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## Optimization of protein intake in the elderly beyond the amino acid composition. What is the positioning of plant proteins and under what conditions?

Isabelle Savary-Auzeloux, Laurent Mosoni, Marie-Agnès Peyron, Sergio Polakof, Didier Remond, Dominique Dardevet

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# Optimization of protein intake in the elderly beyond the amino acid composition.

## What is the positioning of plant proteins and under what conditions?

Dominique Dardevet, Isabelle Savary-Auzeloux, Laurent Mosoni, Marie-Agnès Peyron, Sergio Polakof, Didier Rémond.

**INRAE**  
science for people, life & earth

**UnH**  
Unité de Nutrition Humaine



# Protein Nutrition: The Basics

- To fulfill the body's requirements for amino acids
- To cover the need for all essential amino acids
- If the minimal requirement for a single essential amino acid is not covered  
= Negative impact on the optimal use of all other amino acids



Recommended Daily  
Allowance (RDA)  
at 0.83g/kg BW/day

Healthy adult population

The recommendation is based if the dietary protein is of good quality

# The FAO has elaborated the composition of the ideal dietary protein in term of essential amino acid composition

i.e the protein that will cover the requirement of all EAA when ingested at 0.83 g.kg.day in healthy human above 5yo

Amino Acid	HIS	ILEU	LEU	LYS	CYS + MET	TYR + PHE	THR	TRP	VAL
mg/g of dietary protein	16	30	61	48	23	41	25	6.6	40

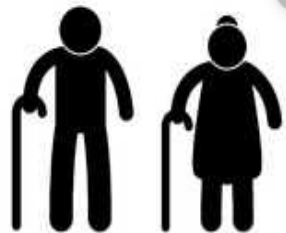
# Protein Nutrition: The Basics

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**Recommended Daily Allowance (RDA)**  
**0.83**

**Healthy adult population**



**Recommended Daily Allowance (RDA)**  
**1 to 1.2**

**Healthy elderly population**

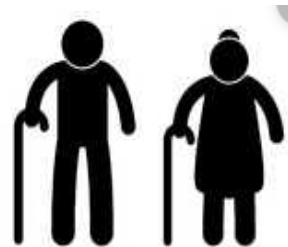
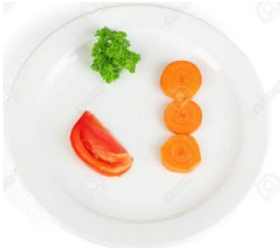
# Protein Nutrition: The Basics

Increasing protein intake and more generally an increase in food intake in such population could be difficult to achieve

Loss of Appetite /Undernutrition

Protein palatability

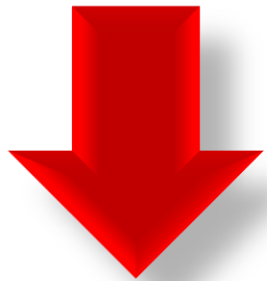
Urea production and clearance



Recommended Daily Allowance (RDA)  
1 to 1.2

Healthy elderly population

**The quality of a dietary protein in elderly should take into account more than just its amino acid composition**



**in order to constrain as much as possible the increase in protein consumption while ensuring the coverage of the need for each AA**

**Equilibrated proteins but also with specific amino acids**

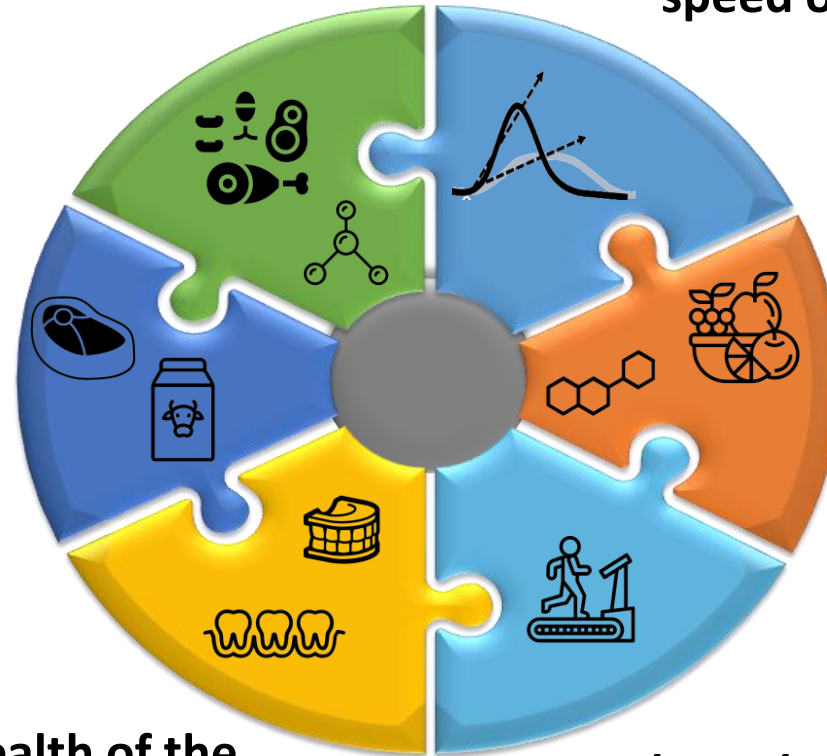
**Digestibility and digestion speed of dietary proteins**

**Food matrix**

**Timing and Interaction with other nutrients in the meal**

**Oral health of the target population**

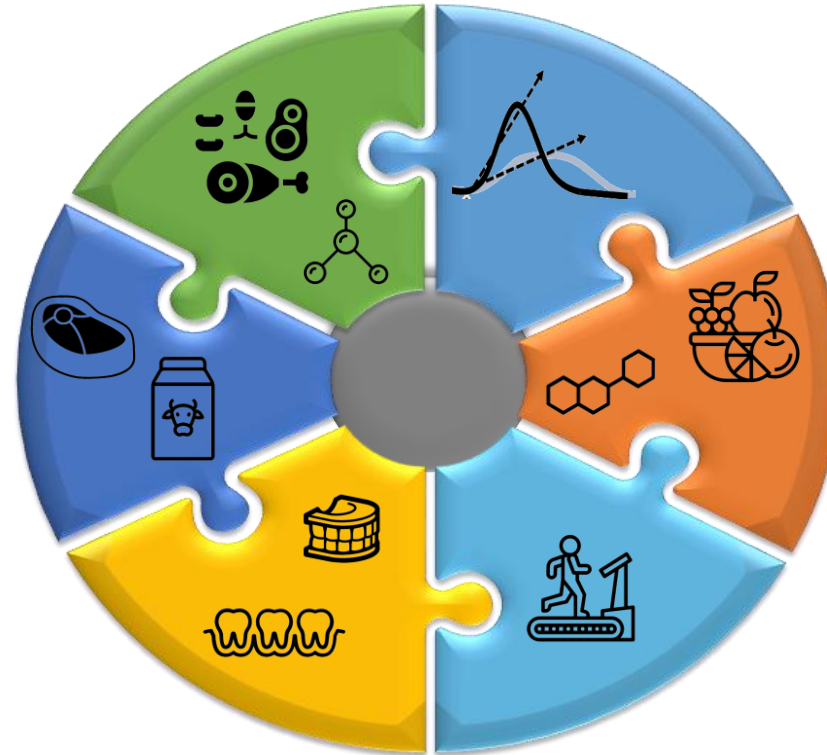
**Adapted physical activity**



Efficient at a  
RDA of  
0.83 instead of  
1.0 g.kg.d



Equilibrated proteins  
but also with  
specific amino acids



- ✓ Efficient if 100% of the dietary proteins are whey proteins
- ✓ In supplementation, it remains non optimal





RDA is based on a dietary protein which is 100% digested

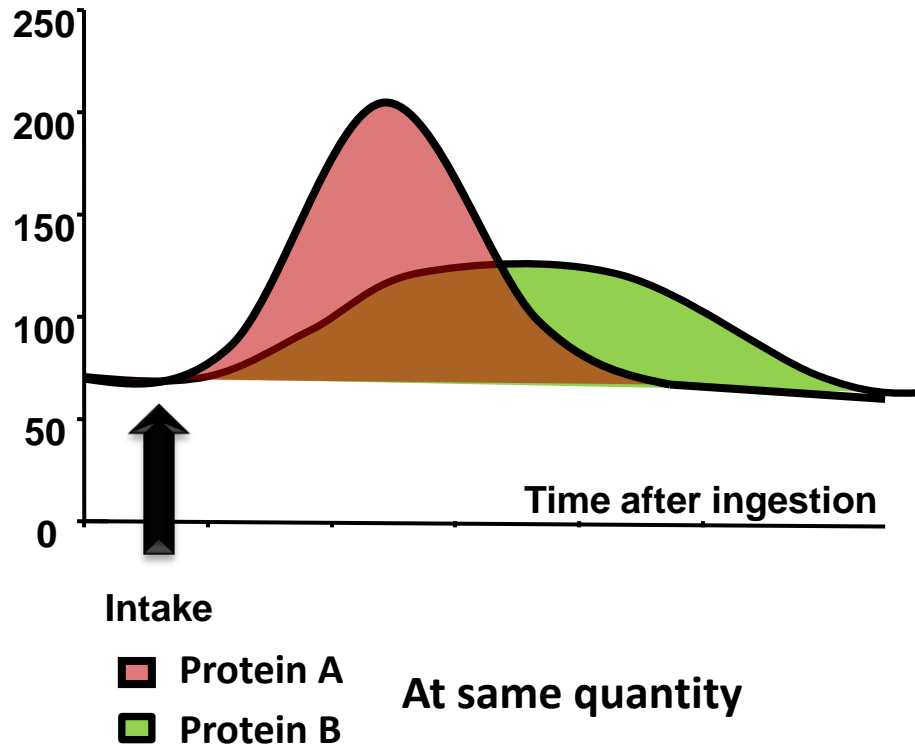


✓ Favor highly digested dietary proteins in elderly

Digestibility and digestion speed of dietary proteins



## Plasma aminoacids ( $\mu\text{M}$ )



**Digestibility and digestion speed of dietary proteins**

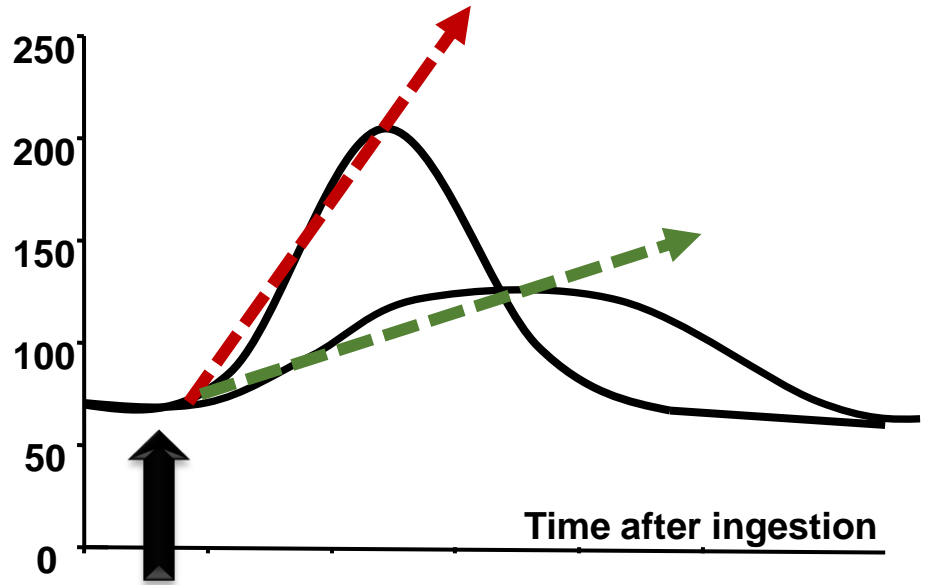


**AUC after ingestion is similar**



**Same digestibility so  
Same bioavailability**

### Digestion speed ( $\mu$ moles per min)



Intake

- Protein A
- Protein B

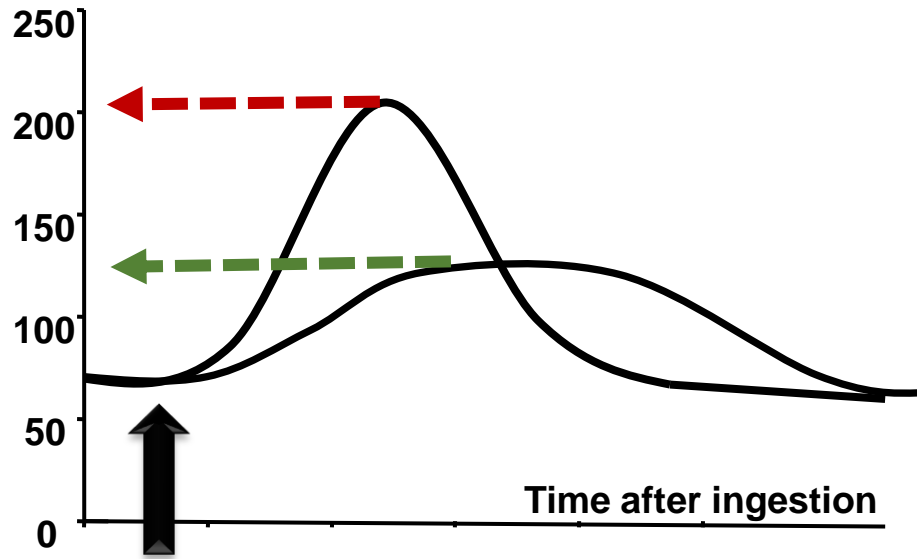
At same quantity

### Difference in digestion speed

### Digestibility and digestion speed of dietary proteins



### Max AA concentration ( $\mu\text{M}$ )



Intake

- Protein A
- Protein B

At same quantity

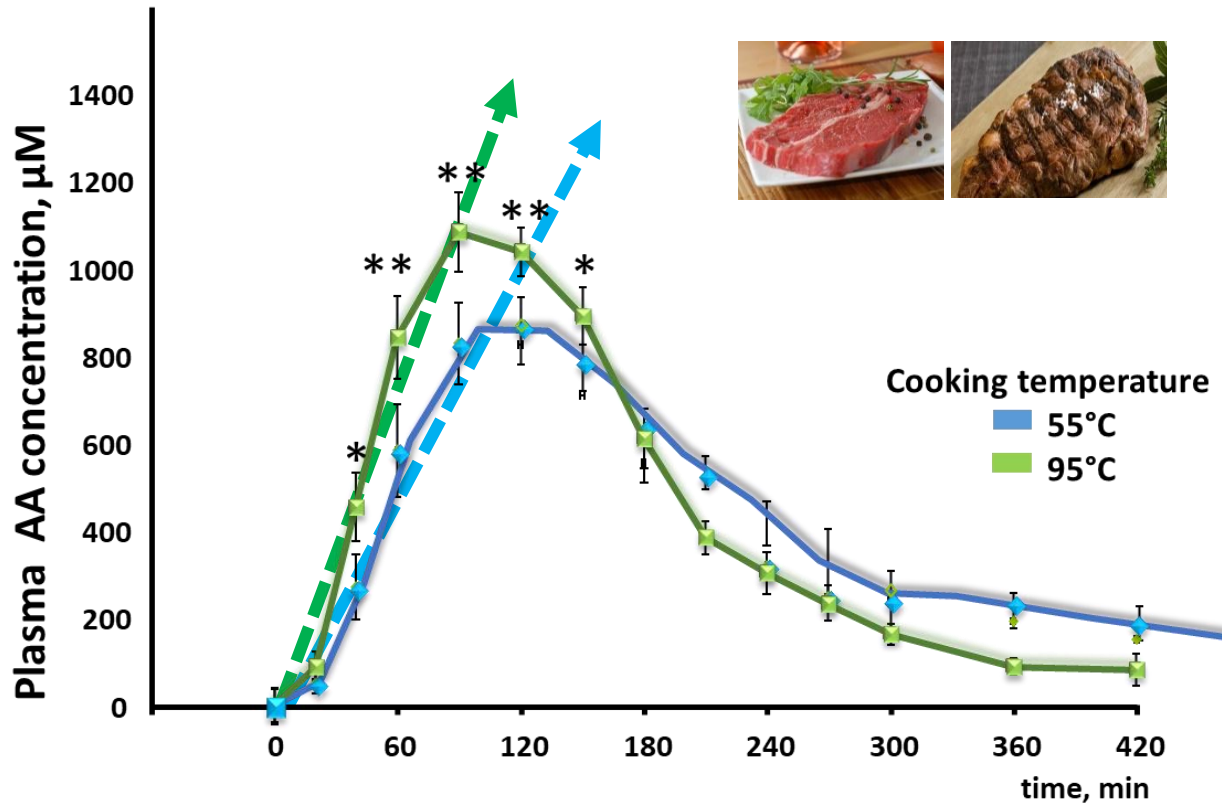
**Digestibility and digestion speed of dietary proteins**



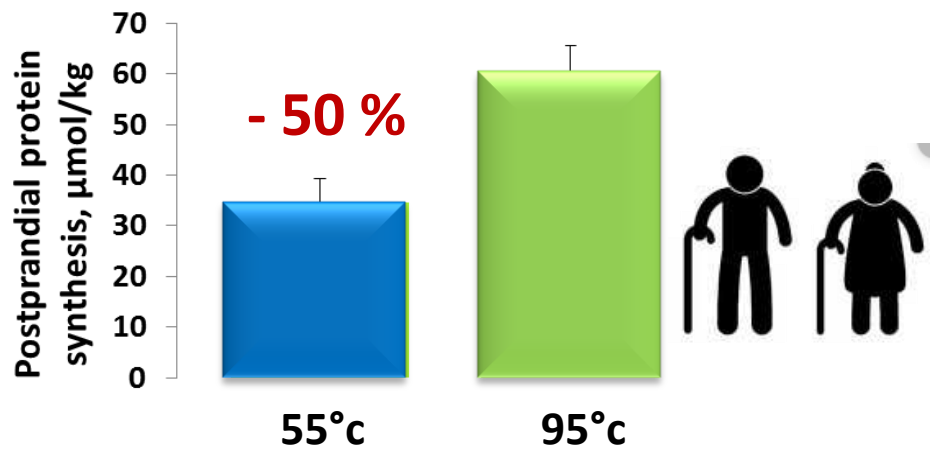
**Difference in digestion speed**



**Difference in the maximal plasma AA concentration**



## Digestibility and digestion speed of dietary proteins



# To be efficient anabolically 30+ g of dietary proteins in the meal

## Non undernourished elderly population

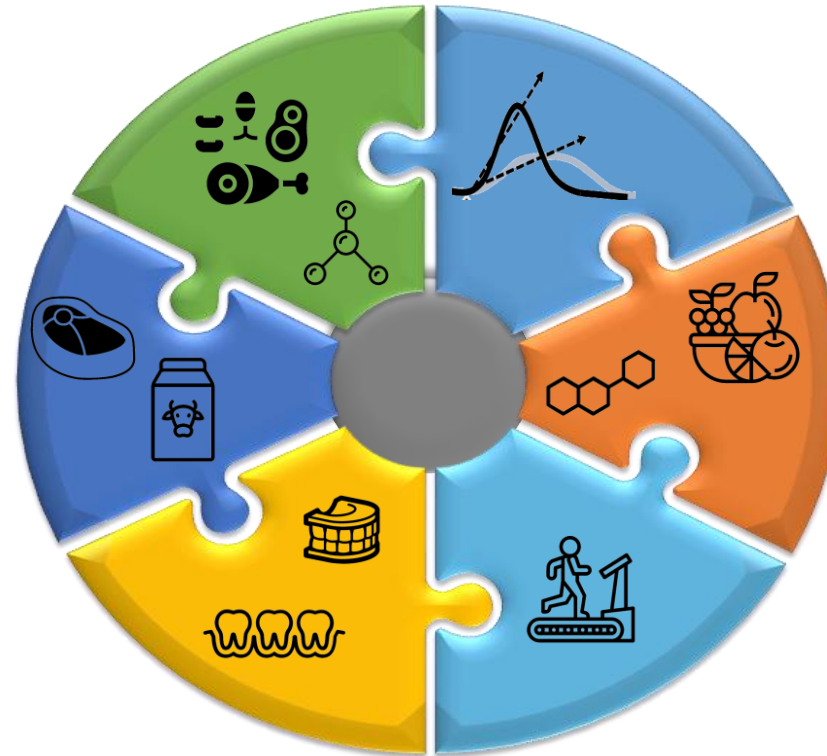
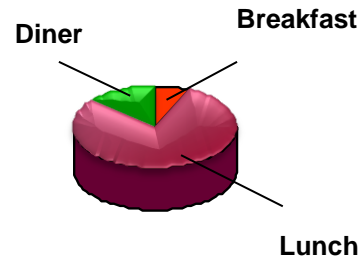
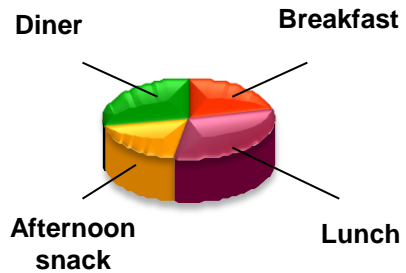


Arnal MA et al. 1999, 2000a, 2000b, 2002

Spread intake of dietary proteins



Bolus intake of dietary proteins



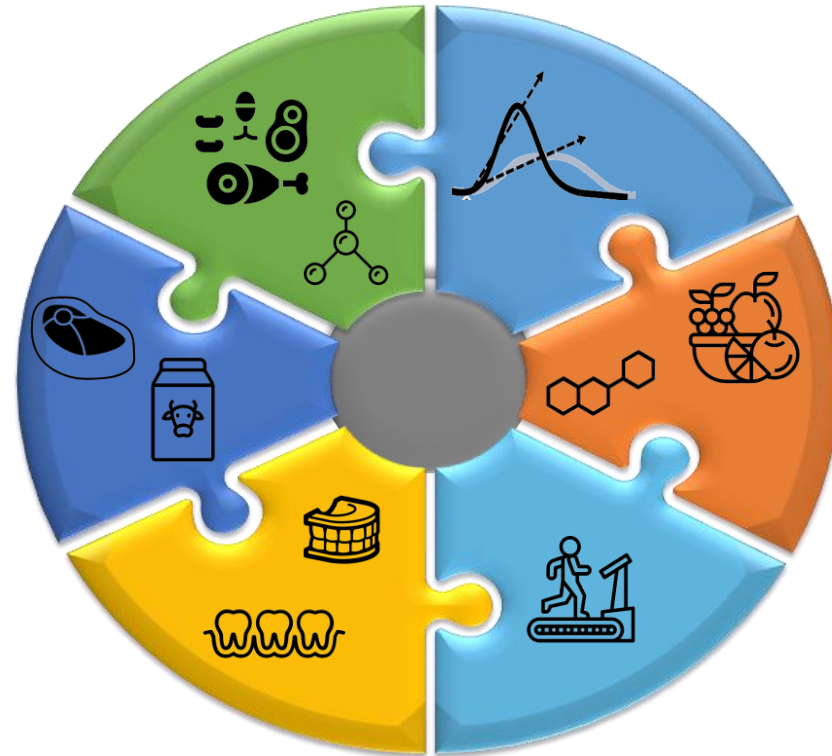
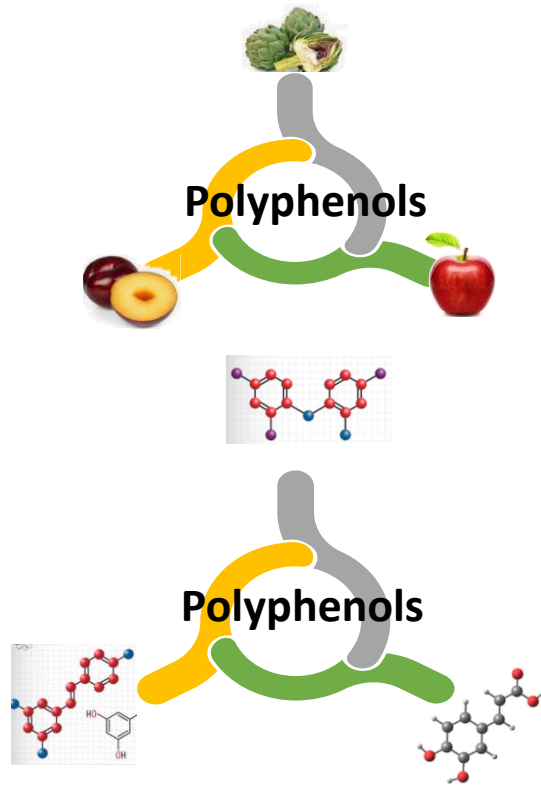
**Timing and Interaction with other nutrients in the meal**

## Undernourished elderly population

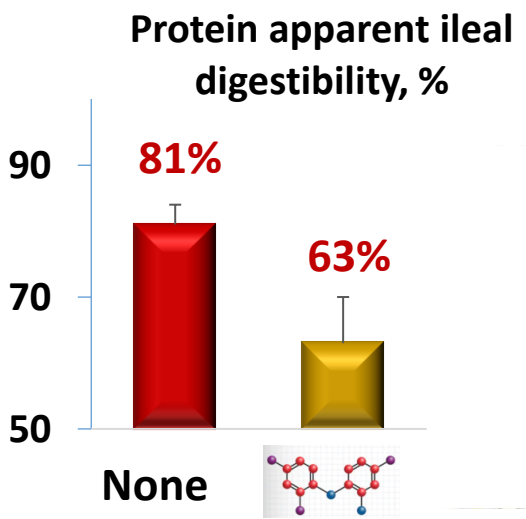
Bouillanne O et al. 2013, 2014

**Meal :**  
beef meat,  
starch,  
oil

**+**  
**or**



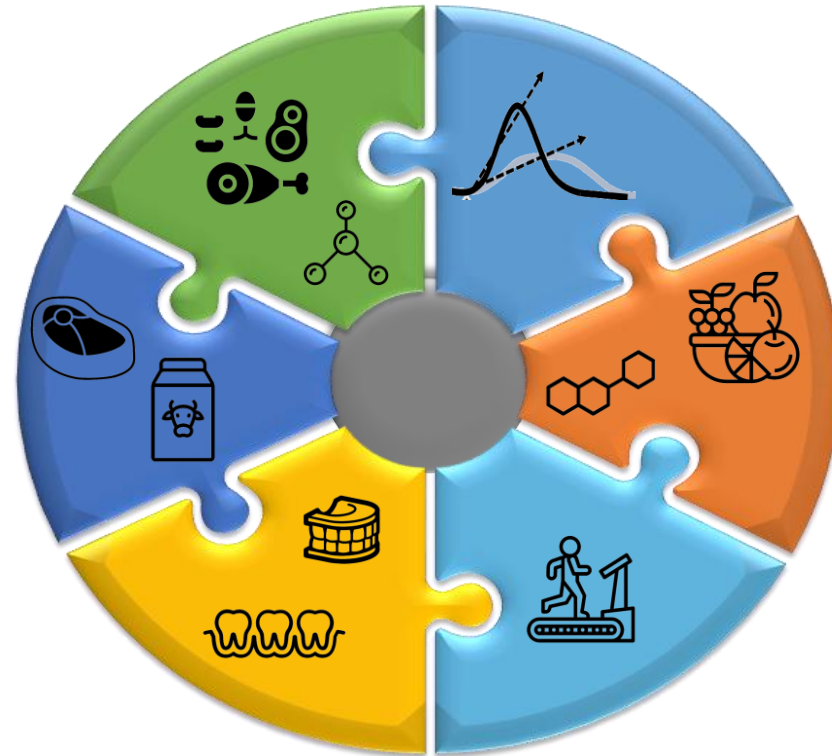
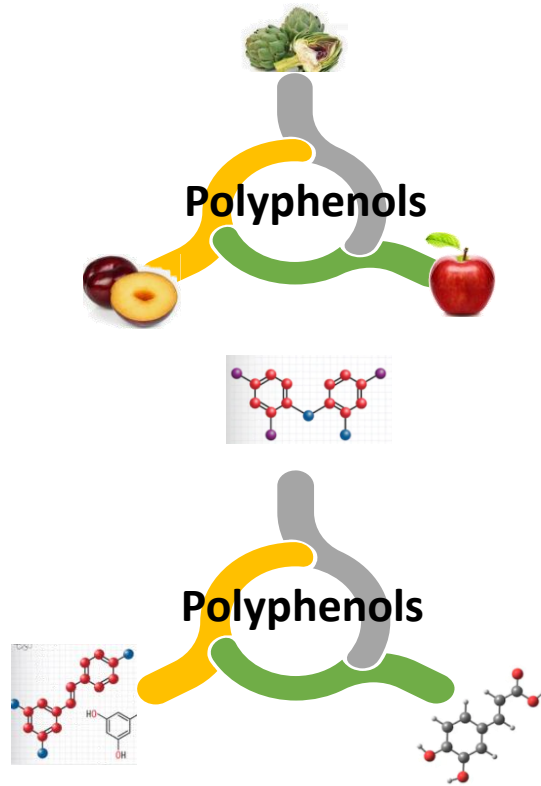
**Timing and  
Interaction with  
other nutrients  
in the meal**



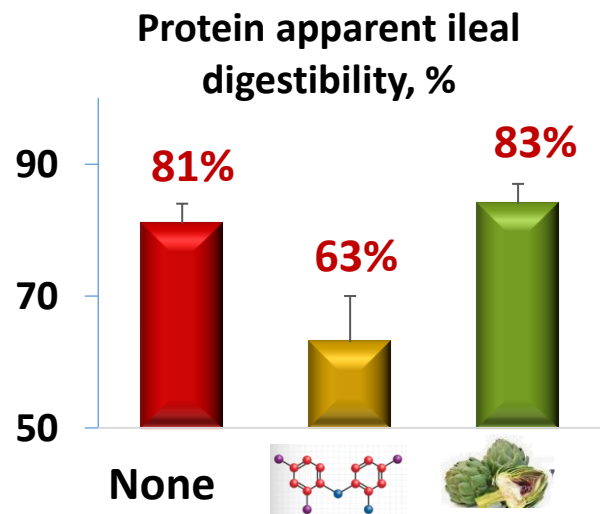
**Meal :**  
beef meat,  
starch,  
oil

+

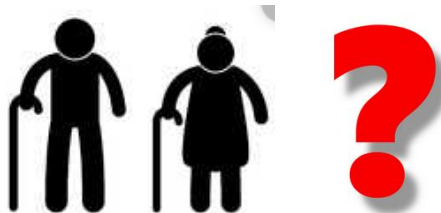
or



**Timing and  
Interaction with  
other nutrients  
in the meal**



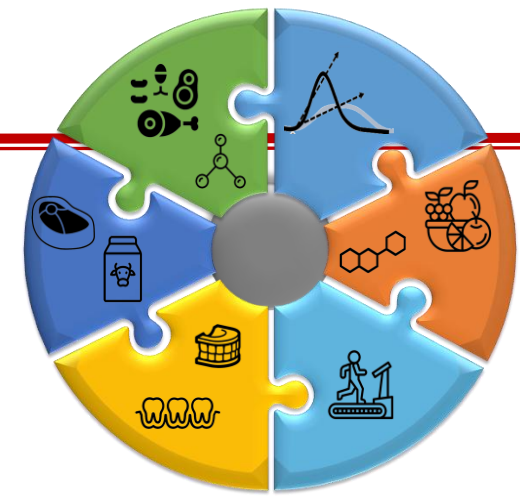
**Anti oxidant  
supplement with  
purified plant  
bioactives?**





# Plant Proteins in Older Adults?

Equilibrated proteins but also with specific amino acids

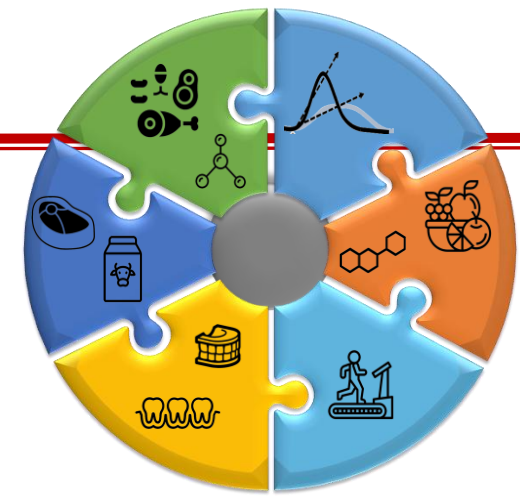




Amino Acid	HIS	ILEU	LEU	LYS	CYS + MET	TYR + PHE	THR	TRP	VAL
mg/g of dietary protein	16	30	61	48	23	41	25	6.6	40
<b>Animal</b>	<b>24</b>	<b>63</b>	<b>88</b>	<b>70</b>	<b>58</b>	<b>99</b>	<b>51</b>	<b>16</b>	<b>68</b>

# Plant Proteins in Older Adults?

Equilibrated proteins but also with specific amino acids

In general, plant proteins are not optimal in their EAA composition



Amino Acid	HIS	ILEU	LEU	LYS	CYS + MET
mg/g of dietary protein	16	30	61	48	23
<b>Animal</b>	24	63	88	70	58
	23	43	68	75	19
	27	37	125	27	35



RDA  
0.83

1.00

1.47

RDA  
1.00

1.20

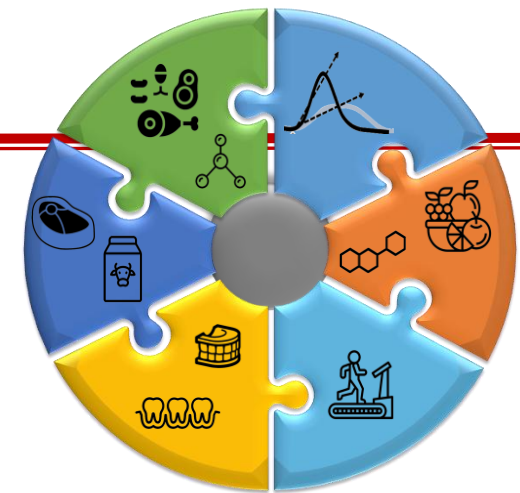
1.77



# Plant Proteins in Older Adults?

Equilibrated proteins but also with specific amino acids

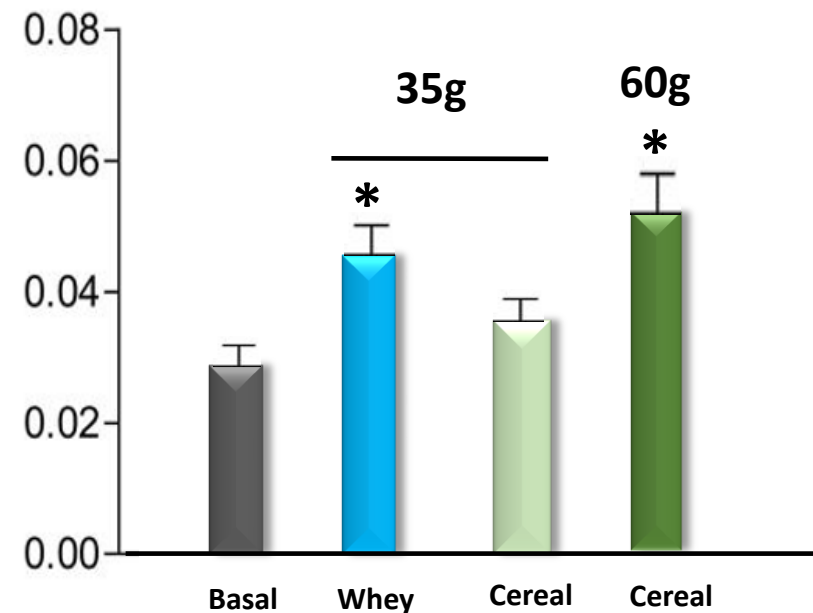
In general, plant proteins are not optimal in their EAA composition

Gorissen SH J Nutr. 2016



Amino Acid	HIS	ILEU	LEU	LYS	CYS + MET
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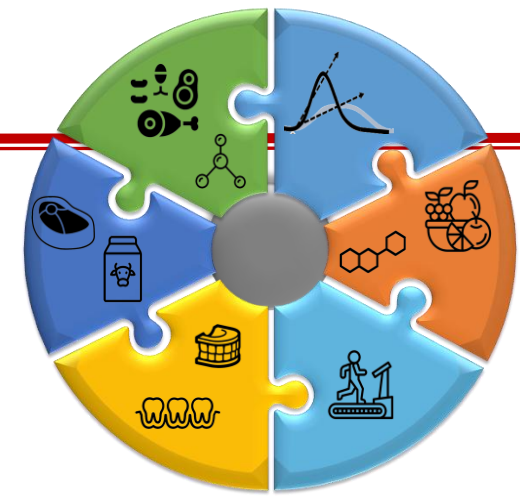
## Older Adult Anabolic effect





# Plant Proteins in Older Adults?

Equilibrated proteins but also with specific amino acids

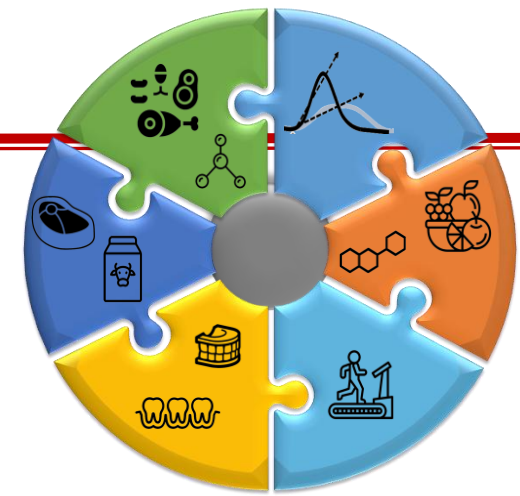
Solution is to combine pulse and cereal protein sources



Amino Acid	HIS	ILEU	LEU	LYS	CYS + MET
mg/g of dietary protein	16	30	61	48	23
<b>Animal</b>	24	63	88	70	58
 50%  50%	25	40	96	51	27,5

**There are other limiting factors associated with plant protein sources**

# Plant Proteins in Older Adults?

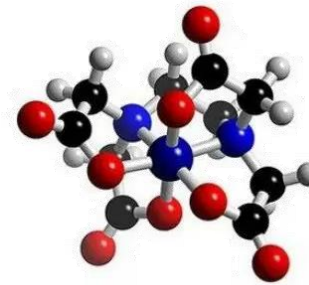


**Digestibility: Lower than for animal proteins because**

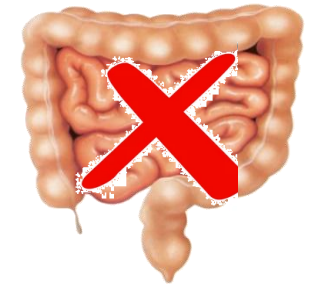
■ **Seed matrix**



■ **Intrinsic protein properties**



■ **Presence of anti nutritional factors (phytic acid, anti trypsin factor ....etc )**



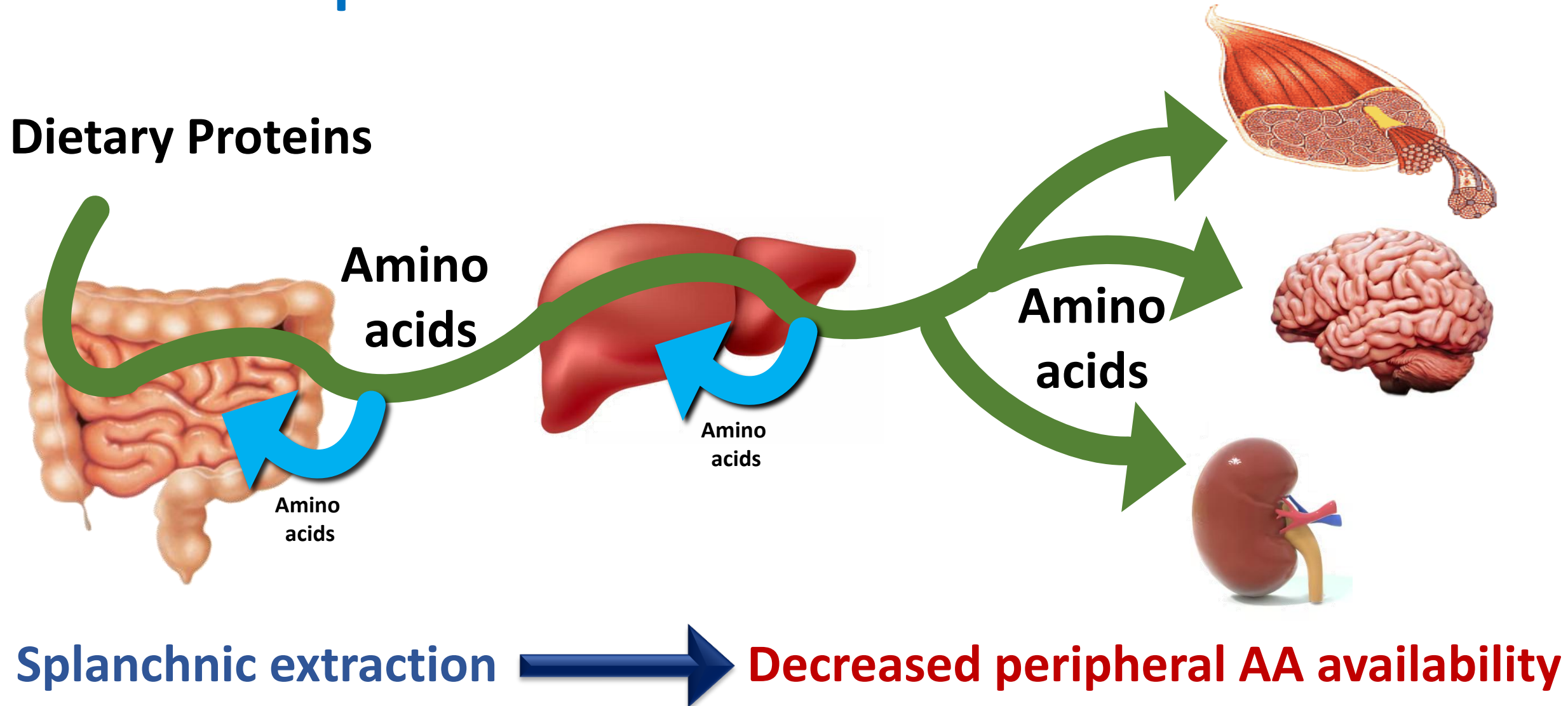
■ **Processes of protein fraction production**

Corn or potato protein concentrate were digestible only at 50%



# Plant Proteins in Older Adults?

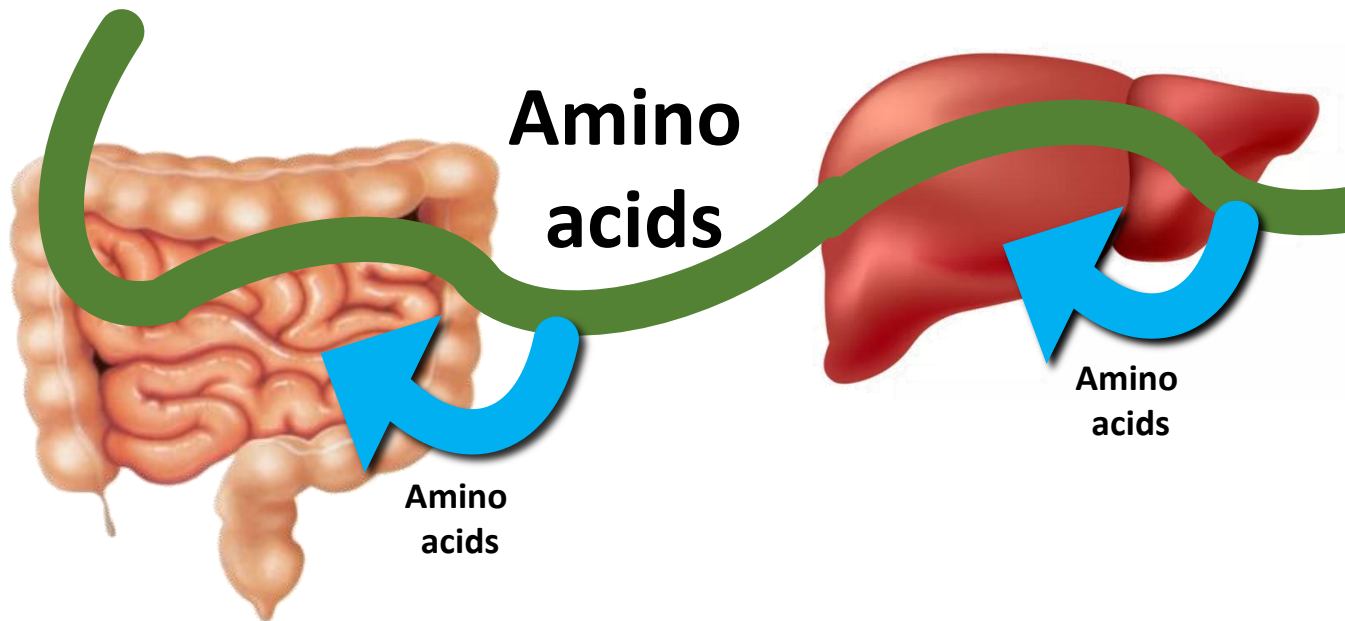
## Splanchnic extraction of EAA



# Plant Proteins in Older Adults?

## Splanchnic extraction of EAA

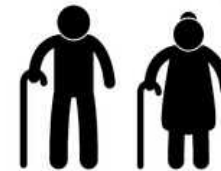
Dietary Proteins



Splanchnic extraction



Splanchnic extraction of AA is higher with plant proteins than with animal proteins (Fouillet 2002, 2009; Van Vliet, 2015)



Splanchnic extraction of AA is higher in older adults than in adults (Boirie 1996, Volpi 1998)

**Further increase of protein intake in elderly with a plant protein diet**

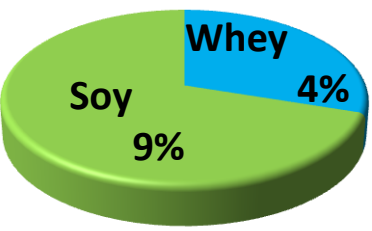
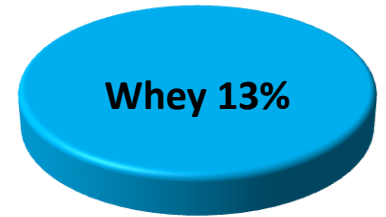
**Diet with 100% of « green » proteins would be quantitatively too important and difficult to sustain in older adults**

# Mix between animal and plant proteins is the solution?

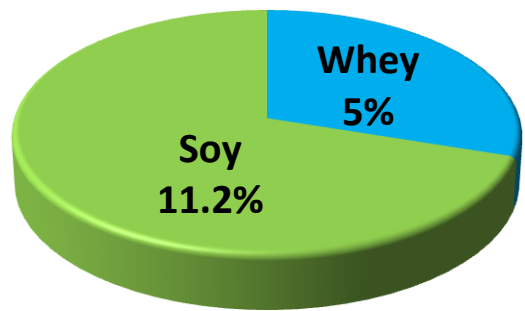
Anabolic response



Old rats



**+25%**  
**Protein intake**

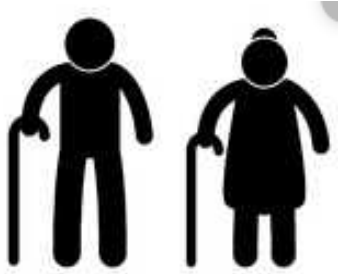


13%

16.5%



# Message(s) to take home



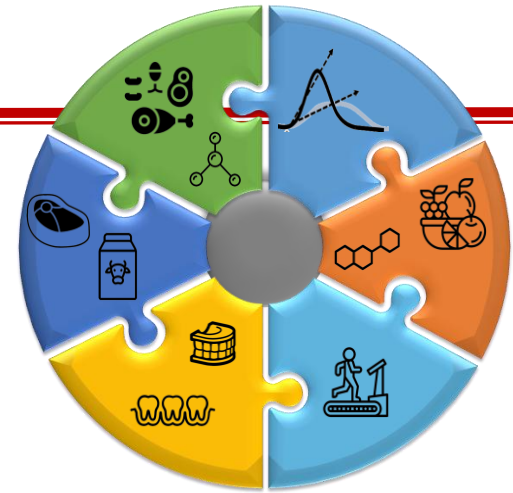
## In older adults,

- Protein nutrition is key and more than just their amino acid composition has to be taken into account

- The determinants associated with all the dimensions of protein quality have to be taken into account much more with the vegetarianization of dietary proteins

- However, « greening » significantly dietary proteins in older adults is possible but with some cautions and it should be supervised and followed

- In protein nutrition, an ally to optimize and constrain the increase of protein intake could be a program of adapted physical activity





**Thank you for your  
attention**



# Optimiser l'apport protéique mais une fois consommées?

## SOURCES OF Plant PROTEINS

GET HEALTHY



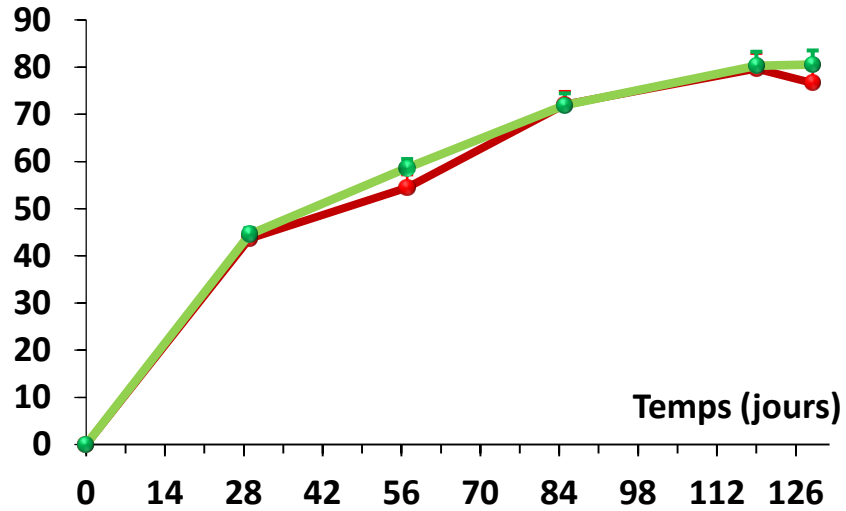
ProVegOmicS

## Au delà de la fraction protéique.. Métabolisation des protéines végétales données au besoin

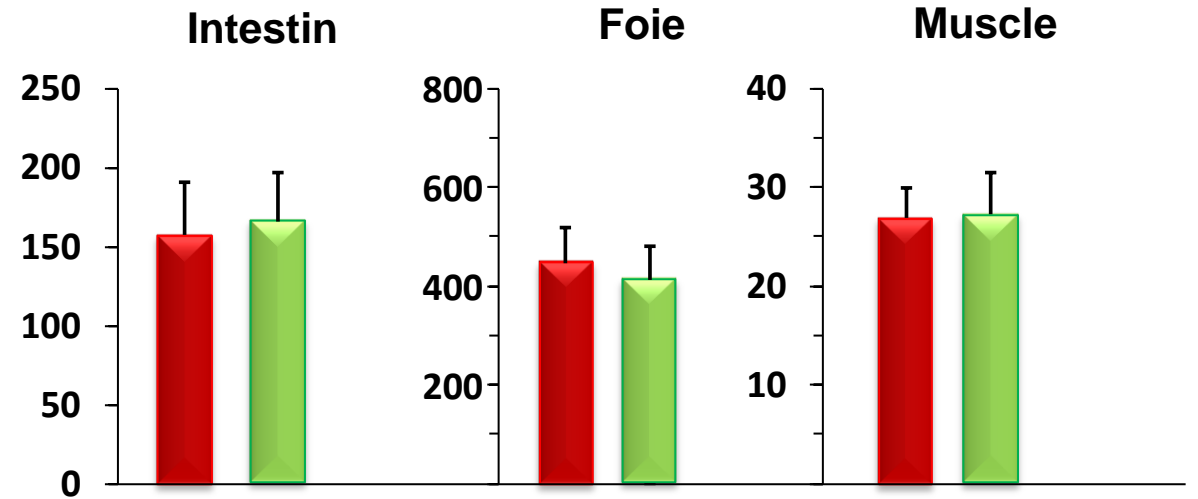
	Animal g/kg	Végétal g/kg
Protéines de lait	150	Protéines de pois 75 Protéines de blé 75
Energie (kcal/kg)	4 044	Energie (kcal/kg) 4 068
	% Energie	% Energie
Protéines	15%	Protéines 15%
Glucides	58%	Glucides 59%
Lipides	27%	Lipides 27%

# Optimiser l'apport protéique mais une fois consommées?

## Masse maigre (%)

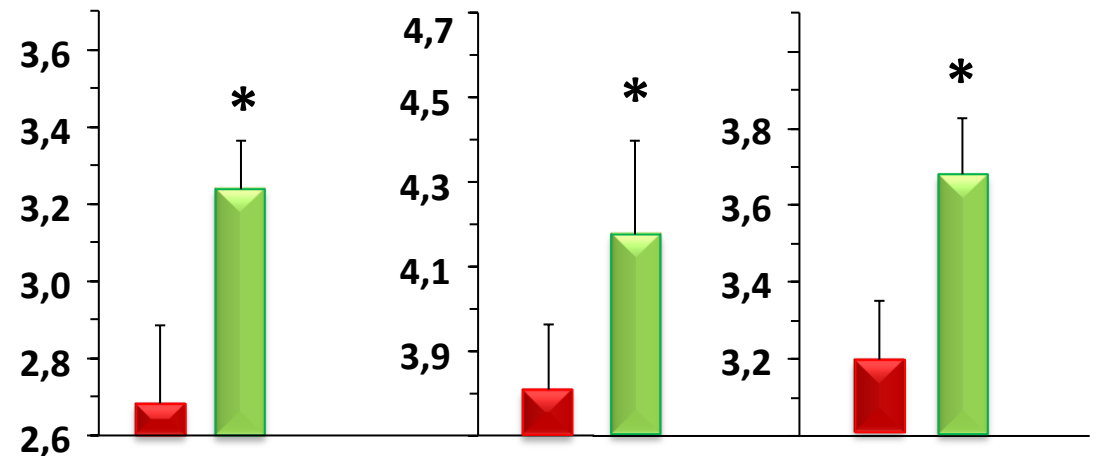


## Masse protéique (mg N)

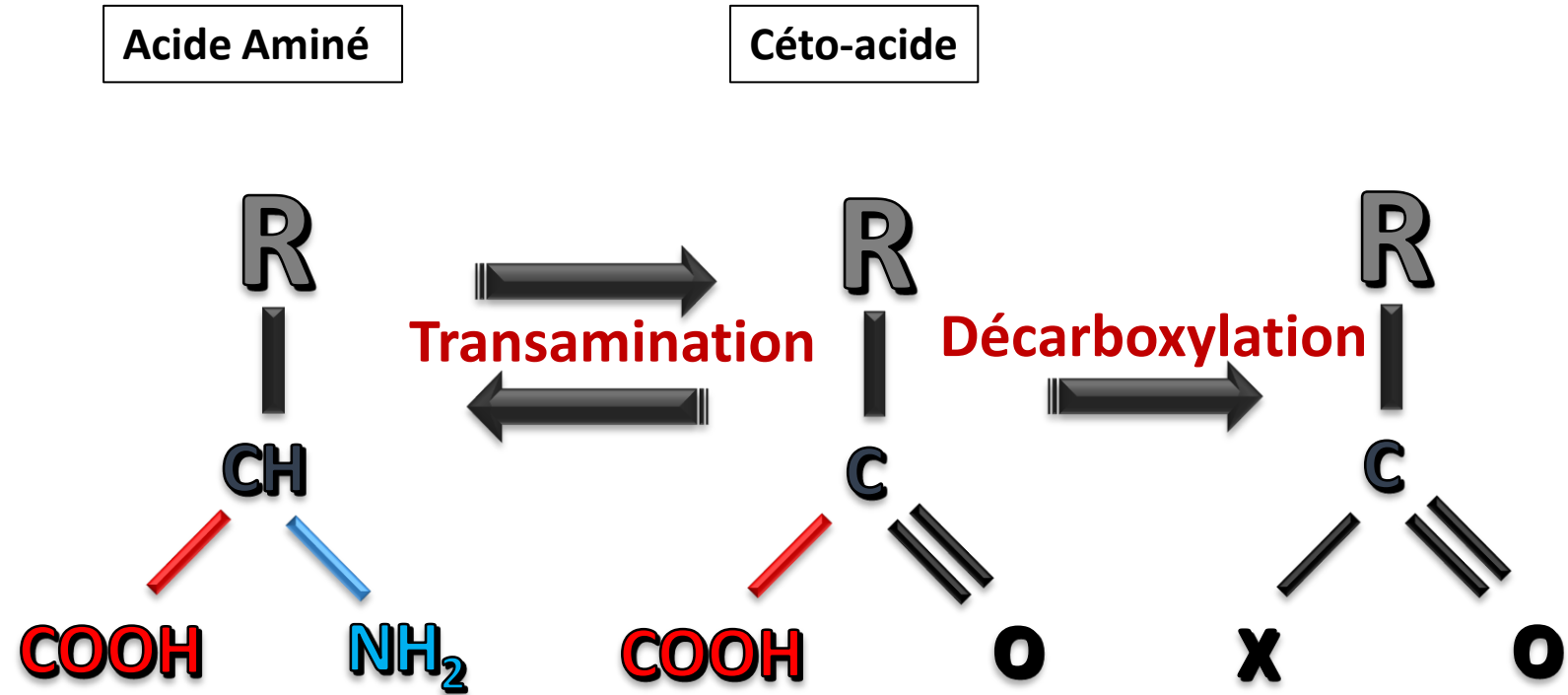


**Et alors?**

## Transamination



# Optimiser l'apport protéique mais une fois consommées?

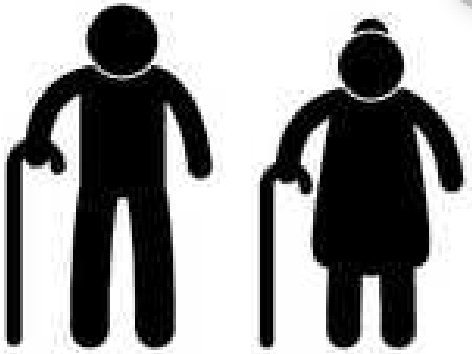
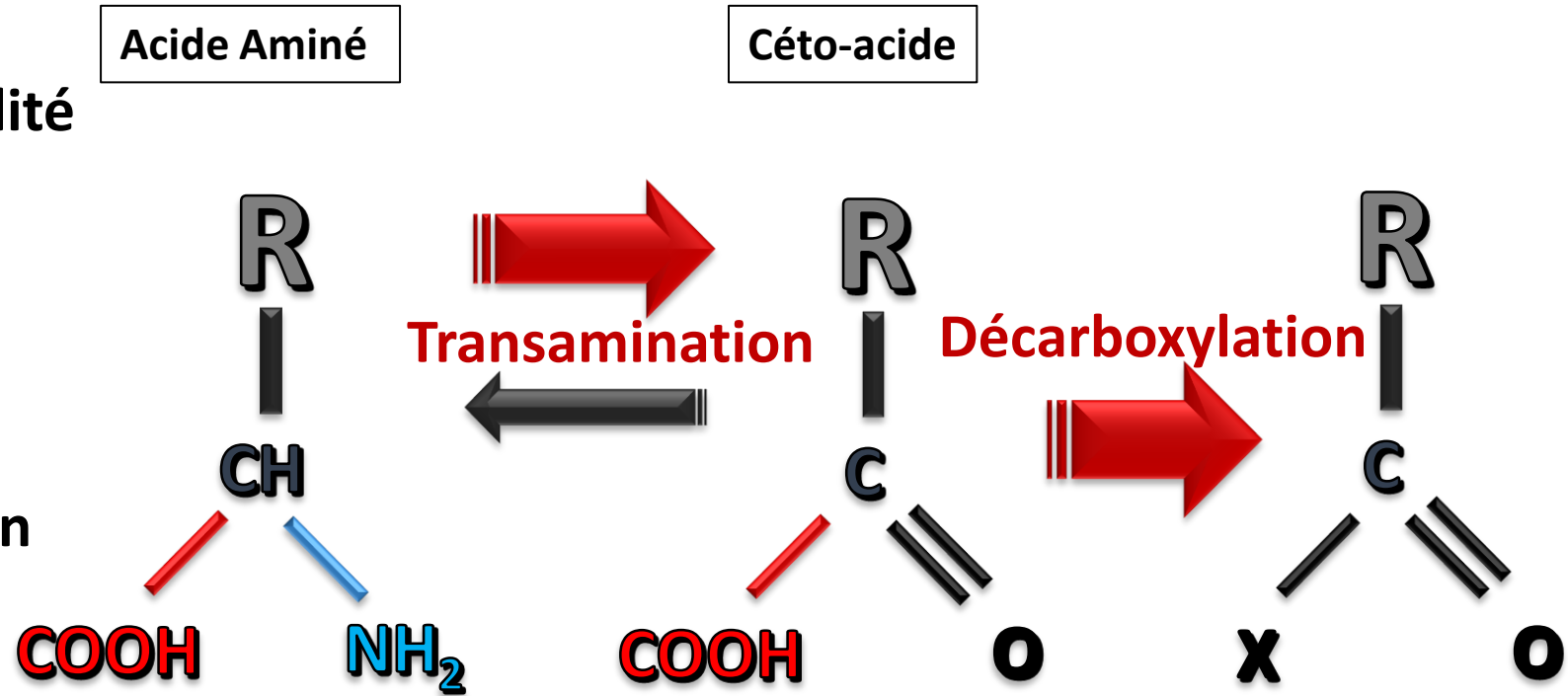


Avec un régime protéines végétales



# Optimiser l'apport protéique mais une fois consommées?

- Diminution de la biodisponibilité en AA ?
- Augmentation de la dépense énergétique ?
- Augmentation de la production d'urée ?



Avec un régime «protéines végétales »





