



Digestion and oral comfort of cheese developed to meet the sensory and nutritional needs of the elderly

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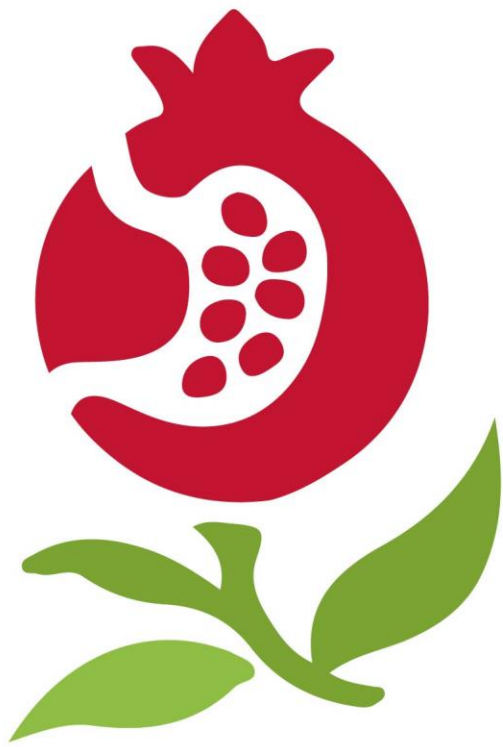
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**6th INTERNATIONAL
CONFERENCE
ON FOOD DIGESTION
GRANADA 2019**
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Digestion and oral comfort of cheese developed
to meet the sensory and nutritional needs of
the elderly

Didier DUPONT, STLO, INRA-Agrocampus Ouest, Rennes, France

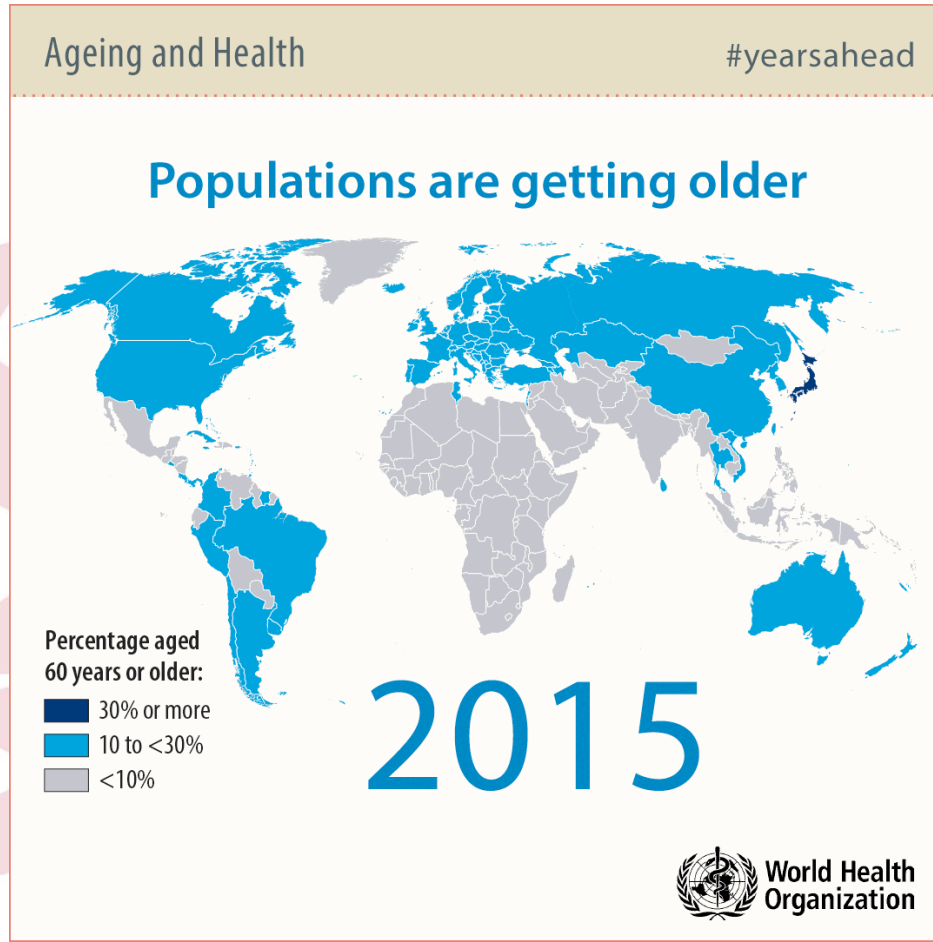
AGEING = a world problem...



The EU population over 65

2015 : **1/5** of the population

2050 : **1/3** of the population

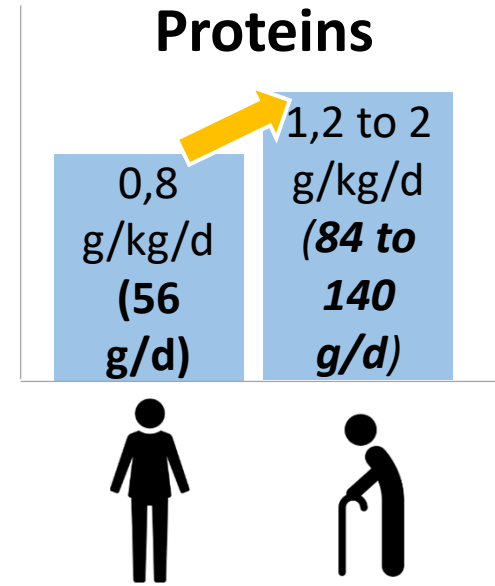
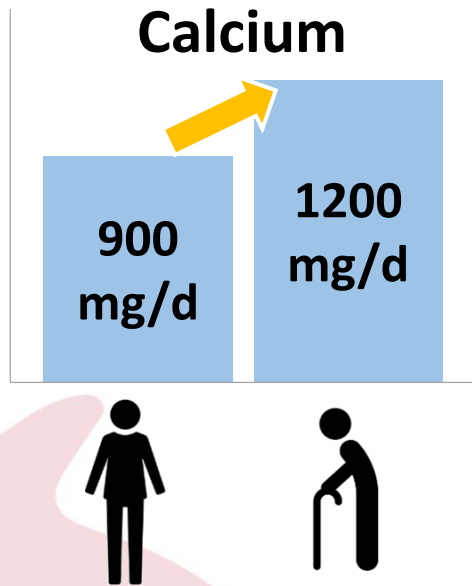


Challenge : healthy ageing

=

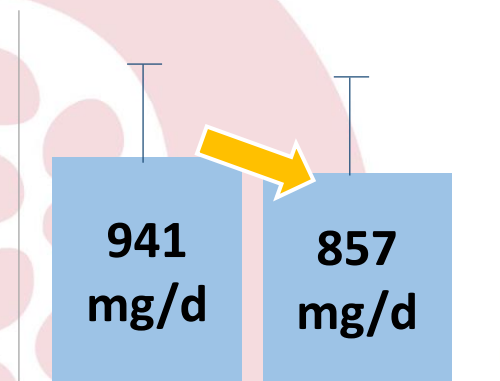
- Keeping people autonomy
- Offering them physical and social activities
- Preventing the development of pathologies
- **Offering them an adequate diet**

The nutritional needs of elderly people

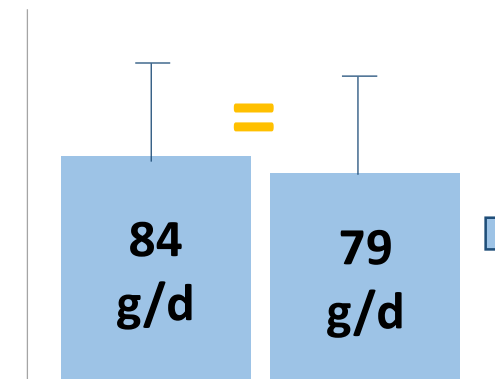


(Baum et al. 2017)

Mean daily intake



Osteoporosis

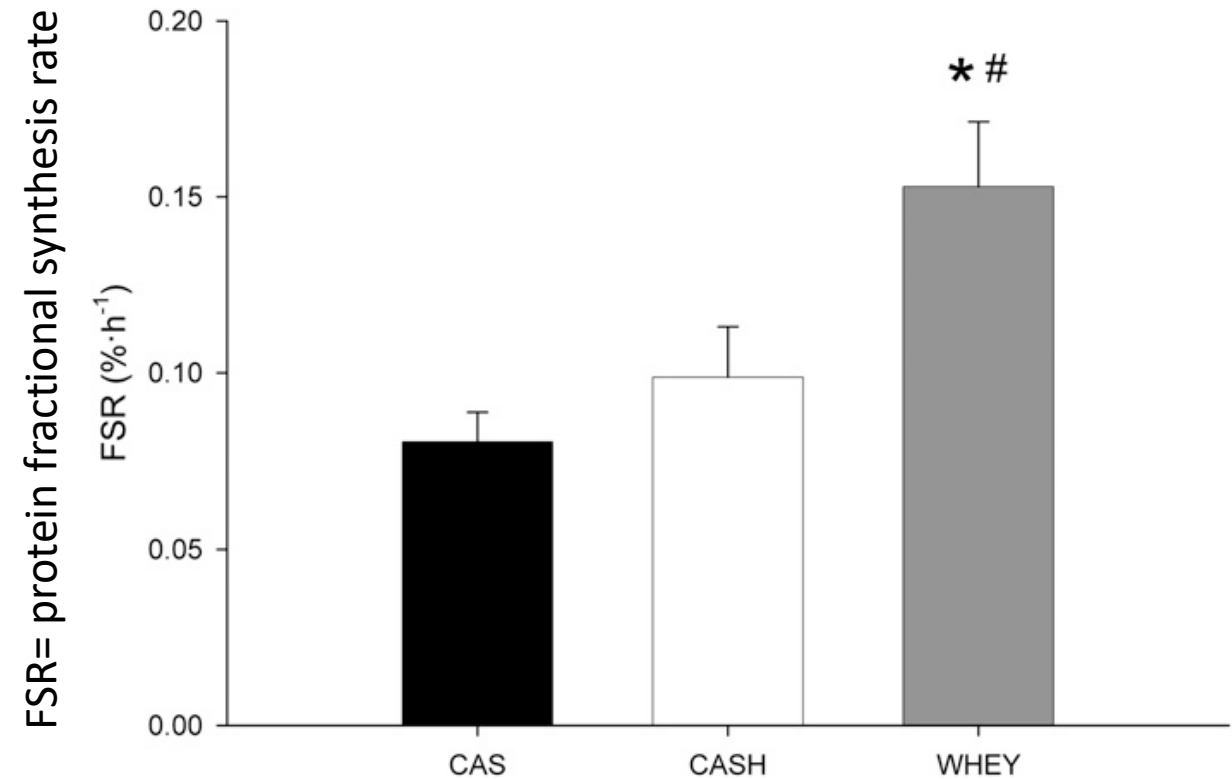
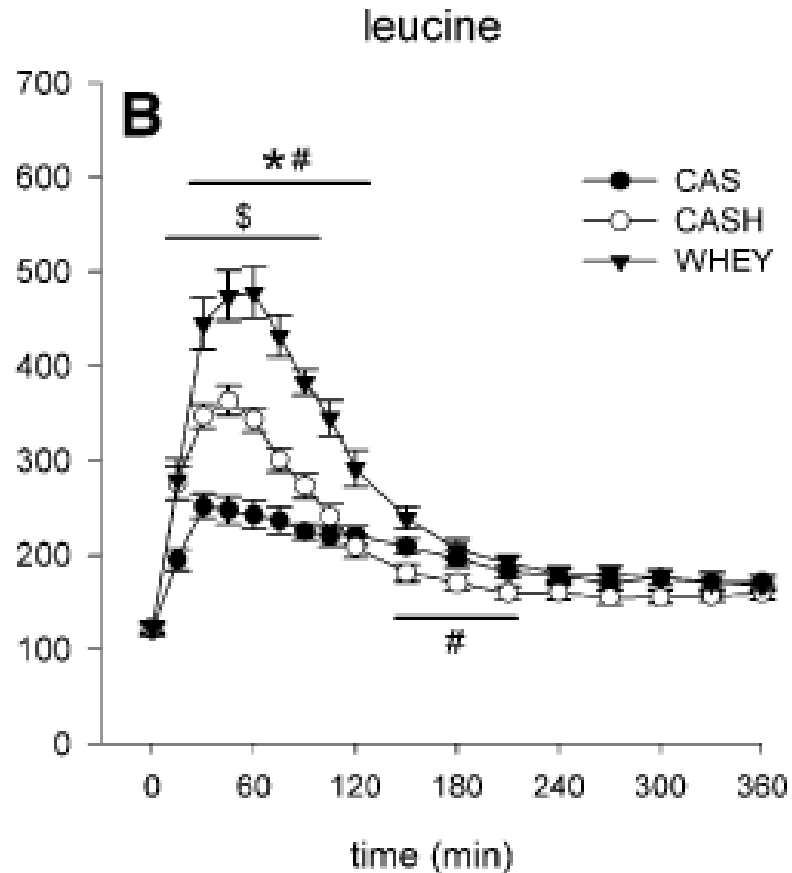


Sarcopenia



(INCA 3, 2017)

Muscle protein synthesis can be restored when providing high amounts of Leucine through whey proteins (10 g) but not caseins



Pennings et al. 2013

Objectives of the project

To **design a range of cheeses** with identical composition (n=4):

- ☞ exclusively made of whey proteins to provide 10 g of protein/portion and high intake of Leucine
- ☞ enriched in calcium to provide 280 mg of calcium (25% of the daily intake)



To **assess the sensory perception of these cheeses** by elderly people with impaired or intact dental health (n=76)











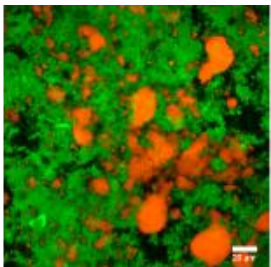
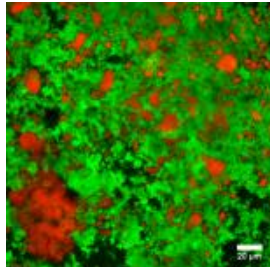
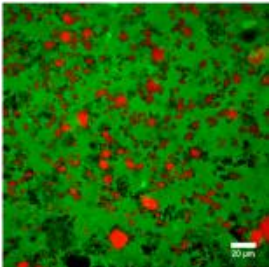
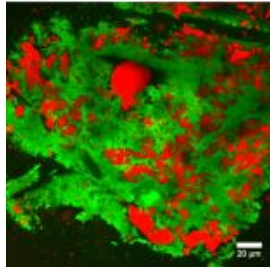
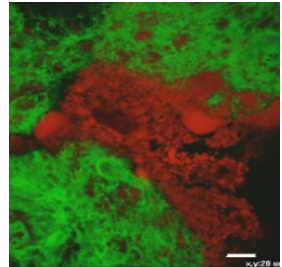
To **assess the calcium and amino acid bioavailability** in conventional pigs



Design of the cheeses

Heat Treatment (HT)



	Liquid (24%) 	Soft 	Processed 	Hard 	Whipped 	Mozzarella 
Texture perception		Soft and melting	Sticky and pasty	Firm and slightly dry	Dry and granular	Elastic
pH	6.4 ±0.05	6.4 ±0.05	6.0 ±0.05	6.4 ±0.05	5.6 ±0.05	5.3 ± 0.05
Hardness		16 ±8	9 ±4	108 ±20	6 ±1	95 ± 1
Type of protein	Whey proteins					Caseins
[Leucine] g/kg	4.70 ±0.41					3.61 ±0.01
Microstructure confocale x60 scale: 20 µm  Proteins  Lipids						

Which textures of cheeses are comfortable for older people with or without oral health impairment?



76 volunteers + 65 y.o
(Dentition and Flow saliva)

x

4 cheese models



Perception

Food comfortability

Questionnaire

(Vandenberghe-Descamps *et al*, 2017)

- Q1. Comfort
- Q2. Bolus formation
- Q3. Pain
- Q4. Product texture
- Q5. Flavor

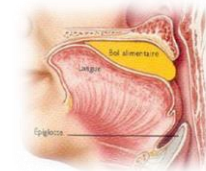


Bolus formation

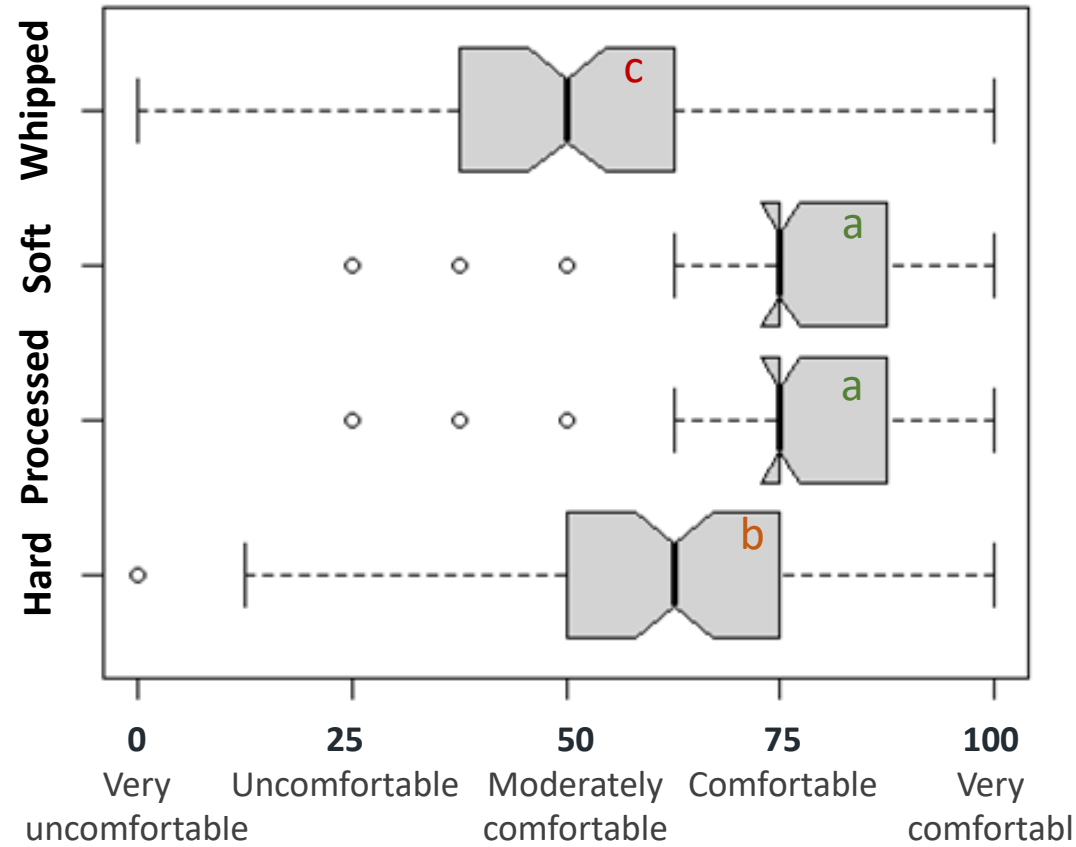
- **Chewing behavior :**
Video

Cycle number
Chewing time

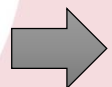
- **Food bolus**
Rheology - *Compression*
Quantity of saliva– *Dry extract*
(Drago *et al*, 2011)



The food comfortability is mainly impacted by the type of product consumed

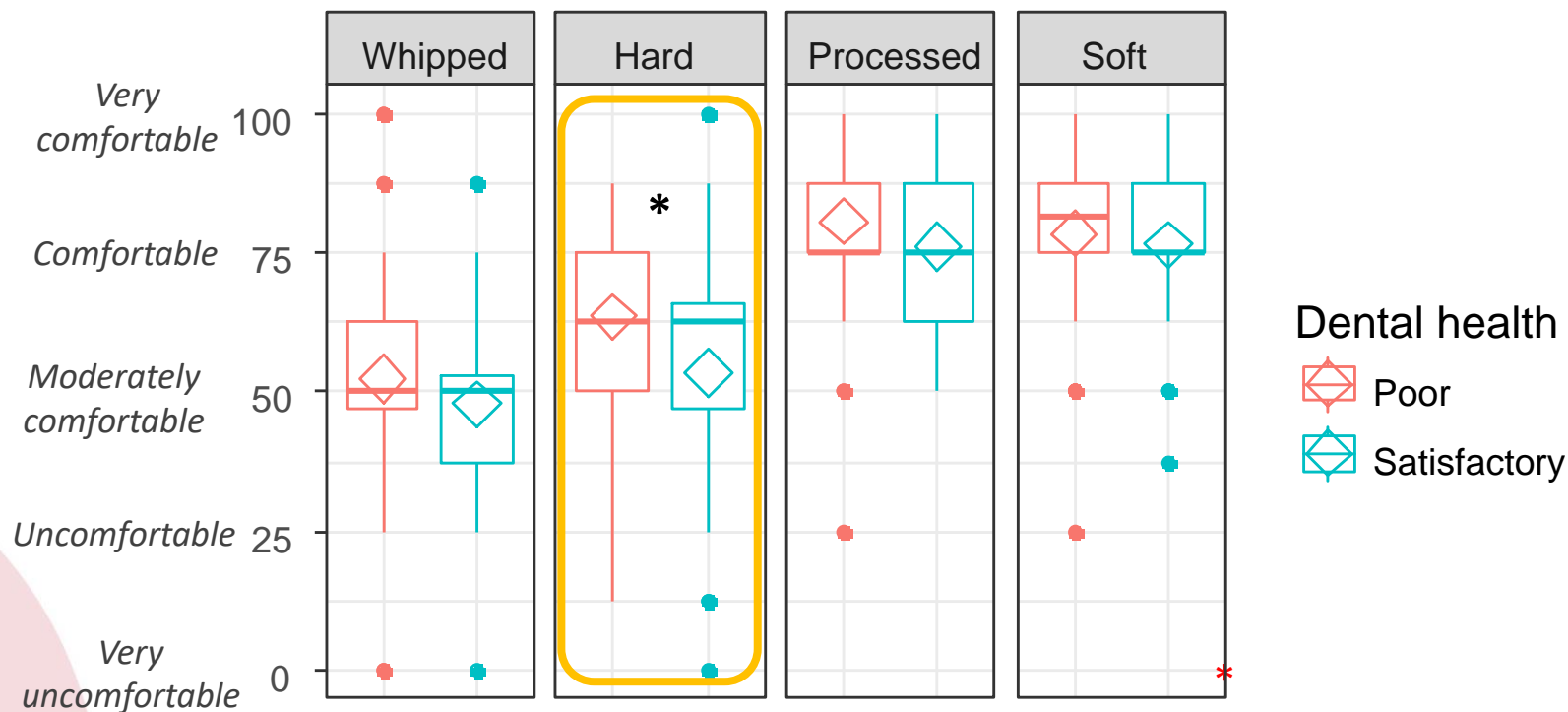


$ANCOVA : Variable \sim Product + Error(Subject)$



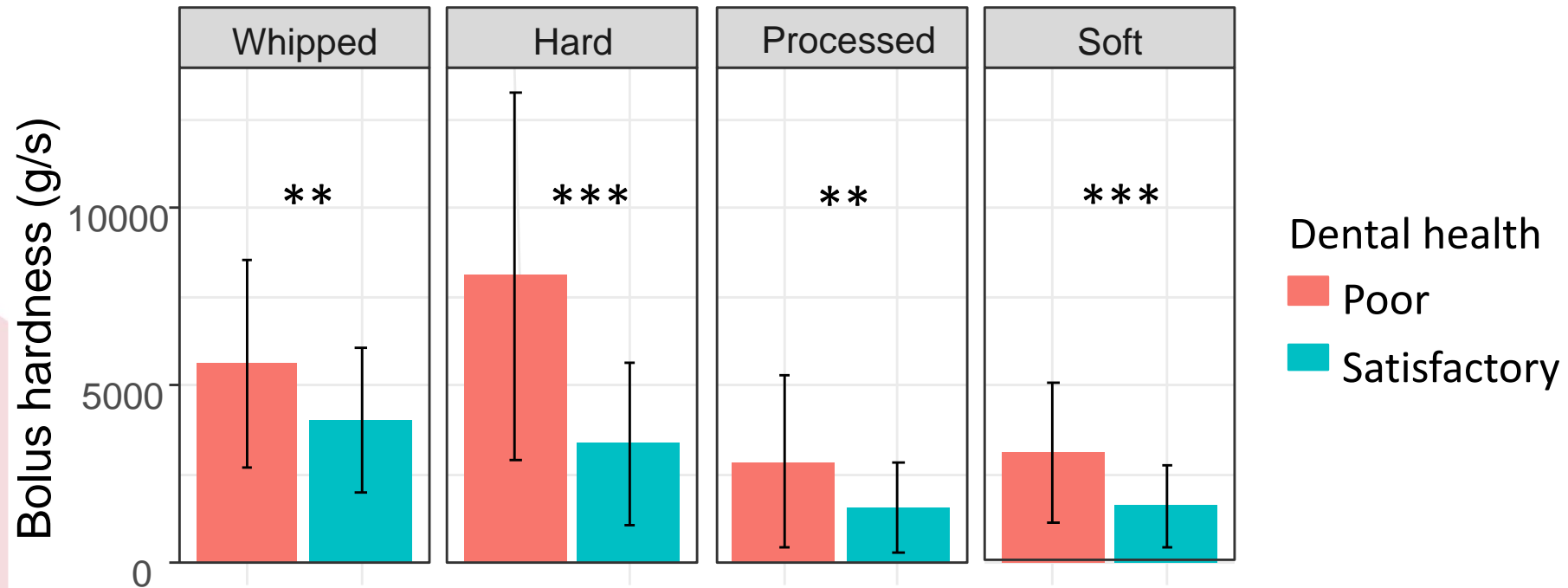
The most comfortable products are the Soft and Processed products

The food comfortability is not negatively impacted by the dental health



Elderly people with a poor dental health considered the Hard product more comfortable than elderly people with a satisfactory dentition

Elderly persons with a poor dental health made harder bolus than elderly persons with a satisfactory one

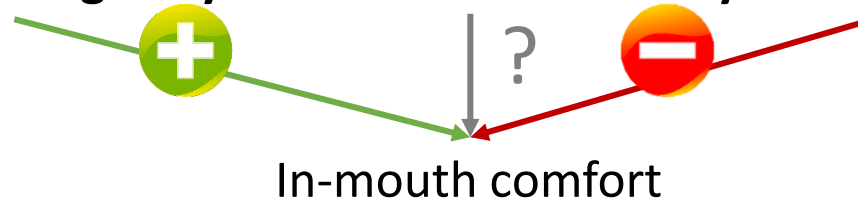


Decrease in food bolus disintegration by denture wearers observed by Mishellany-Dutour *et al.* (2008), Woda *et al.* (2006), Yven *et al.* (2006)

Which textures of cheeses are comfortable for older people with or without oral health impairment?

1 . A product is comfortable when the bolus is easy to form

2 . Melting and greasy Firm Dry and very sticky



3 . Oral health alterations do not negatively impact the in-mouth comfort

Vandenbergh-Descamps et al (2017), Assad-Bustillos et al. (2017), Laguna (2016)

But the bolus formed are different (hardness and humidity)

In vivo digestion

Whey-based
Soft cheese
CaCO₃



Mozzarella



Milk Calcium

Whey-based
Soft cheese
CaP



Iso-calcium : 0,7%
Isocaloric ≈
280 kcal /100g

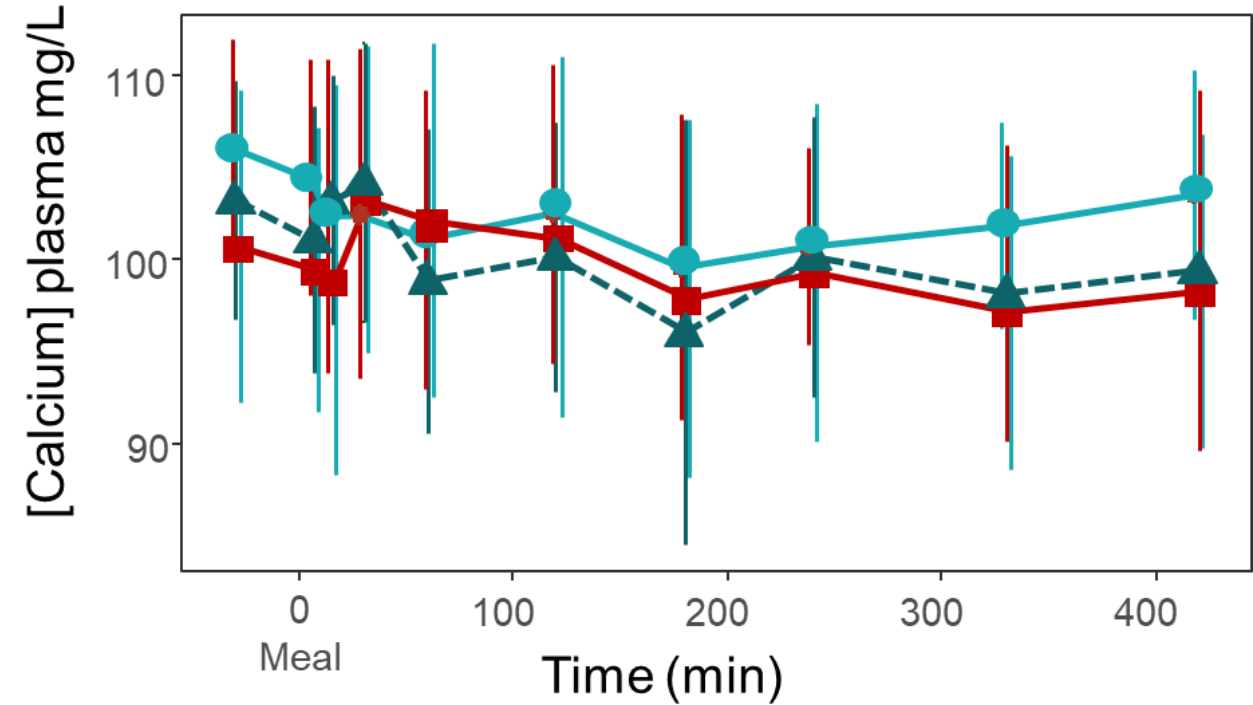
Test meals



Blood samples

from 30 min before to 7h after meal ingestion

6 canulated and
catheterized pigs



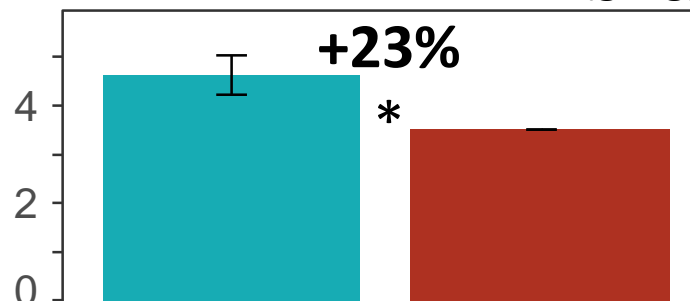
[Calcium] in plasma is highly stable

Both calcium sources allow to provide bioavailable calcium

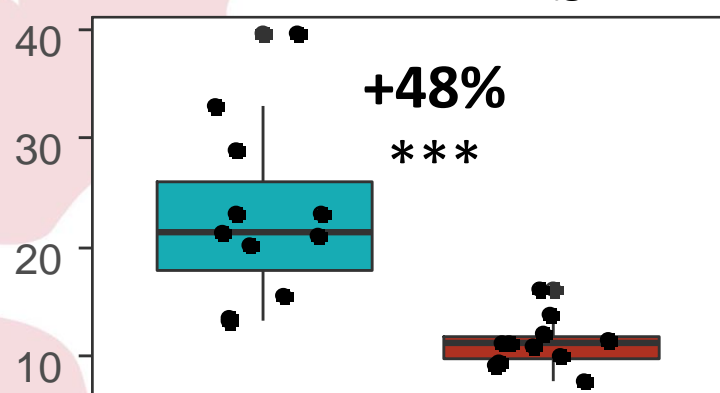
Needs long-term studies for possible consequences on bone health

Leucine bioavailability

Cheese leucine content (g/Kg)

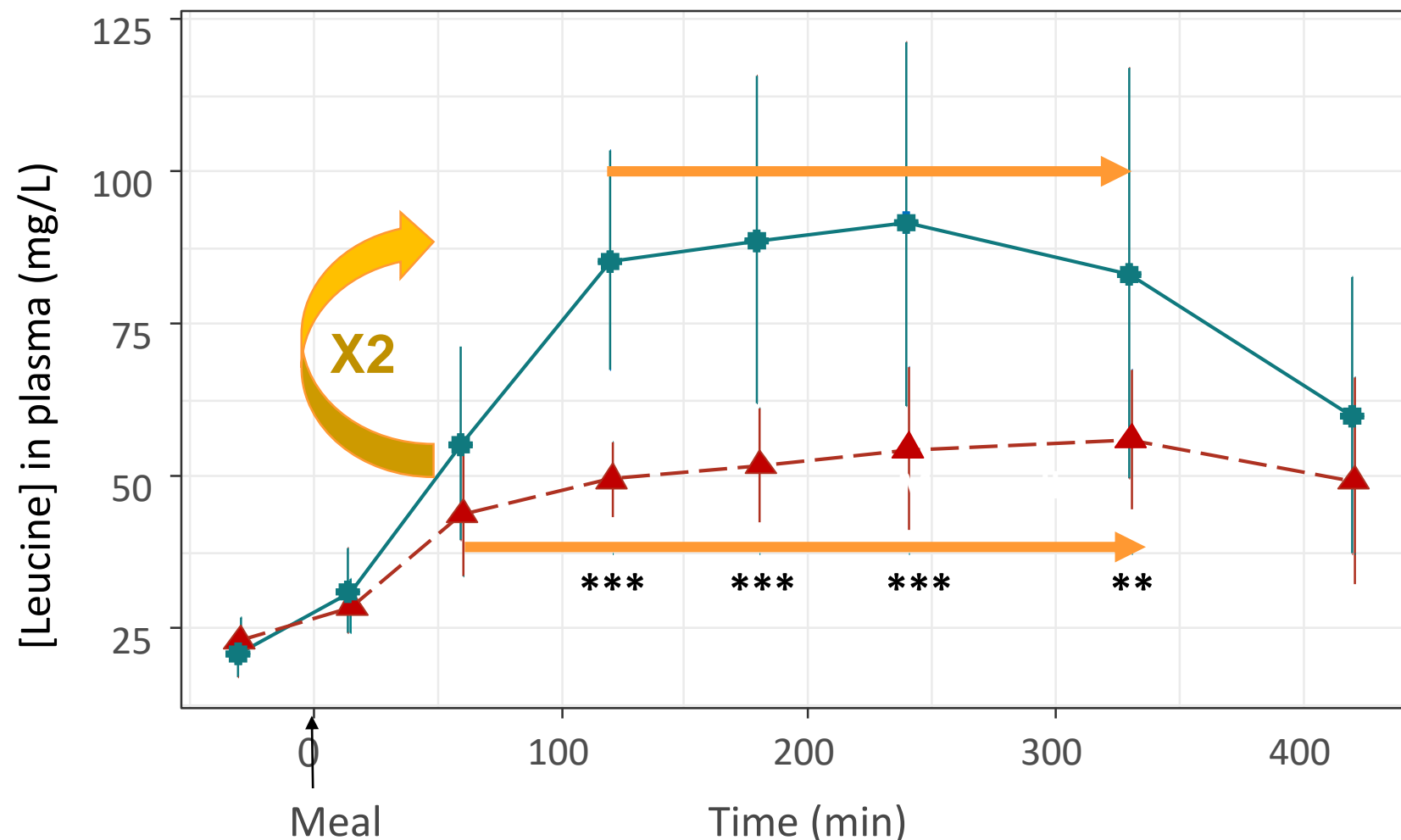


Area under the curve (g/L/min)

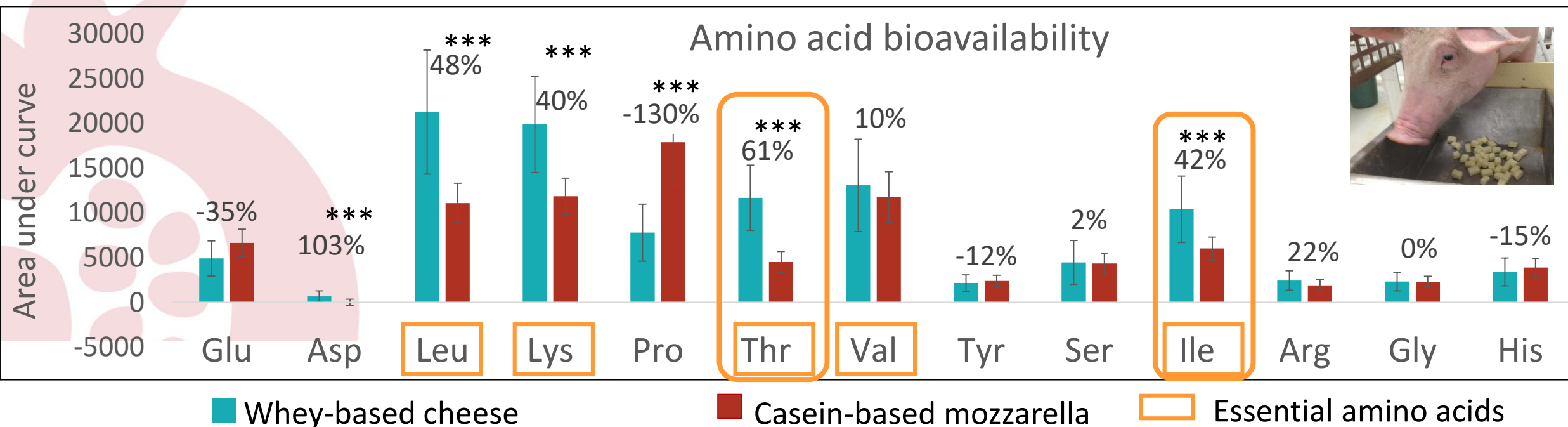
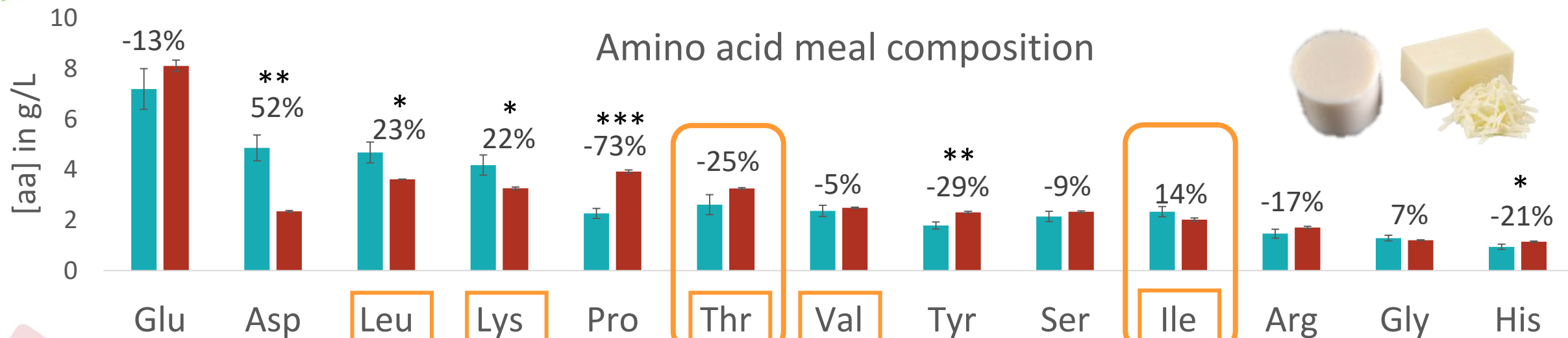


Whey-based
cheese

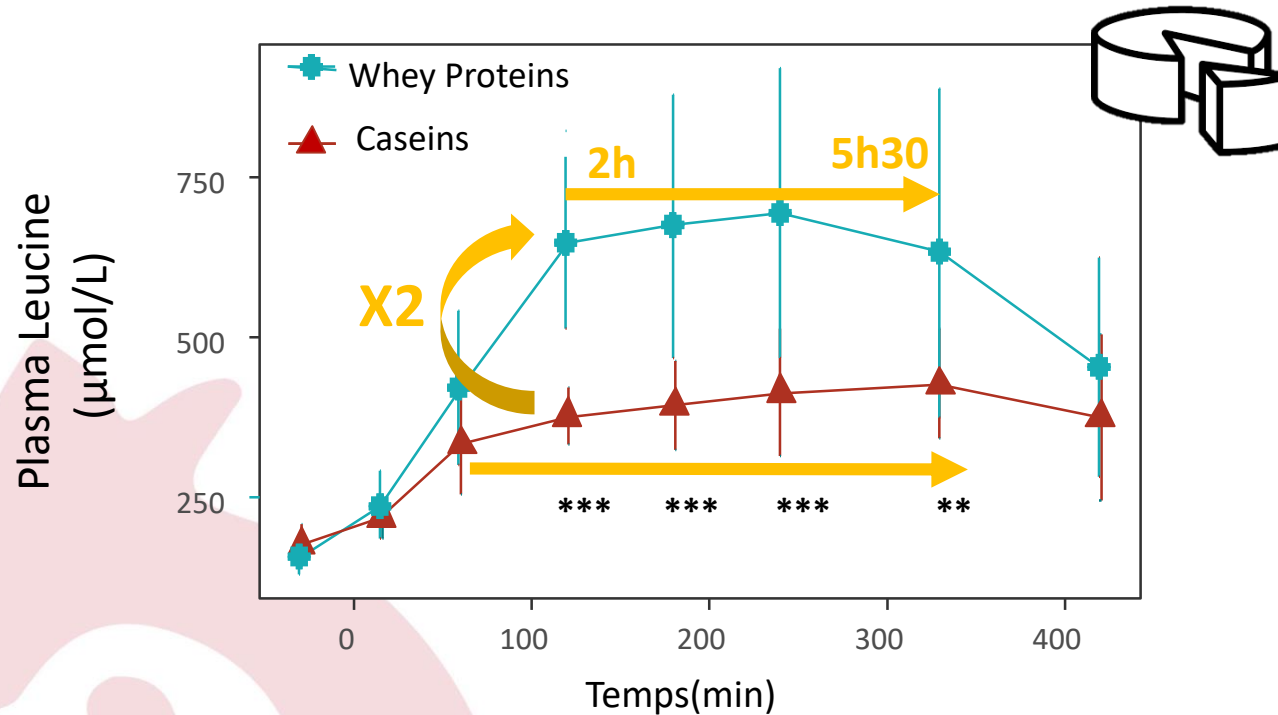
Casein-
based
mozzarella



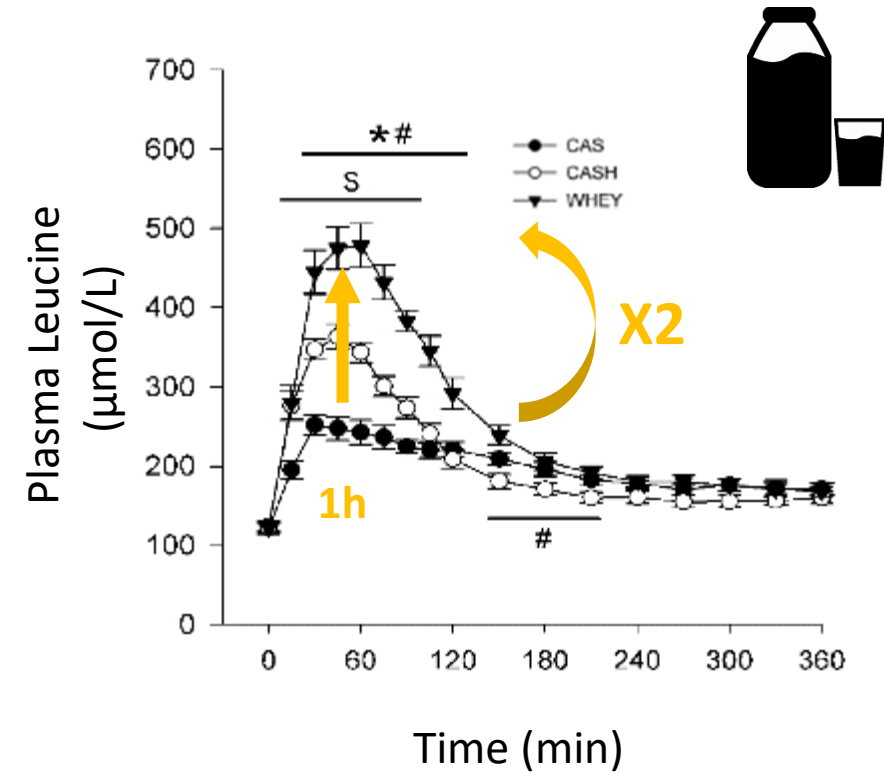
Leucine Bioavailability
Whey-based cheese > Casein-based Mozzarella



Amino acid bioavailability for solid foods



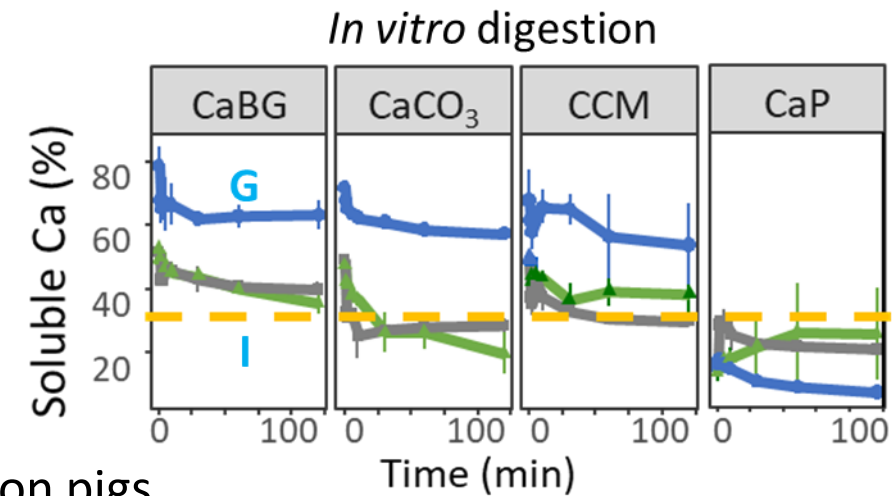
Lorieau *et al.* 2018



In elderly people (~74 y)
Pennings *et al.*, 2011

👉 **Our data confirm those previously obtained on elderly for liquid samples**

Conclusion & perspectives



No differences in Ca bioavailability were seen during the *in vivo* study on pigs

Whey-based cheeses allowed to increase Leu bioavailability

The differences between casein and whey-based cheeses could be due difference in kinetics of digestion. This could result in the selective sequestration of some AA by the splanchnic area ? Or be due to oxidation of some AA before and after absorption???

In the future, we would like to determine:

if other sources of calcium can increase its bioavailability

how the hardness and humidity of the bolus will affect digestion in elderly

if the whey-based cheeses really allow to restore muscle synthesis in elderly



Further readings

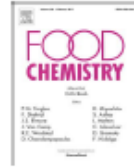
Food Chemistry 245 (2018) 454–462



Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem



Bioaccessibility of four calcium sources in different whey-based dairy matrices assessed by *in vitro* digestion

Lucie Lorieau^a, Linda Le Roux^a, Frédéric Gaucheron^a, Amandine Ligneul^b, Etienne Hazart^b, Didier Dupont^a, Juliane Floury^{a,*}



Food Research International 111 (2018) 31–38



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Bolus quality and food comfortability of model cheeses for the elderly as influenced by their texture

L. Lorieau^a, C. Septier^b, A. Laguerre^b, L. Le Roux^a, E. Hazart^c, A. Ligneul^c, M.-H. Famelart^a, D. Dupont^a, J. Floury^a, G. Feron^b, H. Labouré^{d,*}



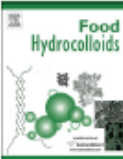
Food Hydrocolloids 82 (2018) 399–411



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Impact of the dairy product structure and protein nature on the proteolysis and amino acid bioaccessibility during *in vitro* digestion

L. Lorieau^a, A. Halabi^a, A. Ligneul^b, E. Hazart^b, D. Dupont^a, J. Floury^{a,*}



Food Chemistry 277 (2019) 63–69



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Whey-based cheese provides more postprandial plasma leucine than casein-based cheese: A pig study

Lucie Lorieau^a, Yann Le Gouar^a, Gwenaëlle Henry^a, Ting Ting Mao^a, Amandine Ligneul^b, Etienne Hazart^b, Didier Dupont^a, Juliane Floury^{a,*}



In preparation:

- Lorieau L., Septier C., Laguerre A., Le Roux L., Hazart E., Ligneul A., Dupont D., Floury J., Vigneau E., Hanafi M., Feron G., & Labouré H.
The influence of oral health of the elderly on the bolus formation and food comfortability of model cheeses.



Juliane Floury
Lucie Lorieau



Gilles Feron, Hélène Labouré

And all the Bioactivity & Nutrition group



Human volunteers



Etienne Hazart
Amandine Ligneul



And the pigs!!!