

Protein transtion

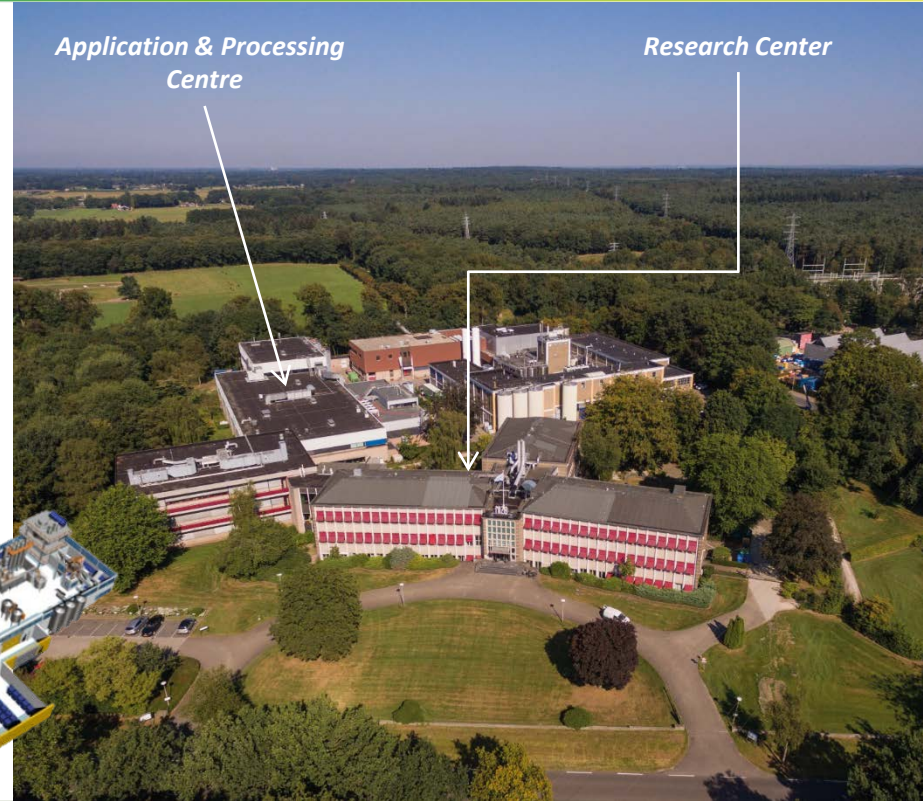
from animal to plant-based foods



NIZO

for better food & health

- Independent, private contract research company for food and health
 - Proteins
 - Bacteria
 - Processing
- HQ in The Netherlands (Food Valley)
- 100 professionals
- From lab to practice
 - Food-grade pilot plant



PROTEIN TRANSITION IN FOOD

BY **2050** WE WILL BE MORE THAN

AND WE WILL NEED TO **produce**

9 billion HUMANS



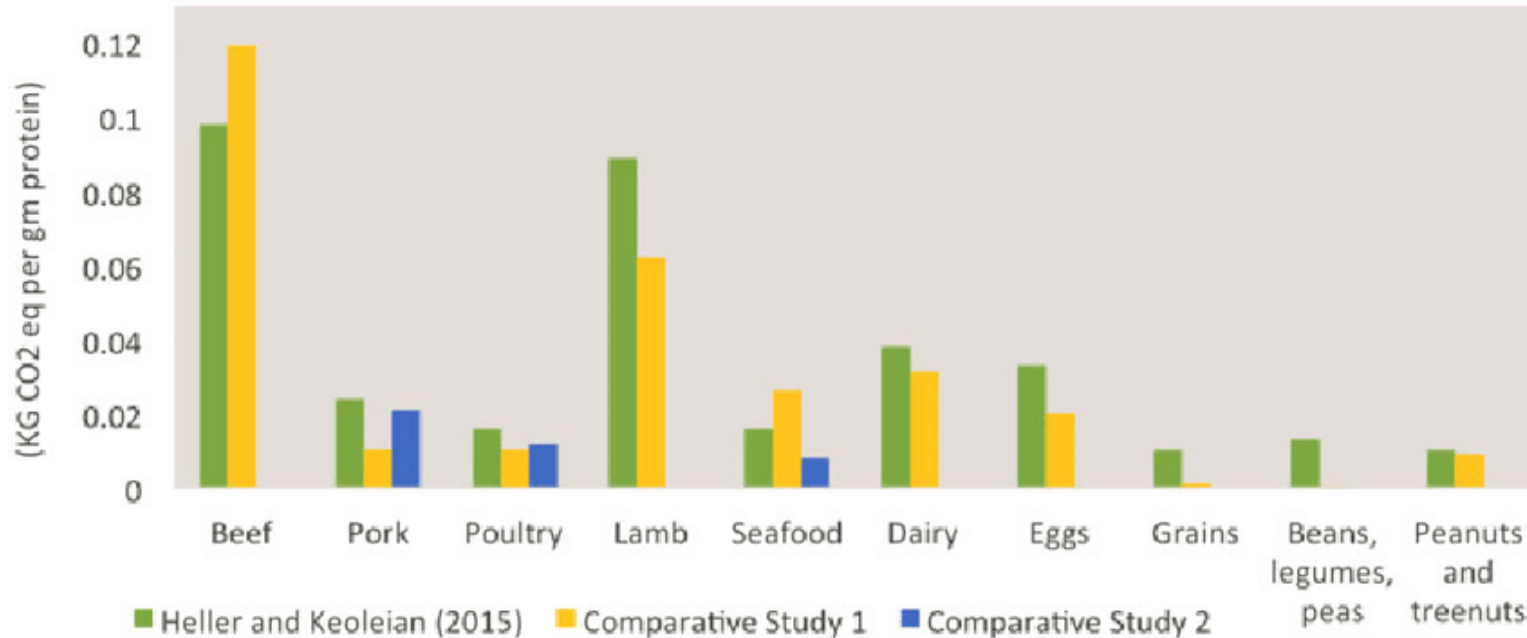
ON **Earth**



60%
MORE FOOD

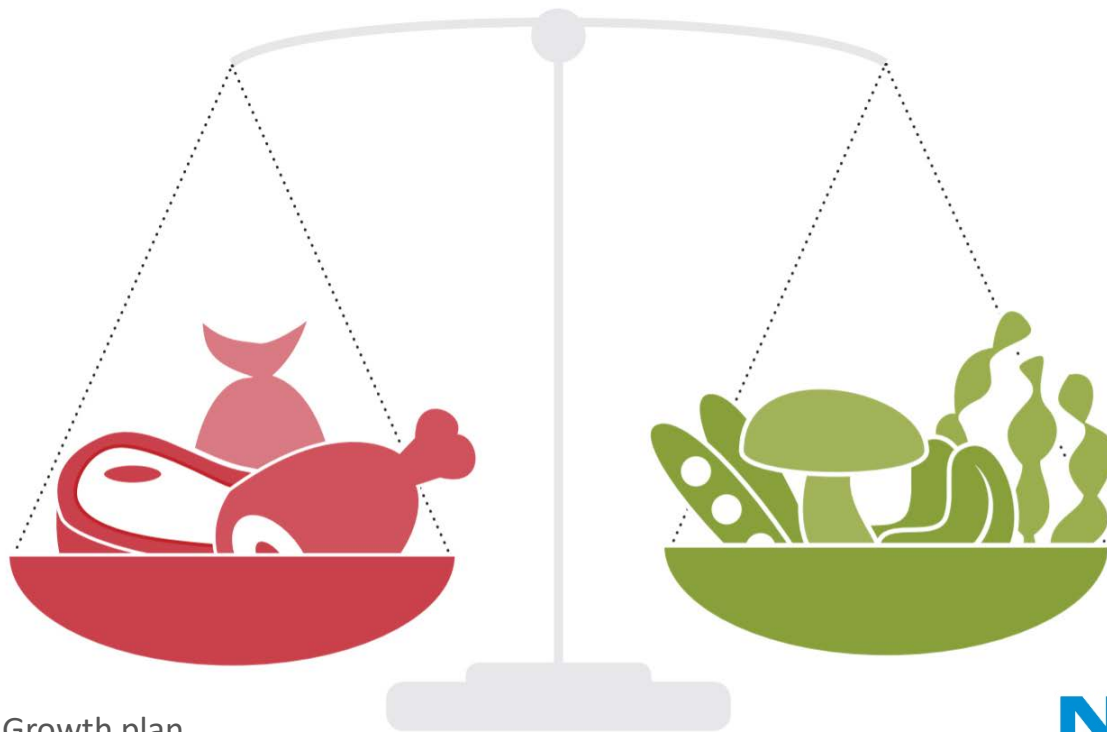
Climate impact of Protein Sources

Carbon Footprint of Protein Sources



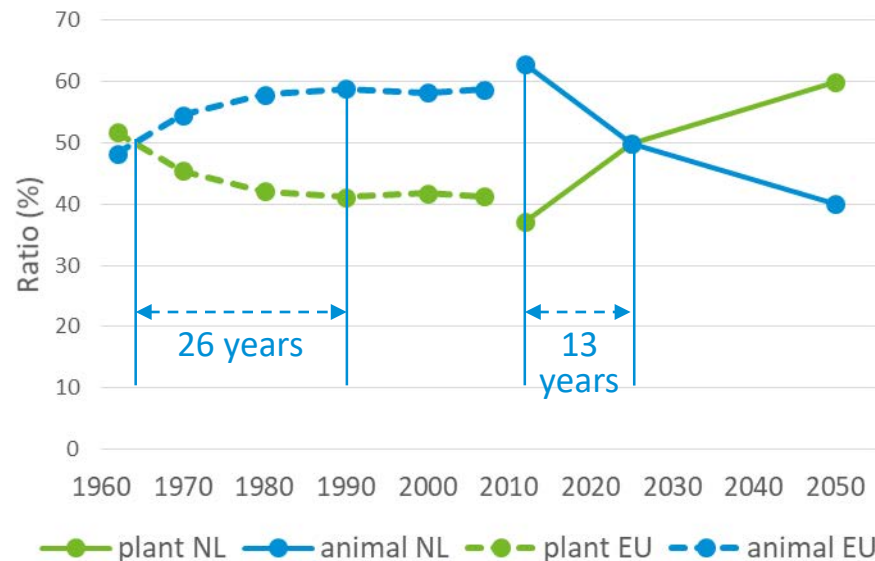
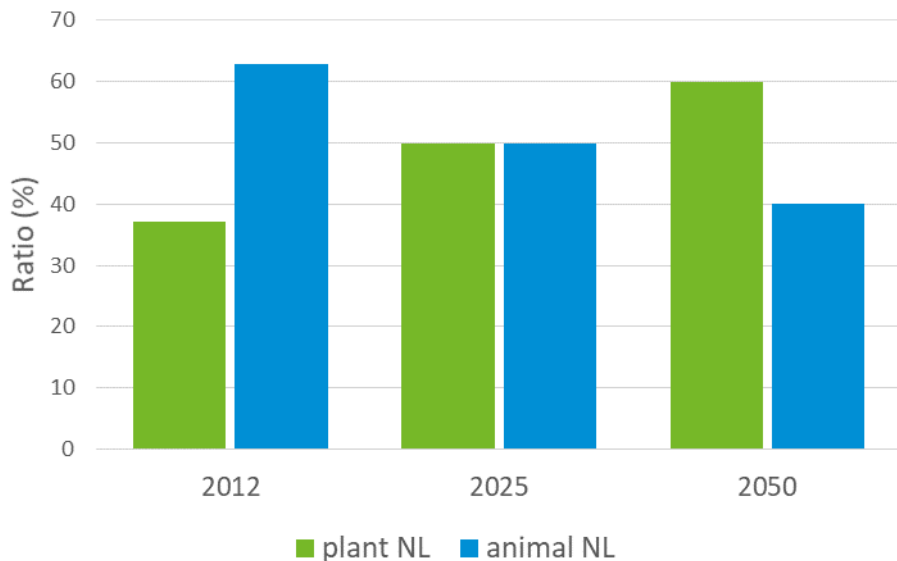
Healthy balance

50:50 target



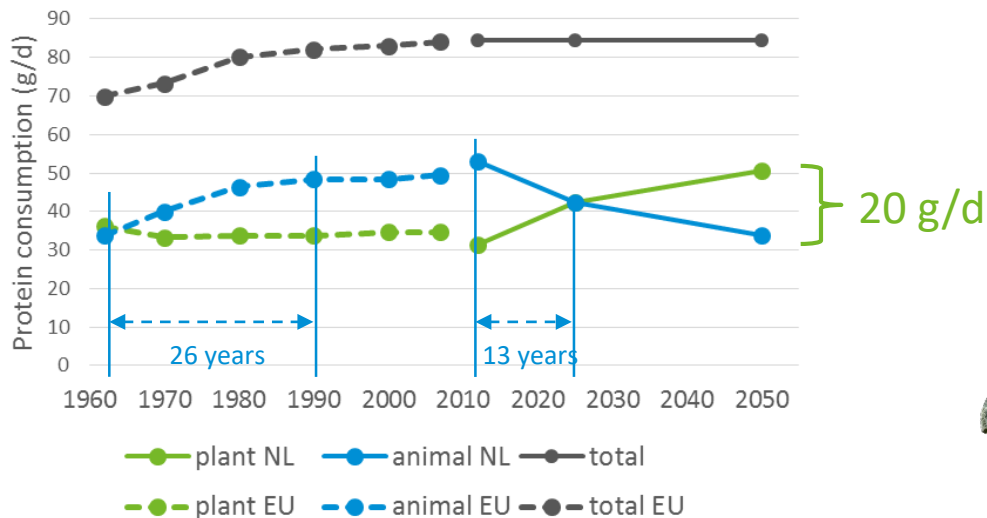
Healthy balance

historical perspective



Protein transition

the historic perspective in absolute numbers



20 g protein = 1 kg of lettuce

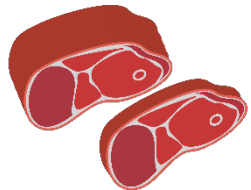
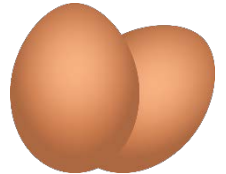
Alternatives for animal products



Protein transition in food

boundaries

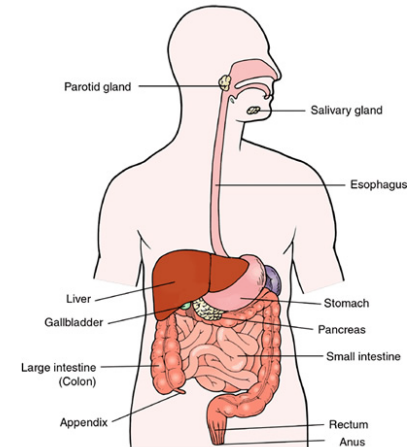
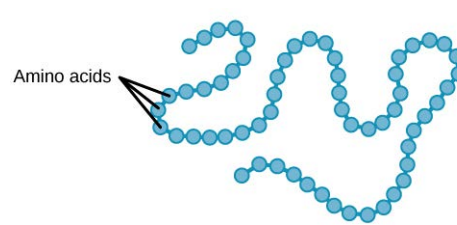
- The transition from animal protein to plant protein
 - This is not about alternative proteins in general
- Proteins for human consumption
 - Excluding animal feed
- Insects are excluded
 - Insects are animals and do not contribute to the protein transition
- Not limited to meat replacement
 - Replacing milk, egg and meat proteins



Proteins

what are proteins

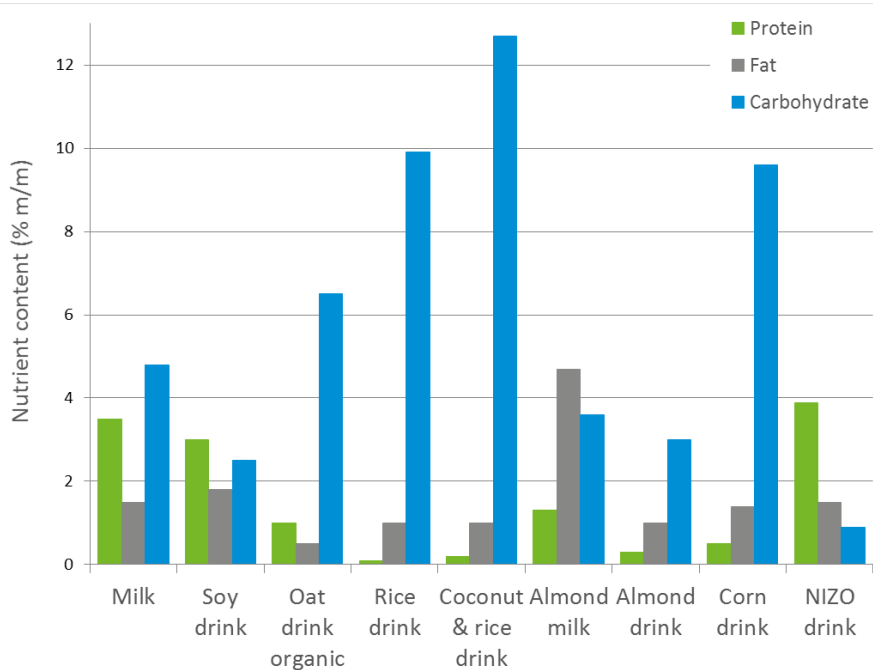
- Chain of amino acids
 - Polypeptides
- Source of nutrients
 - Essential nutrients
- Food ingredient
 - Technical functionality



How to tempt the consumer?

plant protein drinks, a full alternative to milk?

- Nutritional composition varies widely

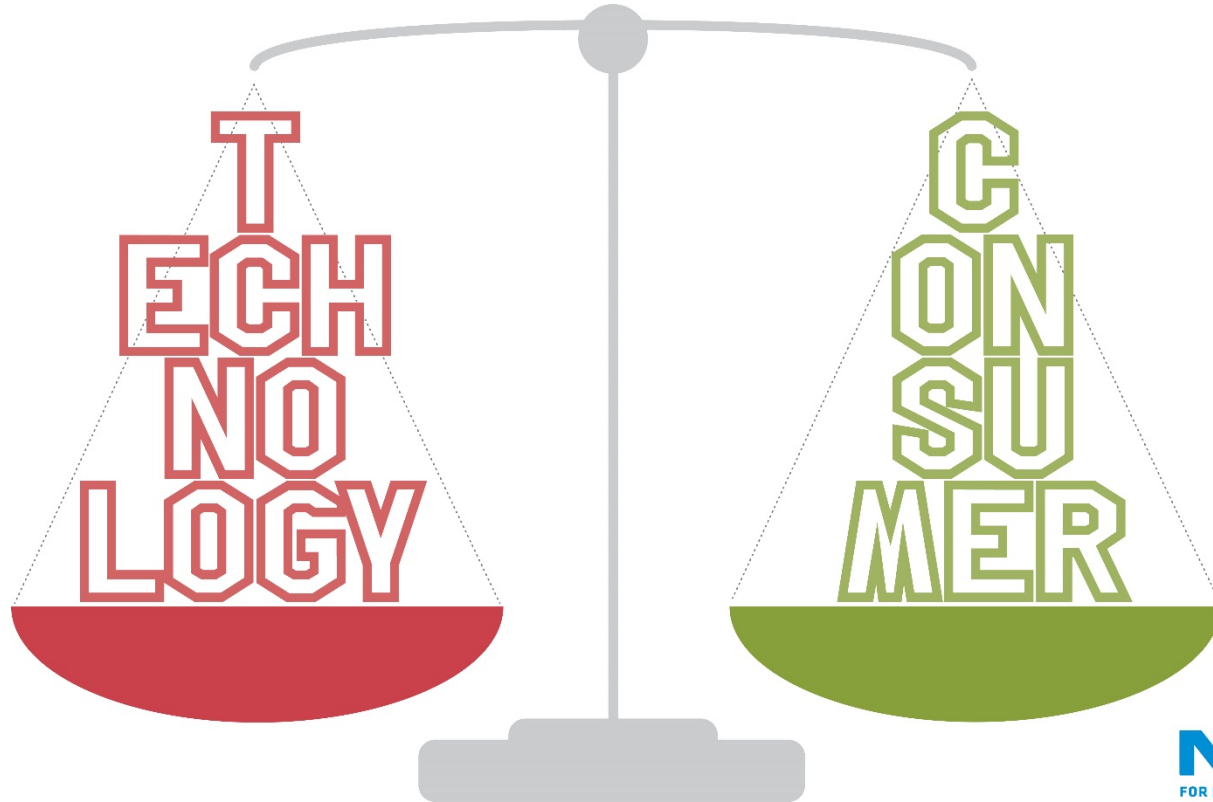


US
Focus on protein
Nutritional parity

- 8g protein per serving
- Zero sugar
- 50% more calcium than milk
- 32mg DHA Omega 3s
- Vitamin D & Iron

Protein transition in food

balance between technology and consumer



How to tempt the consumer?

eating more protein rich vegetable products?

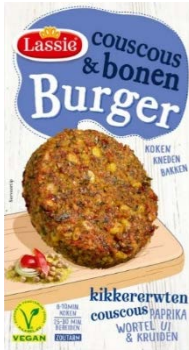


How to tempt the consumer?

developing the ultimate burger?



MADE FROM PLANTS!



CRUNCHY WEED BUN

enriched with Chlorella,
a microalgae

JUICY WEED BURGER

patty made of crispy soyshreds, enriched
with Dutch Royal Kombu, a seaweed

CREAMY WEED SAUCE

with Dutch Sea lettuce

Meat alternatives

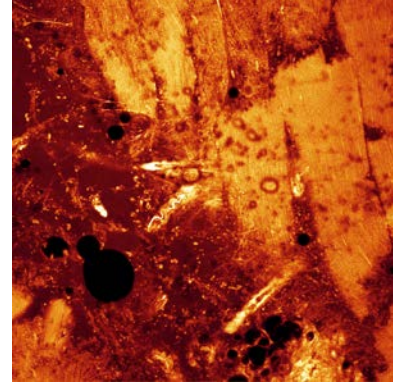
different types of meat alternatives

- Pulses as part of the daily diet
 - Pea, soy, chickpea, beans and so on
- Protein rich meat replacers
 - (traditional) plant-based products to are rich in protein
 - Tofu, tempeh, seitan
- Meat substitutes, meat analogues
 - Products based on plant protein ingredients
 - Aimed at mimicking the eating experience of meat and meat products



Issues with meat alternatives

- The major issue with meat alternatives
 - Structure
 - Texture (perception)
 - Nutritional profile, salt content
- Categories of meat alternatives
 - Meat: focus on developing meat like structure/texture
 - Ready to use (minced meat analogues)
 - Processed meat (sausages, ham: almost not meat structure)



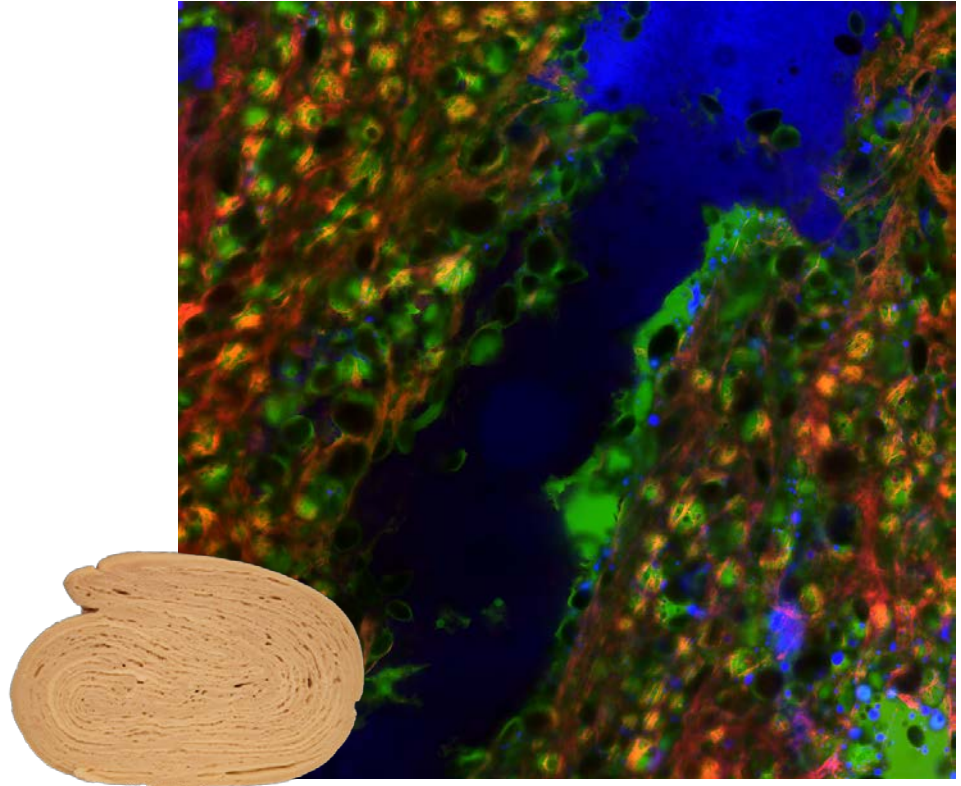
MICROSTRUCTURE

the gateway to understand ingredient functionality

- Need for low cost sources of ingredients / proteins
- Need for flexibility in ingredient sourcing

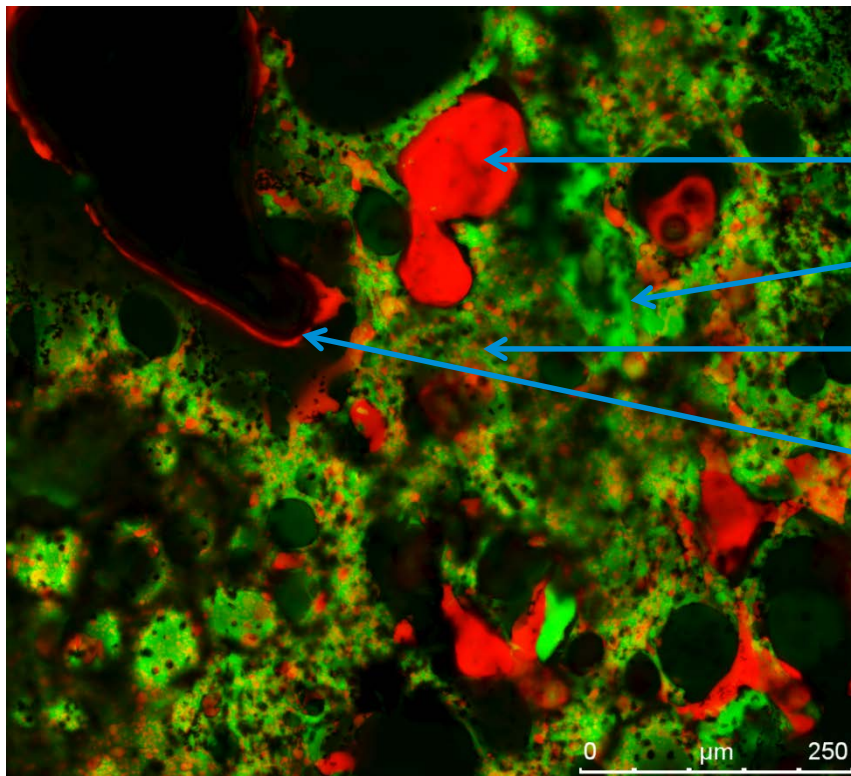
NIZO offers state-of-the-art CLSM equipment combined with 20+ years of experience

- Confocal Laser Scanning Microscopy
 - Limited sample preparation
 - 3D imaging
- Simultaneous visualization of different ingredients
 - Protein, fat, starch
- Visualize the impact of processing and ingredients



COOKED SAUSAGE

microstructure



Fat

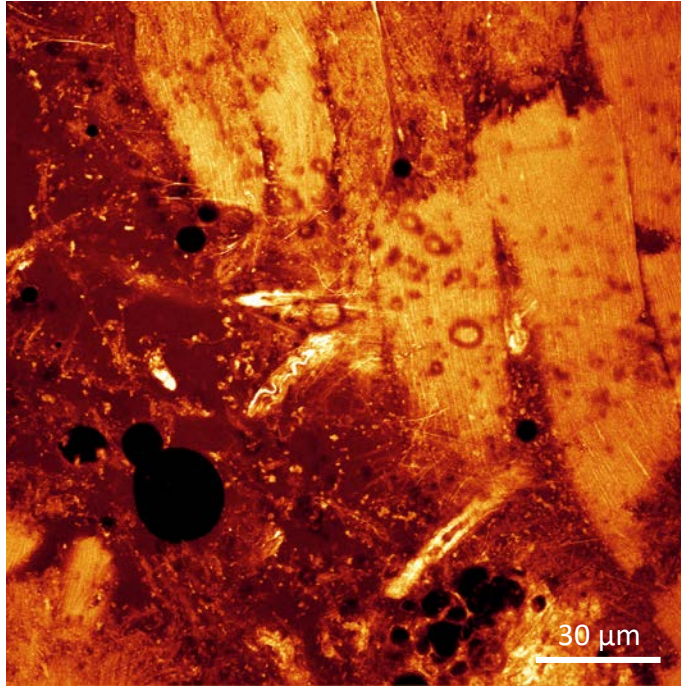
Protein network

Emulsified fat

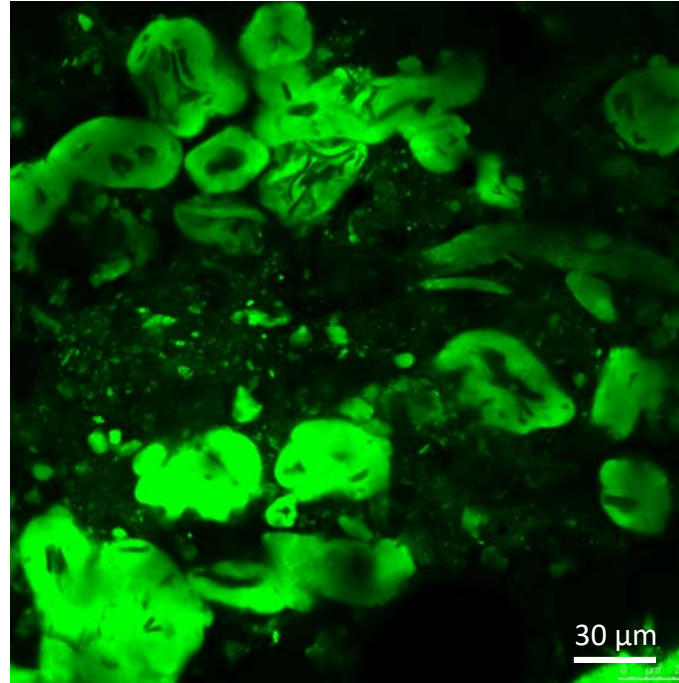
Fat at surface of air bubble

MEAT VS. MEAT ALTERNATIVES

different microstructures different perception



Fresh chicken meat showing fibres

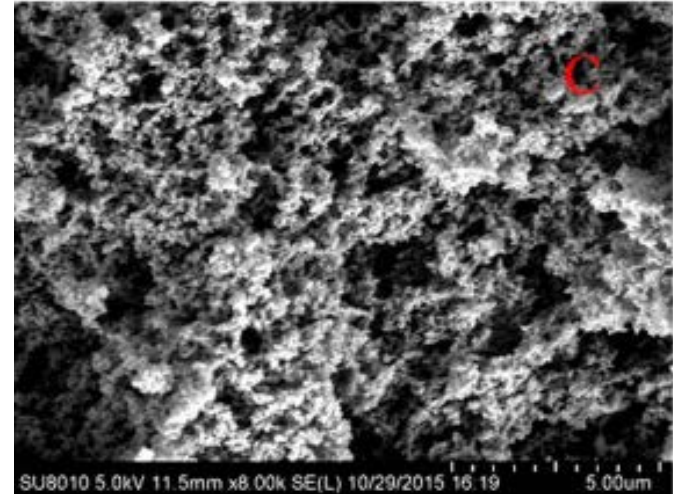


Meat alternative composed of protein “lumps”

Tofu

a traditional Asian product

- Traditional tofu
 - Soy milk prepared from whole soy beans
 - Coagulation of soy with heat and salts
 - CaSO_4 , CaCl_2 , MgSO_4 ,
- New process: silken tofu
 - Soy milk prepared from whole soy beans
 - Gelation by slow acidification
 - Addition of glucono- δ -lacton



Tempeh

a traditional Asian product

- Fermented soy beans
 - Dehulled, partly cooked soy beans
 - Controlled fermentation by *Rhizopus oligosporus*
 - Soy beans hold together by the mycelium
 - Cakes of fermented soy beans can be sliced

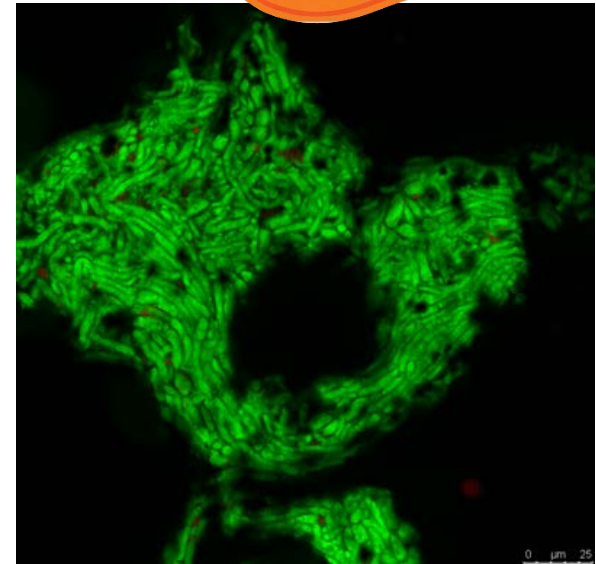
- Specialty tempeh
 - Other beans, wheat or whole grains



Quorn

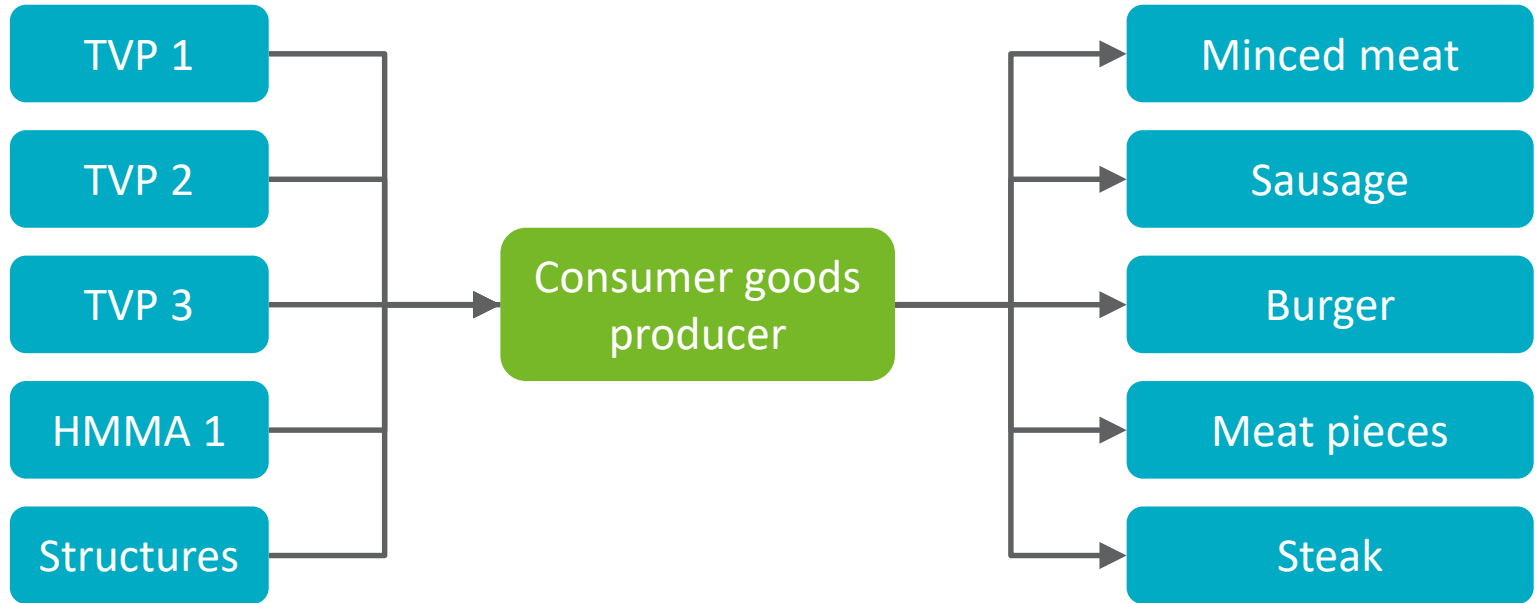
British company founded in 1985

- Mycoprotein
 - Mycelium resembles meat texture
 - Produced by fermentation with *Fusarium Venenatum*
 - Glucose as carbohydrate source
 - Vitamins and minerals added for nutritional profile
 - Mycelium is cooked and dried
 - Mixed with chicken egg white as binder
 - Potato protein is used in the vegan products
 - Shaped into products



Copyright: NIZO food research B.V.

Production of meat alternatives



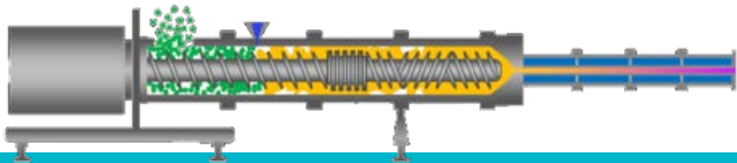
Fibre technologies

- Proven technologies
 - Extrusion
 - Texturised Vegetable Proteins (TVP): dry extrusion
 - High Moisture Meat Analogues (HMMA): wet extrusion
 - High Moisture Extrusion Cooking (HMEC)
 - Calcium alginate technology
- Experimental technologies
 - Shear cell technology
 - Cultured meat (clean meat)



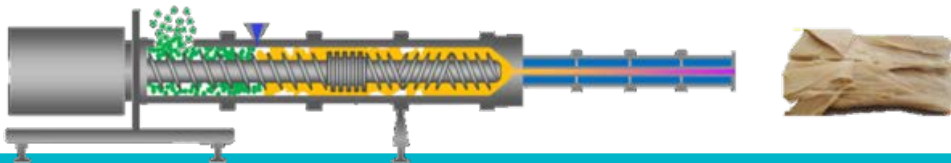
Extrusion

- Texturised Vegetable Proteins (TVP)
 - Dry ingredients
 - Mainly soy
 - Steam injection
 - Extrusion
 - Drying
- Sponge-like texture
 - Rehydration is required before use



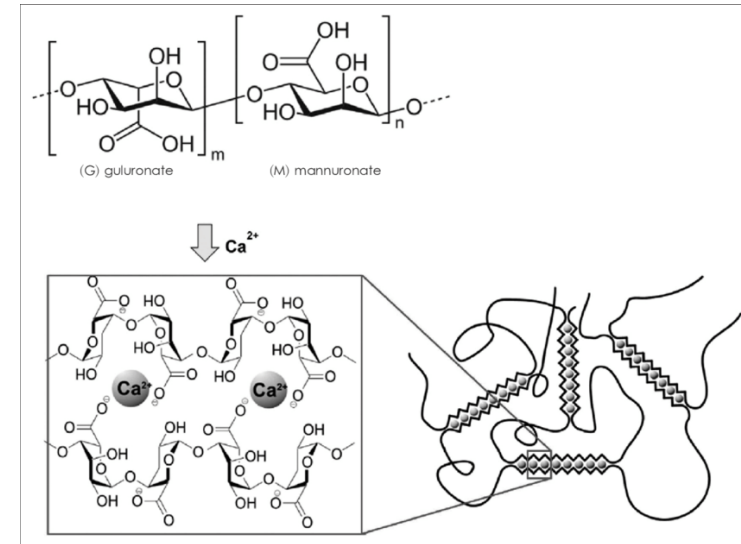
Extrusion

- High Moisture Meat Analogues (HMMA)
 - Recipe
 - Different protein sources
 - Water
 - Fat
 - Wet extrusion
 - Texturising, cooling, cutting
- Fibrous texture
 - Ready to used



Calcium alginate method

- Interactions results in structured products
 - Alginate originates from seaweeds
 - Produced as sodium alginate
 - Mixed with the protein source
 - Flour, concentrate, isolate
 - Interaction with calcium chloride results in skin formation
 - Cooking and freezing



Shear cell technology

- Homogeneous shear field
- Mixture of proteins
 - Soy, Pea, Wheat, Lupin
- Up-scaling is ongoing



WAGENINGEN
UNIVERSITY & RESEARCH

STRUCTURING PROTEIN INTO FIBROUS TEXTURES

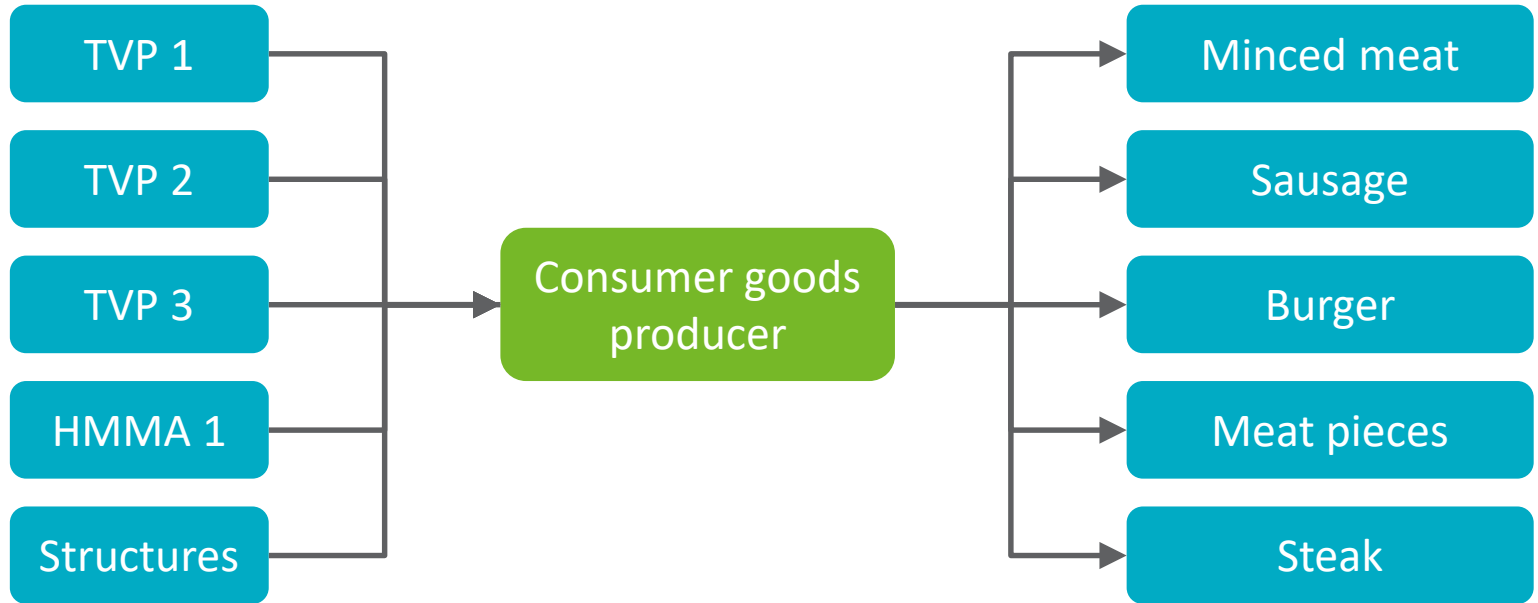
the NIZO fibrous proteins bring “bite” and juiciness

- Demand for a sustainable food production, protein enrichment and meat alternatives with the ‘bite of meat’
- NIZO fibrous proteins bring texture & “bite”
 - in Meat and meat alternatives
 - with a wide range of protein sources

The NIZO fibrous proteins bring “bite” and juiciness



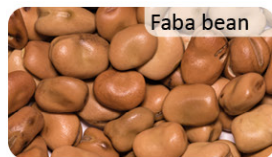
Production of meat alternatives



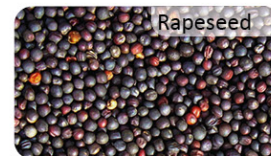
HOW TO TEMPT THE CONSUMER?

which protein ingredient is most appealing

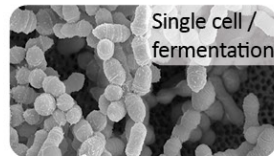
ESTABLISHED



EMERGING



UP COMING



**INNOVATING
TOGETHER**

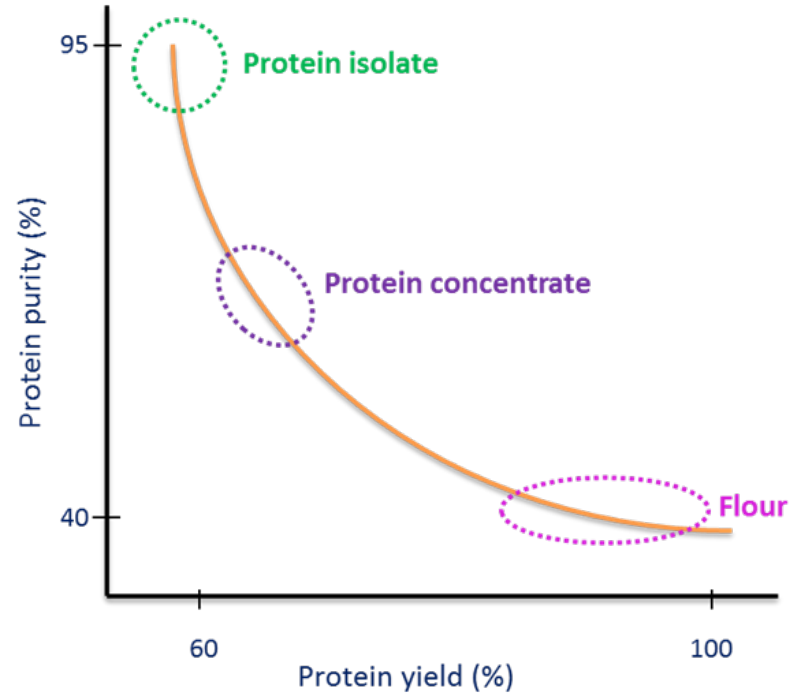
Photos by Sanjay Acharya, Shihmei Barger, Kristina D.C. Hoepfner,
Luis Molinero, Mirjam van de Velde and others.

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FOR BETTER FOOD & HEALTH

Protein source

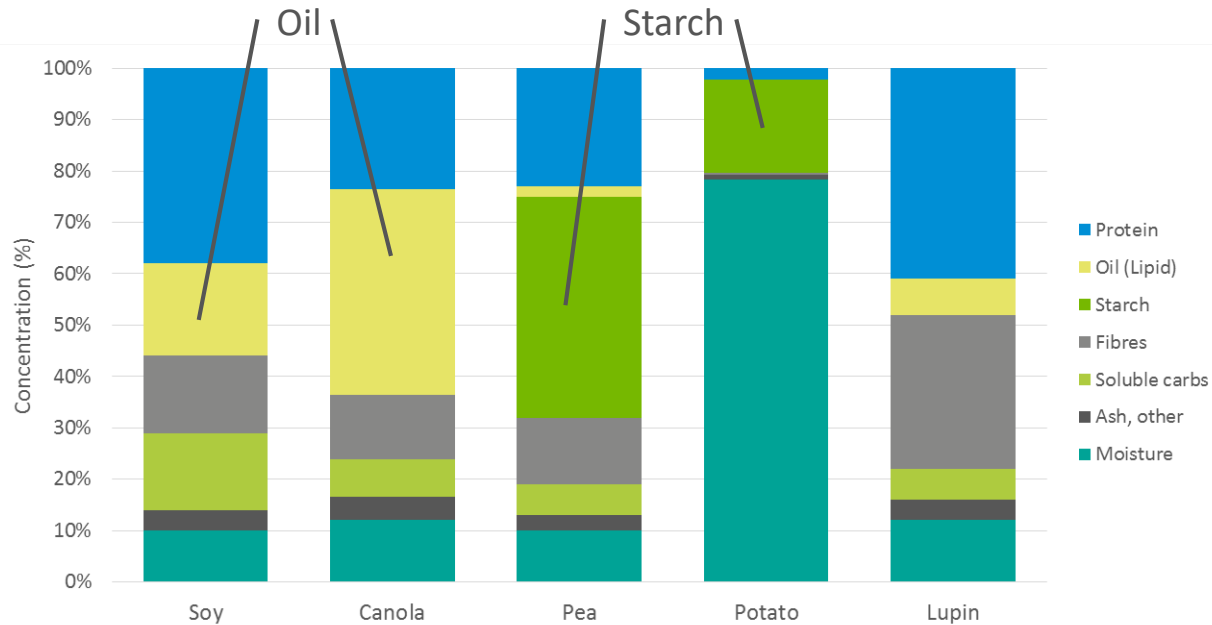
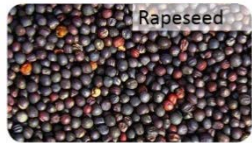
how to select the right ingredient

- Flour
 - Low in protein
- Concentrate
 - Highly purified
 - High in protein
- Isolate
 - Highly purified
 - High in protein



PLANT PROTEINS

economic drivers



Oil and starch are part of the economic picture of plant proteins

EXTRACTION PROCESS

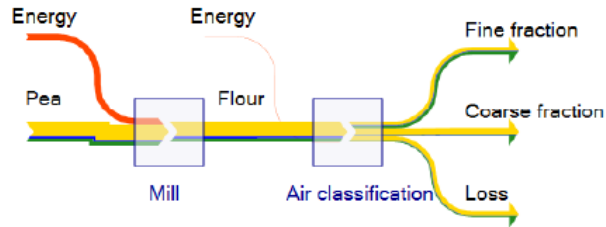
pea proteins (and other starch seeds)



DRY VS. WET SEPARATION OF PEA PROTEIN

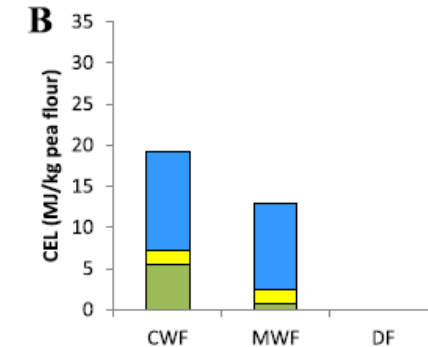
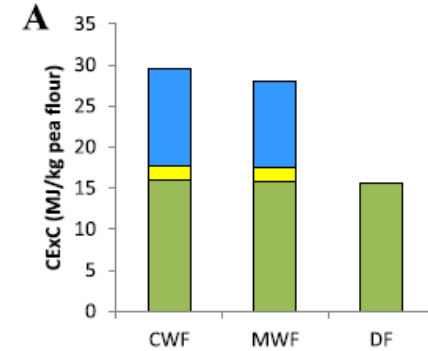
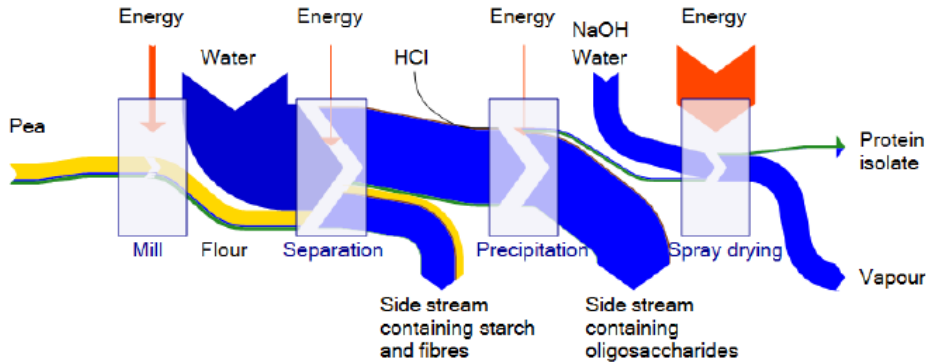
analysis of the environmental impact

Dry fractionation



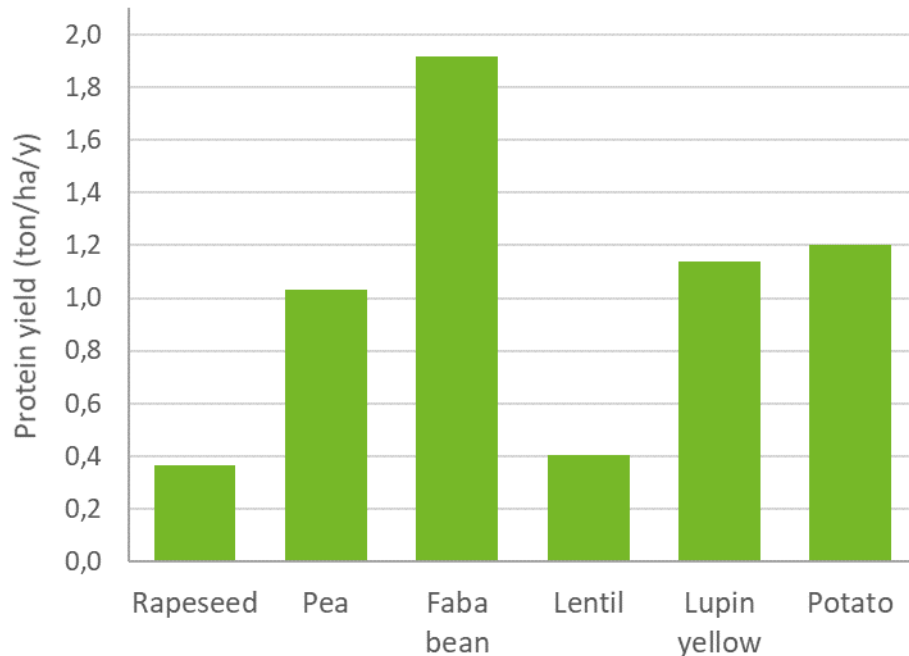
Scale			
Mass	2000 kg	300 kg	70 kg
Energy	2000 MJ	300 MJ	80 MJ

Wet fractionation



Protein yield of different crops

comparing proteins based on their yield (ton protein/hectare/year)



PULSE project

from seed to food

Breeding

SEED

Agriculture

CROP

Harvest

SEEDS

Extraction

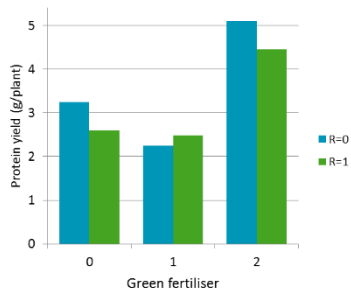
PROTEIN

Process

FOOD



Breeding your profit

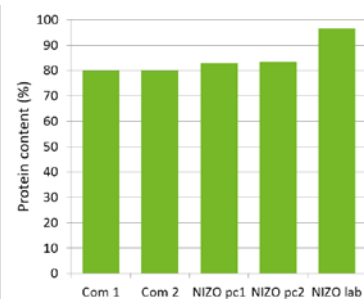


From seed to food. Naturally



RUITENBERG

INNOVATION AS MAIN INGREDIENT



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Protein Utilisation from Legumes for a Sustainable European crop Legumes as a source of dietary protein in a sustainable food chain (PULSE)

Mail Share Print

Details
Project number
RAAK_PROO2_051

NIZO
FOR BETTER FOOD & HEALTH

has
hogeschool

PULSE project

a multi-disciplinary project

Breeding

SEED

Agriculture

CROP

Harvest

SEEDS

Extraction

PROTEIN

Process

FOOD

Applied
Biology



Toegepaste
Biologie

Agriculture



Tuin- en
Akkerbouw

Environmental
Technology



Milieukunde

Food
Technology



Voedingsmiddelen-
technologie

Food
Innovation



Food Innovation

HAS Food Experience 2018



HAS Food Experience 2020



APPLICATIONS IN MEAT ALTERNATIVES

salt content under discussion

food ingredients 1st
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beverages made brilliant

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You are in: All News > "Excessive salt levels" found in meat alternatives, says UK campaign group

"Excessive salt levels" found in meat alternatives, says UK campaign group

Email Print Share - A +

23 Oct 2018 --- Campaign group Action on Salt (AoS) is urging the government to step up legislation on salt reduction after finding "excessive amounts" in some processed meat alternatives. A UK product survey reveals several meat-free products are far higher in salt than the recommended guidelines. And, Public Health England, the government agency responsible for the UK's salt reduction program, admits "there is still a long way to go" on decreasing the nation's salt intake.

Based at Queen Mary University London, Action on Salt claims that meat-free products, like alternative burgers, bacon-style rashers and sausages, often contain more salt than their real meat counterparts. These meat-free alternatives are often perceived by consumers to be a healthier alternative, according to AoS, but 28 percent of all products surveyed are higher in salt than the UK government's recommended salt targets.



INNOVATING
TOGETHER

fd. Mijn nieuws Laatste nieuws Krant Dossiers Beurs Meer

DCWJ 26.034.83-077% Abonneren

Meer lezen

BETA

Vegaburger: goed voor dieren, minder voor nieren

De vleesvervanger is ongekend populair, zeker na het knallende beursdebuut van Beyond Meat op Wall Street. Ook in Nederland voorspelt ABN Amro een flinke groei van de markt voor vleesvervangers, dankzij voedingsinnovaties. Er is alleen nog wel wat te verbeteren aan de producten, melden voedseldeskundigen. Vegaburgers en 'kipstuckjes' blijken namelijk niet zo gezond. Hoe zit dat?

Volgen via mijn nieuws

- Beursgang + Volg
- Beyond Meat + Volg
- Beta + Volg

eerlijk over eten

Voedingencentrum

Home Vraag en antwoord Professionals Onderwijs Pers Over ons

Schijf van Vijf Mijn gewicht Mijn kind en ik Mijn boodschappen Recepten Encyclopedie Webshop

vraag en antwoord / ... / wat zijn gezonde vleesvervangers als...

Wat zijn gezonde vleesvervangers als je meer vegetarisch wilt eten?

- Vraag en antwoord
- Gezonde voeding en voedingsstoffen**
- Aandoeningen
- Afvallen en gewicht
- Zwangerschap en baby
- Kinderen en jongeren
- Eten kopen en keurmerken
- Veilig eten en E-nummers
- Koken en bewaren
- Vragen aan het Voedingencentrum

Als je een gezond vegetarisch gerecht wilt maken, kun je vlees of vis vervangen door bijvoorbeeld eieren, noten, peulvruchten of producten op basis van soja (tofu of tempé/tempeh), lupine of tarwe-eiwit (seitan). Je kunt ook kiezen voor een kant-en-klare vleesvervanger zoals een vegetarische burger, groenteburger, vegetarisch gehakt, vegetarische balletjes (o.a. falafel) of vleesstukjes, of een vleesvervanger van merken zoals de Vegetarische Slager, Quorn, Valles, Tivall, Vivera of een huismerk van je supermarkt.



Veel kant-en-klare vleesvervangers zijn echter niet zo gezond, omdat ze veel zout en

IZO
BETTER FOOD & HEALTH

EXTRACTION PROCESS

pea proteins (and other starch seeds)

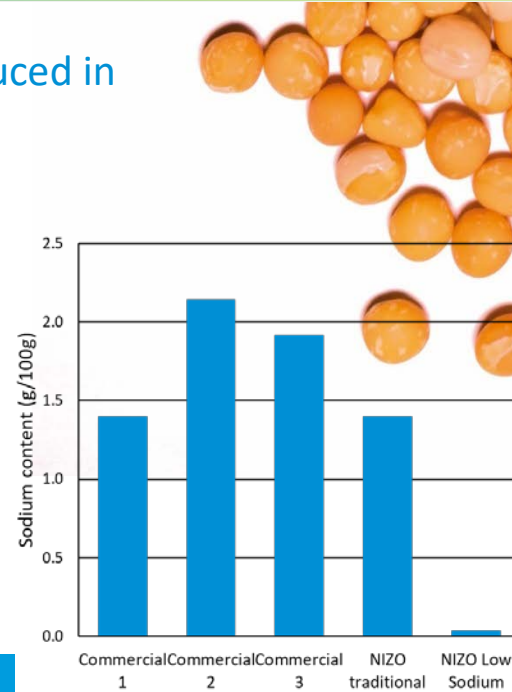


LOW SODIUM PEA PROTEIN ISOLATE

mildly extracted PPI

- Low Sodium pea protein isolate has been produced in the NIZO processing centre
 - Starch separation
 - Protein purification
 - Spray drying
- Batch size: 1 – 4 m³
- Low Sodium PPI showed
 - Good solubility/dispersibility
 - Good emulsifying properties
 - Excellent heat stability

Sodium content of NIZO Low Sodium PPI is 40 times lower than commercial PPI



PROTEIN FLEXIBILITY

developing new protein ingredients

- One-to-one protein or ingredient replacement is not always possible
- Nutritional quality
 - Proteins from different sources have different amino acid profiles (essential amino acids) and digestibility
- Technical functionality
 - Solubility, gelling, emulsifying, foaming
 - Interaction with hydrocolloids
- Taste and smell
- Environmental impact

A Infant, Sport & Clinical

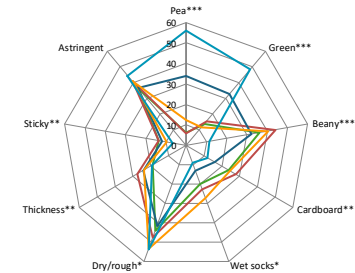
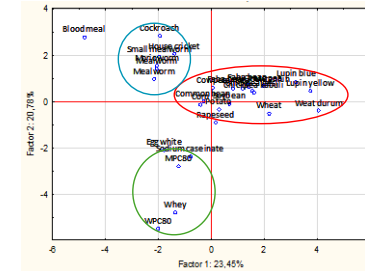
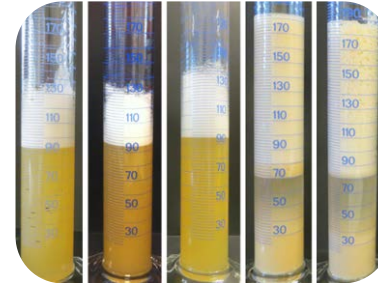
B Food - functional ingredient

C Food - bulk nutrition

D Pet food

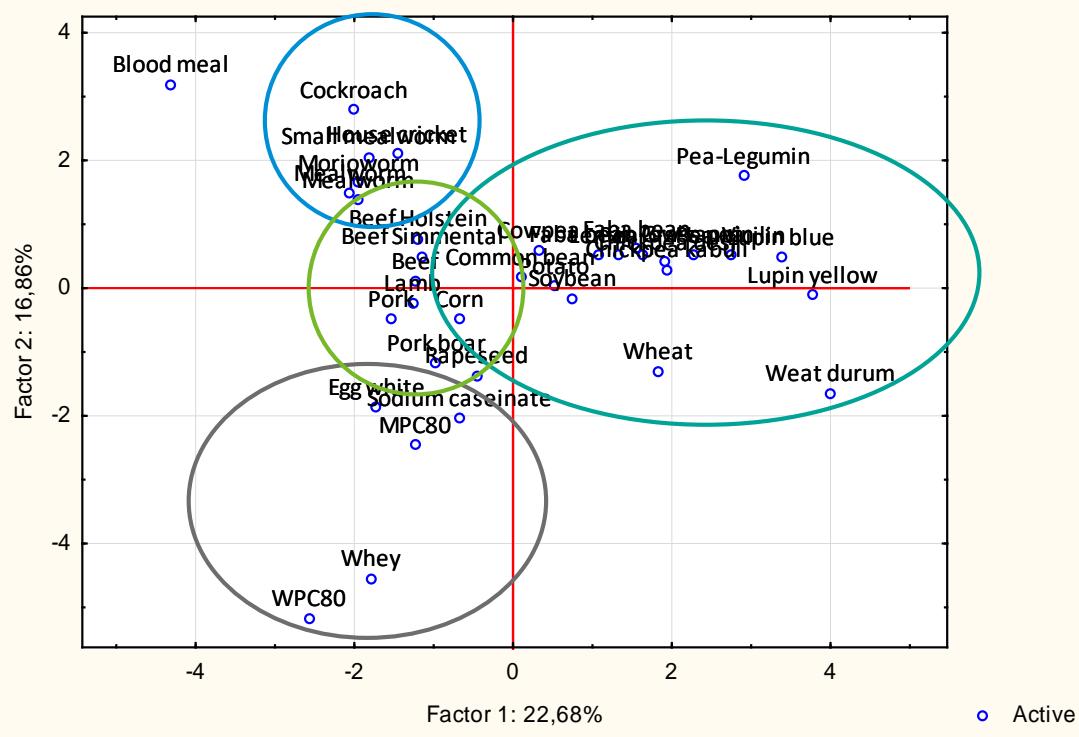
E Feed

F Energy, Bioplastics & Chemicals



PROTEINS

amino acid composition



Dairy proteins

Meat proteins

Vegetable proteins

Insects

Clustering of the amino acid composition per origin

DIGESTIBILITY

FAO discussion on methods



Food and Agriculture
Organization of the
United Nations

- PDCAAS: Protein Digestibility Corrected Amino Acid Score

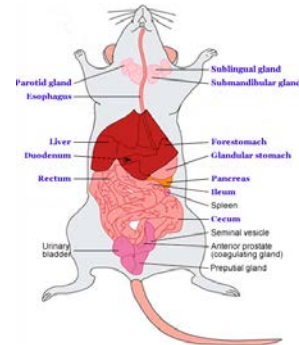
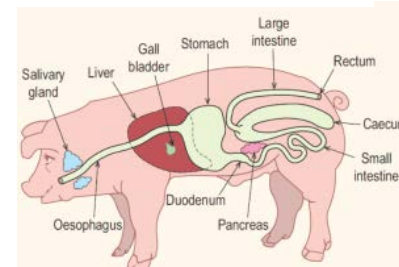
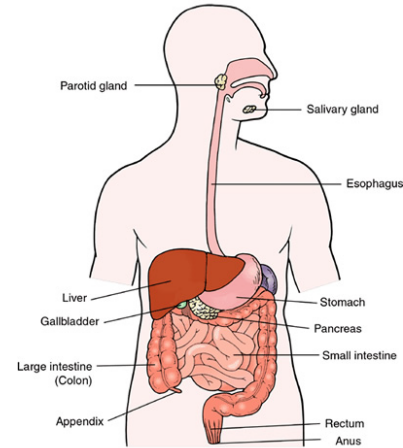
- Established method according to AOAC
- Measurement in the faeces
- Bioavailability of single amino acids is not taken into account

FAO expert consultation 2012:
Dietary protein quality evaluation should
be performed by **DIAAS**

- DIAAS: Digestible Indispensable Amino Acid Score

- True ileal digestibility → sampling at terminal ileum
- Measure digestibility for individual essential amino acids
- Preferably determined in humans > if not possible: pigs > if not possible: rats

- No established AOAC method yet

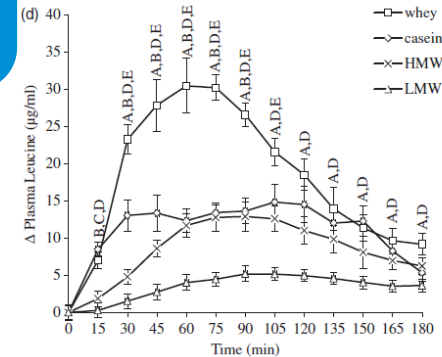
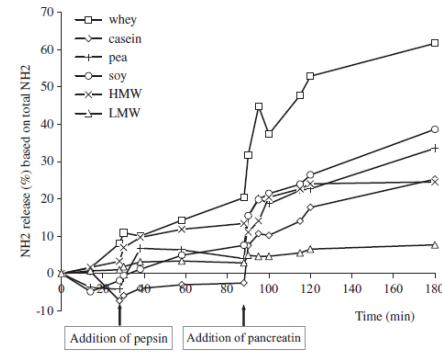


WHAT DOES YOUR BODY THINK OF NEW PROTEINS?

- Growing demand for the use of new protein sources
- Evaluate digestibility of emerging and upcoming protein sources compared to established ingredients

In vitro digestibility increased with: low MW potato < casein < high MW potato < pea < soy << whey protein
A similar trend was observed for the in vivo amino acid digestion profiles: TAA, EAA, BCAA and Leucine

- Screen protein digestibility using *in vitro* GI model
- Relate data to *in vivo* absorption kinetics: postprandial plasma amino acid concentrations



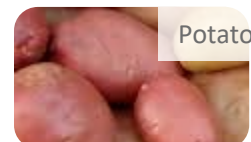
Dairy



Pea



Soybean



Potato



Bedankt voor uw aandacht!

