



Funds for this project were provided through the Idaho State Department of Agriculture Specialty Crop Block Grant Program.



webinar presentation



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

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## Section 1

# Overview: Pulse and Pulse-Based Ingredients

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



### REMINDER

Please email WEBINAR questions to [amcdaniel@pea-lentil.com](mailto:amcdaniel@pea-lentil.com)



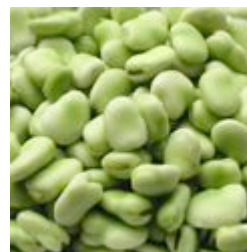
## What are Pulses?

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 <sup>1</sup>	77.5	8.6	0.0	0.0
Whole Soy Flour - Raw	35.0	20.0	25.6	9.6
<b>Dry Peas</b>	<b>23.7</b>	<b>1.3</b>	<b>45.5</b>	<b>16.6</b>
<b>Regular Lentils</b>	<b>26.3</b>	<b>1.1</b>	<b>45.0</b>	<b>13.6</b>
<b>Chickpeas</b>	<b>24.4</b>	<b>5.9</b>	<b>41.1</b>	<b>8.7</b>
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

<sup>1</sup> 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...

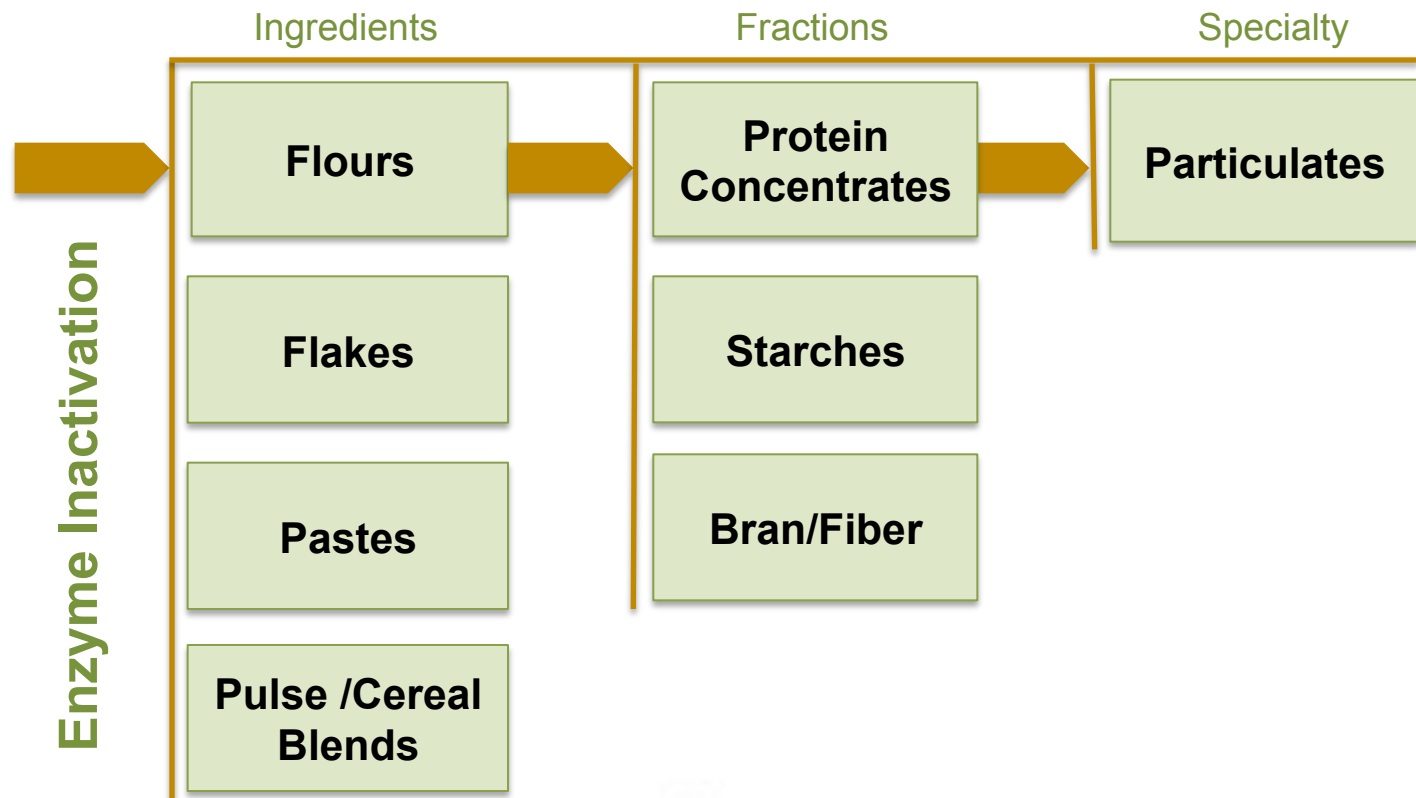
- A superior production, manufacturing and distribution infrastructure.
- Multiple university and technical centers to provide technical support and innovation.

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

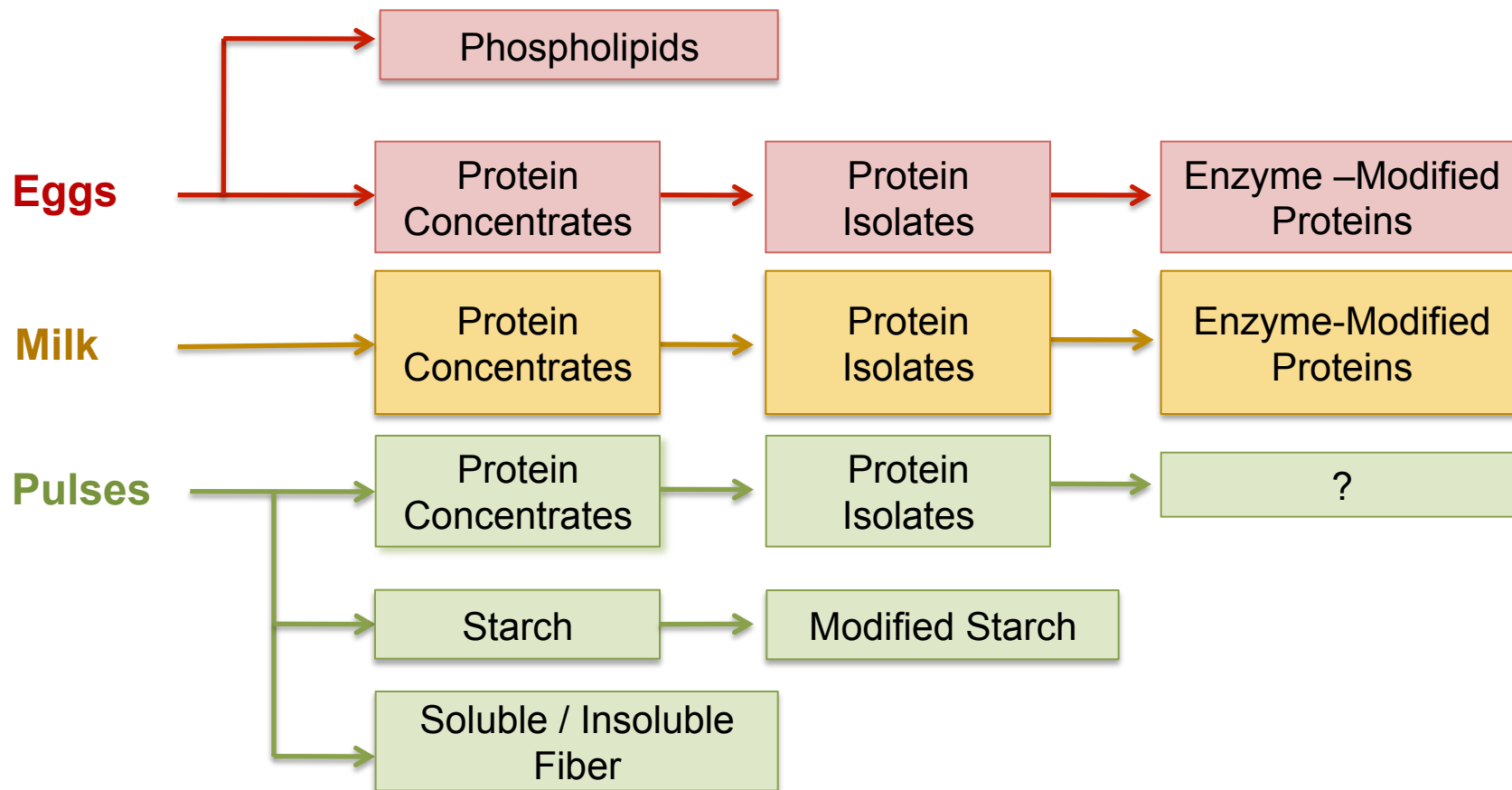


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# Functional Ingredients



# Functional Protein Ingredients

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

# 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?

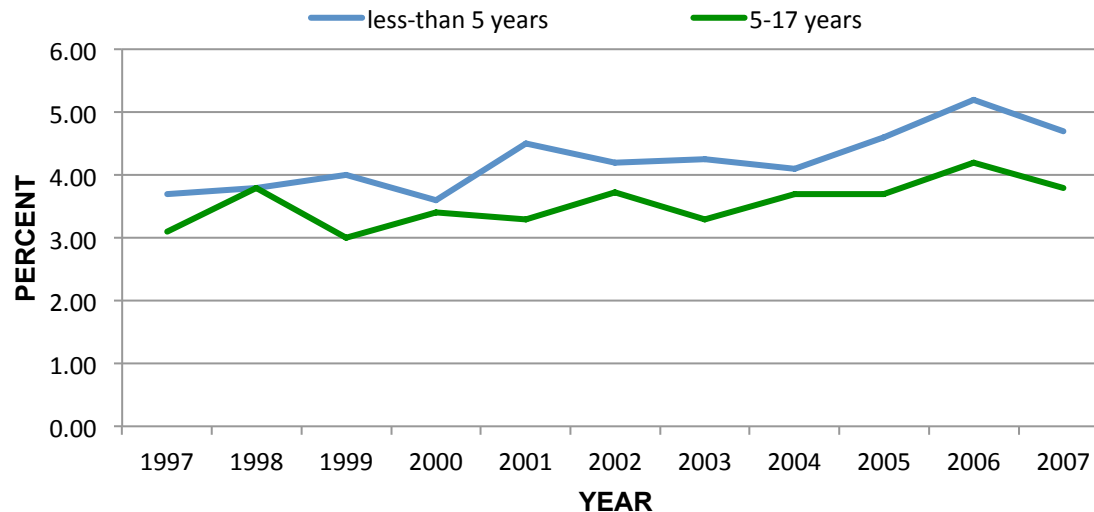
## U.S. Food Allergen Labeling and Consumer Protection Act of 2004

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**



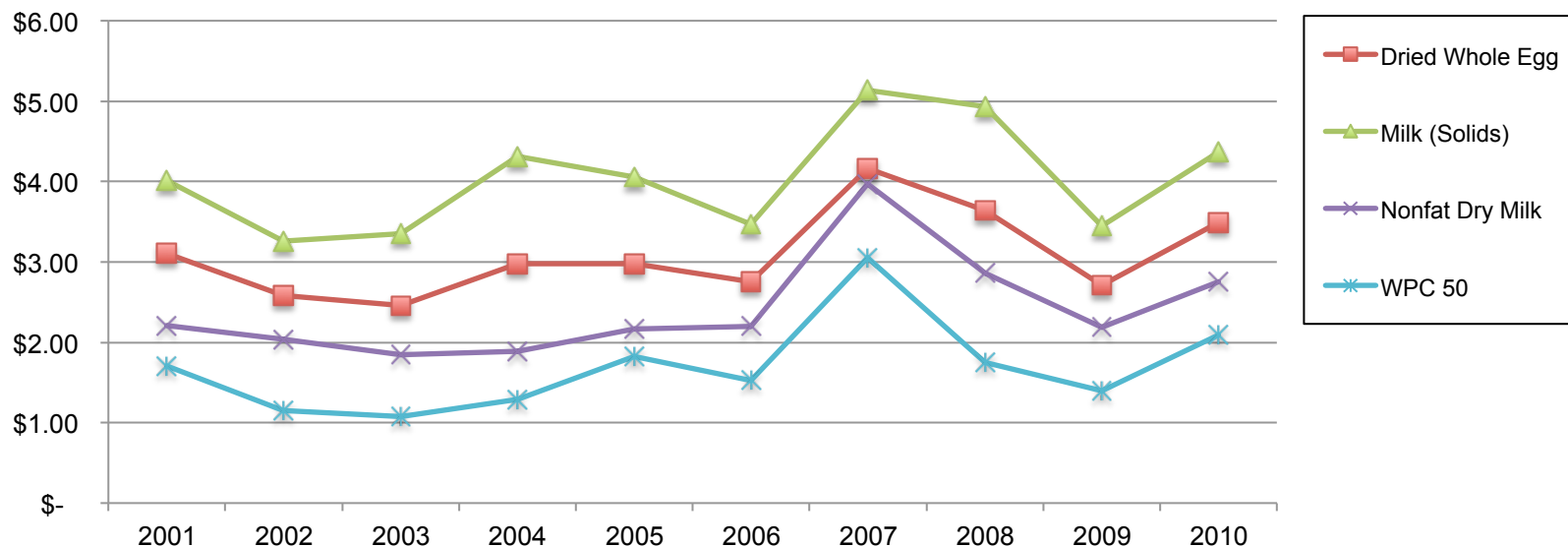
***The incidence of food allergies in children has been trending upwards.***

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:**

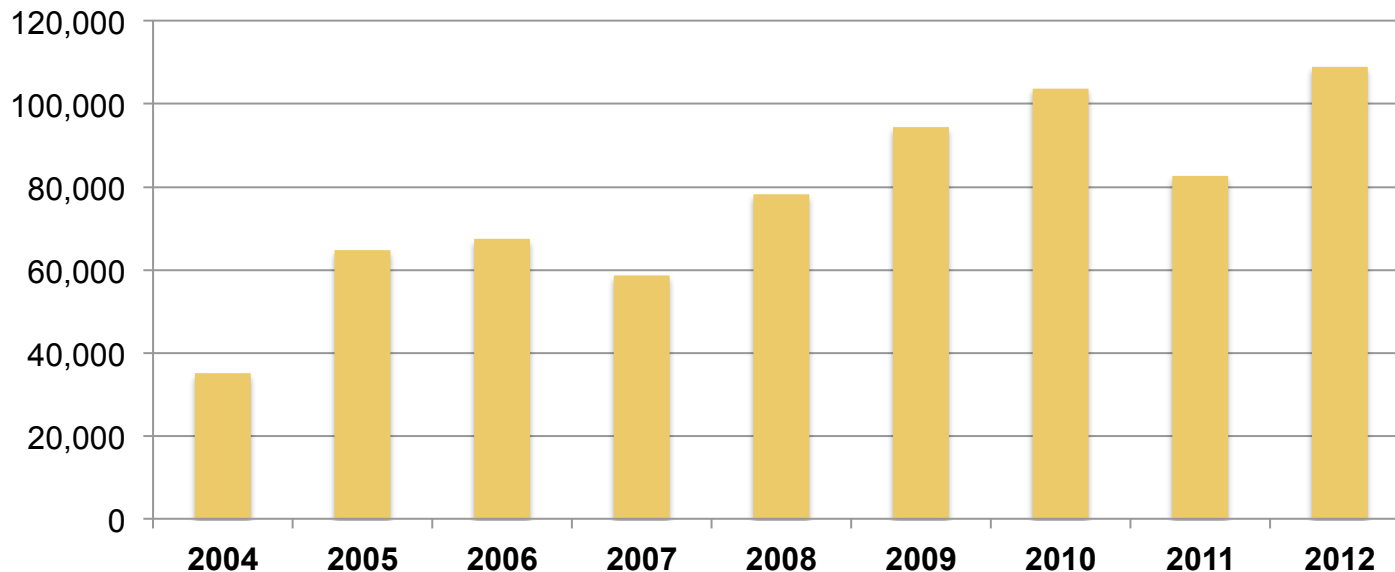
- Corn, soy and alfalfa exports are increasing rapidly.
- Corn diversions to biofuels remain high.
- Alfalfa remains vulnerable to drought conditions.



# 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
<b>Dried Whole Egg Powder</b>	47%	\$ 3.49	\$ 7.42
<b>Nonfat Dry Milk</b>	34%	\$ 2.75	\$ 8.09
<b>Whole Milk Solids</b>	27%	\$ 4.36	\$16.16
<b>WPC 50</b>	50%	\$ 2.09	\$ 4.18
<b>Peas (field)</b>	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
- Strength
- Texture /mouthfeel
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- Water control
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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



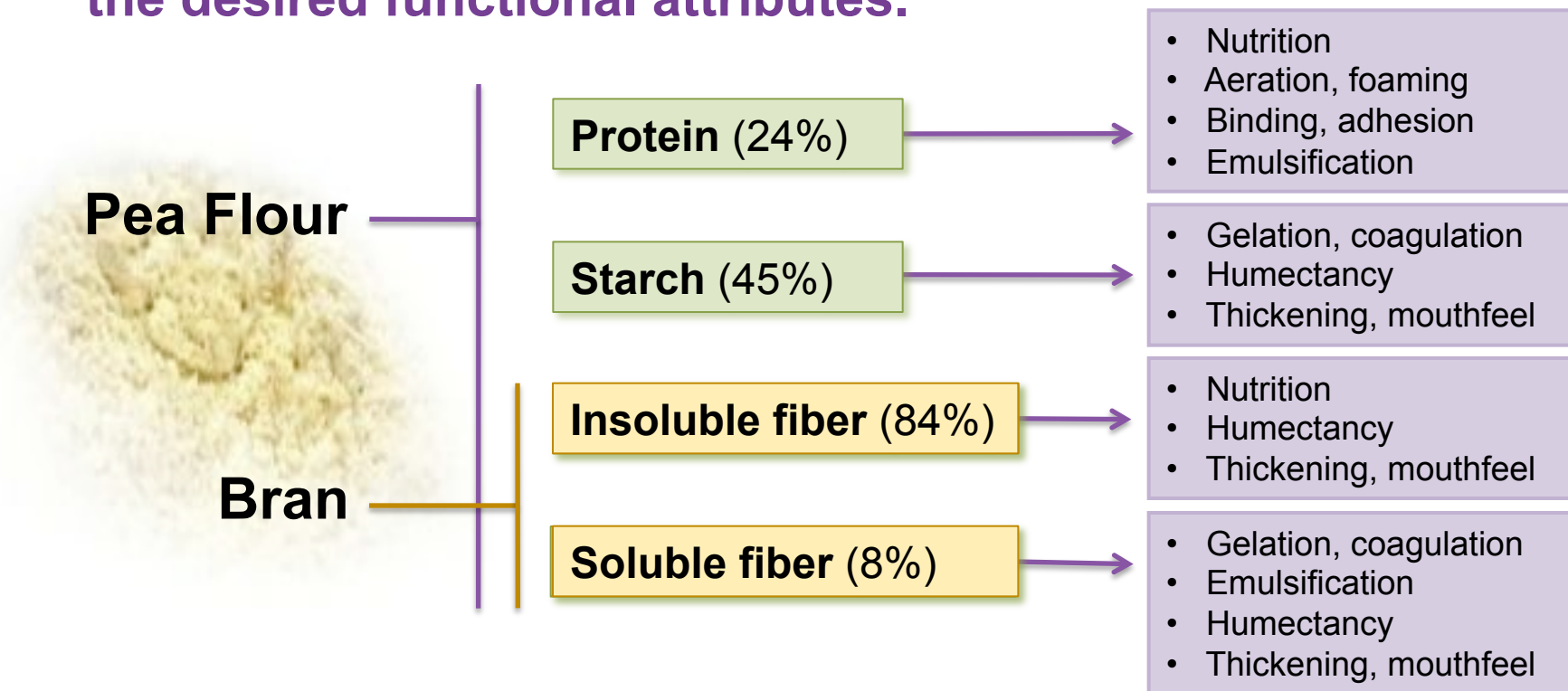
# How to use pulses as egg and dairy alternatives and extenders

## 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:

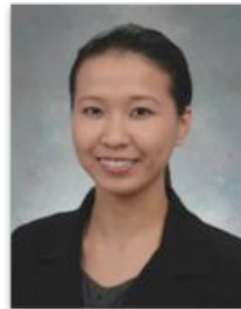


### **Northern Crops Institute**

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



**Prof. Cliff Hall III**



**Thunyaporn ("Naggie")  
Jeradechachai**

# How to use pulses as egg and dairy alternatives and extenders

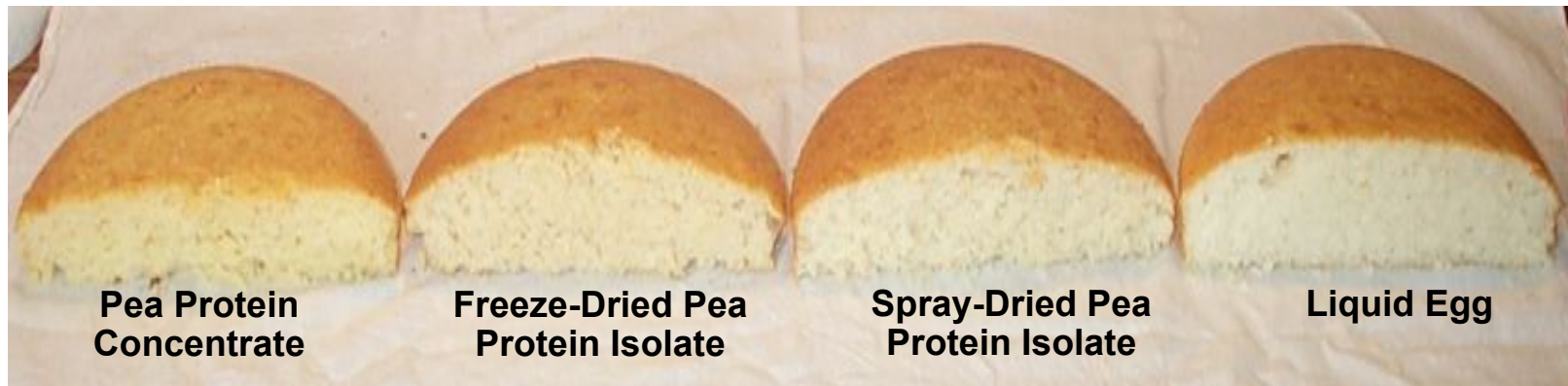
## Example 1:

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
	<b>407</b>	<b>414</b>

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



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

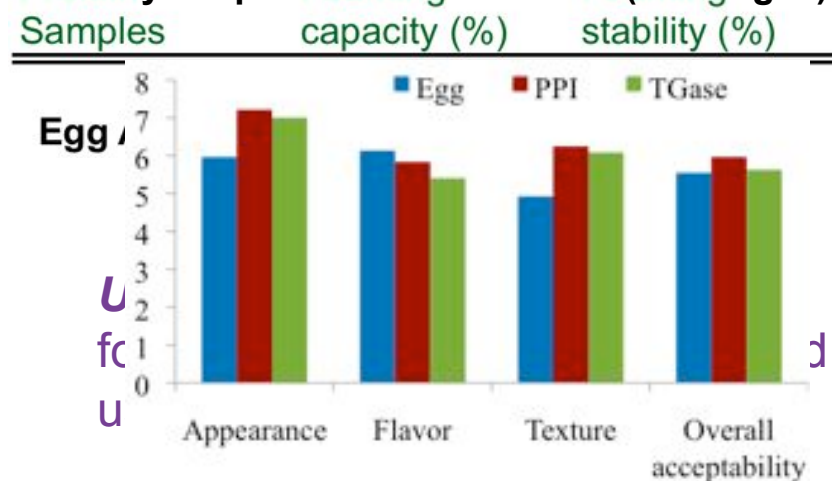
*Research conducted by Dr. Clifford Hall III, Associate Professor, Food and Cereal Science, North Dakota State University*

# 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
	<b>407</b>	<b>414</b>

## Sensory Properties of White Cake (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

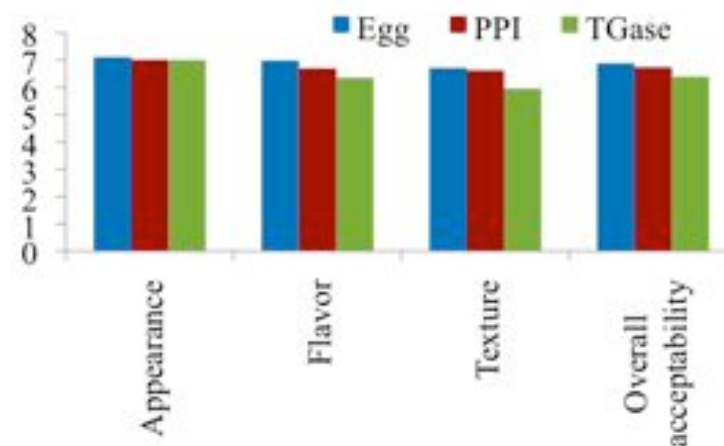
# How to use pulses as egg and dairy alternatives and extenders

## Example 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
	<b>446.2</b>	<b>448.2</b>

**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%
<b>Cooking Quality (al dente)</b>					
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
<b>Cooking Quality (overcook 6 min)</b>					
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](mailto:amcdaniel@pea-lentil.com)  
**Tel.** 1-208-596-5026  
**Website:** [www.pea-lentil.com](http://www.pea-lentil.com)

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

**Contact:** Thunyaporn “Naggie” Jeradechachai  
**Email:** [T.jeradechachai@ndsu.edu](mailto:T.jeradechachai@ndsu.edu)  
**Tel.** 1-701-231-7736  
**Website:** [www.northern-crops.com](http://www.northern-crops.com)

- **BEST VANTAGE Inc.**

**Contact:** Daniel Best  
**Email:** [info@bestvantageinc.com](mailto:info@bestvantageinc.com)  
**Tel.** 1-847-714-9527  
**Website:** [www.bestvantageinc.com](http://www.bestvantageinc.com)

## Industry Resources

### **Best Cooking Pulses, Inc..**

Portage la Prairie, MB

[www.bestcookingpulses.com](http://www.bestcookingpulses.com)

### **Dakota Dry Bean, Inc.**

Grand Forks, ND

[www.dakotadrybean.com](http://www.dakotadrybean.com)

### **Fiberich Technologies, Inc.**

St. Louis Park, MN

[www.fiberichtech.com](http://www.fiberichtech.com)

### **George F. Brocke & Sons**

Kendrick, ID

[gfbrocke.com](http://gfbrocke.com)

### **Harvest Innovations**

Indianola, IA

[harvest-innovations.com](http://harvest-innovations.com)

### **Hinrichs Trading Co.**

Pullman, WA

[www.hinrichstrading.com](http://www.hinrichstrading.com)

### **Inland Empire Foods, Inc.**

Riverside, CA

[www.inlandempirefoods.com](http://www.inlandempirefoods.com)

### **SK Food International**

Fargo, ND

[www.skfood.com](http://www.skfood.com)

### **United Pulse Trading**

Bismarck, ND

[www.alliancegrain.com](http://www.alliancegrain.com)

### **Woodland Foods, Inc.**

Gurnee, IL

[woodlandfoods.com](http://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](http://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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