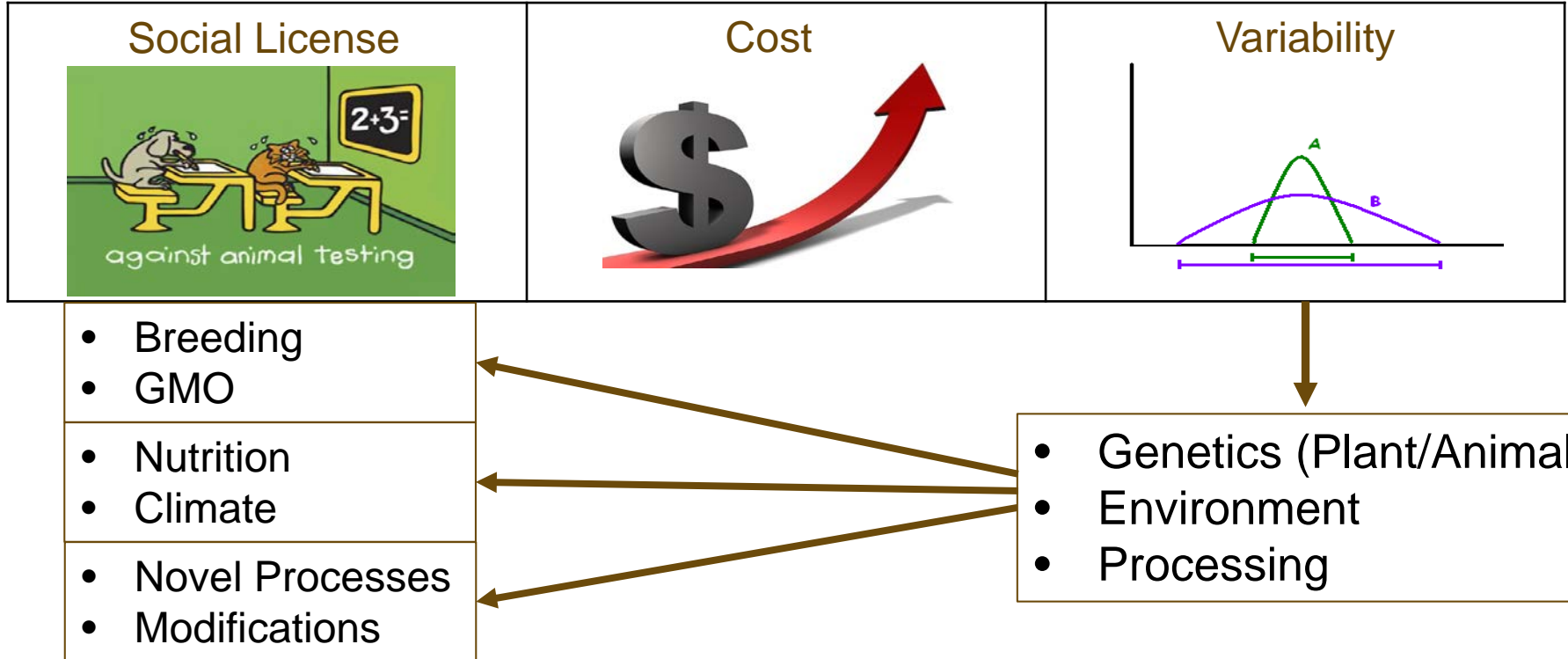


The Numbers

Reference Pattern
Serving Size
Threshold Values
Conversion Factors

Methods Comparison

Other Considerations

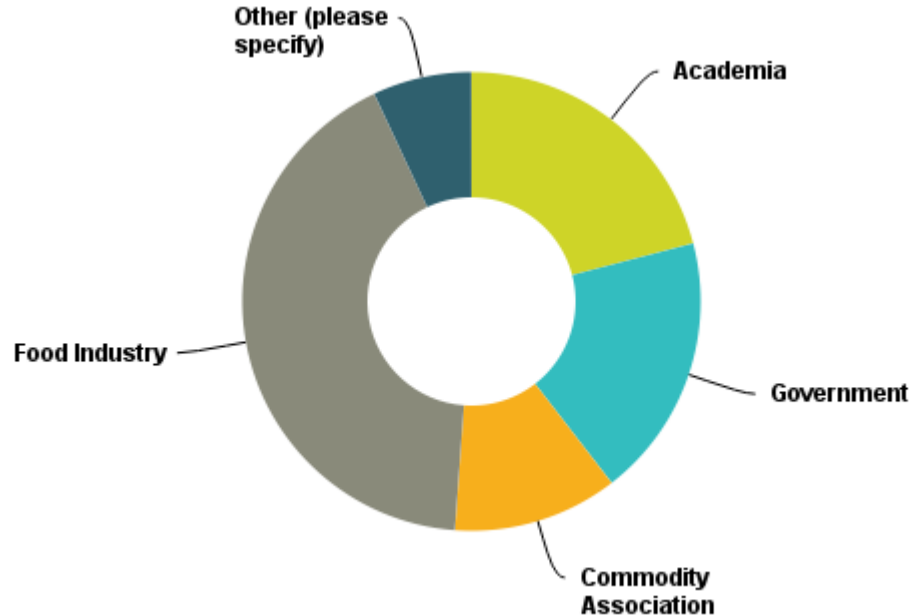


Protein Quality Workshop – Addressing Research Gaps

November 16, 2016, Toronto, ON



Program in Food Safety, Nutrition and Regulatory Affairs (PFSNRA)

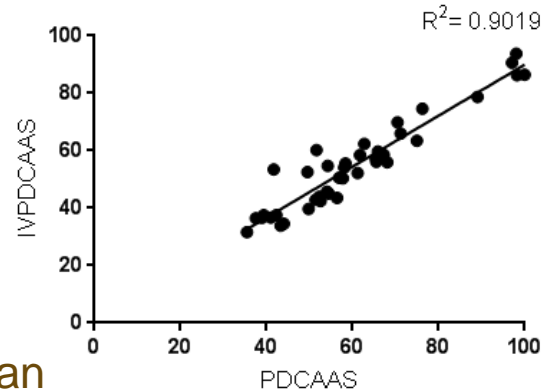


Protein Quality Workshop – Addressing Research Gaps

November 16, 2016, Toronto, ON

Workshop – Key Themes

- Harmonize approaches used across jurisdictions
 - Provide certainty, affordability, accessibility, predictability
- Address significant research gaps
 - Does measuring protein quality address a human health concern
 - Dietary patterns vs. special purpose foods (RUTF)
 - Alternatives to *in vivo* assays?



White paper being prepared for publication