In vitro digestion of protein-rich dairy products in the ageing gastrointestinal tract

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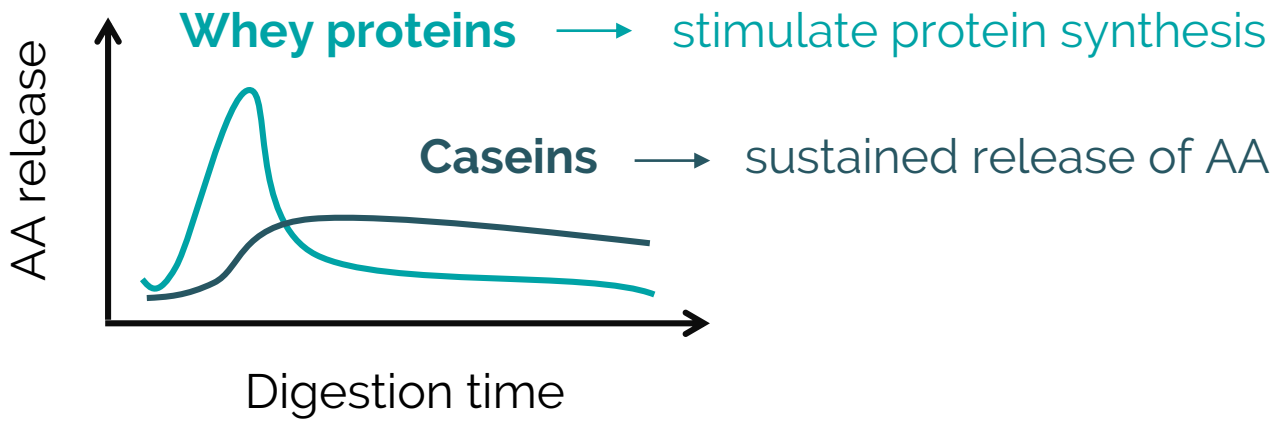
Insufficient protein intake may lead to sarcopenia, characterized by the loss of muscle mass, strength, and function.

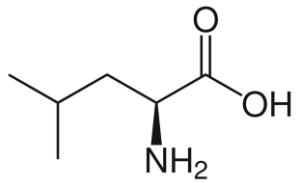
Older adults > 65 years old need to increase the amount of high-quality proteins in their diet: at least 1 g protein /kg body weight /day.

Ageing leads to changes in the functionality of the digestive tract but the impact of ageing on digestion, and absorption of nutrients is still unclear.

Milk proteins are interesting to promote muscle health: contain all the essential amino acids and have very high digestibility ratings.

Synergistic effect between caseins and whey proteins in milk to sustain the anabolic requirements during the whole postprandial period.





Leucine

Investigate *in vitro* the influence of age on the rate and extent of proteolysis of high-protein dairy products.

High-protein (10% w/w) dairy products considered suitable for older adults in terms of texture and oral comfort.

Skyr

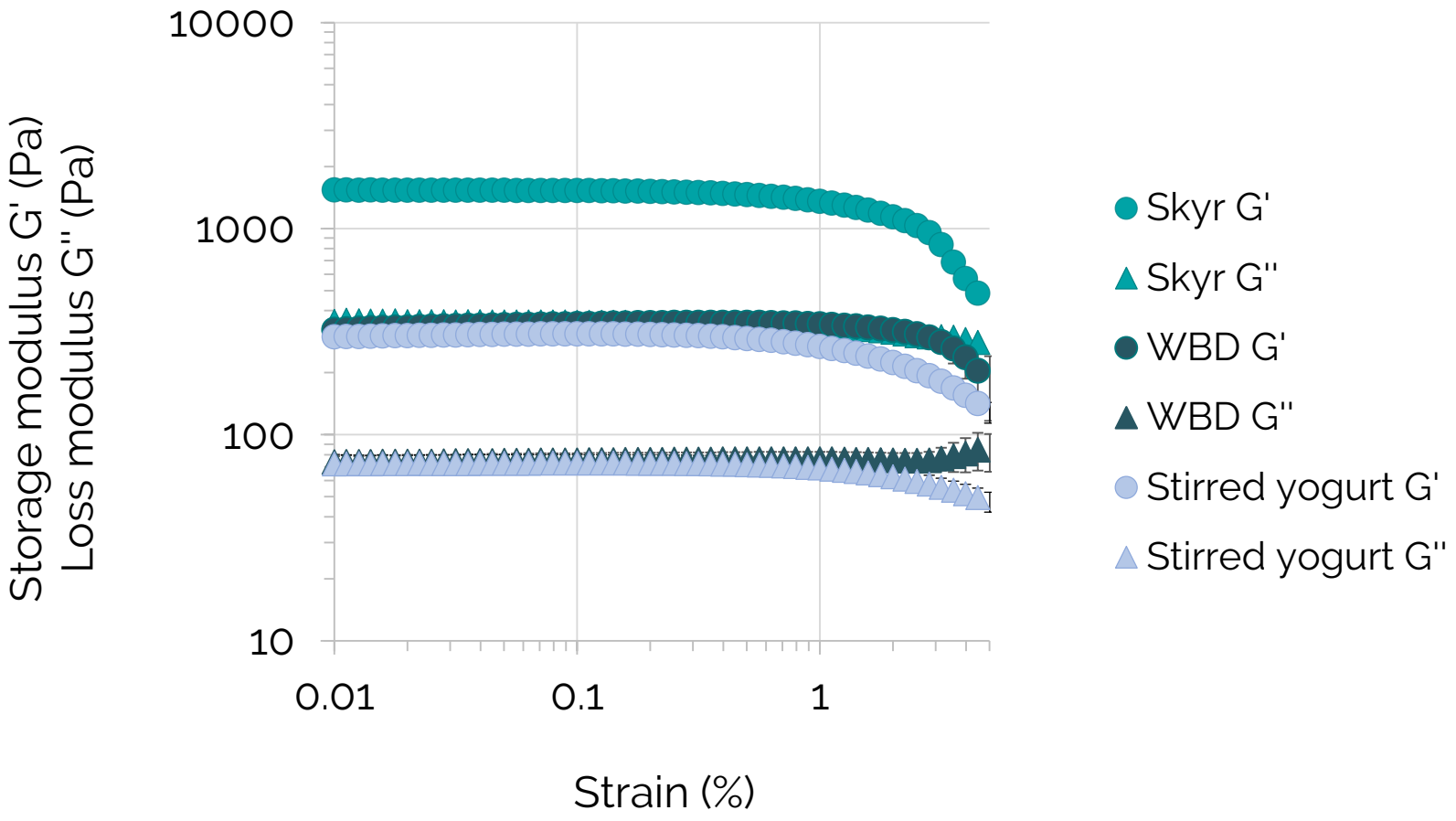
Commercial fermented dairy product containing mainly caseins

Whey-based dairy (WBD)

Lab scale fermented dairy product, formulated with a ratio of whey proteins to caseins of 80 to 20 %, as opposed to milk

WBD had rheological properties comparable to a stirred yogurt.

Amplitude sweeps,
1 Hz, 10°C.



WBD was acceptable to older adults, even with poor oral physiology (low number of posterior functional units, low salivary flow, and high saliva viscosity).

Panel of 80 subjects (49 women, 31 men), aged 76 ± 6 y.

Centre des Sciences du Goût et de l'Alimentation

Ratings of food comfortability attributes for WBD:

Oral comfort = 83 ± 20 /100

Easy to eat = 94 ± 12 /100

Static *in vitro* digestion

Oral phase

1: 1 food: SSF dilution according to dry matter
pH = 7.0, no chewing, no amylase

	Young adults	Older adults
Gastric phase		
pH:	3.0	↗ 3.7
Duration:	2 h	↗ 3 h
Pepsin:	2000 U ml^{-1}	↘ 1200 U ml^{-1}
Gastric lipase:	60 U ml^{-1}	↘ 36 U ml^{-1}
Intestinal phase		
$[Ca^{2+}]$:	0.6 mM	↗ 1 mM
pH:	7.0	7.0
Duration:	2 h	2 h
Pancreatin:	100 U ml^{-1}	↘ 80 U ml^{-1}
Bile salts:	10 mM	↘ 6.7 mM

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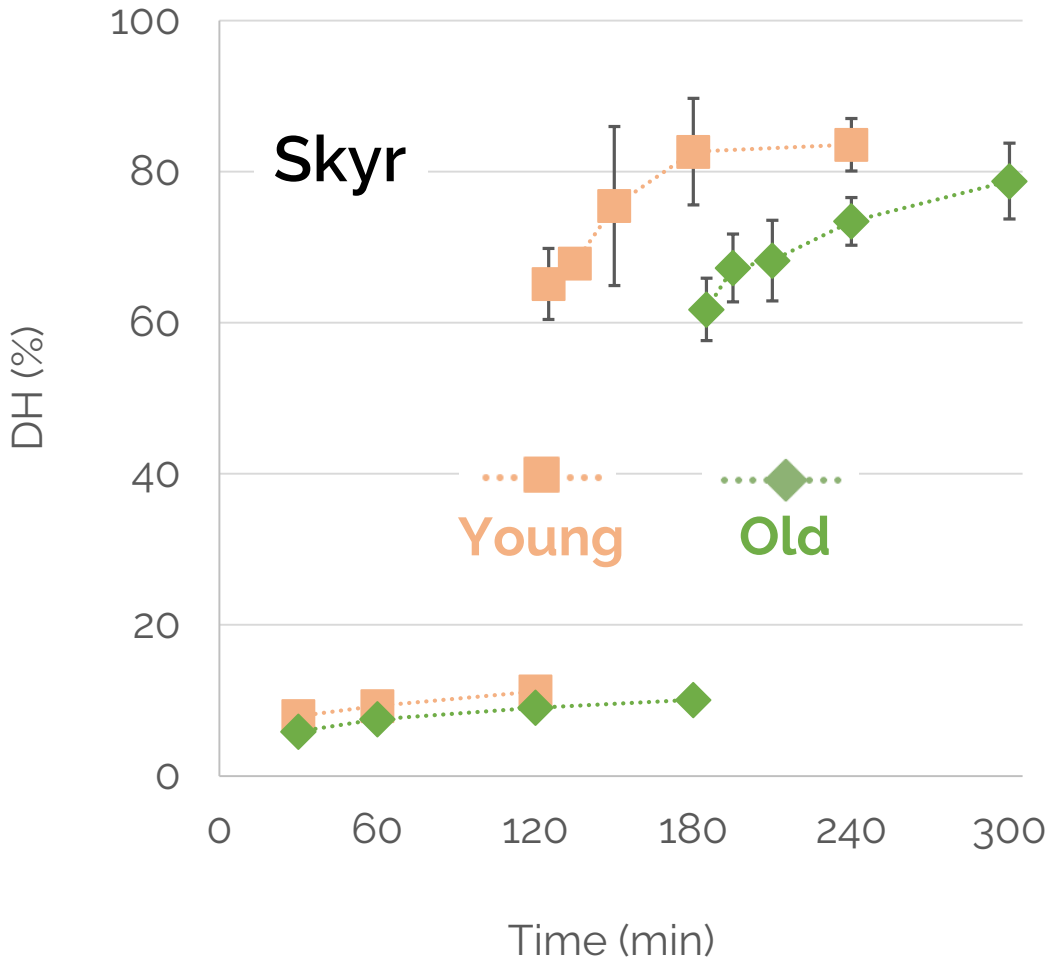
Static *in vitro* digestion model adapted to the general older adult population: an INFOGEST international consensus

O. Menard,†[a] U. Lesmes,†[b] C. S. Shani-Levi,[b] A. Araiza Calahorra,[c] A. Lavoisier,[a] M. Morzel,[a] A. Rieder,[d] G. Feron,[e,f] S. Nebbia,[a] L. Mashiah,[b] A. Andres,[g] G. Bornhorst,[h] F. Carrière,[i] L. Egger,[j] S. Gwala,[k] A. Heredia,[g] B. Kirkhus,[d] A. Macierzanka,[l] R. Portman,[j] I. Recio,[m] V. Santé-Lhoutellier,[n] C. Tournier,[e,f] A. Sarkar,[c] A. Brodkorb,[k] A. Mackie*[c] and D. Dupont*[a]

Degree of hydrolysis (DH), OPA method



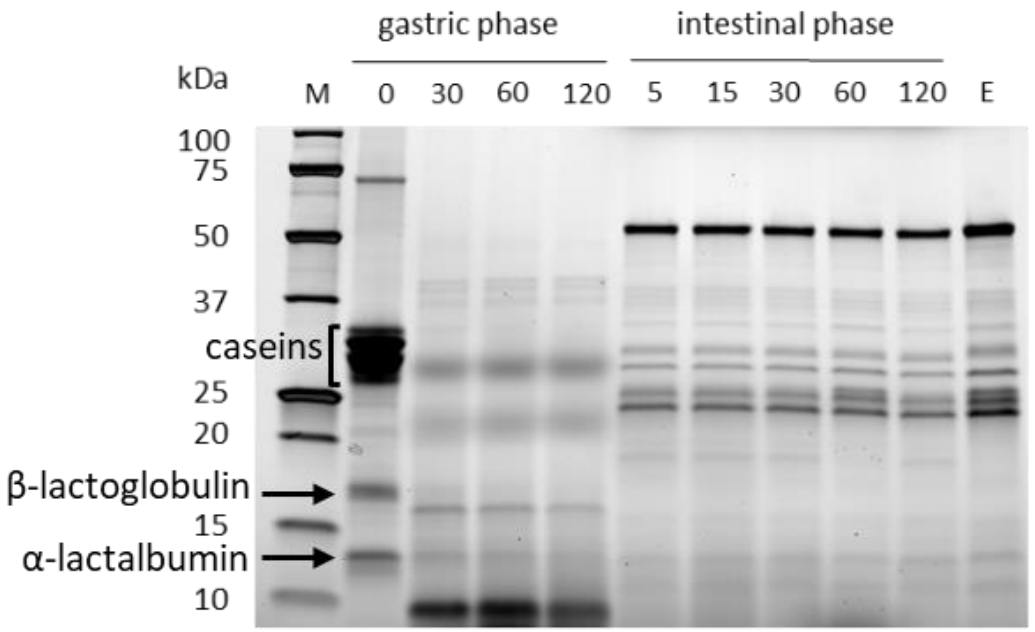
Gastric phase

DH **old** < DH **young** during the whole gastric phase **(-20%)** due to the reduction in pepsin activity.

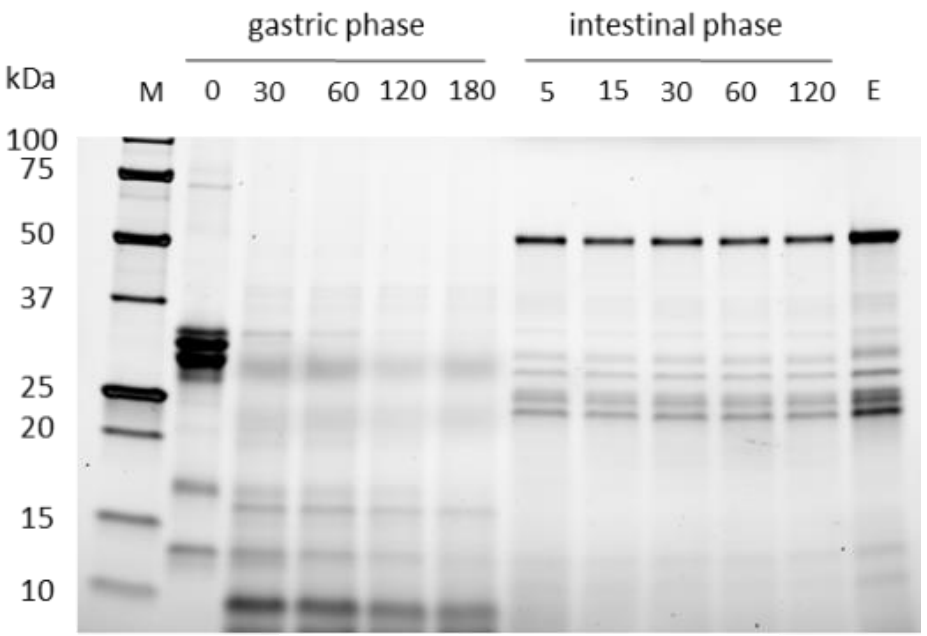
Intestinal phase

High DH values reached at the end of the digestion: **75-85%** in both conditions.

Protein hydrolysis, SDS-PAGE



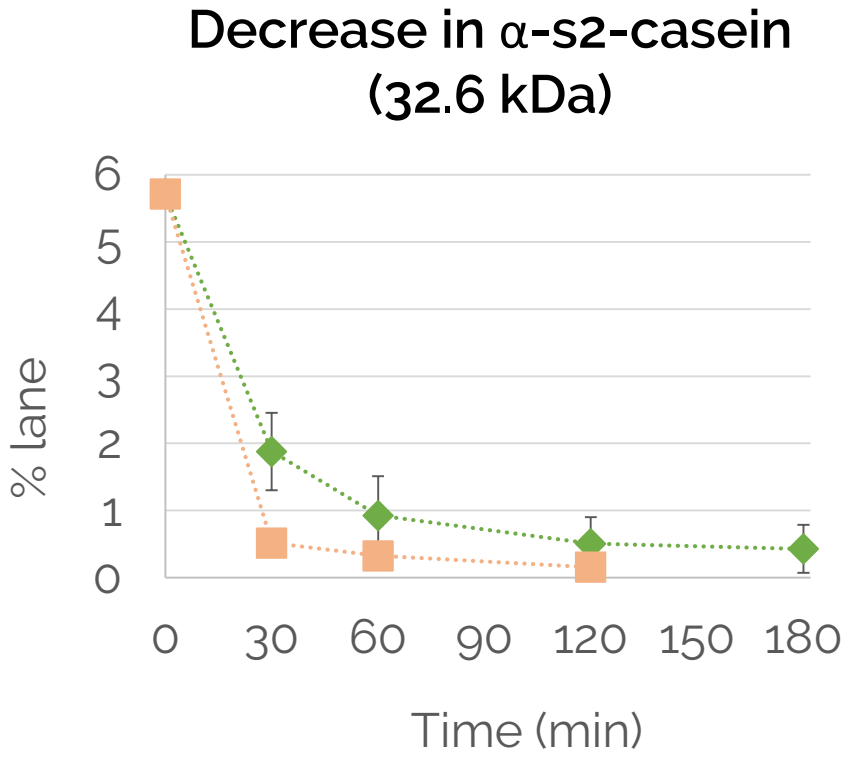
Skyr - Young

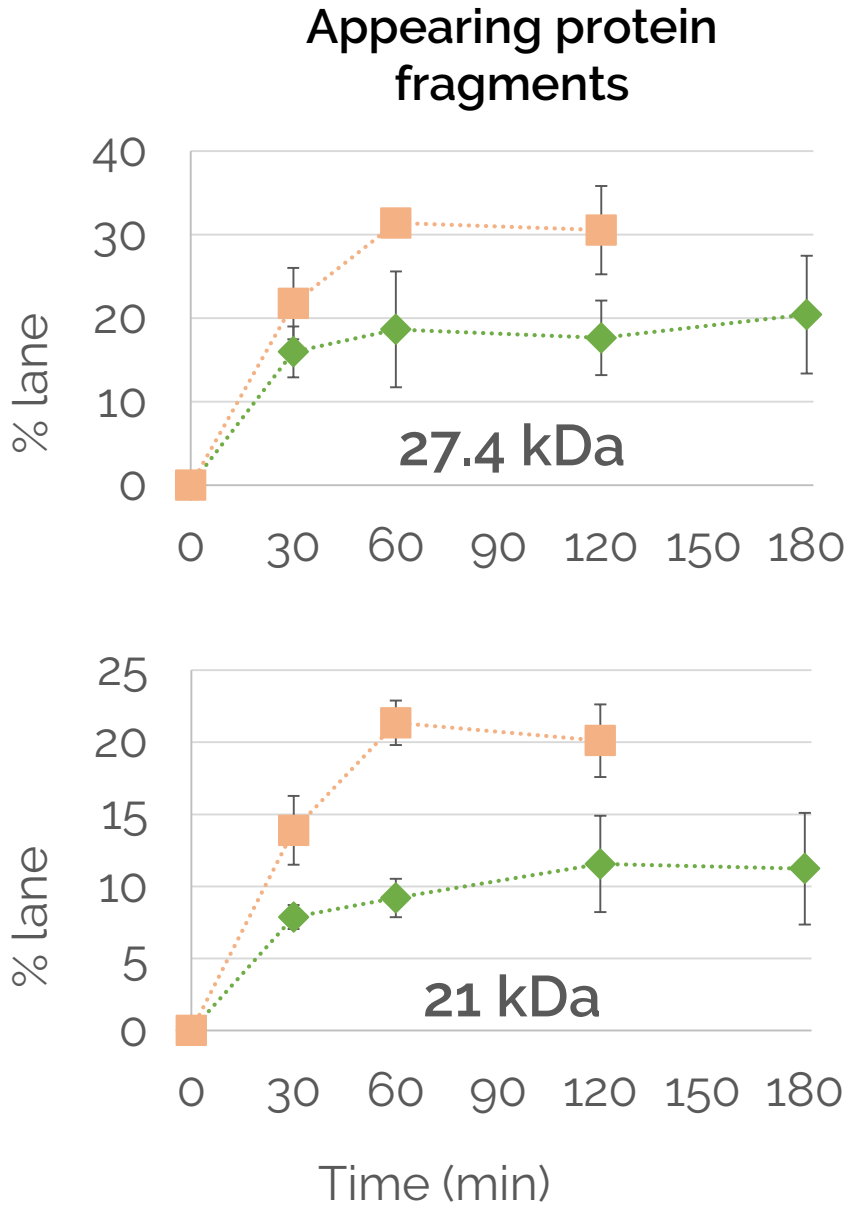


Skyr - Old

Caseins were rapidly digested by pepsin even at pH 3.7

Protein hydrolysis, SDS-PAGE

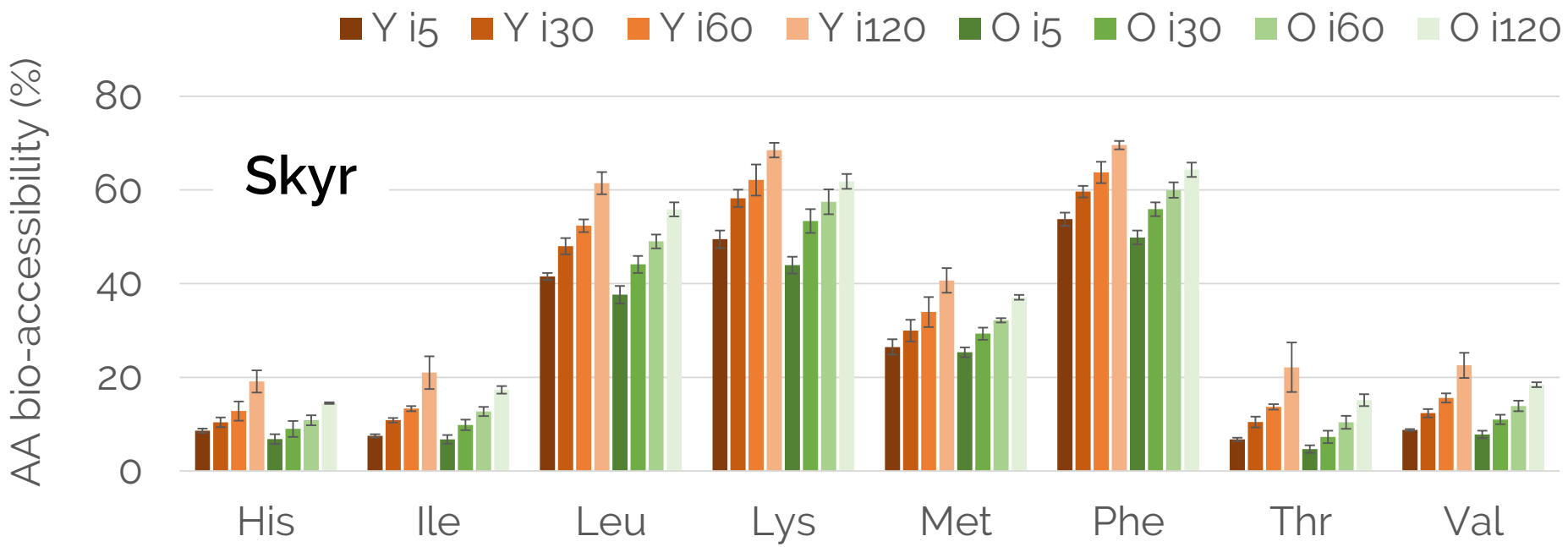




Young

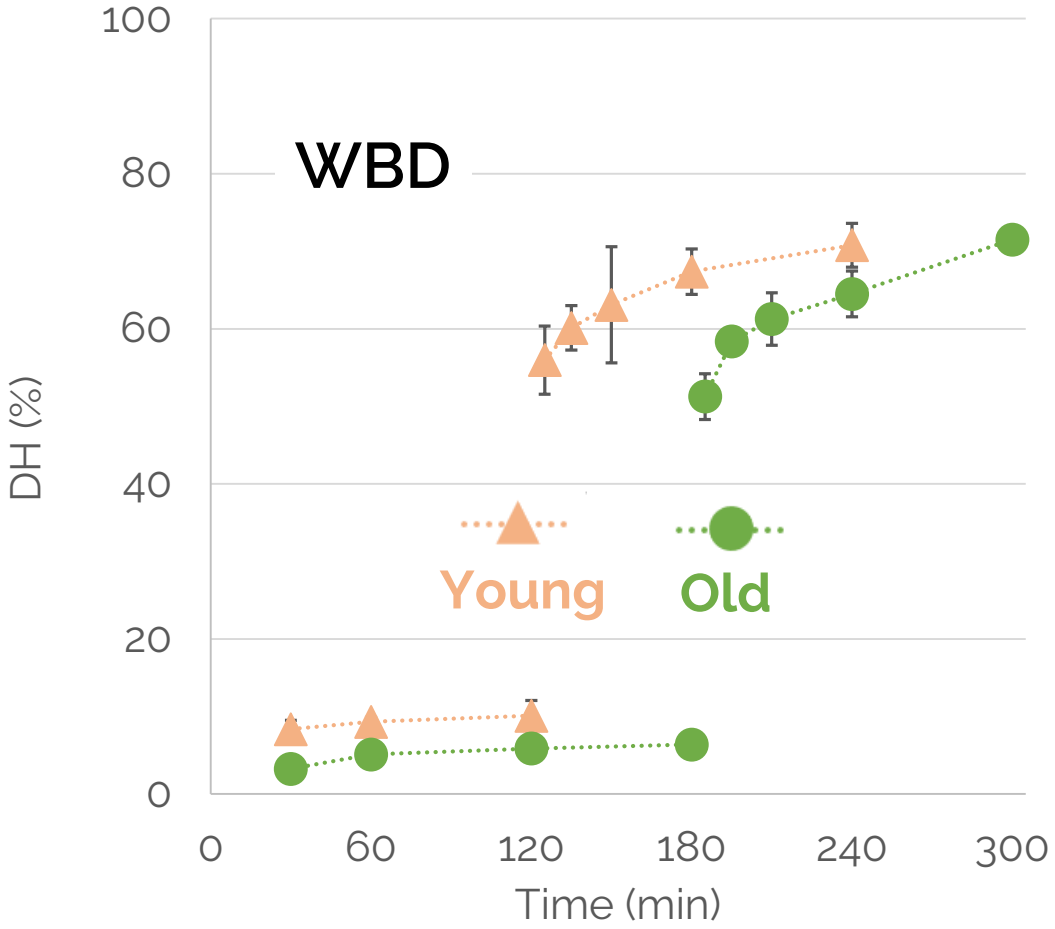
Old

Essential amino acids bio-accessibility, HPLC



Slightly less essential free AA with the older adult model: **-14%** overall, and **-10%** Leu at the end of the digestion (i120)

Degree of hydrolysis (DH), OPA method



Gastric phase

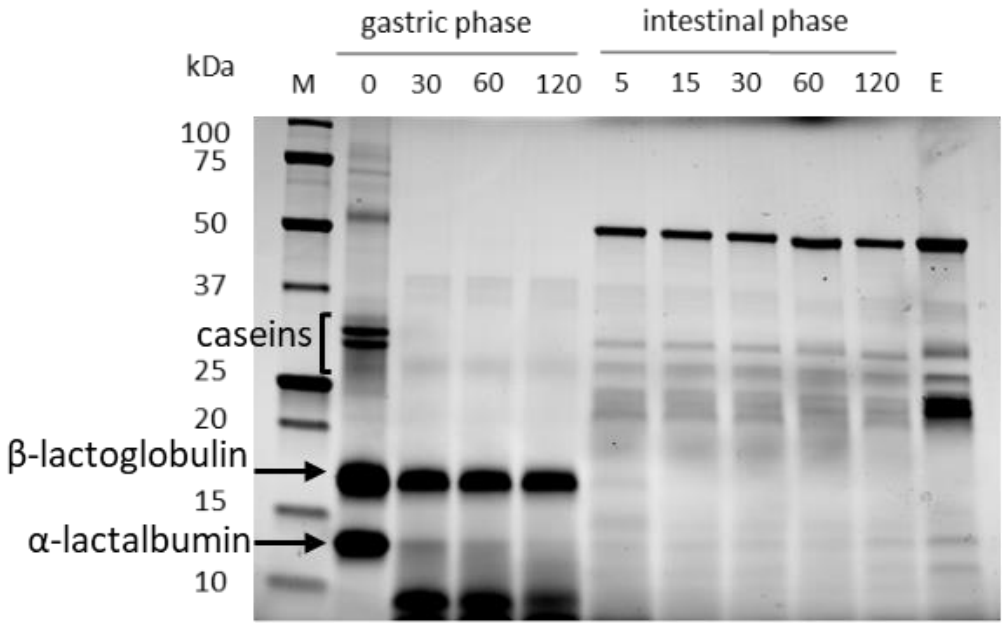
No changes in DH **after 30 min** (young) or **60 min** (old) in the gastric phase.

DH **old** **<** DH **young** at the end of the gastric phase **(-37%)** due to the reduction in pepsin activity.

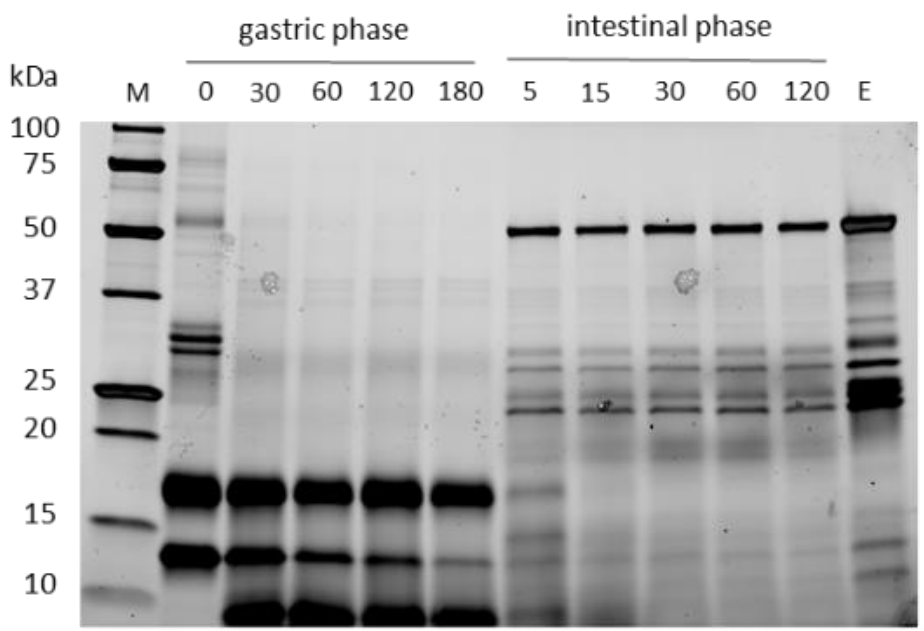
Intestinal phase

High DH values reached at the end of the digestion: approx. 70% in both conditions.

Protein hydrolysis, SDS-PAGE



WBD - Young

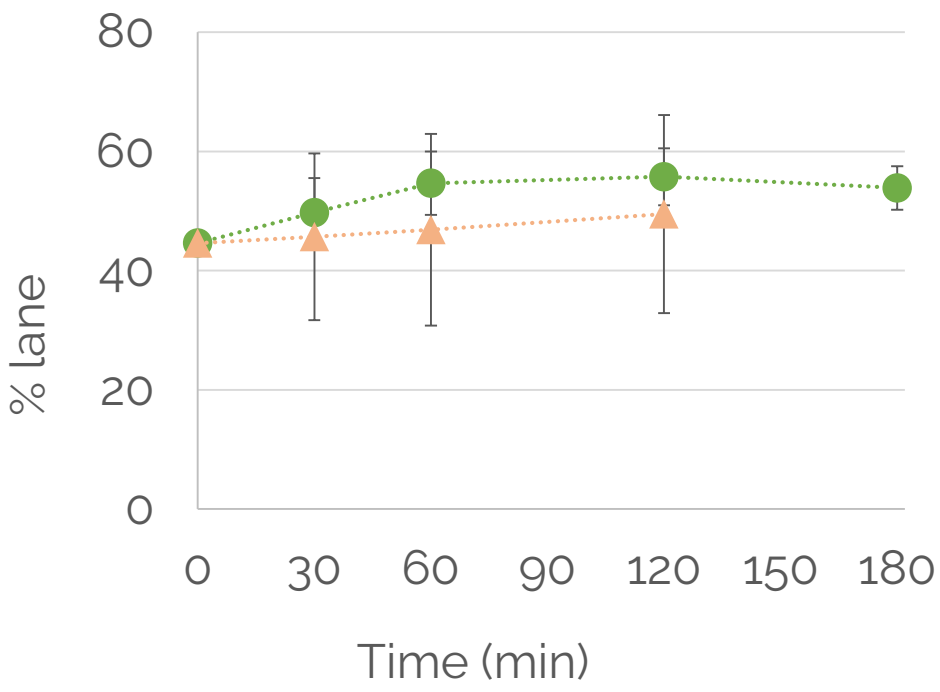


WBD - Old

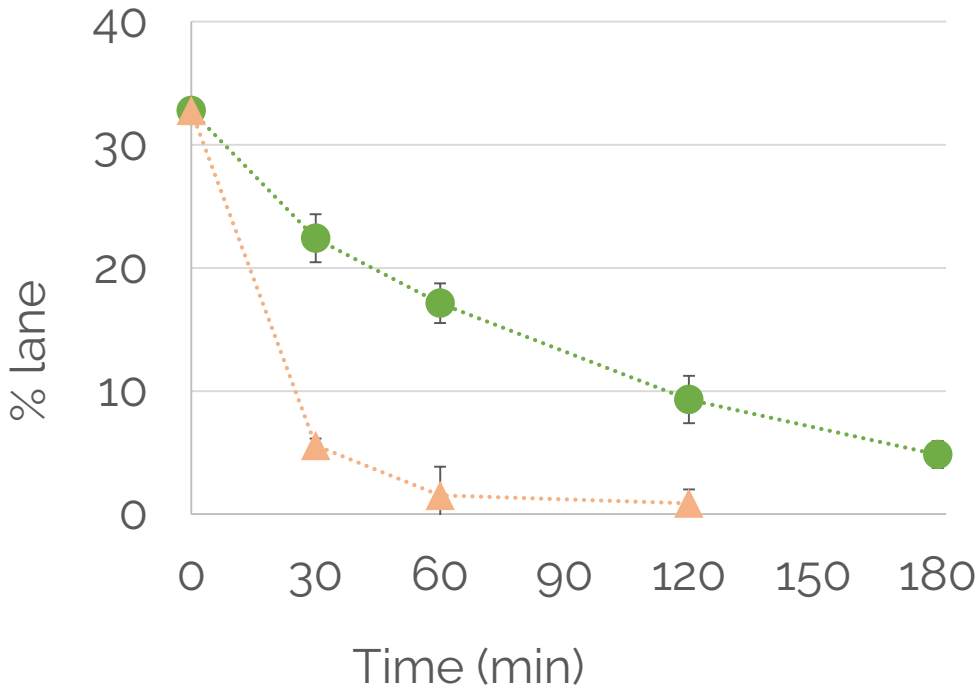
β-lactoglobulin was resistant to pepsin

Protein hydrolysis, SDS-PAGE

Resistant β-lactoglobulin (16.6 kDa)



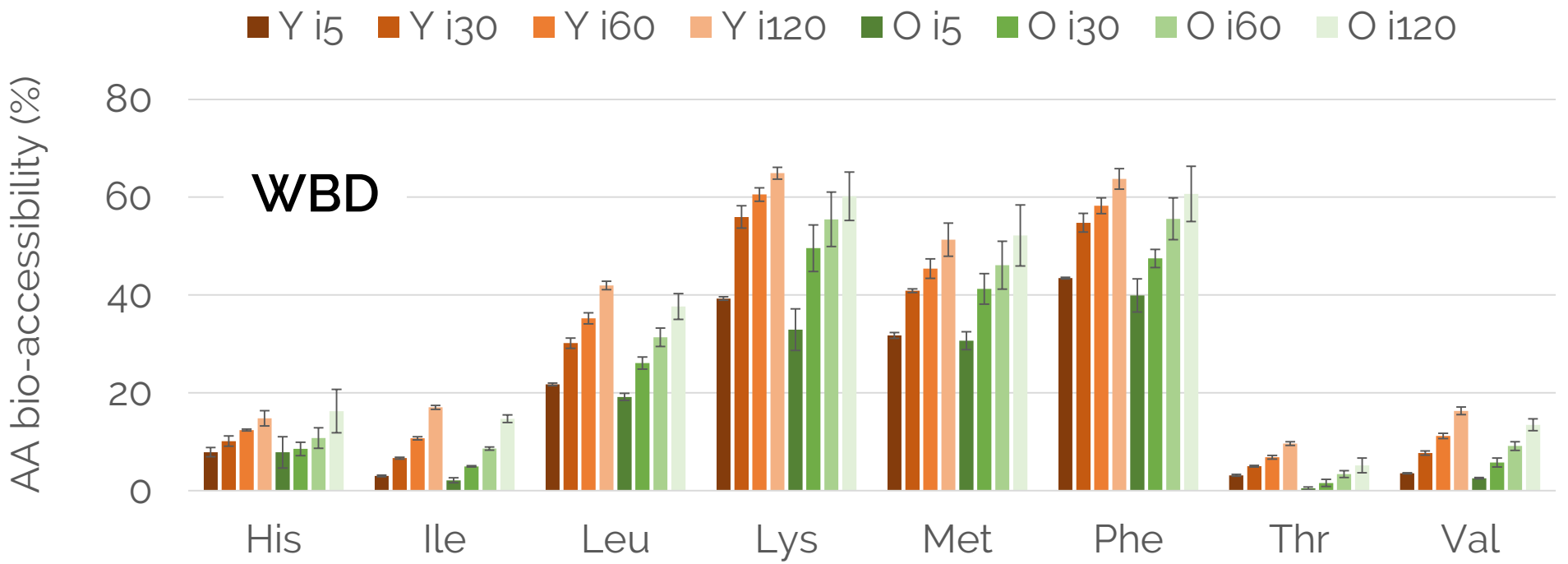
Decrease in α-lactalbumin (12.6 kDa)



Young

Old

Essential amino acids bio-accessibility, HPLC



No significant differences between young and older adults during the whole intestinal phase.

In vitro digestion conditions influenced the kinetics and extent of proteolysis, but differences were mainly observed in the gastric phase.

Different scenarios were observed depending on the composition of the dairy product studied.

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Cream cheeses with 24% lipids and different WP:CAS ratios have been formulated and digested *in vitro.*

A clinical study comparing the effect of WBD, Skyr, and cream cheese on young and older adults' postprandial muscle synthesis is underway.

NIH NORWEGIAN SCHOOL OF SPORT SCIENCES

Thank you

EAT4age
Palatable, nutritious and digestible foods for prevention of undernutrition in active aging

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Bioactivity and Nutrition (BN) team