



# North Dakota Pulses: “Your Healthier Choice”

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## 2013 China ‘Better for You Foods’ Conference and Exhibition



# North Dakota's Top Agricultural Commodities

2011 rank in the US	Commodity	Percent of Nation's production
1	Beans, dry edible, all	25
1	Beans, navy	35
1	Beans, pinto	46
1	Canola	83
1	Flaxseed	87
1	Honey	22
1	Sunflower, oil	40
1	Wheat, Durum	36
1	Wheat, spring	37
2	Sunflower, all	38
2	Sunflower, non-oil	24

# PULSE - DEFINITION

The term “**legume**” originates from the Latin *legere, to gather*. Similarly, the term “pulse” is derived from the Latin *puls*, meaning *thick soup or potage*.

“Pulses” are defined by the Food and Agricultural Organization of the United Nations (FAO) as annual leguminous crops yielding from one to twelve grains or seeds of variable size, shape and color within a pod. FAO recognizes 11 primary pulses. Dry beans (*Phaseolus spp. including several species now in Vigna*); lentils (*Lens culinaris*), dry peas (*Pisum spp.*); chickpea (*Cicer arietinum*) also known as garbanzo and Bengal gram, are pulses of great economical importance worldwide.

# LEGUMES

Includes:

Alfalfa

Peanuts

Soy

Mesquite

Pulses

## PULSES

Includes:

**Peas**

Lentils

Chickpeas

Dry edible beans

## BEANS

Includes:

Kidney bean

navy bean

pinto bean

black bean

# PULSES



Dry Peas



Lentil



Chickpea



Lupin



Pinto bean



Red bean



Pink bean



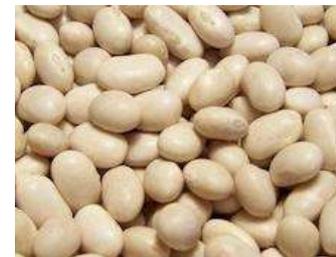
black bean



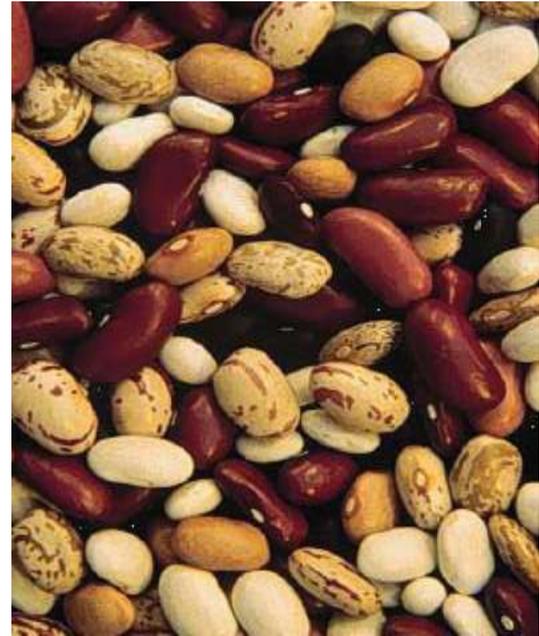
Navy bean



Cranberry bean

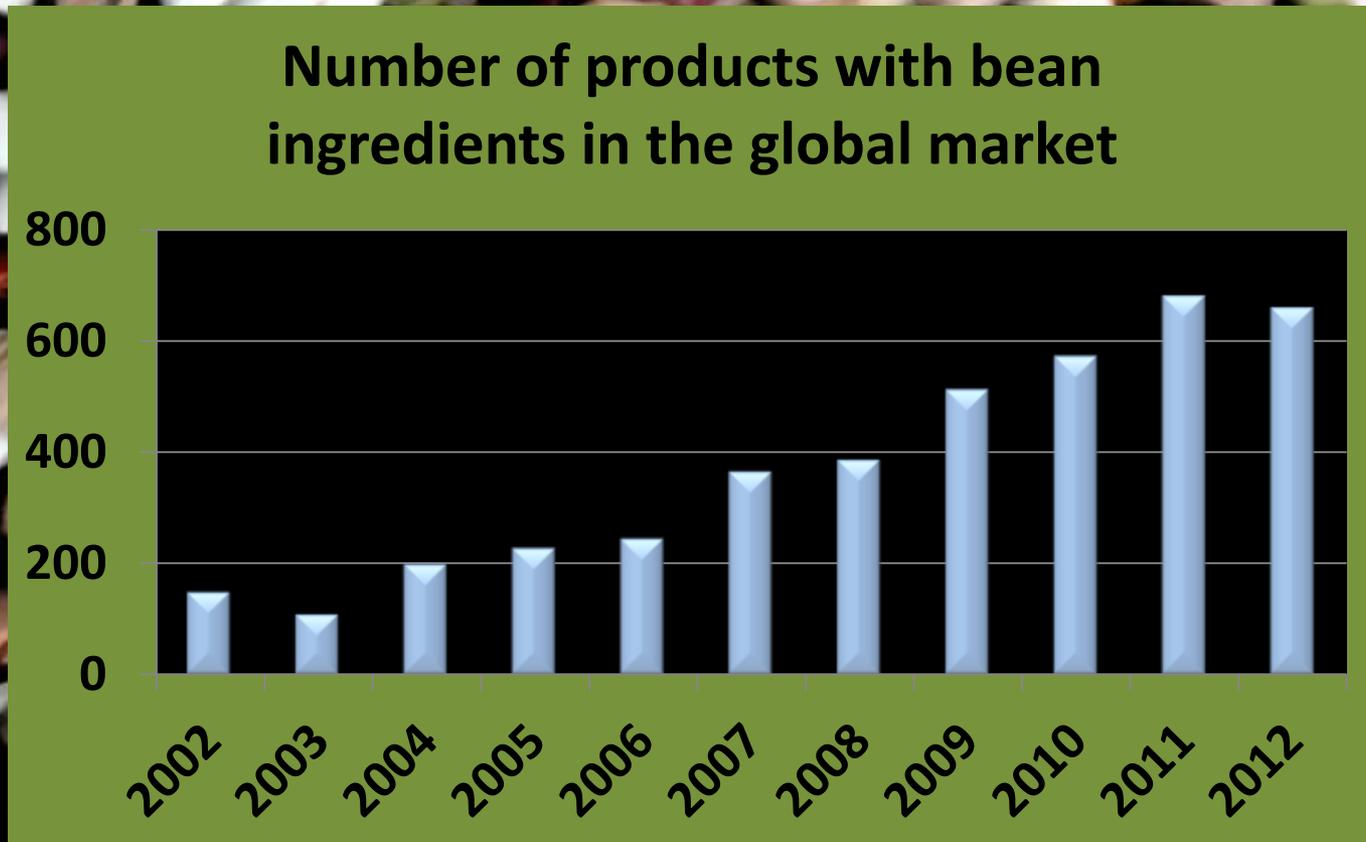


Great northern



# NORTH DAKOTA BEANS

# Market trends



# Dry Bean Classes

- Pinto--42 percent
- Navy (pea)--17 percent
- Black--11 percent
- Great Northern--5 percent
- Garbanzo (large chickpeas)--5 percent

# The top dry-bean producing States in 2006-08 were the following

- North Dakota--38 percent
- Michigan--14 percent
- Nebraska--11 percent
- Minnesota--10 percent
- Idaho--7 percent
- California--4 percent
- Washington--4 percent
- Colorado--3 percent

# ND Dry Bean

- According to the 2007 Census of Agriculture, 1,682 farms produced dry edible beans in ND on 664,389 acres, with most of these acres in pinto beans (70 %) and navy beans (17 %).

# ND Dry Bean

- ND is the leading producer of both pinto beans (62 % of the U.S. crop) and navy beans (42 % of the national total).
- The majority of the crop is produced in the fertile Red River Valley, with Pembina, Walsh, and Grand Forks Counties the top producers.
- About 2 % of the State's dry bean crop is produced under irrigation.

# North Dakota Dry Edible Bean Planted Acreage, 2000 to 2011

Year	Acreage
2000	610,000
2001	440,000
2002	790,000
2003	540,000
2004	560,000
2005	620,000
2006	670,000
2007	690,000
2008	660,000
2009	610,000
2010	800,000
2011	414,000

Source: ND Agriculture  
Statistical Service,  
USDA

# North Dakota Dry edible Bean Production by Commercial Class

Year	Pinto (Cwt)	Navy (Cwt)
2000	5,294,000	1,620,000
2001	4,050,000	1,327,000
2002	7,184,000	2,340,000
2003	5,864,000	1,164,000
2004	3,573,000	650,000
2005	6,584,000	1,343,000
2006	4,988,000	1,585,000
2007	7,606,000	1,611,000
2008	6,660,000	2,087,000
2009	5,950,000	1,255,000
2010	7,543,000	1,958,000
2011	2,683,000	1,142,000

Source: ND Agriculture  
Statistical Service,  
USDA

<b>Market Class</b>	<b><u>Acres Planted</u></b>	
	<b>2010</b>	<b>2011</b>
	----- (1,000s) -----	
<b>North Dakota</b>		
Navy	132.0	94.0
Great Northern	5.6	1.8
Pinto	530.0	225.0
Dark Red Kidney	0.9	1.5
Pink	12.5	10.0
Small Red	1.2	2.5
Black	101.0	69.0
Chickpeas, All (Garbanzo)	16.0	4.7
- Small	2.0	3.0
- Large	14.0	1.7
Other	0.8	1.5
<b>Total</b>	<b>816</b>	<b>414.7</b>

# Reasons for using bean ingredients

According to the market database search, the most popular bean product claims are:

Rank	Claims
#1	Vegetarian
#2	Low/no allergen
#3	Gluten-free
#4	Organic
#5	All Natural products

# Why Dry Beans?



- ✓ High protein
- ✓ High dietary fiber
- ✓ Gluten free
- ✓ Non GMO
- ✓ Low allergen
- ✓ Lower glycemic index scores compared to cereals
- ✓ High in vitamins, minerals and antioxidants

# What is the nutritional profile of cooked beans?

- Beans are an excellent source of vegetable protein and minerals such as iron, magnesium and zinc.
- They are rich in folic acid, an element associated with the reduction of such birth defects as Spina Bifida and also protect against heart disease.
- Beans are also a good source of non-lactic calcium.
- They are rich in soluble dietary fiber which helps to bring down cholesterol levels and also contain estrogens of vegetable origin which contribute towards reducing certain cancers caused by hormonal action.

## Nutritional values of cooked beans

PER 100 GRAMS	UNIT	MINIMUM	MAXIMUM
Water	g	60.00	70.00
Calories	Kgal	115.00	164.00
Proteins	g	7.70	9.34
Fats	g	0.38	2.59
Carbohydrates	g	20.77	27.41
Dietary Fibre	g	5.30	10.00
Ashi	g	0.92	1.35
Calcium	mg	17.00	70.00
Iron	mg	2.09	2.89
Magnesium	mg	43.00	70.00
Phosphorous	mg	111.00	168.00
Potassium	mg	291.00	508.00
Sodium	mg	1.00	7.00
Zinc	mg	0.88	1.53
Copper	mg	0.21	0.35
Manganese	mg	0.37	1.03
Selenium	µg	1.20	3.70
Vitamin C	mg	0.00	1.30
Thiamine	mg	0.12	0.26
Riboflavin	mg	0.06	0.09
Niacin	mg	0.40	0.68
Pantothenic Acid	mg	0.22	0.47
Vitamin B-6	mg	0.07	0.18
Folic Acid	µg	83.10	207.00
Vitamin A	UI	1.00	27.00
Vitamin E	mg-aTE	0.18	0.94

(\*) Values for:  
Mature beans boiled without salt.

(\*\*) Units:  
g gram  
mg milligram  
µg microgram  
IU International Unit  
aTE a-Tocopherol equivalent

### Types of beans analysed:

**Bean Baby Lima**

**Bean Black**

**Bean Blackeye**

**Bean Cranberry**

**Bean Dark Red Kidney**

**Chickpea**

**Bean Great Northern**

**Bean Light Red Kidney**

**Bean Navy**

**Bean Pink**

**Bean Pinto**

**Small Red Beans**

NUTRIENTS (per 100 grams)	Average REA Range (for Persons 1-51+year)	 Small red Beans
Calories (Kcal)	1900	18,42%
Proteins (g)	39,5	55,70%
Vitamin A (mcg RE)	2331	0,00%
Vitamin C (mg)	50	0,00%
Thiamine (mg)	1,1	63,64%
Riboflavin (mg)	1,3	15,38%
Niacin (mg NE)	14,5	15,17%
Vitamin B6 (mg)	1,5	20,00%
Folate (mcg)	125	0,24%
Iron (mg)	12,5	56,00%
Zinc (mg)	13,5	22,22%
Selenium (mcg)	57,5	0,00%
Calcium (mg)	1050	14,29%
Phosphorous (mg)	975	46,15%
Magnesium (mg)	250	80,00%

NUTRIENTS (per 100 grams)	 Pinto Beans	 Navy Beans
Calories (Kcal)	17,89%	17,63%
Proteins (g)	52,91%	56,46%
Vitamin A (mcg RE)	0,21%	0,17%
Vitamin C (mg)	14,60%	6,00%
Thiamine (mg)	54,55%	58,64%
Riboflavin (mg)	15,38%	17,85%
Niacin (mg NE)	9,66%	14,23%
Vitamin B6 (mg)	26,67%	29,13%
Folate (mcg)	405,04%	295,76%
Iron (mg)	47,20%	51,52%
Zinc (mg)	18,96%	18,81%
Selenium (mcg)	32,17%	19,13%
Calcium (mg)	11,52%	14,76%

NUTRIENTS (per 100 grams)	 <b>Black Beans</b>	 <b>All Kidney Beans</b>
Calories (Kcal)	17,95%	17,53%
Proteins (g)	54,68%	59,75%
Vitamin A (mcg RE)	0,73%	0,34%
Vitamin C (mg)	0,00%	9,00%
Thiamine (mg)	72,73%	45,45%
Riboflavin (mg)	14,85%	15,38%
Niacin (mg NE)	13,48%	14,48%
Vitamin B6 (mg)	19,07%	26,67%
Folate (mcg)	355,44%	315,28%
Iron (mg)	40,16%	65,60%
Zinc (mg)	26,67%	20,74%
Selenium (mcg)	5,57%	5,57%
Calcium (mg)	11,71%	13,62%
Phosphorous (mg)	36,10%	41,74%
Magnesium (mg)	68,40%	56,00%

**NUTRIENTS** (per 100 grams)



**Great Northern Beans**



**Cranberry Beans**

Calories (Kcal)	17,84%	18,05%
Proteins (g)	55,44%	53,16%
Vitamin A (mcg RE)	0,13%	0,00%
Vitamin C (mg)	10,60%	0,00%
Thiamine (mg)	63,64%	72,73%
Riboflavin (mg)	15,38%	15,38%
Niacin (mg NE)	13,79%	13,10%
Vitamin B6 (mg)	26,67%	33,33%
Folate (mcg)	385,60%	370,56%
Iron (mg)	44,00%	54,40%
Zinc (mg)	17,04%	19,26%
Selenium (mcg)	22,43%	22,61%
Calcium (mg)	16,67%	12,38%
Phosphorous (mg)	45,85%	42,56%
Magnesium (mg)	75,60%	72,80%

NUTRIENTS (per 100 grams)



Blackeye Beans

Calories (Kcal)	17,68%
Proteins (g)	59,49%
Vitamin A (mcg RE)	2,15%
Vitamin C (mg)	3,00%
Thiamine (mg)	91,82%
Riboflavin (mg)	15,38%
Niacin (mg NE)	14,48%
Vitamin B6 (mg)	26,67%
Folate (mcg)	506,08%
Iron (mg)	66,40%
Zinc (mg)	25,19%
Selenium (mcg)	15,65%
Calcium (mg)	10,48%
Phosphorous (mg)	43,49%
Magnesium (mg)	73,60%

# What is the yield and average serving size of dry beans?

- A portion of uncooked beans typically doubles after cooking (e.g. 2 cups uncooked equals between 4-5 cups of cooked beans).
- Average serving size is estimated to be 1/4 cup of uncooked beans (56.70 grams) per person (approx. 1/2 cup or 113.40 grams of cooked beans).
- Based on this serving size, one 110 lb. bag (50kg) of uncooked beans will yield approximately 880 servings.

# What benefits do dry beans offer to restaurants and food service operations?

- These days restaurateurs must be prepared to respond to their clients' growing concern about health and diet.
- In terms of both their nutritional qualities and their culinary potential, legumes are one of the healthiest and wisest choices as dietary constituents.

# Can I boost my antioxidant intake by eating dry beans?

- Although researchers haven't come up with a foolproof way to avoid the indelicate side effect of beans, they have found yet another reason why you should eat more of them.
- In addition to their high fiber and protein content, a new study finds that beans, particularly black ones, are a rich but overlooked source of antioxidants and may provide health benefits similar to some common fruits, including grapes, apples and cranberries.

## Beans are a rich but overlooked source of antioxidants by Mark T. Sampson

- The researchers tested the antioxidant activity of flavonoids - plant pigments - found in the skin of 12 common varieties of dry beans. Antioxidants destroy free radicals, which are highly active chemicals whose excess has been linked to heart disease, cancer and aging.

# How can I reduce the flatulence- and gas-causing properties of dry beans?

- If high-fiber foods such as dry beans are not a regular part of your diet, the natural oligosaccharides (complex carbs.) in beans may cause temporary digestive discomfort. Research shows that adding beans to your diet on a regular basis — at least once or twice a week — reduces flatulence.
- The best way to reduce beans' naturally occurring oligosaccharides, tannins, phytic acid, and trypsin inhibitors is to use the quick hot-soak method to soften dry beans, then drain the soaking water and start with fresh water for cooking.

# How many beans should I eat in order to maintain a healthy lifestyle?

- The U.S. Government's Dietary Guidelines 2005 urge adults to consume three (3) cups of cooked dry beans a week, while most Americans don't even eat one (1) cup in a week.

# I know that beans are a good source of fiber, but is it soluble or insoluble fiber?

- Neither soluble nor insoluble fiber is digested or absorbed into the bloodstream.
- The difference between the two is that soluble fiber forms a gel when mixed with liquid, while insoluble fiber does not.
- Soluble fiber binds with fatty acids, prolonging stomach emptying time so that sugar is released and absorbed more slowly.
- Its benefits include lowering total cholesterol and LDL cholesterol (the bad cholesterol), therefore reducing the risk of heart disease, and regulating blood sugar for people with diabetes.

# I know that beans are a good source of fiber, but is it soluble or insoluble fiber?

- Insoluble fiber, on the other hand, passes through our bodies largely intact, moving bulk through and balancing the acidity of the intestines.
- It promotes regular bowel movement, helping to remove toxic waste through the colon in less time, and helps prevent colon cancer by keeping an optimal pH in intestines, which prevent microbes from producing cancerous substance.
- While beans contain both types of fiber, they are particularly high in soluble fiber content.

# Why can't I eat dry beans raw?

- Many types of beans contain a class of proteins called lectins.
- These proteins have the ability to interfere with the cell membrane repair process that occurs as a part of digestion.
- If not destroyed by cooking, lectins can cause a severe form of food poisoning, with attendant nausea, vomiting, and diarrhea.

I'm a vegetarian/vegan, so I eat beans for protein. But, I've heard that beans do not provide a complete protein on their own. What can I do to get complete proteins into my diet?

- Improve the nutritional quality of a meal containing beans by consuming them with cereal grains.
- Beans are a rich source of lysine (an amino acid), which is low in cereal grains.
- On the other hand, cereal grains are high in methionine and other important amino acids (building blocks that make up a complete protein).
- Together, beans and grains, or grain-based foods such as rice, tortillas and pasta, complement each other to provide a complete protein.

I maintain a gluten-free diet, and my doctor recommended that I substitute beans and bean flour for wheat products, which contain gluten. Where can I find more information about the benefits of beans in keeping a gluten-free diet?

- Gluten is a protein found in wheat and wheat-related grains including barley, rye, spelt, kamut, and triticale.
- According to the National Institutes of Health (NIH), one in every 100 Americans has celiac disease, an autoimmune condition in which gluten inhibits the body's ability to absorb nutrients from food.
- The only treatment is a lifelong, gluten-free diet. In addition, people with allergies or intolerances to gluten must also avoid this naturally occurring ingredient.

- Beans are important for people on a gluten-free diet because they can't rely on whole grain sources of wheat, barley, rye, or spelt to meet their recommended intake of 25-38 grams of fiber per day.
- According to the Beans for Health Alliance, beans are a good choice because they are nutritious, inexpensive, widely available, and delicious!

# Beans for Healthy Hearts

- Unlike meat-based proteins, beans are naturally low in fat, are free of saturated fat and trans-fat, and are a cholesterol-free source of protein.
- Research shows that a diet including beans may reduce your risk of heart disease.

<http://www.usdrybeans.com/2010/09/cardiovascular-disease-bibliography/>

# Beans for Reduced Risk of Certain Cancers

- Beans are a natural source of antioxidants and phytochemicals.
- Research reveals that a diet including beans may reduce your risk of certain cancers.

<http://www.usdrybeans.com/2010/09/cancer-bibliography/>

<http://www.usdrybeans.com/2010/09/antioxydants-bibliography/>

<http://www.usdrybeans.com/wp-content/uploads/2010/09/NewAmericanPlate-CancerBeans-AICR.pdf>

# Beans for Energy and Vitality

- A nutrient-rich food, beans contain protein, complex carbohydrates, fiber, antioxidants, and important vitamins and minerals, such as folate, manganese, potassium, iron, phosphorous, copper and magnesium.
- The lean protein in beans helps maintain and promote muscle while beans' complex carbohydrates provide a sustained energy source.

<http://www.usdrybeans.com/2010/09/longevity-bibliography/>

<http://www.usdrybeans.com/2010/09/general-reviews-bibliography/>

# Beans for Weight Management

- Beans are naturally low in fat, an excellent source of fiber, and a good source of protein.
- Research shows that people who eat more fiber tend to weigh less.
- Protein helps you feel full and promotes muscle building.

<http://www.usdrybeans.com/2010/09/FDA-Benefits-of-Fiber.pdf>

# Beans for Pregnancy and Healthy Babies

- Folate, a vitamin very important for pregnant women and their unborn babies, is found in beans.
- During pregnancy, women need more folate. Expectant mothers who consume enough of the right nutrients can help reduce the risk of birth defects.

# Beans for People with Allergies and Intolerances

- Beans are especially important for people with certain food allergies and intolerances. Because beans don't contain major allergens found in various some grains, substituting beans can help provide the fiber and other nutrients that people on restricted diets may be missing.
- Beans come in a variety of convenient forms (such as canned beans, bean flours and dehydrated beans) that can be used in place of allergenic and gluten-containing ingredients.

# Dry Bean in Baby Foods

- Established process
- Proprietary
- Dry bean flakes and flour



Black bean



Black bean



Chickpea



Kidney bean



Red kidney

# SOUPS – DRY MIXES



➤ Convenience food

➤ Precooked

➤ Powders

➤ Flake

# Beverages with dry beans



**Pinto bean powder**  
**Black bean powder**  
**Kidney bean powder**  
**Garbanzo bean powder**  
**Red bean powder**

- Roasted pulse for coffee application
- Sprouted pulse for malt drinks
- Pulse flakes and powder for instant drink applications

# Commercially available beverage products made with dry beans



White kidney



Black bean milk drink



Chickpea malt



Black bean tea



Red and black bean



Adzuki



Black bean tea



Navy bean shake

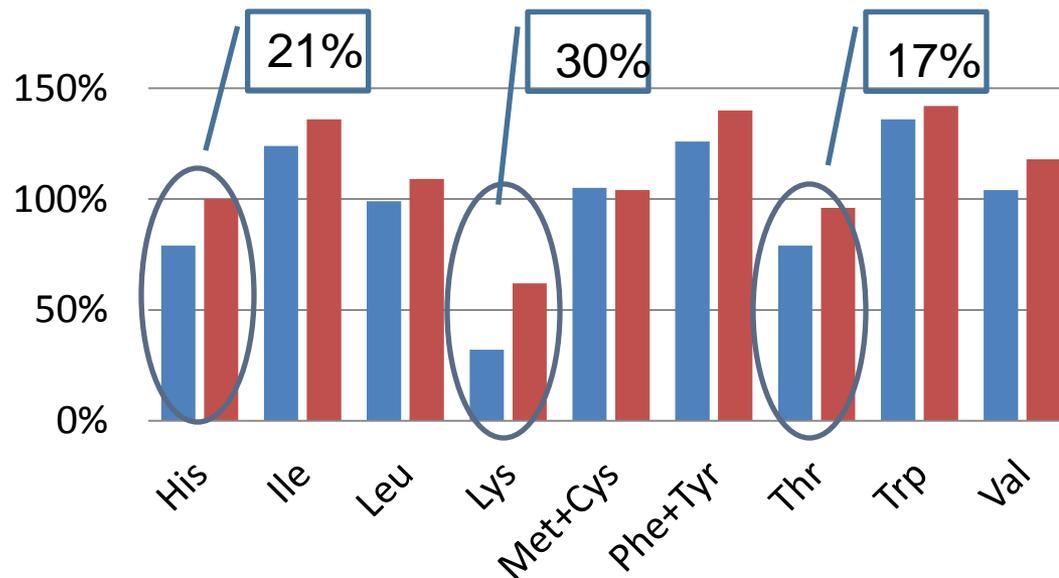
# Dry Bean Flour In Pan Bread Application

Bean flour can be added into pan bread for:

- Nutritive values
  - Increase Protein, fiber, micronutrients
  - Recommended amount is 15-25%
- Increase yield

# Amino Acid Profile Of Breads With And Without Pulse Flour

Addition of 20% pulse flour increased – Dietary fiber ~2g, Protein ~ 1g, iron ~2%, and protein quality.



# Baking with Edible beans flour

- Main interest- Flavor, appearance, texture, and water absorption capacity between different beans.
- Product- White pan bread
  - ❖ 3% Great northern bean flour.

# Water absorption capacity of Great Northern Beans

<b>Treatment #</b>	<b>Sample</b>	<b>Water Baker's %</b>	<b>Water (g)</b>
Treatment 1	Control	66	592
Treatment 2	Control	69	616
Treatment 3	Control	74	640
Treatment 4	Control	77	664
Treatment 5	Bean	69	688
Treatment 6	Bean	71	616
Treatment 7	Bean	74	640
Treatment 8	Bean	77	664



# Results

- Control samples at 74 and 77 were very hard to work with (too wet).
- The optimum water absorption was 66% for control and 74% for bean samples.
- For every 1000kg of flour,
- we yield 110kg more dough,
- equivalent to 220 loaves (500g wt)

	Control	Bean
Ingredients	Kg	Kg
Patent Flour	1000	1000
Vital Wheat gluten	20	20
Yeast	15	15
Sea salt	20	20
Sugar	100	100
Dependox	5	5
Canola oil	30	30
Vinegar	10	10
Honey	80	80
Water (16°C)	660	740
Great Northern flour	-	30
<b>Total</b>	<b>1940</b>	<b>2050</b>

# NCI Short Courses

- <http://www.northern-crops.com/education/education.htm>

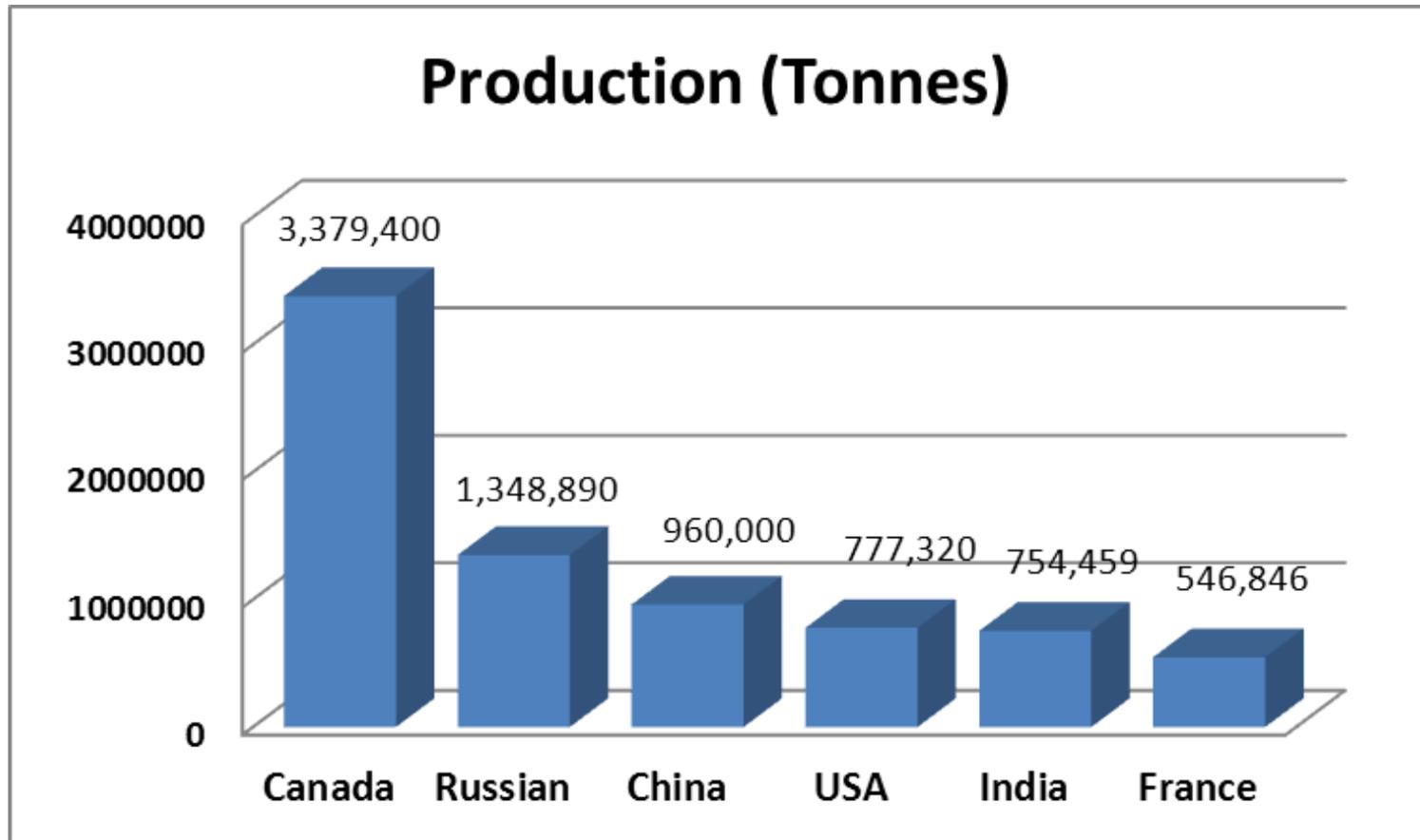
Edible Bean Quality and Utilization Short Course

Legumes in Food Products Short Course

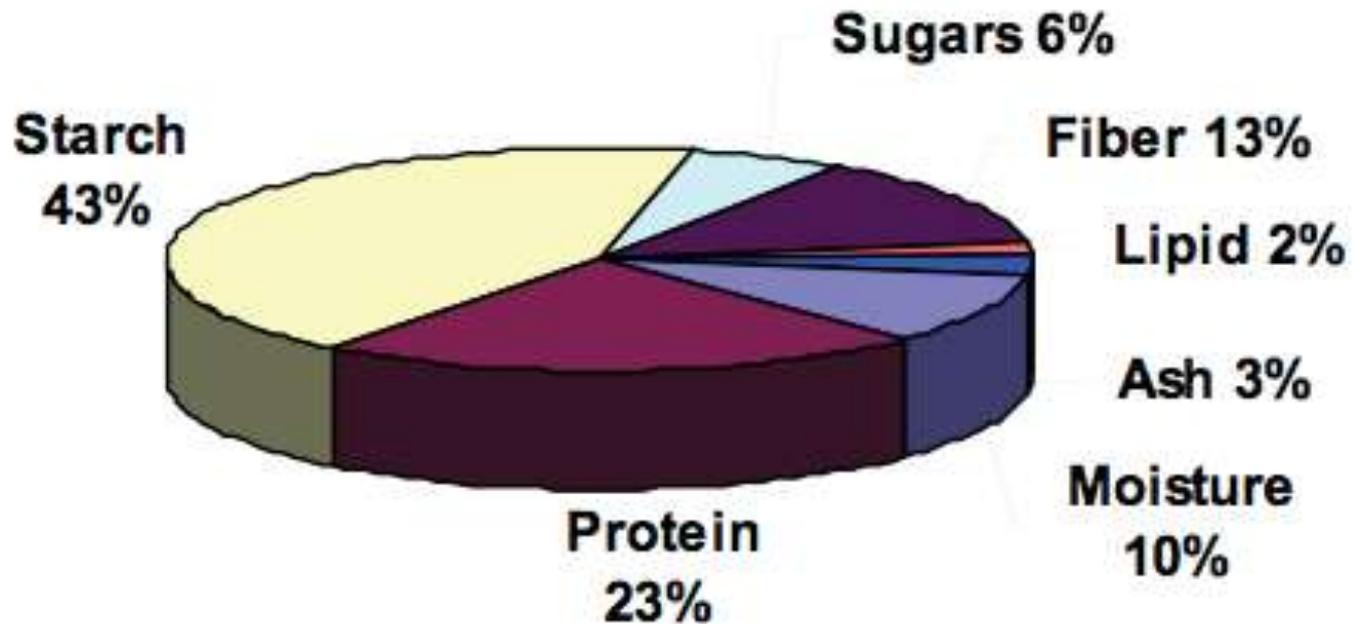
# North Dakota Peas and Lentils

- Pulses have rapidly gained importance in the United States over the past decade. Expansion of pulses acreage, especially dry peas, their increased frequency in crop rotations.
- Pulses are valued for their nitrogen fixing ability and play a key role in crop rotation.

# Dry Peas Production (MT) FAOSTAT 2009



# Dry Pea Composition



# PULSES:

Play important role in human nutrition

- Rich sources of protein, calories, certain minerals and vitamins
- Lower Glycemic Index (GI) than non-legumes
- Consumed for Economical and Cultural reasons



# DRY PEAS



- ✓ High protein
- ✓ High dietary fiber
- ✓ Gluten free
- ✓ Non GMO
- ✓ Low allergen
- ✓ Lower glycemic index scores compared to cereals

# USA Pea Varieties and Their Characteristics

- Dry Green Peas Light- green seed coat, dark green cotyledon
- Dry Yellow Peas Light- yellow seed coat, deep-yellow cotyledon
- Green Split Peas Dark- green cotyledon
- Yellow Split Peas Deep- yellow cotyledon
- Marrowfat Peas Light- green seed coat, dark-green cotyledon
- Austrian Winter Peas- Mottled dark green/brown seed coat, yellow cotyledon

# USA Lentil Varieties and Their Characteristics

- Regular Lentils Light- brown, mottled seed coat; yellow cotyledon
- Eston Lentils- Tan to green seed coat, yellow cotyledon
- Red Chief Lentils- Light/tan seed coat, red cotyledon
- Pardina Lentils- Speckled, grayish brown seed coat; yellow cotyledon
- Large Green Lentils- Bright-green, clear seed coat; yellow cotyledon
- Crimson Lentils Reddish- brown seed coat, red cotyledon

# Chickpeas

- Like lentils, chickpeas take their name comes from their shape, which resembles the beak of a baby chick. Some may also know chickpeas by their other name, garbanzo beans.

# Use of Dry Peas

- Dry peas can be hydrated by soaking and either canned or frozen and then served as a vegetable.
- Applications for canned or frozen peas include stir-fry dishes, pot pies, salads, and casseroles.
- Most dry peas are put through a splitting process and the split peas are then used in the popular North American dish, split pea soup.

# Use of Dry Peas

- Peas are roasted, salted, and consumed as snacks.
- In parts of the Mediterranean, they are added to meat and potatoes to make a hearty stew.
- Dry yellow split peas are used in the UK to make the traditional pease pudding or porridge, while dried, rehydrated, and mashed marrowfat peas, known in England as “mushy peas,” are a common accompaniment to fish and chips and meat pie.

# Use of Dry Peas

- Pea is valued not only as a vegetable protein source, but also, in part, for its unique functional properties.
- In keeping with the increasingly popular use of vegetable proteins as functional ingredients in the food industry, dry peas have proven especially sought after due to their wide acceptance as part of the human diet.

# The Health Benefits of Dry Peas

- As with other legumes, dry peas are rich in nutrients.
- A good source of protein, one quarter cup of dry split peas also provides 13 grams of dietary fiber or 52 percent of the daily recommended 25 grams (based on a 2000-calorie diet).
- Peas offer more than one-third of the recommended daily value for folate, a nutrient that plays a critical role in the prevention of birth defects.

# The Health Benefits of Dry Peas

- Dry peas also have little or no fat and no cholesterol, making them a smart addition to almost any diet.
- The many nutrients in dry peas may help lower the risk of heart disease, stroke, and various cancers, while enhancing quality of life by helping manage weight and prevent hemorrhoids and diverticulitis.

# The Health Benefits of Dry Peas

- The soluble fiber in dry peas and low glycemic index may help stabilize blood sugar levels, which is especially important for people with diabetes.
- In addition, the presence of phytochemicals in dry peas is another reason why they, like other legumes, should be consumed regularly.
- The body uses phytochemicals to fight disease.

# Use of Lentils

- Lentils are most well known for their namesake soup, which is popular across North and South America and Europe.
- In India and elsewhere, lentils are often combined with rice, which has a similar cooking time.
- Typically, lentils are consumed as a soup or joined with vegetables and boiled to a stew-like consistency before being seasoned with a mixture of spices to make a variety of side dishes, including the Indian dhal.

# Use of Lentils

- These are then served over rice and roti.
- In the Jewish tradition, the round shape of the lentil symbolizes the life cycle, and for this reason they have become traditional food for mourning.

# The Health Benefits of Lentils

- The Superfoods Rx Diet, released in 2008, included lentils for their nutritional attributes.
- In addition, lentils and legumes are highlighted as key daily ingredients in the Mediterranean Diet.
- The product of more than 50 years of scientific research into the eating habits of those living along the Mediterranean Sea, the diet is today considered by many to be the “gold standard” for healthful eating.

# The Health Benefits of Lentils

- Lentils in particular offer a high level of protein that is well-suited to this diet, which recommends eating an abundance of foods from plant-based sources.

# Lentils are an excellent source of:

- Fiber
- Folic Acid (Folate)
- Iron
- Manganese
- Phosphorus
- Thiamin

# Lentils are a good source of:

- Copper
- Magnesium
- Pantothenic Acid
- Potassium
- Vitamin B6
- Zinc

# USA Chickpea Varieties



## USA Large Kabuli Chickpeas

Large Kabulis have a lighter color, larger seeds, and a smoother coat than the Desi variety of the chickpea.



## USA Small Kabuli Chickpeas

All U.S. chickpea varieties are identifiable by a white seed coat and golden-yellow cotyledon.



## USA Desi Chickpeas

All U.S. chickpea varieties are identifiable by a dark-brown coat and brown-yellow cotyledon.

- Kabuli takes its name from the Hindi word for “from Kabul” as the variety was thought to have originated in Afghanistan.

# Use of Chickpeas

- Chickpeas are consumed mostly as a dry pulse crop. They are one of the most popular vegetarian foods the world over and can be prepared in a variety of ways for an almost limitless range of dishes.
- Mature chickpeas can be cooked and eaten cold in salads, cooked in stews, ground into flour, ground and shaped into balls and fried (falafel), stirred into a batter and baked (farinata), cooked and ground into a paste (hummus), or roasted, spiced, and eaten as a snack.

# Use of Chickpeas

- Unripe chickpeas are often picked out of the pod and eaten raw, while the leaves are used as a green vegetable in salads.
- In the Philippines, chickpeas are preserved in syrup and enjoyed as sweets and in desserts.
- They can even be fermented into an alcoholic drink similar to sake or ground, roasted, and brewed as a coffee substitute.

# Use of Chickpeas

- In North America, most Kabuli chickpeas are marketed as canned chickpeas for salads at home or in restaurant salad bars.
- They are also marketed as dry chickpeas and ground flour for baking purposes.
- Other common uses in the U.S. include as an ingredient in soups and stews and as part of vegetable combinations.

# Use of Chickpeas

- Hummus, a dip or spread made from cooked, mashed chickpeas, has also become a major product in the U.S. in recent years.



# The Health Benefits of Chickpeas

- As well as being good to eat, chickpeas are also good for you.
- Some ancient cultures associated them with Venus, thinking them an effective medicinal for increasing milk for breastfeeding moms even
- helping to treat kidney stones.

# The Health Benefits of Chickpeas

- Today, we know that chickpeas, like other legumes, provide a valuable source of folate, iron, manganese, and protein.
- They are also a healthy source of complex carbohydrates and are low in fat.
- Most notably, chickpeas are high in dietary fiber—one-half cup of canned chickpeas provides 24 percent of the daily recommendation of 25 grams of fiber (based on a 2000-calorie diet).

# The Health Benefits of Chickpeas

- The benefit of a high fiber diet goes beyond regularity and prevention of hemorrhoids and diverticulitis.
- It reduces the risk of cardiovascular disease by lowering blood cholesterol levels, helps control blood sugar levels in people with diabetes, and may even help protect against several forms of cancer.

Table 1. Protein, Lipid, and Carbohydrate Composition (%) of pulses and soybean.\*

Nutrients	Split peas	Lentil	Chickpea	Pinto	Black bean	Kidney	Soybean
Protein	24.6	25.8	19.3	21.4	21.6	23.6	36.5
Fat	1.2	1.1	6.0	1.2	1.4	0.8	19.9
Carbohydrate	60.4	60.1	60.7	62.6	62.4	60.0	30.2
Total dietary fiber	25.5	30.5	17.4	15.5	15.5	24.9	9.3
Sugars, total	8.0	2.0	10.7	2.1	2.1	2.2	7.3

\*Values are based on USDA National Nutrient Database and recalculated on a dry weight basis.

# Quick Facts

Legumes contain:

- 3 times as much iron as meat
- 2 times as much magnesium as rice
- 4 to 5 times as much potassium as meat
- 2 times as much phosphorous as 2 pounds of eggs, 3 times as much as a two pounds of meat

# DRY PEA MILLING & QUALITY

- Whole pulse flour
- Dehulled pulse flour
- Air-classified products
  - Protein rich pea flour
  - Starch rich pea flour



# PRE-COOKED PEA FLOUR

- ❖ Improvement of functional attributes
  - Gelatinize starch / denature protein
- ❖ Stability – color
- ❖ Stability – lipid oxidation
- ❖ Stability – microbial quality
- ❖ Flavor – sensory attributes
- ❖ Nutrition- Trypsin inhibitor, lectins

# Soaking



# Roasting



# Milling

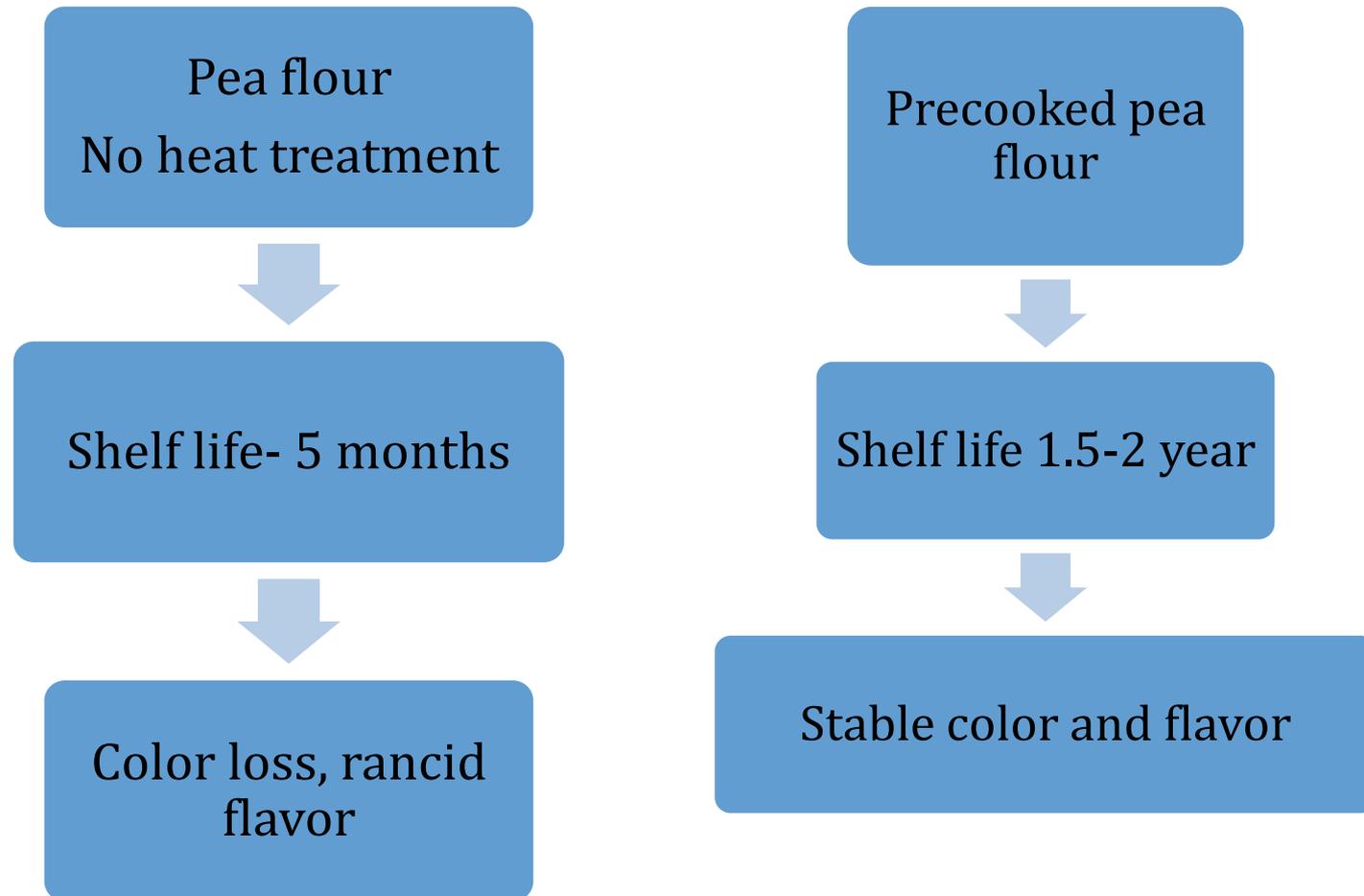


# EXTRUDED LENTIL FLOUR

- Develop a precooked lentil flour ingredient
  - Milling whole lentils
  - Extrusion
  - Milling extruded lentils



# PEA FLOUR SHELF LIFE STABILITY



# DRY PEA FLOUR SPECIFICATIONS

	Moisture (%)	Ash (%)	Protein (% dm)	Starch (% dm)	Fiber (%)	Lipid (%)	APC (CFU/g)	Mold & Yeast (CFU/g)
Whole Pea	13.2	2.6	24.1	46.7	7.3	2.1	8500	400
Pea hulls	8.2	2.1	2.0	<1.0	>85	0.1	1200	150
Split Peas	12.1	2.5	26.5	50.5	1.0	2.2	1000	200
Split Pea Flour	7.2	2.5	26.3	50.1	0.9	2.2	6200	70
Starch Rich Pea Flour	9.2	1.7	12.4	73.1	0.8	0.7	820	30
Protein Rich Pea Flour	8.7	4.6	53.5	8.0	1.0	2.2	500	200

# PROTEIN AND STARCH ISOLATE PRODUCTION

## ❖ Dehulling

- ❖ Key process for the removal of 97-98% of the fiber portion
  - same as dry fractionation

## ❖ Wet fractionation

- ❖ Protein & starch separation – high purity
- ❖ Hammer milling
- ❖ Soaking and acid-base treatment
- ❖ Decanter – filtration - spray or drum drying

# PEA HULLS (PEA FIBER)

- High water binding capacity, fat absorption and dough conditioning properties.
- Modifies texture
  - Granola bars
- Veggie burges, hamburgers, sausages, nutritional bars, sauces, fillings, pasta, noodles, baked products

# PEA PROTEIN ISOLATE

- High level of functionality, bioavailability and lysine content.
  - >%85 Protein, %3 Fat, %4 Ash
- Good alternative to soy protein isolate (Non GMO and non allergen)
  - Granola bars, baby foods, pasta, noodle, baked products, dressings, meat products, veggie burgers

# PEA STARCH ISOLATE

- Excellent gel strength and bland taste
  - >%98 purity
- Superior gelling properties -20-30% lower usage level
- Excellent film forming properties
- Excellent acid, retort and shear stable similar to many modified starches
- Improves crispness in baked products
- Contributes to increased volume/expansion in extruded products

# Pulse Proteins



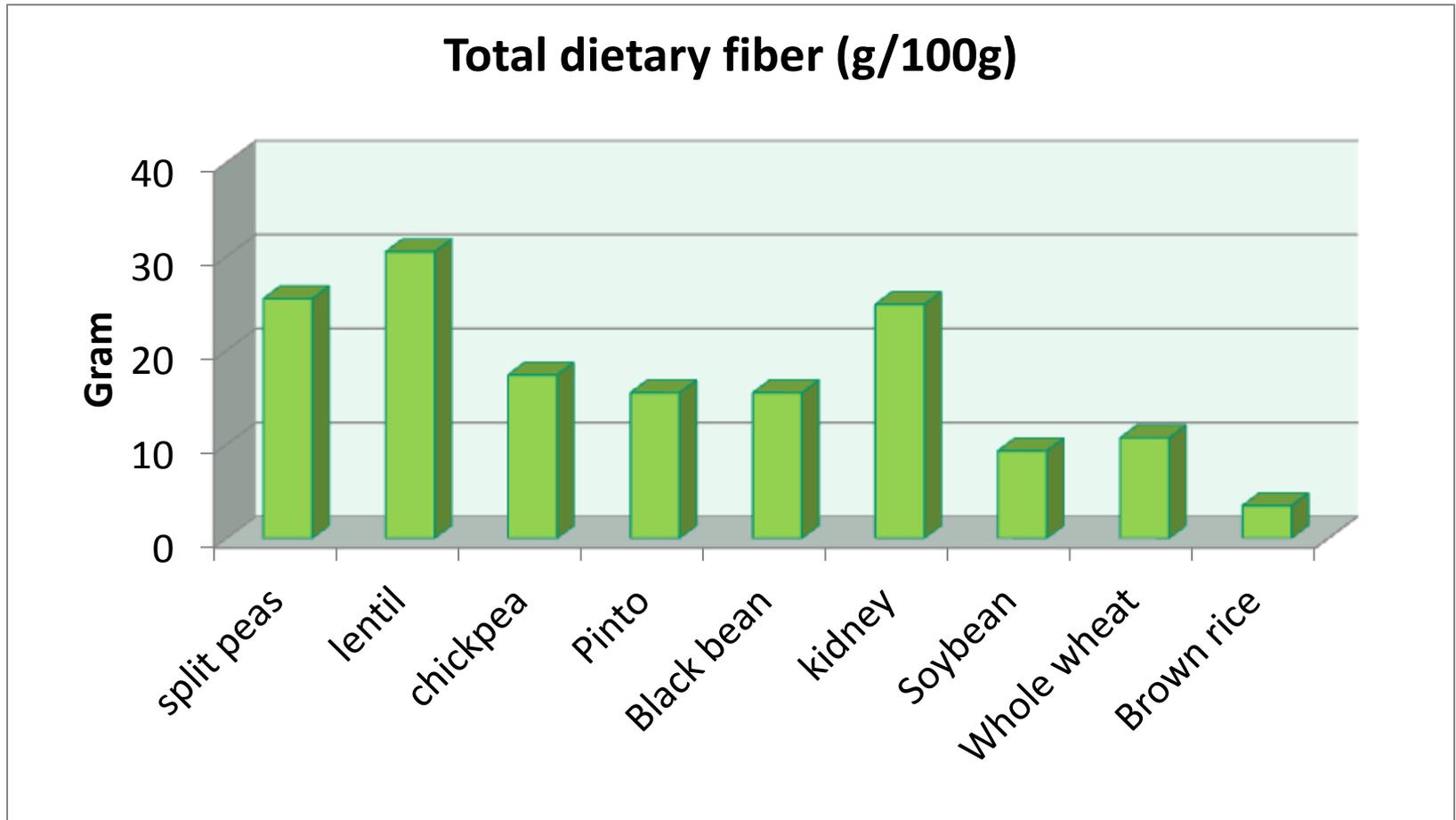
- ❖ 17 – 29% of composition
- ❖ Rich in essential Amino Acids (lysine, alanine and tyrosine)
- ❖ Deficient in sulfur-containing amino acids, methionine - limiting amino acids (combine with other protein sources)
- ❖ 89 – 96%<sup>a</sup> digestibility

<b>Protein Source</b>	<b>Limiting Amino Acid</b>
Wheat	Lysine
Rice	Lysine
Maize	Lysine and tryptophan
Dry Peas, lentils, chickpeas	Methionine (or cysteine)
Beef	Phenylalanine (or tyrosine)
Egg, chicken	None, Reference for absorbable protein
Milk or Whey, bovine	Methionine (or cysteine)

# Essential Amino Acids to Total Amino Acids Ratio in the Protein

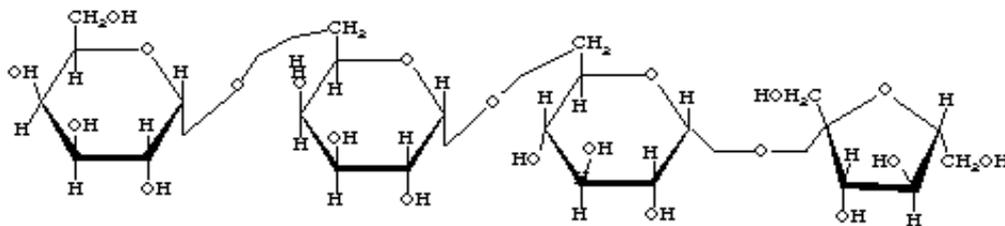
<u>Sources</u>	<u>Essential amino acid ratio</u>
Chickpea	0.66 (Alajaji, S. and T. El-Adway. 2006. J. Food Comp. Anal. 19:806-812)
Peas	0.41 (Pownall et al. 2010. J. Agric. Food Chem. 58:4712-4718)
Soybeans	0.36 (Wang, H. and J. Cavins. 1979. Cereal Chem 66:359-361)

# Carbohydrate: Fiber



# Pulse sugars (6%)

- Sucrose (Glu + Fru)
- Raffinose (Glu + Fru + 1Gal)
- Stachyose (Glu + Fru + 2Gal)
- Verbascose (Glu + Fru + 3Gal)



## **Raffinose, stachyose, verbascose**

### **✓ activities**

**❖ flatulence**

**❖ diarrhea**

**❖ reduced protein digestibility**

### **• levels**

**❖ raffinose - 5 to 7 mg / g**

**❖ stachyose - 19 to 32 mg / g**

**❖ verbascose – 7 to 13 mg / g**

### **• location**

**❖ cotyledon**

## Minerals:

- Legumes contain all 15 essential minerals required by humans

# Minor Nutrients: Mineral content (mg/100g)

Minerals	Split peas	Lentil	Chickpea	Navy	Pinto bean	Black bean	Kidney bean	Average	RDI	% RDI
Calcium, Ca	55	56	105	15	113	123	143	87	1000	9
Iron, Fe	4	8	6	2	5	5	8	5	18	31
Magnesium, Mg	115	122	115	101	176	171	140	134	420	32
Phosphorus, P	366	451	366	100	411	352	407	350	1000	35
Potassium, K	981	955	875	307	1393	1483	1406	1057	3500	30
Sodium, Na	15	6	24	13	12	5	24	14	2400	1
Zinc, Zn	3.0	4.8	3.4	0.9	2.3	3.7	2.8	3	15	20
Copper, Cu	0.9	0.5	0.8	0.4	0.9	0.8	1.0	1	2	38
Manganese, Mn	1.4	1.3	2.2	0.4	1.1	1.1	1.0	1	2	61

# Selenium

## Main role

- Antioxidant
- Catalyst for the production of active thyroid hormone.

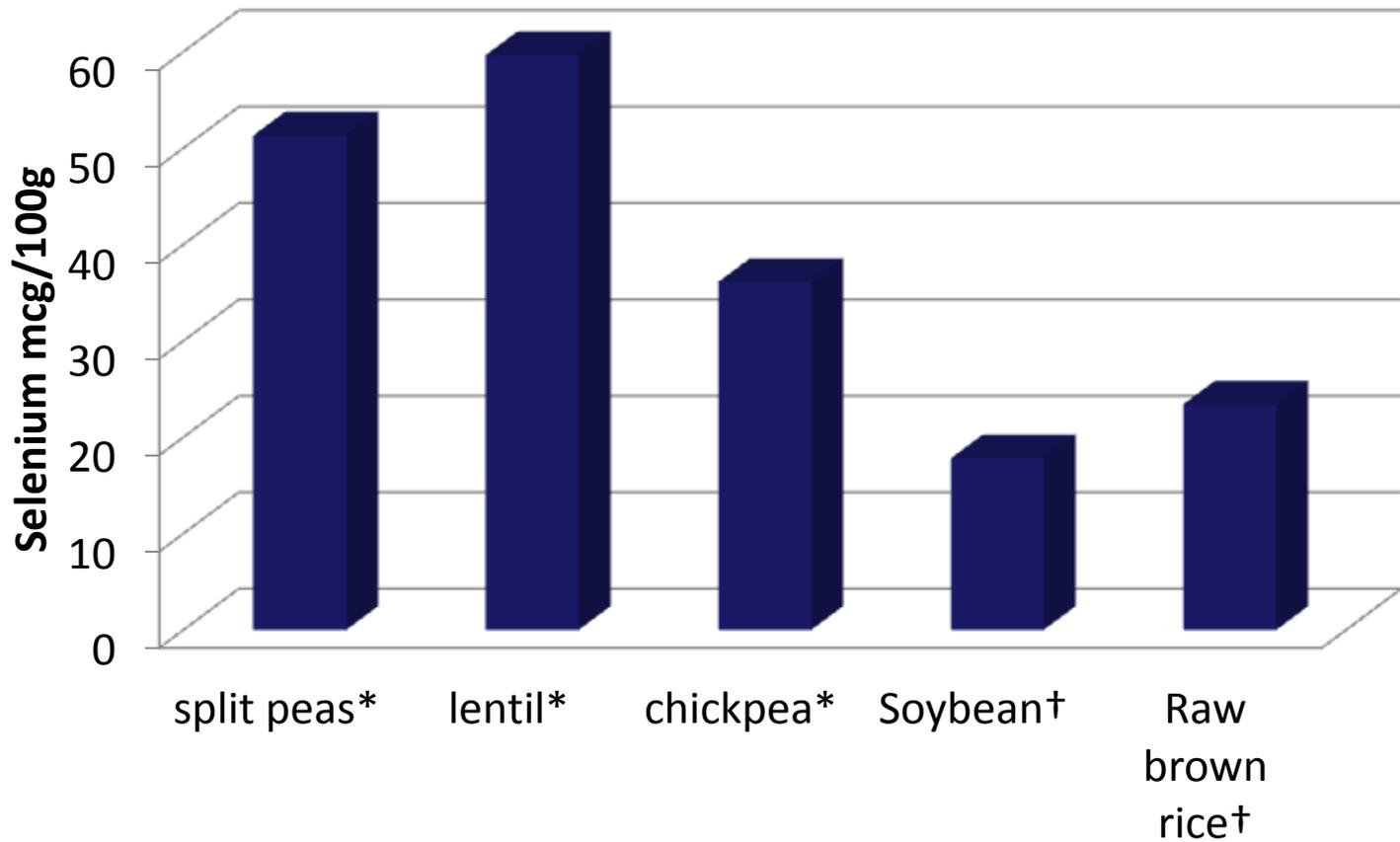
## Other associated health benefits

- Selenium is needed for the proper functioning of the immune system,
- Key nutrient in counteracting the development of virulence and inhibiting HIV progression to AIDS.
- May reduce the risk of miscarriage.
- Oxidative stress and inflammation have shown benefits of a higher selenium status.
- An elevated selenium intake may be associated with reduced cancer risk.

→ Low or diminishing selenium intake in some parts of the world is giving cause for concern.

## Selenium content

RDA = 55 mcg/day



# Minor Nutrients: Vitamins

Vitamins	Unit	Value per 100g	DRI
Vitamin C	mg	8.93	90
Thiamin	mg	0.56	1.2
Riboflavin	mg	0.24	1.3
Niacin	mg	1.76	16
Pantothenic acid	mg	0.86	5
Vitamin B-6	mg	0.34	1.7
Folate, total	µg	243.81	400
Choline, total	mg	58.74	550
Vitamin B-12	µg	0	2.4
Vitamin A, RAE	RAE	0.21	900
Vitamin E (alpha-tocopherol)	mg	0.8	15
Vitamin K	µg	16.71	120

47%

20%

61%

# Folate:

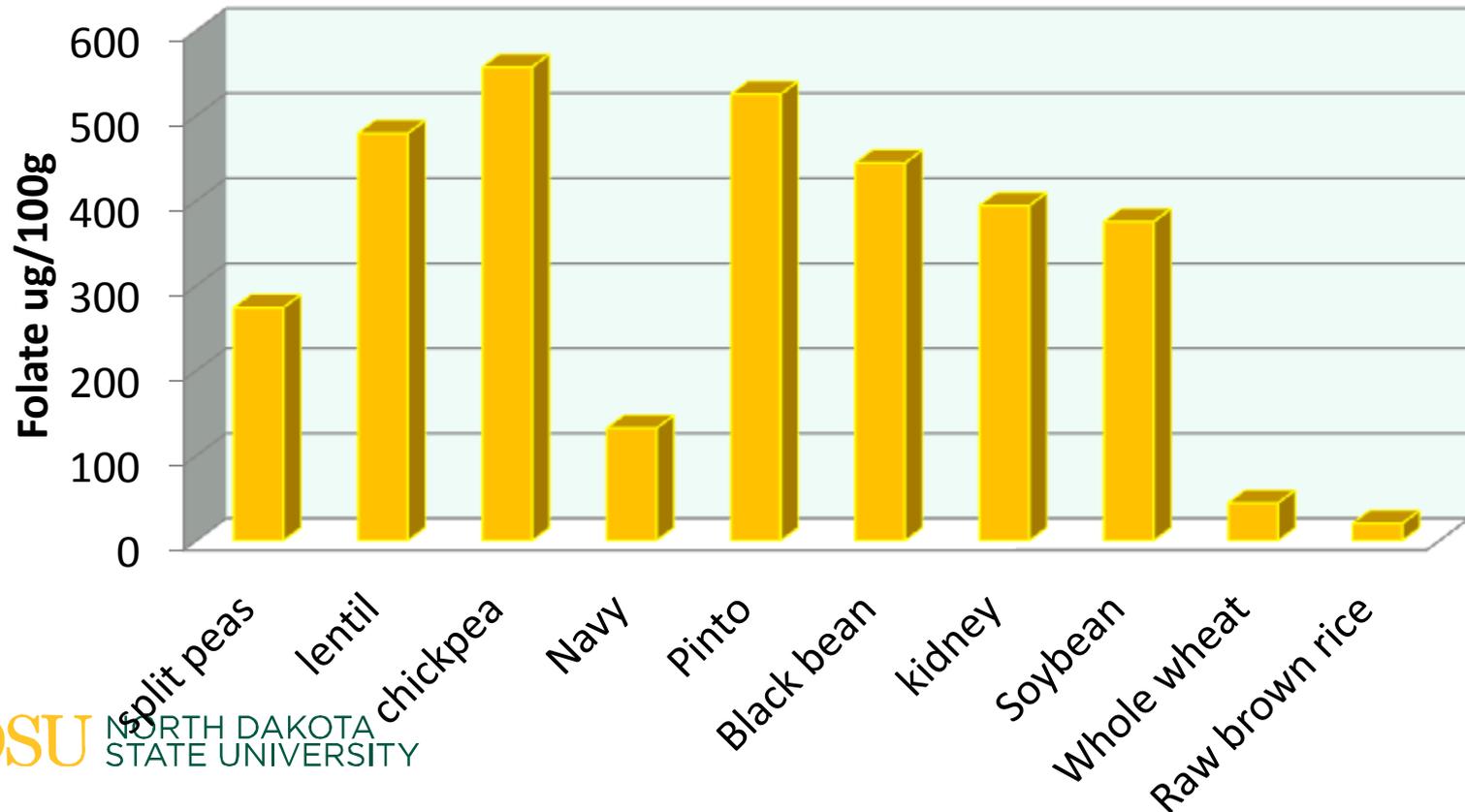
- Prevent neural tube birth defects and heart attack and stroke
- Recommended Dietary Allowance of 400 micrograms
- 6 or more servings daily from bread & grains or legumes

**Flour Fortification with Folate (Folic Acid) Effective January 1998**

# Minor Nutrient: Folate content

**DRI = 400 mcg/d**

## Comparison of Folate (Total)

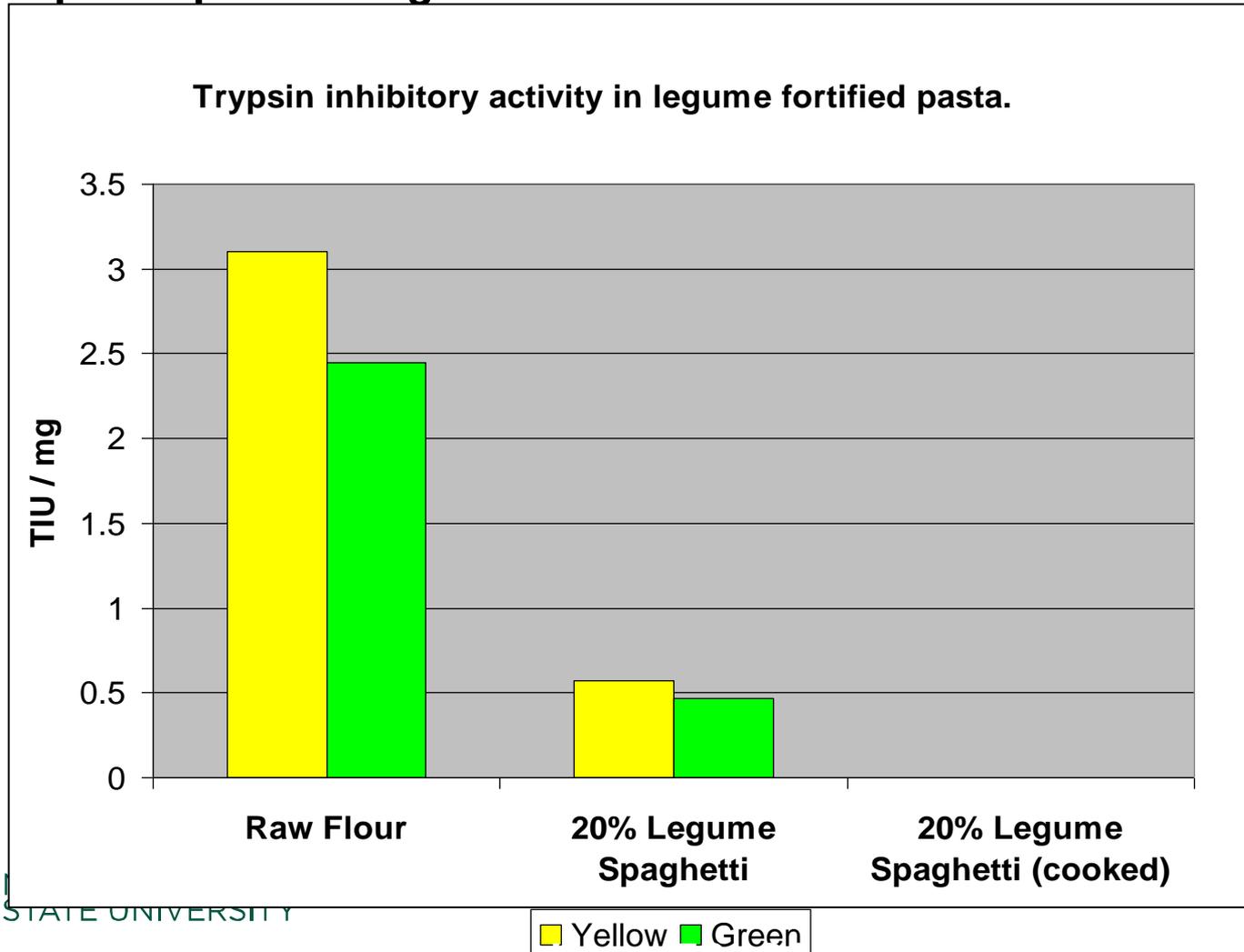


# Pulse Antinutrients

- **Protease inhibitors (i.e. trypsin inhibitors)**
  - **activities**
    - reduce protein digestibility and bioavailability
    - may be part of plant defense
    - may inhibit cancer
  
- **Protease inhibitors**
  - **levels**
    - green pea – 1.5 to 2.7 TIU / mg
    - yellow pea – 3.0 to 3.1 TIU / mg
    - chickpea – 12.5 TIU / mg
    - soybean – 143 TIU / mg
  - **location**
    - 10% in the seed coat
    - 90% in the cotyledons

- **Trypsin inhibitors (TI)**
  - **soaking**
    - 15.4% reduction in TI after 16 hr soak @ 30°C
    - 8.5 % reduction in TI after 12 hr soak @30°C (Alonso et al. 1998).  
Food Chemistry 63:505-512)
  - **cooking**
    - Boil (100°C) – 20 minutes
    - Autoclaved (121 C) – 10 minutes
    - Microwave – 4 minutes
    - (Habiba, R. 2002. Food Chemistry 77:187-192)
  - Microwave – 36 and 68% reduction in TI when peas were microwaved in a dry and wet state, respectively

✓ **Trypsin inhibitors**  
• **pasta processing**



# Antioxidants in Pulses

# Antioxidants in Pulses

## Location in the plant

- Seed coat color

### Common Beans (*Phaseolus vulgaris*)



Red Kidney Beans



Pinto Beans

### Peas (*Pisum sativum L.*)



Green Peas



Yellow Peas



Red Lentil  
(*Lens culinaris*)



Azuki bean/red bean  
(*Vigna angularis*)



Black Gram Bean  
(*Vigna mungo L*)



Chickpea  
(*Cicer arietinum*)

# Antioxidant Activities



Food	$\mu$ mol TE/100g.
Kidney bean	8,606
Lentils	7,282
Black bean	6,416
Blueberries	4,669
Broccoli	1,510
Chickpeas	847
Peas (Yellow)	741
Carrot	697



✓ Phenolic acids (from Lopez-Amoros et al., 2004)

Compounds	Beans	Peas	Lentils
Protocatechuic acid	32.8–41.4	206–221	49.9–52.3
p-Hydroxybenzoic acid	32.3–36.1	46.5–49.9	93.6–100
p-Hydroxybenzoic aldehyde	nd	nd	13.3–15.3
Vanillic acid	90.9–97.9	19.4–22.2	73.6–79.6
p-Hydroxyphenylacetic acid	45.8–51.6	nd	nd
trans p-Coumaric acid	nd	37.7–41.5	322–342
cis p-Coumaric acid	nd	65.5–70.1	nd
trans p-Coumaric acid	nd	nd	82.8–89.6
cis p-Coumaric acid	nd	31.9–33.7	nd
trans Ferulic acid	342–366	9.1–10.9	20.9–25.7
cis Ferulic acid	74.1–79.1	nd	nd
(+)-Catechin	—	—	0.1 –0.3
Procyanidin B <sub>2</sub>	—	—	0.3–0.5
Procyanidin B <sub>3</sub>	—	—	0.3–0.5
Procyanidin C <sub>1</sub>	—	—	trace
Procyanidin tetramer	—	—	0.2–0.3

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# Pulse Nutrition Summary:

↑ Protein

↑ Starch

↑ Fiber

↑ in some vitamins and minerals

↑ Antioxidants

↓ Glycemic Index

↓ Fat



# PRODUCTS WITH PULSES

Beans, Peas and lentils

# Pulse Fortification:

- Cereal and Bakery Products:
- Improve nutritional quality of wheat protein
  - wheat - Lysine is limiting amino acid in wheat
  - When paired- complete protein needed for growth
- Pulse– source of Lysine, can fortify cereal/wheat products
- Complete Protein (all essential amino acids)

# PILOT SCALE PEA FORTIFIED PASTA PROCESSING



# PASTA COLOR



# Commercially available pasta/noodle products made with dry beans flour



GF Black bean



GF Chickpea



Black bean



GF chickpea



GF Navy bean spaghetti



Chickpea spaghetti

# PASTA PRODUCTS WITH PULSE FLOURS



UK PLC flours



AUS Pea flour



USA lentils



Germany  
Chickpea



Vietnam Pea flour



UK Chickpea



Italy Lentil



South Africa Pea flour

# BAKING WITH PULSE FLOUR



# Baked products with Japanese bean paste



# Product development project: Texturized Vegetable Protein from Bean flour/ Protein



# GLUTEN FREE DIET

- Important for patients with
  - Celiac patients
  - Dermatitis herpetiformis
  - ADHD
- Gluten is a protein found in wheat (including kamut and spelt), barley, rye, malts, triticale.
  - Oats is a concern due to high wheat contaminants.

# BAKING GLUTEN FREE WITH PULSE FLOUR



# Gluten free pasta using pre-gelatinized flour



Blending dry ingredients



Adding water (40 deg C)



Adding the mixture to the extruder

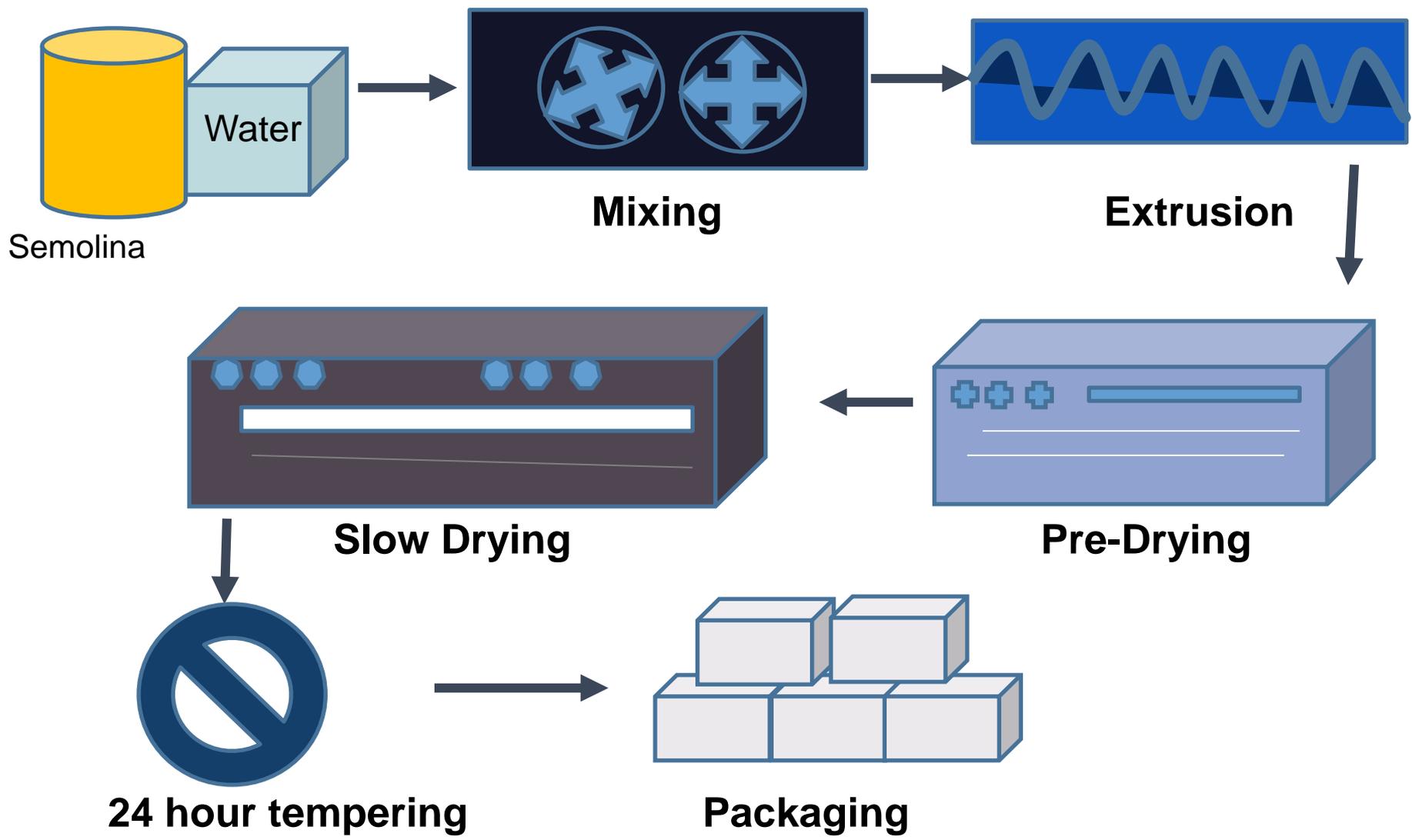


Dry GF pasta



Extrusion of GF flour





# GLUTEN FREE PASTA

- The wheat gluten provides pasta dough with the visco elastic property that holds the structure of pasta together and provides the unique texture.
- Gluten free pasta relies on gelatinized starch and additives, including gums, emulsifiers, and proteins, to produce a cohesive structure that can overcome the absence of gluten.
- The key of producing gluten free pasta is to pregelatinize starch prior to extruding.

# GLUTEN FREE PASTA (DRIED) MADE WITH PREGELATINIZED FLOUR



**Yellow Pea**



**Navy Bean**



**Semolina**



Rice: Quinoa  
(75:25)



Chickpea



Yellow Pea



Yellow corn

# Gluten free pasta using raw pulse flour



Dry Whole GF yellow peas penne



Cooked GF Whole yellow peas

# CANNED DRY PULSES

- Water absorption
- Bulk density
- Color



# CANNED PRODUCTS

- Established product
- Proprietary processing
  - Soaking – water quality (100-150 ppm Ca-carbonate)
  - Starch content - <40%



# SOUPS – DRY MIXES



- Convenience food
- Precooked pulses



- Pulses
- Powders
- Flake

# PEAS IN BABY FOODS

- Established process
- Proprietary
- Whole and split peas
- Pea flakes, pea flour,



Photos courtesy of Mintel GNPD, 2012

# COOKED PULSES IN RICE

- Food service operations
- Convenience food
  - Served in combination with rice
  - 10-20% mixes



# Hot Beverage



- Roasted pulse for coffee application
- Sprouted pulse for malt drinks
- Pulse flakes and powder for instant drink applications



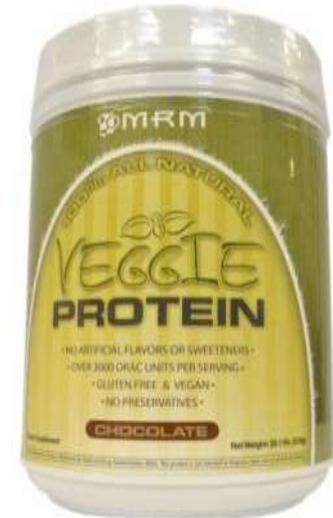
# HIGH PROTEIN DRINKS

For meal replacement or weight training

Traditional ingredients

- Whey protein concentrate
- Soy protein concentrate
- Whey protein isolate
- Soy protein isolate

➤ Pulse proteins – alternative protein sources



DAKOTAJNIVER



Photos courtesy of Mintel GNPD, 2012

# Food Service Industry Guide Using Pulse Ingredients



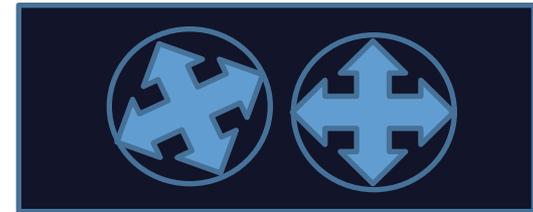
# EXTRUDED SNACKS WITH PULSES



**Raw pulses**



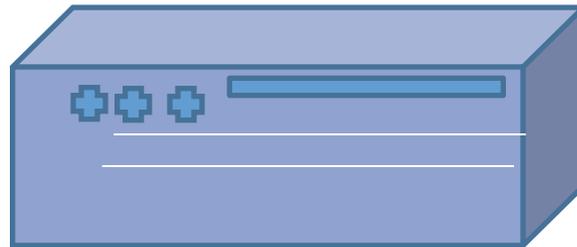
**Milling**



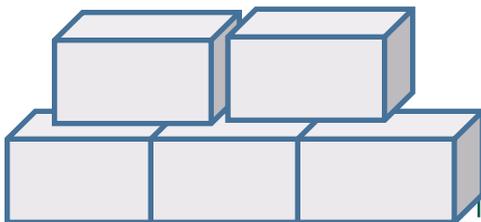
**Blending ingredients**



**Single or Twin screw extrusion**



**Drying**



**Packaging**

# EXTRUDED SNACKS WITH PULSES

- Technological advantages
  - ✓ Excellent extrusion properties
  - ✓ Expansion rate
- Nutritional advantages
  - ✓ High protein, high fiber
  - ✓ Low fat content
  - ✓ No-gluten



# Product development projects with US Dry Beans



Chickpea: corn  
50:50



navy bean



Red bean: corn  
50:50



black bean: corn  
50:50



navy bean: corn  
50:50



pinto

# EXTRUDED CHICKPEAS AND GREEN PEAS



Chickpea



Chickpea: corn  
50:50

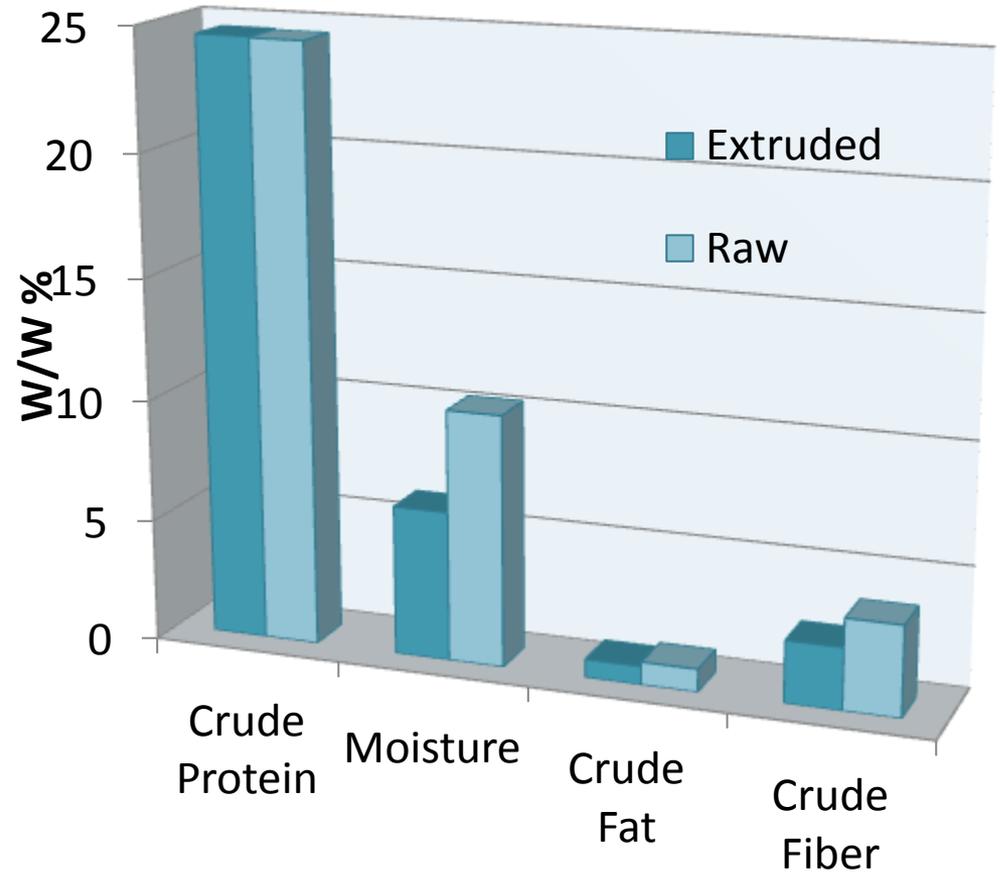
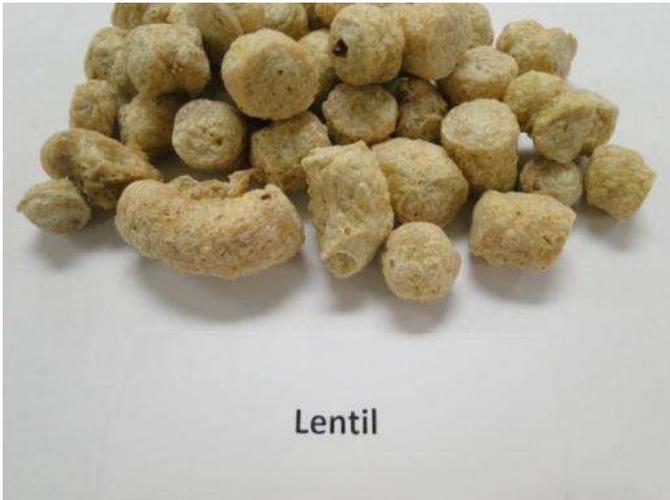


Green peas

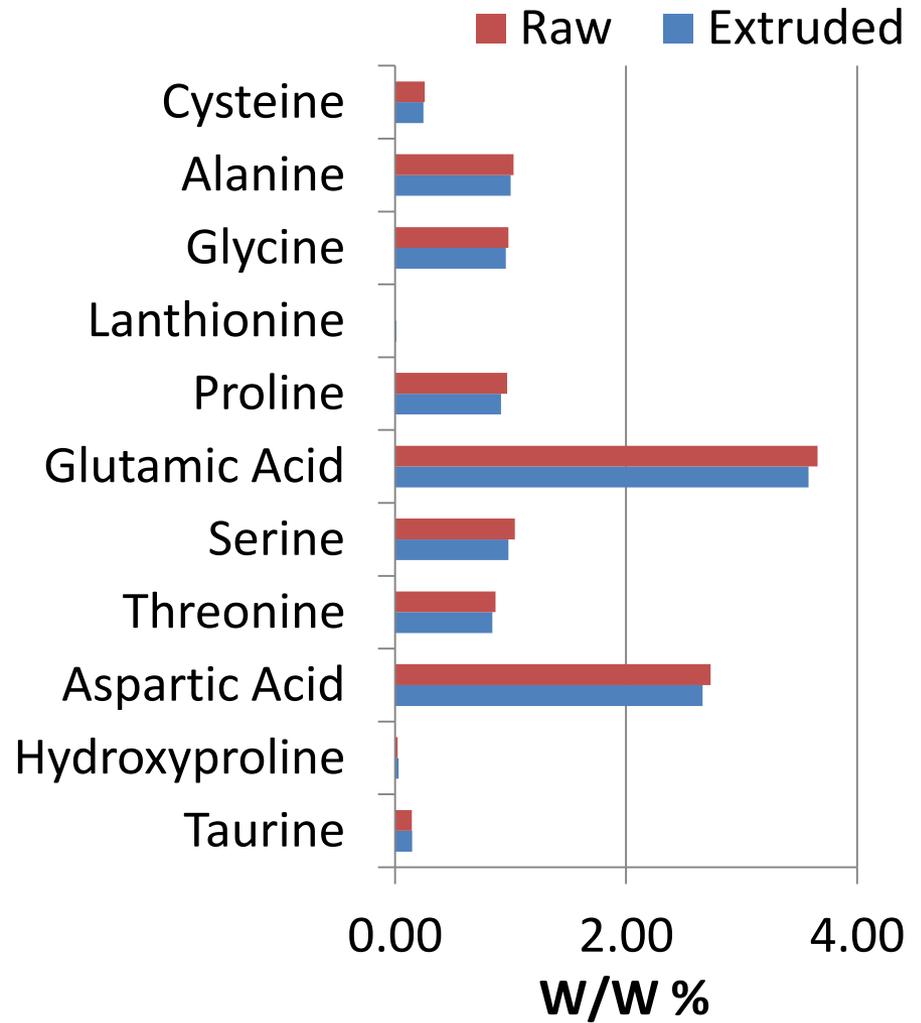
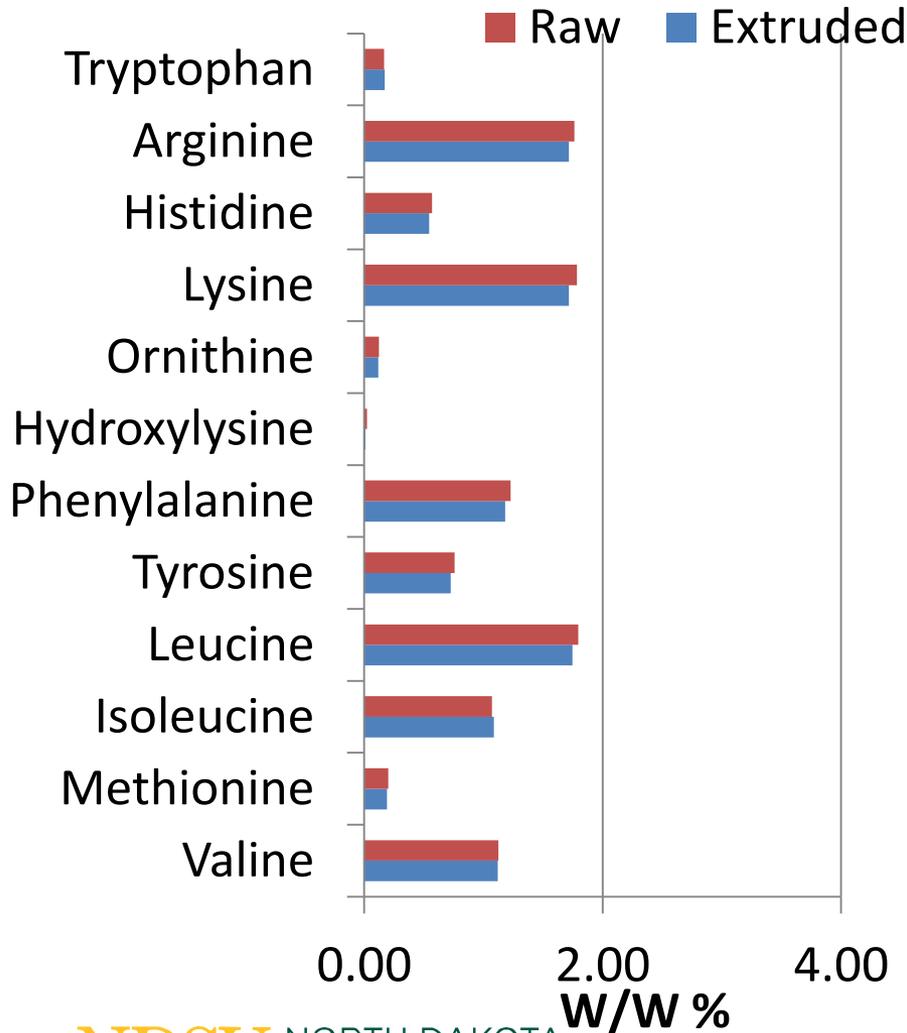


Green peas: corn  
50:50

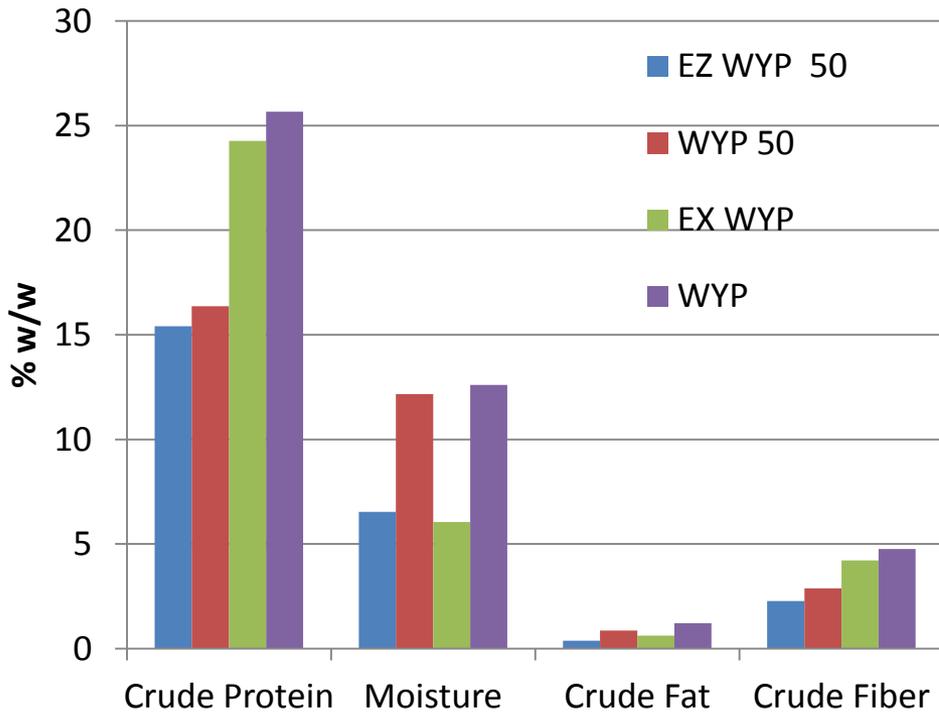
# EXTRUDED LENTILS



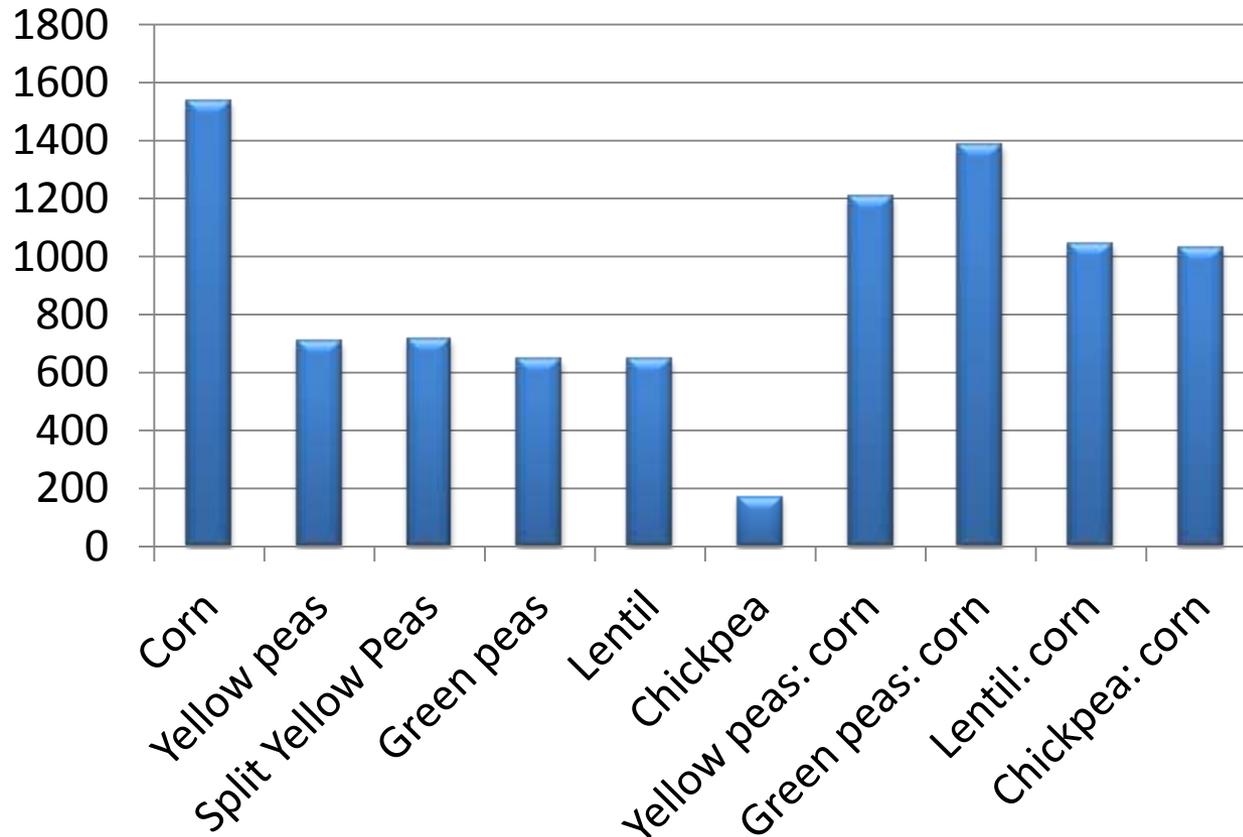
# EXTRUDED LENTILS AMINO ACIDS PROFILE



# EXTRUDED YELLOW PEAS



# EXPANSION COMPARISON



Commercial products in China containing pulse ingredients



Red bean and grain drink



shreded porn



Plant nutrition powder



Baby formula



Snowy mooncake



Blackbean biscuits



Coarse grain drink



chocomochi



Pea crisps



wild prawn floss



crispy chickpea



energy

# COMMERCIAL PULSE SNACK PRODUCTS

In 2011, there are 190 snacks product made from pulse flours launched worldwide (Mintel GNPD, 2012)



USA



China



Thailand



UK



India- Lay's



Phillippines



Thailand



Malaysia



China



Singapore

# Examples of products in South East Asia region



Malaysia



Vietnam



Vietnam



Thailand



Thailand



Indonesia



Indonesia



Thailand, Malaysia

**Thank you very  
much for your  
attention!  
Questions?**

