

Healthy Ingredients for Health & Fitness with special emphasis on Proteins & Fibre

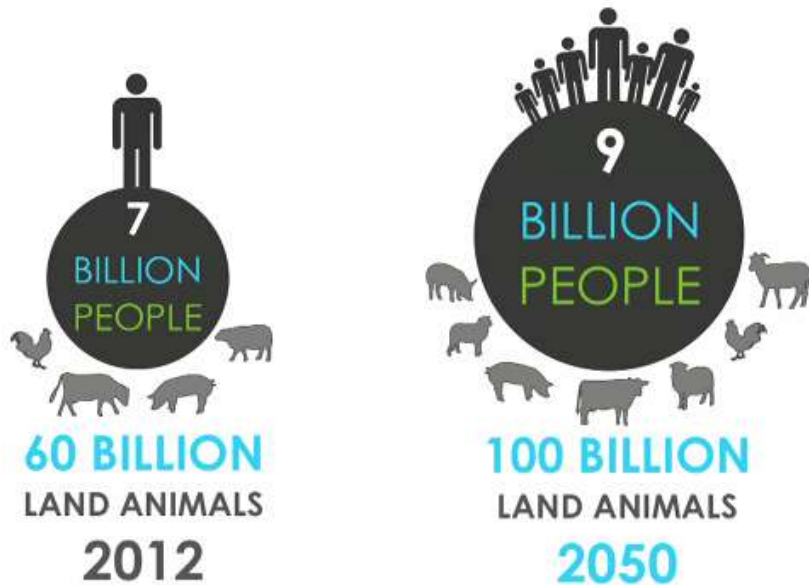
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Tata Chemicals Limited, Mumbai

PFNDAI, June 8, 2017, Mumbai



Ensuring Food and Nutritional Security



**Biggest Challenges will be
Protein
Fibers**

Meat as a protein source is not sustainable

Sources of Protein

Meat

Poultry and Fish

Egg

Diary

Pulses

Nuts, cereals,

Algae

Insects

Laboratory meat

Pulses : Smart Foods of Future

Health
Of
People

Health
Of
Planet



Health
Of
Economy



Globally Sales and product launches using pulses are booming



Foods and drinks made with pulse ingredients are in more households than ever and in many new products

34% household penetration of pulse ingredients

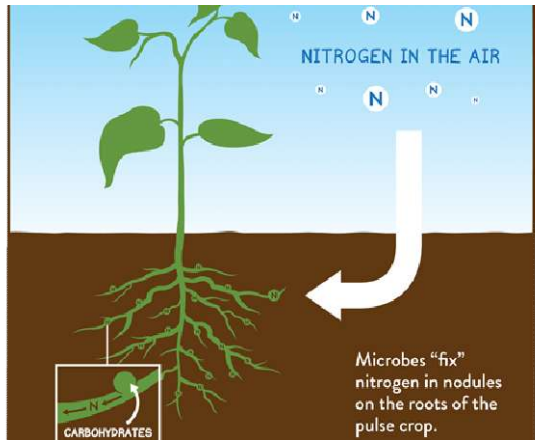
74% increase in new product launches with pulses from 2010 to 2013

Pea protein has seen 50% YOY sales growth — that's nearly 5x faster than soy protein

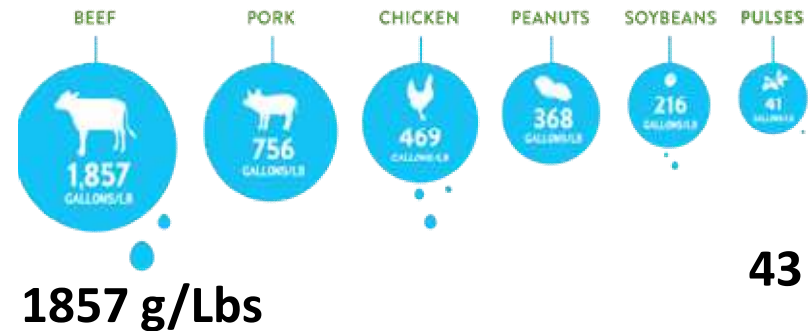
Chickpea flour has experienced 155% YOY sales growth

**India largest producer, consumer and importer of pulses.
The Per capita consumption of pulses in India has dropped
to 50% in the last two decades**

Fixes Soil nitrogen and reduces the need for fertilizers

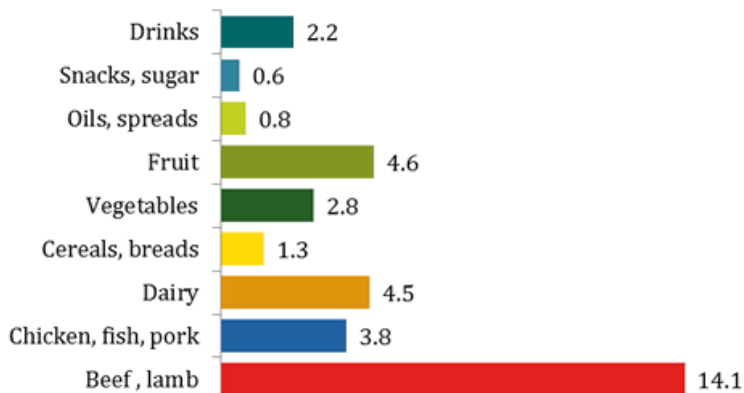


Water efficient Protein Source Low water foot print

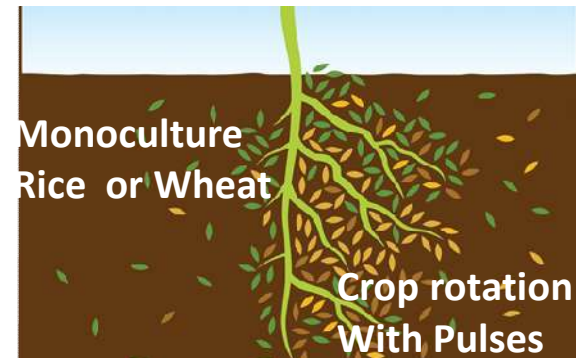


Low Carbon Foot Print, most economical Protein

Carbon Intensity of Eating:
g CO₂ e/Kcal



Enrich the Soil where they are grown



Microbial life flourishes, breaks weeds
And diseases life cycle, increases microbial
bio diversity and nutrient uptake

Benefits of Dietary Pulses



Replacing wheat and rice with pulse will reduce the carbon foot print , increase protein and fiber content, decrease the GI and GL of food the food you eat

Pulses: Importance in Human Nutrition-Health Benefits And meeting consumer expectations

High Protein Content
Protein complimentary to Cereals
High Fiber Content
Rich in Phytonutrients,
Not on the list of allergens
High on Amylose content
High Resistant Starch
High Mineral Content
Low on GI and GL
Gluten free, Non GMO
Cholesterol Free
Low on Fat
Low on free sugar
Long shelf Life
High on Biodiversity

Interest in Vegetable –based ingredients is skyrocketing

Vegetable-based proteins experienced 61% growth from 2010 to 2014
One in three consumers prefers non-animal protein

Pulses help meet many of the hottest Trends in foods and beverages including

Nutrition and wellness
Clean label and formulations
Growth of Vegan diets
Sustainable sourcing

Chemical Composition Of Pulses

Pulses

| Moisture 8- 10% | Fat 2-6% | Proteins 20-25% | Carbohydrates 55 to 65% | Minerals 2-3% | Vitamins | Phytochemicals |
|--------------------|-------------|--|--|---------------------------|---|---|
| | | Structural Proteins Enzymes Peptides Trypsin Inhibitors Protease Inhibitors Hemagglutins | Amylose Amylopectin Resistant Starch Insoluble fiber Oligosaccharides Monosaccharides Arabinose rich pectins Hemicellulose Lignins Raffinose Stachyose Verbacose Ciceritol | Fe Ca Mg Zn K | Vit C Thaimine Riboflavin Niacin Folate Vit B6 | Phytic acid Flavonoids Tannins Gallic acid Saponins Phytosterols Dihydroxy Phenylalanine Glycosides Cyanogens Ployphenols Phenolic acids Catechins Gallocatechins |

This complexity, protein and starch structures, level and type of oligosaccharides, level of antinutrients change with different variety of pulses, the processing and cooking conditions resulting in a wide variety of textural and sensorial variations that are appealing to taste buds. These in combinations with wide variety of spices seem to be the essence of Indian traditional use of pulses in daily diet



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

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Rich Indian Tradition of Pulse based foods

• Different Forms of Pulses

- Whole Pulses with the husk (RTC)
- Whole pulse soaked and cooked (RTE)
- Whole pulse sand roasted and puffed, with and without husk (RTE)
- Whole pulse roasted with flattening (RTE)
- Germinated Pulses with husk, raw and cooked (RTE)
- Split and dehusked (referred to as dal) (RTC)
- Dry roasted dal (RTE)
- Dal soaked and ground to paste (RTC/RTE)
- Dal soaked, ground to paste and fermented (RTC)
- Pulse flour from dal (RTC)
- Pulse flour from roasted dal (RTE)
- Dal soaked and fried in oil (RTE)

The exact chemistry changes and the Changes in physical behaviour have Not been scientifically quantified and Correlations not established.

• Cooking (processing) conditions

- Dehusking
- Soaking
- Pressure cooking, Pot cooking
- Soaking, and wet grinding
- Soaking, wet grinding and fermentation
- Soaking and roasting (puffing)
- Soaking and flaking
- Dry roasting
- Roasting with fat (enhanced aroma)
- Extrusion, rolling and roasting or frying
- Steaming and baking

The above step necessary for
Developing commercial
technologies
For value added convenience
products

Changes in the physical and chemical Properties in the pulses on account Of these process lend very interesting Texture , flavour and sensory profiles These in combination with different spices results in several dishes that have become part of the daily Diet in India

Pulse Consumption in India

World's largest, producer, consumer and importer of Pulses

Pulses are consumed as part of daily diet, Predominantly a vegetarian country, with low per capita consumption of dairy products, thus pulses are the main protein source

Thousands of traditional dishes both savoury and sweet are made from pulses

The sensory and texture profile ,the type of spices and souring agents used (lemon, tamarind, tomato, garcinia cambogia, raw mango, yoghurt) vary from region to region resulting in a large variety of dishes.

There are regional preferences of type of pulse used. Pulses are consumed during every meal namely breakfast, lunch, mid day snacks and dinner.

Pulses are a dominant ingredient of all types of savoury snacks. This is the fastest growing market with new varieties and flavours constantly being introduced using traditional platforms

Pulse based preparations are still limited to house hold preparations and small un organised sectors catering to local markets. Thus technology development for standardising and scaling up these traditional preparations is yet to happen.

Processing and cooking still very time consuming



India : Road side all time snack



“I grew up in India and roasted chickpeas were a very common snack. I would get a paper cone full of them after school. But I never thought of them as healthy, just that they were tasty and warm and fresh.”

USA: Branded snack

CRACKED PEPPER
new! CHOCOLATE
new! THAI COCONUT
new! MESQUITE BBQ
SWEET CINNAMON
SMOKY CHILI & LIME



100% Goodness

Our roasted chickpea snacks are so darn crispy, crunchy and flavor packed that you might think they're junk food.

Not to worry, one serving has as much **protein as almonds**, as much **fiber as two cups of broccoli** and as much folate as three cups of spinach!

0% Badness

Nothing over-engineered, nothing artificial. Gluten-free, Nut-free, Vegan, Kosher, and Non-GMO. A snack that is good for ***every***body!

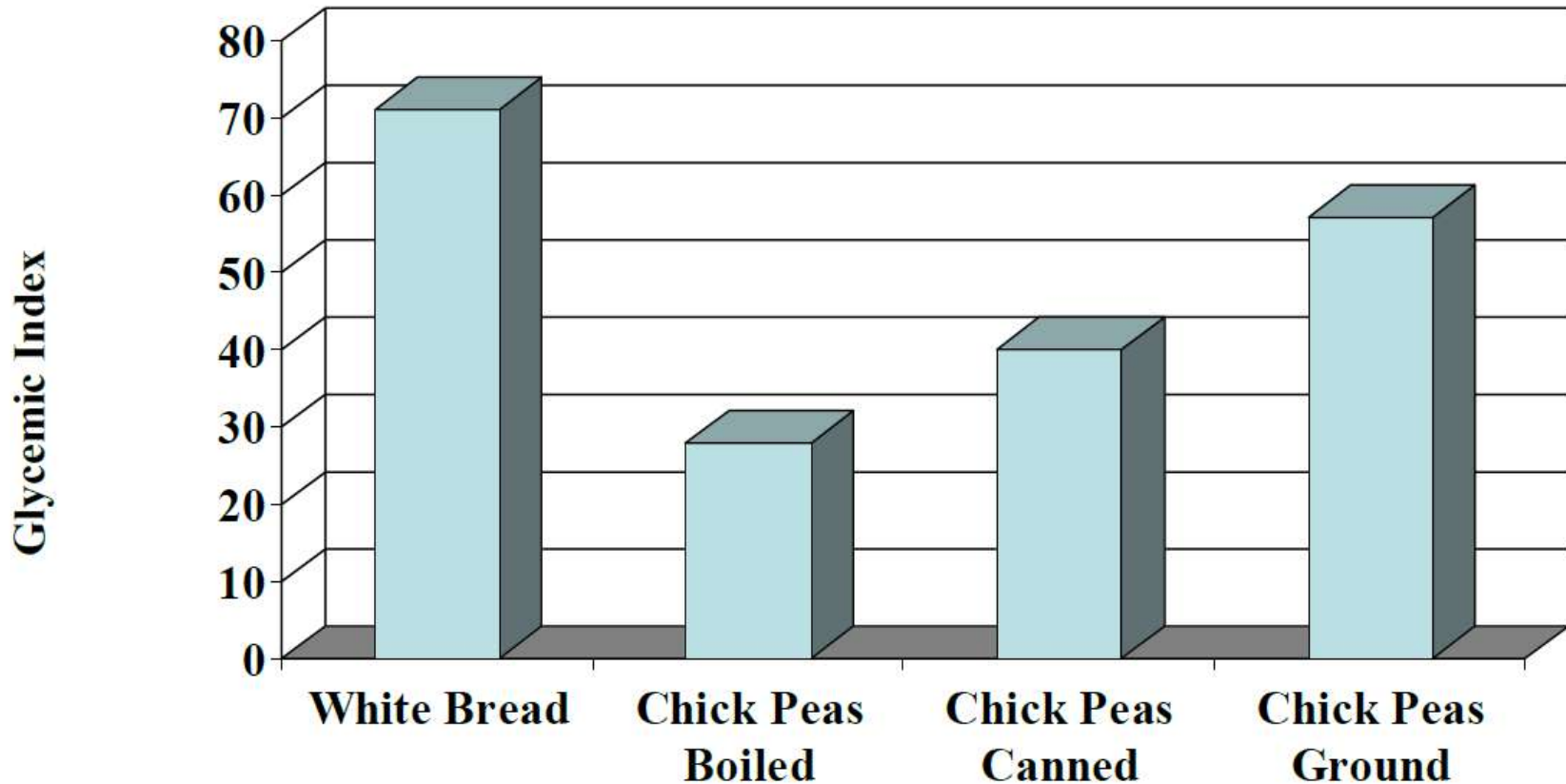
| Calories | Sodium | Sat Fat | Fiber | Protein |
|----------|--------|---------|-------|---------|
| 120 | 185 mg | 0g | 5g | 5g |

Natural (no preservatives added) all time snack, low on fat, high on protein and fiber fiber, Low GI (~30), gluten free, crispy and crunchy mouth feel and comes in various flavors

Americans are more familiar with garbanzo beans in a can or in a tub of hummus than in the snacks aisle. This form offers a convenient on the go snack, healthier option than chips

Roasting with Puffing further reduces GI of pulses

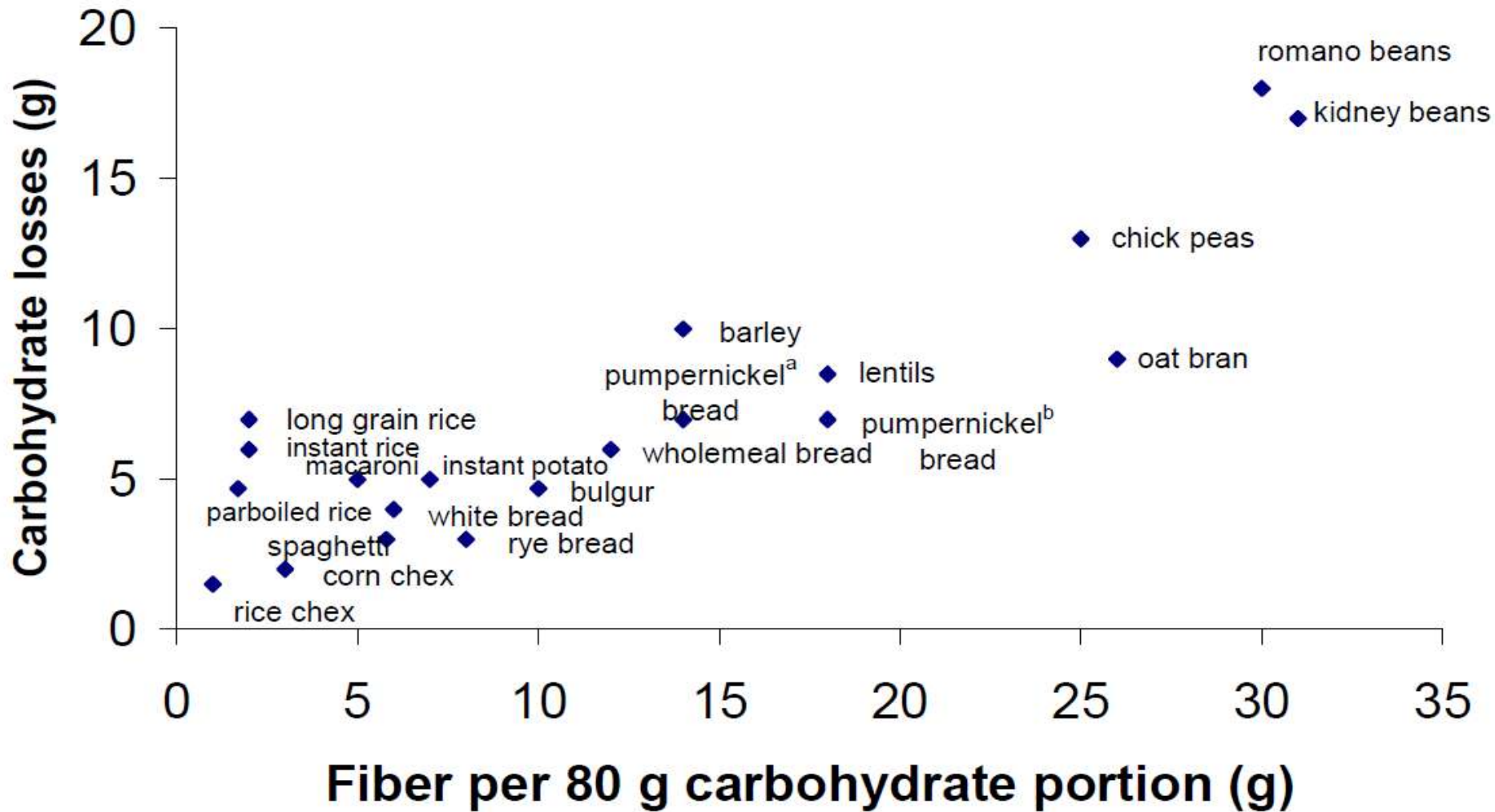
GI and Food Form



GI values of Pulses vary based on the processing conditions

High Amylose leads to formation of resistant starch during processing

Fiber Vs Carb Malabsorbed

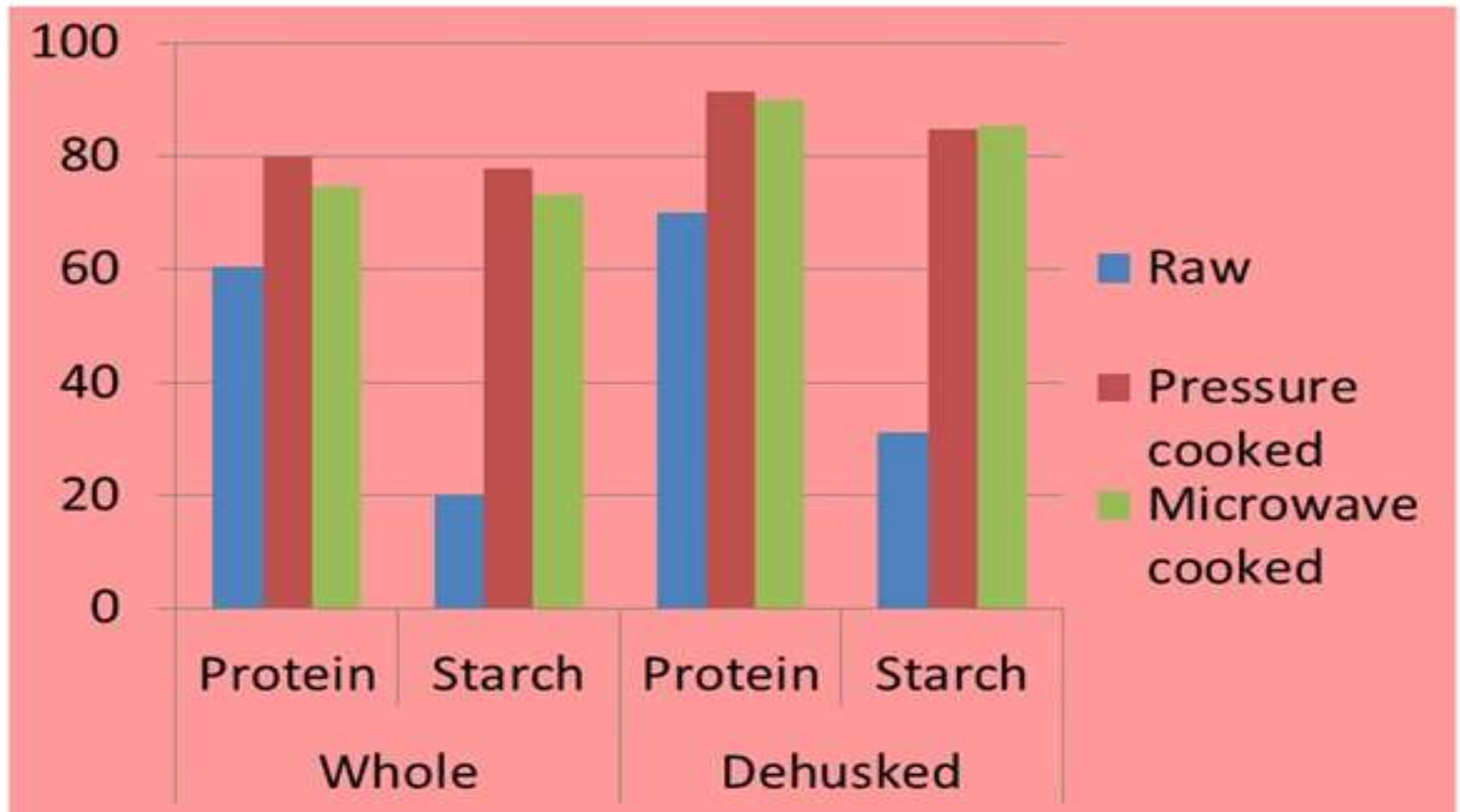


Moisture and fat content of fried Bengal gram dhal snack (%)

| Nutrient | Control | Microwave treated |
|----------|--------------|-------------------|
| Moisture | 1.65 | 0.8 |
| Fat | 28.15 | 16.01 |

Pre-treating the soaked dhal reduced oil absorption significantly in fried snack.

Effect of cooking on mean *in vitro* protein and starch digestibility (%)



Increase in TDF on cooking Pulses

Mean nutritional composition of cooked dehusked legumes (per100g DW)

| Constituent | Raw | Pressure cooked | Microwave cooked |
|-------------------|------|-----------------|------------------|
| Protein (g) | 23.3 | 22.3 | 22.3 |
| Fat (g) | 2.4 | 2.6 | 2.6 |
| Iron (mg) | 5.8 | 4.2 | 4.0 |
| Calcium (mg) | 56 | 48 | 46 |
| Thiamin (mg) | 0.43 | 0.33 | 0.28 |
| Dietary fiber (g) | 8.93 | 10.3 | 11.4 |
| Insoluble DF (g) | 8.66 | 9.68 | 11.2 |
| Soluble DF (g) | 0.14 | 0.42 | 0.36 |

Changes in Nutrition Profile of Pulses on Germination

1

INCREASES **NUTRIENT ABSORPTION** - B12, IRON, MAGNESIUM, ZINC



2

MAKES FOODS EASIER TO **DIGEST**



3

DECREASES **ANTINUTRIENTS & PHYTIC ACID**



4

INCREASES **PROTEIN AVAILABILITY**



5

INCREASES **FIBER CONTENT**



6

BREAKS DOWN **GLUTEN** FOR EASIER **DIGESTIBILITY**



7

HELPS REDUCE OTHER **ALLERGENS** FOUND IN GRAINS



8

MAY INCREASE **ENZYMES & ANTIOXIDANTS**



India

The germinated pulses are served raw as salads, with lemon , chilli and salt

Steamed, or pressure cooked and Sautéed with chopped onion, chilli, turmeric, Spices and salt and served as snack or accompaniment with rice or bread

Can be added rice preparation along with vegetables

Added to curry and served as accompaniment to rice or bread

Global

Good value addition by germination, a natural process

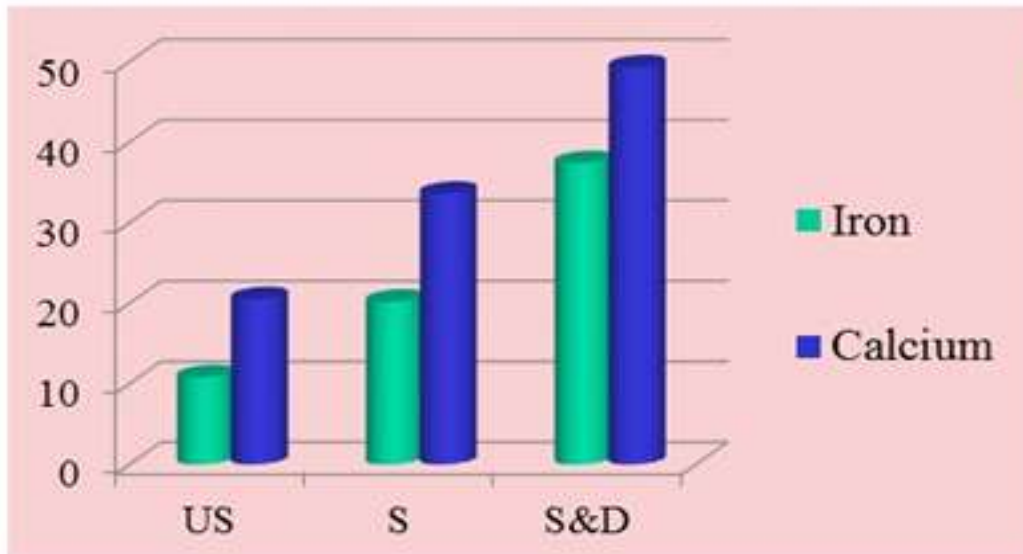
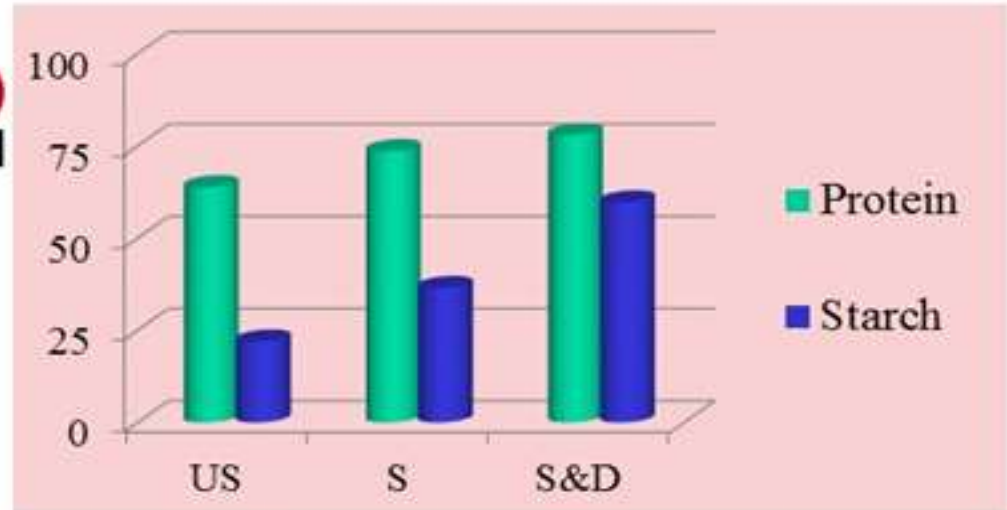
Flour from germinated, dried pulses will have better nutritional and profile, is easy to digest and different physical properties for incorporating in cakes, pasta and bread making

Germinated roasted pulses with salt and flavours as healthy snacks

Commercial technologies for germinated, dried pulses needed

Germination

Digestible protein & starch (%)
Significantly higher in sprouted and dehusked legumes.

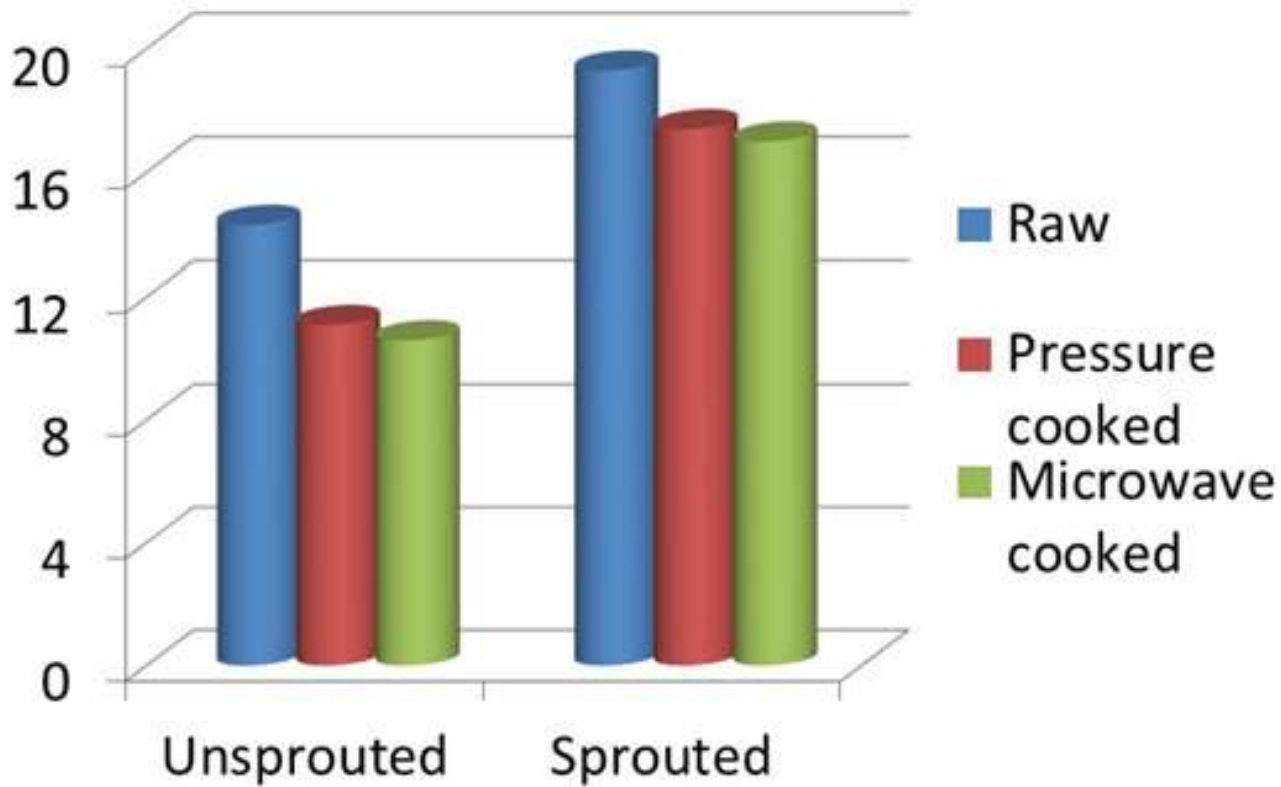


Bioavailable iron & calcium (%)
Significantly higher in sprouted and dehusked legumes.



US: Unsprouted
 S: Sprouted
 S&D: Sprouted & dehusked

Mean Bioavailable iron from sprouted & cooked legumes (as % of total iron)



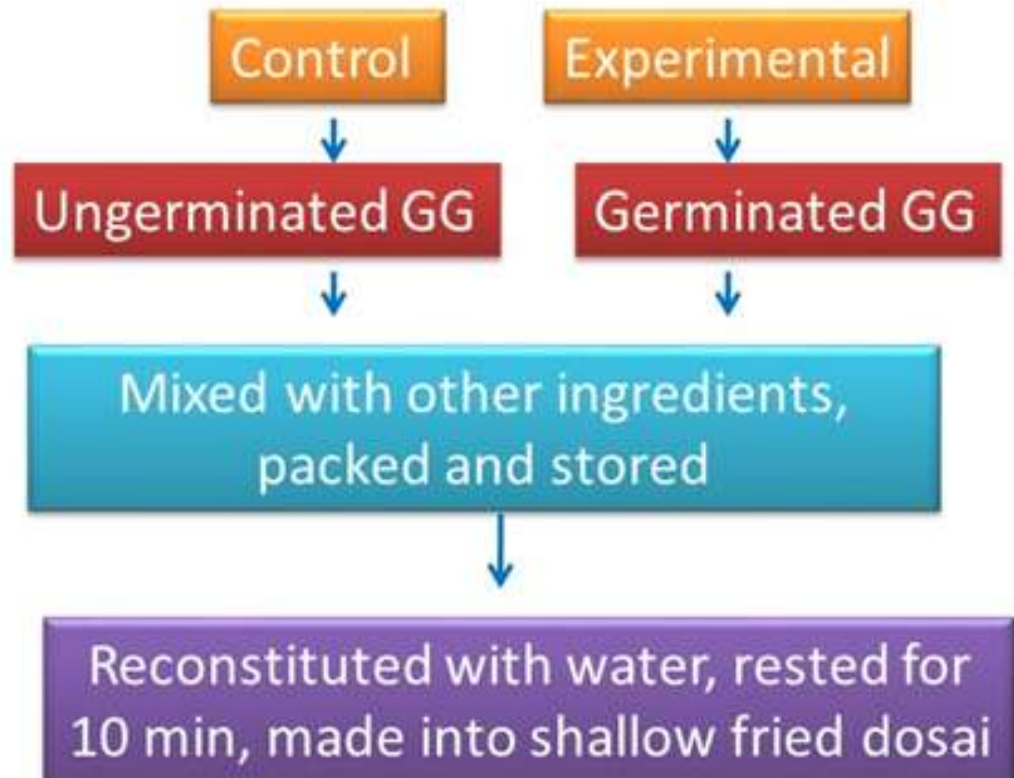
GREEN GRAM BASED INSTANT DOSAI MIX

- ‘*Dosai*’ is a South Indian breakfast item traditionally made with legume and rice.
- Germinated whole legumes are nutritionally superior and can be used in preparation of traditional products.

Ingredients

- Rice flour or wheat semolina – 50g
- Green gram flour – 46g
- Salt 3.5g
- Sod.bicarbonate 0.5g

Mix with 170ml water for making dosa.



Complémentation to improve protein quality

| Table 1 | Amino Acid Score ¹ | True Protein Digestibility ² (%) | PDCAAS ³ |
|--------------------------------|-------------------------------|---|---------------------|
| Pea (yellow, split) | 0.73 | 87.9 | 0.64 |
| Pea (green, split) | 0.59 | 85.2 | 0.50 |
| Lentil (green, whole) | 0.71 | 87.9 | 0.63 |
| Lentil (red, split) | 0.59 | 90.6 | 0.54 |
| Chickpeas | 0.61 | 85.0 | 0.52 |
| Pinto Beans | 0.77 | 76.2 | 0.59 |
| Kidney Beans | 0.70 | 78.6 | 0.55 |
| Black Beans | 0.76 | 70.0 | 0.53 |
| Navy Beans | 0.83 | 80.0 | 0.67 |
| Soy Flour | 0.92 | 83.5 | 0.77 |
| Wheat Flour* | 0.47 | 92.3 | 0.43 |
| Rice Flour* | 0.54 | 92.0 | 0.50 |
| Lentil-Wheat (25:75) Blend* | 0.78 | 91.0 | 0.71 |
| Lentil-Rice (20:80) Blend* | 0.82 | 90.0 | 0.74 |
| Black Bean-Rice (25:75) Blend* | 0.81 | 93.0 | 0.75 |
| Pea-Wheat (30:70) Blend* | 0.83 | 90.0 | 0.75 |
| Casein | 1.04 | 96.6 | 1.00 |

Share the Plate



Photo: www.foodnetwork.com

www.pulsecanada.com

¹ Amino acid score is limiting the amino acid with the lowest ratio relative to the established amino acid requirement values for humans, aged 2 to 5 years old.

² AOAC Method 991.29 (n = 10).

³ PDCAAS = Amino Acid Score x % True Protein Digestibility.

* Calculated data obtained from the 1989 WHO/FAO Report on Protein Quality.

Pulse Pasta: Tastier and Healthier

Lentil Pasta is filling, has double protein , one third less carbs and double fiber than normal pastas

Presentation format and cooking and recipes same as normal pasta.



European food manufacturers are brightening up the mature and somewhat staid dry pastas category with innovative flavours, bright colours and vegetable based ingredients

Pulses on McDonald's Menu In India



Mc Dosa : A thin Pan cake made by **fermented** rice and **black gram**

Molga Podi: Roated chick pea and roasted black gram powder flavoured with chilli and sesame seed



Big Dhokla Mac

Steamed cake made from fermented chick pea and rice paste



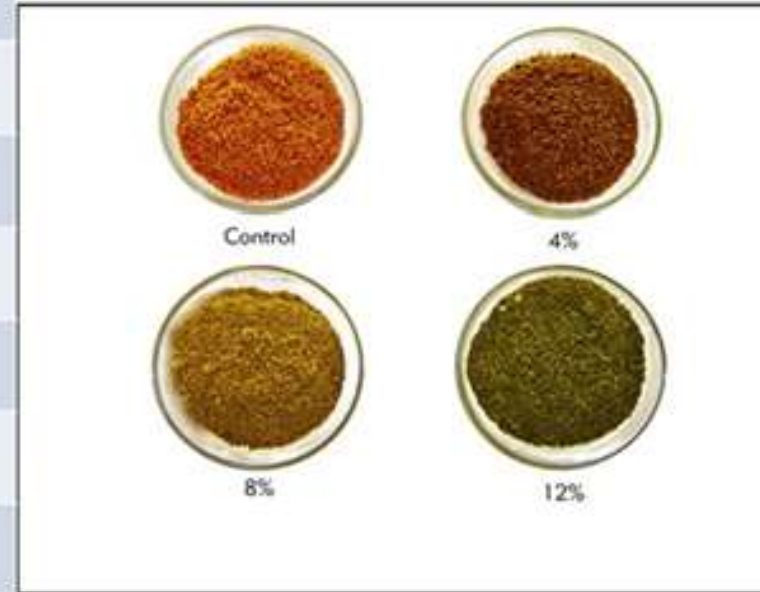
Idli MacGrill

Steamed cake made from fermented rice and Black gram served with Indian sauce (Chatni)

We continue to look at inspiration from Indian cuisine and bring it in McDonald's format

Value addition of Traditional Products: Chutney powders are dry spicy adjuncts used with meal. Generally they are legume or oilseed based. Nutritional quality of these can be improved by addition of rice bran, wheat bran, dry greens powder, etc.

| Ingredients | Amount |
|--------------------|--------|
| Bengal gram dhal | 40 g |
| Black gram dhal | 12.5 g |
| Green gram dhal | 12.5 g |
| Roasted wheat bran | 10 g |
| Dried coconut | 8 g |
| Red chillies | 4 g |
| Sunflower oil | 5 ml |
| Tamarind powder | 3 g |
| Salt | 5 g |



Dahi Vada (Bhalla): Symbiotic food

Black gram soaked in water for 4 hours, Grind to fine paste and ferment for 12 hrs

Deep fry in to small balls and dump in hot water (retrogradation)

Squeeze water and oil out of these balls and suspend them in yogurt

Serve after chilling



Prebiotic, probiotic, low fat, gluten free, phytonutrient rich
All time snack

Indian Tikki

Traditional Indian Tikki

Soak Lentils for four hours, coarse grind

Stir fry finely chopped ,
vegetables, onion, spices, mix
with above

Make burger style buns, shallow
fry or deep fry

You can also mix millets, quinoa
or other grains, flax seeds etc.



Possible Global formats

Serve as replacement for hash
brown

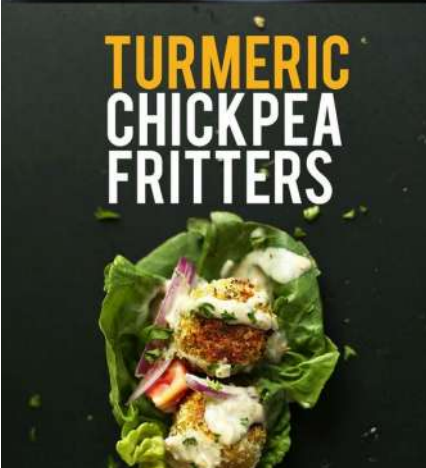
Make Veg Burgers

Frozen packs for convenience

Mixture of lentils, millets,
quinoa, flax seed meal for
balanced protein and fiber

Mix with Cheese for western
taste

Offer global spice combinations



Soaking, Grinding and shallow frying

Everything made of Beans

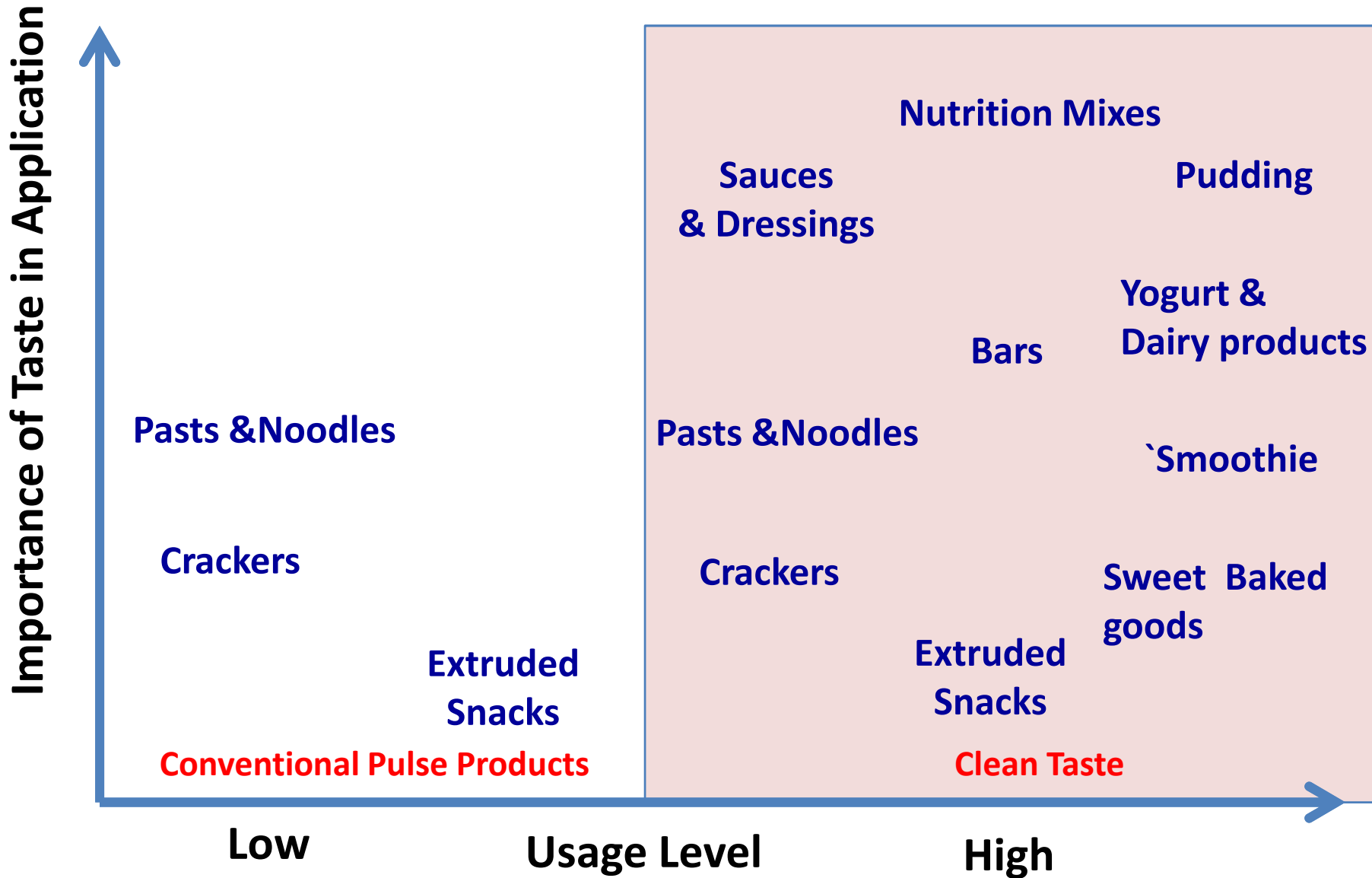
Annual Bean festival called “ Avaraekai Sante” held every January in Bangalore in the month on January

The name of the India’s IT capital means boiled beans

In this festival farmers and chefs come together to display a variety of beans and serve the consumers with a variety of dishes made from different beans.



Needs Of Target Segments



Pulse based Ingredients for Innovation

Yellow Pea, Green Pea, Yellow lentil, Faba Bean, Chick Pea, Red Lentil

Functionality

- Emulsification
- Texture
- Gelation
- Water-holding
- Adhesion
- Film-forming
- Blending

HEMECRAFT

Clean taste Pulse flour

Functionality

Enhance texture and provide
Moist mouth feel

Good Synergy with other
Gluten free flours

Increase protein

Eliminate other protein such
As egg whites, & dairy protein

VITESSENCE

Pulse Protein

Ingredient
idea labs
IDEAS TO SOLUTIONS

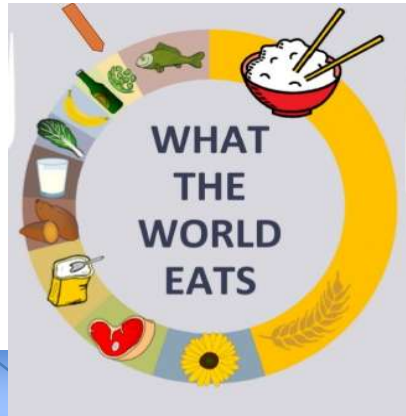


Products made from combinations of HOMECRAFT and VITESSENCE

- Extruded Puffs
- Direct expanded crisps for bars
- Granola clusters
- Bakery products (Bread, Muffin, Cake)
- Gluten free Pizza base
- Gluten free Tortilla
- Cracker
- Gluten free savory (add on to soups)
- Batter for Chicken
- Egg white replacement for past
- Pudding
- Yogurt
- Smoothie
- Nutrition Beverages



Pulses : Products with Global appeal



**Traditional knowledge of pulses
In the world
Especially India**

**Chemistry and functional properties
Of Pulses and their manipulation**

**Innovative Foods based on Pulses
To Increase Pulse consumption**

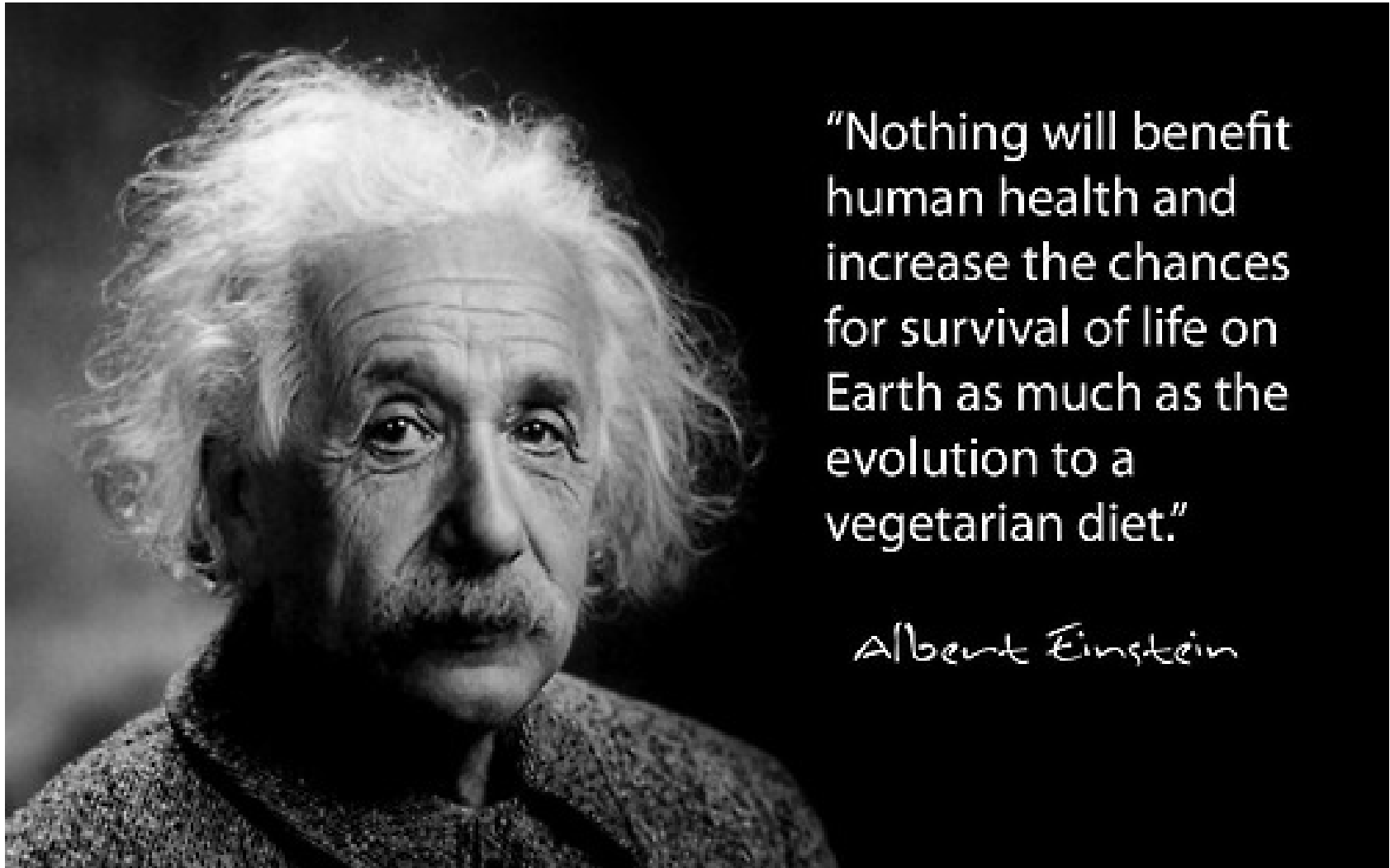
**Modern food processing
Technology
And formats**

**Dynamics of ever changing
consumer trends and appeal**

Pulses : Image needs to Change

- **Not Aspirational**
- **Not the hero ingredients**
- **Usage convenience a challenge**
- **Negotiable as part of the Thali**
- **Does not fit in to the trendy foods**
- **Green revolution completely missed them**
- **Not part of PDS**
- **Does not make to the list of essentials for fortification**

Value added products, trendy, convenient and part of Thali



"Nothing will benefit human health and increase the chances for survival of life on Earth as much as the evolution to a vegetarian diet."

Albert Einstein

Thank You

