



Plant Based Protein from Grains, Seeds and Pulses

Trends, Sources & Applications



February 11, 2019



Chicago Section
Institute of Food Technologists

Bay State Milling Overview

Family owned –
founded in 1899

Professionally
governed &
managed

Committed to safe,
healthy, plant
based solutions

Expanding
national network of
facilities

Pioneer in organic
supply chains,
grains, &
ingredients

Leader in edible
seeds, ancient
grains & blends

Integrated gluten
free grain milling &
blending

Proprietary varietal
specific
ingredients

Highlights

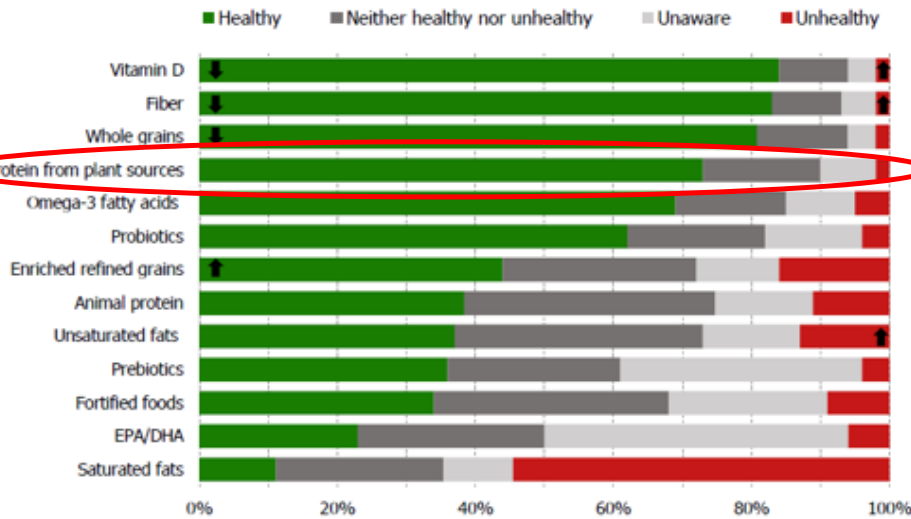
- Market Overview
- Formulating with Plant Proteins
 - Nutrition and Functionality
 - Quantity and Quality
- Sourcing and Supply Chain
- Applications & Launches
- Q&A



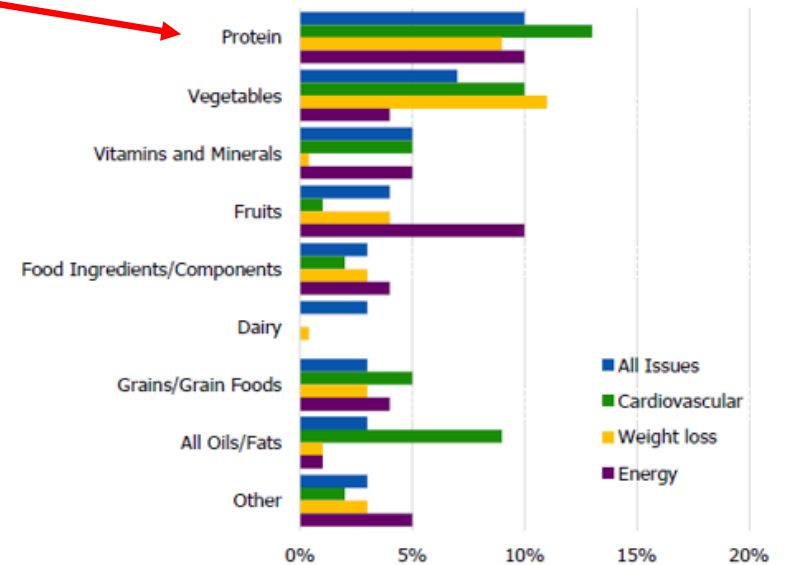
The Market

The Case for Protein

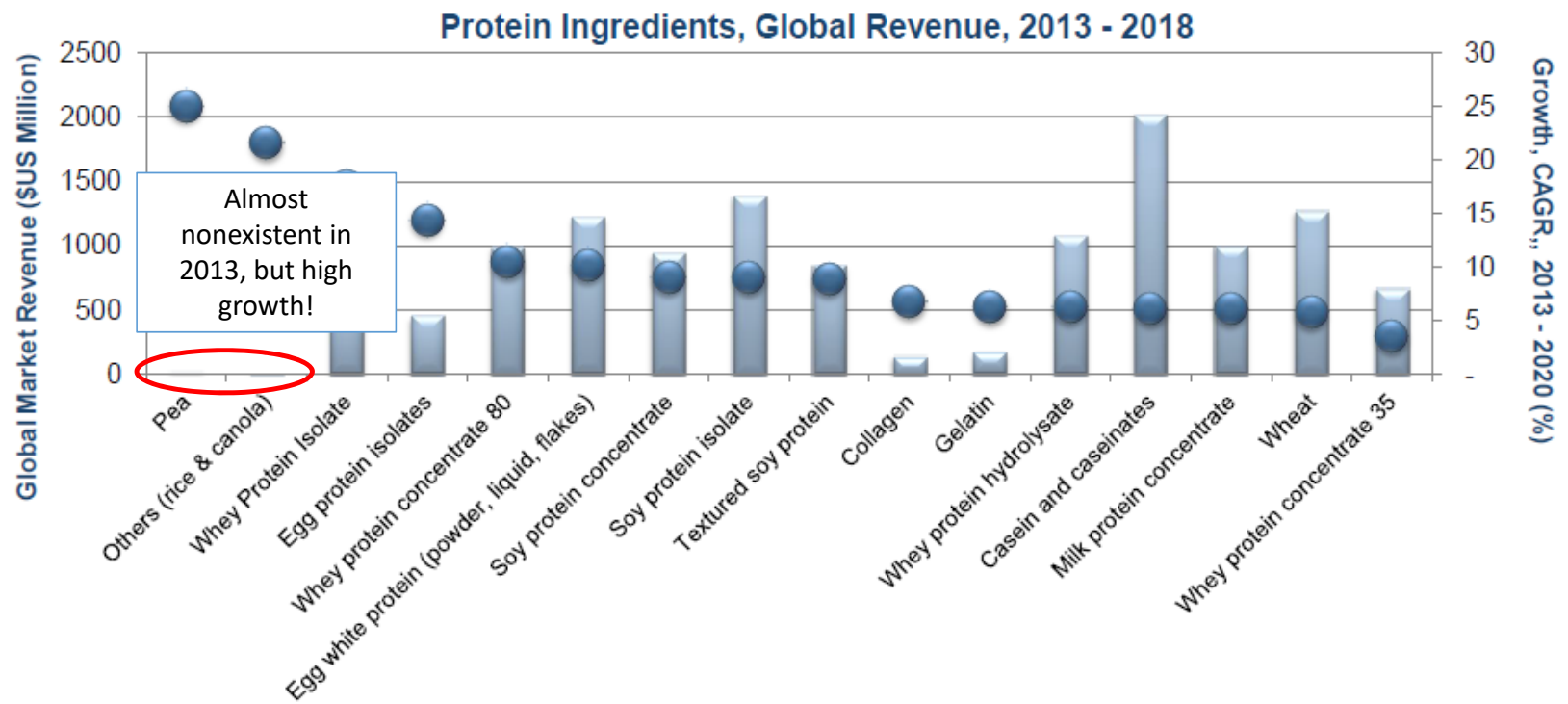
Perceived Healthfulness of Foods



Food or Nutrient Sought for Top Health Issue



Protein Ingredients Market



Frost & Sullivan 2013



The Case for Plant Proteins

✓ Sustainability

- Meat is resource intensive
- Plants can be soil regenerative

✓ Health

- Plants bring additional nutrients (fiber, vits/mins, antioxidants) without the saturated fats

✓ Lifestyle

- Consumers moving towards humane foods

✓ Availability

- Sources can be grown affordably worldwide

*1kg of bean protein vs. 1kg beef protein**

- 18x less land
- 10x less water
- 9x less fuel
- 12x less fertilizer
- 10x less pesticides

The Market for Plant Based Foods



2018 Retail dollar sales:

- Plant based milks grew 9% vs. -6% for dairy milk
- Plant based meats grew 24% vs. 2% for animal meats

This does not include sales of foods that are enhanced with plant based protein ingredients such as cereals, snacks, baked goods and pet foods.

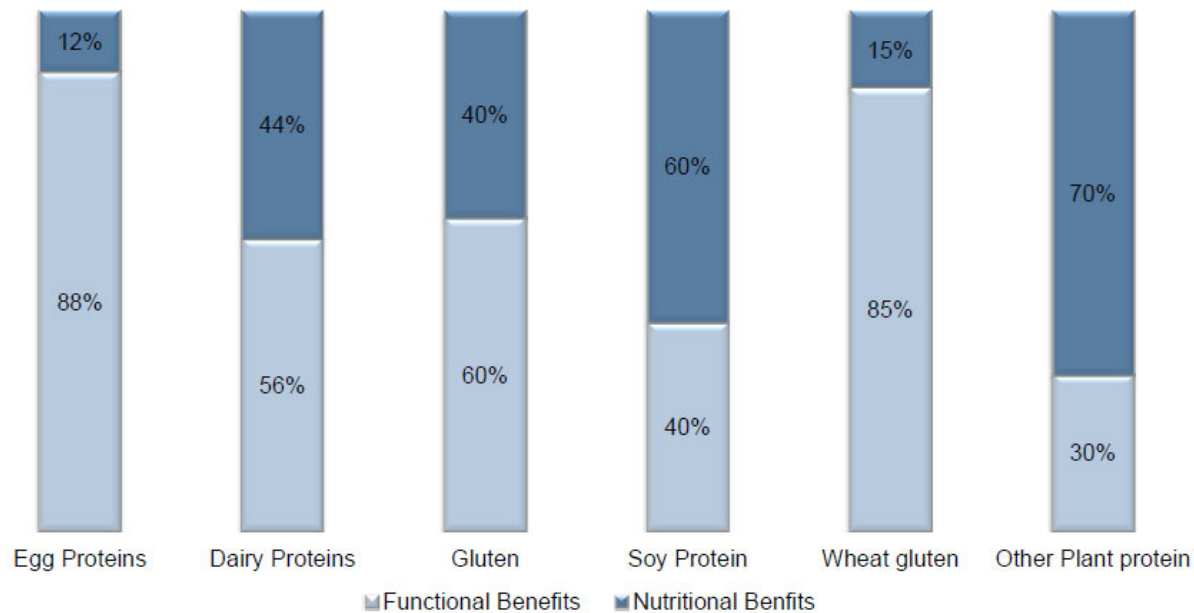


Formulation Considerations

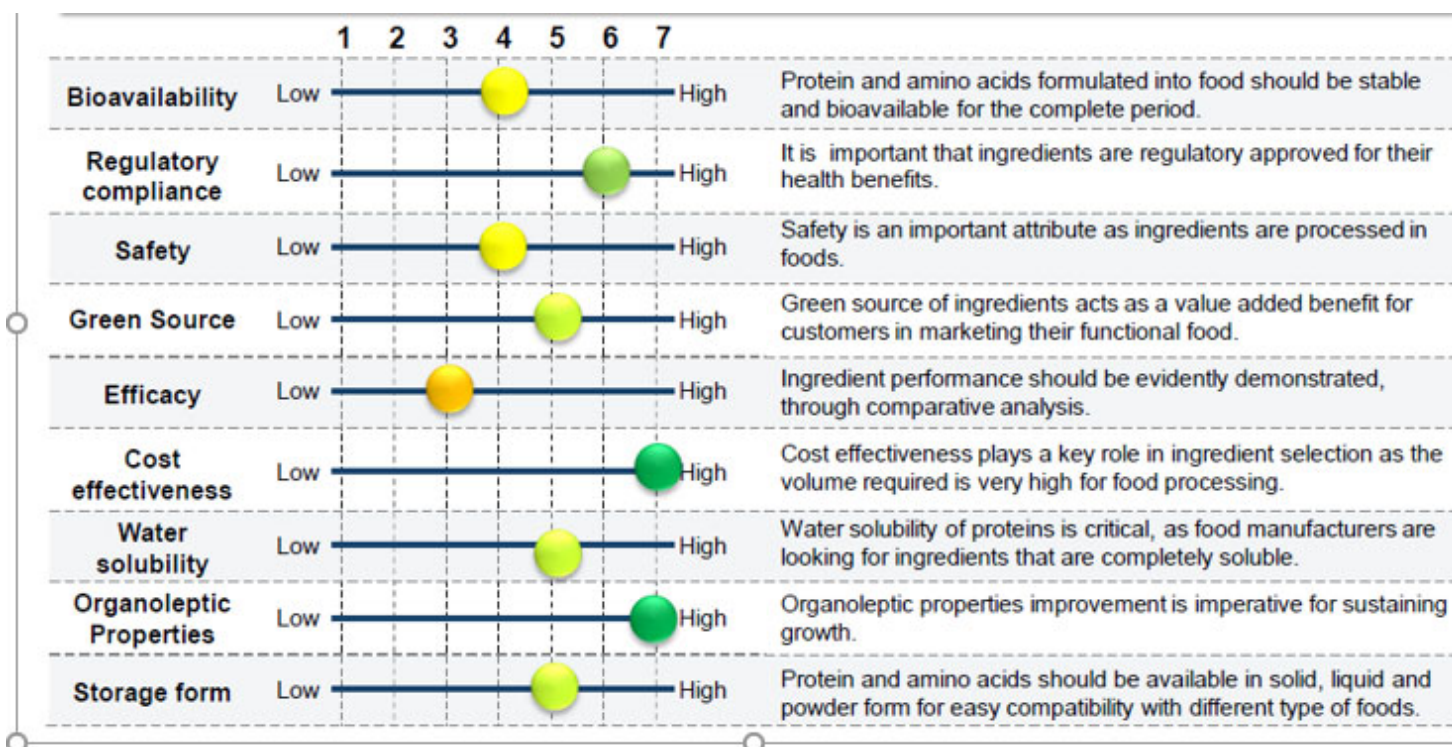
Proteins for Nutrition & Functionality

At the total level, functional demand of proteins hold the largest share with 59.8 percent. The functional properties are often enhanced by associated nutritional benefits.

Proteins and Amino Acids Usage Analysis, US, 2013



Key Selection Criteria

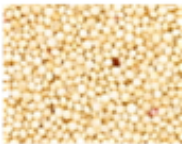


BSM Research also found important:

- Allergen Free
- Protein Quantity
- Protein Quality

Visual & Allergen Properties

Amaranth



Buckwheat



Caraway



Chia



Oats



Flaxseed - Brown & Gold



Garbanzo



Millet



Poppy



Pumpkin



Quinoa Real & Red



Rice - MG/O/C



Rice - LG/O



Sesame - Natural, Hulled & Black



Sorghum



Sunflower



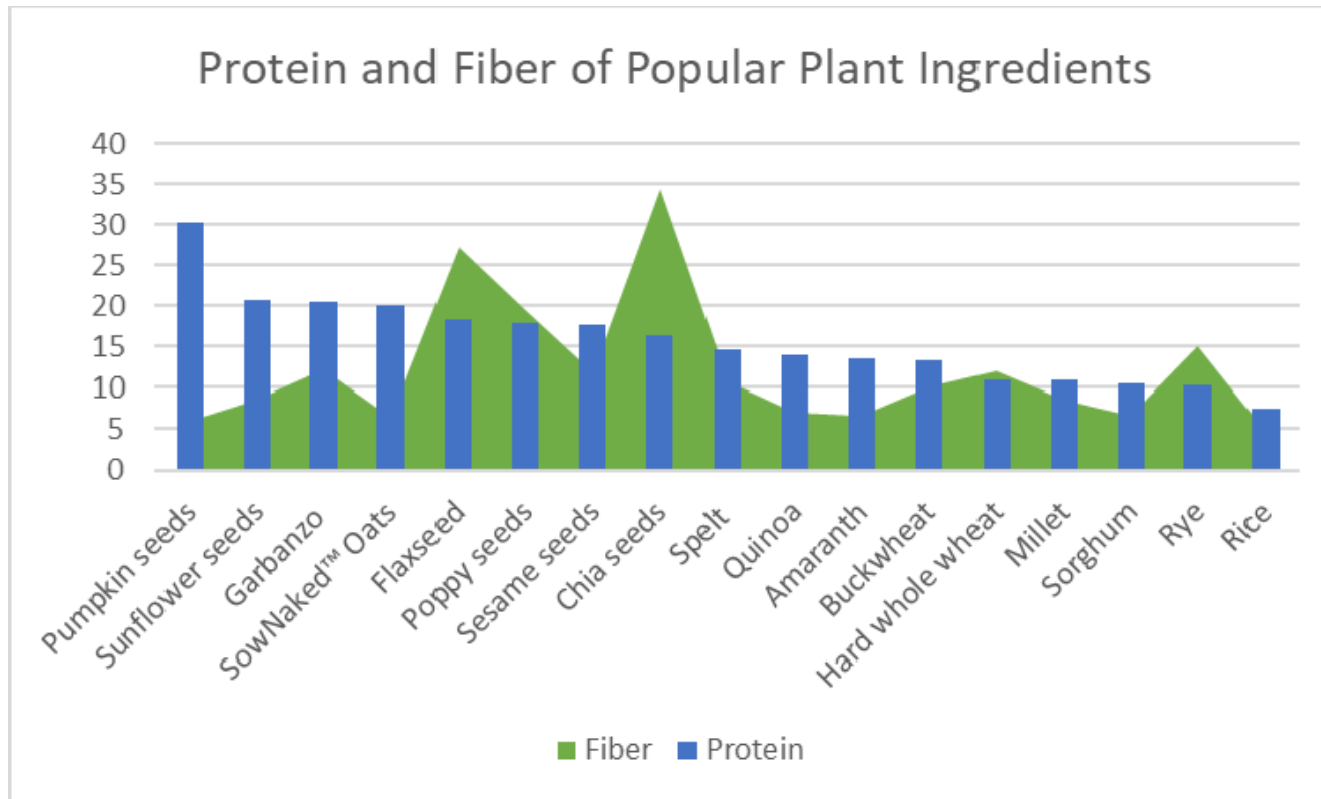
Teff



Free From:

- ✓ **Gluten**
- ✓ **Soy**
- ✓ **Dairy**
- ✓ **Nuts**

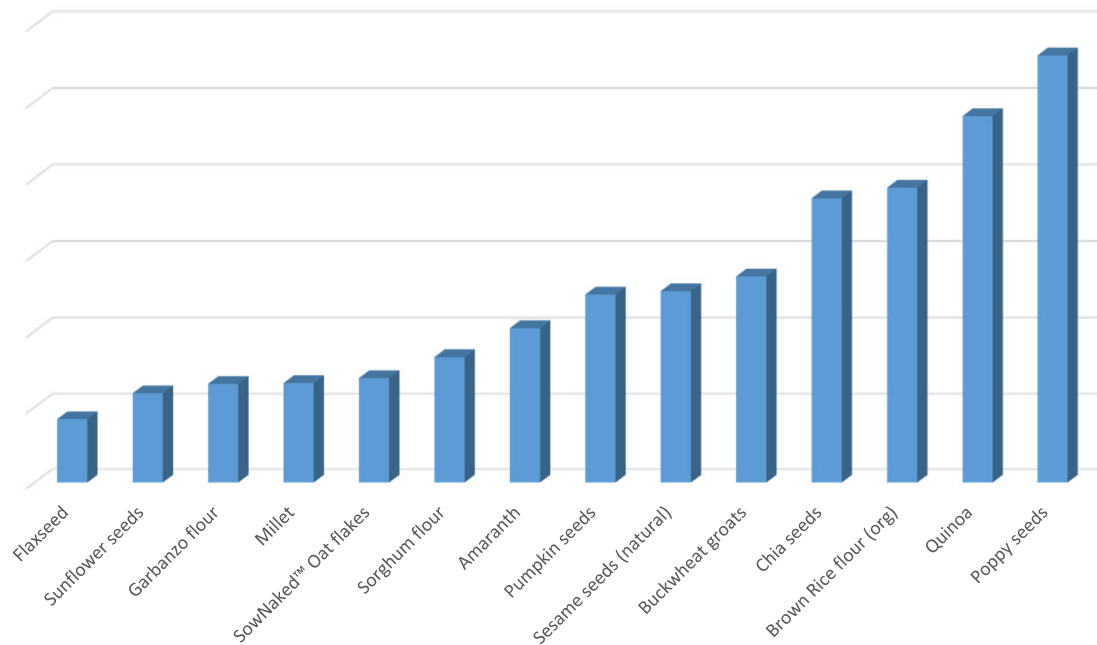
Protein Quantity



- ❑ Seeds are rich sources of protein and fiber
- ❑ SowNaked™ Oats have 30% more protein than traditional oats
- ❑ Quinoa is popular for protein but not highest

Cost Effectiveness

Relative Cost per Gram of Protein Delivered



- ❑ Best to assess cost effectiveness based on relative cost of protein delivered
- ❑ Raw material costs fluctuate based on market factors such as weather, demand and transportation costs

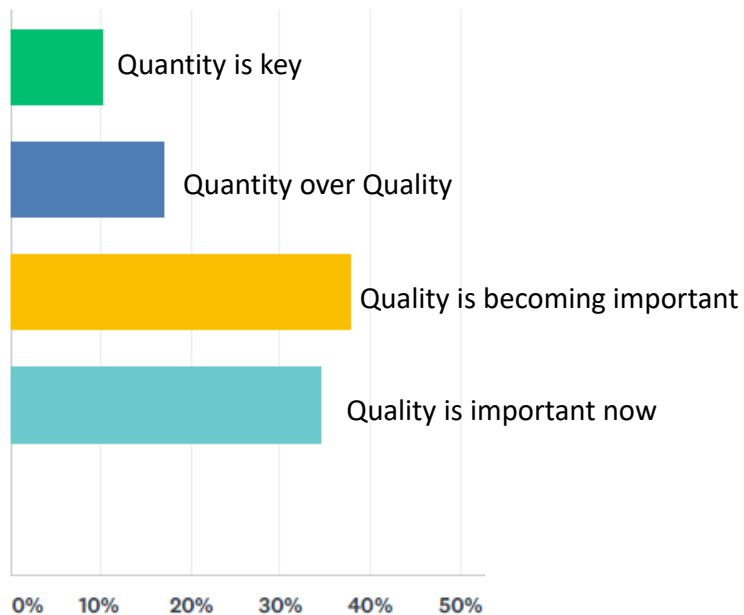
Protein Quality

- The FDA has set the daily value for protein intake at 50 grams of *high quality protein* per day for the average American consumer.
- High quality protein sources are highly digestible and contain all of the essential amino acids our body requires for growth and maintenance.
- Protein Quality is measured using the Protein Digestibility Corrected Amino acid Score (PDCAAS):
 - The closer the score is to 1.00, the higher the protein quality.
 - PDCAAS reference scores for egg and whey = 1.00
 - This test is a requirement for determining protein quality on nutrition facts panel!

$$PDCAAS = \frac{\text{mg of limiting amino acid in 1 gram of test protein}}{\text{mg of the same amino acid in 1 gram of reference protein}} * \text{Faecal digestibility}$$

Quality is an Emerging Differentiator

Importance for claims



But, usage remains limited for plant based proteins due to limited availability of PDCAAS data.

Quality for Claims

Protein content on Nutrition Facts Panel

Nutrition Facts	
17 servings per container	
Serving size 3/4 cup (28g)	
Amount per serving	
Calories	140
% Daily Value*	
Total Fat 1.5g	2%
Saturated Fat 0g	0%
Trans Fat 0g	
Polyunsaturated Fat 0.5g	
Monounsaturated Fat 0.5g	
Cholesterol 0mg	0%
Sodium 160mg	7%
Fluoride 0mg	
Total Carbohydrate 22g	8%
Dietary Fiber 2g	7%
Soluble Fiber <1g	
Insoluble Fiber 1g	
Total Sugars 9g	
Includes 8g Added Sugars	16%
Protein 9g	

Grams Protein
(measured @ lab)



Protein quality claim on front of package

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Total Sugars 9g	
Includes 8g Added Sugars	16%
Protein 9g	10%

Vs.

Good Source
of Protein=
10% of DV

% DV = (Grams Protein * PDCAAS Score)/50



Formulating for Quality

Whole food, plant based protein sources are not created equally:

- PDCAAS may be used to guide formulation of plant protein foods but if not available, start with amino acid data.
- Complexing different plants together allow for enhanced protein quality and optimal nutrition for the consumer.
 - Grains and seeds are high in sulfur containing amino acids and low in lysine.
 - Some grains and legumes are high in lysine, but low in sulfur containing amino acids.

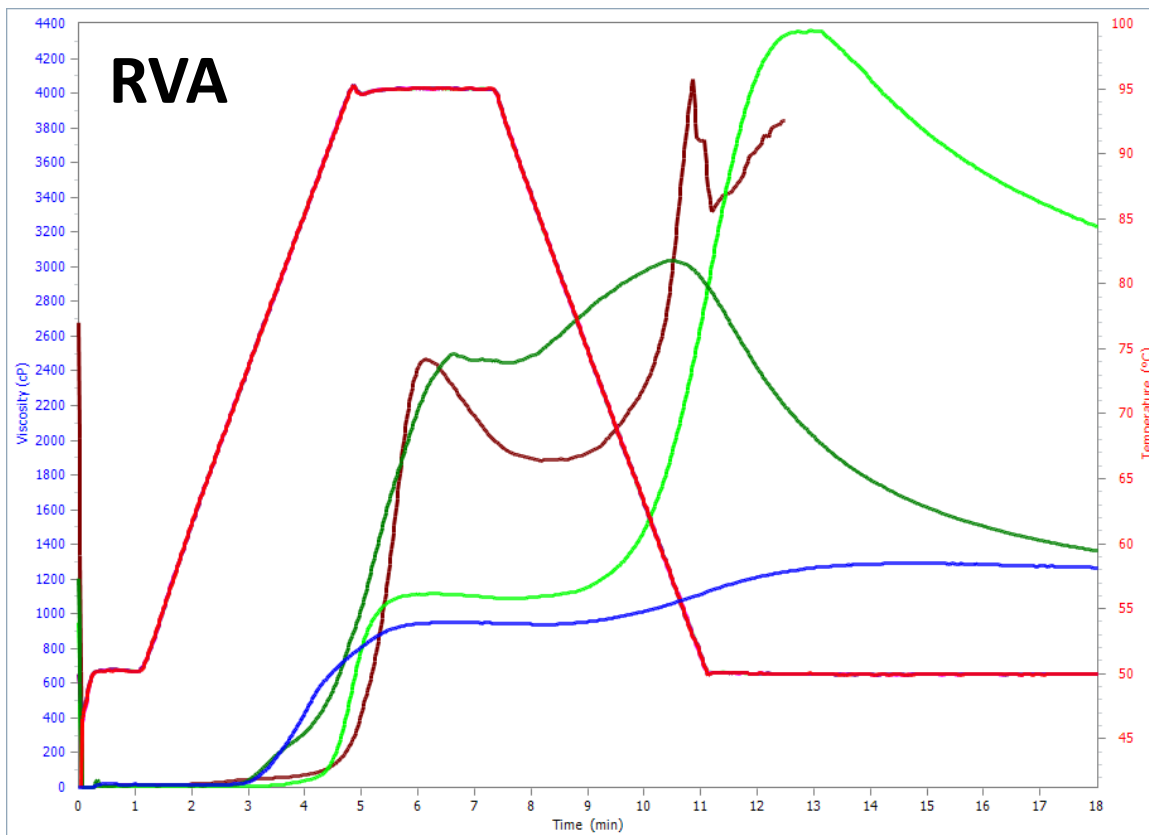
Formulating for Quality: Bar

<u>Ingredient</u>		<u>True %</u>
Crushed Wheat	★	8.96%
Whey Protein Concentrate		1.79%
Rolled Oats	★	8.96%
Rye Meal Fine	★	4.48%
Whole Brown Flax	★	2.99%
Brown Flaxseed, Ground	★	2.99%
Sunflower Seeds	★	4.48%
Pumpkin Seeds	★	8.96%
Quinoa flakes	★	2.99%
Garbanzo flour	★	4.18%
Sesame Seeds Toasted	★	2.99%
Ancient Grain Crisps		5.97%
Binder (corn syrup, oil, glycerine, sugar, salt)		40.27%
Total		100.00%

Protein Content = ~20.00%



Formulating for Functionality



- Rapid Visco Analyzer may be used to predict functionality & applicability
- Performance may be altered by combining sources with different starch pasting properties
- Tests such as absorption, pH and AACC standard bake tests are helpful

— Garbanzo Flour
— Quinoa Flour
— Sorghum Flour
— SowNaked™ Oat Flour

Textural Properties-Extrusion Example

Textural Attributes of Extruded Pulse Flours

- Chickpea 50% (50% rice)
- Décor Red lentil 85%
- Split yellow pea 85%
- Corn 100% (control)
- Décor Yellow lentil 85%
- MG Brown Rice 100%

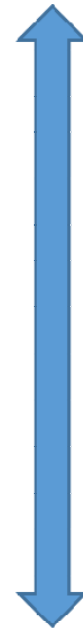


Textural Attributes of Extruded Grain Flours

- Millet 100%
- White sorghum 100%
- SowNaked oat 50% (50% rice)
- MG Brown Rice 100%
- Quinoa 100%
- Cassava 100%
- Corn 100% (control)



Highest Expansion



Medium Grain rice

Corn
Decorticated Lentils/Yellow Peas

Sorghum

Quinoa
Millet

Garbanzo (50%)
SowNaked Oats (50%)

Lowest Expansion





Sourcing Plants for Protein

Approach to Sourcing



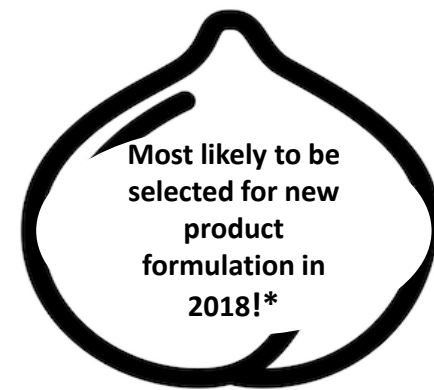
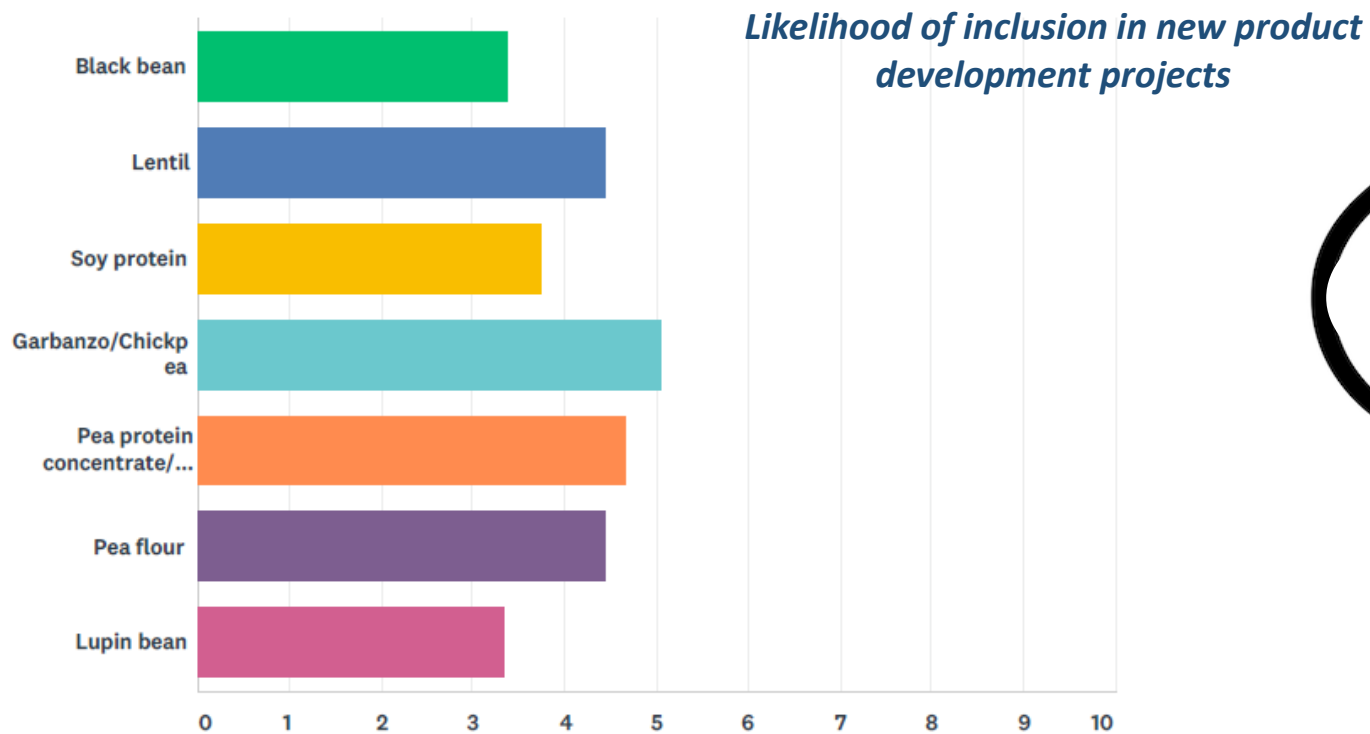
Quality. Honesty. Trust

Bay State Milling's objective is to develop lasting partnerships with our ingredient suppliers. We share in their challenges and benefit from their success. We are actively engaged in providing resources and support to enable them to improve operational processes, enhance product quality systems and develop new supply chains. Our supply chain partners are an extension of our business and their practices must align with our values.

Partner Sourced Ingredients Program



Preference For Sources



*BSM customer survey

Popular Sources



Quinoa

- ✓ Whole or flour
- ✓ 14% Pro
- ✓ \$\$\$/g protein
- ✓ Gluten free



SowNaked™ Oats

- ✓ IP Variety
- ✓ 20% Pro
- ✓ \$/g protein
- ✓ Gluten free <5



Chickpea Flour

- ✓ Pulse flour
- ✓ 20% Pro
- ✓ \$/g Pro
- ✓ .77 PDCAAS
- ✓ Gluten free



Pumpkin Seed

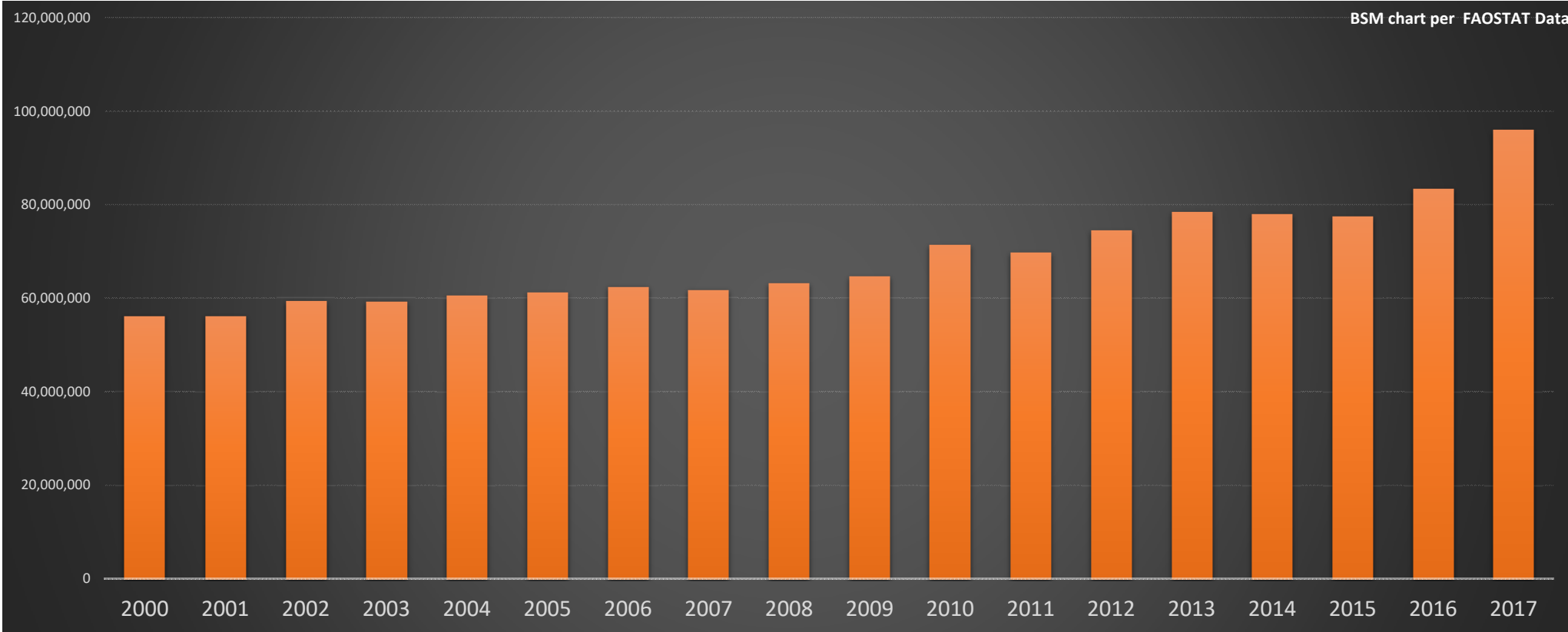
- ✓ Whole seed
- ✓ 30% Pro
- ✓ \$\$/g Pro

SowNaked™ Oat Supply Chain

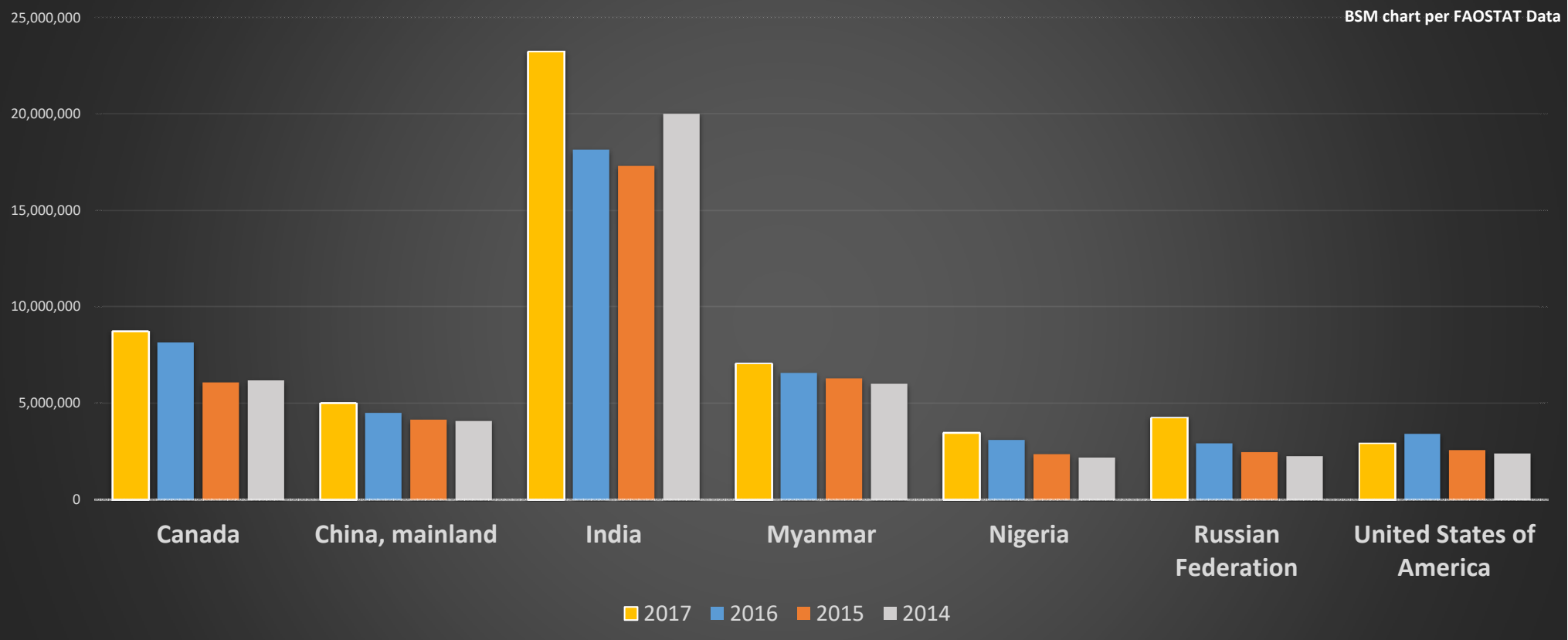
- Grown from variety specific hull-less oats higher in protein (**20% dmb**) than standard oats (15% dmb).
- Supply chain managed under **Purity Protocol** gluten free system to <5ppm gluten.
- **Identity Preserved** to the individual farm and grower, conventional and organic.



Historical Global Pulse Production



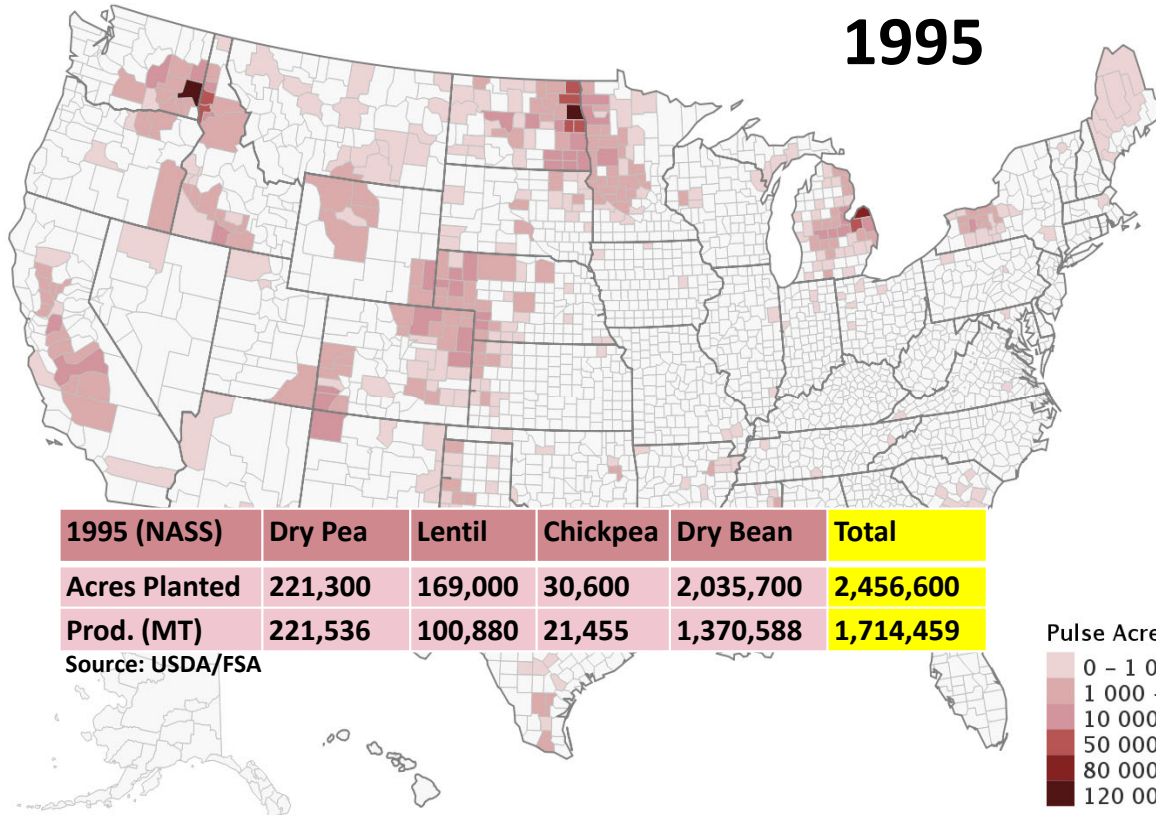
Pulse Production by Country



USA Pulse Growing Regions by County



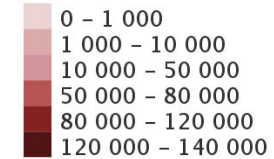
1995



1995 (NASS)	Dry Pea	Lentil	Chickpea	Dry Bean	Total
Acres Planted	221,300	169,000	30,600	2,035,700	2,456,600
Prod. (MT)	221,536	100,880	21,455	1,370,588	1,714,459

Source: USDA/FSA

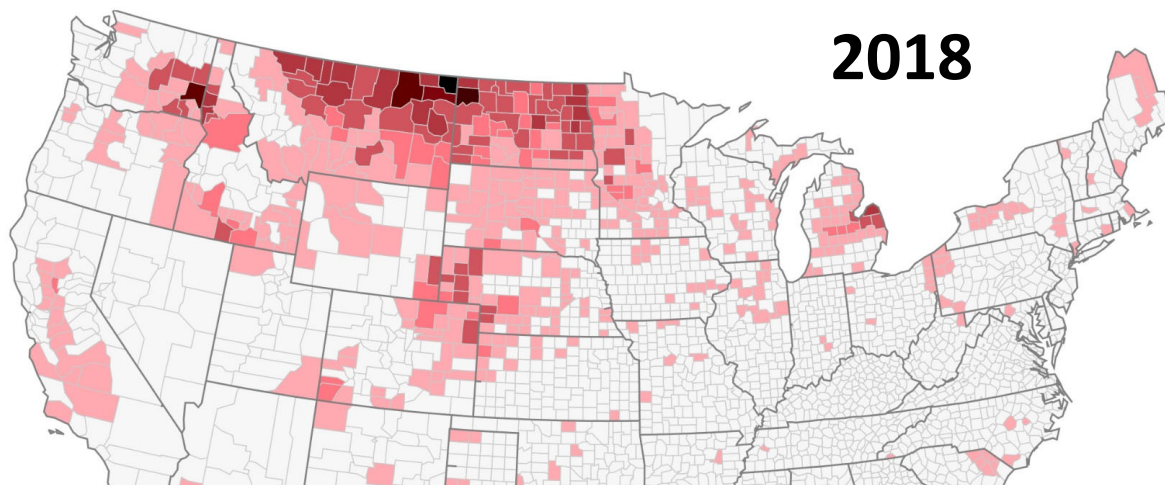
Pulse Acreage



USA Pulse Growing Regions by County

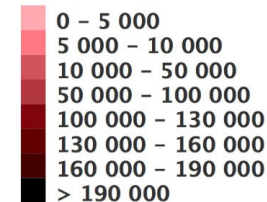


2018



2017 (NASS)	Dry Pea	Lentil	Chickpea	Dry Bean	Total
Acres (Planted)	1,154,500	1,104,000	618,800	1,473,200	4,350,500
Prod.(MT)	648,734	339,381	313,209	1,312,709	2,614,033
2018 (NASS)	Dry Pea	Lentil	Chickpea	Dry Bean	Total
Acres (Harvested)	824,500	758,000	651,300	1,366,000	3,599,800
Prod.(MT)	629,314	398,572	425,870	1,290,904	2,744,660

Pulse Acreage

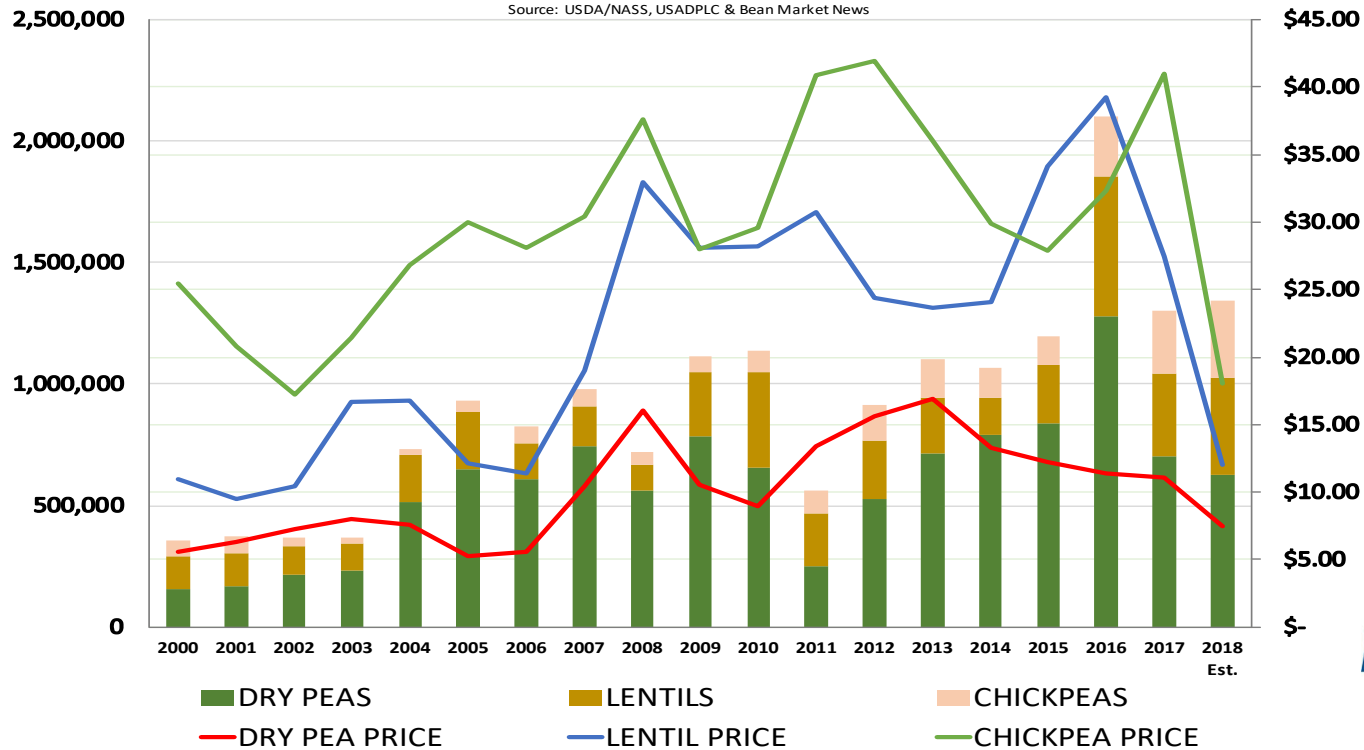


USA Pulse Production and Average Price



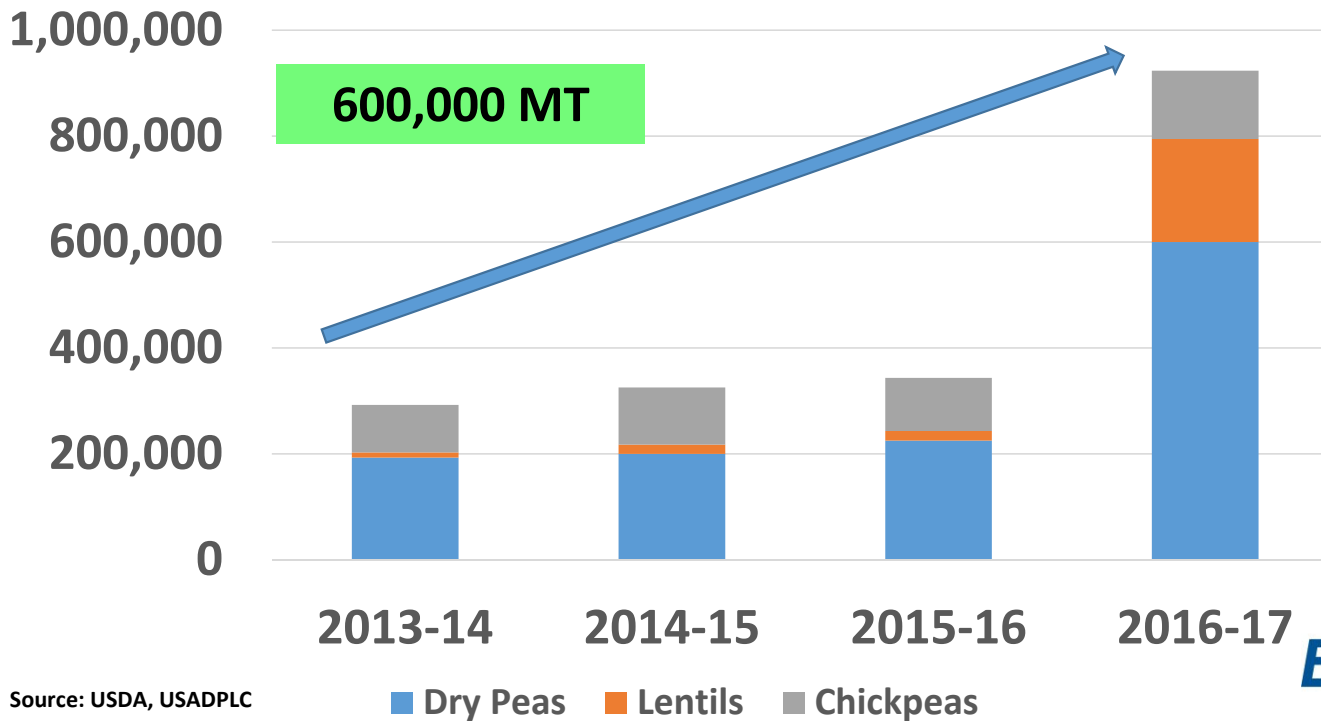
USA Pulse Production (MT) / Annual Average Price

Source: USDA/NASS, USADPLC & Bean Market News



USA Domestic Pulse Consumption

Estimated (Metric Tons)
Crop Year (June/May)

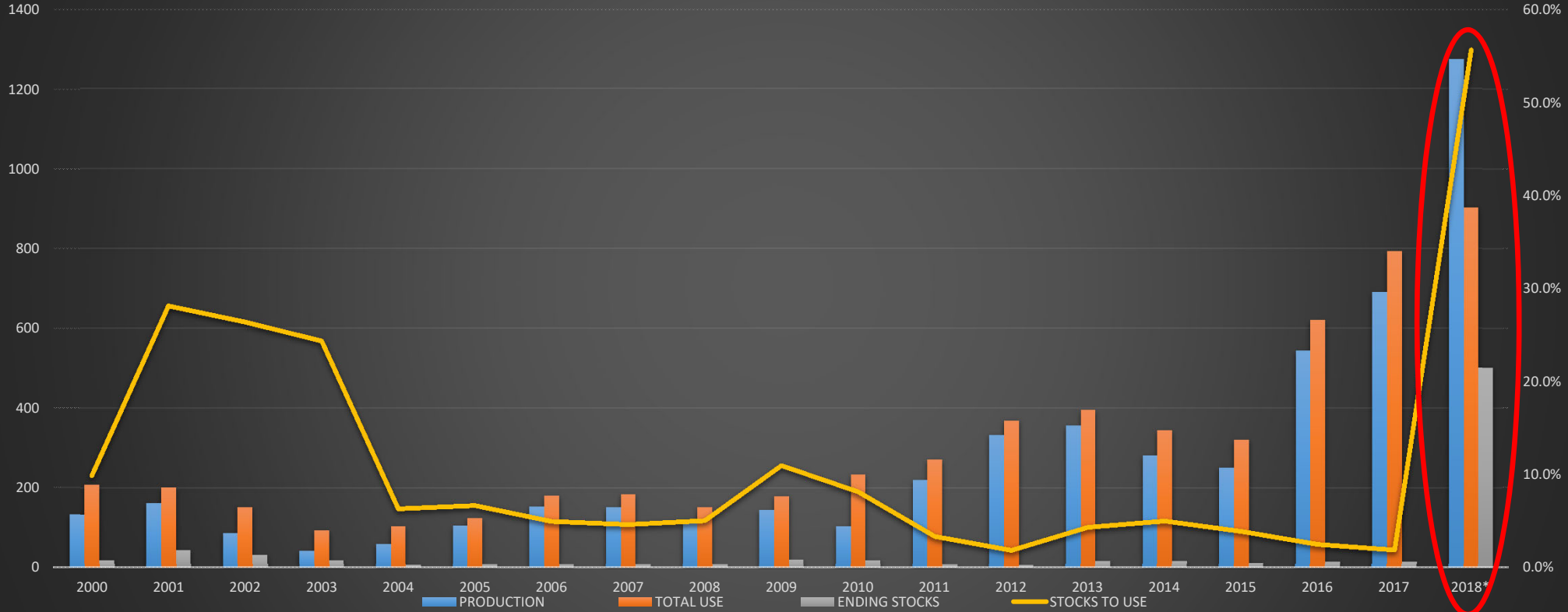


Source: USDA, USADPLC



Chickpeas – U.S. Production, Use, Stocks

BSM chart per ERS/USDA Data

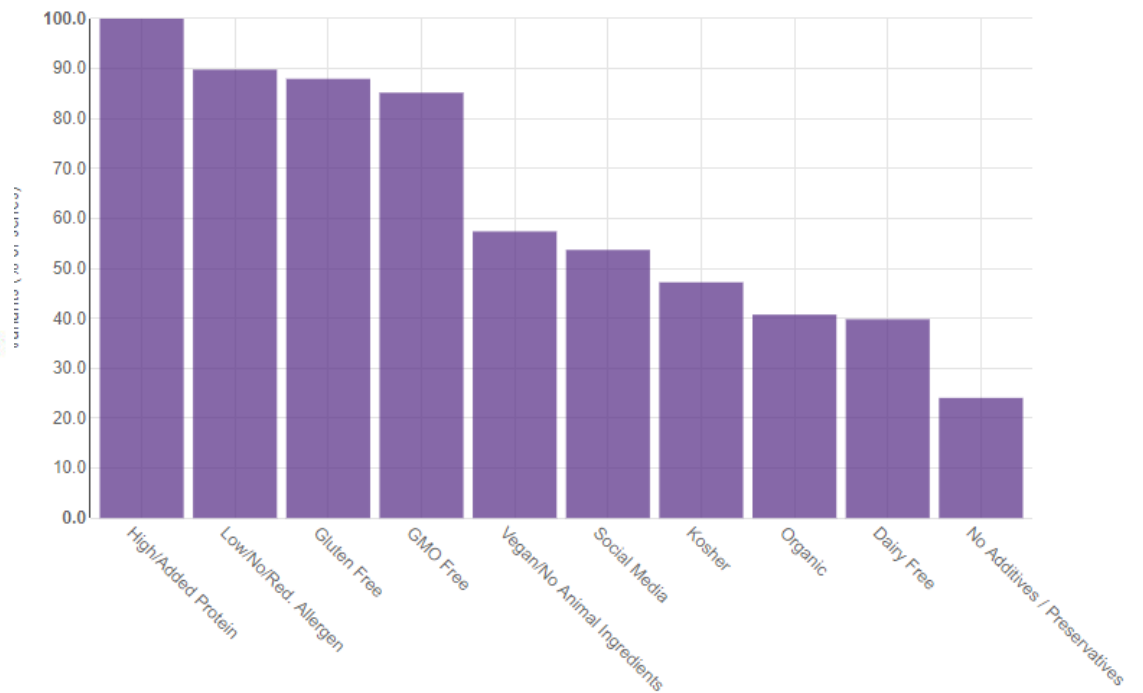
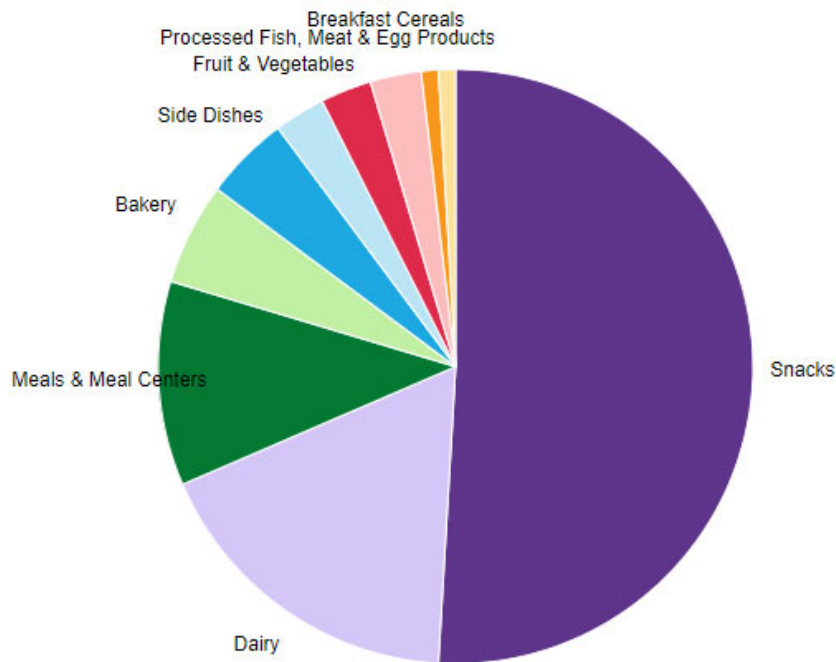




Applications and Launches

Plant Protein Applications

New product launches in 2018 using "plant" in description and making a protein claim



Oat Milk Disruption!



Multiple brands have moved into the US oatmilk category over the past couple of years

Main consumer driver plant-based milks is protein!



Snacks & Bars



Allergen Free



Front of Pack
PB Protein



PALEO

Meals & Sides



Chickpea Source
Protein/Fiber Claim



Ancient Grains
Protein/Fiber Claim



Quinoa, Lentil Source
Protein/Fiber Claim



Breakfast Protein



GF Oats, Chia, Quinoa
B Corp



Sorghum & Bean Flour
Low Sugar



Oats, Nut Butters
Organic

Sweet Snacks



Oats, Nuts
Vegan



Seeds
Free from Big 8 Allergens



Oats, Seeds
Metabolism Support

Bay State Milling
A Trusted Family of Ingredients.

Salty Snacks



Black Beans Source
Non-GMO



Lentil Source
Vegan



Pulse Blend Source
Nothing Artificial

Summary

- Protein is the nutrient for life (not fad)
- Plant-based foods are the growing delivery vehicle
- Variety provides taste, functionality and nutrition
- Whole food sources deliver quantity and quality
- Growth is happening across supply chains
- Sourcing partnerships are key to successful products

Thank a Farmer!

