

The Plant Protein World

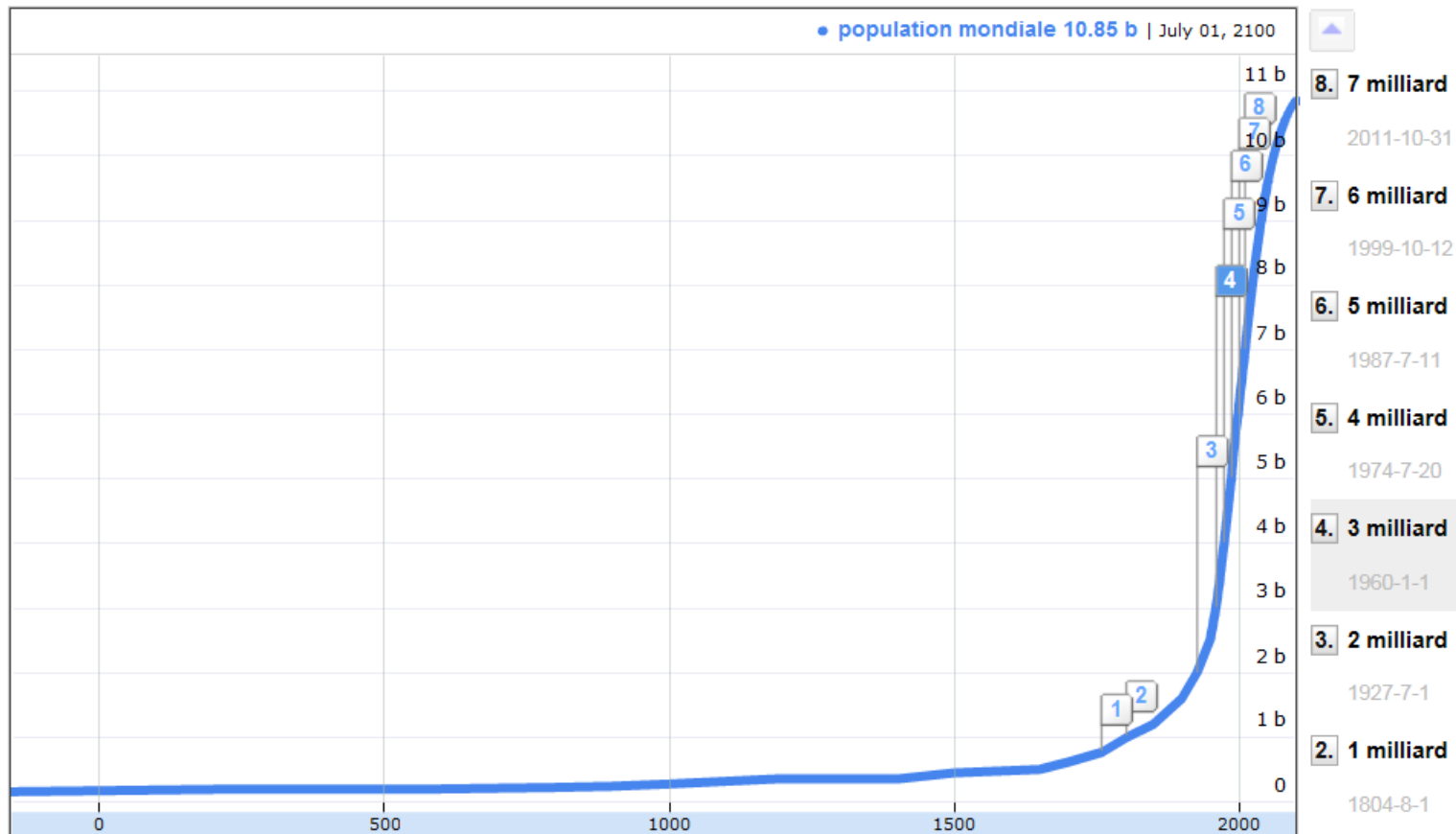
Workshop on "Supply Chains in the EU Protein Sector"



The world protein challenge



The world population is exploding, it took **200 000 years** to get the 1st billion humans, it will take **11 years** to get the next one!



Nutritional transitions

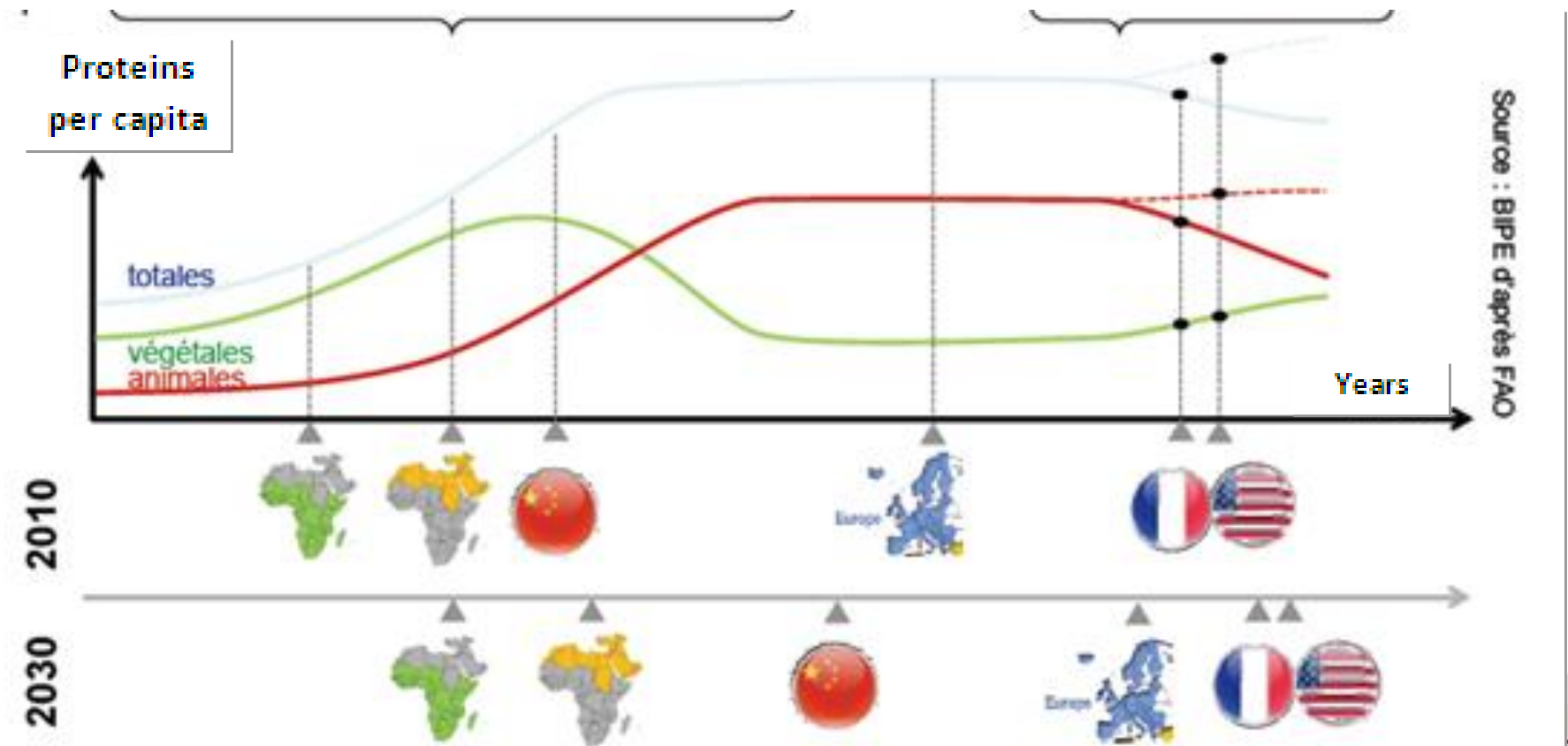
1st nutritional transition

Phase 1 : increase of total proteins demand, based on plant sources complemented with animal sources.

Phase 2: stabilisation of the total demand with a switch from plant to animal proteins

2nd nutritional transition

Increase of the plant proteins demand following 2 models
“American” observed in USA, UK, Germany, Finland Sweden
“European” observed in Norway, Denmark, Austria, France



Agricultural resources usages

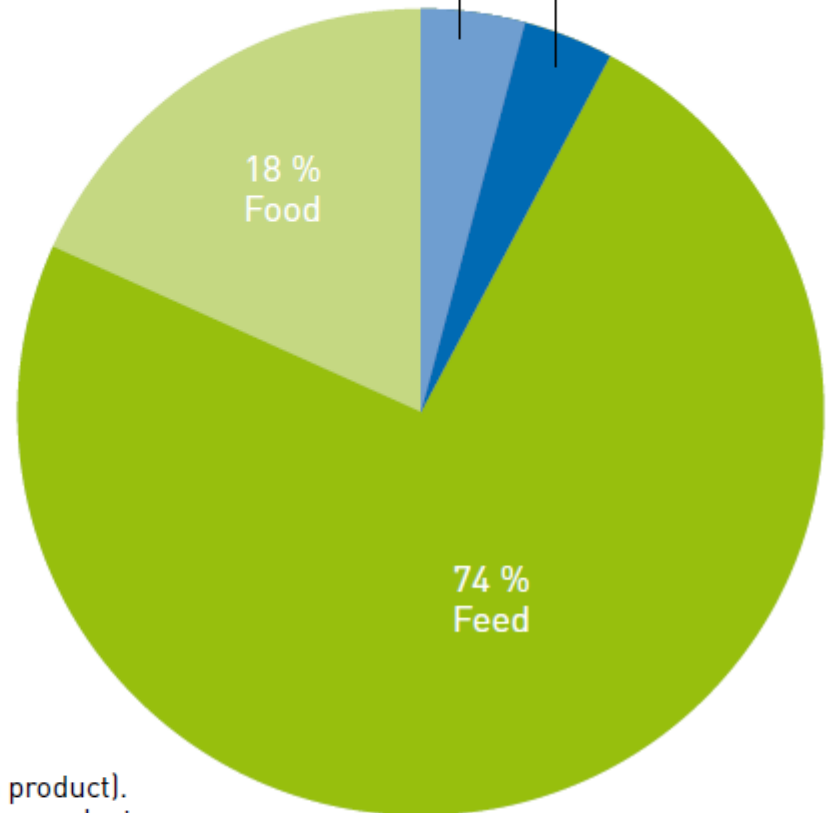
*Use of harvested agricultural biomass worldwide (2008)
(source: nova-Institute)*

Total biomass ca.
10 billion tonnes

Biomass for
industrial material
use 4,3 %

Biomass for energy
use 3,7 %

- Usages dominated by feed
- 50% of the world population is using less than 25 g of animal proteins/day
- 18% of the world population is using more than 60 g of animal proteins per day

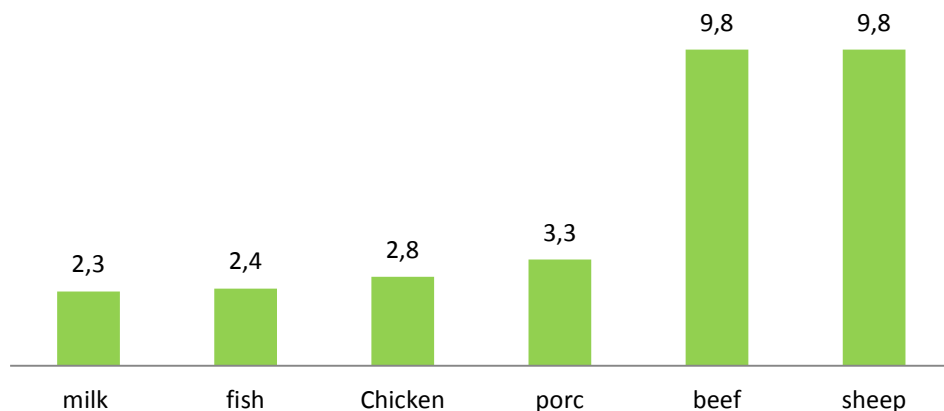


Allocation of biomass to production target (main product).
Respective amounts include raw materials and by products,
even if their use fall into a different category.



How do we utilize proteins?

Proteins conversion ratio kg/kg



Animal proteins production <i>FAO 2013</i>	Production MT	Proteines MT
meat	296	59,2
eggs	69	5,5
milk	724	22,7
cheese	22	2,0
fish aquaculture	75	15,0
total	1 111	104
wild fish catch	75	15,0
TOTAL		119

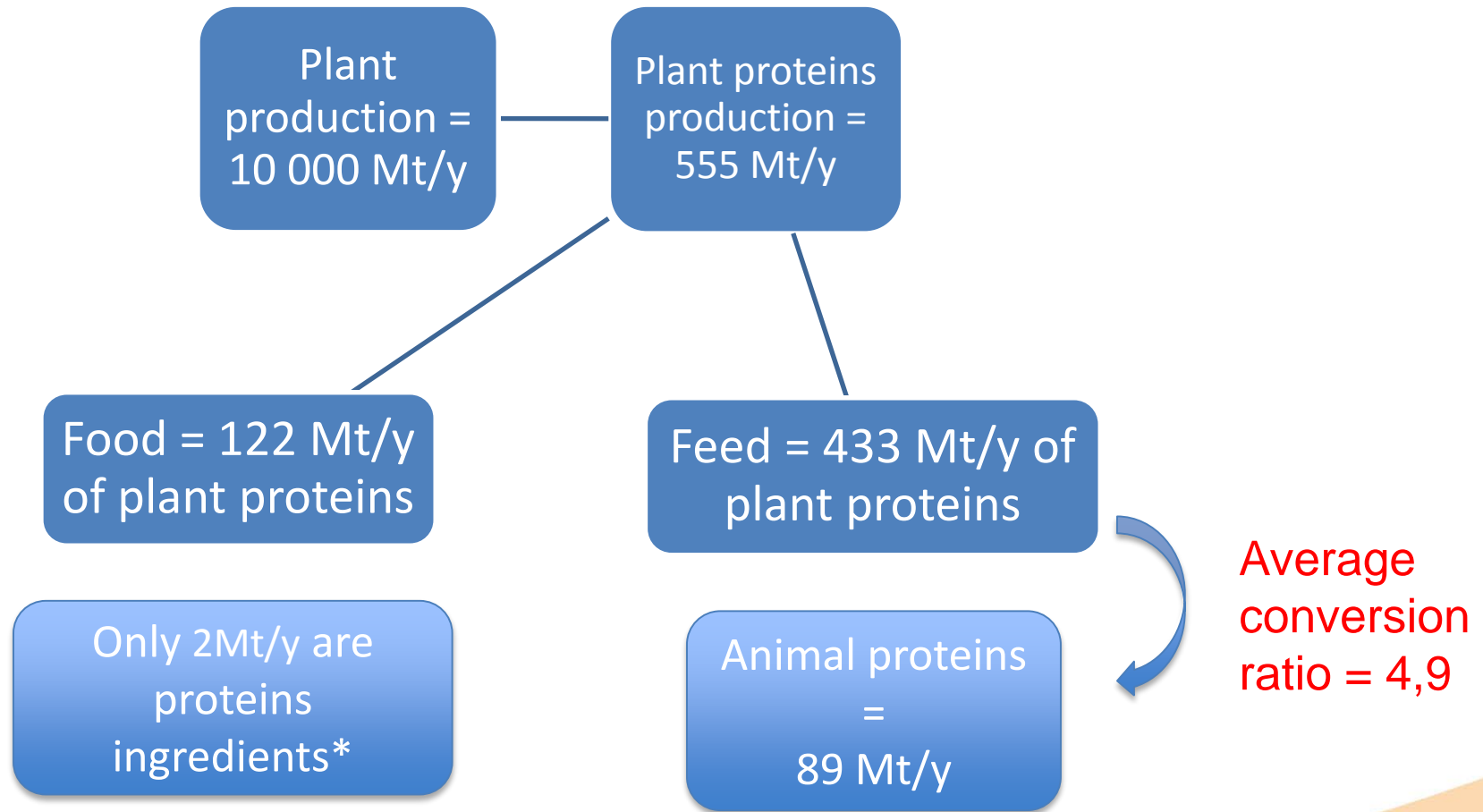
World agro-production

plant origin	Production	Proteines
<i>FAO 2013</i>	MT	MT
Soya	260	98,8
Corn	883	88,3
Wheat	704	77,4
Rice	722	57,8
Oil seeds without Soya	203	50,8
Barley	134	17,4
Pulses	69	17,3
Legumes	1 044	10,4
Sugar cane	1 794	9,0
Fruits	608	6,1
Potato	374	3,7
Other roots	374	3,7
Nuts	13	3,3
Others	2 818	111,3
Total	10 000	555



How do we utilize proteins?

World proteins balance:



- 56% from soy, 43% from wheat and less than 1% for pea, rice, potatoes, rape seeds
faba beans, lupine, sun flower, algae's,



4 complementary ways to characterize protein

Nutritional

Functional

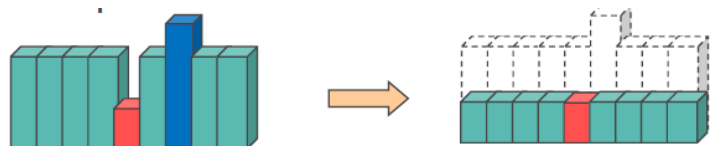
Organoleptic

Claim &
Labelling

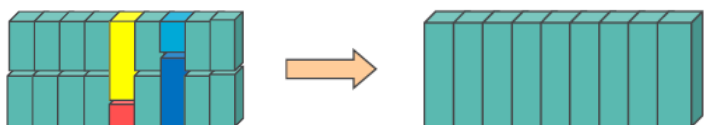


Nutritional properties

Essential AA balance



Unbalanced diet leading to AA oxidation

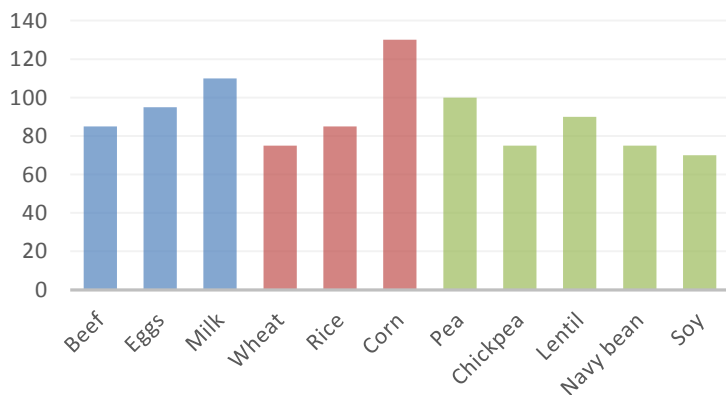


Well balanced diet leading to an optimal protein anabolism

AA having messenger function

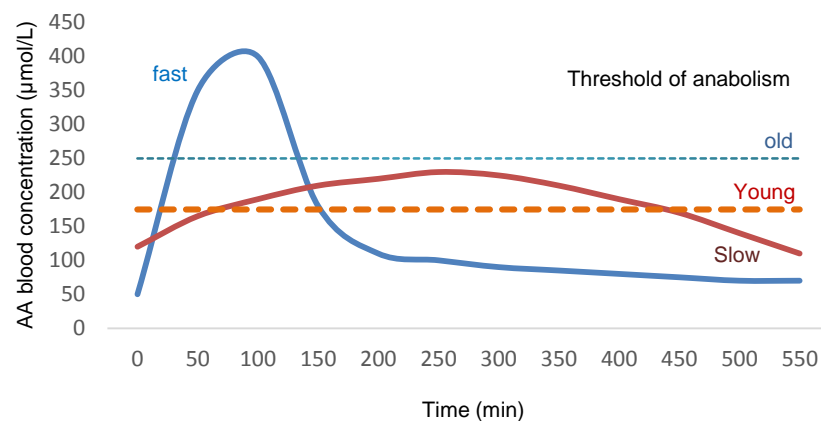
Leucine is known to stimulate protein anabolism

mg Leu / g protein



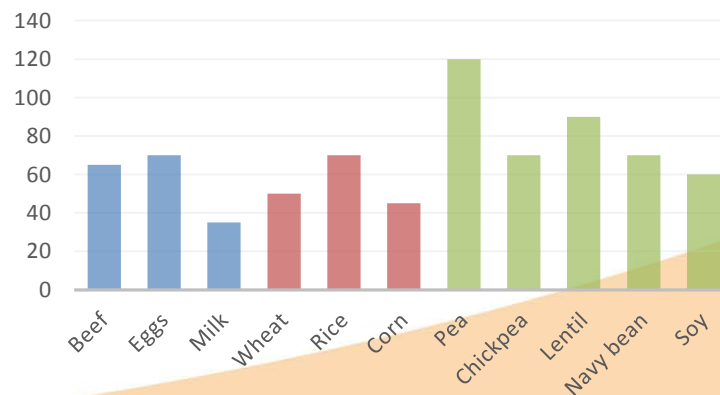
Protein digestibility: PDCAAS

Protein digestion speed



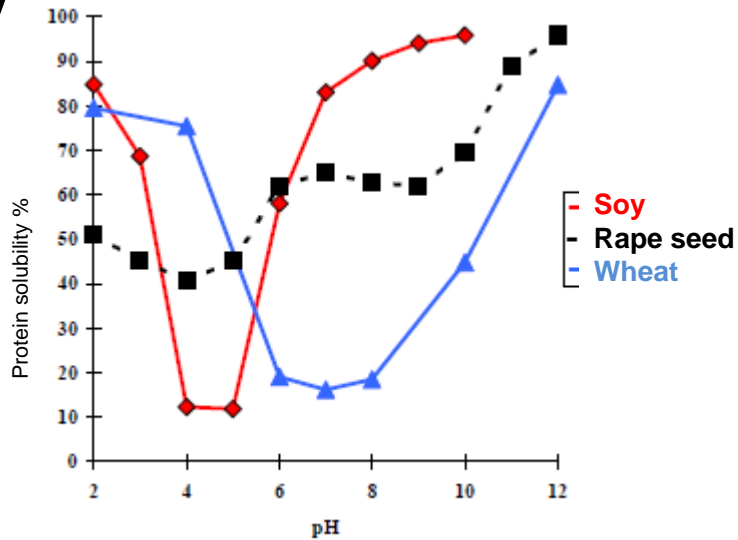
Arginine is known to reduce blood pressure

mg Arg / g protein



Functional properties (30%)

Solubility



Dispersibility



Viscosity

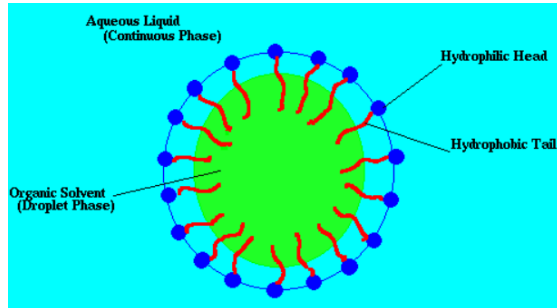


Gelling



Functional properties

Emulsifying



Foaming



Binding (water or oil)



Texturizing



Heat Stability

Organoleptic properties



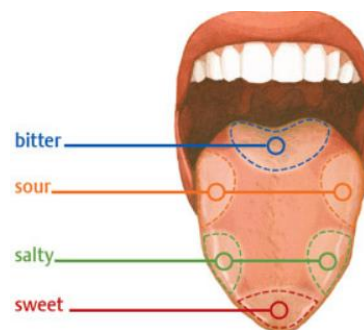
Flavor is a combination of

- **Taste**
 - Non volatile compounds
 - 8 (or more?) basic tastes: sweet, bitter, sour, salty, pungent, metallic, umami, astringent
- **Aroma / Smell / Odor**
 - Volatile compounds
 - More than 10 000 different aromas



Flavor is strongly influenced by

- **Texture**
 - Smoothness, coarseness, hardness, thickness, slipperiness, viscosity...
- **Trigeminal responses**
 - Heat of spices, cooling of menthol
 - Astringency: a dry sensation in the mouth caused by interaction with salivary protein and mucins → loss of lubrication



Organoleptic properties














Plant proteins

- **Often associated with off notes**
 - Astringency
 - Bitterness
 - Beany, hay, cardboard aroma
- **5 strategies to deal with off-notes**
 1. Selecting favorable **raw material** (variety selection, storage conditions...)
 2. **Prevent** using an appropriated processing (dehulling, enzymes deactivation, microbio control ...)
 3. **Eliminate** by post processing (flash under vacuum, extraction....)
 4. **Masking**
 5. **Formulate**
- What is perceived is most of the time a combination of aroma and taste.



Claim & Labelling


Items for communication	raw material	process
Food Allergens (8 in USA, 14 in Europe, 27 in Japan...)		
Anti nutritional factors		
Bio activities (more than 30 linked to peptides)		
Clean label		
GMO free		
Organic		
Plant origin		
Protein purity		



Plant protein diversity

 Protein can be extracted from many different raw materials

- Seeds (Pulses; Cereals; Oilseeds)
- Roots
- Algae's
- Leaves
- Coproducts from the agro-industry
- Microorganisms
- Alternative animal sources
 - Insects
 - Sea food / krill
 - Animal byproducts
- ...

 Processes need to be adapted accordingly



Protein ingredients



Protein can enter the food chain in different forms mainly linked to concentration:

- Flour
- Protein concentrate
- Protein isolate
- Protein hydrolysate



They are more than 1000 different protein isolate or concentrate on the market world wide.



35 different raw material



138 different producers



66 distributors

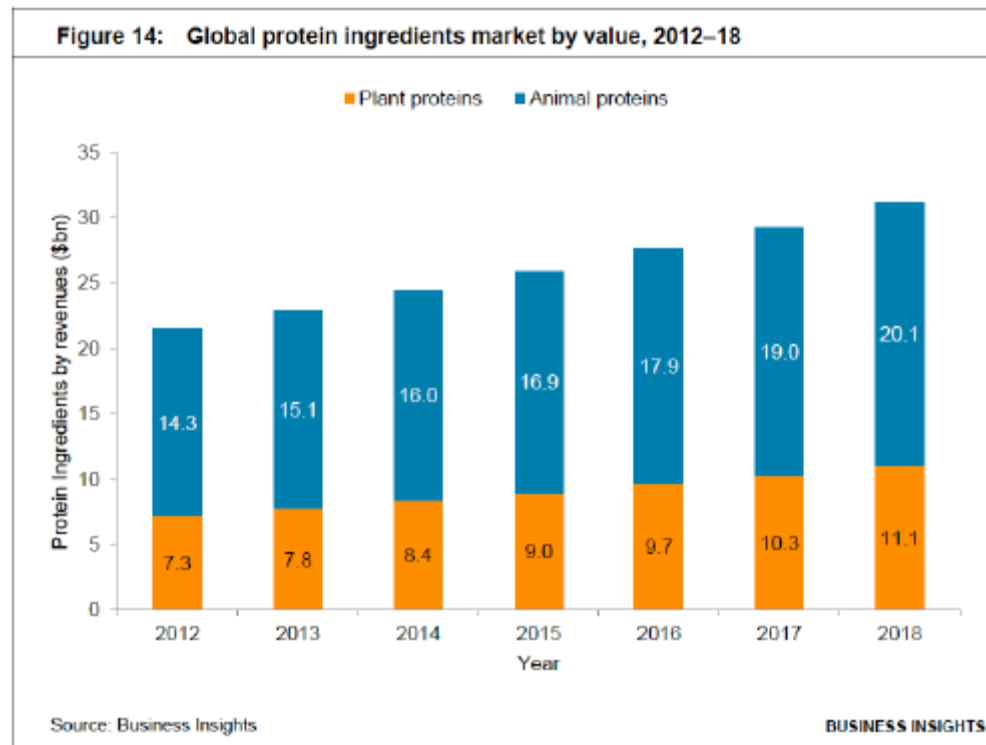


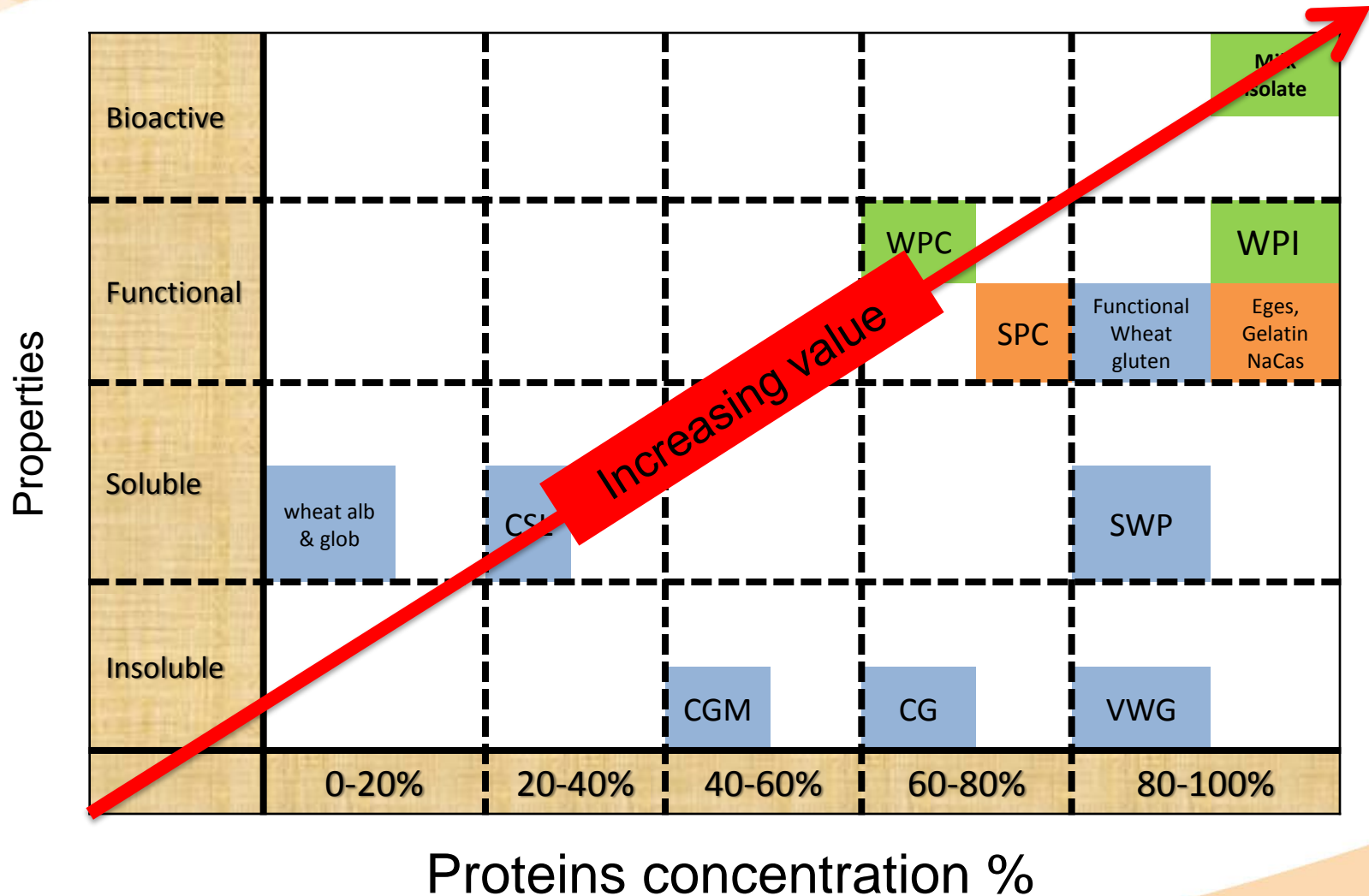
Protein ingredients

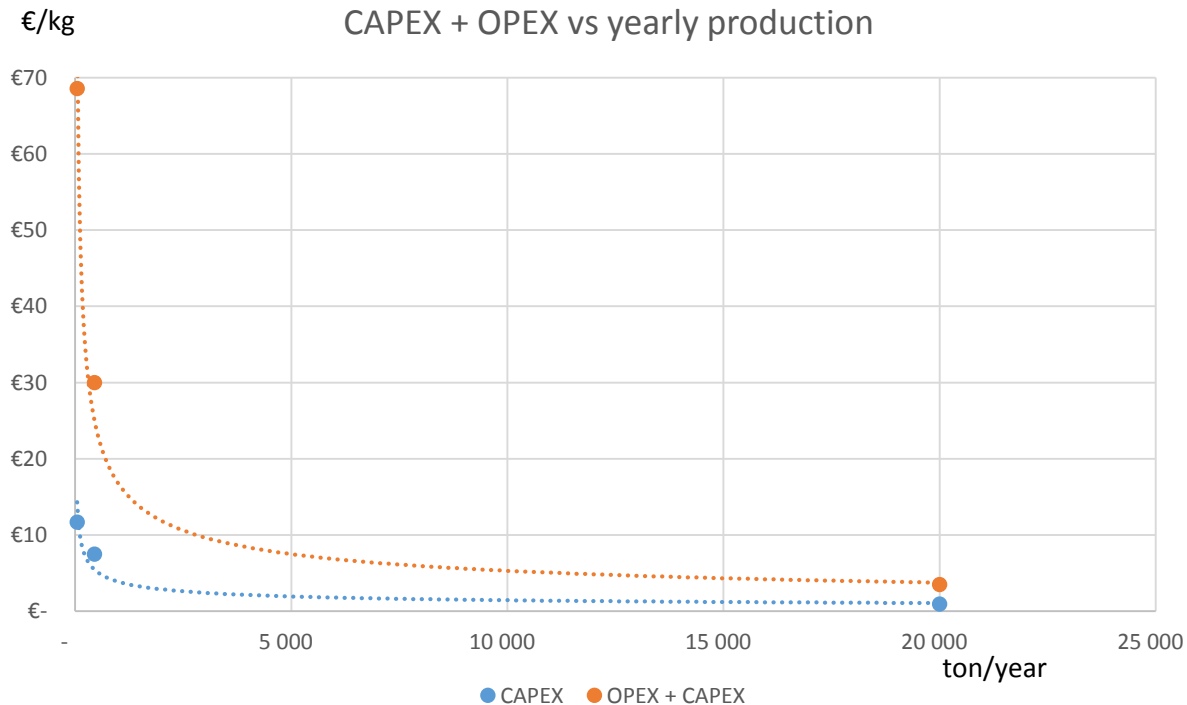
Raw material	Nb of references	Raw material	Nb of references
Total	1019	unidentified	4
soy	465	alfalfa	3
pea	134	Lentil	3
wheat	123	microorganisms	3
rice	85	oat	3
yeast	42	black bean	2
Hemp	20	chia	2
potato	20	mung bean	2
pumpkin	16	sesame	2
plant proteins	13	broadbean	1
algae	12	carob	1
almond	9	chickpea	1
corn	9	coconut	1
faba bean	9	cottonseed	1
lupin	8	flaxseeds	1
rapeseed	8	mankai	1
sunflower	8	psyllium	1
sacha Inchi	5	water lentils	1



Protein ingredients







It is key to know which market is targeted in order to define the size of the project



Protein ingredients



Out of 1019 products

- 39% claim to be functional
 - 12% emulsifying
 - 3% foaming
 - 6% gelling
 - 6% adding viscosity
 - 14% water / fat binding
 - 14% good solubility
 - 15% texturizing
- 29% claim to be nutritional
- 30% claim to have a positive organoleptic impact
- 19% are GMO free
- 7% are organic

Once can claim more than one criteria !



What's IMPROVE SAS ?

- IMPROVE was founded in July 2013 by 4 major French Agrofood companies and some academic partners like Amiens' University and INRA.
- IMPROVE is a private R&D center, services provider of technical and scientific expertise, focused on proteins.
- IMPROVE is a fast growing company, working in confidential contractual research for food and feed innovation, Intellectual Property is 100% for customers.
- IMPROVE offers the best of 23 brains and diversified technologies with 1200m² of laboratories, and pilot facilities (from pilot scale to pre industrial samples / grams to few tons of feedstock).
- IMPROVE is your incubator for food innovation based on our expertise in proteins processing and our network.



Our offer

- ❖ A single entry point to access to a wide range of technologies and competences, dedicated to proteins.
- ❖ Extraction, fractionation, purification, concentration and drying of proteins by using wet and dry process.
- ❖ Physico-chemical, biological and functional proteins characterization.
- ❖ Optimization of a specific unit operation, design of global new process, production of pilots lots and test productions.
- ❖ Strategic support for innovation (audit & brain storming).



**IMPROVE can help you to make
Alternative Protein strong again!**

Thanks



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