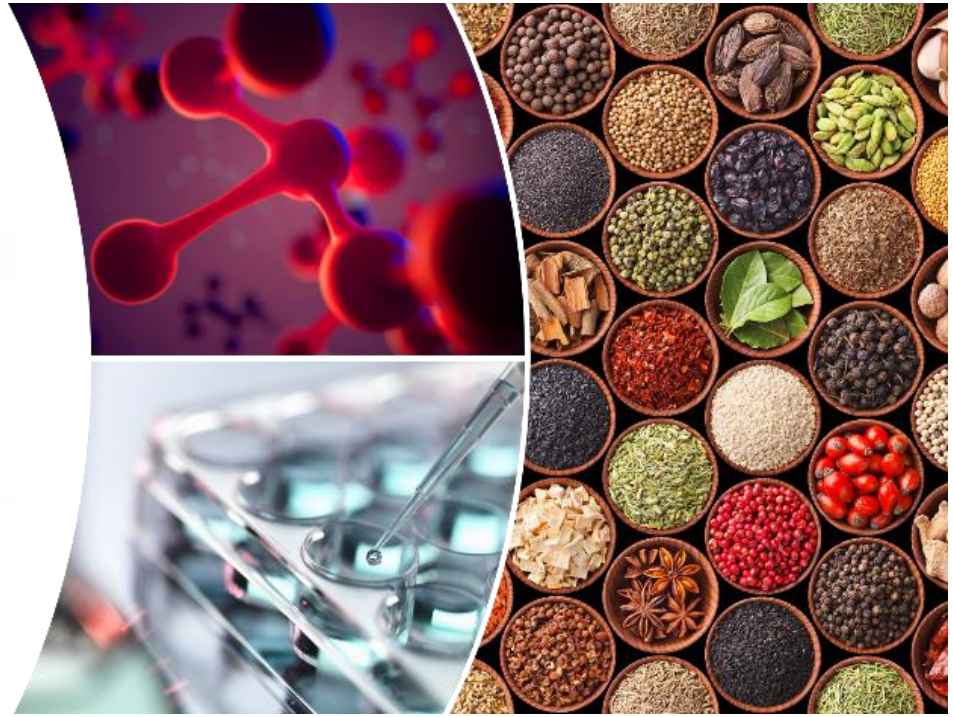
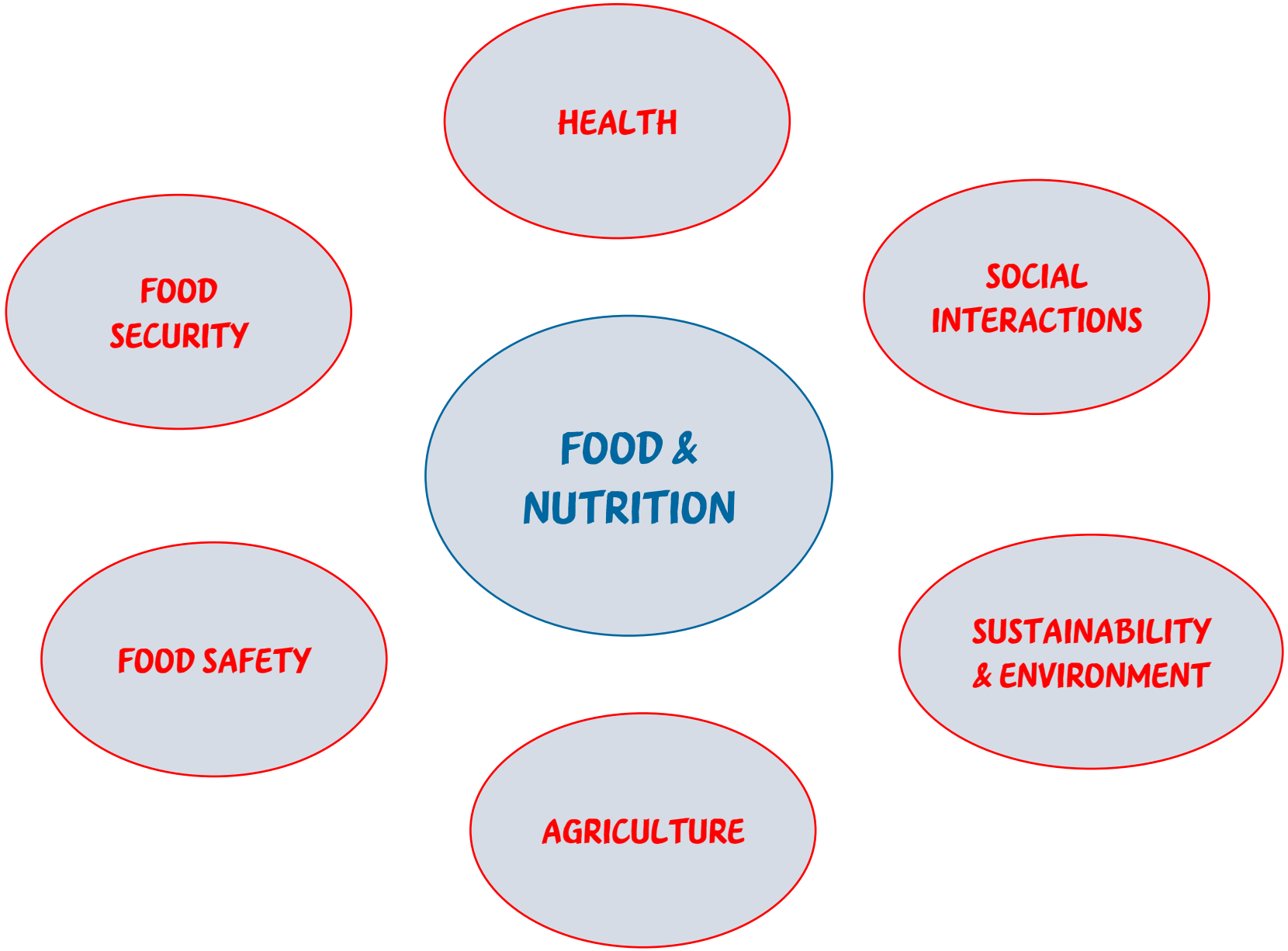



Entrepreneurship in Food & Nutrition Science (EFNS)

Jerome Feige
Kim-Anne Lê Bur
Eline Van der Beck

SV MSc course (BIO-498)

Food & nutrition are at the root of major society questions

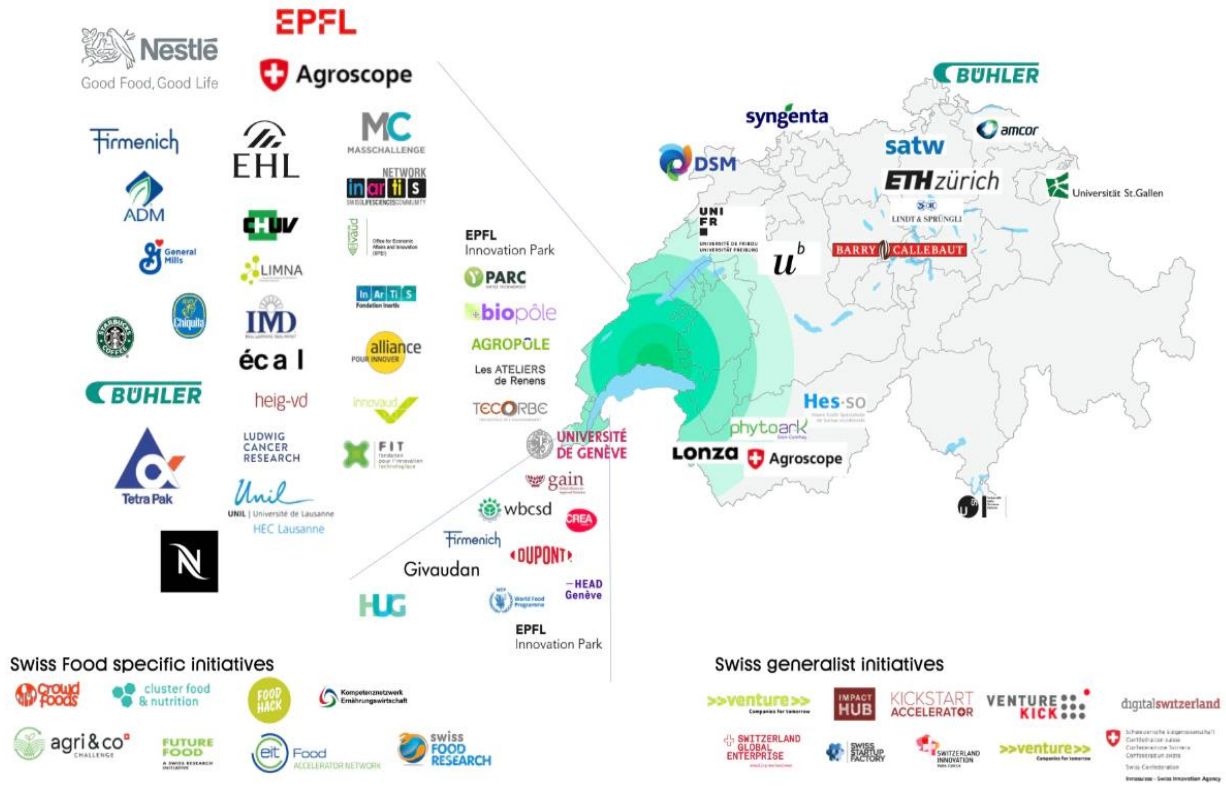


EPFL

Switzerland is a dynamic food & nutrition innovation ecosystem

SWISS FOOD & NUTRITION VALLEY

https://swissfoodnutritionvalley.com/



EPFL INTEGRATIVE FOOD & NUTRITION CENTER

https://www.epfl.ch/research/domains/nutrition-center/

EPFL

Ambition of the course

EMBRACE GLOBAL CHALLENGES IN FOOD & NUTRITION

PROJECT-BASED INNOVATION VIA TEAMWORK

LEARN NUTRITION & HEALTH SCIENCE VIA REAL-LIFE EXAMPLES

DISCOVER INDUSTRY & INNOVATION ECOSYSTEM

EPFL

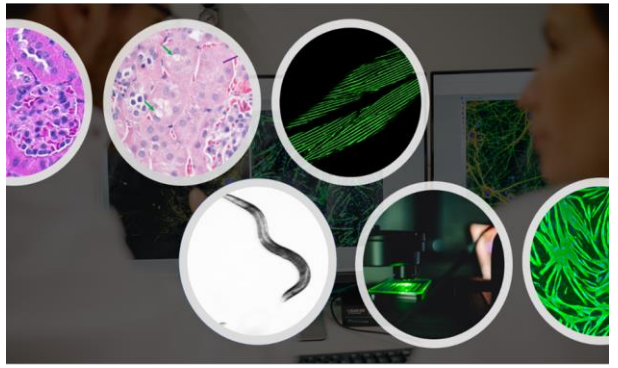
JEROME FEIGE

- Senior expert musculoskeletal & adult health, Nestlé Institute of Health Sciences, Nestlé Research
- PhD & postdoc in molecular physiology: Nuclear receptors & metabolic health
- Experience ind drug discovery in pharma industry
- EPFL Maitre d'Enseignement et de Recherche, Translational Muscle & Aging Biology since 2013

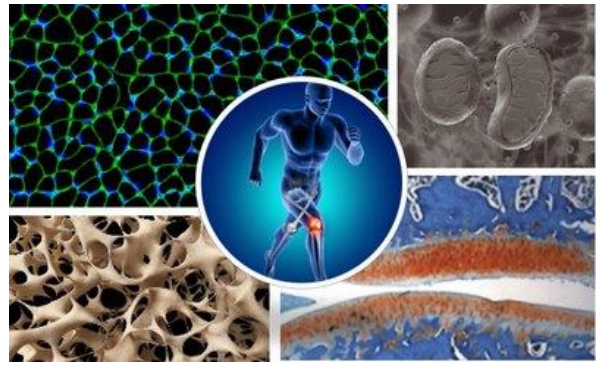
SCIENTIFIC EXPERTISE

Bioactive nutrients for functional health benefits

Cellular mechanisms & model organisms



Muscle & Aging biology



TRANSLATION: FUNCTIONAL FOODS FOR HEALTHY AGING

Cellular health supplements

Functional milk for mobility

Medical drink for sarcopenia

KIM-ANNE LÊ BUR

- Group Leader – Metabolic Health, Nestlé Institute of Health Sciences, Nestlé Research
- PhD in human physiology: fructose & insulin resistance
- Post-doc on childhood obesity
- Lecturer: Swiss Technical School of Engineering (EPFL), National University of Singapore

SCIENTIFIC EXPERTISE

Carbohydrates & alternatives

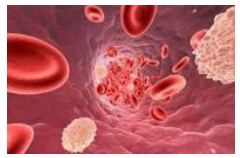
sugars

sweeteners

Whole grain / fibres

Metabolic health

Glycemic control



CVD risk factors

Proteins quality in plant-based products

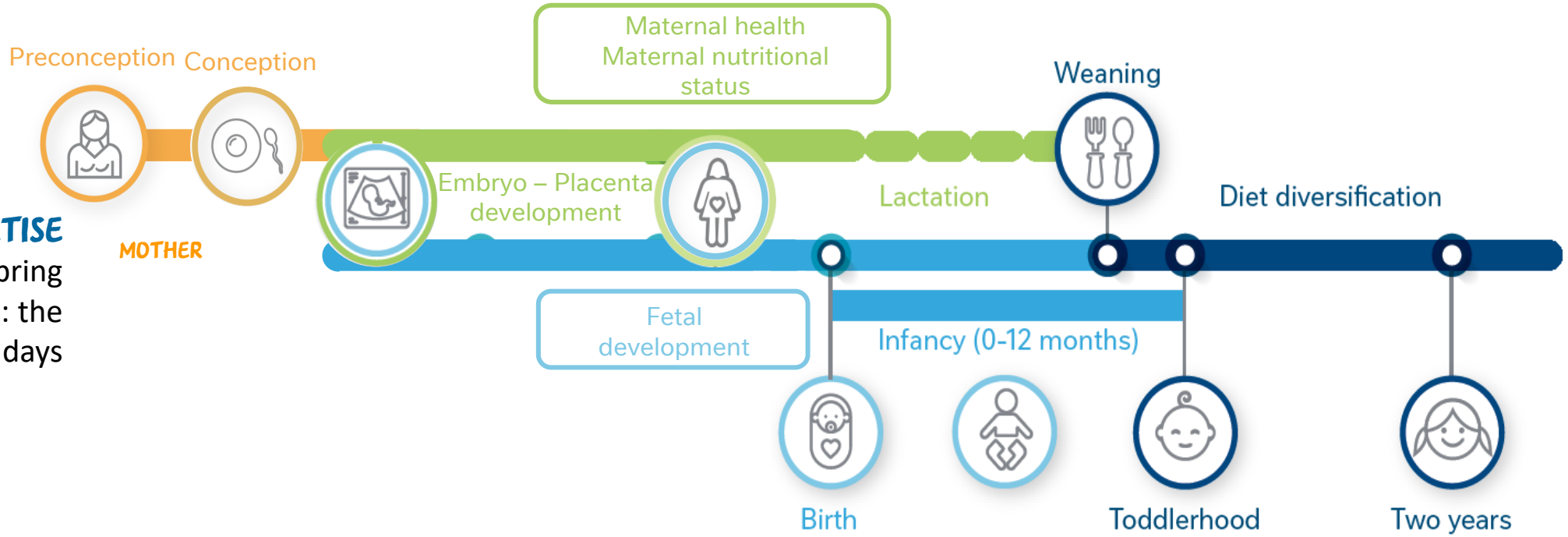
PRODUCTS & CLAIMS

ELINE VAN DER BEEK

- Head Nestlé Institute of Health Sciences
- PhD in Reproductive Neuroendocrinology
- A/Professor Wageningen University (NL) - 20 years of experience in R&D industry (Numico – Danone NL-SGP)
- Professor in Nutritional Programming, University of Groningen (NL)

SCIENTIFIC EXPERTISE

Maternal health & offspring growth & development: the first 1000 days



NUTRITIONAL PROGRAMMING

Macronutrient quantity & quality – stage adapted nutrition

Assistants

SRUTHI RAJA

PHD STUDENT, PHYSICAL HEALTH DEPARTMENT, NESTLÉ RESEARCH & EPFL LABORATORY OF BIOMECHANICAL ORTHOPEDICS

Contact: Sruthi.raja@epfl.ch

Home country: India **Languages :** Tamil and English

Background: B.Tech Industrial Biotechnology, MSci. Molecular Bioscience

Research interests: Muscle stem cells, Cell metabolism

Passion and purpose in teaching: Science discussions, brainstorming, problem solving, project management

BUSE TATLI

PHD STUDENT, EPFL IMX SUSTAINABLE MATERIALS LABORATORY

Contact: buse.tatli@epfl.ch

Home country: Turkey **Languages :** Turkish and English

Background: B.Sc. And M.Sc. in Materials Science and Engineering

Research interests: Bio-based polymers, cellulose nanomaterials

Passion and purpose in teaching: Sharing knowledge, continuous learning, project management, getting inspiration

MATTEO RICCARDO DARRA

PHD STUDENT, EPFL IMX SUSTAINABLE MATERIALS LABORATORY

Contact: matteo.darra@epfl.ch

Home country: Brazil **Languages :** Italian, English, Portuguese

Background: Bachelor in Chemistry, Master in Photochemistry and Molecular Materials

Research interests: Materials Science, Materials Chemistry, Sustainable Materials

Passion and purpose in teaching: Sharing and learning from others, work in a group, help developing a project

Conflicts of interest



KA Lê Bur, J Feige & E Van der Beek are employees of Nestlé Research and adjunct lecturers/professors of EPFL

Sruthi Raja is employed by Nestlé Research during her PhD at EPFL and is SV teaching assistant

WE OPERATE LOCALLY IN THE LAUSANNE RESEARCH COMMUNITY


Nestlé Research buildings on EPFL innovation park


Nestlé Research Center at Lausanne / Vers-chez-les-blanc

ALL INDUSTRY EXAMPLES WILL BE PRESENTED FOR LEARNING PURPOSES AND ARE OPEN FOR DISCUSSION & DEBATE

Nestlé/EPFL collaboration enables innovation & training

Collaborations

21 active contracts:

12 @ EPFL

- Sarcopenia, cognition
- Cellular nutrition
- Sustainable packaging
- Antiviral surface coatings
- Astringency modulation

9 @ ETHZ

- Enteric methane reduction in dairy cattle
- Soil health and GHG emission
- Astringency modulation
- Microalgae
- Micro-nutrient bioavailability

Endowed Chairs

Prof. Auwerx
Lab. of Integrative Systems Physiology
(2008-2018)

Prof Graff
Lab. of Neuro-Epigenetics
(2017-2022*)*

Prof Abitbol
Lab. of Sustainable Materials
(since *2022)*

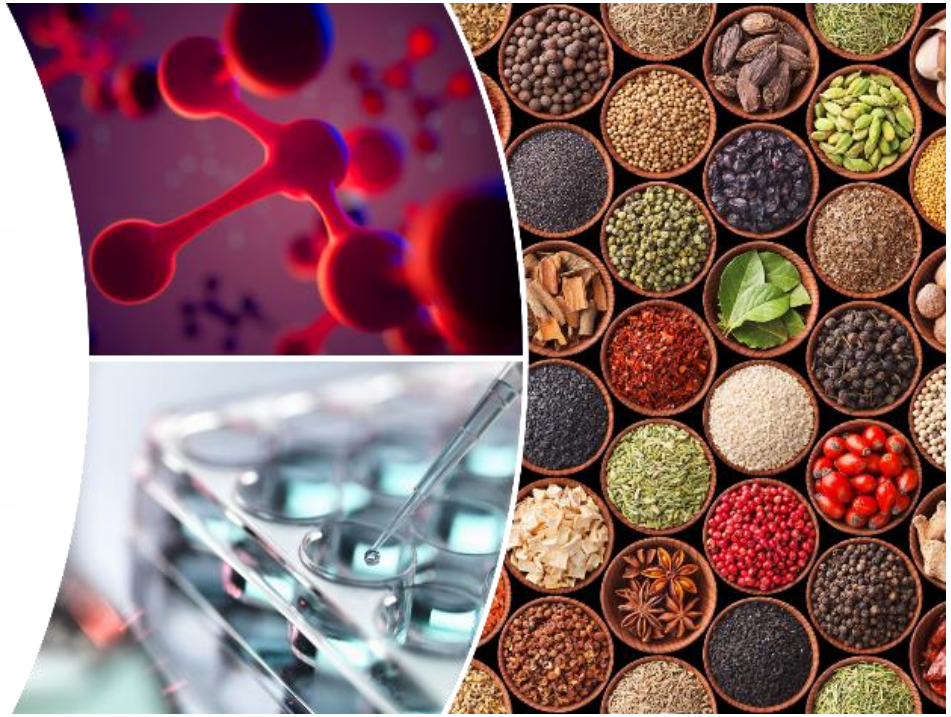
Young Talents

- **53 young talents** trained since 2018
- **29** Masters
- **14** PhDs
- **16** Post-Docs
- **5** Alumni hired

FUTURE FOOD
A SWISS RESEARCH INITIATIVE

Teaching

- **12 Nestlé employees** engaged in teaching
- **7** courses
- **3 Nestlé employees** accredited as MER in the EPFL School of Life Sciences
- Affiliations of NIHS scientists to other Universities in CH, but also in ES, IR and NL

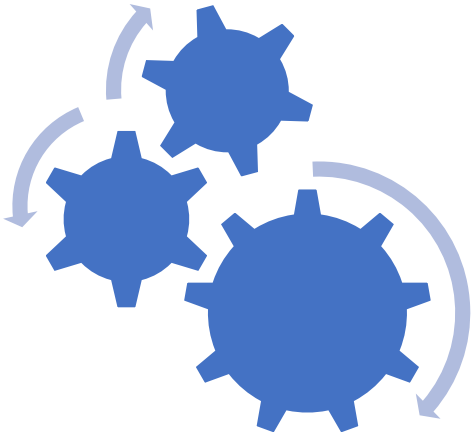


Introduction to the aims & logistics of the course

Topline aim of the course

By the end of the course, you should be able to:

- Design the strategy, content and operations of a R&D innovation project in the food industry
- Translate an idea in a food innovation concept
- Organize a project team & collaborate to deliver collective results
- Pitch an opportunity & influence R&D deciders

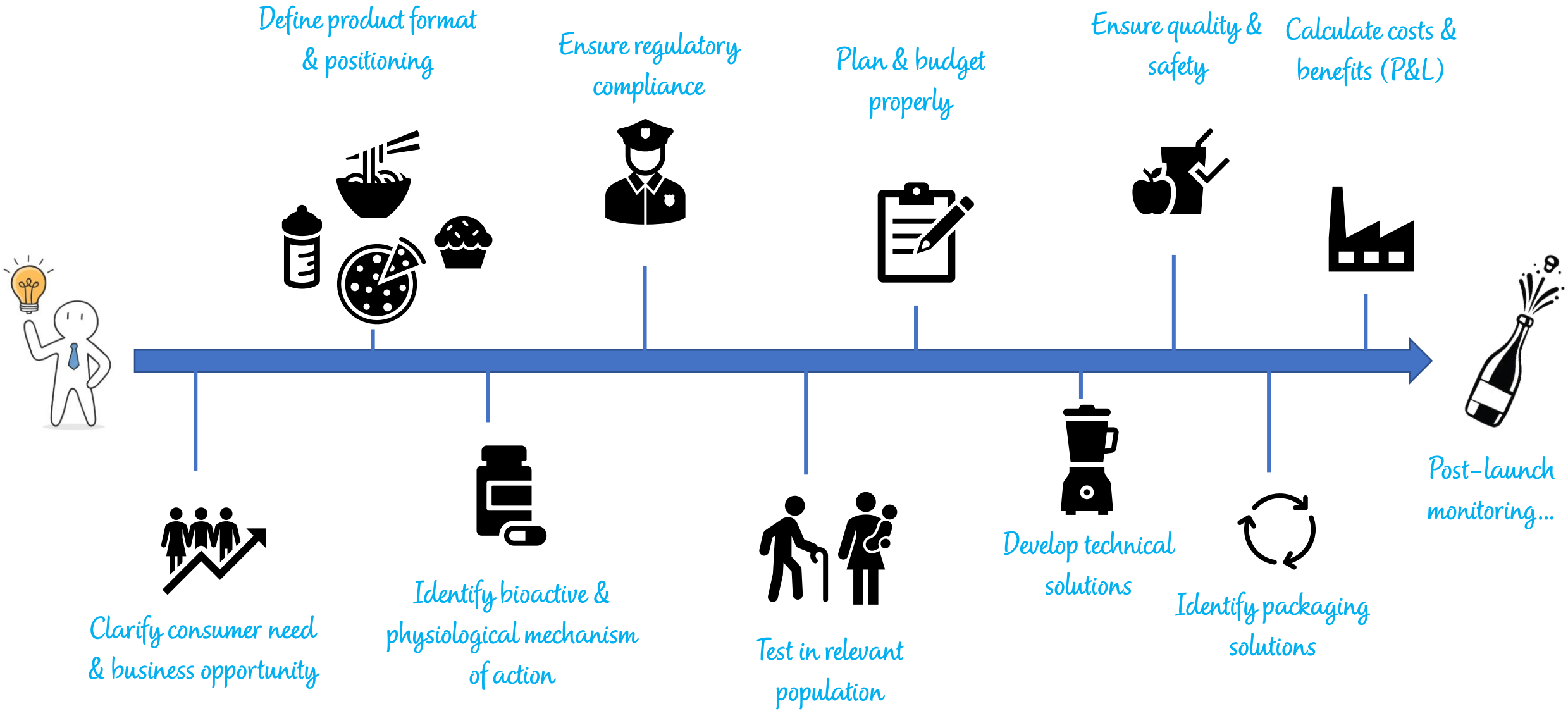


Learning goals

Transversal skills

- Access and evaluate appropriate sources of information
- Set objectives and design an action plan to reach those objectives
- Communicate effectively with professionals from other disciplines
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles
- Demonstrate a capacity for creativity.
- Demonstrate the capacity for critical thinking
- Make an oral presentation.
- Write a scientific or technical report

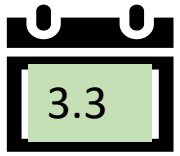
From Idea… to launch!



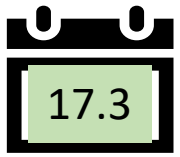
Course content

Week	Date		Responsible core team	Lecturer
1	Tues 18 Feb	**Introduction to course**	Eline Jerome Kim-Anne	
2	Tues 25 Feb	Nutrition boosters: bioactives, pre & probiotics Scientific substantiation: MoA, RTB, experimental models	Jerome	Jerome
2	Friday 28 Feb 13h	**Group selection in moodle**		
3	Monday 03 march 23h59	Topics handin in moodle (what, for who)	Assistants	
3	Tues 04 March	Innovation environment: consumer needs, competitive advantage	Eline	Eugenia Barcos
4	Tues 11 March	Nutrition building blocks: macro- & micronutrients	Kim-Anne	Kim-Anne
4	Monday 17march 23h59	Hand in report1 in moodle	Assistants	
5	Tues 18 March	**Projects follow-up session 1**	Eline, Kim-Anne, Jerome	STUDENTS
6	Tues 25 March	Regulatory & claims / IP	Jerome	Mariana Rodriguez , Cécile (TBC)
7	Tues 01 April	Scientific substantiation 2: Clinical trials designs	Kim-Anne	Mickael Hartweg
8	Tues 08 April	Food science & technology	Kim-Anne	Patricia Murciano
9	Tues 14 April 23h59	Hand in report2 in moodle	Assistants	
9	Tues 15 April	**Projects follow-up session**	Eline, Kim-Anne, ~~Jerome~~	STUDENTS
	Easter break			
10	Tues 29 April	Project management: gant chart/milestones, stakeholders, project execution	Eline	Corina Mudini
11	Tues 6 May	Food safety & quality	Jerome	Safety: Myriam Coulet Quality: Irene Clédat + Manuella)
12	Tues 13 May	Financial feasibility: cost of goods & production, size of opportunity, positioning of product (marketing)	Jerome	Benoit Idieder
13	Tues 20 May	Packaging / design - workshop type	Kim-Anne	Gerhard Niederreiter
14	Tues 27 May	**Final presentations**	Eline, Kim-Anne, Jerome	STUDENTS
15	Friday 07 June 23h59	Hand in final report in moodle		

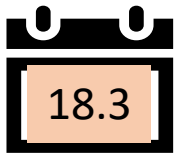
Key dates



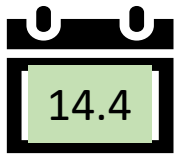
Group & Topic selection in Moodle



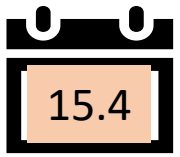
1-page report 1 in Moodle



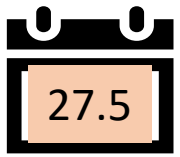
Project follow-up session 1:
for feedback and guidance only, no grading!



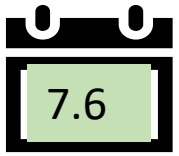
1-page report 2 in Moodle



Project follow-up session 2:
for feedback and guidance only, no grading!



Final presentation



Final report in Moodle

Project examples

#	Bioactive/ingredient	benefit	population	country/market
1	texturized sugar	to lower sugar intake	overweight adults	UK
2	Blueberry extract	to improve cognitive performance	school-aged children	South-East Asia
3	Mulberry leaf extract	to lower glucose response	in prediabetic adults 40-60y	South-East Asia
4	beta-glucan from barley	to lower blood cholesterol	in overweight women	France
5	Polyphenols from superfruit	to improve energy and performance	in recreational adult athletes	China
6	NAD+ precursor	to support healthy aging	in 55+ goodlifers	US
7	Medium chain triglycerides	to improve memory and cognition	in senior adults with mild cognitive impairment	
8	blend of antioxidant	to improve difficult mornings	young adults	Switzerland
9	carb quality index for breakfast products	to increase fiber intake / manage blood glucose	breakfast skipper adolescents	South east Asia
10	synbiotic	to reduce bone loss	post menopausal women	tbd
11	specific probiotic	to reduce perceived stress	University students	tbd
12	milk + specific ingredients	to support muscle recovery	moderately active adults	tbd

Examples of past student projects

Chili Up, efficient fat-burning supplement combining the effects of phenylcapsaicin and astaxanthin

Product & Research Report
BIO-498, Spring Semester 2023

Written by Mara Terzi, Izabella Pomykalska, Méline Cretegny

Lecturers: Jerome Feige, Kim-Anne Lê Bur & Eline Van der Beck
Teaching Assistants: Selima Zahar, Sruthi Raja & Lisa Watt

Probiotic soy-based yogurt against mild symptoms of stress

Pro-Up: Enhance your mood

Discover the full pot

Figure 1 : Front packaging of the carton of our six pack

VITA LATTE

Cold decaf coffee tasting beverage supplemented Magnesium, Vitamin D and Vitamin B12

MITO WIN
MEANT TO BE SUPERIOR

BioBistro
Guilt-Free Tartare

Project follow up session 1

Wk 3 **Submit project title** *'what and why, for who / where'*

Wk 5 **Each group to present their project idea**

- Descriptive project title
- Relevant background information
- Research question
- Product concept

6 slides max (1-2 for each topic already covered)
10 min to pitch + 15 min for questions & discussion (to be adapted depending on number of groups)

- Submit your project summary (group)

Project follow up session 2

Each project team presents a **detailed research plan**

Presentation,

- Product concept – health benefit – target population in more detail
- Relevant background information: size of the problem / what is the opportunity,
- Scientific substantiation required (how to address it) to reach your objective
- Which hurdles do you need to overcome to put a product on the market

max 10-12 slides

15 min + 10 min discussion (to be adapted depending on number of groups)

Project follow up session 3

Final presentation for each project team

Product pitch (40%)

- Open format (slide presentation / video pitch / product mock-up presentation / etc)

Thesis - group (40%)

- Group effort according to strict guidelines (format / content & length)

Thesis - individual (20%)

- Discussion
- Personal implications
- Executive summary

Report structure

Thesis - group

- Title
- Target consumers & business context (200 words)
- Product solution (150 words)
- Introduction (500 words)
  - Scientific background
- Research outline (1000 words)
  - Research & product development plan
- Technical feasibility & quality safety (200 words)
- IP and regulatory evaluation & strategy (200 words + image label)
- Timeline & budget (200 words)

Thesis - individual

- Discussion (800 words)
  - Critical evaluation of the project viability, risks & opportunities
- Implications (500 words)
  - Personal role and contribution to project, providing personal reflection and recommendations for further studies in the area
- Executive summary (250 words)
  - Standalone “pitch” – convince a potential investor to support you

Evaluation

Product pitch

- Format
- Content
- Questions

Thesis - group

- Content and clarity
- Research plan and methodology
- Analysis and strategy

Thesis - individual

- Discussion: critical thinking
- Implication: self-reflection
- Executive summary: writing & communication

(micro)nutrient inadequacies and deficiencies are driven by malnutrition

Undernutrition

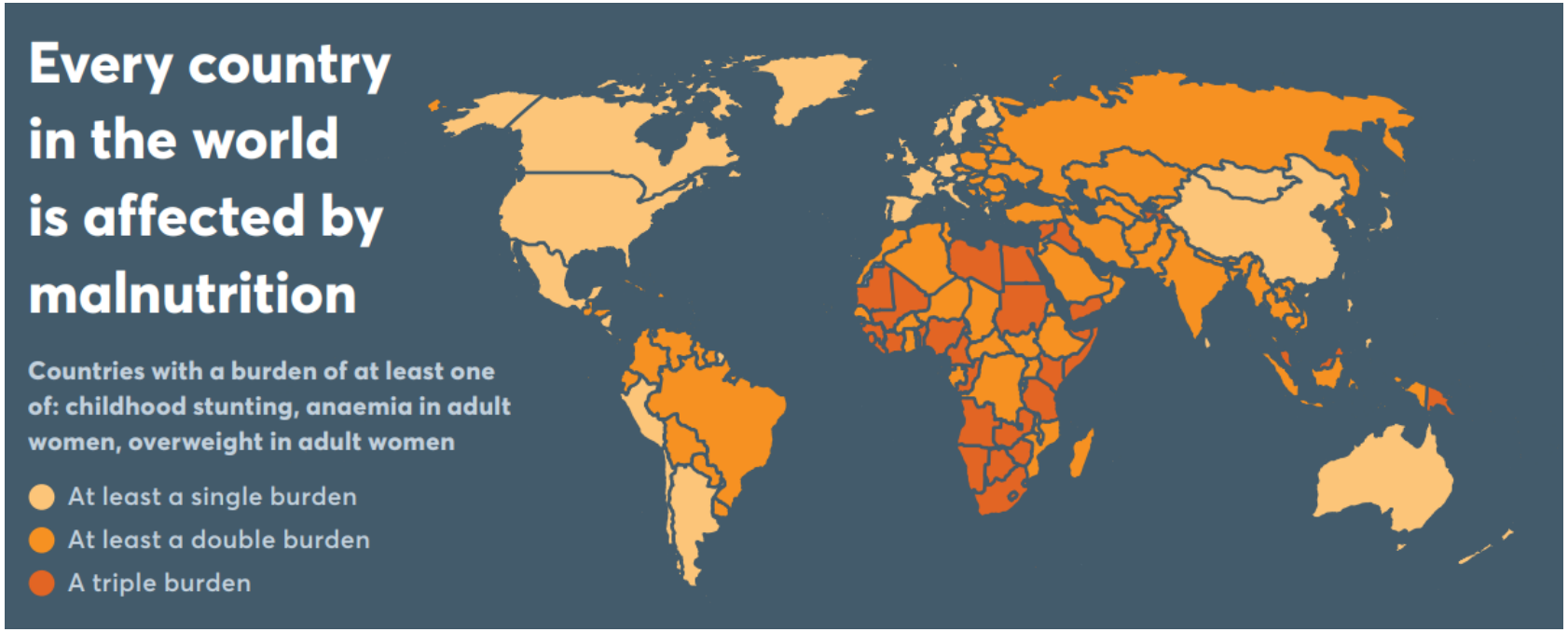
Inadequate nutrient intake
low diet diversity

Hidden Hunger

Unbalanced diet / insufficient nutrient dense foods

Overnutrition

Excessive energy intake / nutrient poor foods

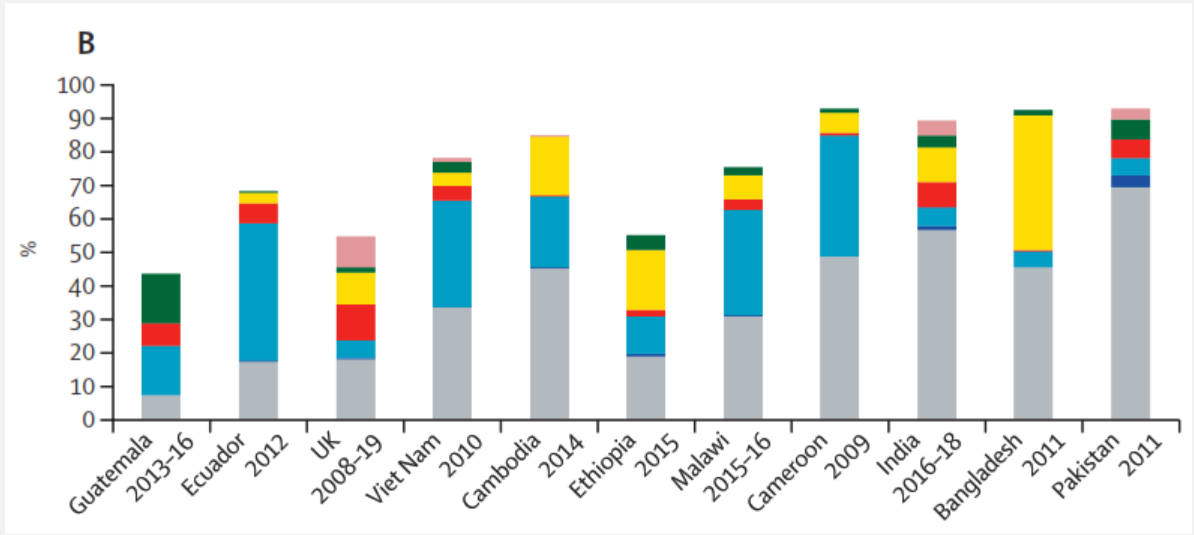


The Global Nutrition Report, 2018; Prentice A., NNI W97, 2022

Research and Development

Micronutrient deficiencies are prevalent across the world

Women of childbearing age



Stevens et al, 2022

Vulnerable populations with at least one micronutrient deficiency:

- 56% of preschool-age children
- 69% of women of reproductive age

Additional nutrients gaps:

- Vitamin B12
- Folate
- Vitamin D

A large proportion of women of reproductive age have **2 or more micronutrient deficiencies** across geographies

Research and Development

Micronutrient needs can be addressed in different ways

FOOD FORTIFICATION

- No need to change dietary habits
- Cost effective
- Product addition / substitution

DIETARY DIVERSITY

- Increase food intake diversity
- Naturally rich in nutrients (nutrient dense foods)

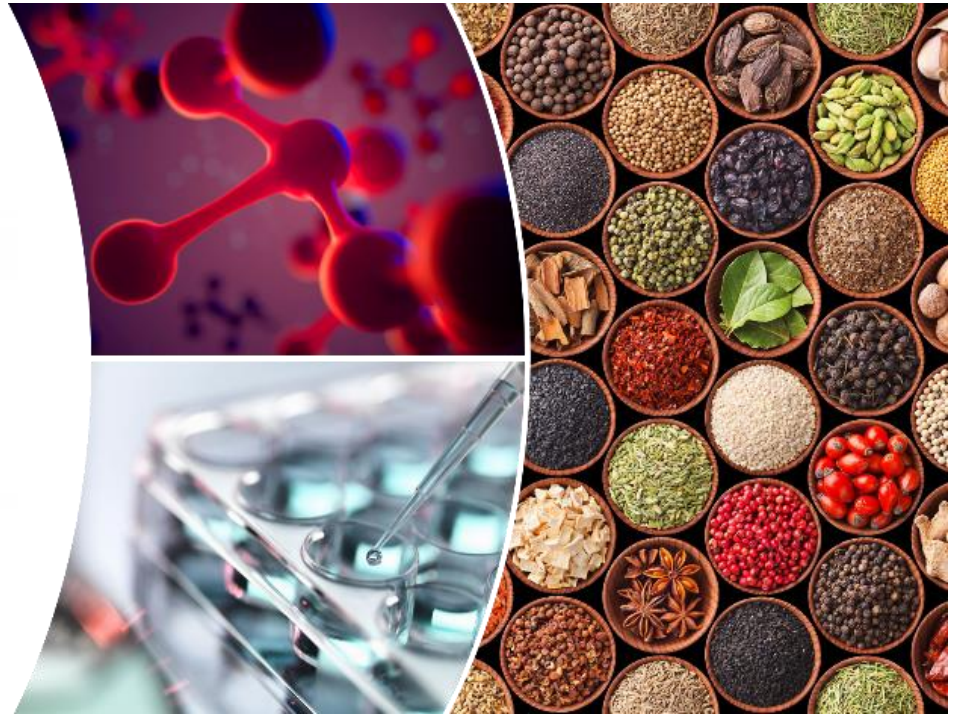
SUPPLEMENTATION

- Severe deficiency (treatment)
- Specific target populations
- Personalization

persona

ATRIUM INNOVATIONS

Research and Development



Example of healthy carbs & cereals for metabolic health

A balanced diet requires the right quantity but also quality of macronutrients

Carbohydrates
(50-55% daily energy)

Proteins
(10-15% daily energy)

Fats
(20-35% daily energy)

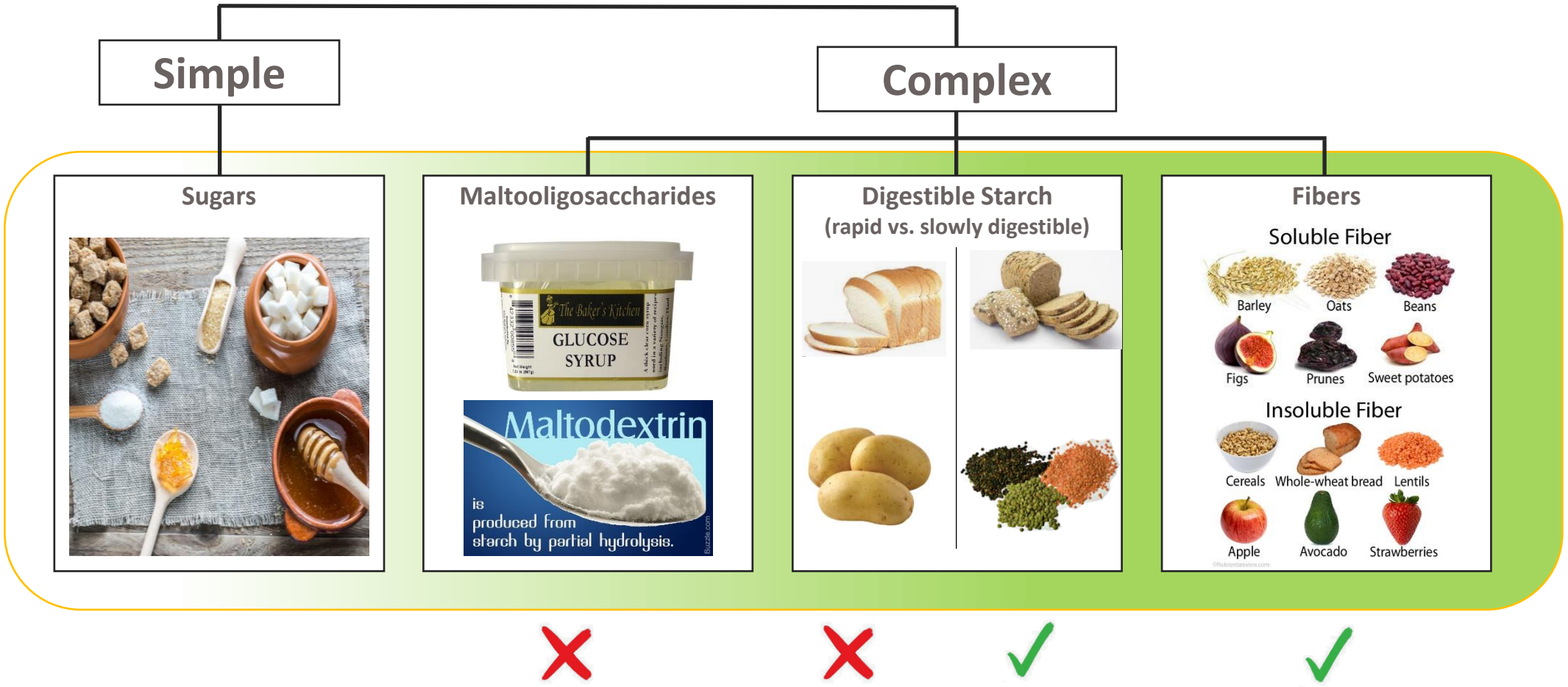
Sugars, refined carbs — Fibres

Lower in essential amino acids — High in essential amino acids

Saturated fatty acids (SFA) — Mono- & poly-unsaturated fatty acids (MUFA, PUFA)

EPFL

Nutritious alternatives for sugar reduction must be found

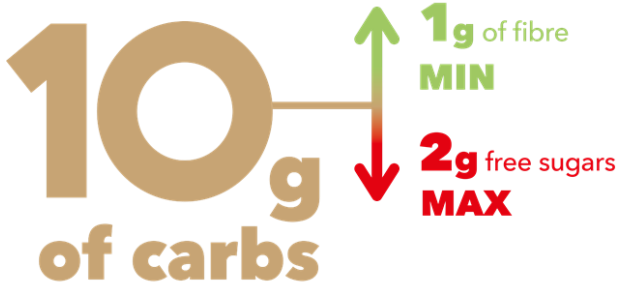


Lamothe LM, Lê KA, Samra RA, Roger O, Green H, Macé K. The scientific basis for healthful carbohydrate profile. *Crit Rev Food Sci Nutr*. 2019;59(7):1058–1070

Scientific Advisory Committee on Health (SACN). Carbohydrates and Health. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/445503/SACN_Carbohydrates_and_Health.pdf

Healthy porridge with optimized carbohydrates profile for general population in Europe

THE CARB-FIBRE-SUGAR RATIO



Germany
France
Greece

Poland

Portugal

GRAIN SMART BALANCE

POLSKIE TOWARZYSTWO DIETETYKI
Since 1986

Back of pack /side panel text:

Why is this recipe unique and nutritious? Because of GrainSmart™ balance, which means that this product has been developed to respect the right balance between 3 important nutrients to start the day: carbohydrates, fibers and sugars. This has been validated by nutrition experts to deliver balanced energy and good nutritional quality*.

*The Obesity Society. Nov 2019. T-P-3338

EPFL

From Idea… to launch!

Initial brief:

- Brand defined by the business
- Market defined
- Target population

From Idea… to launch!

Competitive advantage defined:

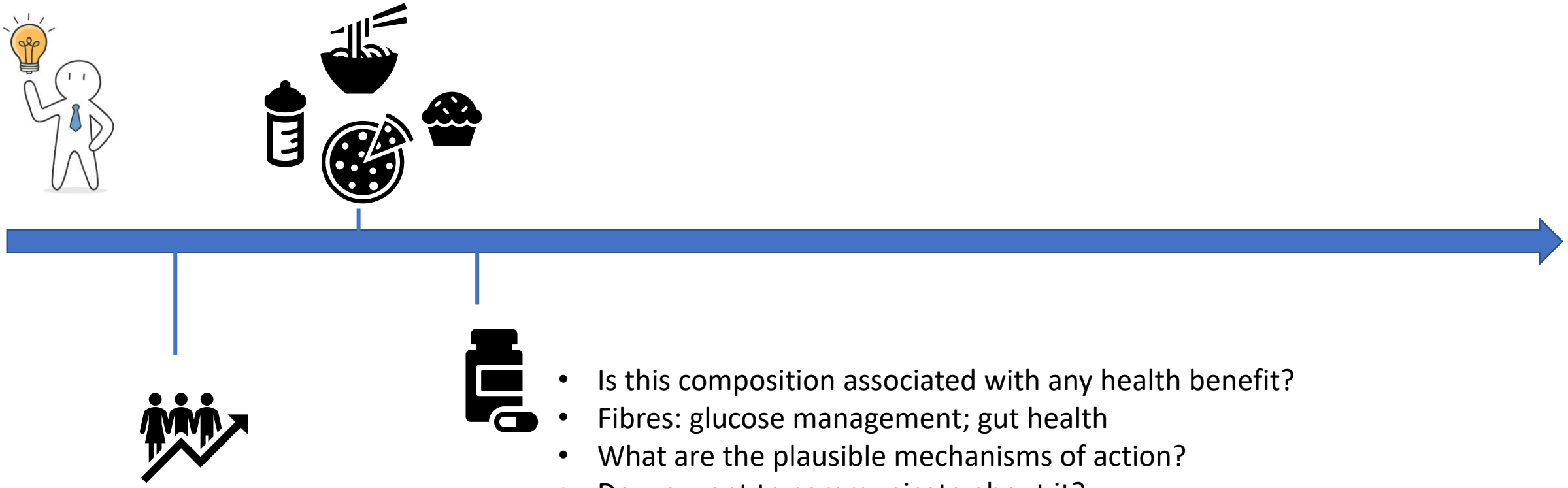
- Nutritional superiority compared to competitors
- Unique offer (porridge with great taste liked by children)

From Idea… to launch!

Nutritional composition:

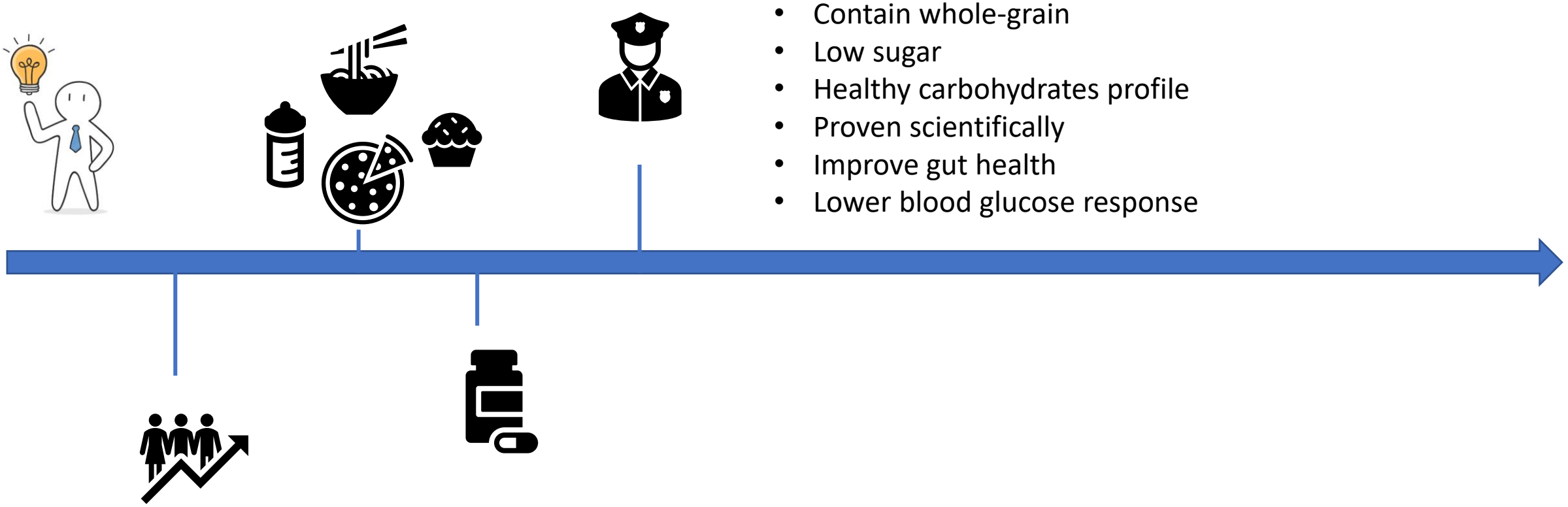
- Define the list of ingredients (5 max)
- Evaluation with nutrient profiling systems (target: NutriScore A)
- Constraints identification (fiber-containing ingredients adding viscosity; cost; taste)

From Idea… to launch!



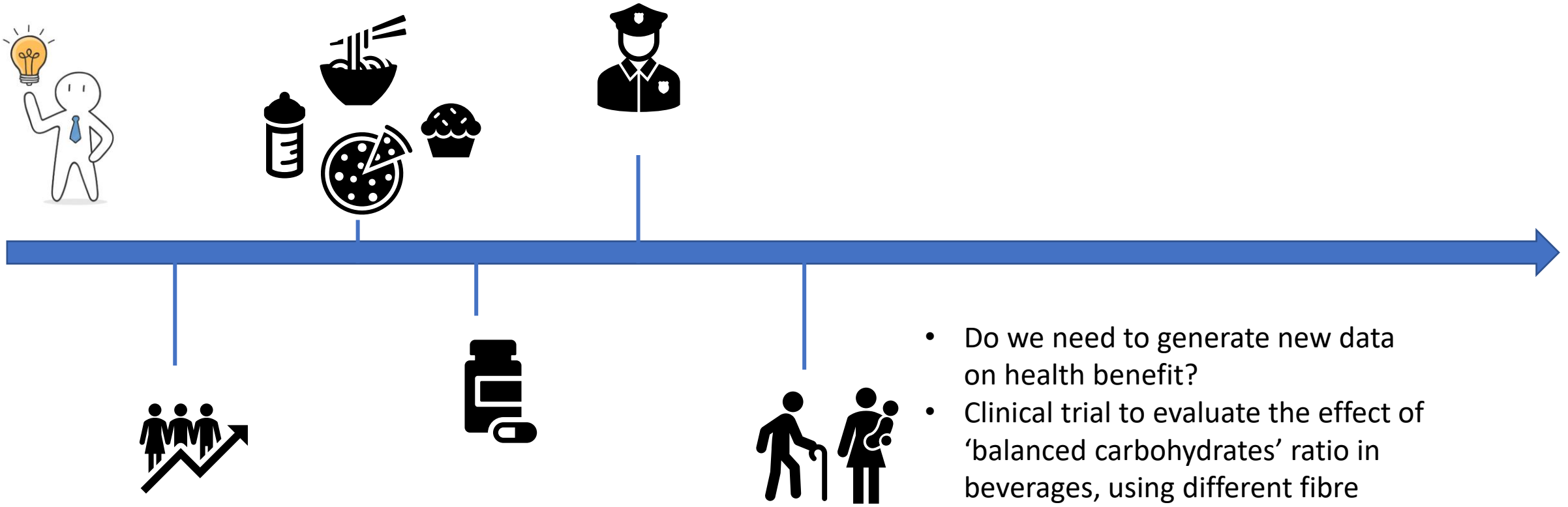
- Is this composition associated with any health benefit?
- Fibres: glucose management; gut health
- What are the plausible mechanisms of action?
- Do we want to communicate about it?

From Idea… to launch!



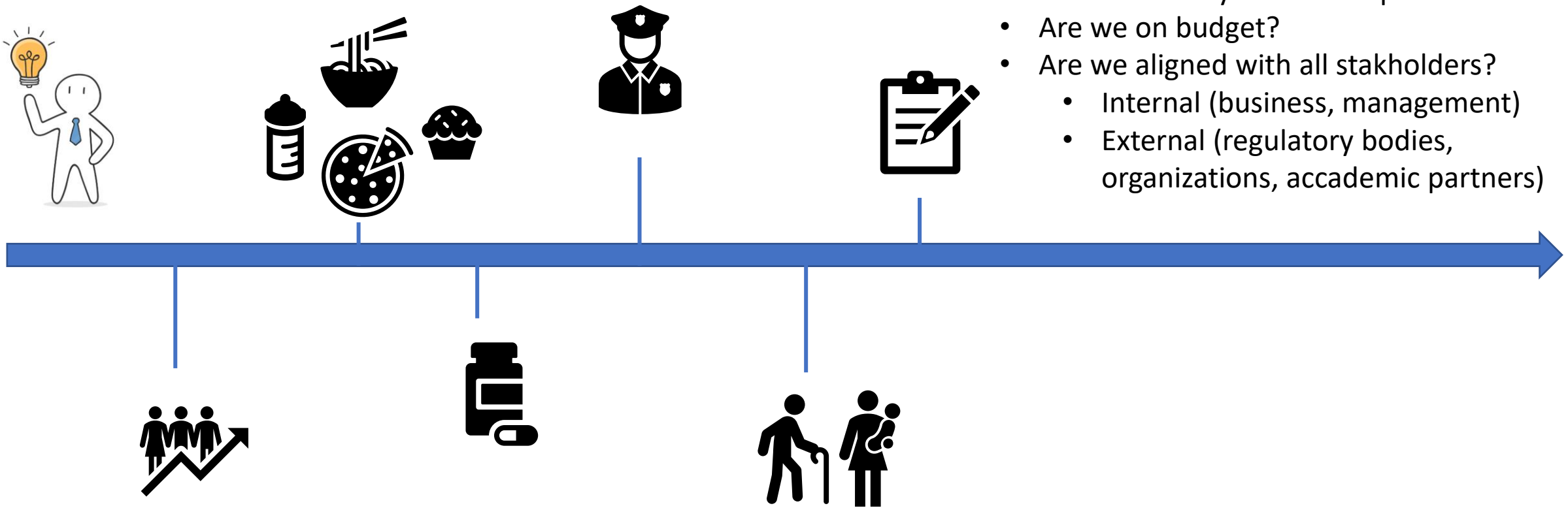
- What is the desired communication? Is it allowed?
  - Source of fibres
  - Contain whole-grain
  - Low sugar
  - Healthy carbohydrates profile
  - Proven scientifically
  - Improve gut health
  - Lower blood glucose response

From Idea… to launch!



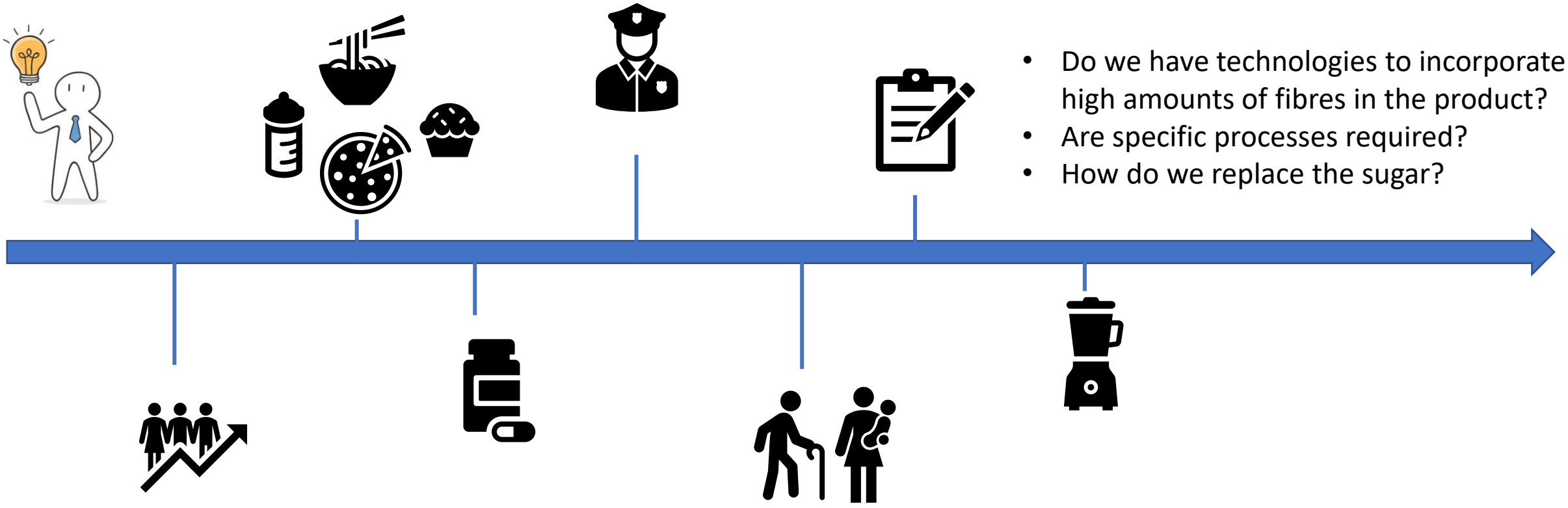
- Do we need to generate new data on health benefit?
- Clinical trial to evaluate the effect of ‘balanced carbohydrates’ ratio in beverages, using different fibre sources

From Idea… to launch!



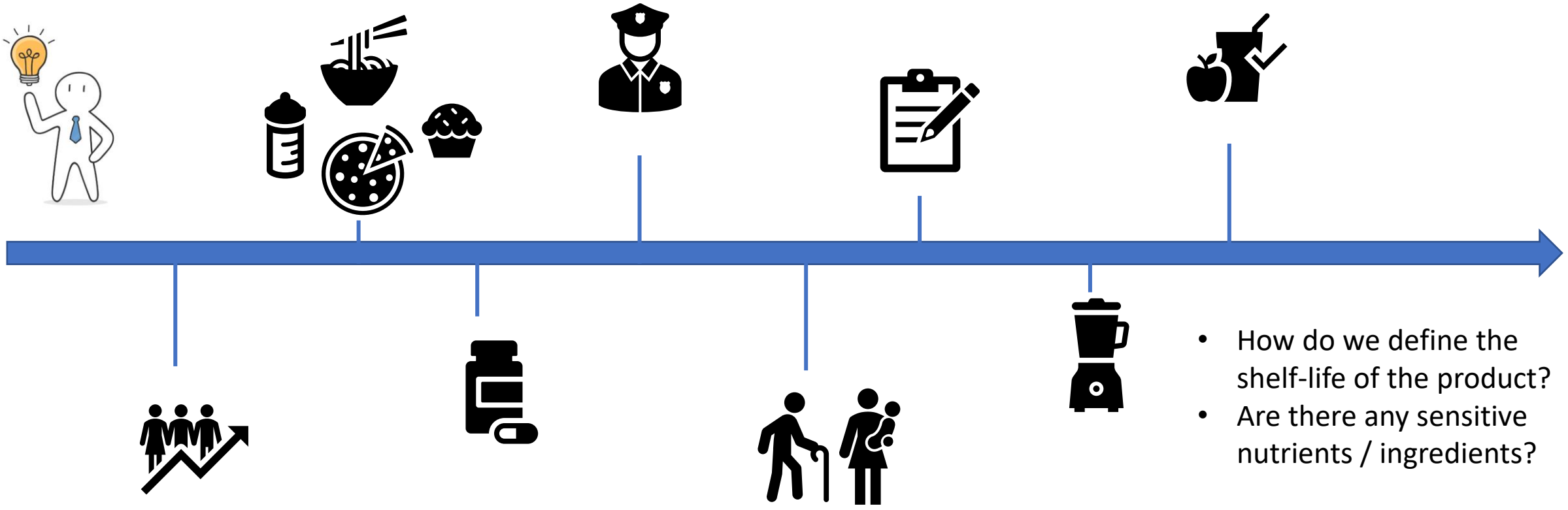
- Are we on time for the launch?
- Did we identify the critical paths?
- Are we on budget?
- Are we aligned with all stakholders?
  - Internal (business, management)
  - External (regulatory bodies, organizations, accademic partners)

From Idea… to launch!



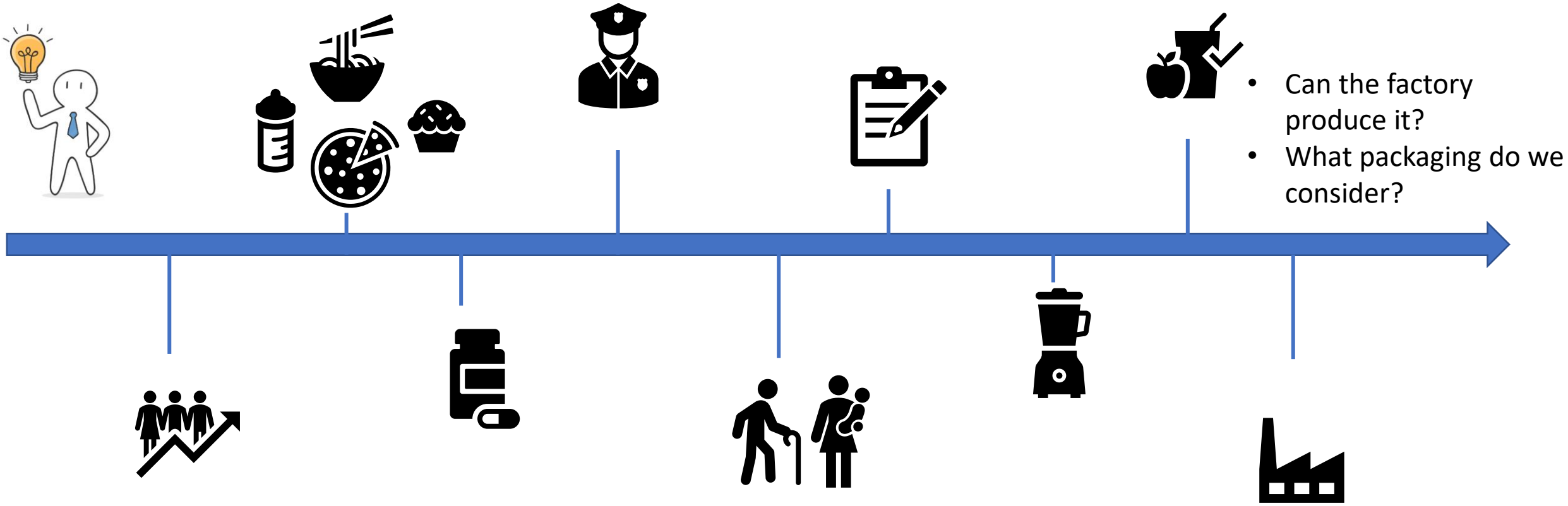
- Do we have technologies to incorporate high amounts of fibres in the product?
- Are specific processes required?
- How do we replace the sugar?

From Idea… to launch!



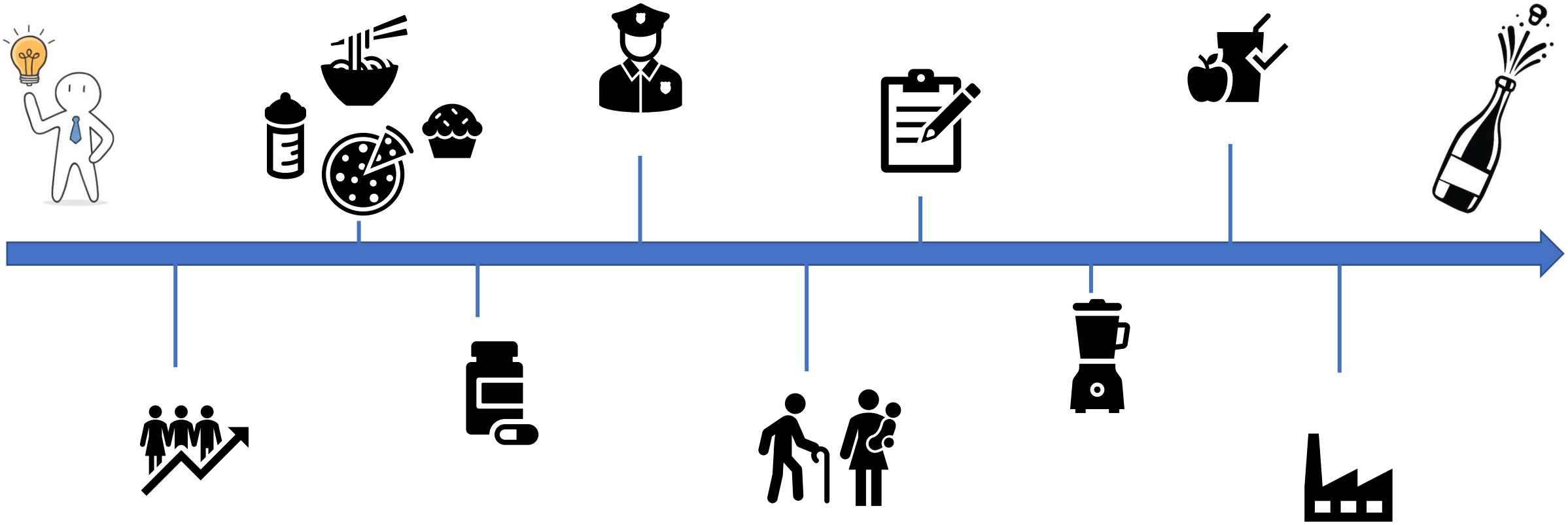
- How do we define the shelf-life of the product?
- Are there any sensitive nutrients / ingredients?

From Idea… to launch!

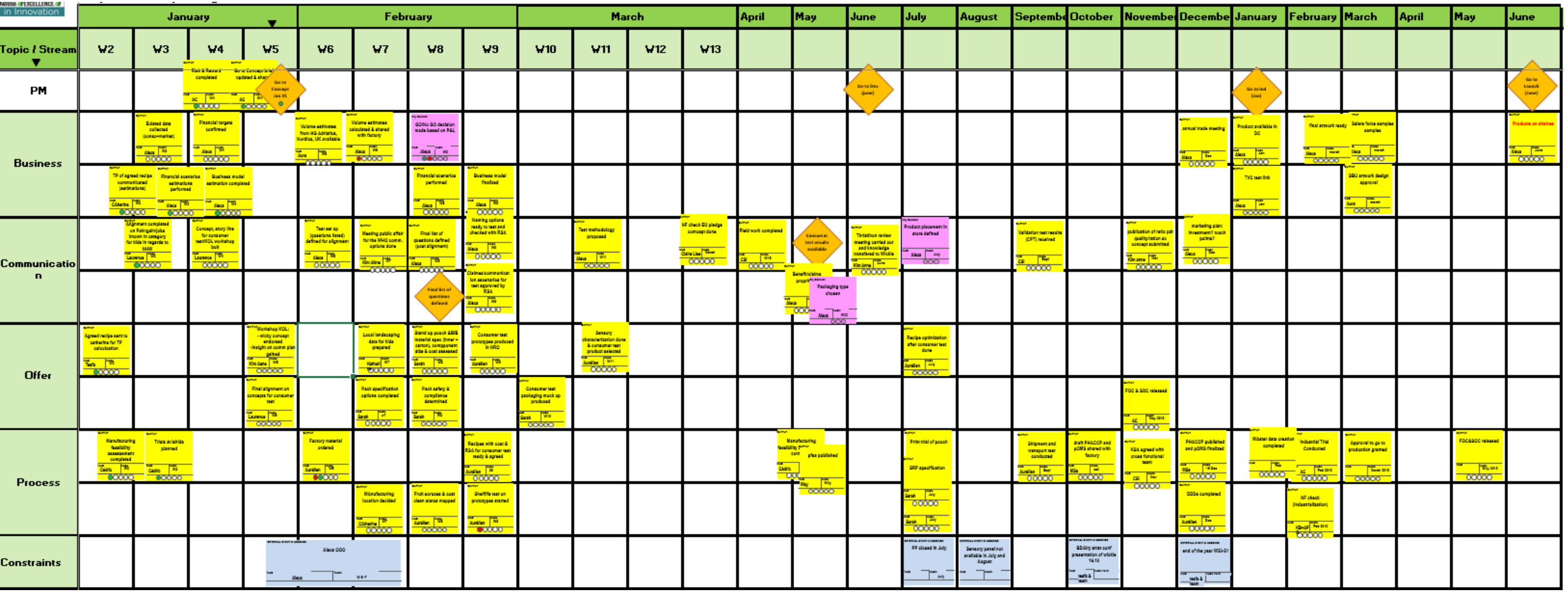


- Can the factory produce it?
- What packaging do we consider?

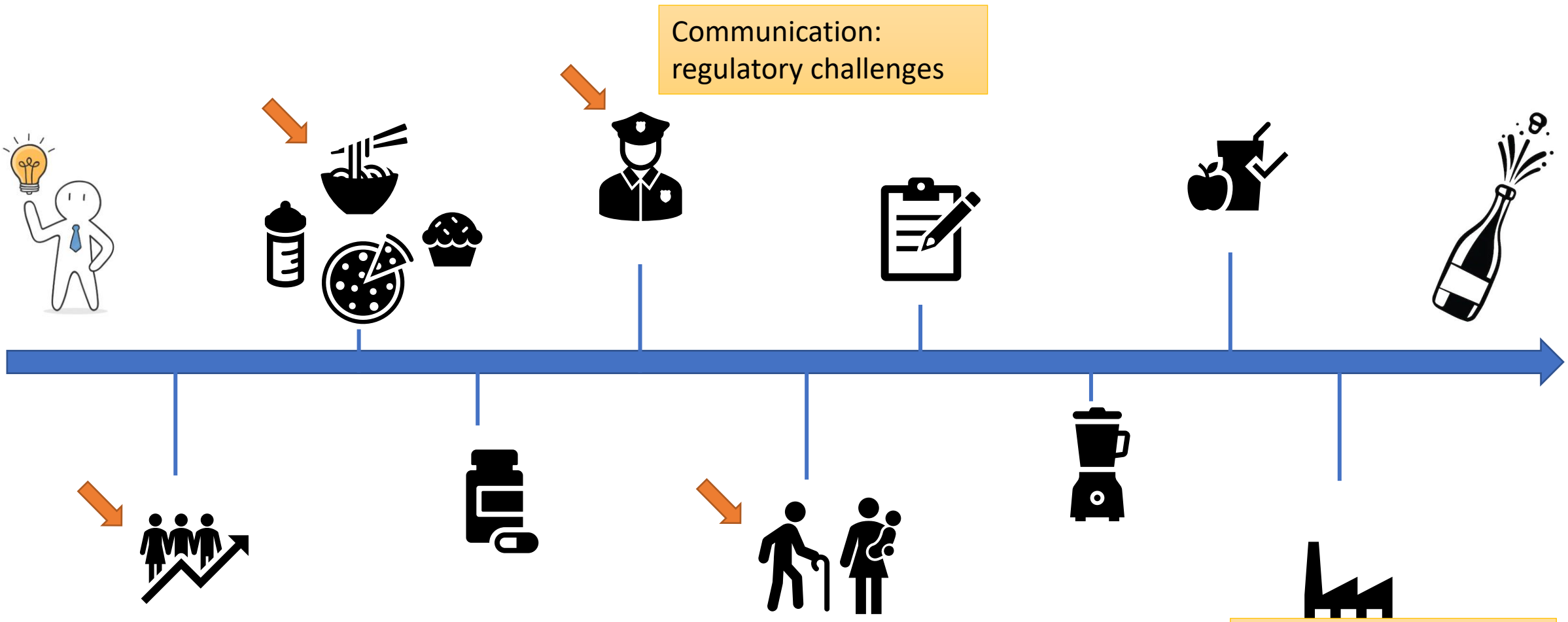
From Idea… to launch!



Complete overview from Idea to Launch



From theory… to reality



Communication: regulatory challenges

Consumer insight: sweet spot very difficult to identify

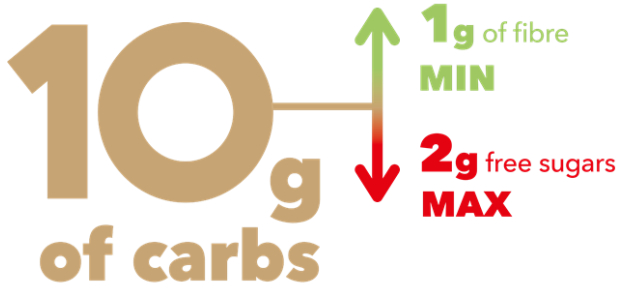
Timing of scientific substantiation not aligned with launch

Delays in manufacturing & raw ingredient sourcing

EPFL

Nutrition science to support product development

THE CARB-FIBRE-SUGAR RATIO



Adapted from external recommendations (e.g. WHO)

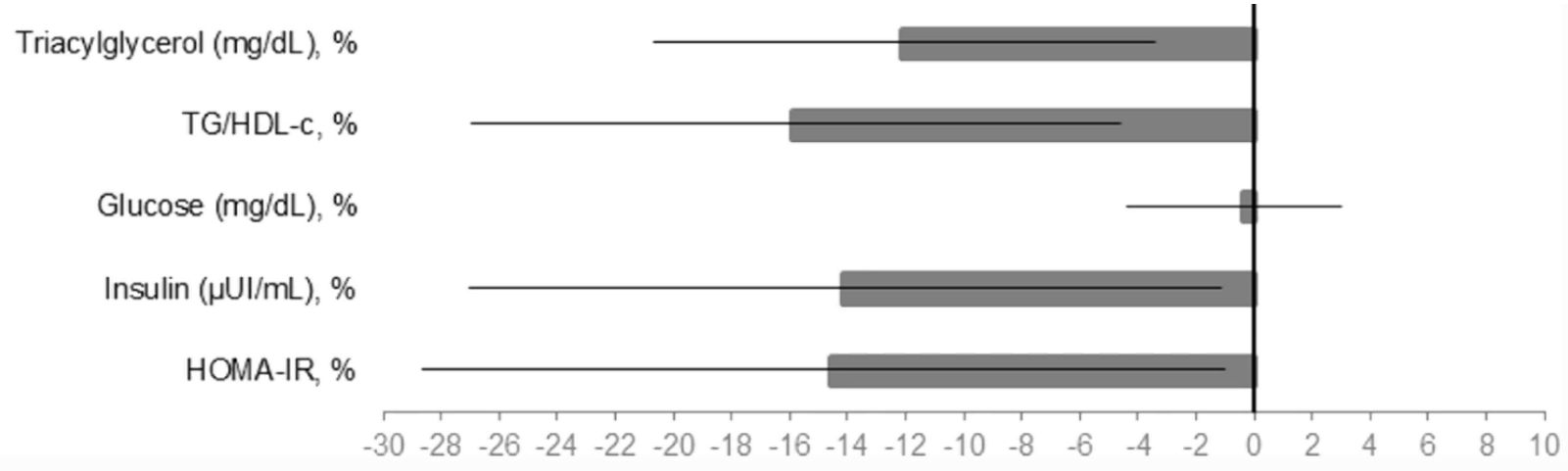
- Fibres: >25g/d
- Free sugars: < 10% of total energy

ARE PRODUCTS WITH THE RATIO MORE NUTRITIOUS?

DOES THE RATIO HELP INDIVIDUAL REACH A BALANCED DIET?

IS THERE ANY HEALTH BENEFIT ASSOCIATED WITH THE RATIO?

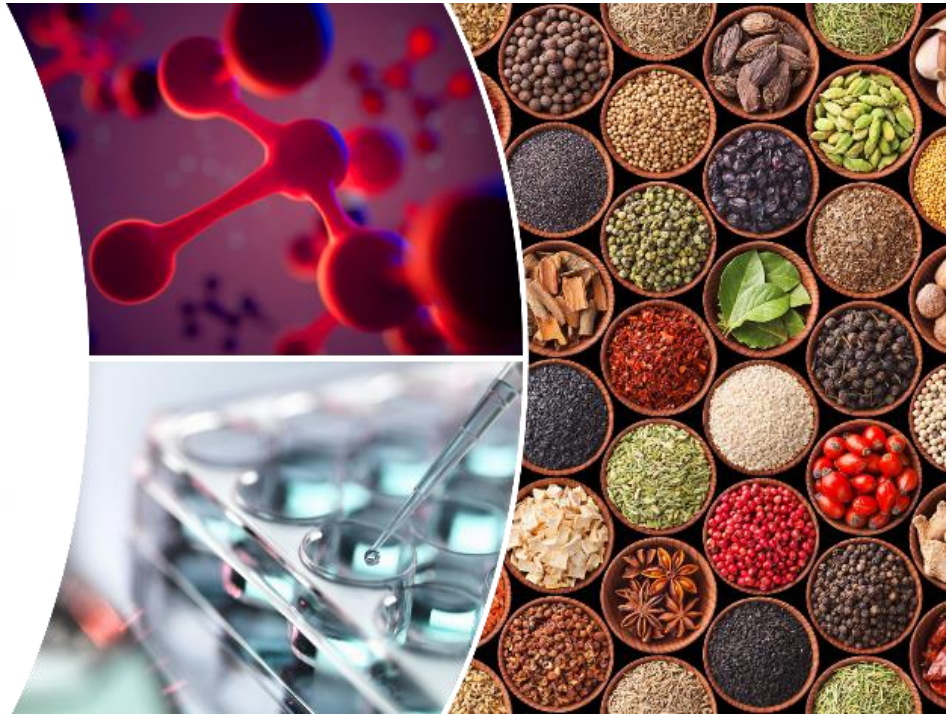
Method: cross-sectional population-based study 2015 Health Survey of São Paulo (n = 1188)



Fontanelli MM, Micha R, Sales CH, Liu J, Mozaffarian D, Fisberg RM. Eur J Nutr. 2020 Oct;59(7):3269-3279.

Ref: [1] Liu et al, PLOS One 2020; [2] Tan et al, Nutrients 2020; [3] Blumfield et al, PLOS One 2021

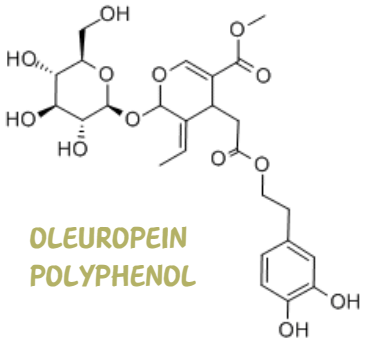
EPFL



Example of olive leave polyphenol for energy and endurance

What it looks like today

A science-rooted **natural ingredient**…



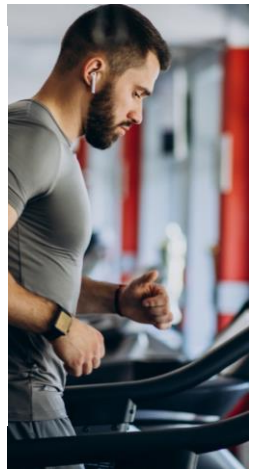
OLEUROPEIN POLYPHENOL

… to stimulate **mitochondria** to boost cellular ATP…

…and increase **muscle energy & sports performance**

Incubated for **open innovation**

ACCELERATOR TEST LAUNCH FOR SPORTS ENERGY

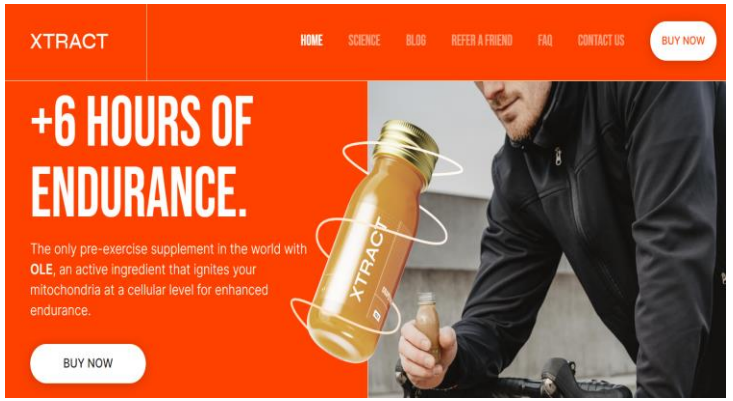


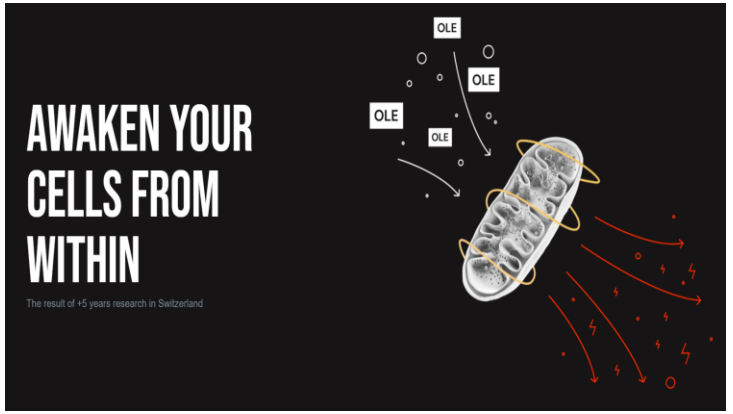
ENERGIZE

The Accelerator
Powered by Nestlé R+D

- MVP «Minimal viable product»
- Consumer communication
- Shop test in Italy

Launched by a **start-up**





https://www.oleus.com

EPFL

From Idea to ~~launch~~ decision… and agility & entrepreneurship !

High protein healthy aging drink

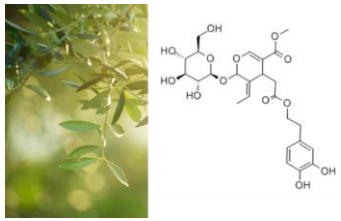
Define product format & positioning

✓ Food supplement
X Food

Ensure regulatory compliance

Clarify consumer need & business opportunity

Older people with mobility concerns



Identify bioactive & mechanism of action

Plan & budget properly

Test in relevant population

Develop technical solutions

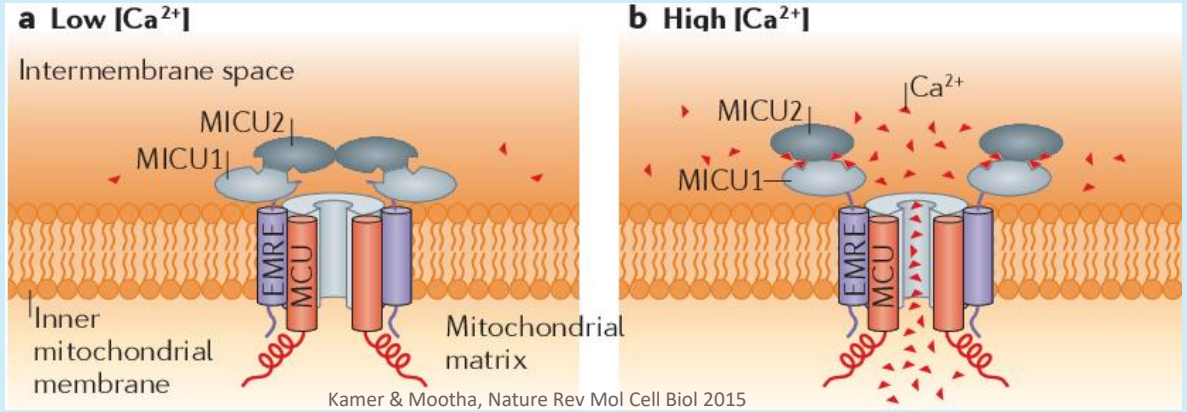
Ensure quality & safety

Calculate costs & benefits (P&L)

Post-launch monitoring…

Deep rooted in scientific discovery

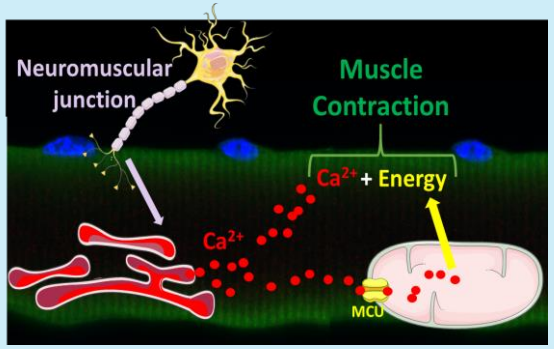
The MCU complex transports Ca2+ in mitochondria



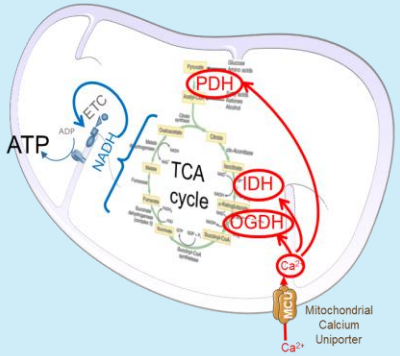
Kamer & Mootha, Nature Rev Mol Cell Biol 2015

De Stefani et al, Nature, 2011 / Baughman et al, Nature, 2011

Mito-Ca controls muscle health via energy production



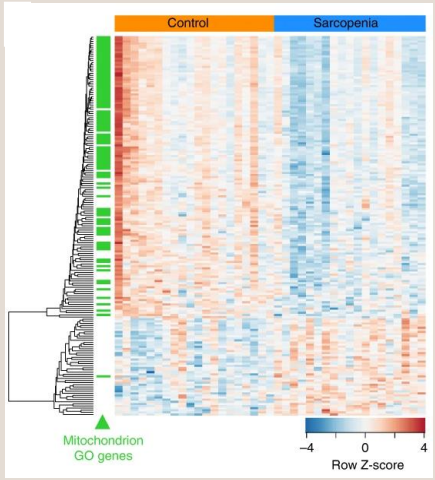
Logan C.V. et al, Nature Genetics, 2014
Lewis-Smith D. et al, Neurology, 2016

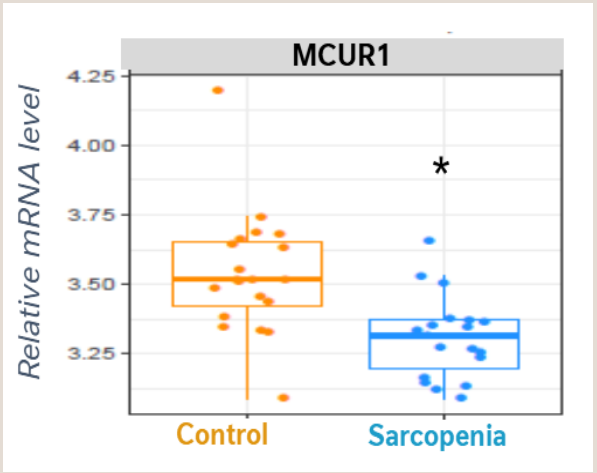


Mammucari et al, Cell Reports 2015
Debattisti et al, Cell Reports 2019

Discovery in a human cohort of muscle aging

- **Mitochondrial dysfunction** is the major transcriptional signature of sarcopenia in human muscle biopsies.
- **Mitochondrial calcium import** is a downregulated pathway in the sarcopenia signature.

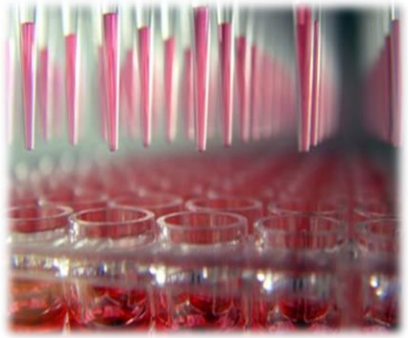


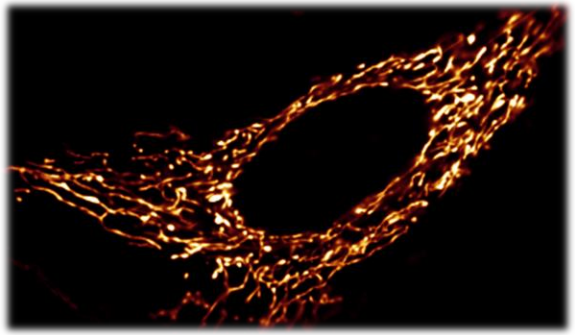


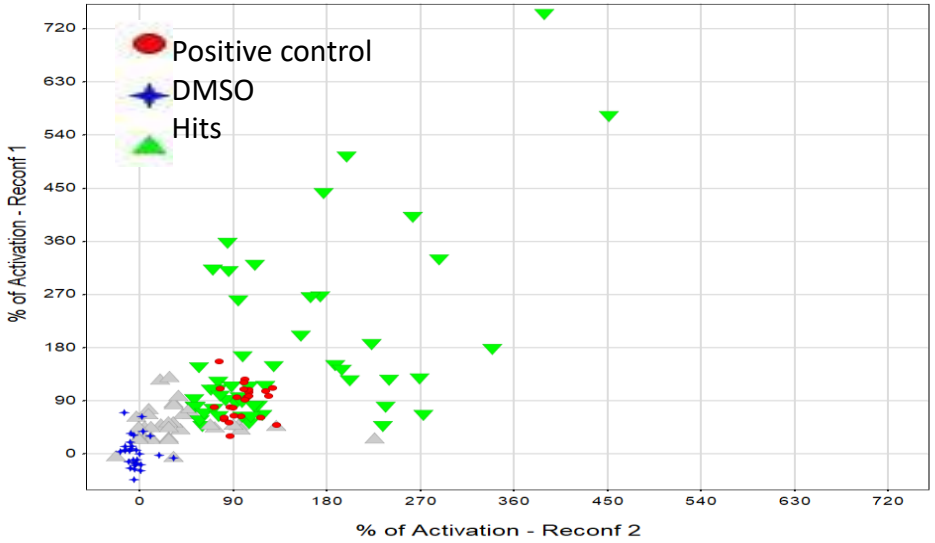
Migliavacca, … & Feige, Nature Comms 2019
Gherardi et al, Biorivx 2023

Enabled by experimental biology

SCREENING OF 5000 BIOACTIVES WITH MITOCHONDRIAL CALCIUM REPORTER

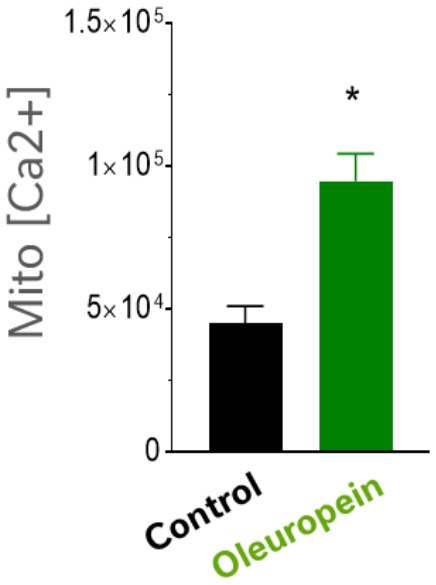




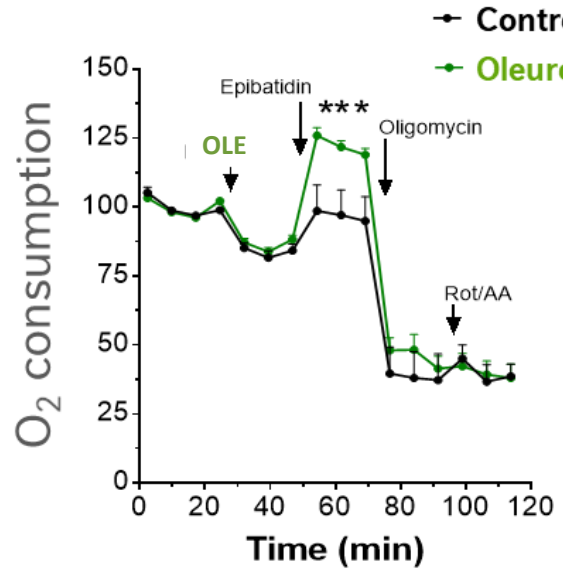


COUNTER-SCREEN & CELLULAR VALIDATION

Mitochondrial Ca^{2+} import



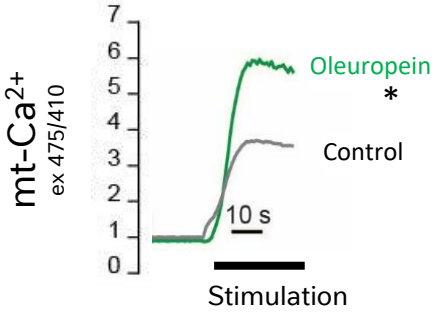
Mitochondrial respiration

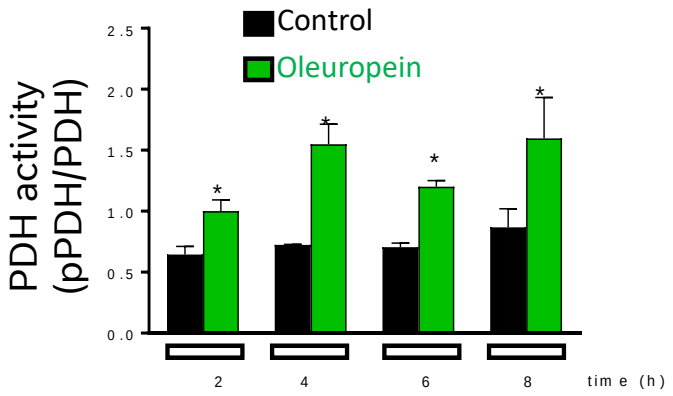


-- Active at 5µM in 5min --

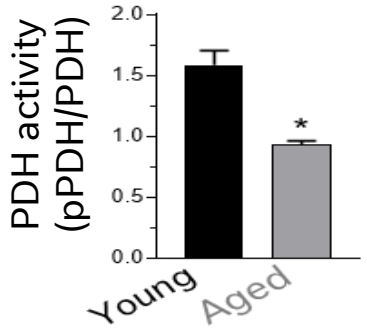
Guided by physiology in model organisms

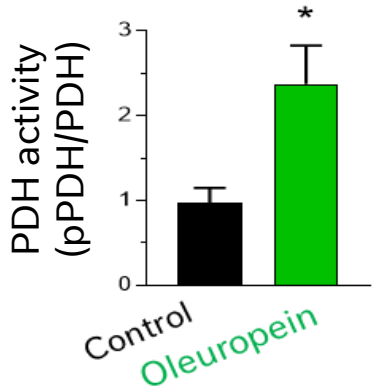
Enhances muscle bioenergetics acutely



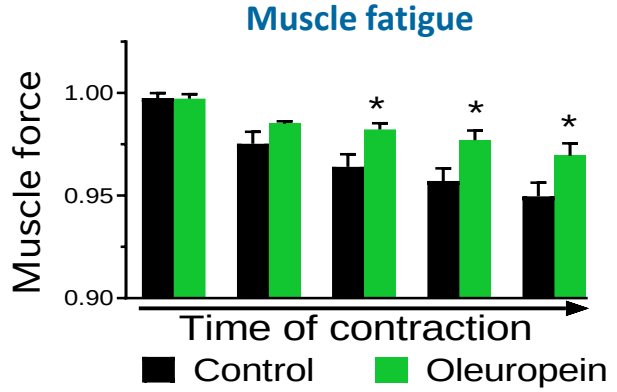


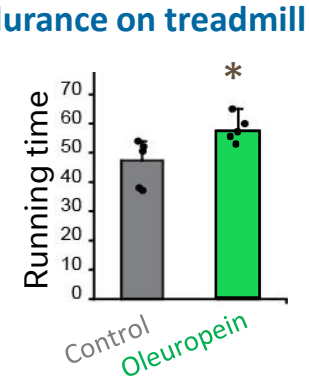
Restores bioenergetic defects during aging





Prevents muscle fatigue





CONSUMER COMMUNICATION

STIMULATES MUSCLE ENERGY ACUTELY

PREVENTS LOW MUSCLE ENERGY DURING AGING

ENDURE FOR LONGER

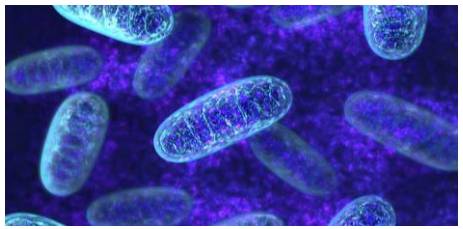
Repurposed via open innovation

The accelerator :
translating innovation into a test launch in 6 months

ENERGIZE

The Accelerator
Powered by Nestlé R+D

Scientific discovery	Growth hacking & concept prioritization	Sensory optimization	Communication strategy	Test launch



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Research and Development