

# **New Product Development**

## **HIGH PROTEIN TORTILLA**

**Incorporating Plant Based Protein**

**A Look at Pulses, Legumes & even Fungal**

Appendix 1: The Protein Brewery

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Both serve on Tortilla Industry Association Europe Committee



# The Story

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**Someone Once Said ...**

***‘ Food First then Morality ’***

***Bertolt Brecht (1898-1956)***

*German dramatist, poet. "What Keeps Mankind Alive?"*

*Act 2, sc. 6, The Threepenny Opera.*

*‘ Men do not despise a thief,  
if he steal to satisfy his soul when he is hungry... ’*

*Proverbs 6:30*

# Need for Protein

## Globally; Dietary Trends



# Case for Alternative & Plant Based Proteins

## 1) The Requirement:

### Global Protein Nitrogen Demand

- Sustaining ~10 billion people by 2050
- Can livestock be scaled\*?
- Can we avoid food waste?
- Plus a contribution from plants?

## 2) Recent Consumer Market Trends:

### Vegan Trend shift to eating less meat:

- Meat-free Mondays + Veganuary

Vegetarian → Vegan + Flexitarian = Product Demand

Incidence 7.5% 1% (2% recovering) 15%

- **Trail Blazers Oatly, Beyond Meat, Impossible Foods**

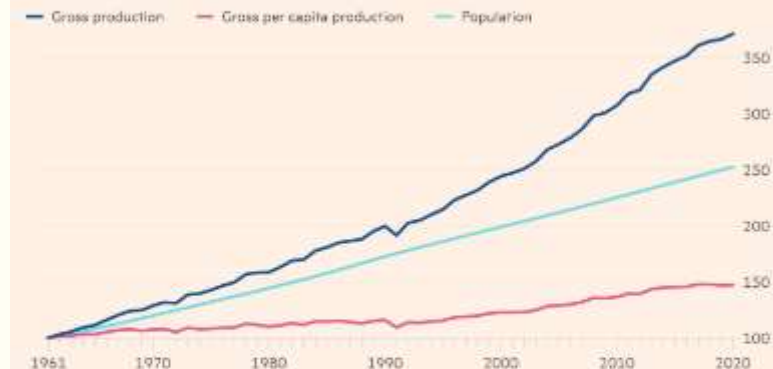
- Huge stock valuations, but **no** profits and now lay-offs ☹️

\* *Sustain: Note role in carbon fixation for grass-fed livestock*



Global food production has outstripped population growth over the past 60 years

World food production and population (Indices, 1961 = 100)



Source: FAO  
© FT

... and all but the poorest countries are now self-sufficient in food, according to the FAO's definition, producing enough calories to meet basic dietary requirements.

# Case for Higher Protein

## 3) Current Trends - Paleo, Keto, #NSNG #LCHF: Low Carb Healthy Fat Lifestyle

- Low fat dietary guidelines 40 years ago put more carbohydrate & sugar into Western diets
- Seed oils high in Linoleic acid: pufa was heart healthy...  
= Metabolic dysregulation
- Rehabilitation of sat. fats; hi oleics **Zero Acre Farms**

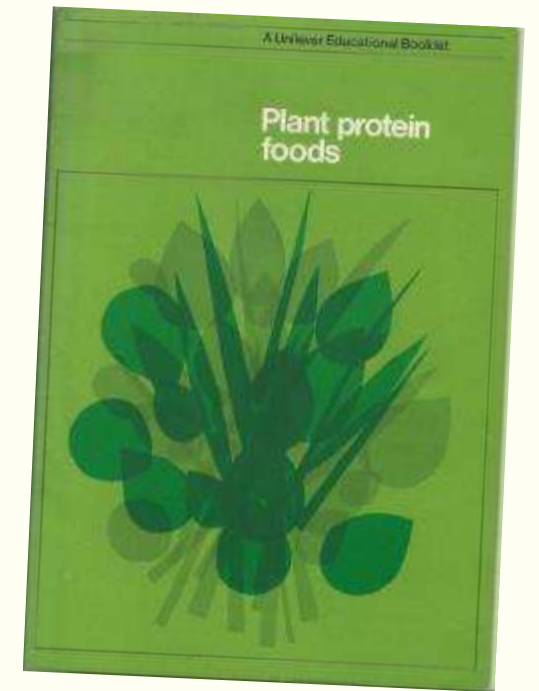


- ## 4) DiaBesity tidal wave = vast healthcare need
- Eliminated by low carb approach: LCHF lifestyle (*Virta Health, USA*; Dr David Unwin, UK)
  - More **protein** required as dietary intake increases



# **Legislation & Regulation**

## **On-Pack Nutrition Labelling**



# Key Macro-Nutrients – 3

## On-Pack Nutrition Declaration

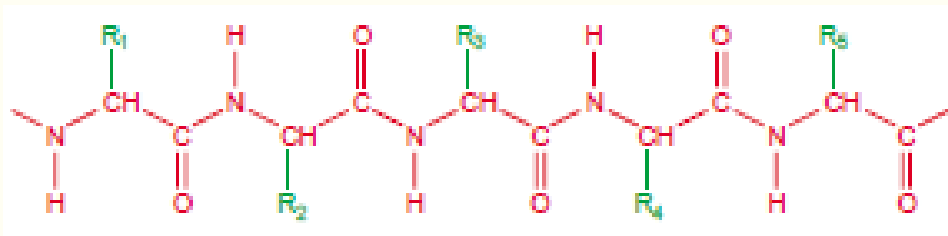
- **Carbohydrate:** C, H, O : Bread, rice, tapioca
- **Fat:** C, H, O : Butter; olive oil; lard

## Protein is different

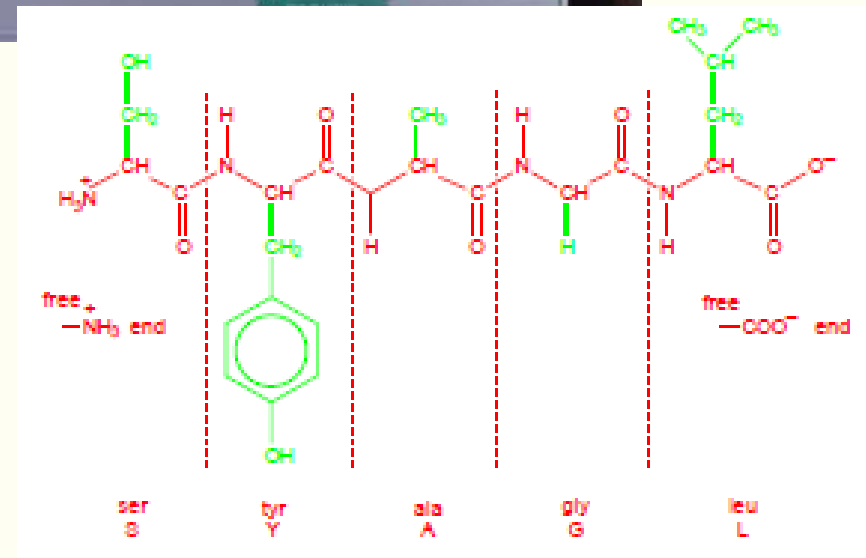
- **Protein:** C, H, O & N + S : Eggs, meat; lentils
- N.B. The body can't store protein !!!**

## Polymers of ~22 Amino Acids

- Nitrogen in – N-C-C polymer backbone



- **Zwitterionic:** Zero charge – but a balance of +ve and –ve  
- NH<sub>2</sub>RCHCO<sub>2</sub>H equilibrium with NH<sub>3</sub><sup>+</sup>RCHCO<sub>2</sub><sup>-</sup>
- **Amphoteric:** May act as both acid & base
- Depends on pH...





# Nutrition Labelling

**Food Protein Content:** Mandatory information in the **nutrition declaration** on food labels

- Regulation (EU) No. 1169/2011
- For labelling, average adult protein reference intake (8400kJ/2000kcal) is 50g/day

Nutrition label (100g / 25g serving)		Per 100g	Per 25g
Energy (Energie) / Energi / Energia / Energie / Энергия	4240 (1060kcal)	4240 (1060kcal)	1060 (265kcal)
Fat (vet) / Vets / Matieas grasses / Vet	1.4g	1.4g	0.35g
of which saturated (of wien gesättigte / eetsäuren / waarvan verzadigd / jossa / jystettyitä / soort woden gras saturés / waarvan verzadigd)	0.4g	0.4g	0.1g
Carbohydrates (koolhydraat) / Kohydrat / Hiilihyaatti / Carbs / Koolhydraten	7.5g	7.5g	1.87g
of which sugars (of wien suiker / vanas sockerarter / josta sokerista / vanas / waarvan suikers)	0.0g	0.0g	0.0g
Fibre (vezel) / Fiber / Kuitu / Fibres alimentaires / Vezels	1.5g	1.5g	0.37g
Protein (Eiwit) / Proteini / Proteines / Eiwit	20.5g	20.5g	5.12g
Salt (Zout) / Suola / Salt / Zout	0.0g	0.0g	0.0g

## ‘Complete’ Protein (or whole protein)

- Contain adequate amount of all 9 Essential Amino Acids:-
  - **Isoleucine; Leucine;** Lysine; Methionine; Phenylalanine; Threonine; Tryptophan; **Valine;** Histidine
  - Conditionally essential in children: unable to make enough Arginine; Cysteine; Glutamine; Proline; Tyrosine
- Branched Chain Amino Acids (BCAA):
  - **Bold:** 3 Proteinogenic BCAA’s, with aliphatic side-chains
  - **‘Leucine Trigger’** For sport recovery – supports protein & muscle synthesis

# Nutrition RDI & Quality

## Protein: Recommended Daily Intake USA / UK

- RDA (CDC) is ~**13g** / day for a child (1-3 years);  
**56g** for an adult ~0.8g / kg daily → 1.2-2g / kg if active

## Digestibility

- **Biological value (BV)** measures proportion absorbed from food, incorporated into body proteins
- Speed of uptake important for nutritional products
  - Plant '**Matrix**' inhibits absorption...
- **PDCAAS**: Protein Digestibility Corrected Amino Acid Score (WHO 1993), superseded by DIAAS  
Maximum score = 1 [truncated] for complete protein:-
  - Casein; egg white; soy; whey
  - 0.99 mycoprotein; 0.91 soybeans; 0.82 yellow peas

Protein Source	PDCAAS Value*
Casein	1.00
Egg White	1.00
Soy Protein Concentrate	0.99
Rapeseed Protein Concentrate	0.93
Soy Protein Isolate	0.92
Beef	0.92
Rapeseed Protein Isolate	0.83
Pea Protein Concentrate	0.73
Kidney Beans	0.68
Peas	0.61-.068
Pinto Beans	0.57-0.63
Rolled Oats	0.57
Black Beans	0.53
Peanuts	0.52
Lentils	0.51-0.52
Whole Wheat	0.40
Wheat Gluten	0.25

\*These values are from the Report of the Joint FAO/WHO Expert Consultation on Protein Quality Evaluation

# Nutrition Claims

## EU: Nutrition Claims

### Source of Protein

- A claim that a food is a source of protein, and any claim likely to have the same meaning for the consumer, may only be made where at least **12%** of the energy value of the food is provided by protein

### High Protein

- A claim that a food is high in protein, and any claim likely to have the same meaning for the consumer, may only be made where at least **20%** of the energy value of the food is provided by protein

### Bakery Example

#### *'Source of Protein'*

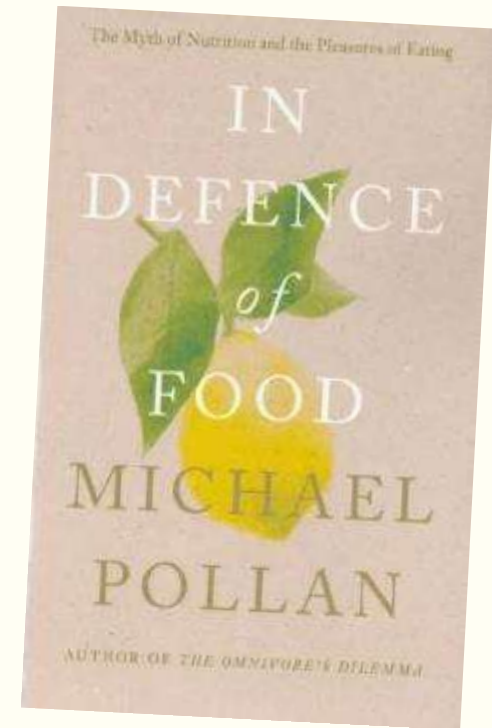
- Brown wheat bread:
  - 236 kcal/100 g
  - 9.8 g protein (= ~ 39 kcal)
  - **12% energy** = 28.32 kcal

#### *'High Protein'*

- Wholemeal bread:
  - 236 kcal/100 g
  - 9.8 g protein (= ~ 39 kcal)
  - **20 % energy** = 47.2 kcal
- So add 2g protein (= 8 kcal)

# Plant Based\*

## Alt Protein Selection ...



\* p.163 & 5, 2008

# Plant Based - Since?

- After Dairy: Butter, milk, eggs & cheese  
Historically **all** ingredients were plant based
  - Nuts
  - Spices
  - Flour

- Victorian Industrialisation
  - Roller milling flour
  - Sugar
  - Vegetable Fats
  - Cocoa
  - Fry's Cream Sticks, 1853

- Processing: Cottonseed Oleomargarine (Mark Twain *'Life on the Mississippi'* 1883)
  - Branded from ~1911: Crisco

- **Proteins:** Soy (press cake) since the 70s
  - Big Food corporations thinking about the future: *'Feed the World'*  
Unilever, ICI → Quorn (suggested Egg white binder!)

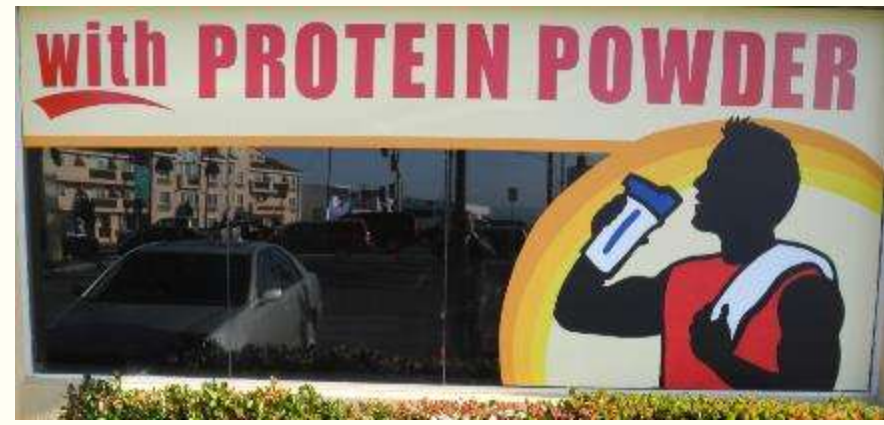


Lipton ad. 1914

# Consumer Products Depend on Ingredients



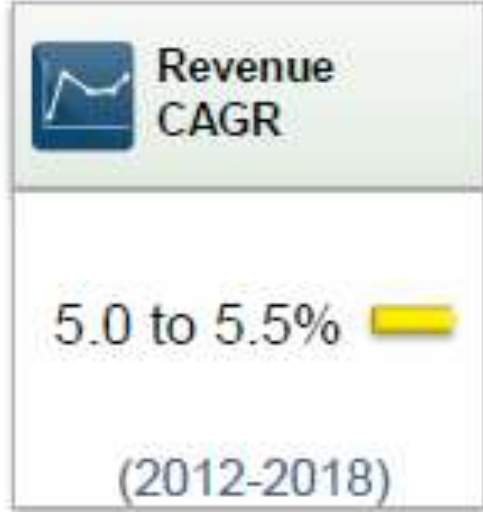
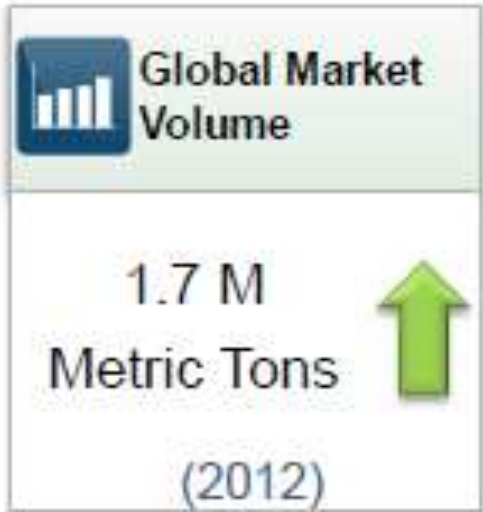
Plant Based Protein, shakes and milks



Pea, rice and coix protein powders



# Global Plant Protein Market: Decade Ago 2012



- **Soy:** 66%
  - SPC 27%
  - SPI 15%
  - TSP 14%
- **Wheat** 43%
- **Other** 1%
- **Pea** !%
- *Pulses, fava & mung beans, lentils etc. don't figure*

Source – Frost & Sullivan analysis, Presentation at Global Food Forums, 2013

# Macro-Nutrient: Protein

2 Types usually required\* :-

i) **Commodity Bulk Protein:**

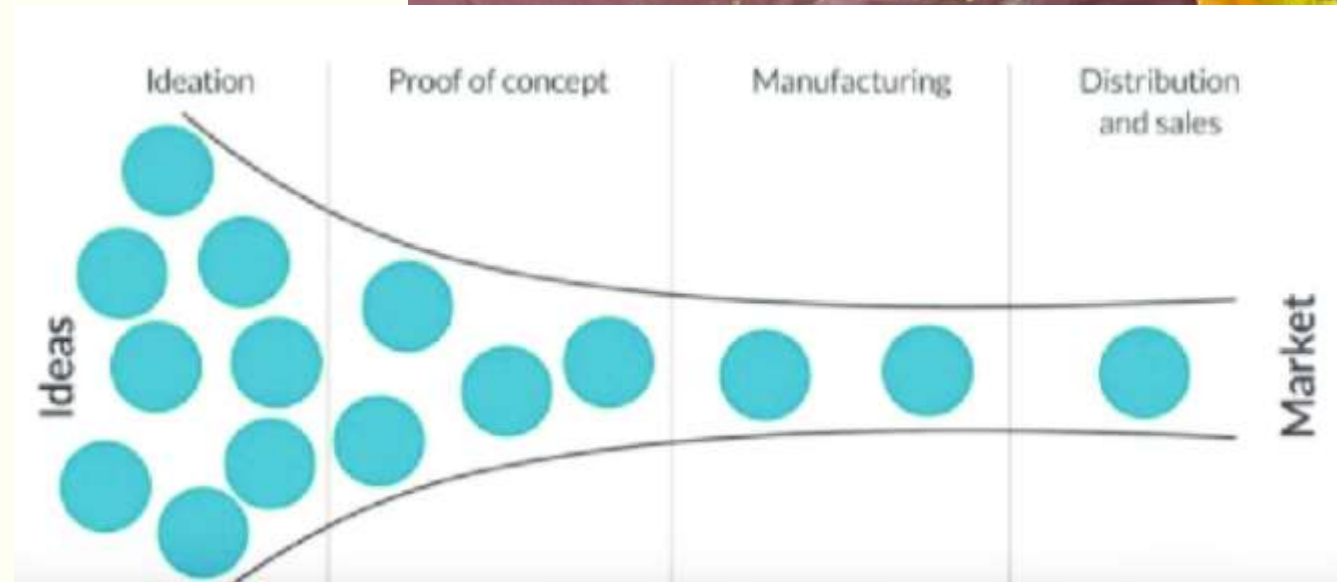
- Supports macro-nutrient protein content
- Application range ~ 4 - 12+% e.g. Gluten

ii) **Speciality Functional Protein:**

Structure, texture & taste

- Higher Solubility permits **Foaming, Emulsifying & Gelation**
- Application range ~ 1 - 4% e.g. Think Egg White

**Issues:** Colour, taste & smell ...



\* Except Nutrition: where purity % x aa profile (Taste less of an issue)



# Functional Hierarchy

## Value Hierarchy

**KEY  
SLIDE**



**1) Fermented / Cultured Proteins:** ← Sterilised = denatured:  
Quorn, algae & insoluble potato Functionally inactive

**2) Cereal Grains:**  
Wheat, oat, rice barley etc. ← Some solubility: gluten functionality, low lysine

**3) Oilseed Press Cake:**  
Soy, canola, hemp, sunflower ← Often heat treated [solvent oil extracted]

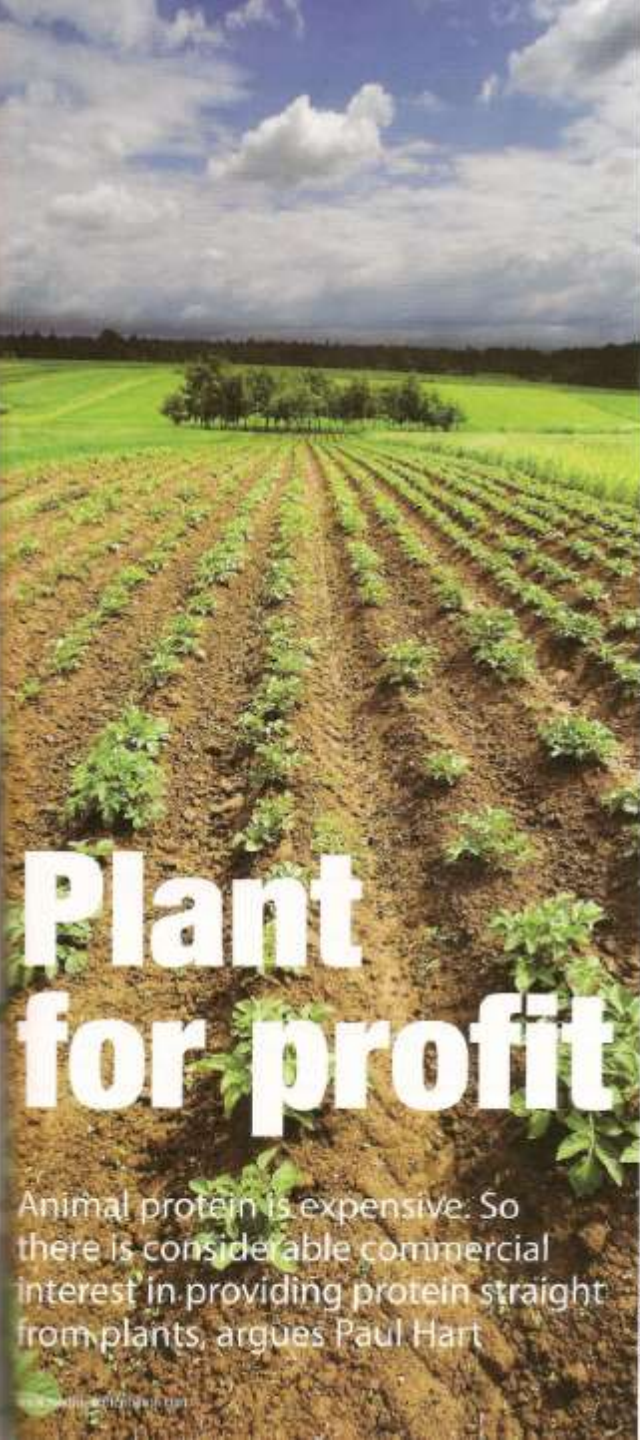
**4) Legume Proteins:**  
Pea, mung, faba, chick pea ← Fermented to improve taste = hydrolysate; low met & cys

**5) Hi Functionality Protein:**  
Potato, RuBisCO, SCP,  
Engineered proteins etc ← Cold aqueous separation of whole cell protein  
Hi functionality; thermo-set gelation  
Nano-Filtration + Ion Exchange

**REMEMBER :**

***There's No Starch, Complex  
Carbohydrate or Fibre  
in Meat, Fish, Dairy, Eggs or  
Cheese***

... Hence a Big Opportunity for High Protein Bakery!  
Seamless Fit!



# Plant for profit

Animal protein is expensive. So there is considerable commercial interest in providing protein straight from plants, argues Paul Hart

## Vegetable proteins

**D**espite the fact that 80% of the atmosphere we breathe is nitrogen, nature has not blessed us with a convenient molecule to do for nitrogen what haemoglobin does for oxygen – collect, store and circulate it. Thus we need a regular intake of protein to provide vital nitrogen in a convenient form for our metabolism.

Protein is essential for life and required for new cell growth and tissue repair. Adequate intake is particularly important during growth, or when we're stressed through athletic activity. Protein quality is expressed as biological value. This is assessed by the quantity of eight essential amino acids the body can't make. These are: isoleucine; leucine; lysine; methionine; phenylalanine; threonine; tryptophan and valine. Children also need histidine.

A protein supplying all the essential amino acids has a high biological value – milk, casein, egg albumen and soya are examples. Cereal proteins tend to be low in lysine and legumes low in methionine, although plant breeding can improve levels.

Beside nutritional value, digestibility may also be quoted – this indicates availability to the body. Here plant protein is considered slightly inferior to animal protein. Beyond nutritional enrichment of food, certain plant peptide isolates may help satiety – appetite reduction for weight control.

Western diets are high in animal protein which involves an expensive and slow transition from plants, through grass and grain, into meat – which also delivers saturated fats. So there is considerable interest in providing high quality protein from plants. It also makes economic sense since the rising global demand for protein cannot be sustained from meat and fish.

Beside nutrition, proteins are a functional ingredient added to food, where they control water and fat binding. They help emulsification and provide texture control through whipping and gelation. Increasingly, plant proteins can provide all these functions. They are also lactose and cholesterol free and come in grades with kosher and halal certification. Processing quality helps remove anti-nutritional factors such as tannins, phytates and lectins, trypsin inhibitors and phytosterols.

**PLANT OPTIONS**  
The world's chief oilseed crop, soya has a good biological value and is the standard against which other plant proteins are benchmarked. Textured vegetable soy protein has been on the menu for over 20 years and soy milks have built up a substantial representation in the chilled dairy sector. Soy represents the

# Plant for Profit FIHN Autumn 2007 – Author writes –

- Key Points: -**
- Soy is plant protein market leader, but has issues: allergen, ANF**
- Pea (EU) cites Cosucra & Roquette [Water absorption often associated with starch!]**
- Canola: cites Burcon NutraScience [After 14 years now: DSM CanolaPro® 2022 on!]**
- Potato: Solanic cited just as author joins**

## Vegetable proteins

nutritional ideal for vegetarians. Soy flour is predominant in bakery for its lipoygenase bleaching activity as well as for a range of protein concentrate isolates.

European consumers have only recently been exposed to soy in quantity, hence its allergen status on product labelling – but that also goes for milk, eggs and wheat. Other consumers also like to know about the supply chain, in case their food contains genetically modified (GM) ingredients.

Recent health studies have also claimed that phytosterols could cause male testosterone to fall – termed an anti-nutritional effect. So despite soy's dominance, natural alternatives are sought.

**PEA PROTEIN**  
Yellow split peas are a popular northern European crop across France, Belgium and the UK. One of the traditional crops, peas combine starch with protein and being a legume they fix soil nitrogen and don't require much support from chemical crop protection. Also peas are not on the EU list of allergens.

Cosucra's Pisane pea protein isolate with a balanced amino acid profile is GM-free, low in anti-nutritional factors, and can be labelled as "vegetable" or "pea protein". With a protein content of 90%, it can be used to correct or increase the protein content of a recipe, and it is lower in anti-nutritional factors compared to soy.

Nutritionist Helena Hall, account manager with Cosucra's UK agent, says: "We have noticed an increased interest in ingredients for weight management, sports nutrition and appetite reduction products. Pisane offers food manufacturers a near complete amino acid profile. "Unlike soya protein, pea protein is a clean-label product, allowing the food industry to offer a unique product to consumers with real health benefits. It is high in lysine and arginine, amino acids which help maintain lean body mass and increase muscle mass whilst reducing body fat."

Since the end of 2006 Roquette has also been progressing its Nutralys pea protein, citing excellent water and fat binding with high nutritional value. And its digestibility exceeds de-hulled pea flour. The non-dusting powder is easily dispersed and has a good solubility across a wide pH range.

Roquette senior market development manager Bruno Gehin says: "Nutralys has high functionality and can partially or totally replace other proteins – for example to reduce water loss in sausages and improve juiciness.

Higher in lysine than soya, it's also high in arginine, the branched chain amino acids good for sports recovery." Roquette's extraction process eliminates most of the



Peas a source of clean-label protein

legume off-taste to give a clean taste in most applications. It works well in bakery and is being looked at for ice cream.

**CANOLA**  
The North American variety of rapeseed, canola, is grown world-wide. After oil extraction it leaves a protein-rich meal. Winnipeg-based Burcon NutraScience is developing the application and has patents around extraction and purification. Fractionation is achieved through a process using few chemicals.

It is considered environmentally friendly and an alternative to the existing industry standard iso-electric precipitation. Burcon's extraction depends on an ionic shift with water and salt, to yield pure protein isolate micelles.

The firm, which is working with ADM to commercialise canola protein to compete with soy, dairy and egg proteins in prepared foods and nutritional supplements, is now preparing to make a Novel Food application to gain access to the European market.

Toxicology studies are also underway in order to apply for GRAS (generally recognised as safe) status in the UK, says the company. "The required scientific studies will be initiated within the next quarter."

The world's second largest oilseed crop after soybeans, canola has a high level of protein purity without high fat levels, while its amino acid content is comparable to animal proteins and superior to soy. Its high protein efficiency ratio is double that of soy, according to Burcon. The

### The rising global demand for protein cannot be sustained from meat and fish

cholesterol-lowering and antioxidant activity of canola protein are also well-documented.

Burcon's protein will complement soy, dairy and egg. Indeed the protein mimics many of the functions of egg white. However, for Europe the novel foods process will present a regulatory hurdle. While rape oil has a history of human consumption, this is not the case for rape protein.

**POTATOES**  
So far we have considered seeds, now let's look at a root crop, the potato. The potato is 18% starch and 2% protein, but starch giant Avebe has established a new company Solanic to fractionate and purify potato protein down stream, following starch extraction. With the world's number one potato starch company behind it, Solanic has an immediate advantage of scale and breadth.

Frank Goovaerts, Solanic's director of commerce, says: "Protein recovered from seeds suffers through the natural drying process, which lowers quality. Potatoes are moist, growing in the damp soil.

"With innovative processing we can recover excellent quality protein with extremely high functionality." Simply put, the original potato protein is not lost by drying out.

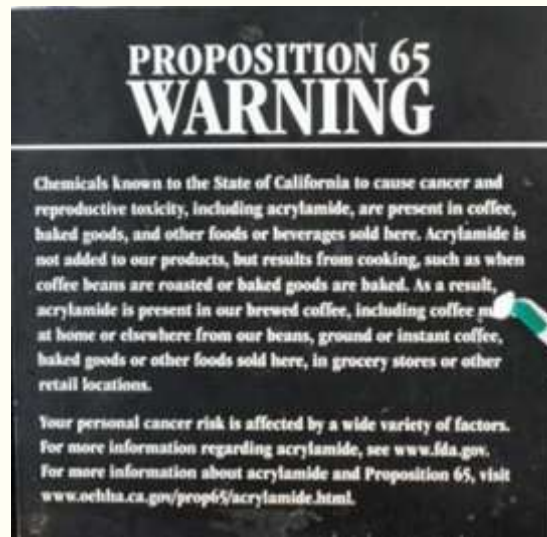
Nutritionally the potato's profile can't get any better for a plant protein, putting oven soy in the shade. Perfectly natural, potato has no allergen status. Depending on the fraction, functional properties such as solubility, emulsification, foaming and gelation at least match or even exceed the best animal or other plant proteins.

Paul Hart is general manager of ingredients consultancy NutraScience Ltd. Contact him at: paul.m.hart@topensworld.com

# Anti Nutritional Factors (ANF)

- **Soy:** Phyto-estrogens, Trypsin Inhibitors (TIA)
- **Wheat:** Mycotoxins
- **Pea:** Galactosides, phytic acid, TIA
- **Potato:** Glycoalkaloids, TIA
- **Rape (Canola):** Erucic acid
- **Red Kidney Beans:** Phyto-haemagglutinin (Lectin)
- **Rice:** Heavy Metals (As); Microbiology
  - Cal. Prop 65 compliance
- **Cotton:** Gossypol

Typically: Heat inactivated  
or leached out



## Regulatory Permissions:

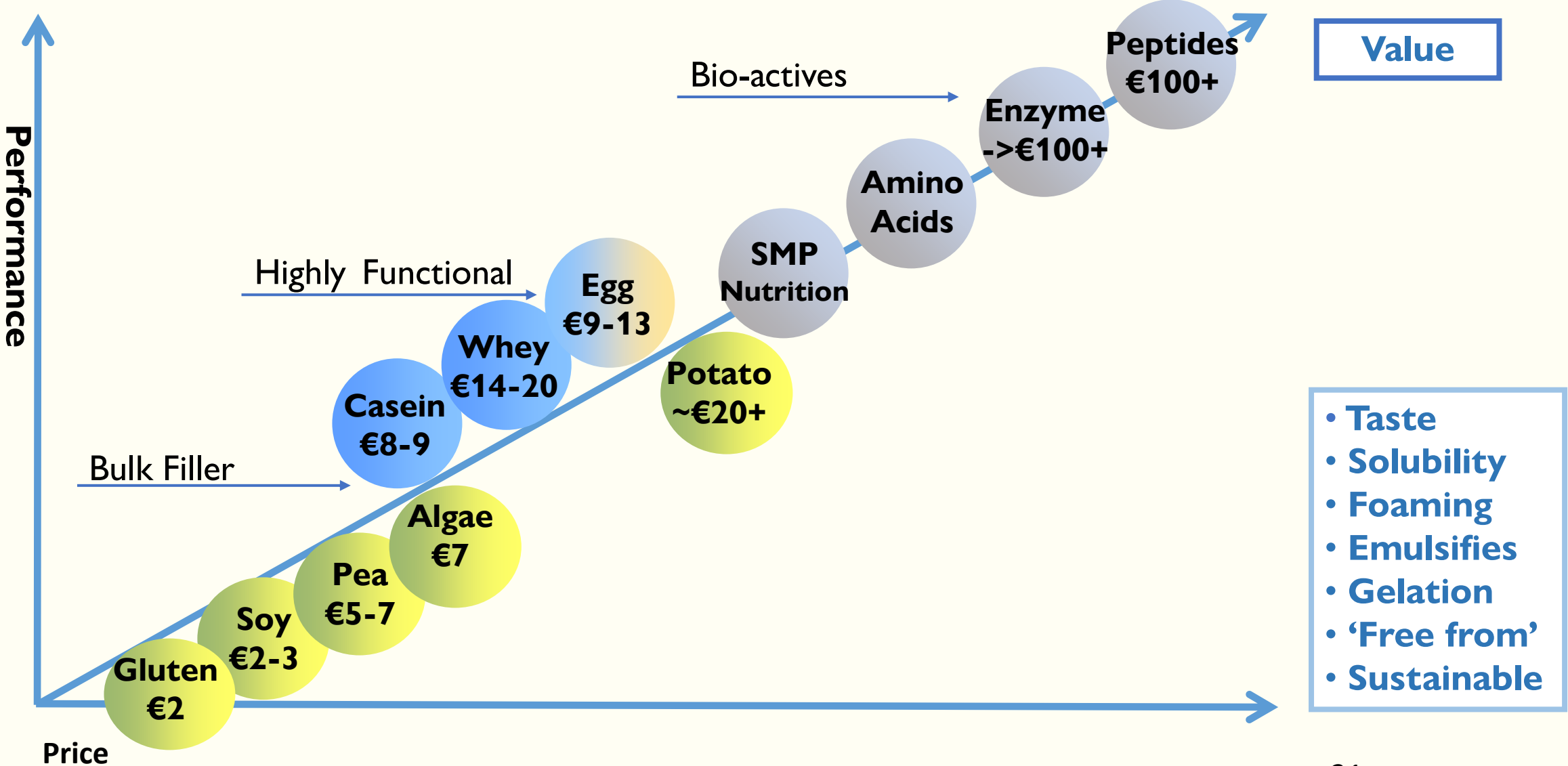
If novel, by territory

- **EFSA:** Novel Foods?  
No consumption history pre-1997
- **FDA** Self-Affirmed GRAS  
**FDA** Approved GRAS

## Contaminants: Cal Prop 65

- **Heavy Metals** Pb, Ca, Hg, Sb
- TIA, lectin, tannin, phytin, saponin and oxalate – are Heat Reduced
- Myco-toxins; Dioxins etc.

# Purity: Performance x Price



# Protein Ingredient Valorisation

Agropur 'biPro' whey:  
97% pure via ion exchange



**Valorisation:** Based on 3 key aspects : -

- i) Purity
- ii) Amino Acid Profile
- iii) Functionality

**Purity:** Flours ~34%    **Concentrate:** 60 - 80%    **Isolate:** 80+%

## For Nutritional Applications:

- Protein Quality: Amino Acid Profile x Purity
- Absorption: BV; PDCAAS [DIAAS], allergens, ANF
- 'Complete' Protein; BCAA level
- Solubility: also **Fast** (whey) / **Slow** (casein) digestion



## Heliaflor® Amino acid profile (mean values in g/100 g)

Amino Acid	45 %	55 %
Asparagine	4.26	5.10
Threonine*	1.65	2.00
Serine	1.78	2.21
Glutamic acid	9.26	11.38
Proline	2.08	2.46
Glycine	2.79	3.41
Alanine	2.02	2.55
Valine*	2.55	3.07
Methionine*	0.94	1.14
Isoleucine*	2.13	2.52
Leucine*	2.95	3.62
Tyrosine	1.17	1.41
Phenylalanine*	2.25	2.68
Lysine	1.55	1.95
Histidine	1.14	1.46
Arginine	3.77	4.90
Cystine	0.51	0.68
Tryptophan	0.43	0.96

\*= essential amino acids

**Functional Properties:** Solubility: Foams; Emulsifies & Gels

**Plant Proteins:** Sustainable: but shift from animal depends on:

- Taste x Texture + Nutrition + Functionality
- Cost-in-use Vs Market Position

# Protein Isolate Functionality

## Hierarchy

- **Isolate Purity: 85+%**

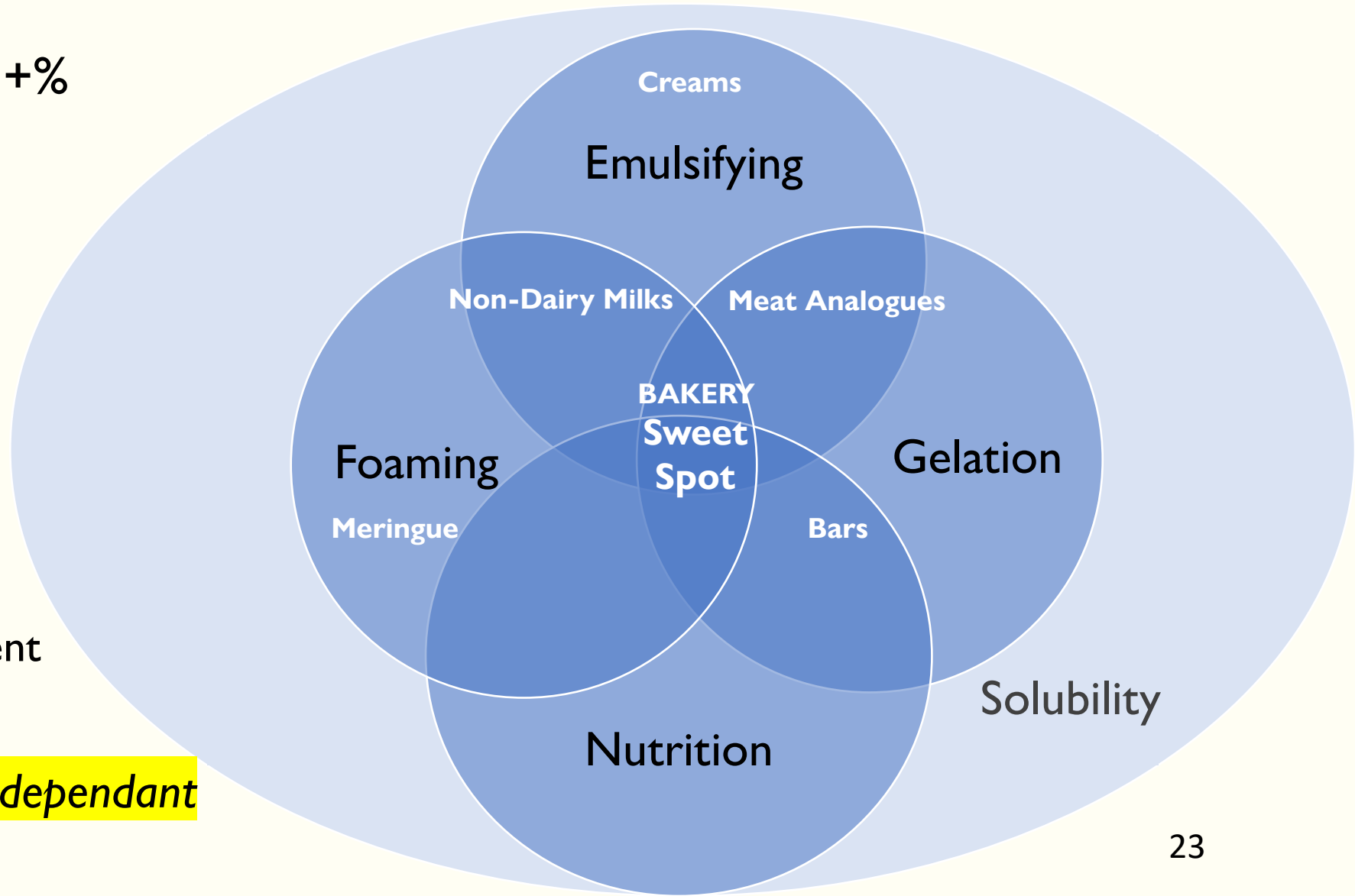
- **Solubility\***

Water binding

- **Foaming**
- **Emulsifying**
- **Gelling**

- Texture Development
- ? In Combination ?

- ***N.b.\* Iso-Electric-point dependant***



# Key Consumer Trends

**Natural**    **Free-From**  
**Ultra-Processed**

**Clean Label**





# Trend Definitions

## All about 'Real Food'

- **Natural**: No regulatory definition anywhere  
But we all know what it means
- **Defining 'Natural':** -  
'... **Real food does not come in a box,**  
and no-one should have to tell you real food is **naaa-tural**  
you should know that when you look at it!' ...
- **Virta Health's Dr Sarah Hallberg** at 12:20 in  
'Reversing Type 2 diabetes starts with ignoring the  
guidelines' TEDxPurdueU <https://youtu.be/da1vvigy5tQ>



# 'Free From' Allergens



**Free from** means no food **Allergens: 14 EU** (or intolerances)

**Celery**

**Crustacea**

**Egg**

**Fish**

**Lupin**

**Milk (Lactose)**

**Mustard**

**Peanuts**

**Sesame Seed**

**Soy**

**Tree Nuts:** Almond, Cashew, Hickory, Pistachio, Walnut

**Wheat (Gluten)**

Plus **Marketing** claims:

- No E-Numbers
- No colourants
- No MSG
- No GMO
- **Palm Free: Iceland**
- **Sugar Free**



# 'Free-From': 20 Cent Sauce Sachet

**ALLERGY ADVICE:** now reaches all products

May Contain (gratuitous catch-all):-

- Nuts; Peanuts; Sesame Seeds
- Mustard
- Celery
- **Wheat; Barley**
- Fish; Eggs; Soybeans; Milk
- Sulphites
- **and Cereals Containing Gluten**

- **Commodity**  
proteins all allergenic
- **Lower allergenic**  
e.g. pea, rice, maize  
– low **functionality**

**Ingredients:** Water; Glucose-fructose Syrup; Tomato Paste 15%; Modified Maize Starch; Salt; Acidity Regulators (E260, E330); Preservative (E202); Tomato Ketchup Spice.



# 'Clean Label' Consumer Concerns

## Definitions

- **'Clean label'** no chemicals
  - no E-numbers
  - 'natural'
- Gentle processing
  - low temp; solvent free

**Spot the difference**

**INGREDIENTS DECLARATION**

Tomatoes  
Onions  
Herbs  
E200 Sorbic acid  
E202 Potassium sorbate  
E203 Calcium sorbate  
E210 Benzoic acid  
E211 Sodium benzoate  
E212 Potassium benzoate  
E213 Calcium benzoate  
E214 Ethyl p-hydroxybenzoate  
E215 Sodium ethyl p-hydroxybenzoate  
E218 Methyl p-hydroxybenzoate  
E219 Sodium methyl p-hydroxybenzoate  
E220 Sulphur dioxide  
E221 Sodium sulphite  
E222 Sodium hydrogen sulphite  
E223 Sodium metabisulphite  
E224 Potassium metabisulphite  
E226 Calcium sulphite  
E227 Calcium hydrogen sulphite  
E228 Potassium hydrogen sulphite  
E230 Biphenyl; diphenyl  
E231 Orthophenyl phenol  
E232 Sodium orthophenyl phenol  
E234 Nisin  
E235 Natamycin  
E239 Hexamethylene tetramine  
E242 Dimethyl dicarbonate  
E249 Potassium nitrite  
E250 Sodium nitrite  
E251 Sodium nitrate  
E252 Potassium nitrate  
E280 Propionic acid  
E281 Sodium propionate  
E282 Calcium propionate  
E283 Potassium propionate  
E284 Sodium propionate

**INGREDIENTS DECLARATION**

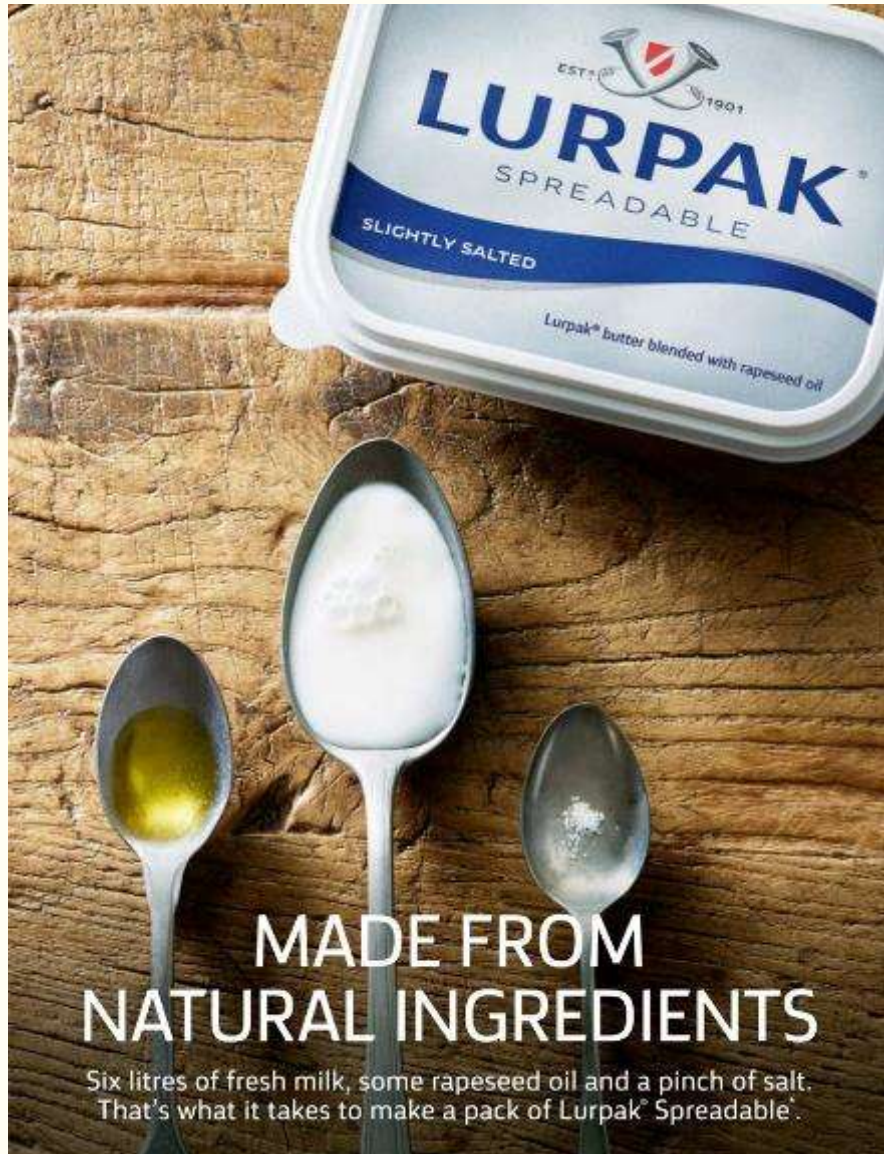
Tomatoes  
Onions  
Herbs  
Vegetable extract



# Additive Groupings: E-Numbers

- **Acids / Acidity Regulator**
  - Citric acid
- **Anti-caking agents**
- **Antifoaming agents**
- **Antioxidants**
  - Vitamin C
- **Bulking agents**
- **Colours**
- **Emulsifiers**
- **Flavours & Enhancers**
- **Flour treatment agents**
- **Glazing agents**
- **Humectants**
  - Glycerol
- **Leavening Compounds**
- **Preservatives**
  - Benzoate / sorbate
- **Stabilisers / Thickeners**
  - Pectin
- **Sweeteners**
  - Stevia E960
- **Salt:** No E-number
- **Process Aids!** – Enzymes

# Sunday Supplement Adverts: Rule of 5 + 'Natural'

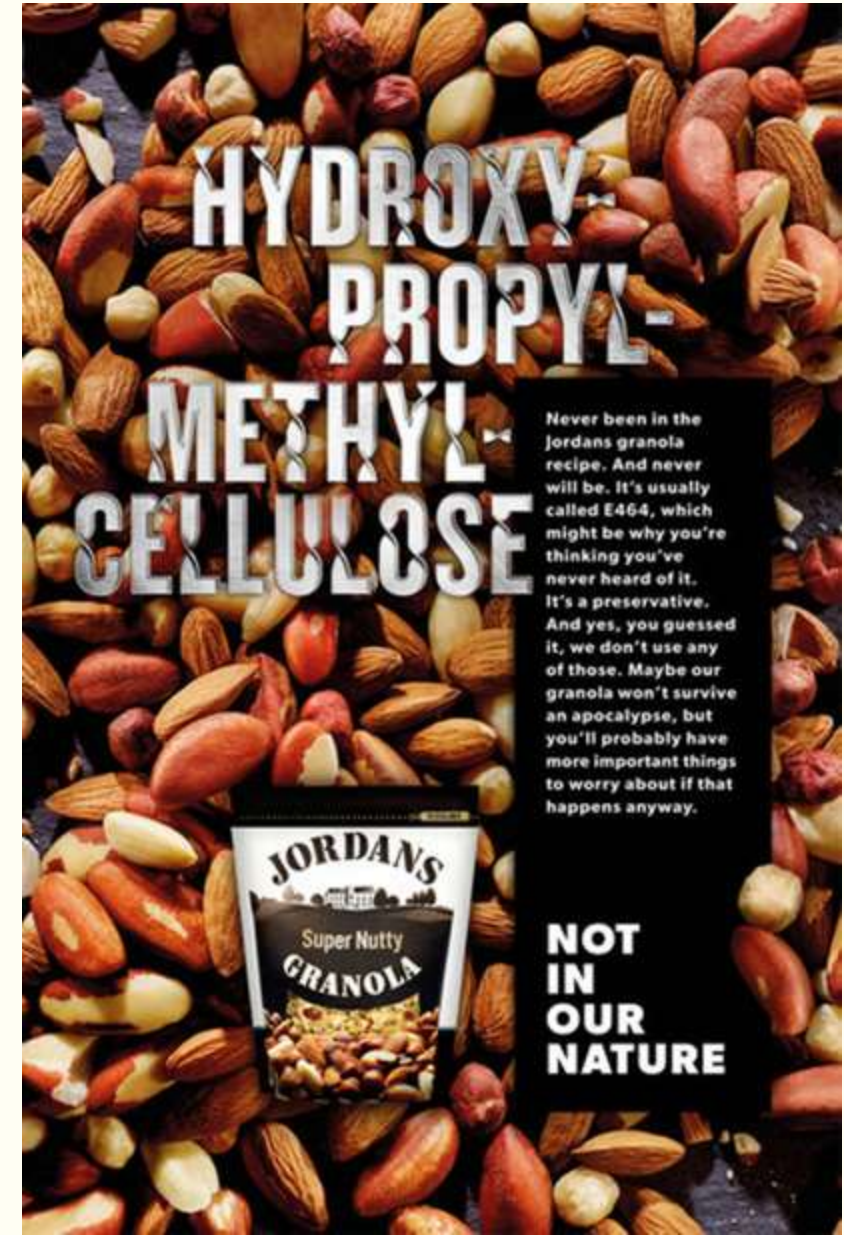


**JORDANS:  
ABSOLUTELY NOTHING  
ARTIFICIAL**

We never add any **salt** or **artificial additives** like **preservatives** or **colourings**, nor do we fortify our ingredients with **vitamins** and **minerals**. So we'll never use **sulphur dioxide** or anything you can't pronounce or picture what it looks like. We choose our ingredients because they have all of this goodness naturally, so why would we need to manufacture it or add it in artificially?

<https://www.jordanscereals.co.uk/about/our-ingredients/absolutely-nothing-artificial>

Advert DT Style July 2016



Look what a month of eating processed food did to me! It's what millions of us - including children - eat every day. But as Dr Chris van Tulleken discovered in a BBC experiment, it's making us fatter, unhealthier... and even changing our brains

By DR CHRIS VAN TULLEKEN FOR THE DAILY MAIL  
PUBLISHED: 22:00, 17 May 2021 | UPDATED: 09:02, 18 May 2021

608 shares 1k View comments

A mere four weeks — that's all it took for me to pile on enough fat to move from being a healthy weight to being overweight, putting my health at real risk.

At the same time, my thinking became sluggish and I slept badly, lying in bed racked with anxiety, sweating with fears about everyday life. I developed heartburn as well as constipation. I got piles.

But worst of all, my brain rewired itself just as if I had developed an addiction to a drug of abuse. How did I wreak such terrible damage?

I wasn't even trying to gain weight. I did it simply by following the same type of diet that millions of Britons, including children, now follow every day of the year.

For one month, under scientific supervision, I consumed 80 per cent of my calories from ultra-processed foods (or UPFs).



# Ultra-Processed Foods:

## Increasing Popular Concern: -

“They have a long scientific definition but it boils down to this — if it’s prepared in a factory, wrapped in plastic and contains an ingredient that you don’t typically find in a domestic kitchen — emulsifiers, stabilisers, humectants, preservatives, bulking agents, flavourings and so on — then it’s a UPF.

UPFs are typically convenience foods. Some are obvious — chicken nuggets, pizza, sweets, cheese strings, frozen chips, ready meals — but some are sold as healthy: many sandwiches, breads, cereals and low-calorie snacks are UPFs.

The main ingredient is often a **protein**, fat or carbohydrate extracted from a cheap crop, soy or corn and then industrially modified, shaped, coloured and flavoured. A long shelf life is a good giveaway. As well as being convenient, UPFs are cheap — and massively popular, making up nearly two-thirds of the calories that we consume in the UK.”

**Daily Mail 18 May 2021**



# Defining Ultra-Processed

The [NOVA](#) food classification [Monteiro et al]: -

## Group 1: Unprocessed & Minimally Processed

- Cooking, pasteurisation permitted  
No added ingredients
- Fruit, veg, nuts, grains, eggs, meat, milk

## Group 2: Processed Culinary Ingredients

- **Oils**, fats, butter, flour, vinegars, sugars & salt  
Eaten with Group 1: Artisanal / Kitchen Cooking

## Group 3: Processed

Mix of Group 1 & 2 for preserving  
Smoked & cured meats, cheese, fresh bread, bacon,  
salted / sugared nuts, tinned fruit, beer & wine



*The Food System*

*Food classification. Public health*

**NOVA. The star shines bright**



Open Access

Research

## BMJ Open Ultra-processed foods and added sugars in the US diet: evidence from a nationally representative cross-sectional study

Euridice Martinez Steele,<sup>1,2</sup> Larissa Galastri Baraldi,<sup>1,2</sup>  
Maria Laura da Costa Louzada,<sup>1,2</sup> Jean-Claude Moubarac,<sup>2</sup>  
Dariush Mozaffarian,<sup>3</sup> Carlos Augusto Monteiro<sup>1,2</sup>

**To cite:** Martinez Steele E, Baraldi LG, Louzada M L da C, et al. Ultra-processed foods and added sugars in the US diet: evidence from a nationally representative cross-sectional study. *BMJ Open* 2016;6:e009892. doi:10.1136/bmjopen-2015-009892

### ABSTRACT

**Objectives:** To investigate the contribution of ultra-processed foods to the intake of added sugars in the USA. Ultra-processed foods were defined as industrial formulations which, besides salt, sugar, oils and fats, include substances not used in culinary preparations, in particular additives used to imitate sensorial qualities of minimally processed foods and their culinary preparations.  
**Design:** Cross-sectional study.

### Strengths and limitations of this study

- Use of a large, nationally representative sample of the US population, increasing generalisability.
- Use of data on added sugars rather than total sugars or sugar-sweetened beverages, which correspond to the guidelines relevant area of prioritisation.
- Unlike most articles which have focused on specific food items such as soft drinks or fast food



# Defining Ultra-Processed

## Group 4: Ultra-processed

- Made with non-home available ingredients
- Factory scale: machinery and process lines
- **Can't be made in a home kitchen**

## Chemical Additives

- Acidity regulators; Anti-caking; Anti-foaming; Anti-oxidants; Colours, Emulsifiers, Flavours; Flour Treatment agents; Glazes; Humectants; Leavening Agents; Preservatives; Gums, Stabilisers & Thickeners; Sweeteners

## Industrial Products: Bakery, cereals, sausage, dressings, snacks

- High fat, sugar and salt content common

### The Quorn revolution: the rise of ultra-processed fake meat



▲ Sales of Quorn grew by 10% globally last year - and increased by 25% in the US. Photograph: Guardian Design Team

It was reported last week that Quorn is on course to become a billion-dollar business. It is part of a booming industry of meat alternatives - but many of these products are a far cry from the idea of a natural, plant-based diet

### 'Ultra-processed' products now half of all UK family food purchases

Exclusive: health experts warn increasing popularity of industrially-made food will lead to negative effects such as obesity and poor health



▲ Some of the UK's best-selling ultra-processed foods. Photograph: Jill Mead/The Guardian

Half of all the food bought by families in the UK is now "ultra-processed", made in a factory with industrial ingredients and additives invented by food technologists and bearing little resemblance to the fruit, vegetables, meat or fish used to cook a fresh meal at home.

### Fast food fever: how ultra-processed meals are healthier than you think



© Most fast foods, even those options, don't contain processed food. Copyright: GIM Imaging/Getty Images

UPFs form 38% of British calorie intake - and vegans beware, this includes many plant-based meals. Now food scientists are learning more about what makes them so damaging

**F**or a long time it has been known that diets dominated by ultra-processed food (UPF) are more likely to lead to obesity. But recent research suggests that high UPF consumption also increases the risk of cardiovascular disease, dementia and, according to a recent American study involving 30,000 health professionals, of developing colon cancer.

### Americans Are Eating More Ultra-Processed Foods

Oct 14, 2021  
Modified Oct 14, 2021

Posted in  
Health and  
Medicine  
Topped  
Research  
School of Global  
Public Health  
New York City

18-year study measures increase in industrially manufactured foods that may be contributing to obesity and other diseases

Consumption of ultra-processed foods has increased over the past two decades across nearly all segments of the U.S. population, according to a new study by researchers at NYU School of Global Public Health.

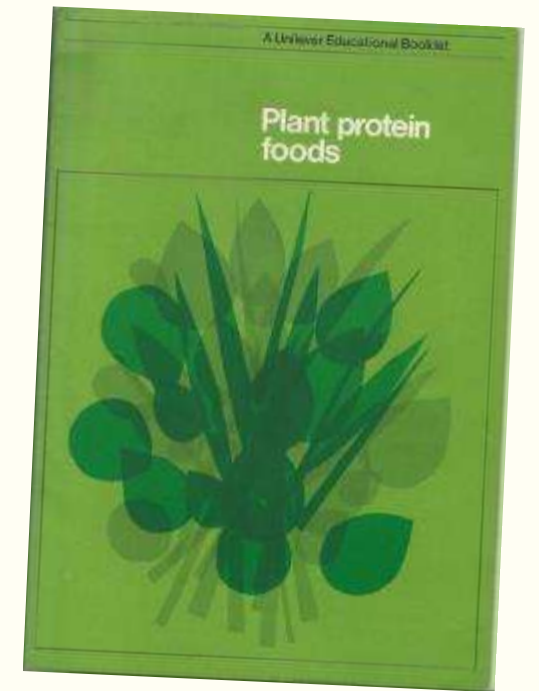
"The overall composition of the average U.S. diet has shifted towards a more processed diet. This is concerning, as eating more ultra-processed foods is associated with poorer diet quality and higher risk of several chronic diseases," said F. Paya, an assistant professor and postdoctoral fellow at NYU School of Public Health and the study's lead author. "The high and increasing consumption of ultra-processed foods in the 21<sup>st</sup> century may be a byproduct of the obesity epidemic."



© Daily Express

# **New Product Development**

**A New Philosophy**



# Let's Improve Plant Based Products

v2 11-20

## ASPIRATION: Way to go!

- 1<sup>st</sup> Generation products try to solve **taste & texture** issues
  - Achieved with >20 ingredients; many costly functional specialties
- **Format:** Must it mimic processed meat?
  - Appeal to Flexitarians? Why not Plant Based veggies (*Bird's Eye*)?
- **Nutrition:** Macro-nutrient profile to match conventional
  - Micro-nutrient profile also to be considered (see Alt 'Milks')
- **Reduced Ultra-Processing:** Target 'Rule of 5'
  - Simplify Ingredient Declaration. Also 'free from', 'clean label' ?
  - Cost: Use whole ingredients to close functional performance gap
- **Sustainability:** Avoid Pea Protein → Grown, Canada
  - Processed, Shandong, China → Sold, EU
  - Consider local sourcing: 2021 launch UK grown fava bean protein!



## Target Vision:

Won't be realised right away - but do adjust your cross hairs!

# **Protein Benchmarking: Reference**

**Conventional & Gluten Free Wheat Bread & Tortilla**

# Bread: Wheat Versus Gluten Free – Reference Products –



- **ABF Allied**  
Soft White Sandwich Bread
- **BFree Soft White Loaf**



**10/22** Wheat flour (with Calcium, Iron, Niacin (B3) and Thiamin (B1); Water, Yeast, Salt, Vegetable oil (rapeseed, sustainable palm), Sustainable Soya Flour, Vinegar, Preservative: Calcium Propionate; Emulsifier E472e, Flour Treatment Agent: Ascorbic Acid Vitamin C

**800g 15 Ingredients £1.20**

Nutrition	K'gsmill %	BFree %
<b>Protein</b>	<b>8.0</b>	<b>7.3</b>
<b>CHO</b>	45.6	39.1
<b>Fat</b>	<b>2.0</b>	<b>1.1</b>
<b>Fibre</b>	2.7	8.7
<b>Salt</b>	0.95	1.05
<b>Kcal</b>	238	213

Water, Corn Starch, Potato Starch, Tapioca Starch, White Rice Flour, Rapeseed Oil, Humectant: Glycerol, Psyllium Husk (**Mustard**), Thickening Agents: Xanthan Gum, Cellulose, Hydroxy - propyl Methylcellulose, Agar Agar, Carboxymethylcellulose, Buckwheat Flour, Yeast, Emulsifier: Mono & Di-Glycerides of Fatty Acids, Sugar, Rice Bran, Apple Juice Concentrate, Pea Protein, Sourdough: Fermented Quinoa, Rice and Maize Flour, Bamboo fibre, Salt, Cultured Dextrose, Anti-caking agent: Calcium Sulphate, Acids: Citric Acid, Malic Acid, Tartaric Acid, Flour Treatment Agent Ascorbic Acid

**400g 31 Ingredients £3.15 (brown)**

# Wheat Tortilla

## – Reference Products –



**CLEAN LABEL**

- **Old El Paso 8 Pack** super soft & flexible Preservative Free
- **Hacendado wheat Tortilla** Delicious, Easy & Fun \* E-numbers \*



**Wheat** Flour, Water, Stabiliser: Glycerol, Sunflower Oil, Emulsifier: Mono- and Diglycerides of Fatty Acids, Dextrose, Raising Agents: Sodium Bicarbonate, Diphosphates, Salt

**326g 8 Ingredient £1.45**

Nutrition	El Paso %	H'cndo %
<b>Protein</b>	<b>9.1</b>	<b>8.0</b>
<b>CHO</b>	53.2	53.0
<b>Fat</b>	<b>5.2</b>	<b>5.3</b>
<b>Fibre</b>	1.61	2.5
<b>Salt</b>	1.00	1.30
<b>Kcal</b>	299	294

**Wheat** Flour 61%, Water, High Oleic Sunflower Oil 3%, Stabilizer: E422 Glycerol, Emulsifier: E471 Mono- & diglycerides of Fatty Acids, Salt, Acidity regulators E296 Malic Acid, Preservatives: E202 Potassium Sorbate, E282 Calcium Propionate, Raising Agent: E500ii Sodium Bicarbonate, Thickener: E415 Xanthan Gum, Flour treatment agent: E 920 L-Cysteine

**360g 12 Ingredients €1.41**



## Product Benchmarking Hi Protein, Zero Carb & Keto

# Wheat Bread Versus Hi Protein Reference



- **Warburtons Medium Sliced Soft White Sandwich Bread**
- **Plant Power Blend of 12 Delicious Pulses, Grains and Seeds**



**Wheat** Flour, with Calcium, Iron, Niacin (B3) and Thiamin (B1), Water, Yeast, Salt, Vegetable Oils: Sunflower, Rapeseed and Sustainable Palm in varying proportions, **Soya** Flour, Emulsifiers: E472e, E481; Preservative: Calcium Propionate; Flour Treatment Agent: Ascorbic Acid (Vitamin C)  
**800g 15 Ingredients £1.25**

Nutrition	White %	Plant %
<b>Protein</b>	<b>9.1</b>	<b>15.9</b>
<b>CHO</b>	45.4	35.1
<b>Fat</b>	<b>2.0</b>	<b>4.6</b>
<b>Fibre</b>	2.1	7.0
<b>Salt</b>	0.98	0.90
<b>Kcal</b>	244	259

Wholemeal **Wheat** Flour, Water, Pulse Blend: 12% Kibbled **Soya** Bean, Navy Bean, Yellow Lentil, Red Lentil, Black Bean, **Wheat** Gluten, Grain Mix: (2%) Malted **Barley** Flour, **Oat** Flakes, Toasted **Rye** Flakes, Yeast, Seed Mix: Brown Linseed, **Sesame**, Pumpkin, Sunflower, Millet, Demerara Sugar, Salt, Vegetable Oil: Sunflower, Rapeseed and Sustainable Palm in varying proportions, **Soya** Flour, Emulsifiers: E472e, E471, Preservative: Calcium Propionate, Glaze: Water, Pea Protein, Glucose Syrup, Rice Flour, Flour Treatment Agent: Ascorbic Acid (Vitamin C)  
**700g 30 Ingredients £1.95**



# Mission Foods launches Zero Net Carbs tortillas

09.27.2022

By [Eric Schroeder](#)



IRVING, TEXAS — Mission Foods, a subsidiary of Gruma SAB de CV, has introduced Zero Net Carbs tortillas. The new tortillas are zero net carbs and zero sugar, and they also are keto-certified, high fiber and low in calories, according to Mission.

The new tortillas are available in two varieties: Original and sundried tomato basil. They have a suggested retail price of \$3.99 for a 14-count bag.

“These new products represent Mission Foods once again rising to meet consumer needs with products that taste great while fitting into consumers’ dietary patterns,” said Sathish Mohanraju, vice president of marketing and trade marketing at Mission Foods. “Someone on a low-carb or keto diet will still be able to enjoy our delicious tortillas in their favorite wraps, tacos or snacks without sacrificing flavor.”

The launch of the new tortillas comes a year after Mission [introduced almond flour tortillas and cauliflower tortillas](#).

# Zero Net Carbs & Low Carb Keto Tortilla



- **Mission® Zero Net Carbs, USA** Original Tortillas have zero net carbs, zero sugar and all the flavor you'll need
- **Simson's Pantry, Australia** Better For You, Low Carb Keto



Modified Wheat Starch, Water, Vital Wheat Gluten Isolate, Vegetable Shortening: Inter-esterified and Hydrogenated Soybean Oils, Salt, Calcium propionate - to preserve freshness, Sodium Acid Pyrophosphate, Baking Soda, Distilled Monoglycerides, Sorbic Acid – to preserve freshness, Fumaric Acid, Cellulose Gum, Sunflower Oil, Natural Flavors, Steviol glycosides

Nutrition	Zero %	Keto %
<b>Protein</b>	<b>11.1</b>	<b>21.3</b>
<b>CHO</b>	-	2.9
<b>Fat</b>	<b>11.1</b>	<b>12.1</b>
<b>Fibre</b>	38.9	21.4
<b>Salt</b>	1.7	1.0
<b>Kcal</b>	299	246

Water, Seed Flours: Chia Seed, Flaxseed, Soy Protein, Vegetable Fat & Oil, Wheat Protein: Gluten, Wheat Fibre, Apple Cider Vinegar, Modified Wheat Starch (E1413), Oat Fibre, Wheat Bran, Pea Protein, Thickeners E412, E415, E464, Acidity Regulator E297, Iodised Salt, Emulsifier E471, Baking Powder Raising Agents E339, E341, E450, E500, Preservative E200

**252g 15 Ingredients \$3.99**

**200g 23 Ingredients \$5.00**

# Product Nutrition: Increasing Protein



Nutri'n	K'smill	Bfree	El Paso	H'cndo	Warbies	Mission	Warbies	S. Pantry
Protein	9.1	7.3	9.1	8.0	9.1	11.1	15.9	21.3
CHO	45.4	39.1	53.2	53.0	45.4	-	35.1	2.9
Fat	2.0	1.1	5.2	5.3	2.0	11.1	4.6	12.1
Fibre	2.1	8.7	1.61	2.5	2.1	38.9	7.0	21.4
Salt	0.98	1.05	1.00	1.30	0.98	1.7	0.90	1.0
Kcal	244	213	299	294	244	299	259	246
Ingdts.	15	31	8	12	15	15	30	23

# NPD Goal: High Protein Tortilla

## Developing Formula; Protein Selection



# Objectives

- **More Protein**
  - Select Claim : -
- **‘Source of Protein’**
  - 12% by energy value
- **‘High Protein’**
  - 20% by energy value

**Note: Protein is 4 kcal / g**

**Looking at :-**

- Protein sources
- *Not gluten-free*
- *Care: Bakers % convert to True %*

<b>BASE FORMULA</b>	<b>Range</b>	<b>Typical</b>
<b>Ingredient</b>	<b>Flour %</b>	<b>Flour %</b>
Flour	100%	100%
Water	45-50%	32%
Sunflower Oil	4-5%	4%
Glycerol	3-4%	4%
Salt		1%
Malic Acid	0.5-0.7%	0.7%
Mono & Di Glycerides	2-2.5%	0.6%
Calcium Propionate	0.3%	0.4%
Sodium Bicarbonate	0.3-0.5%	0.3%
Xanthan gum	0.5%	0.2%
Potassium Sorbate	0.3%	0.15%
		<b>143%</b>

# Protein Source: %

## Wheat, Oat, Lupin Flours + Gluten & Pea Isolate

Nutrition	Caputo Manitoba Flour	Oat ' Flour (Organic)	Lupin Flour	Amina^ Wheat Gluten	Yosin Pea Isolate
<b>Kcal</b>	348	365	373	395	395
<b>Protein</b>	14.9	14	46	79	81.5
<b>Carbs</b>	70.1	56	14	8.1	0
<b>Sugars</b>	24	1.3	12	1	0
<b>Fat</b>	1.5	6.9	11	5.0	6.72
Safa	0.4	1.2	1.8	1.0	1.8
Pufa				4.0	
Mufa				0.0	
<b>Fibre</b>	<b>2.7</b>	11'	15	1.0	2.2
<b>H<sub>2</sub>O</b>		<12		6	7.02
<b>Ash</b>	<b>trace</b>	1.7	0.08	0.74	3.6

**BULK  
VERSUS  
FUNCTIONAL**

Vital wheat gluten **can't** do it all!  
 – Over-binds  
 – Poor amino acid profile

^ Aa profile ' Includes 5% g β-glucan

# Protein: Where?

## Key Indicators: -

- **Flour:** High protein wheat flour helps
  - e.g. Caputo or Manitoba flour
  - Reduces impact of ingredient dilution
- **Vital Wheat Gluten:** Supports development and maintains dough strength
  - **Keep total gluten % as in Conventional**
- **Legume Flours:** Adds bulk protein ~23%  
**See Lupin Flour 46%! BUT:** Protein is non-functional: won't thermo-set like gluten
  - Impacts recipe also adding starch and fibre
- **L-Cysteine:** Reduces Cystein sulphhydryl cross-links – S – S – between gluten protein chains
  - Makes dough sticky, and less tight – SH – SH

## Baker-Pedia.com Dr Lin Carson

While oxidizers create bonds to strengthen or mature the dough (**Ascorbic acid**), reducing agents like **L-Cysteine** weaken the gluten structure in the dough by breaking intra and/or intermolecular covalent disulphide bonds between proteins.

As a result, S-S bonds disappear and sulphhydryl or thiol groups (S-H) are formed. Protein chains become smaller or are broken down, causing the gluten network to become extensible.

– This is very important when bakeries receive high-protein flours or need to process (mix) strong doughs in a short time to reduce energy consumption.<sup>2</sup>

<https://bakerpedia.com/ingredients/reducing-agents/>



# Modelling High Protein on Old El Paso

## Nutritional Information

### Calculating:-

– Typical product energy is 300 kcal / 100g

### Based on Old El Paso

– A simple formulation  
**9.1%** protein meets :-

### ‘Source Of’ Claim

12% 300 kcal = 36 kcal  
 36 / 4 = **9g** Protein

### But Hi Protein

20% 300 kcal = 60 kcal  
 60/4= requires **15g** Protein

Parameters	Per 100 g	Per 41 g	% RI*	Lupin Flour	Pea Isolate
Energy kJ/Kcal	<b>1264 / 300</b>	<b>515 / 122</b>	<b>5</b>	~300	~300
Fat	<b>5.2</b>	<b>2.13</b>	<b>3</b>	5.2	5.2
Saturates	<b>1.2</b>	<b>0.49</b>	<b>2</b>	-	-
Carbohydrate	<b>53.2</b>	<b>22</b>	<b>7</b>	46.2	47.3
Sugars	<b>2.1</b>	<b>0.9</b>	<b>1</b>	-	-
Fibre	<b>1.6</b>	<b>0.9</b>	-	2.7	1.6
<b>Protein</b>	<b>9.1</b>	<b>2.9</b>	<b>6</b>	<b>15</b>	<b>15</b>
Salt	<b>1.0</b>	<b>0.41</b>	<b>7</b>	-	-
Sodium	<b>0.40</b>	<b>0.19</b>	<b>7</b>	-	-





# Modelling High Protein: Lupin Flour & Pea Isolate

## Guidelines

– Strongly recommend vital wheat gluten to maintain **functional** protein % of original formula

– **Iso-calorific:** Monitor fat contribution: there's more in legume extracts 7 - 11%  
– It's ~9 kcal/g – not just 4 kcal/g as carbs or protein

**Cost Benefit:** Compare flour cost €/kg to Protein Isolate versus greater formulation impact  
– For very high protein isolates may help

Ingredient	Protein %	Old El Paso True %	Protein	Lupin + VWG True %	Protein	Pea + VWG True %	Protein
Wheat Flour	9.10%	64.00	9.10	48.26	6.76	55.0	7.70
Water		25.01		25.00		25.42	
Lupin Flour	46.00%			12.83	5.90		
Yosin Pea Isolate	81.60%					7.23	5.90
Vital Wheat Gluten	80.00%			2.92	2.34	1.75	1.40
Glycerol		3.90		3.90		3.90	
Sunflower oil		3.86		1.28		3.47	
Dextrose		2.00		2.00		2.00	
Emulsifier Mono Di		0.30		0.30		0.30	
Sodium bicarbonate		0.20		0.20		0.20	
Diphosphates		0.20		0.20		0.20	
Enzymes		0.03		0.03		0.03	
Salt		0.50		0.50		0.50	
Total <b>Gluten</b>			9.10		9.10		9.10
Total <b>Protein</b>		100	9.10	100	15.00	100	15.00

# Protein Selection

## Legume Protein:

- Blended with cereal protein gives the **best** amino acid profile
  - Cereals are high in sulphur amino acids (Cys & Met); but low in Lysine
  - Legumes are low in sulphur amino acids but high in Lysine
- Each culture has a culinary tradition: beans on toast; naan and dahl; tortilla and beans

**For Low Cost: Legume Flours (~22%+) or Low end Concentrates (60-75+%)**

[Isolates = ~85% Higher cost + sustainability / over-processing issues]

- **Options:** Flours and 'clean' flours
  - **Gram Flour** (from Chickpeas 22% protein e.g. in Papadums)
  - **Yellow Split Pea Flour:** 23.5% protein
  - **Lupin Flour:** 43-49% Protein
- **Supplant FF-20** Clean tasting chickpea flour 21.5% protein: clean colour + low 'beany' taint
- **Concentrates & Isolates:** **ChickP 70%** and **Innovopro 90** are costly \$15/kg



# Protein Source: Nutritional Value %

Nutrition	Manitoba Flour	Oat Flour ‘ Organic	Amina* Wheat Gluten	Roquette* Nutralys® W	Red Lentil Flour”	White Bean Flour”	Chick Pea Flour”	Lupin Flour	Supplant FFP20 Chick Pea	Innovopro CP-Pro 70	ChickP S930	Yosin Pea Isolate	Evergrain Barley	Fungi: Fermotein
<b>Kcal</b>	<b>348</b>	<b>365</b>	<b>395</b>	<b>394</b>	<b>358</b>	<b>333</b>	<b>378</b>	<b>373</b>	<b>321</b>	<b>403</b>		<b>395</b>	<b>370</b>	<b>341</b>
<b>Protein</b>	<b>14.9</b>	<b>14</b>	<b>79</b>	<b>78</b>	<b>24</b>	<b>23.26</b>	<b>20</b>	<b>46</b>	<b>21.38</b>	<b>70</b>	<b>88.63dm</b>	<b>81.5</b>	<b>87</b>	<b>~45</b>
<b>Carbs</b>	<b>70.1</b>	<b>56</b>	<b>8.1 / 1</b>	<b>6</b>	<b>63</b>	<b>60.27</b>	<b>63</b>	<b>14</b>	<b>48.9</b>	<b>41</b>	<b>1.8</b>	<b>0</b>	<b>7.0</b>	<b>&lt;3</b>
<b>Sugars</b>	<b>24</b>	<b>1.3</b>	<b>1</b>	<b>0</b>				<b>12</b>	<b>0</b>	<b>0</b>		<b>0</b>	<b>0.5</b>	<b>&lt;0.5</b>
<b>Fat</b>	<b>1.5</b>	<b>6.9</b>	<b>5.0</b>	<b>6</b>	<b>1.9</b>	<b>0.85</b>	<b>6.04</b>	<b>11</b>	<b>0,5</b>	<b>11</b>	<b>0.3</b>	<b>6.72</b>	<b>0.8</b>	<b>~8</b>
Safa	<b>0.4</b>	<b>1.2</b>	<b>1.0</b>	<b>1</b>	<b>0.38</b>	<b>0.22</b>	<b>0.603</b>	<b>1.8</b>	<b>0.05</b>	<b>2</b>		<b>1.8</b>	<b>0.2</b>	
Pufa			<b>4.0</b>	<b>3.6</b>	<b>1.0</b>	<b>0.354</b>	<b>2.731</b>			<b>(13 usfa)</b>				
Mufa			<b>0.0</b>	<b>0.6</b>	<b>0.5</b>	<b>0.075</b>	<b>1.38</b>							
<b>Fibre</b>	<b>2.7</b>	<b>11’</b>	<b>1.0</b>	<b>2</b>	<b>10</b>	<b>15.2</b>	<b>12</b>	<b>15</b>	<b>9.92</b>	<b>7.5</b>	<b>1.4</b>	<b>2.2</b>	<b>3.1^^</b>	<b>~36</b>
<b>H<sub>2</sub>O</b>		<b>&lt;12</b>	<b>6</b>	<b>7</b>	<b>7.8</b>	<b>11.32</b>	<b>7.68</b>		<b>7</b>		<b>4.67</b>	<b>7.02</b>	<b>4.0</b>	
<b>Ash</b>	<b>trace</b>	<b>1.7</b>	<b>0.74</b>	<b>06</b>	<b>3.5</b>	<b>4.2</b>	<b>2.85</b>	<b>0.08</b>	<b>2.4</b>	<b>3.8</b>	<b>1</b>	<b>3.6</b>	<b>5.5</b>	

\*N=6.25 “Legume Flours – Molendum \*Aa profile ‘ Includes 5% g β-glucan ^2.4 soluble fibre



# Finally: Check?

## Lab Scale to Production

- Larger trials show dough performance changes
- Suggests formulation tuning

## Technical

- Machinability: Do formulas make good doughs?
- Cooking: Do they give good starch cook-up characteristics?

(Legume starch different to wheat)

## Organoleptic:

- Is the colour right?  
Also taste & smell?

## Proteins

- Retain wheat flour / vital wheat gluten balance

- **Lupin Flours:** Legume, but an allergen. High 46% protein!

- For very high protein an isolate will assist e.g. ChickP ~90% protein
- But costs ~€15 /kg

# Product Benchmarking

## High Protein; Low Carb; Gluten Free



# Zero Carb & Hi Protein Tortilla

- **bestdiet Keto Protein, ES**  
Double protein versus regular tortilla, high in fibre, low carb  
“Helps control anxiety and appetite... (protein) greater satiating power than conventional!”
- **Prozis Protein Wrap, ES**  
GMO-Free, 15g protein per wrap, Vegan  
“Ideal for a quick high-protein meal”



WHEAT Flour 42%, Water, Protein Mix: WHEAT Protein, Pea Protein, Rice Protein, Rapeseed Oil, Humectant: Glycerol, Flaxseed Meal, OAT Vegetable Fiber, Quinoa Flour, Dextrose, Iodized Table Salt: Salt, Potassium Iodate, Emulsifier: Sunflower Lecithin, Acidity Regulators Sodium Diacetate and Malic Acid. May contain EGG, SOY, MILK and LUPINS

Nutrition	Keto %	Protein %
Protein	22	22
CHO	35 /1.7	30
Fat	11.1	12.1
Fibre	6.2	8.7
Salt	1.3	1.6
Kcal	316	304

WHEAT Flour 28%, Water, Lupin Flour 25%, Rapeseed Oil, Humectant: Glycerin, OAT Flour, Salt, Raising Agents: Diphosphates, Sodium Carbonates, Sugar, Acidity Regulators: Citric Acid, Malic Acid, Emulsifier: Monoglycerides & Diglycerides of Fatty Acids, Stabilizers: Guar Gum, Sodium Carboxymethylcellulose, Preservatives: Potassium Sorbate, Calcium Propionate

**320g 16 Ingredients €3.50**

**280g 17 Ingredients €4.99**

# Hi Protein & Low Carb Tortilla



- **The Skinny Food Co., UK**  
**Eddie Hall 'Beast' High protein**  
– 7.2g per Wrap
- **Predator Nutrition, UK**  
**Low Carb High Protein Tortilla Wraps**  
– Lower calories than supermarket wraps. High protein content per wrap



**Wheat** Flour, Water, Protein Mix:

**Wheat**, Pea Rice, Rapeseed

Oil, **Oat** Plant Fibre, Humectant: Glycerol, Linseed Meal, Quinoa Flour, Dextrose, Emulsifier: Mono-and Diglycerides of Fatty Acids, Iodised Table Salt: Salt, Potassium Iodate, Acid: Malic Acid

**320g**   **16 Ingredients**   **€3.50**

Nutrition	Beast %	Predator %
<b>Protein</b>	<b>18</b>	<b>22</b>
<b>CHO</b>	40 / 2.5	11 / 0.75
<b>Fat</b>	<b>8.75</b>	<b>14</b>
<b>Fibre</b>	7.2	26
<b>Salt</b>	3.0	1.75
<b>Kcal</b>	320	307.5

Water, Wheat Gluten, Wheat Fibre, Modified Wheat Starch, Vegetable Fat, Emulsifier, Salt, Preservatives, Inactive Yeast *Basically gluten + wheat fibre!*

**240g (6)**   **9 Ingredients**   **£4.99**

# Gluten Free Hi Protein Too – B’Free



- **Warburton's** Gluten Free High Protein Wraps with super Seeds
- **BFree High Protein Wraps** made using a blend of chickpea flour, rice & pea proteins, with 12g of protein in each delicious wrap.



Water, Pea Protein 13%, Rice Flour, Tapioca Starch, Fruit Extract: Carob and Apple, Seed Mix 5.5%: Chia, Quinoa, Millet, Linseed, Maize Starch, Rapeseed Oil, Humectant: Vegetable Glycerine, Stabilisers: Xanthan Gum E464, Cornflour, Preservatives: Potassium Sorbate, Calcium Propionate, Salt, Emulsifier: Sodium Steroyl Lactate E481, Caramelised Sugar, Sugar Beet Fibre, Natural Flavouring, Flour Treatment Agent: **L-Cysteine** Vegetarian E920 **180g 24 Ingredients £2.80**

Nutrition	W'btns %	BFree %
<b>Protein</b>	<b>15</b>	<b>28.4</b>
<b>CHO</b>	33.6/3.5	9
<b>Fat</b>	<b>3.6</b>	<b>6.9</b>
<b>Fibre</b>	10.0	13.1
<b>Salt</b>	1.19	1.3
<b>Kcal</b>	281	304

Water, Rice Protein, Pea Protein, Chickpea Flour, Bamboo Fibre, Thickening Agents: Xanthan Gum, Guar Gum, Sunflower Oil, Pear Juice Concentrate, Inulin, Milled Flaxseed, Raising Agents: Mono-Calcium Phosphate, Sodium Bicarbonate, Glucono Delta Lactone, Sourdough: Fermented from Corn Starch and Rice Flour, Cultured Dextrose, Acids: Malic Acid, Citric Acid, Tartaric Acid, Rowanberry Extract, Emulsifier: Mono and Diglycerides of Fatty Acids), Psyllium Husk (Mustard), Salt, Natural Flavouring **168g 25 Ingredients £3.80** 56



# THE PROTEIN BREWERY JOURNEY SO FAR

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- **100s of strains of fungi** investigated, and **selected for**: nutrition / sustainability / scalability / able to grow on affordable, non-animal largely available crops
- **Fermotein** = dry, ground mycelia of a specifically selected variety of fungus
  1. **Highly nutritious**: ~50% protein (PDCAAS 1), ~35% dietary fiber, vitamins and minerals
  2. **Neutral** in taste / flavour
  3. Cost-efficient & **easy to scale** -> is why we call it a brewery
  4. **Sustainable & local** supply chain setup
- Pilot plant
- Application trials in various food categories





# FERMOTEIN®

**Fermotein® is an alternative fermented food ingredient with an excellent nutritional and sustainable profile.**

## A HEALTHY AND NUTRITIOUS FOOD INGREDIENT

Fermotein® is a whole cell food ingredient and has the same essential amino acid profile as meat.

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- Complete protein
- Very rich in fiber
- Extremely low in carbohydrates
- Contains essential unsaturated fatty acids, vitamins, minerals

## HIGH APPLICABILITY

- Versatile flavor and color direction due to neutral profile
- Bland, neutral taste
- Nutritious base for meat analogues, baked goods and snacks, dairy alternatives, pasta and more

NUTRITIONAL FACTS	PER 100 G
ENERGY	341 KCAL
PROTEIN	40-49%
SUGAR	<0.5%
FAT	7-9%
CARBOHYDRATES	<3%
TOTAL FIBER	33-39%



Would you like to know more?

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 United States Deb Anderson  
 the Netherlands Headquarters

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[corporatecommunications@theproteinbrewery.nl](mailto:corporatecommunications@theproteinbrewery.nl)

# FERMOTEIN IN TORTILLA WRAPS

Replace part of flour by Fermotein => replace carbs by protein & fibre by 1 ingredient which doesn't change organoleptic properties nor functionality

*Nutritional values per 75g tortilla wrap*

VARIABLES	ORGANOLEPTIC OBSERVATIONS	PROTEIN	FIBER	TOTAL CARBS
Control	Basic white wheat flour tortilla	4.5	1.4	29
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Effect of Subbing 15% of All Purpose Flour for Fermotein®\*

\*Small panel of semi-trained tasters. No optimization of formula.



50% More Protein



140% More Fiber



20% Less Net Carbs

- ✓ Same liking scores
- ✓ No difference in taste
- ✓ No difference in appearance



# Product Nutrition: Rising Protein Order



Nutri'n	Bfree	H'ndo	K'mill	El Pso	W'bs	M'sn	W'bs	W'bs	B'st	S.Ptry	B'det	Pr'zs	P'dtor	Bfree
Protein	7.3	8.0	8.0	9.1	9.1	11.1	15	15.9	18	21.3	22	22	22	28.4
CHO	39.1	53.0	45.6	53.2	45.4	-	33.6	35.1	40	2.9	35	30	11	9
Fat	1.1	5.3	2.0	5.2	2.0	11.1	3.6	4.6	8.75	12.1	11.1	12.1	14	6.9
Fibre	8.7	2.5	2.7	1.61	2.1	38.9	10.0	7.0	7.2	21.4	6.2	8.7	26	13.1
Salt	1.05	1.30	0.95	1.00	0.98	1.7	1.19	0.90	3.0	1.0	1.3	1.6	1.75	1.3
Kcal	213	294	238	299	244	299	281	259	320	246	316	304	307.5	304
Ingdts.	31	12	15	8	15	15	24	30	16	23	16	17	9	25

# Appendix

## Protein Brewery: Full Fermotein Presentation

Contact Details: Paul M Hart  
Ph: +44 (0) - 1933 - 313623  
Rushden, Northants. UK

Elm Lea Partners Ltd.  
Mob: 07850 035 922  
October 2022

*Ingredient Market Development Solutions*  
Twitter: @Freewheel



## AGRICULTURE ACCOUNTS FOR

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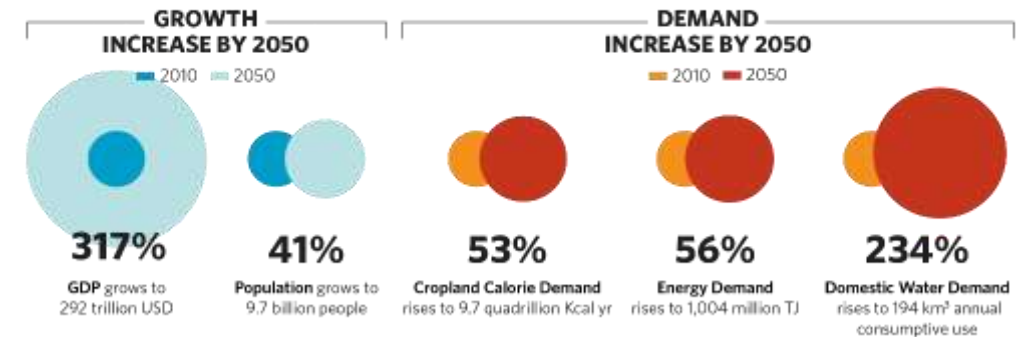
- 70% of fresh water; and 1/3 of this is animal farming
- 50% of habitable land; and 3/4 of this is animal farming
- 26% of GHG emissions; and 1/3 of this is animal farming
- Roughly 1 out of 11 is undernourished, and 1 on 8 of adults is obese



## BY 2050...

- Population will grow 40% to 9,7 bln
- GDP growth will strongly outpace population growth, and grow over 300%
- As GDP grows -> change in diet -> more kcal / more animal products

### Projected Growth in Population and Resource Demands by 2050



Source: [A Sustainable Future: Two Paths to 2050 \(nature.org\)](https://www.nature.org/press-releases/2019/09/20190910-sustainable-future-two-paths-to-2050)

**To cope with demand growth, the world will need to produce more food in the coming 30 years than it has produced since humankind**



## HOW TO COPE WITH GROWTH NEEDED

---

- Traditional agricultural supply chains alone, will not be able to cope with food demand growth
- Need for continuous innovation to grow production sustainably (supply shift) AND a shift towards more plant-based and alternative proteins (demand shift)



# THE MAGIC ABOUT FUNGI

---

- Fungi / mycelium / mushrooms ~> mycelium is the root-like structure of mushrooms (mushrooms are the fruiting bodies of fungi)
- The decomposers of nature
- Long history, **widely accepted** across different cultures
- Typically **high value protein, dietary fiber, low in carbs** and fat, contain essential minerals and vitamins



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# OUR PLAN FORWARD

---

1. Raised 22 mln € series A investment
2. Building demo plant
3. Novel food dossiers are progressing well
4. High-performing team in place
5. Innovation pipeline ~> key is Taste / Functionality / Product story



# FERMOTEIN IN TORTILLA WRAPS

Replace part of flour by Fermotein => replace carbs by protein & fibre by 1 ingredient which doesn't change organoleptic properties nor functionality

*Nutritional values per 75g tortilla wrap*

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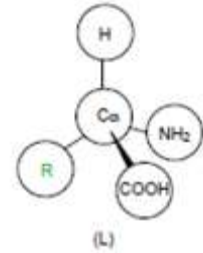


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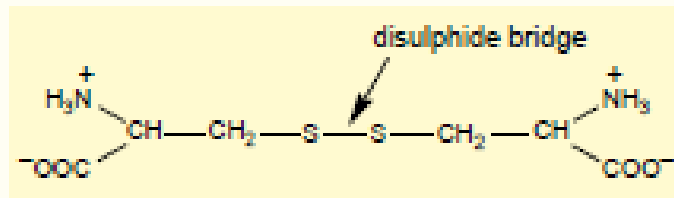


# The Amino Acids



## R-Group : -

- **Simple Alkane:** Glycine; Alanine; Valine; Leucine; Isoleucine
- **Aromatic:** Phenylalanine; Tyrosine; tryptophan
- **Simple hydroxy:** Serine; Threonine
- **Acidic:** Aspartic acid; Glutamic acid
- **Amide:** Asparagine; Glutamine
- **Basic:** (hydroxy-) Lysine; Arginine; Histidine



- **Sulphur:** Cysteine; Methionine
  - **Imino acid:** (hydroxy-) Proline
- In Gluten: Cystine is a dimer of cysteine

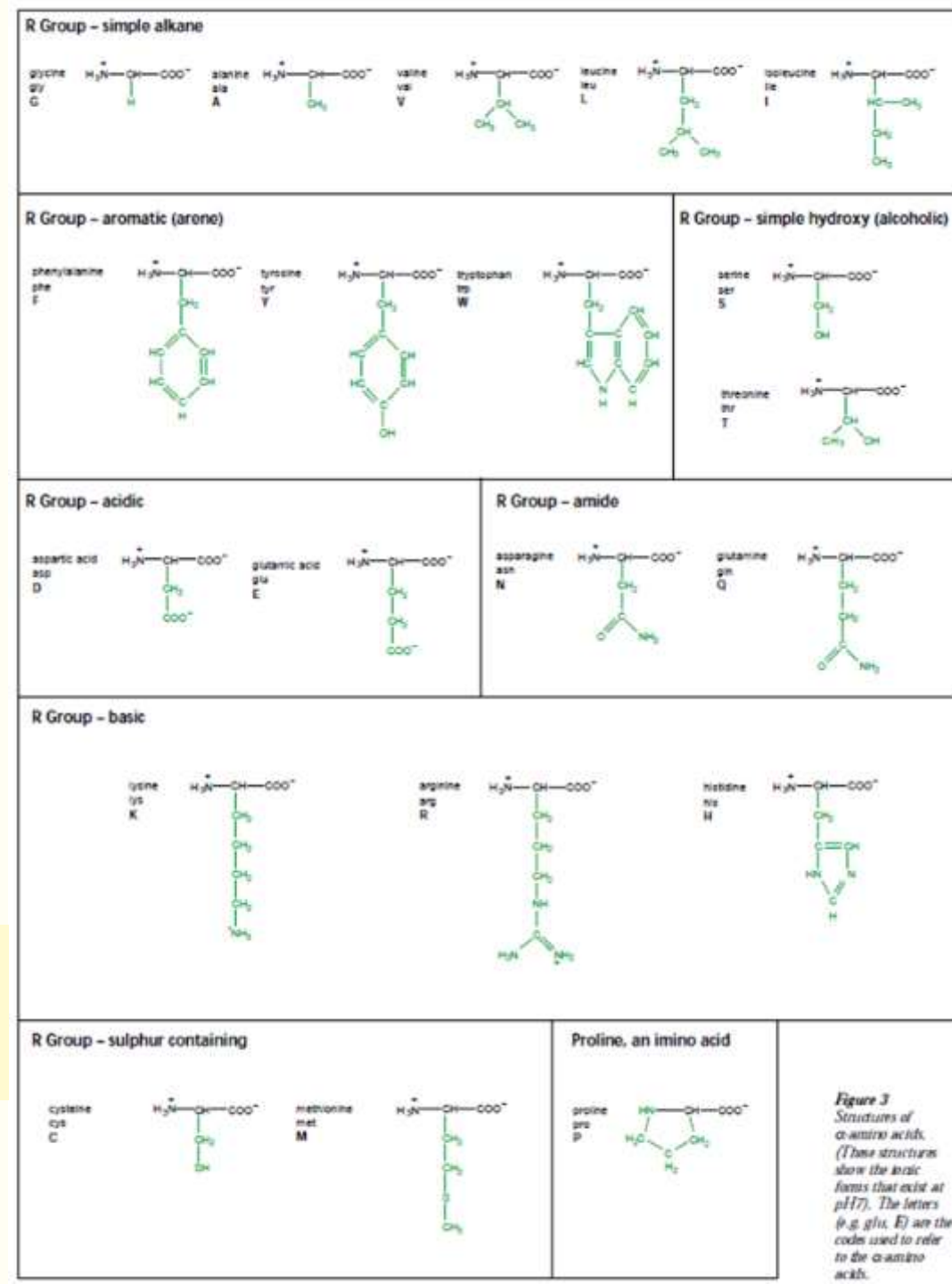


Figure 3  
Structures of  $\alpha$ -amino acids. (These structures show the zwitterionic forms that exist at pH 7). The letters (e.g. gly, E) are the codes used to refer to the  $\alpha$ -amino acids.