

PERFECTING DAIRY AND MEAT ALTERNATIVES

*NIZO's integrated "pyramid approach"
using an innovative high-throughput screening toolbox*



INNOVATING
TOGETHER

Alternative proteins

An ever-evolving playing field

Non-animal proteins

Plant



Soybean



Oat



Faba bean



Chickpea

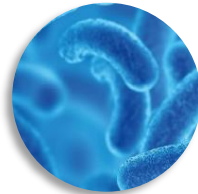


Green leaves



Almond

Microbial/single cell



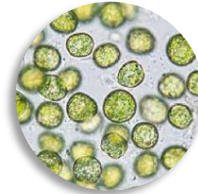
Bacteria



Fungi



Yeasts



Microalgae

Precision ferm./cell ag.



Whey proteins



Egg proteins



Meat



Casein



Seafood

Photos by Sanjay Acharya, Shihmei Barger, Kristina D.C. Hoeppe, K.R. Harsha, Luis Molinero, Stefan Malmesjö, Mirjam van de Velde and others.

Consumer expectations of dairy and meat alternatives

4 levels of consumer expectations

Benchmark set by



Whey proteins



Egg proteins



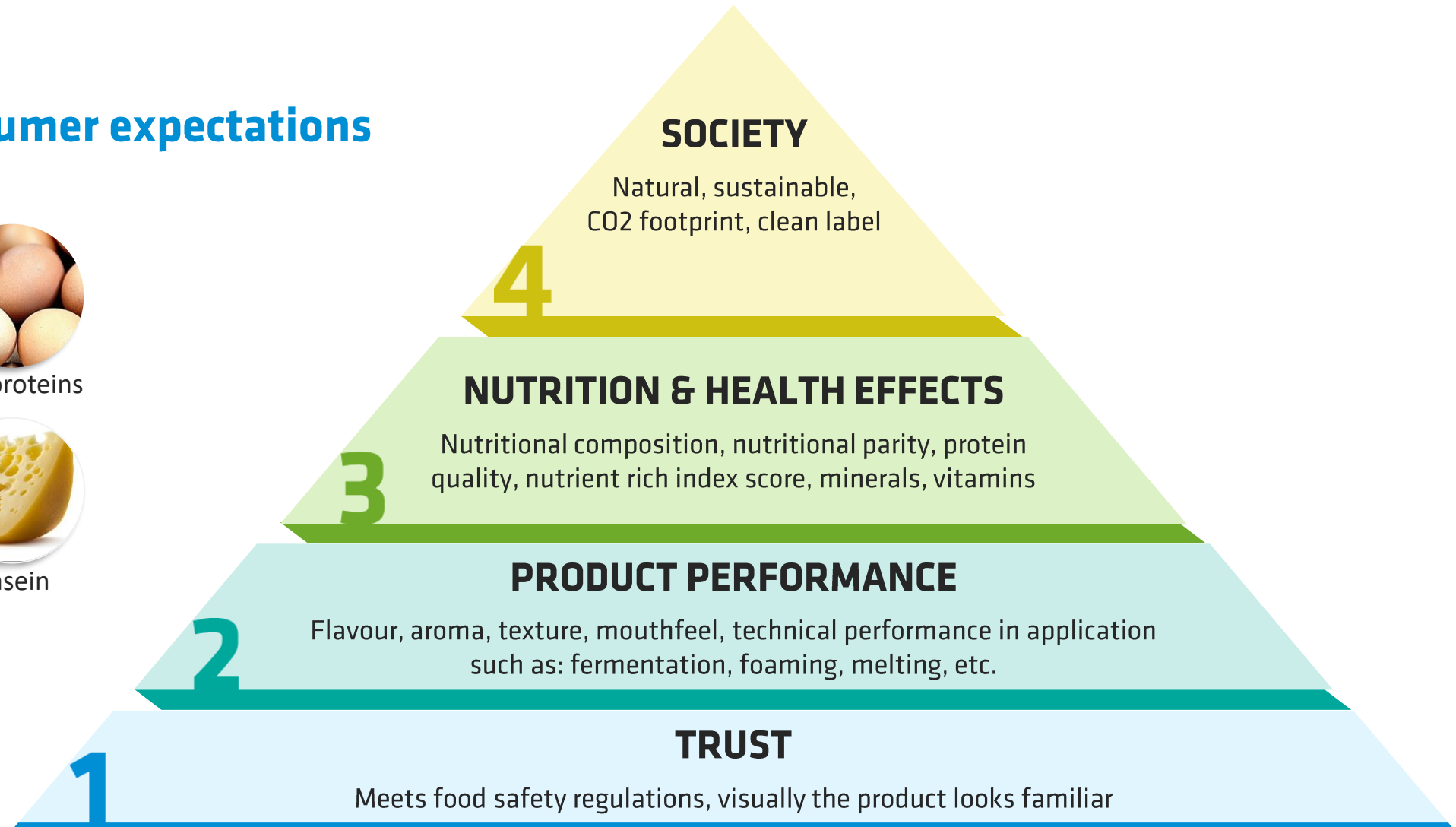
Meat



Casein

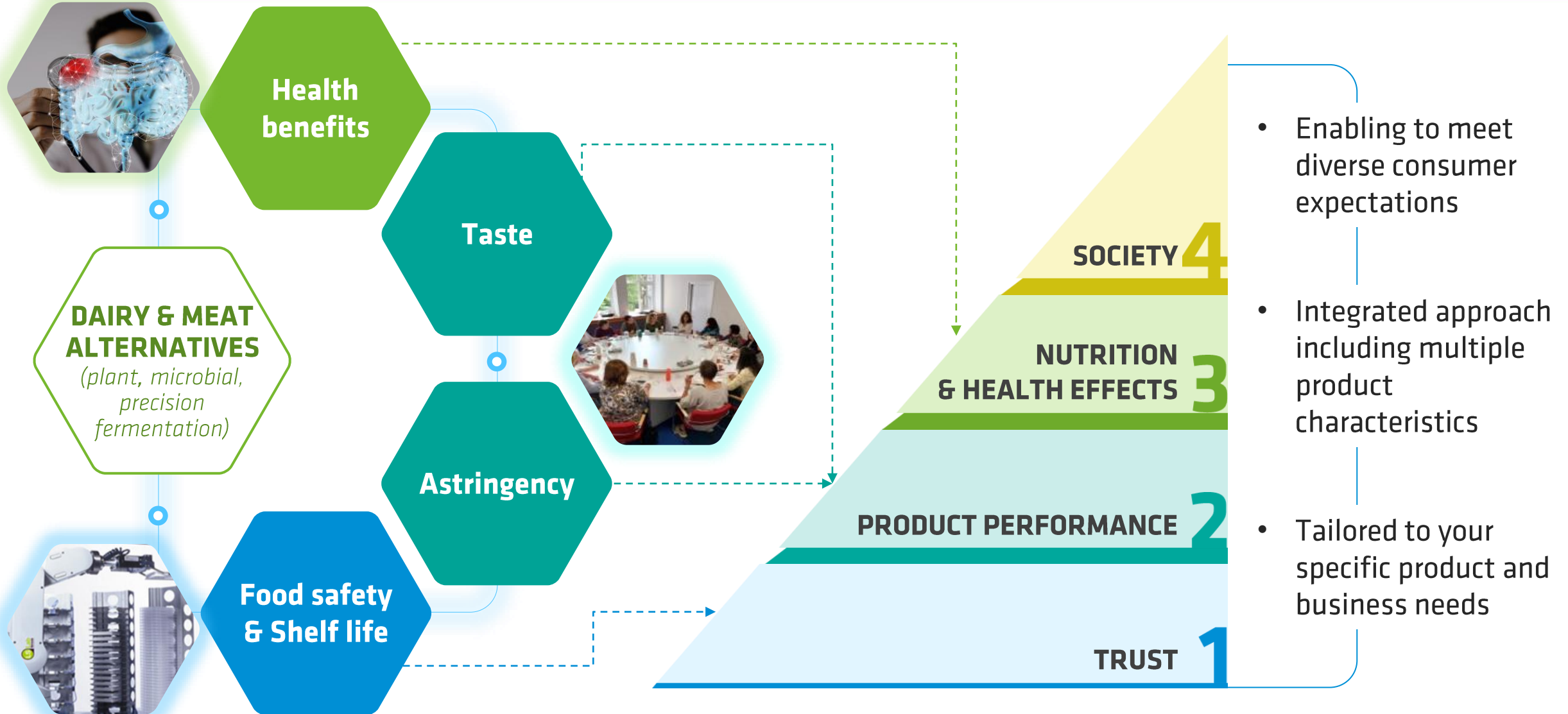


Seafood



NIZO high-throughput screening toolbox for integrated approach

Pick 'n mix



**INNOVATING
TOGETHER**

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NIZO
FOR BETTER FOOD & HEALTH

Food Safety & Shelf Life: Control microbial contaminants

MARKET DRIVEN

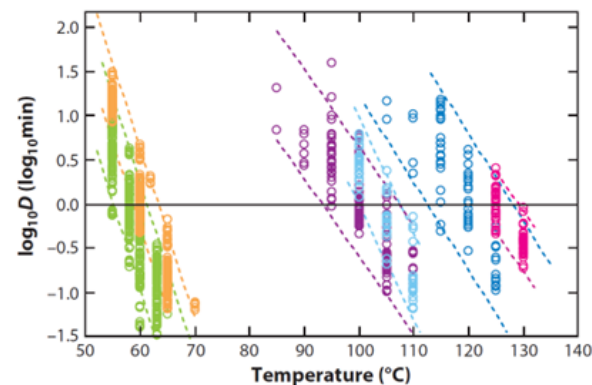
- Spoilage and safety are serious concerns
 - Plant-based ingredients often contain **unwanted micro-organisms**
 - They may **survive processing** or **grow in the finished product**
 - This has **health** (pathogens), **economic & sustainability** (spoilage) impact

APPROACH

- **Type & level** of unwanted micro-organisms
- Risk assessment using **new predictive calculation tool** → experience in NIZO booth
- Define route to **mitigate risks** based on extensive experience and database
- Test mitigation of risk by using **high throughput test systems** -> see next slide
- **Validation** of mitigation strategy by challenge test

RESULT AND BENEFIT

- **Make alt dairy safe, increase shelf life and reduce spoilage**
- **Avoid costly recalls and damage to your brand**



Heat inactivation of different microbial contaminants

Mitigation of risks by high throughput screening in real product

NIZO Micro Food Systems

Screening

Analyse with robots

Different read-outs



yoghurt/cheese



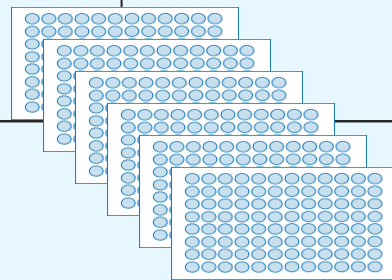
beverages



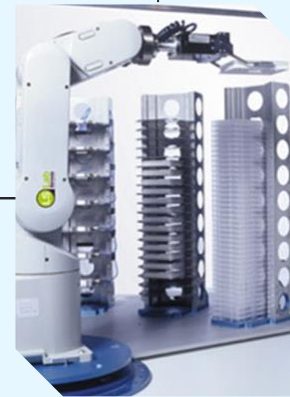
ketchup

Add microbial contaminants
(to test the potential outgrowth of the microbial contaminants)

Screen up to 30 separate 96 wells plates simultaneously

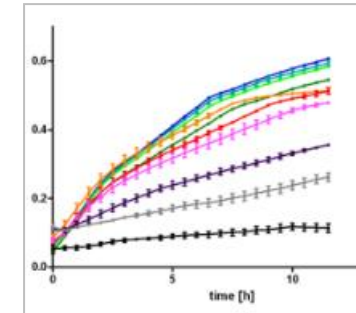


(semi) automatic OD, CFU measurement;

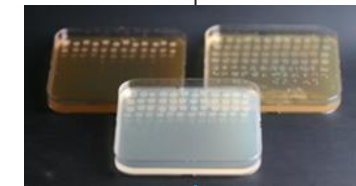


CFU plating to assess outgrowth in opaque/dark products

NIZO HTS SCREENING PLATFORM



Automated OD analysis
Clear liquid products



Automated CFU analysis
Turbid / opaque / dark coloured products



Product Performance: Bio-purification technology reduces unwanted molecules

MARKET DRIVEN

- Vegan products **rapidly gain market share**
- **Taste** is often an **issue**
 - Plant-based ingredients often contain **unwanted (taste) molecules**
 - Microorganisms have **enzymes** that allow to reduce them

APPROACH

- **Optimized approach** to select the most suitable microorganism(s) and processing conditions to improve sensory properties of plant-based products
 - **Large variety** between strains → selecting the right ones
 - **Knowledge based selection** based on genotypes and phenotypes
 - **Upscaling** and food applications

RESULT AND BENEFIT

- Make plant-protein **taste more neutral** (off-flavour removal)
- **Process is fast** (< 1h) and **applicable to ingredients and products**



Flavour analysis (GC-MS) of pea protein before and after biopurification

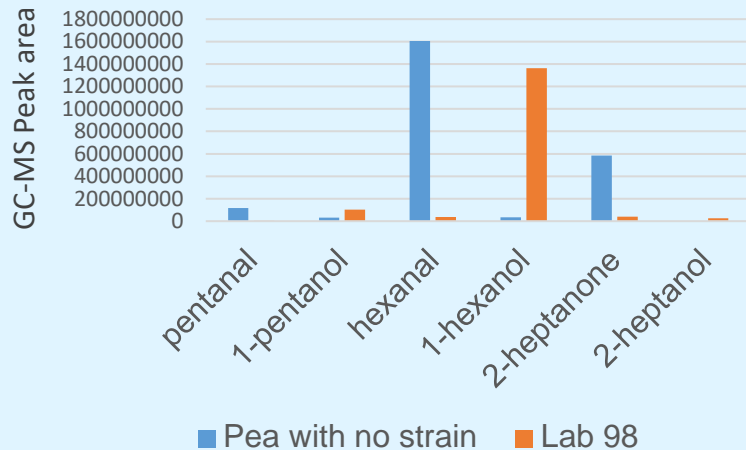
Biopurification of pea protein with strain Lab 98

Beany flavour

Typical Beany flavour = hexanal

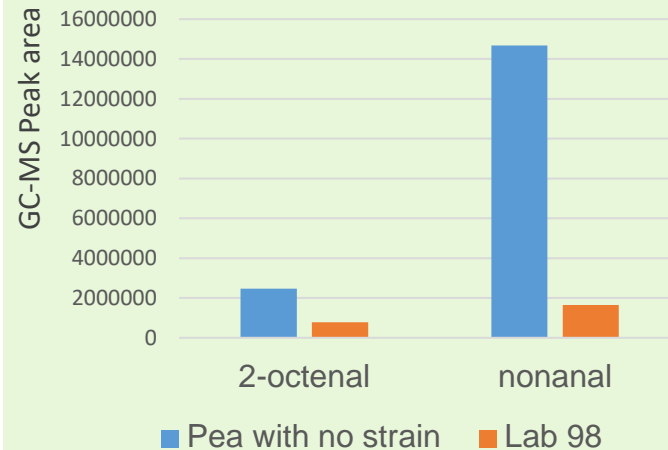
→ **Biopurification:**

- Hexanal reduction to hexanol
- Due to higher odor threshold no sensory perception of hexanol



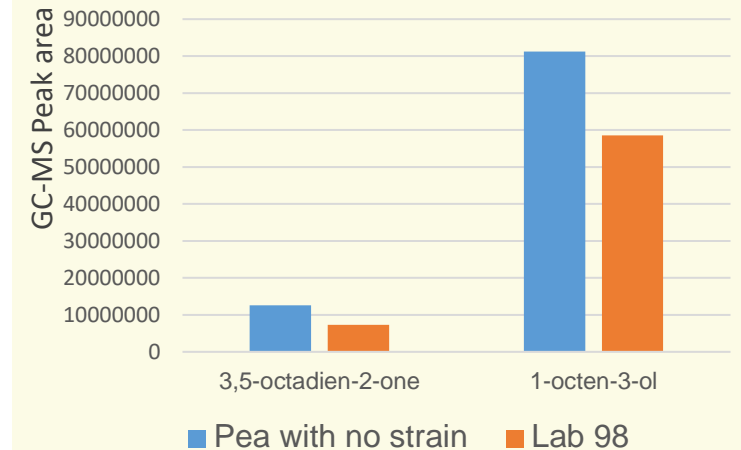
Fatty flavour

Reduction of fatty flavor volatiles



Mushroom flavour

Reduction of mushroom like volatiles



Level 2

Product Performance: Mouthfeel/Astringency

MARKET DRIVEN

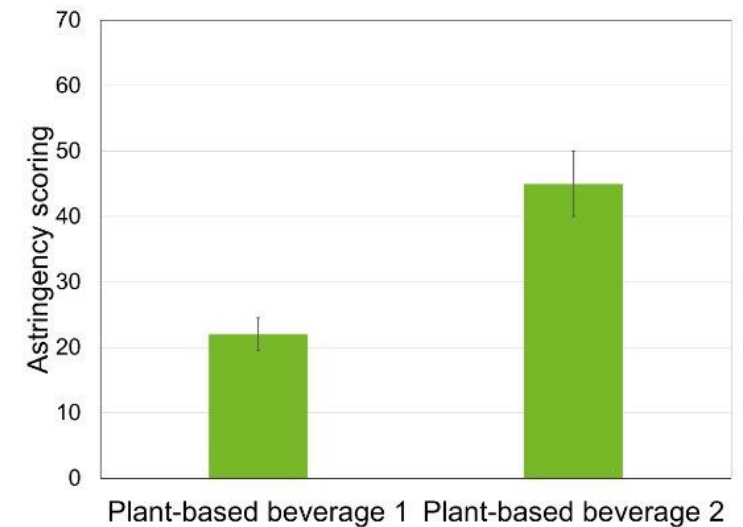
- Transition from animal- to plant-derived proteins brings new sensory challenges
- **Astringency** (dry, unpleasant mouthfeel) is often an issue associated with plant proteins
- Need for understanding the origin of this sensation to define effective **mitigation** strategies

APPROACH

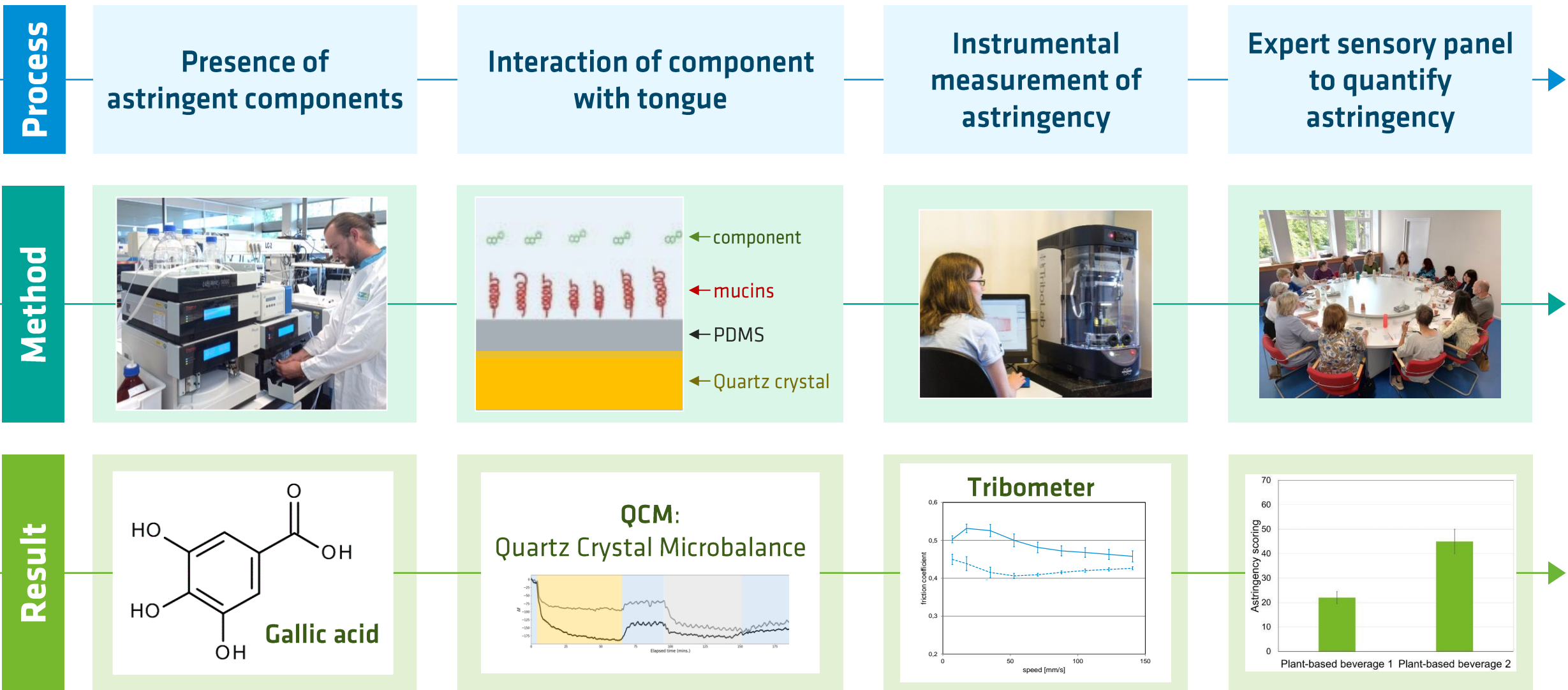
- **Identify** astringency causing compounds in product or ingredient
- Determine **origin** from these compounds, from ingredients to processing steps
- Define **science-based road map** to improve mouth feel with processing, formulation and/or masking technologies
- **Test** selected strategy in model foods, and **validate** in end product application

RESULT AND BENEFIT

- Make plant-protein based product **taste pleasant: smooth, creamy perception**
- Increase **consumer acceptance**



Process approach in Mouthfeel/Astringency reduction



Level 3

Nutrition: Health benefits from plant-based sources

MARKET DRIVEN

- Plant-based ingredients are often rich in **fibres** and **polyphenols**
 - Association with **beneficial** effects on health
 - But also potential **undesired** properties, such as astringency and taste

APPROACH

- Optimized **advanced analytical methods** to measure e.g. polyphenol composition, such as targeted UHPLC-MS/MS
- Combine *in vitro* models** to mimic human gastrointestinal digestion, absorption, gut microbiota metabolism and host responses -> see example
- Applying in-depth plant protein-polyphenol interaction knowledge

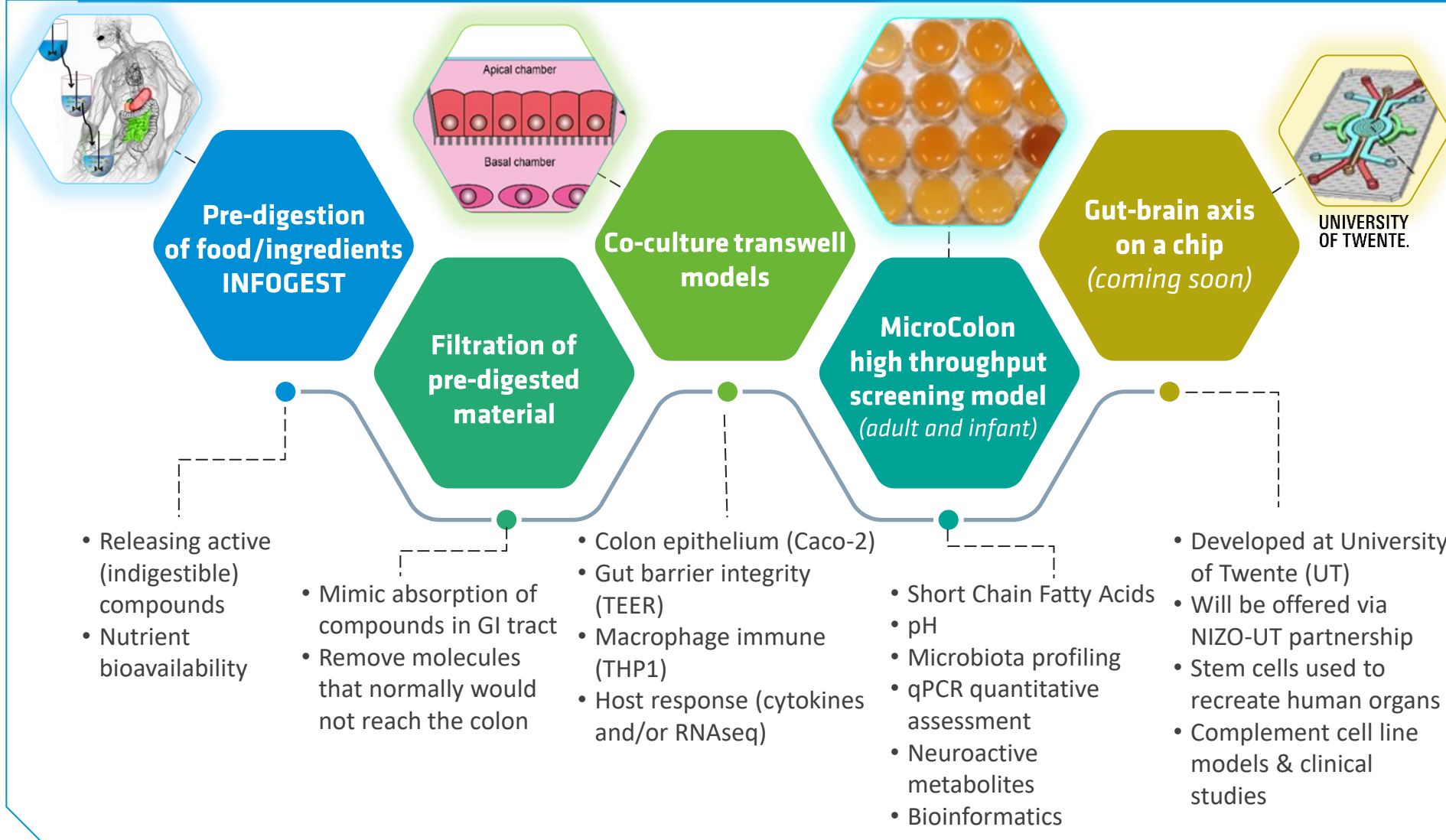
RESULT AND BENEFIT

Insights into composition and activity enable informed decisions for product development to achieve target properties.



How NIZO can help in defining the health benefits of your ingredient

In vitro toolbox; from digestion to gut health and immune responses



Ensuring physiological relevance by combining *in vitro* models simulating:

- Upper GI (pre-) digestion, releasing active components from foods/ingredients
- Colonic fermentation by gut microbiota
- Epithelial / immune cell culture to study host responses

Medium/high throughput models mimicking GI conditions in microplate format

Mechanistic understanding of potential health effects and predictive value towards human studies

Fast, cost-effective options to support IP opportunities

Integrated approach

Confidentiality

Connected in FoodValley
and other eco-systems

Higher chance of success

Excellent track record

Excellent project management

Speed

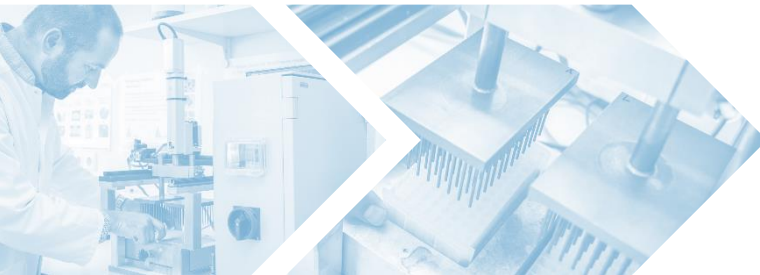


Tailor-made solutions for your next step to market by combining science, technology & practice

75-year experience

Leading experts

Knowledge and
innovations through
consortia



5m€ recent investment on food-
grade scaling up facilities for
dairy and meat analogues

Expansion for Biotechnology
Fermentation upscaling facility,
including Precision Fermentation
up to 10,000 l – Coming soon

Expertise in sustainable
processing & upscaling,
microbiology & fermentation,
protein functionality, sensory
and health.

The largest open-access food
grade pilot plant in Europe &
food application center

80+ specialized labs