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Positive interactions between lactic acid bacteria: A must-have to develop new fermented foods

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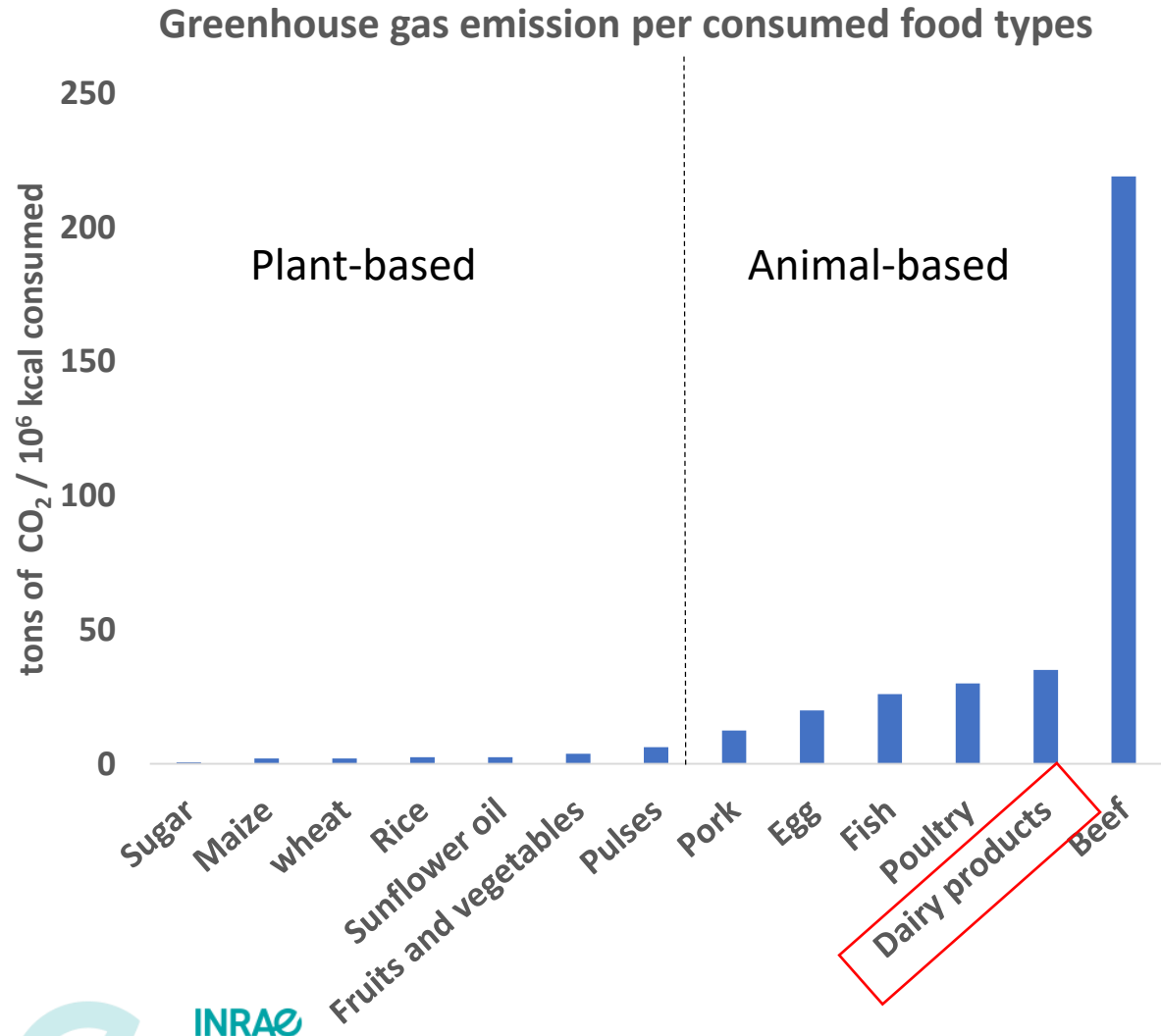
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**➤ Positive interactions between lactic acid bacteria:
A must-have to develop new fermented foods**

Fanny Canon, Anne Thierry, and Valérie Gagnaire

INRAE, Institut Agro, STLO, Rennes, France

➤ Food transition context



- Food: responsible for one third of the greenhouse gas emission worldwide
- Necessity to decrease the proportion of animal-based food, notably proteins, in the diet to 50 % (French health and nutrition program *PNNS4 2019-2023*)
- Compatible with the emerging vegetarian and flexitarian diets: use of dairy products, in combination with plant-based products



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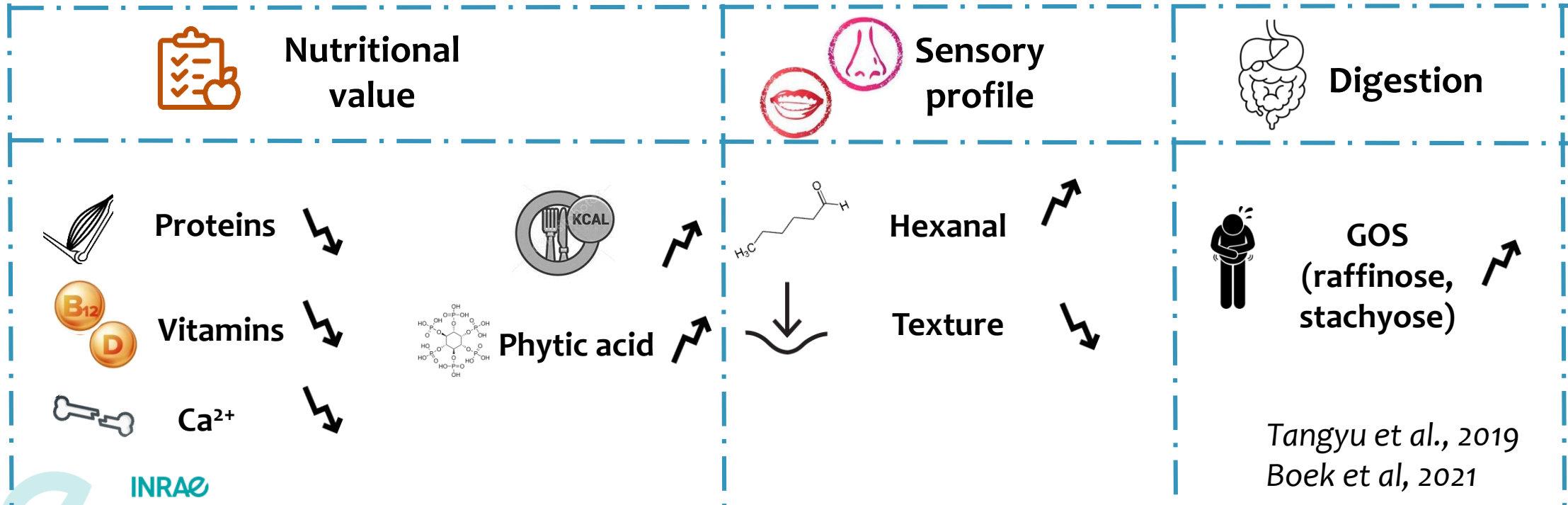
Positive interactions between lactic acid bacteria: a Must-have to develop new fermented foods
2022/01/21 Canon Thierry Gagnaire Webinar Novel Food



➤ 100 % plant-based “yogurts” to help food transition, but...

➤ On the French market, plant-based “yogurts” are made of:

- Soy milk
- Almond milk
- Coconut milk



➤ Mixed dairy- and plant-based “yogurts” » : beneficial in-between

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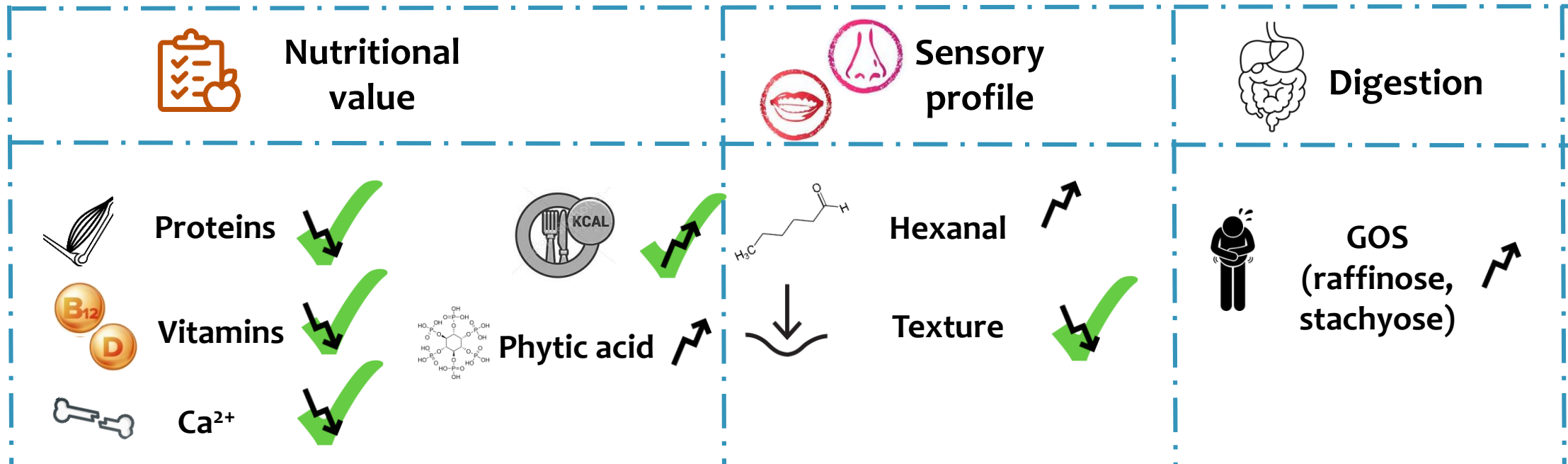


Mixing milk, egg and plant resources to obtain safe and tasty foods with environmental and health benefits

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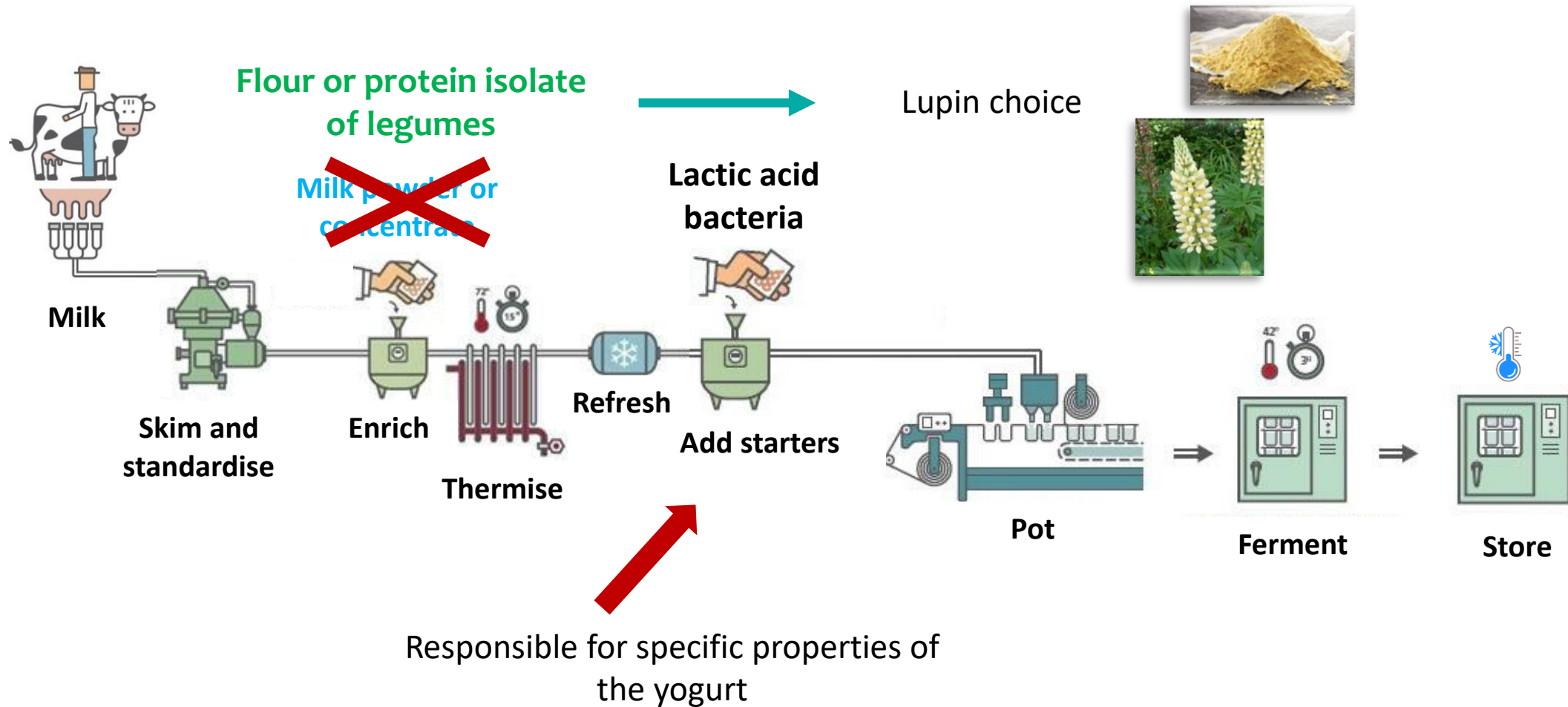
➤ Association of plants with milk
(Guyomarc'h et al. 2021)



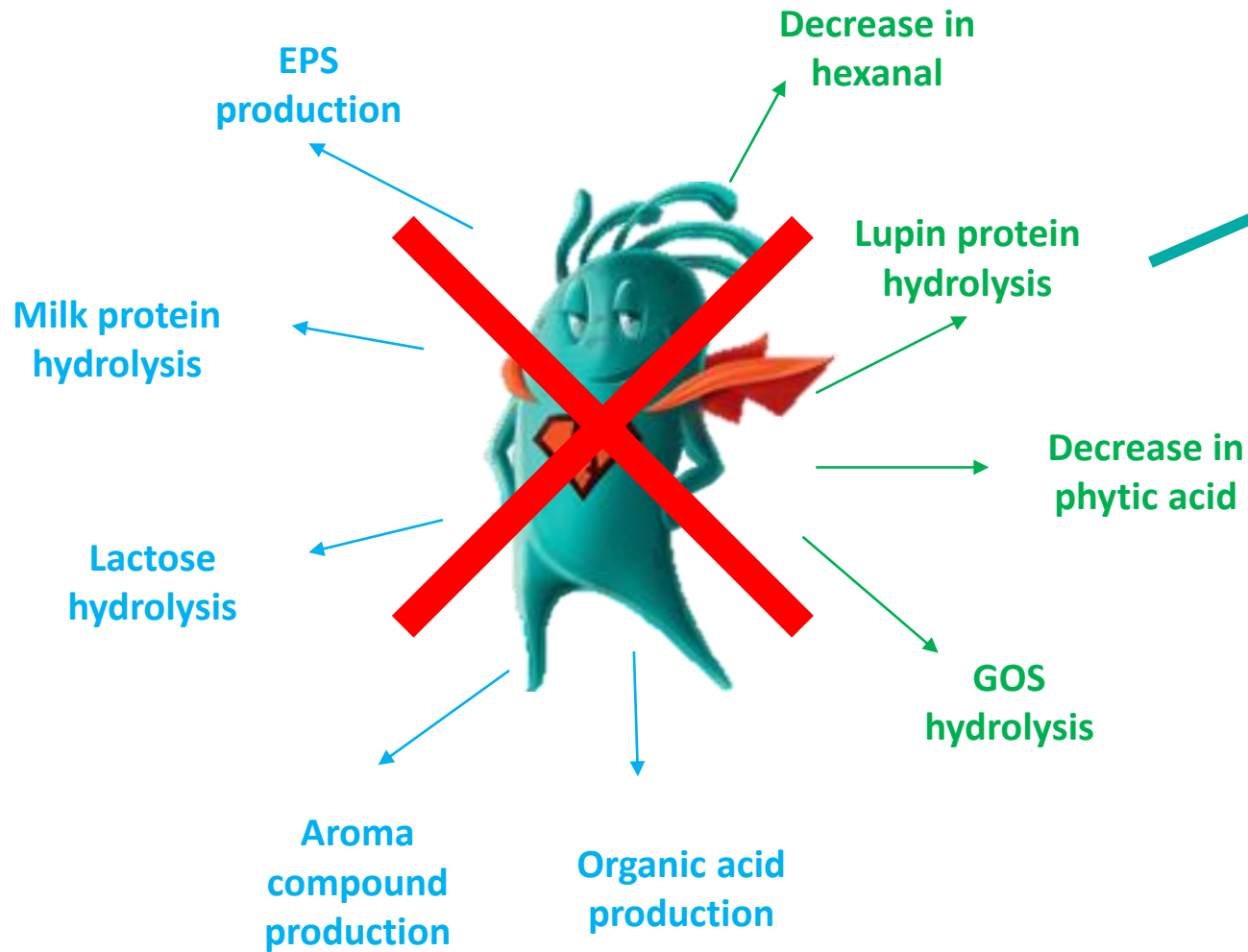
➔ Possible to easily insert the plant fraction in the yogurt process

POSITIVE INTERACTIONS BETWEEN LACTIC ACID BACTERIA: A MUST-HAVE TO DEVELOP NEW FERMENTED FOODS

➤ Scheme of yogurt and fermented milk production

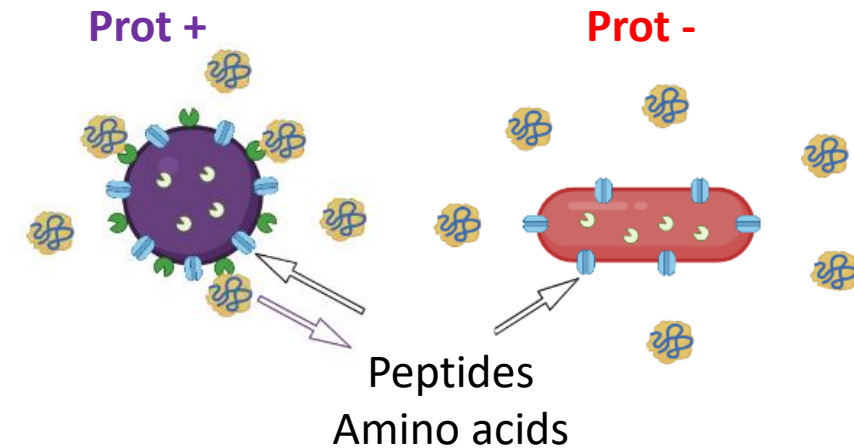


➤ Objective : to add up functionalities of the lactic acid bacteria in fermented mixed plant and dairy based “yogurts”



Association of several strains required

Chosen approach: to favour positive interactions between strains based on their nitrogen metabolism



Canon et al (2021)

➤ Experimental design for mixed milk-lupin yogurt manufacture

Three factors

5 starter cultures



Monocultures

Cocultures

Levels

- *E. faecalis* (F) +++
- *L. lactis* (L) ++
- *L. plantarum* (P) -

- F x P
- L x P

Proteolytic activity

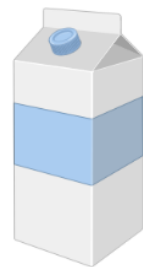
2 fat types



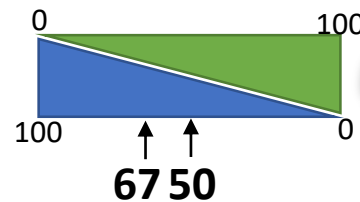
Milk fat (1,5 %)

Coconut oil (1,5 %)

2 milk/lupin protein ratios



Milk



Lupin

Responses



- Bacterial growth
- Acidification
- Proteolysis
- Volatile compounds and organic acid determination
- Physical Properties
 - Firmness
 - Viscosity
 - Water holding capacity (WHC)
- Sensory analyses on L and L x P yogurts



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Positive Canon et al (2022) in revision in Current Research in Food Science

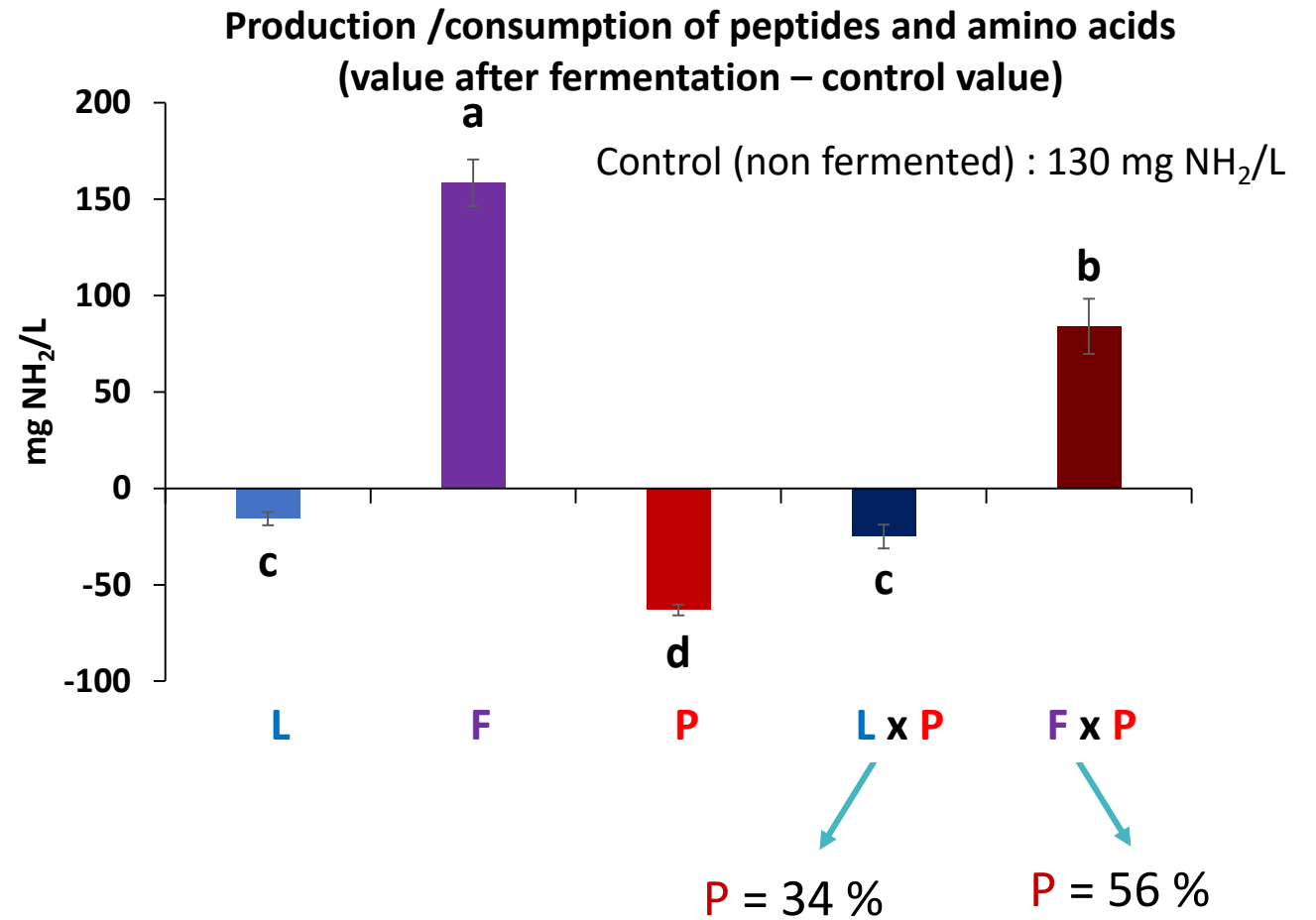
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➤ Growth and proteolytic activity of starter cultures in the milk-lupin yogurts

Cultures	Final pH	Time (h)
L and L x P	4.7	7
F	4.9	12
P and F x P	4.7	12

Total starter counts $>10^9$ cfu/g yogurt



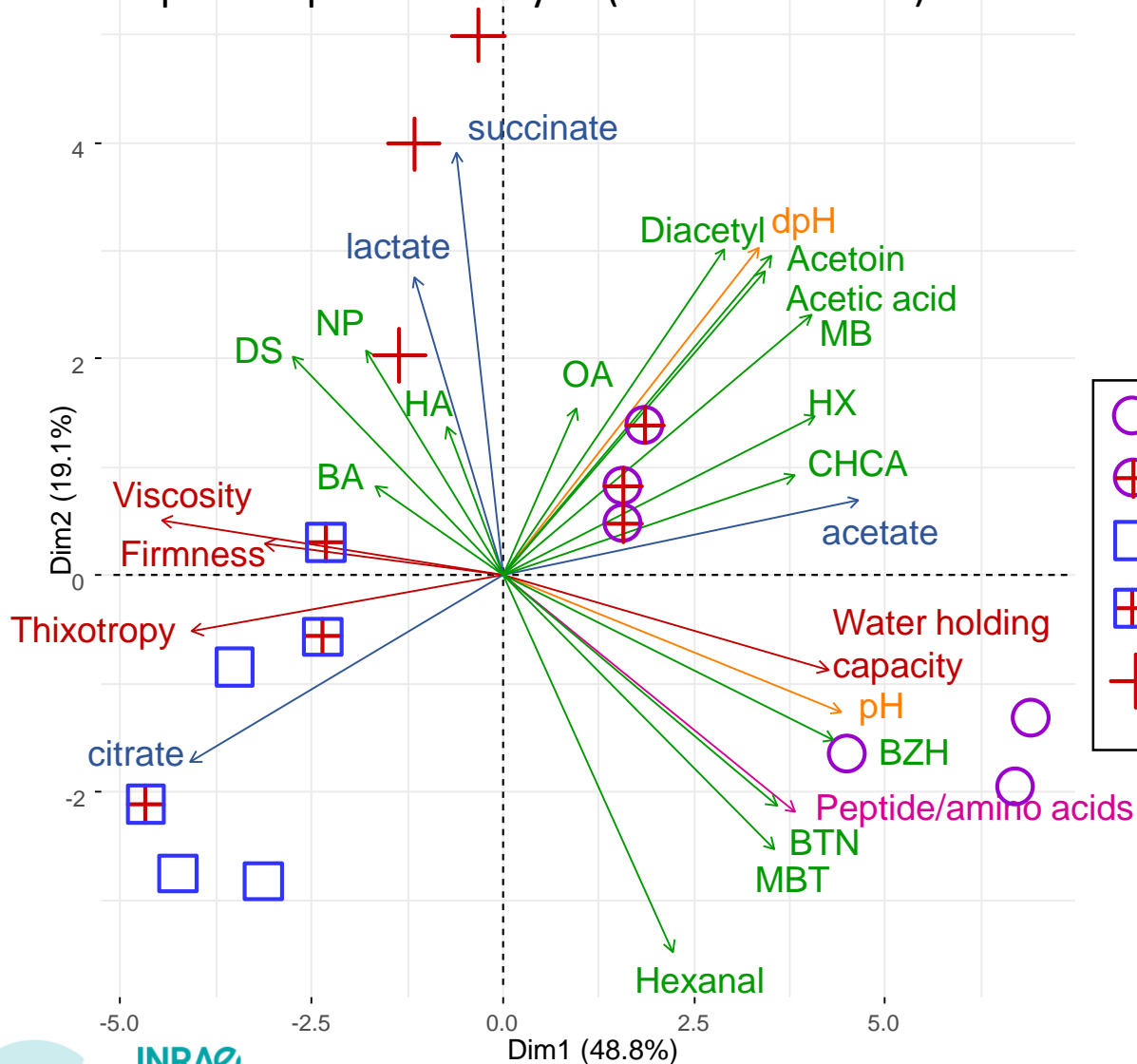
➤ **F** : high proteolysis and high population of **P** in coculture ⇒ positive interaction favoured



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➤ Impact of cocultures on the functionalities of the milk-lupin yogurts

Principal component analysis (67.9 % axes 1+2)



Proteolysis

Physical properties

Organic acids

Acidification

Volatile compounds

BA: Butanoic acid
 BTN: 2-Butanone
 BZH: Benzaldehyde
 CHCA: Cyclohexanecarboxylic acid
 DS: Dimethyl sulfone
 HA: Hexanoic acid
 HX: 1-Hexanol
 MB: 3-Methyl-1-butanol
 MBT: 3-Methylbutanal
 NP: 2-Nitroethyl propionate
 OA: Octanoic acid

➤ F x P : between the two monocultures

➤ L et L x P : indistinguishable, no effect of the coculture



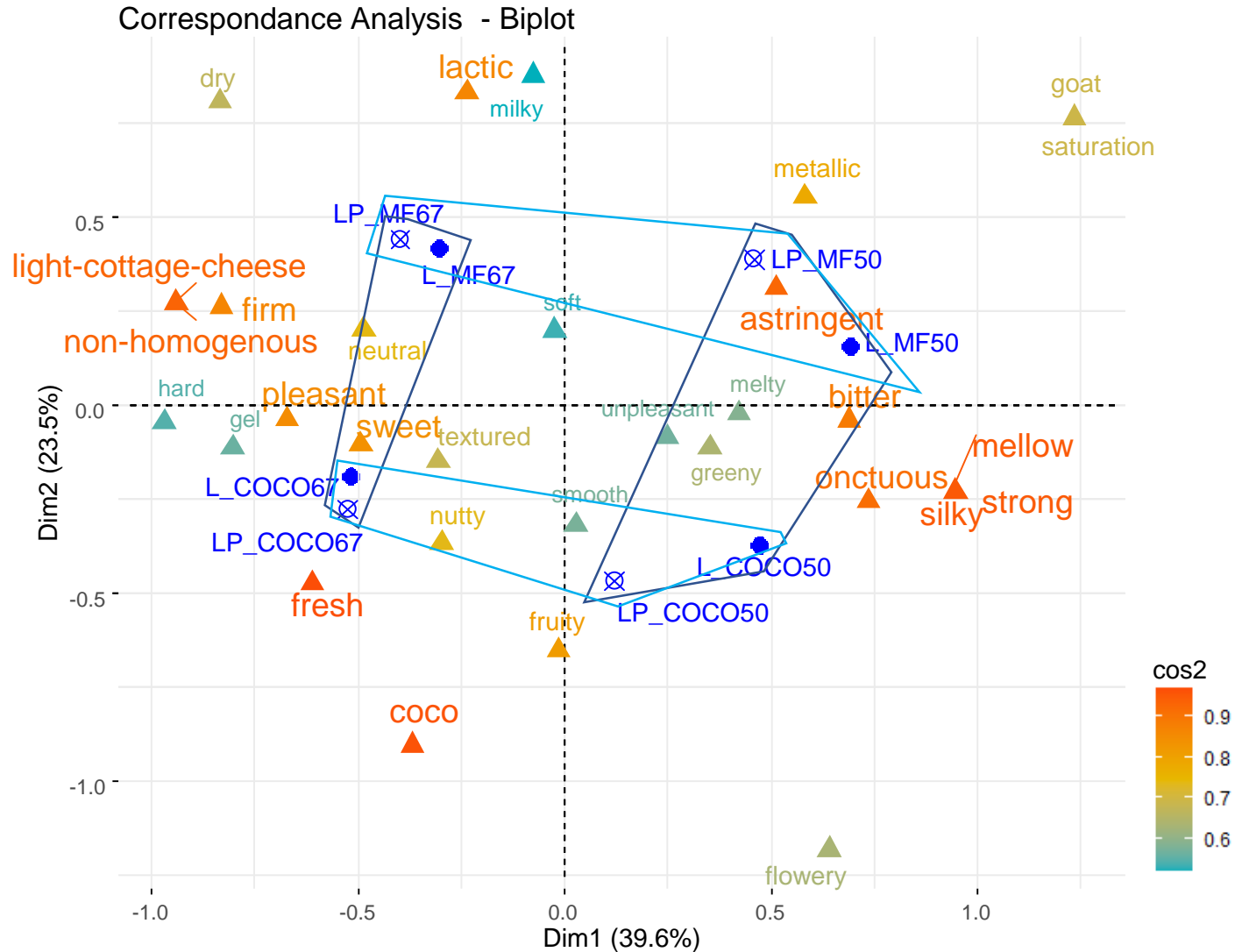
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➤ Sensory analyses (sorting task) also driven by the composition when L and L x P cultures are used



- **Milk/lupin protein ratio** differentiated on the 1st axis
 - ratio 50: unpleasant, bitter and with a mellow texture
 - ratio 67: pleasant, textured (hard gel) and nonhomogeneous
- **Fat type** differentiated on the 2nd axis
 - Milk fat: milky, lactic and “goaty”
 - coco as fruity, fresh and nutty

Untrained panellists



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➤ Take home message



➤ Milk/plant protein ratio:

< 50 % of plant protein : higher firmness, more appreciated by panellists

➤ Fat type:

coco associated with lower firmness, sensorially detected

➤ Starter cultures:

- impact on pH and proteolysis and hence physical properties
- more functionalities expressed in yogurt when there are interactions between strains as observed in the coculture **F x P** in which the proteolytic strain stimulated the non proteolytic strain
Higher firmness and viscosity, higher diversity of organic acids and volatile compounds and higher decrease in hexanal

➤ Mixed dairy-plant-based yogurt: good start for the diet transition as it softly gets consumers acquainted with the unfamiliar properties of plant-based yogurts

➤ Further readings and thanks for your attention...

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Understanding the Mechanisms of Positive Microbial Interactions That Benefit Lactic Acid Bacteria Co-cultures

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Positive Interactions Between Lactic Acid Bacteria Could Be Mediated by Peptides Containing Branched-Chain Amino Acids

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Positive Interactions between Lactic Acid Bacteria Promoted by Nitrogen-Based Nutritional Dependencies

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