Nutritional Aspects of Pulse Crops and Potential for Creating Value

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Prairie Grain Development Committee Annual Meeting
Winnipeg, Manitoba
February 27th, 2008

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Canadian Peas

Peas are grown in Saskatchewan, Alberta and Manitoba.

Predominant Types: Yellow and Green

Whole Peas

Split Peas

Flour

Protein Concentrates and Isolates

Pea Starch

Pea Fibre

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Canadian Lentils

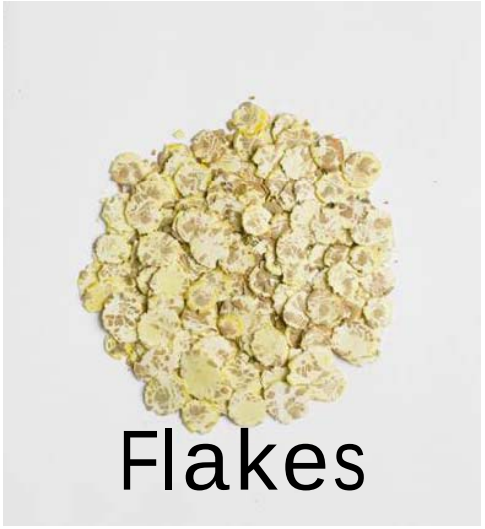
Lentils are mostly grown in Saskatchewan and some grown in Alberta.

Predominant Types: Large Green, Small Green and Red

Whole

Split Red

Flours



Flakes

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Canadian Beans

Beans mostly grown in Ontario, Manitoba and some grown in Alberta.

Predominant Types: Navy, Pinto, Black, Kidney, Cranberry, Small Red

Whole

Flours

Flakes

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Canadian Chickpeas

Chickpeas are mostly grown in Saskatchewan and Alberta.

Predominant Types: Kabuli and Desi

Whole

Flours

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Did you know?

Canada is...

- *World's largest pea & lentil producer & exporter*
- *Selling pulses to 169 countries = diversified export markets*
- *Among top three bean & chickpea exporters in the world*
- *A world leader in the pulse industry, from variety development to production*

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PULSE CANADA'S

Pulse Innovation Project

"The Development of New Market Opportunities for Beans, Peas, Lentils and Chickpeas in the North American Food Sector"

New Target...New Uses...

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- ✓ Focus on the affluent, North American market that is close in proximity
- ✓ Current per capita consumption is low
- ✓ Pulses have appropriate attributes for North American consumer demands for nutritious foods
- ✓ Focus on Research:
  - ➢ Discover potential for pulses to address health problems
  - ➢ Encourage innovation by food processors

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PIP Deliverables

- **Industry Strategy and Action Plan**
  - Strategy & Action plan to stimulate innovation in product development & marketing to increase demand for pulses, leveraging nutrition & health attributes

- **Human Clinical Studies**
  - Selection and management of human clinical trials studying the link between pulse consumption and positive health outcomes

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PIP Committees

Pulse Innovation

Food Companies

Research Institutions

Health Organizations

Government

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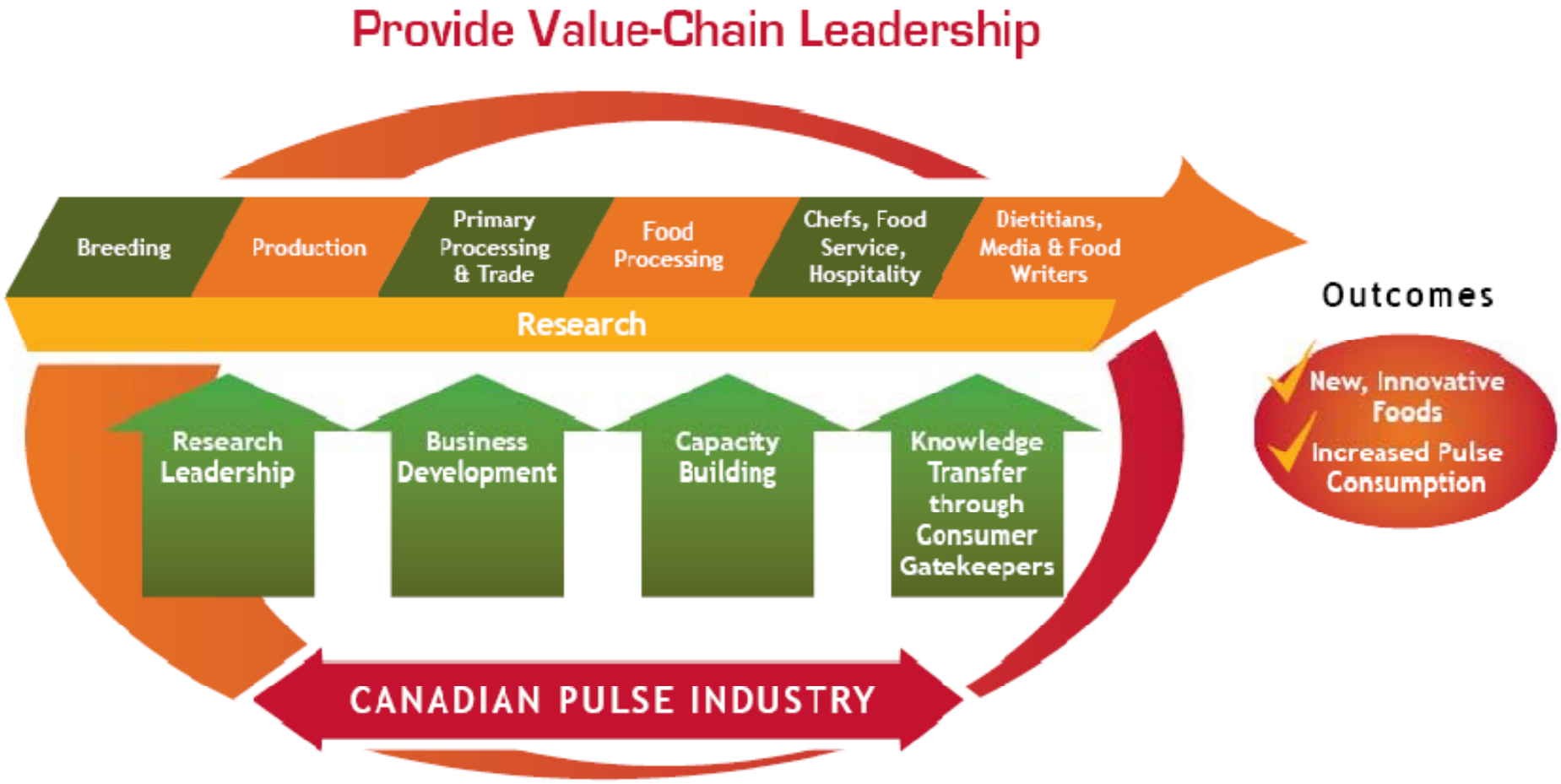
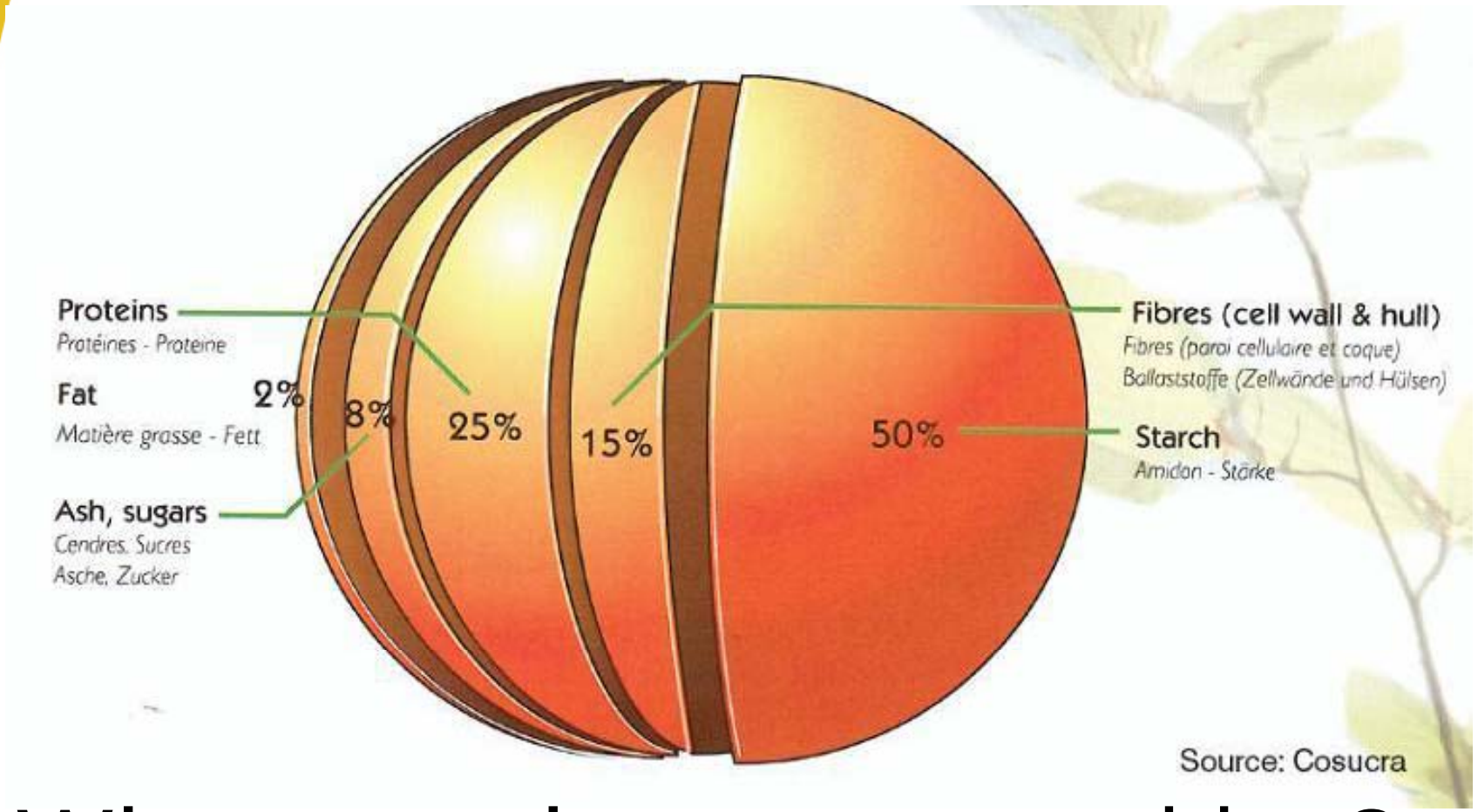
Four Strategic Focus Areas



NUTRITIONAL COMPOSITION OF PULSES



What are the opportunities?

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Pulses as a Protein Source

- About 2x the amount of protein in cereals
- Pulses are deficient in methionine and cysteine, so complement cereal proteins (deficient in lysine)
- Contain some “antinutritional” compounds like enyzme inhibitors, lectins
- Pulses are one of the lowest overall environmental impact sources of protein

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Pulse Proteins – Opportunities for value-added???

- Increase methionine and cysteine in globulin proteins
- Reduce or remove undesirable protein-based antinutritional compounds, improve flavor attributes
- Engineering properties of pulse globulins to alter functional behavior (gelation, emulsification, foaming)

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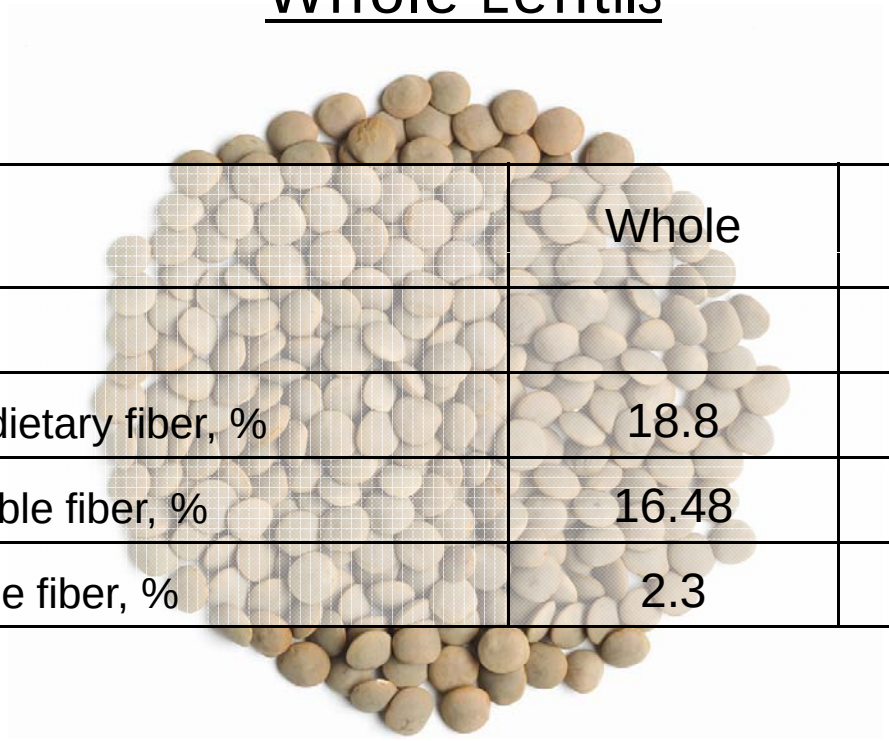
Pulses as a Fibre Source

Whole Lentils



	Whole	Dehulled
Fiber		
Total dietary fiber, %	18.8	10.77
Insoluble fiber, %	16.48	9.08
Soluble fiber, %	2.3	1.53

Source: Ning Wang et al. 2008. Canadian Grain Commission. Unpublished data.

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Whole Peas	Whole	Dehulled
Fiber		
Total dietary fiber, %	15.5	9.4
Insoluble fiber, %	13.8	8.1
Soluble fiber, %	1.6	1.3

Source: Ning Wang et al. 2008. Canadian Grain Commission. Unpublished data.

Yellow Pea Flours	Whole	Split	Fiber
Fiber			
Total dietary fiber, %	17.6	6.5	84.2
Insoluble fiber, %	15.6	5.6	76.3
Soluble fiber, %	2	0.9	7.9
Carbohydrates, total, %	66.3	64.2	89
Carbohydrates, available, %	50.7	58.6	12.7

Source: Medallion Laboratories

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Whole Bean Flours

	Navy	Black	Pinto
Fiber			
Total dietary fiber, %	21.1	18.2	17.5
Insoluble fiber, %	18.1	14.3	13.3
Soluble fiber, %	3	3.9	4.2
Carbohydrates, total, %	61.1	64.2	61.4
Carbohydrates, available, %	43	49.9	48.1

Source: Medallion Laboratories

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Comparing Fibre-Rich Food Sources

	Serving Size	Total Fibre	Soluble	Insoluble
All-bran cereal	1/3 cup	8.43 g	0.59 g	7.84 g
Oatmeal, regular	1 cup	4.45 g	1.64 g	2.81 g
Apple with skin	1 medium	2.76 g	0.28 g	2.48 g
Kidney beans	½ cup	6.66 g	1.41 g	5.25 g
Navy Bean Flour (Source: AAFC data)	50 g	10.6 g	1.5 g	9.05 g

Source: The New Fiber Story: Natural Resistant Starch. Philadelphia, Sept 29, 2007

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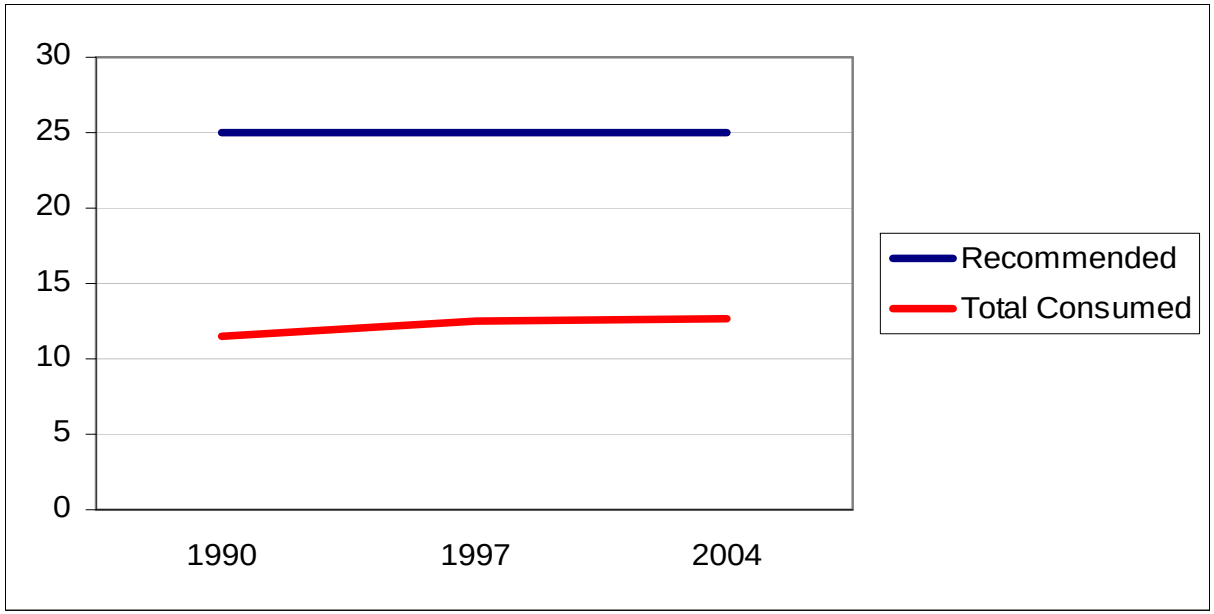
Canadians Need More Fibre!

Recommended Amount: 20-40 g/day

Current Consumption in Canada: < 15 g/day



Source: Canada Food Stats, Statistics Canada

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Effects of processing on fibre in peas and lentils

- Dehulled peas/lentils had ~40% less total fibre than whole peas/lentils
- Cooked whole peas/lentils had ~20% higher levels of total fibre vs raw whole peas
- Levels of insoluble fibre increased ~30% for whole peas and ~20 for whole lentils when cooked whereas soluble fibre levels decreased (~7%)

Source: Ning Wang et al, 2008. The Canadian Grain Commission. Unpublished Data.

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Pulses as a Starch Source

Starch Composition of **Pea** Flours

	Whole Yellow	Split Yellow	Whole Green	Split Green
Total starch, %	43.3	49.8	51.5	47.7
Amylose, %	10.0	13.2	13.0	13.4
RDS, %	7.4	8.5	8.7	8.7
SDS, %	35.4	38.8	36.4	38.6
RS, %	0.5	2.5	6.4	0.4

Source: AAFC, Food Research Program, Guelph, Ontario

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Starch Composition of Whole **Bean** Flours

	Navy	Black	Pinto
Total starch, %	33.3	38.3	37.0
Amylose, %	9.3	9.2	10.5
RDS, %	1.0	0.9	1.3
SDS, %	2.4	3.9	1.9
RS, %	29.8	33.5	33.8

Source: AAFC, Food Research Program, Guelph, Ontario

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Comparing Resistant Starch Food Sources

	Serving Size	Resistant Starch
Banana, raw	1 medium (118 g)	4.7 g
Cold pasta	1 cup (150 g)	1.9 g
High-amylose corn ingredient (Hi-maize)	1 tablespoon	6.6 g
Navy beans, cooked	½ cup (100 g)	9.8 g
Navy bean flour (AAFC data)	50 g	14.9 g

Source: Nutrition Today, Vol 42, No 3, May/June 2007

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Oligosaccharides

(g/100 g)	Peas	Beans	Lentils	Chickpeas
Raffinose	0.7	0.5	0.43	0.61
Stachyose	2.7	4	2.09	2.2
Verbascose	1.0	ND	0.56	ND
Total Oligosaccharides	4.4	4.6	3.07	2.81

Source: Ning Wang. Chemical Composition of Canadian Pulse Crops.

Overall, range of oligosaccharides (alpha-galactosides) in pulses is 2 -10 g/100 g. Stachyose is most predominant.

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Pulse Carbohydrates – Opportunities for value-added???

- Increase soluble fibre content
- Maintain the hull (b/c of fibre) but improve water absorption or decrease cooking time (e.g. lentils)
- Improve starch functionality (amylose/amylopectin) and/or nutrition (resistant starch)
- Oligosaccharides as prebiotics??? Enhance levels?

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Vitamins, Minerals, Phytonutrients

- B Vitamins: Folate, Thiamin, Riboflavin, Niacin, Vitamin B6
- Minerals:
  - Iron
  - Potassium
  - Calcium
  - Zinc
  - Phosphorus
  - Selenium
- Phytonutrients: Saponins, antioxidants, phytates tannins

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Effects of processing on vitamins in peas and lentils

- Folate decreased by ~25% in dehulled peas and ~50% in dehulled lentils
- Folate decreased by ~60% in cooked peas and cooked lentils
- All B vitamins were decreased by 20-40% in peas and lentils after cooking

Source: Ning Wang et al, 2008. The Canadian Grain Commission. Unpublished Data.

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Effects of processing on minerals in peas and lentils

- Iron levels decreased by ~ 10-20% after dehulling
- Iron levels were about ~15% lower in cooked peas and lentils
- Potassium levels decreased by ~40% in cooked peas and lentils

Source: Ning Wang et al, 2008. The Canadian Grain Commission. Unpublished Data.

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Bioavailability of vitamins and minerals in pulses

- Low bioavailability of iron in pulses
- Limited information on bioavailability of other minerals like Zn, Ca, etc but presence of phytate, oxalate, polyphenols may affect bioavailability

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Pulse Vitamins and Minerals – Opportunities for value-added???

- Ways to decrease B vitamin losses (e.g. folate) that occur during cooking
- Increase iron and other mineral bioavailability

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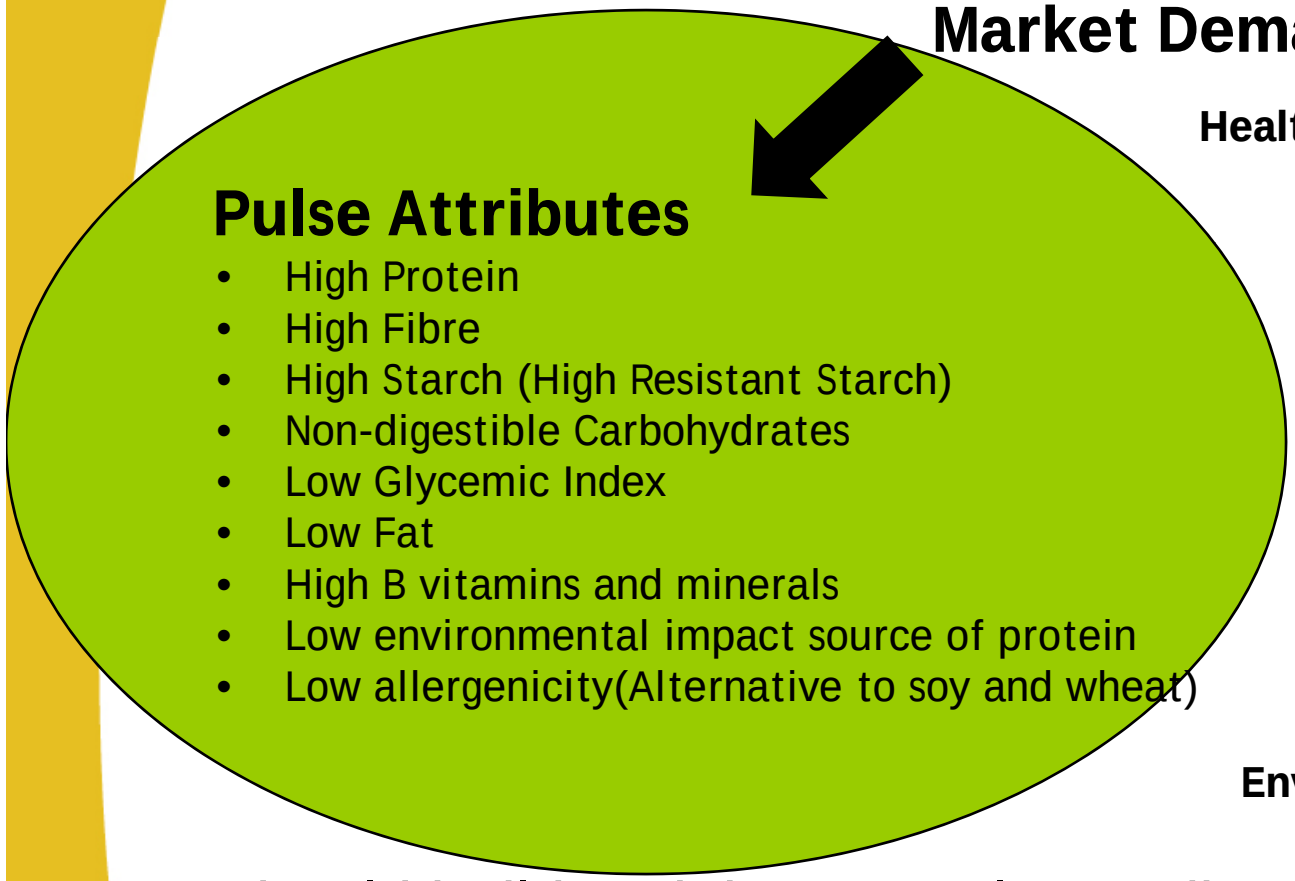
Opportunities to Capitalize on Nutritional Attributes that meet Market Demands



Market Demands

Healthy Meals and Snacks

High Fibre, Vitamins, Antioxidants, Low Fat

Diabetes, Obesity

Prebiotics and Gut Health

Low Allergenicity

Gluten Free

Environmentally Friendly

R&D should build on inherent pulse attributes + end user interest

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