

# USE OF A DYNAMIC TIM-1 MODEL FOR AN IN-DEPTH UNDERSTANDING OF EDIBLE YEAST-BASED PROTEINS DIGESTION IN THE HUMAN STOMACH AND SMALL INTESTINE

Juliette Caron<sup>1#</sup>, Ccori Martinez<sup>1#</sup>, Elyse Parent<sup>1</sup>, Sothany Gastel<sup>1</sup>, Sabrina Telki-Bayens<sup>1</sup>, Isabelle Mouly<sup>1</sup>, Pauline Spolaore<sup>2</sup>, Rudy Menin<sup>2</sup>, Eric Oriol<sup>3</sup> & Nabil Bosco<sup>1\*</sup>

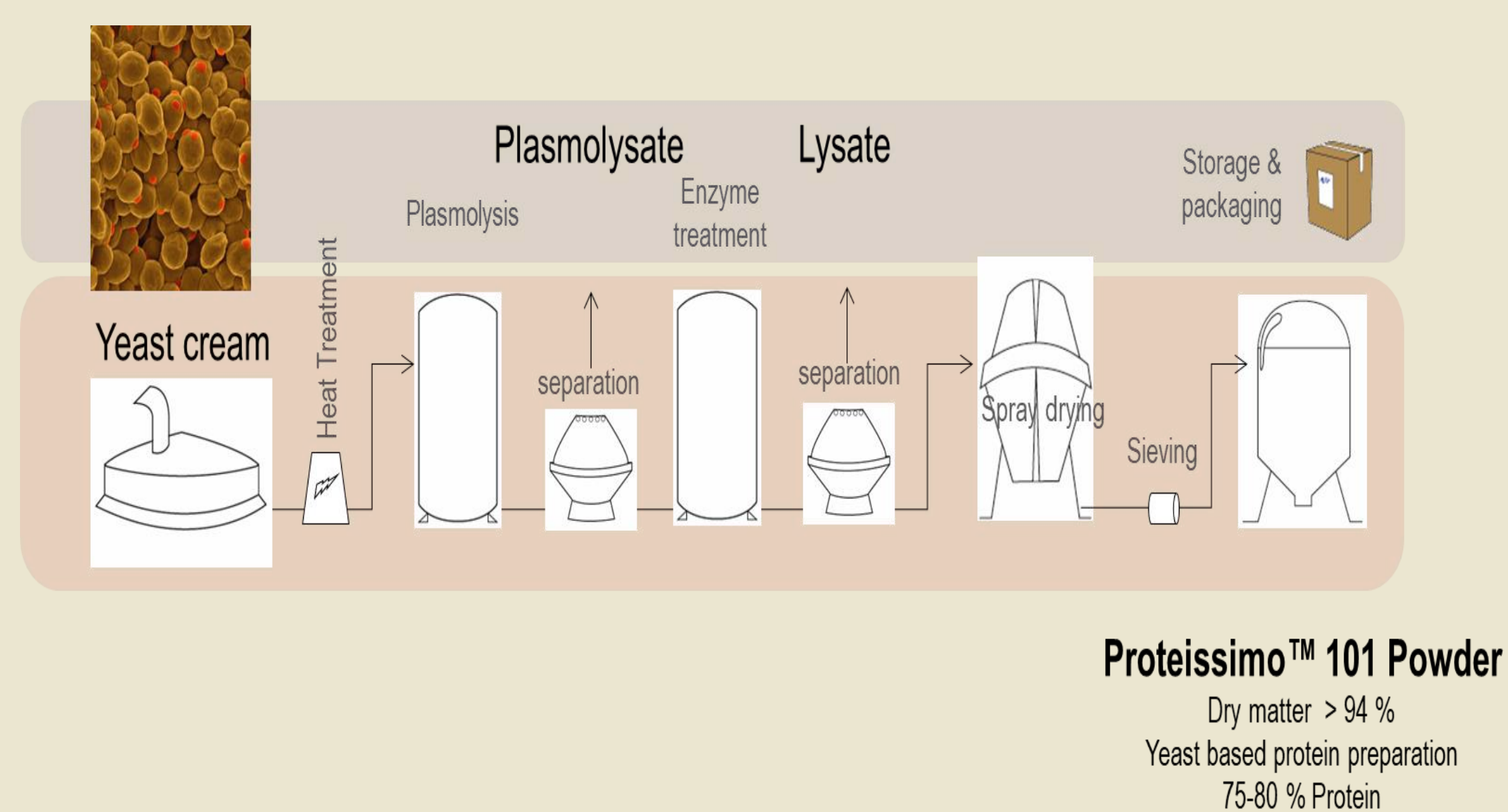
<sup>1</sup> Lesaffre Institute of Science & Technology, Marcq-en-Baroeul, France <sup>2</sup> BioSpringer, Maisons-Alfort, France <sup>3</sup> Procelys, Maisons-Alfort, France

#Equal contribution - \*Corresponding author : n.bosco@lesaffre.com

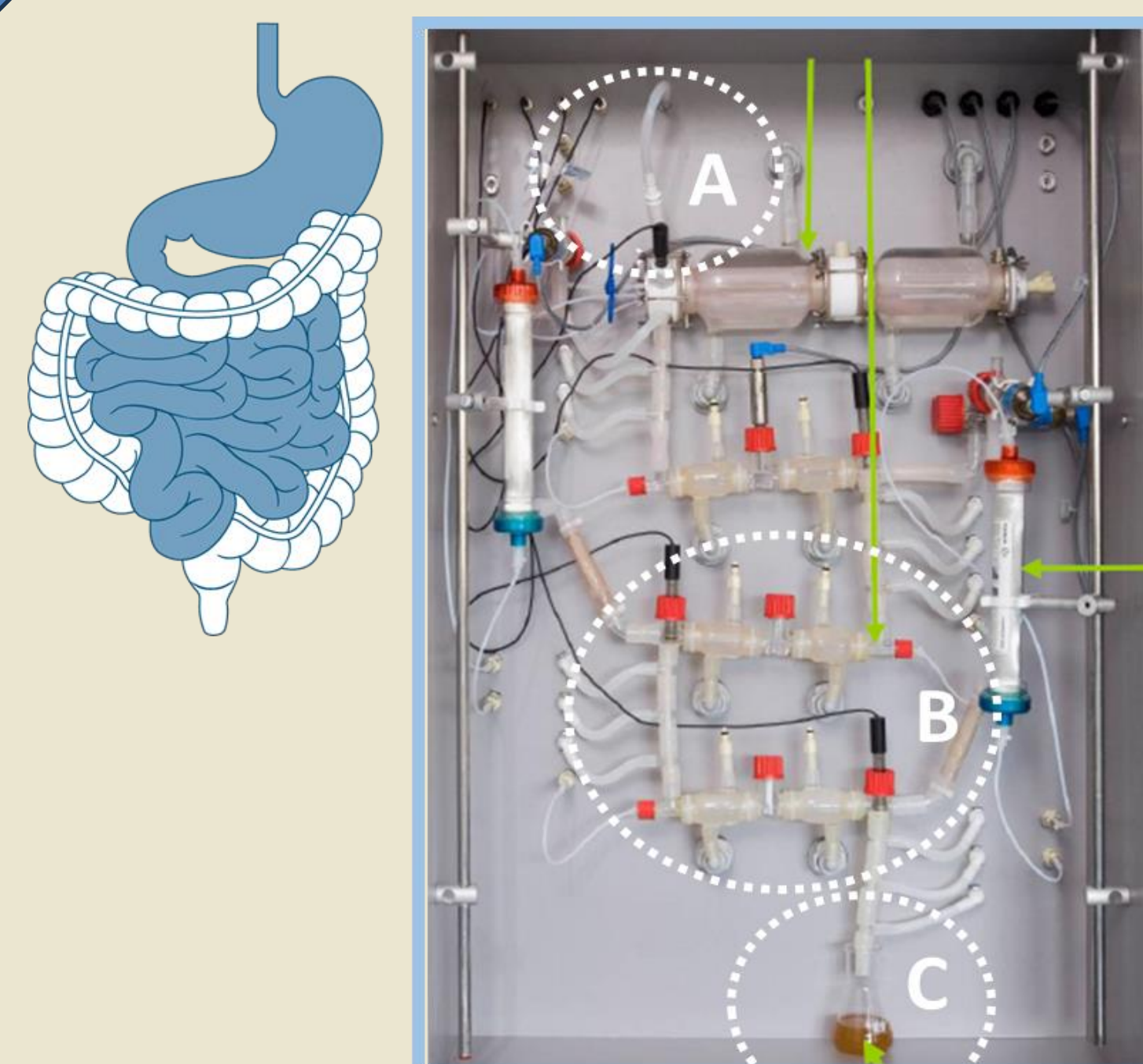
The global protein demand is in constant increase requiring sustainable and healthier alternative proteins for animal and human nutrition. Yeast-based proteins (YBP) represent a non-negligible environmental-friendly fermentation-based solutions with high nutritional quality and bioavailability. Although *in vitro* studies cannot reflect the full complexity of *in vivo* digestion, it is considered as useful alternatives to animal model assessing protein digestibility. Herein, TIM-1 (TNO Gastro-Intestinal Model) was used to assess the digestibility profile of a proprietary edible YBP according to INFOGEST guidelines. We characterized YBP digestibility, amino acid bio-accessibility and compared YBP with milk-based references (casein and whey proteins). Each treatment was evaluated in triplicates during 5h of digestion with hourly collection from jejunum and ileum compartments and final residual ileal samples. Total nitrogen (TN) and free amino acid (FAA) were quantified. Size-Exclusion Chromatography and SDS-PAGE were also applied to assess the fate of protein hydrolysis over time.

## 1. Experimental design & associated analytics

Yeast-based protein (YBP) process implementation with Baker's yeast cream



TNO Gastro-intestinal model (TIM-1) to assess *in vitro* protein digestibility



3 independent batches of YBP were tested and compared with 2 commercial standards of animal proteins (Casein and Whey protein). YBP, Casein and Whey were analysed in TIM-1 with a human fed state protocol in triplicate over 5 hours

**A: Intake (test products) – 20g bolus**

**B: Ileal and jejunum sampling (bio-accessible and non-digested fraction)**

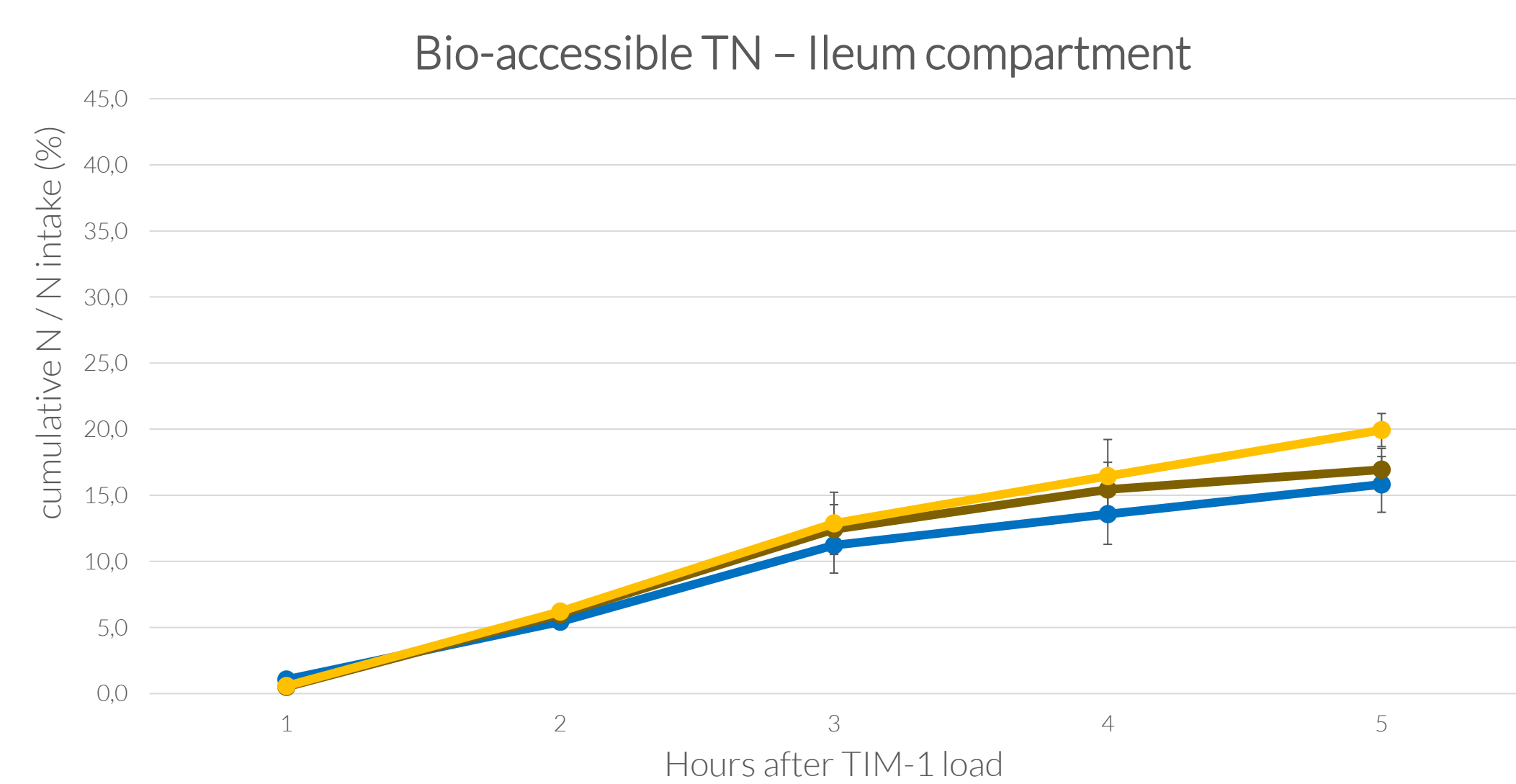
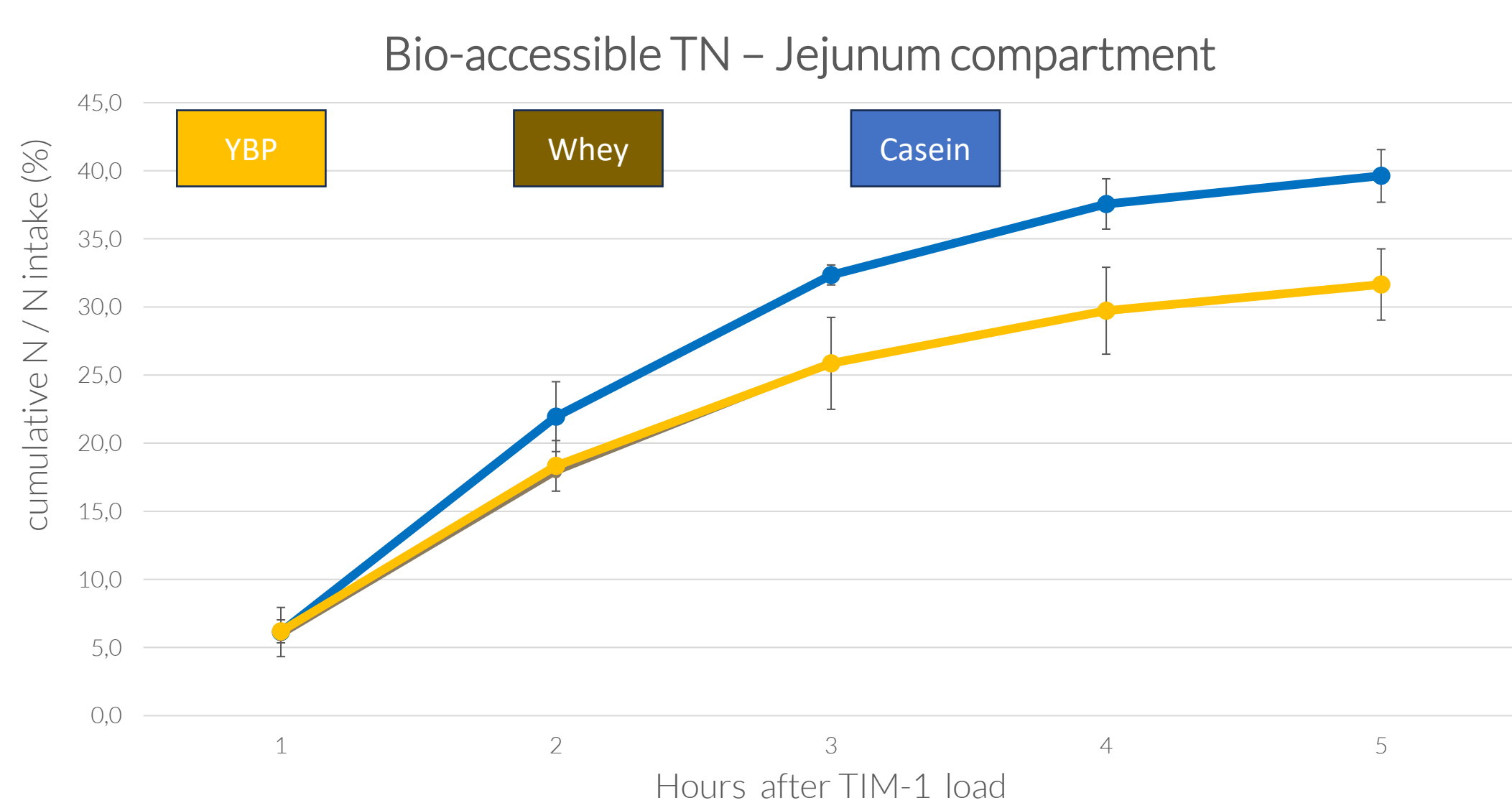
**C: Ileal effluent sampling**

Samples were analysed every hour with:

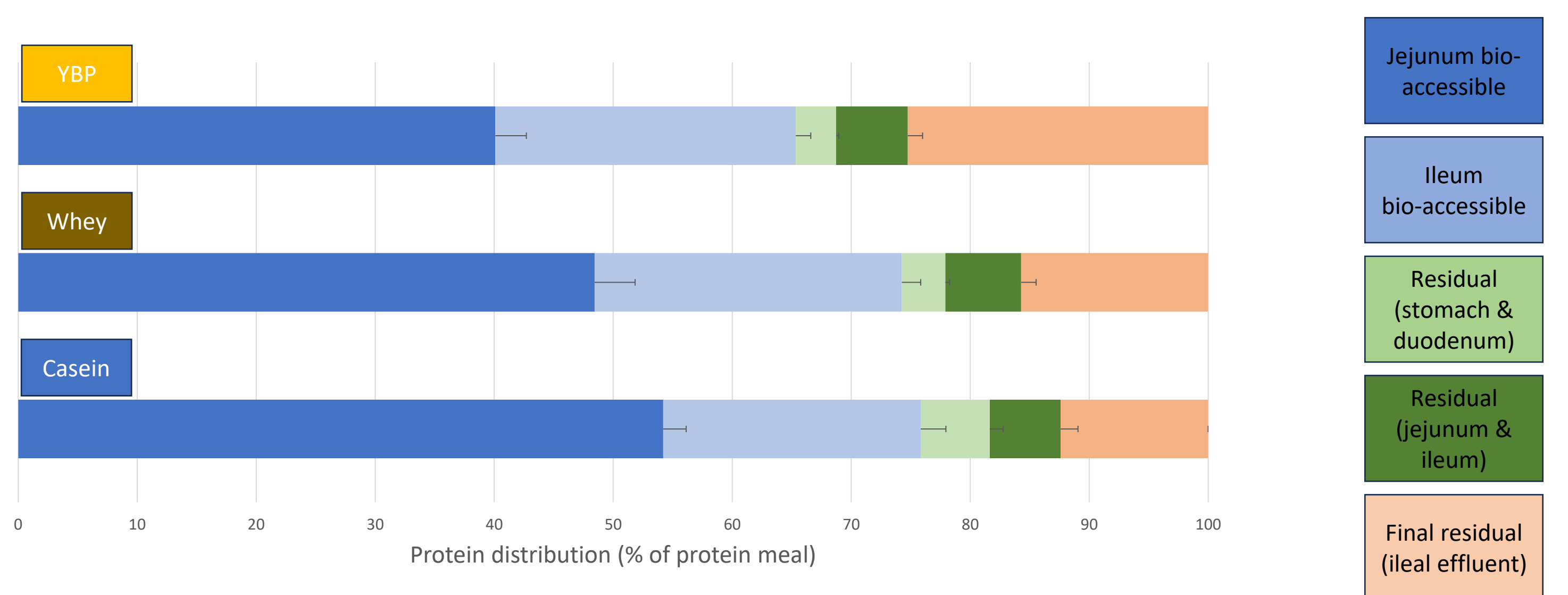
- Total Nitrogen (TN) measure
- Size exclusion chromatography (SEC) to follow protein digestion
- Free amino acids measure

## 2. RESULTS & DISCUSSION

### i. Protein digestion along GI tract TN quantification – Bio-accessible protein

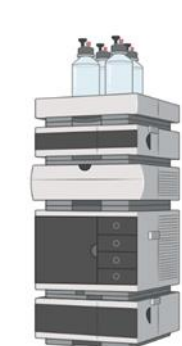
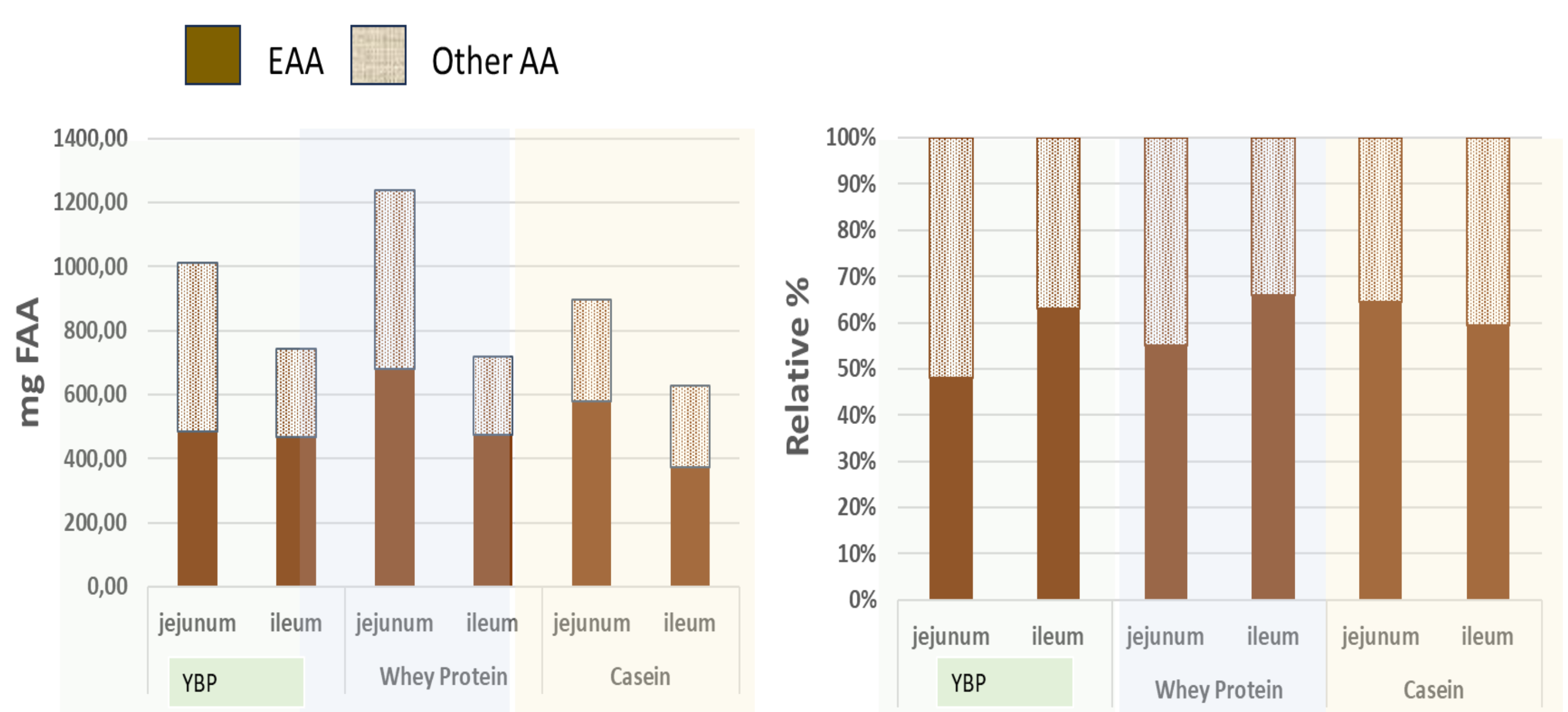


### iii. Comparison of protein digestion distribution along TIM-1

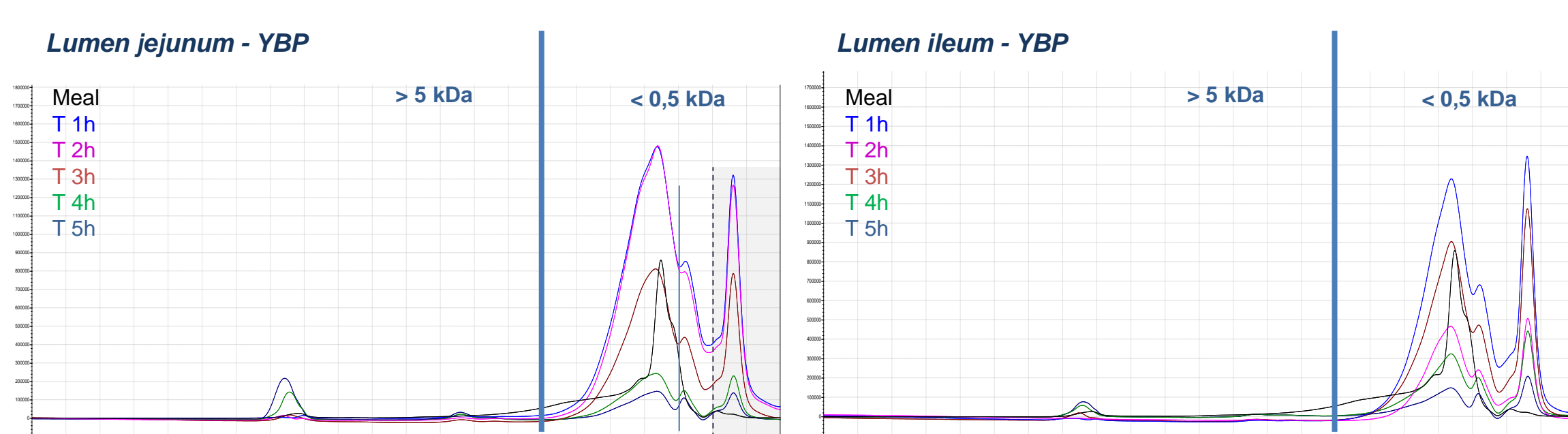


- YBP digestibility profiles were closer to whey protein in TIM-1 device along the 5h TIM-1 assay
- YBP samples reached up to 60% bioaccessible TN (lumen+dialysates) after 5h of digestion.

### iv. Absolute & relative distribution of Essential AA (EAA) and Free AA (FAA) absorbed after 5 h of digestion



### ii. Protein pre- and post-digestion profile with size exclusion chromatography (SEC)



- YBP presented an important fraction of small size peptides with specific MW distribution.
- A similar fingerprint was observed in jejunum & ileum with progressive further digestion.
- SDS-Page analysis confirmed rapid digestion of any of the 3 bolus (<1h, not shown)

- About 2g of FAA were absorbed after 5h.
- YBP has a kinetics of absorption closer to whey proteins.

We showed with a TIM-1 dynamic digestion protocol that YBP were as good as milk-based reference proteins with up to 60% total bio-accessible protein after 5h in small intestine. Noteworthy, total YBP absorption reported a kinetics closer to whey protein in jejunum and ileum compartments. Altogether, our results suggest that YBP could be a nutritionally relevant animal protein alternative. Follow-up work with human trial is warranted to confirm YBP alternative for sustainable nutrition.