



USA Dry Pea & Lentil Council

STATE OF
IDAHO

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USA Dry Pea
& Lentil Council



Presentation Objectives

- Overview: Pulses and pulse-based ingredients
- The role of egg and dairy ingredients in food product development
- Pulse ingredients as egg and dairy alternatives
- How to use pulse ingredients as egg and dairy alternatives and extenders in food formulation
- Conclusions



REMINDER

Please email Post-WEBINAR questions to amcdaniel@pea-lentil.com

Section 1

Overview: Pulse and Pulse-Based Ingredients

- Pulses – definitions and nomenclature
- Nutritional advantages of pulses
- Pulse production in the United States



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Please email WEBINAR questions to amcdaniel@pea-lentil.com

What are Pulses?

1. Pulses are legumes classified separately from oilseeds, such as peanuts and soybeans.
2. There are **10 categories of pulses**, as defined by the U.N. Food & Agriculture Organization (FAO). Of these, seven are of commercial importance as foods and only five are significant in international food trade. The remainder serve primarily as animal feeds.
3. Because they return or “fix” nitrogen in the soil, pulses are **highly sustainable** and often used as rotational crops to restore the quality of farmland.
4. Rich in **protein, protein quality, soluble fiber, insoluble fiber, antioxidants, vitamins, minerals**, and **low in oil content**, pulses are gaining attention as nutritionally superior foods and food ingredients.
5. Pulses are used in many different ways in foods today.
6. Pulses are also **free of gluten and other allergens** that must be declared in FDA allergen declaration labels.

What are Pulses?

Pulses important to human food consumption:

1. Chickpeas (garbanzo beans)
2. Dry beans (*Phaseolus* spp.)
3. Lentils
4. Dry peas (field peas)
5. Broad (fava) beans
6. Pigeon peas
7. Cowpeas



What are Pulses?

Pulses that are important to food formulation

We will focus upon three categories produced in the United States:

- Chickpeas (garbanzo beans)
- Dry peas (field peas)
- Lentils

Chickpeas (Garbanzo)



Split Yellow Peas



Whole Green Peas



Regular Lentils



Pardina Lentils



Red Lentils



Pulses offer Exceptional Nutritional Value

PULSE COMPOSITION [g/100g]

Food Reference	Protein	Fat	Starch & Sugars	Fiber
Beef ¹	77.5	8.6	0.0	0.0
Whole Soy Flour - Raw	35.0	20.0	25.6	9.6
Dry Peas	23.7	1.3	45.5	16.6
Regular Lentils	26.3	1.1	45.0	13.6
Chickpeas	24.4	5.9	41.1	8.7
Whole Wheat	13.2	2.5	61.3	10.0
Whole Rice Flour	5.6	1.4	77.7	2.4
Tapioca Flour	0.2 [†]	0.0	87.8	0.9

Plus...

- Superior amino acid profiles
- Vitamins
- Minerals
- Low-Glycemic Index
- Non-GMO

¹ Whole Chuck, 10% moisture basis

Sources: Canadian Grain Commission; U.S. Dept. of Agriculture-ARS; Cho, S., Prosky, L. and Dreher, M. Complex Carbohydrates in Foods, 1999, Marcel Dekker, Inc., New York, NY.

What about Protein and Fiber?

2012 Food & Health Survey Consumer Attitudes Toward Food Safety, Nutrition & Health

Survey conducted by the International Food Information Council (IFIC)

The percentage of consumers surveyed that have considered whether or not a food contains the following nutrients when making purchase decisions about packed food and beverages is:

- **Fiber 62%**
- **Protein 56%**

Protein and fiber are sought-after nutrients!

Where are Pulses Grown?

The United States is one of the premier pulse-producing regions in the world.

U.S. Pulse Production		
	Metric Tons 2011	Global Rank
Dry Peas	255,150	9th
Lentils	214,640	5th
Chickpeas	97,205	16th

Source: United Nations FAOSTAT

The United States also provides...

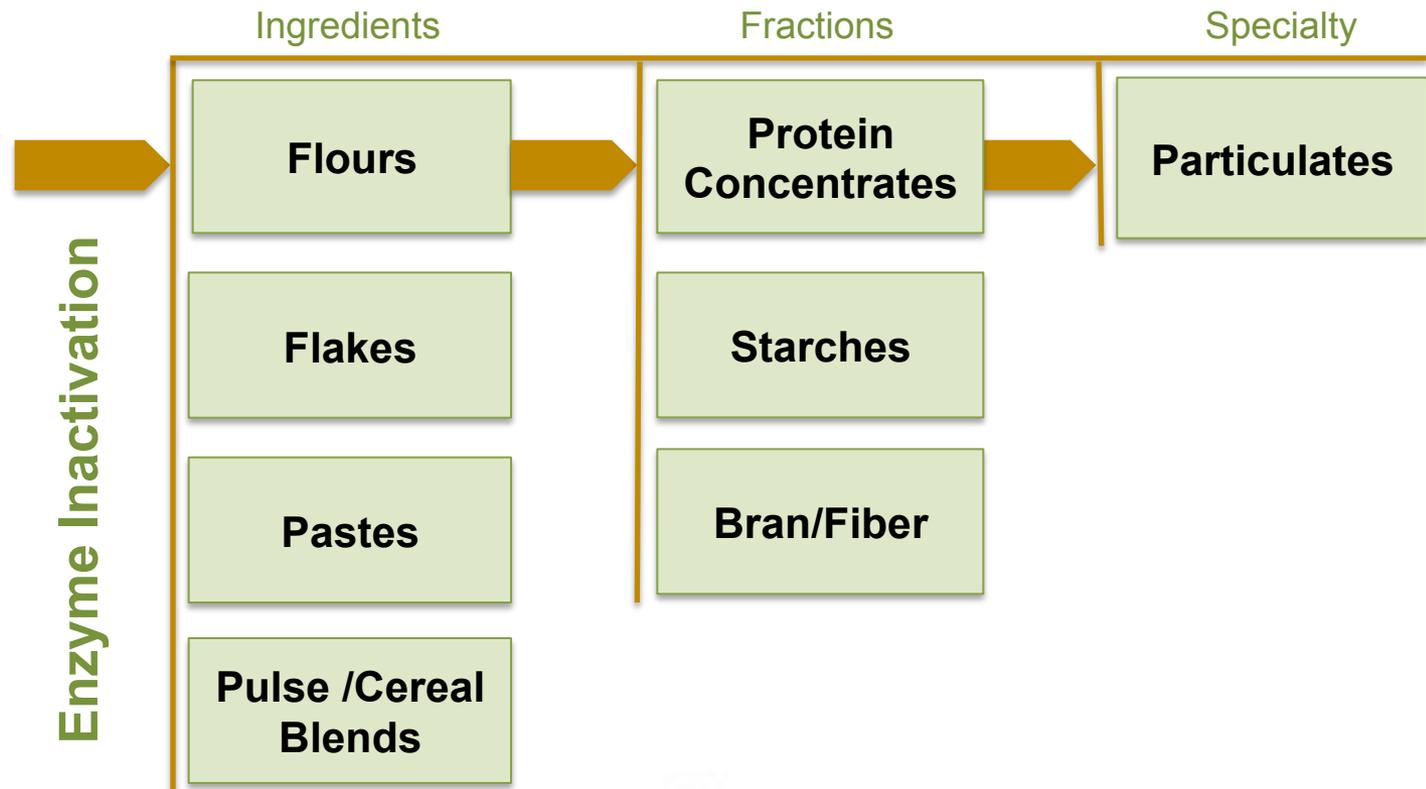
- A superior production, manufacturing and distribution infrastructure.
- Multiple university and technical centers to provide technical support and innovation.

Because of the U.S.'s highly developed quality grading, handling and production control systems, U.S. pulse producers receive top dollar for their pulses in world export markets.

Pulses as Food Ingredients

Pulses can be processed into a variety of food ingredients.

- Dry peas
- Chickpeas
- Lentils



Section 2

The Role of Egg and Dairy Ingredients in Food Formulation

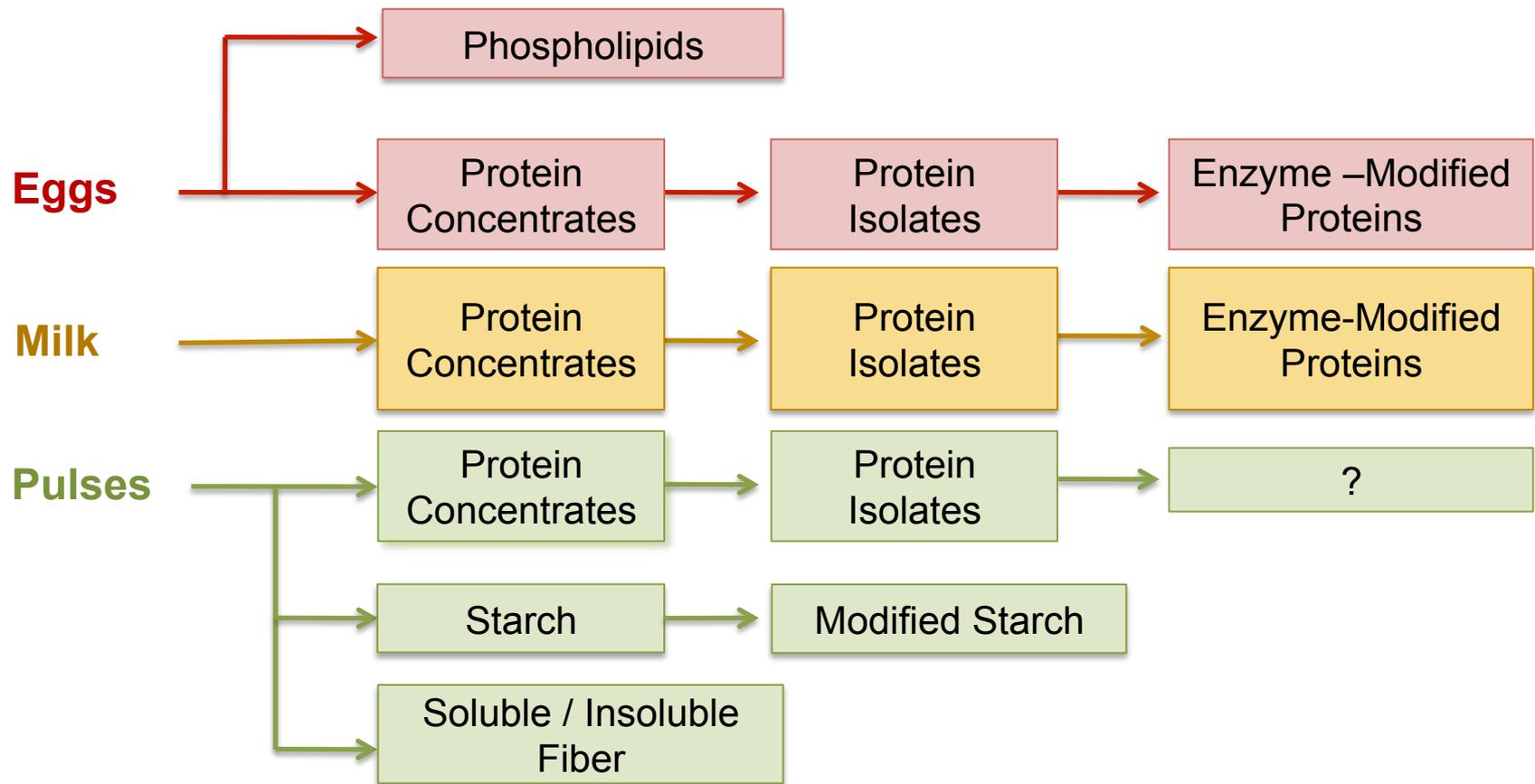
- Functional properties
- Food applications
- Allergenicity issues
- Economics



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Functional Ingredients



Functional Protein Ingredients

Raw Material Sources	<u>%-Protein</u>	Protein Concentrates	<u>%-Protein</u>	Protein Isolates
<ul style="list-style-type: none"> • Soy (dry) • Milk (wet) • Whey (wet) 	<p>35.0 %</p> <p>3.5 %</p> <p>0.8 %</p>	<ul style="list-style-type: none"> • SPC (dry) • MPC (dry) • WPC (dry) 	<p>40-90%</p> <p>40-90%</p> <p>40-90%</p>	<p>SPI 90 + %</p> <p>MPI 90 + %</p> <p>WPI 90 + %</p>
<ul style="list-style-type: none"> • Eggs (wet) 	<p>10.9%</p>	<ul style="list-style-type: none"> • Yolk (wet /dry) • Albumen (wet /dry) 	<p>15.8% protein 26.5% lipid</p> <p>8.0% protein</p>	<p>34.0% protein 55.8% lipid</p> <p>82.4% protein</p>

Functional Properties of Eggs

Eggs

- Proteins
- Fats
- Lecithin

Aeration, foaming

Binding, adhesion

Gelation, coagulation

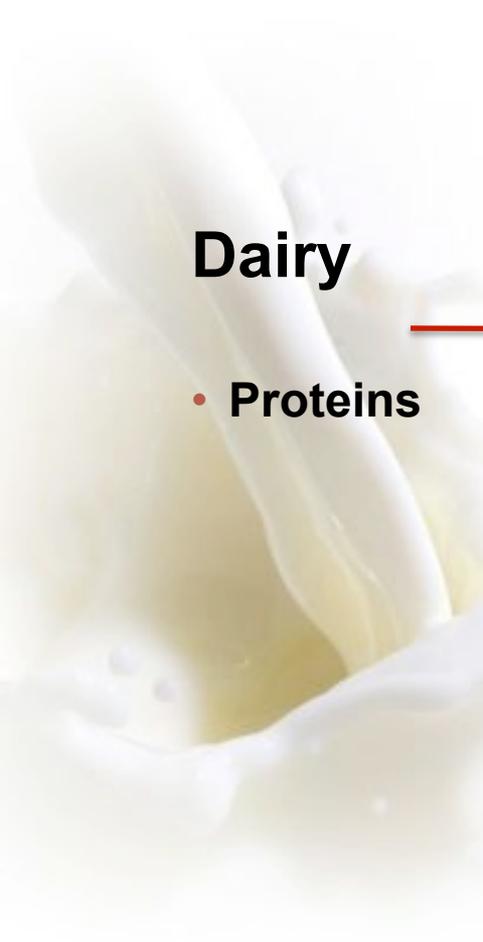
Emulsification

Humectancy

Thickening, mouthfeel



Functional Properties Dairy Ingredients



Dairy

- Proteins

Nutrition

Aeration, foaming

Binding, adhesion

Gelation, coagulation

Emulsification

Humectancy

Thickening, mouthfeel



Gluten-Free and Allergen Concerns?

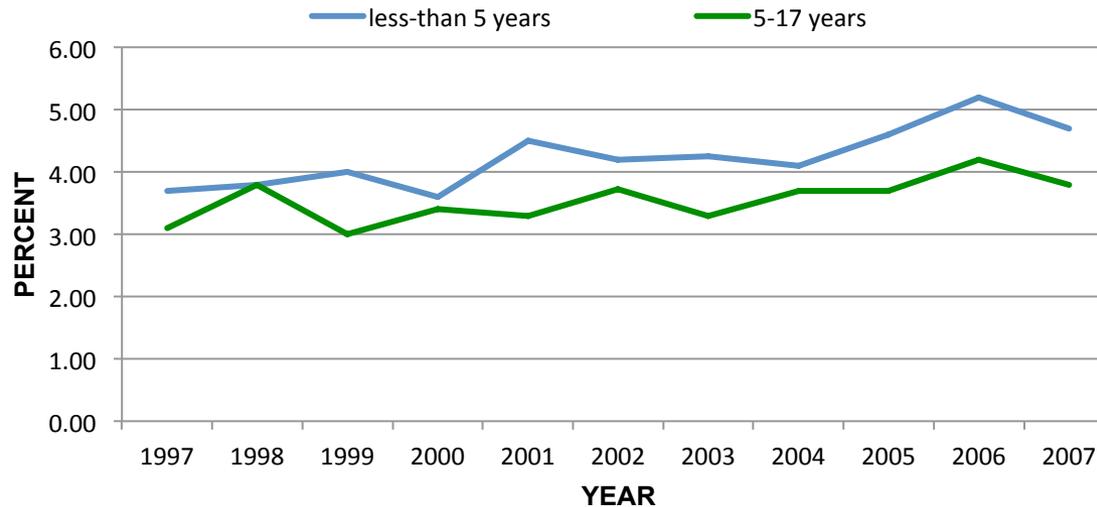
U.S. Food Allergen Labeling and Consumer Protection Act of 2004

FALCPA passage was based on estimates that eight major food allergens account for 90% of all food allergies:

- **Milk**
 - **Eggs**
 - Fish
 - Crustacean shellfish
 - **Tree nuts**
 - **Peanuts**
 - **Wheat**
 - **Soybeans**
- FALCPA required all foods to clearly identify all ingredients that contained one or more of the identified allergens.
 - Pulses can play important roles as ingredient alternatives for those food allergens highlighted in **red**.

Why Food Allergens are of Concern?

Percent of children with a reported food or digestive allergy in 12-month period



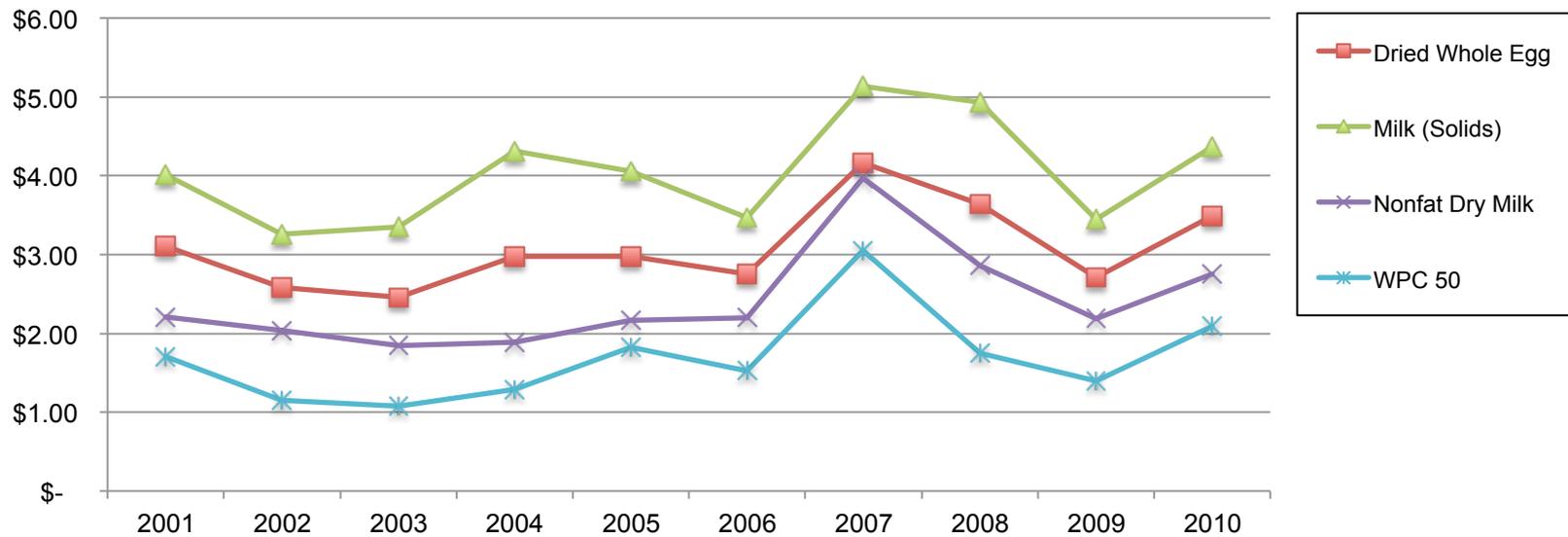
The incidence of food allergies in children has been trending upwards.

Adapted from : Branum A, Lukacs S. Food allergy among U.S. children: Trends in prevalence and hospitalizations. National Center for Health Statistics Data Brief. 2008. Retrieved from <http://www.cdc.gov/nchs/data/databriefs/db10.htm>

Egg & Dairy Ingredients: Economics

Ten-year price trends for dried whole egg and dairy ingredients

Raw Material Price Trends (\$ /kg)



Sources: FAOSTAT, University of Wisconsin Dept. of Agricultural Economic; USDA-ERS

Egg and milk protein price drivers

Global commodities demand

Feed costs: approximately 60-70% of milk and egg costs reflect the price of animal feed.

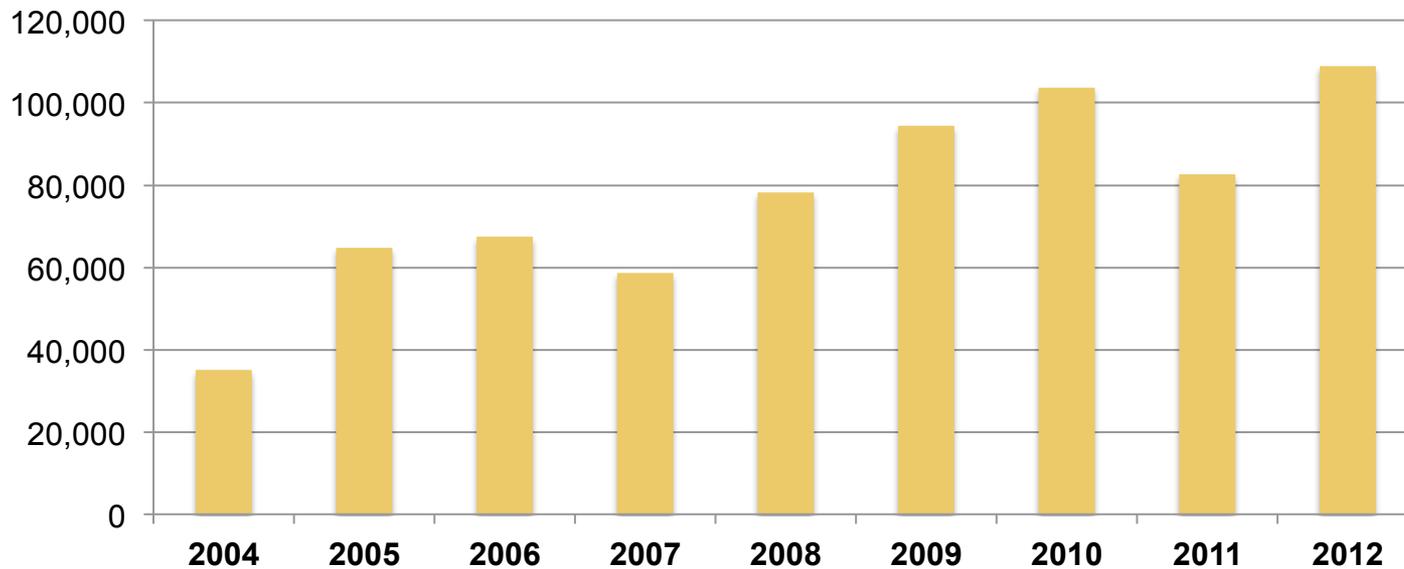
Feed costs have been increasing because:

- Corn, soy and alfalfa exports are increasing rapidly.
- Corn diversions to biofuels remain high.
- Alfalfa remains vulnerable to drought conditions.

Egg and milk protein price drivers

Export demand

Whole Egg Exports
[Thousand-lb Liquid Equivalents]



Source: U.S. Dept. of Commerce

Egg and milk price drivers

New products



Müller-Pepsico Yogurt



**McDonald's
Egg White Delight McMuffin.**

Section 3

Pulse ingredients as egg and dairy alternatives

- Economic benefits of using pulses
- Pulses as egg and dairy alternatives and extenders
- Functional properties of pulses
- Choosing egg and dairy alternatives and extenders



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Ingredient Cost Considerations

When developing new food products, the following ingredient variables are of critical importance.

- Raw material price
- Raw material price volatility
- Raw material availability

Protein Ingredient Cost Considerations

Ten-year price trends for dried whole egg, dairy and pea ingredients.



Sources: FAOSTAT, University of Wisconsin Dept. of Agricultural Economic; USDA-ERS

Protein Ingredient Cost Considerations

Ingredient Price on Unit-Protein Basis (2010)

	%-Protein	\$/ kg -2010	\$/kg Protein
Dried Whole Egg Powder	47%	\$ 3.49	\$ 7.42
Nonfat Dry Milk	34%	\$ 2.75	\$ 8.09
Whole Milk Solids	27%	\$ 4.36	\$16.16
WPC 50	50%	\$ 2.09	\$ 4.18
Peas (field)	24%	\$ 0.19	\$ 0.80

Sources: FAOSTAT, University of Wisconsin Dept. of Agricultural Economic; USDA-ERS

Protein Ingredient Cost Considerations

Ingredient Price Volatility (2001–2010)

	%-Protein	Avg. Price (\$/kg)
Dried Whole Egg Powder	47%	\$ 3.09
Nonfat Dry Milk	34%	\$ 2.41
Whole Milk Solids	27%	\$ 4.04
WPC 50	50%	\$ 1.69
Peas (field)	24%	\$ 0.16

Sources: FAOSTAT, University of Wisconsin Dept. of Agricultural Economic; USDA-ERS

Protein Ingredient Cost Considerations

Conclusions:

- Pulse protein raw material costs are relatively low compared to other protein sources.
- Pulse-ingredient price volatility should have relatively little impact on finished food product prices.
- Pulse proteins are commodity products produced in high abundance and to very high quality standards in the United States.

Functionality Benefits of Pulses

The functional properties of pulses replicate many of the functional properties of egg and dairy proteins.

Egg and Dairy Protein Functionality

- Structure
- Strength
- Texture /mouthfeel
- Coloration
- Emulsification
- Gelation
- Film-forming
- Foaming
- Water control
- Viscosity
- Flavor
- Opacity / turbidity
- Particle suspension
- Adhesion
- Agglomeration



Pulse Ingredient Functionality

- Structure
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- Texture /mouthfeel
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Section 4

How to use pulse ingredients as egg and dairy alternatives and extenders in food formulation.

- Properties
- Formulation
- Cost-Savings
- Examples



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How to use pulses as egg and dairy alternatives and extenders

Step 1: determine what functional role egg or dairy ingredients play in your food product

Dairy

- Proteins

Nutrition

Aeration, foaming

Binding, adhesion

Gelation, coagulation

Emulsification

Humectancy

Thickening, mouthfeel



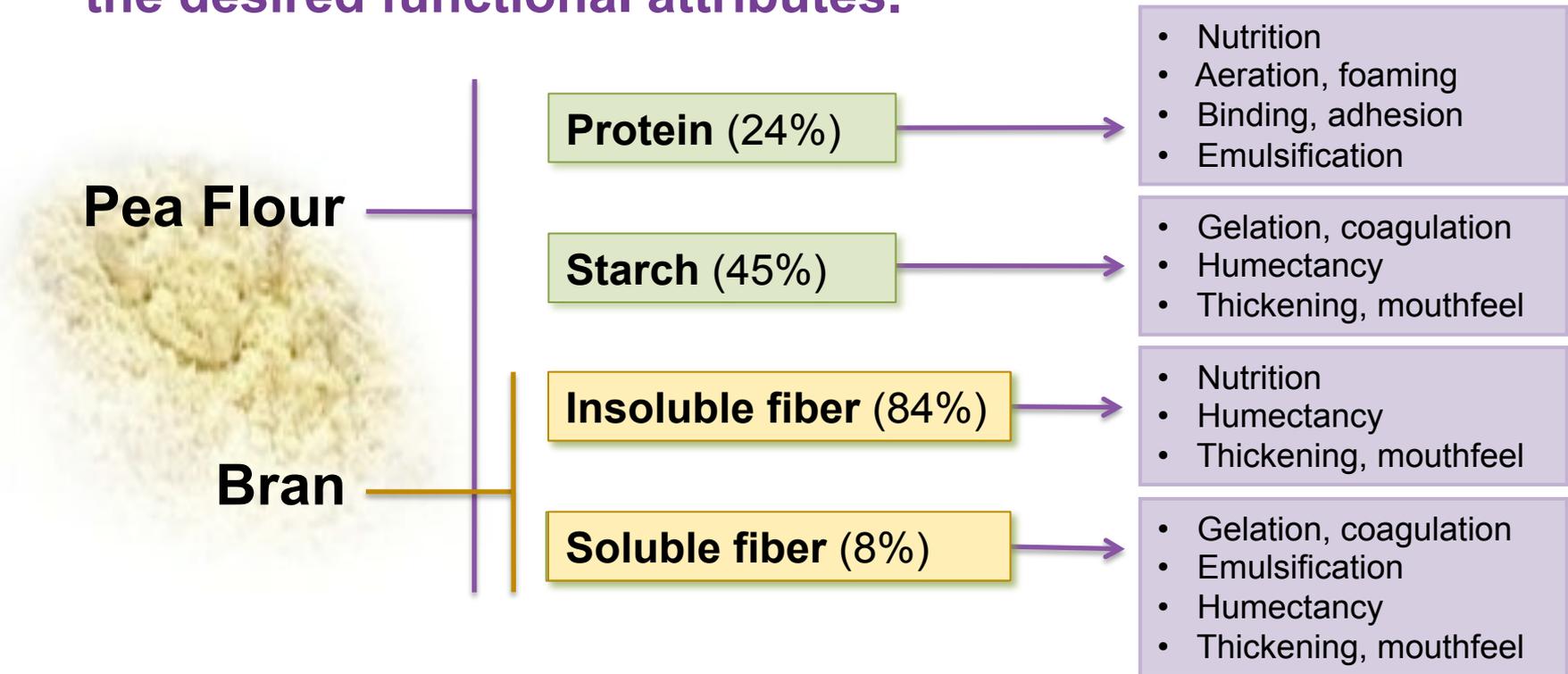
How to use pulses as egg and dairy alternatives and extenders

Step 2: determine what role pulses should play

- 100% egg and dairy replacers
- Partial egg and dairy replacers
- Egg and dairy extenders
- Egg and dairy-extender extenders

How to use pulses as egg and dairy alternatives and extenders

Step 3: determine which pulse components deliver the desired functional attributes.



How to use pulses as egg and dairy alternatives and extenders

Step 4: select the pulse ingredients that deliver the desired functional attributes.

Cakes and Cookies



- Aeration, foaming
- Binding, adhesion
- Emulsification
- Gelation, coagulation

- Pulse flour
- Cooked pulse flour
- Pregel pulse flour
- PPC
- PPI
- Pulse starch
- Pulse bran

Degree of Egg or Dairy Substitution: **100%**

How to use pulses as egg and dairy alternatives and extenders

Step 4: select the pulse ingredients that deliver the desired functional attributes.

Battered & Fried Product



- Binding, adhesion
- Emulsification
- Gelation, coagulation

- Pulse flour
- Cooked pulse flour
- Pregel pulse flour
- PPC
- Pulse starch
- Pulse bran

Degree of Egg or Dairy Substitution: **100%**

How to use pulses as egg and dairy alternatives and extenders

Step 4: select the pulse ingredients that deliver the desired functional attributes.

Pasta



- Binding, adhesion
- Texture, mouthfeel
- Gelation, coagulation

- Pulse flour
- Cooked pulse flour
- Pregel pulse flour
- PPC
- Pulse Bran

Degree of Egg or Dairy Substitution: **100%**

How to use pulses as egg and dairy alternatives and extenders

Resources:

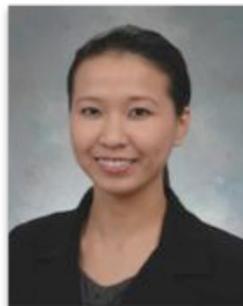


Northern Crops Institute

NDSU Dept. 7400
PO Box 6050
Fargo, North Dakota, USA 58108-6050
Phone: 701-231-7736
Fax: 701-231-7235
Email: nci@ndsu.edu



Prof. Cliff Hall III



**Thunyaporn (“Naggie”)
Jeradechachai**

How to use pulses as egg and dairy alternatives and extenders

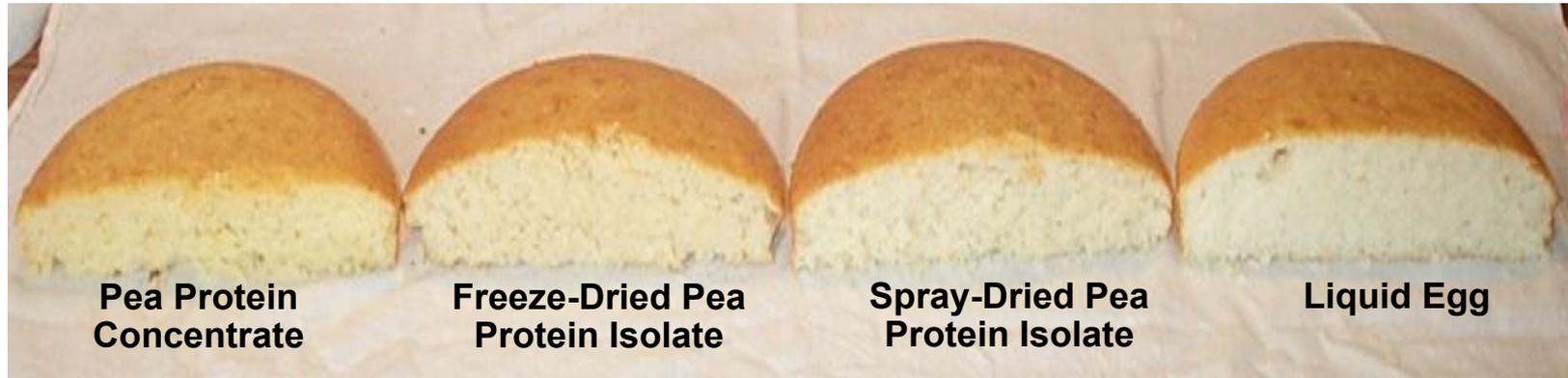
Example 1:

White Cake		
Formula weight (g)		
	w/Egg	w/ PPI
Cake flour	130	130
Baking powder	7	7
Shortening	50	50
Pea Protein	-	6
Water	45	115
Fresh Whole Egg	69	-
Sugar	100	100
Salt	3	3
Vanilla Powder	3	3
	407	414

Source: "Sensory Qualities of Cakes and Cookies Made with Pea Proteins as an Egg Replacer.", 2012: Mary Niehaus, Clifford Hall III and Hieu Hoang; School of Food Systems, North Dakota State University, Fargo, ND

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How to use pulses as egg and dairy alternatives and extenders



White cakes prepared from pea concentrate, peas isolates, and eggs. Surface and cross-sectional views are presented of the cakes.

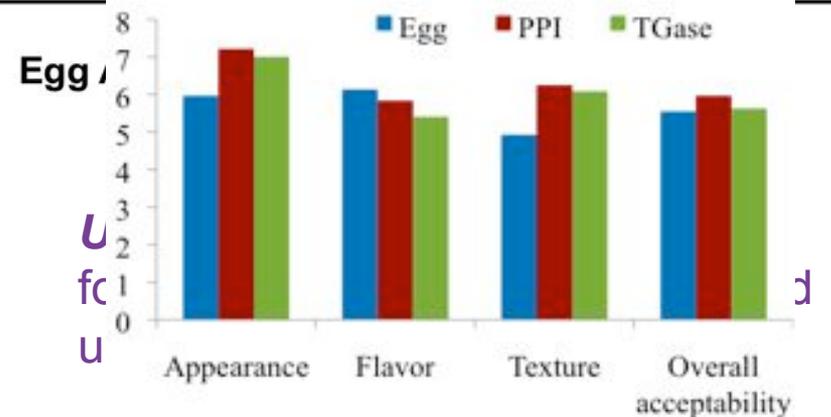
Research conducted by Dr. Clifford Hall III, Associate Professor, Food and Cereal Science, North Dakota State University

How to use pulses as egg and dairy alternatives and extenders

Example 1:

	White Cake Formula weight (g)	
	w/Egg	w/ PPI
Cake flour	130	130
Baking powder	7	7
Shortening	50	50
Pea Protein	-	6
Water	45	115
Fresh Whole Egg	69	-
Sugar	100	100
Salt	3	3
Vanilla Powder	3	3
	407	414

Sensory Properties of White Cake (9 = "high")
Samples: Egg, PPI, TGase



Source: "Sensory Qualities of Cakes and Cookies Made with Pea Proteins as an Egg Replacer.", 2012: Mary Niehaus, Clifford Hall III and Hieu Hoang; School of Food Systems, North Dakota State University, Fargo, ND

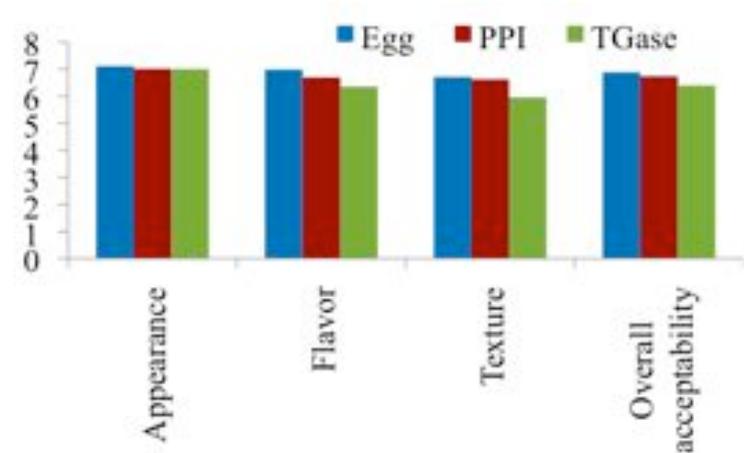
How to use pulses as egg and dairy alternatives and extenders

Example 2:

Sugar Cookie Formula
Formula weight (g)

	w/Egg	w/ PPI
Cake flour	175.0	175.0
Butter	113.0	113.0
Sugar	75.0	75.0
Brown Sugar	56.0	56.0
Fresh Egg	23.0	-
Pea Protein -	-	3.0
Water -	-	22.0
Salt	1.5	1.5
Baking Soda	2.7	2.7
	446.2	448.2

Sensory Properties of Sugar Cookies (9 = "high")



Source: "Sensory Qualities of Cakes and Cookies Made with Pea Proteins as an Egg Replacer.", 2012: Mary Niehaus, Clifford Hall III and Hieu Hoang; School of Food Systems, North Dakota State University, Fargo, ND

How to use pulses as egg and dairy alternatives and extenders

Example 3:

Level of pea flour incorporation

	0%	5%	10%	15%	20%
Cooking Quality (al dente)					
Cooked Wt (g)	75.8	75.3	77.7	77.2	76.3
Cooking Loss (%)	5.9	5.6	5.9	6.1	6.3
Cooked Firmness (g cm)	12.9	12.4	12.5	13.4	14.4
Cooking Quality (overcook 6 min)					
Cooked Wt (g)	87.4	86.7	87.9	88.0	88.0
Cooking Loss (%)	7.2	6.6	7.3	7.2	7.3
Cooked Firmness (g cm)	9.3	9.0	9.1	9.6	10.2

Pasta al-dente quality and robustness increased with increased levels of pea flour incorporation.

Source: Northern Crops institute



Yellow Pea
100%

Corn
100%

100% Legume Pasta

Useful tip: Addition of 0.5-1.0% calcium sulfate will further increase al dente texture and robustness.

* Patent Pending

How to use pulses as egg and dairy alternatives and extenders

Step 2: determine what role pulses should play

- 100% egg and dairy replacers
- Partial egg and dairy replacers
- Egg and dairy extenders
- Egg and dairy-extender extenders

EXAMPLES

Fiberstar, Inc.
River Falls, Wis.

Florida Food Products, Inc.
Eustis, Fla.

Glanbia, Inc.
Madison, Wis.

Section 4

Summary and Conclusions

- Summary & Conclusions
- Resources
- Questions and Answers



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Summary and Conclusions

- Egg and dairy ingredients are high-cost ingredients subject to high price volatility.
- Pulse ingredients (protein, starch, fiber, bran) will duplicate many of the functional properties of egg and dairy ingredients.
- Pulse ingredients are likely to be lower in cost and exhibit lower price volatility than dairy or egg-derived ingredients.
- Pulse-based ingredients can function as egg and dairy replacers and extenders.
- Primary applications for pulses as egg or dairy extenders include:
 - a. Bakery products
 - b. Pasta
 - c. Battered and fried products
 - d. Meat binders
 - e. Beverages
 - f. Soups, sauces and salad dressings
 - g. Extenders for other egg and dairy extenders

Additional Resources

- **The USA Dry Pea and Lentil Council**

Contact: Ali McDaniel
Email: amcdaniel@pea-lentil.com
Tel. 1-208-596-5026
Website: www.pea-lentil.com

- **Northern Crops Institute (North Dakota State University)**

Contact: Thunyaporn “Naggie” Jeradechachai
Email: T.jeradechachai@ndsu.edu
Tel. 1-701-231-7736
Website: www.northern-crops.com

- **BEST VANTAGE Inc.**

Contact: Daniel Best
Email: info@bestvantageinc.com
Tel. 1-847-714-9527
Website: www.bestvantageinc.com

Industry Resources

Best Cooking Pulses, Inc..

Portage la Prairie, MB

www.bestcookingpulses.com

Dakota Dry Bean, Inc.

Grand Forks, ND

www.dakotadrybean.com

Fiberich Technologies, Inc.

St. Louis Park, MN

www.fiberichtech.com

George F. Brocke & Sons

Kendrick, ID

gfbrocke.com

Harvest Innovations

Indianola, IA

harvest-innovations.com

Hinrichs Trading Co.

Pullman, WA

www.hinrichstrading.com

Inland Empire Foods, Inc.

Riverside, CA

www.inlandempirefoods.com

SK Food International

Fargo, ND

www.skfood.com

United Pulse Trading

Bismarck, ND

www.alliancegrain.com

Woodland Foods, Inc.

Gurnee, IL

woodlandfoods.com

Additional Resources

A downloadable copy of this Webinar presentation will be posted on the USA Dry Pea & Lentil Council website in the near future @ www.pea-lentil.com/webinars. We will send webinar registrants an email notification when it becomes available.

Upcoming Webinars: Please stay tuned for future 2013 webinar presentations on more specific uses of pulse ingredients in food product development.

QUESTIONS?



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Thank You
for your participation



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