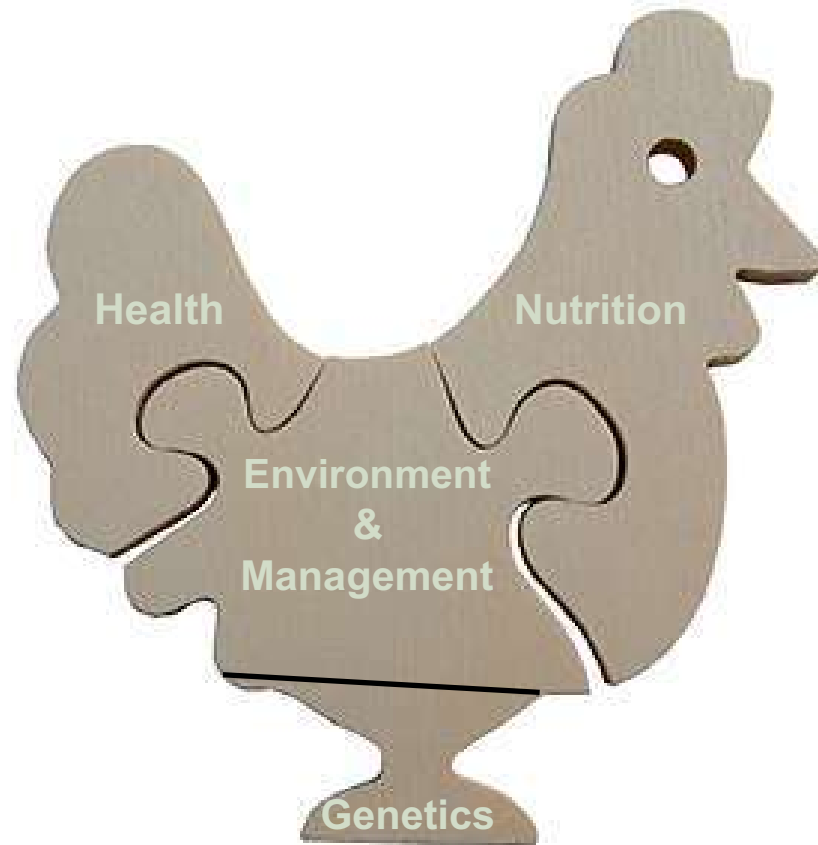


# Advances in poultry early nutrition: Focus on protein and digestive dynamics

Marisabel Caballero  
Global Category Manager Monogastrics  
**Hamlet Protein**



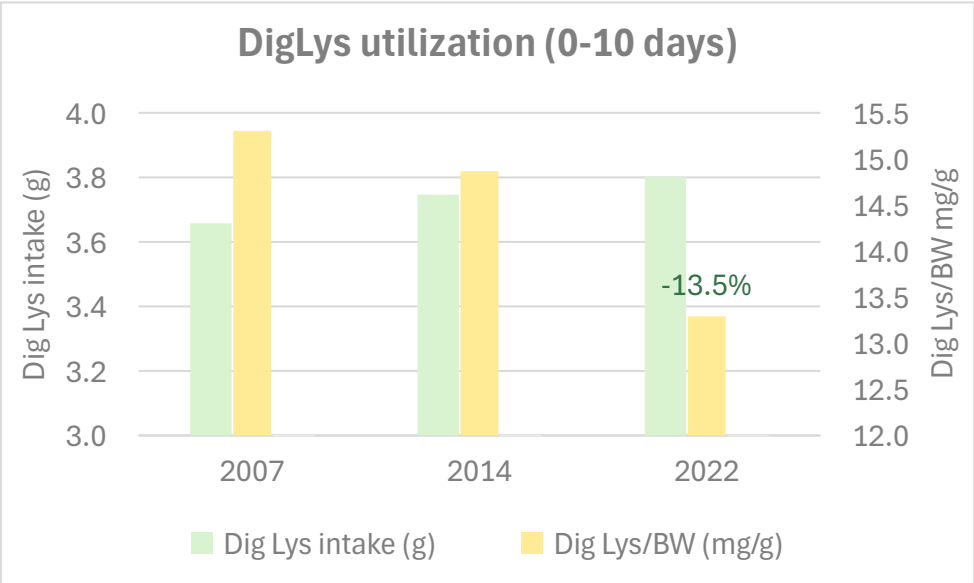
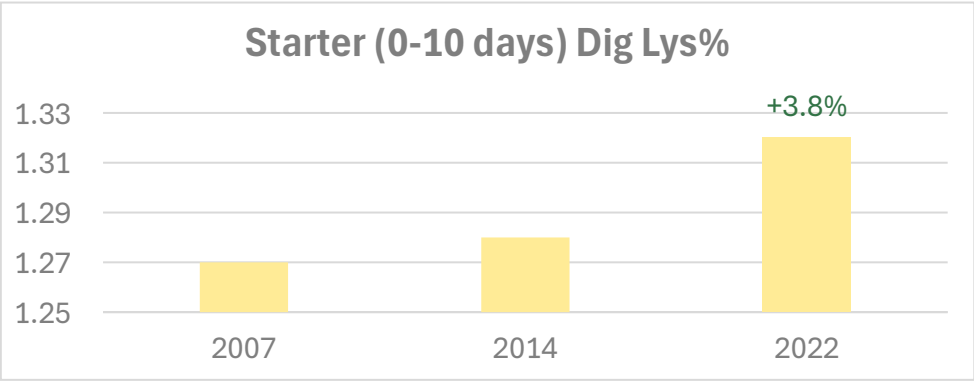
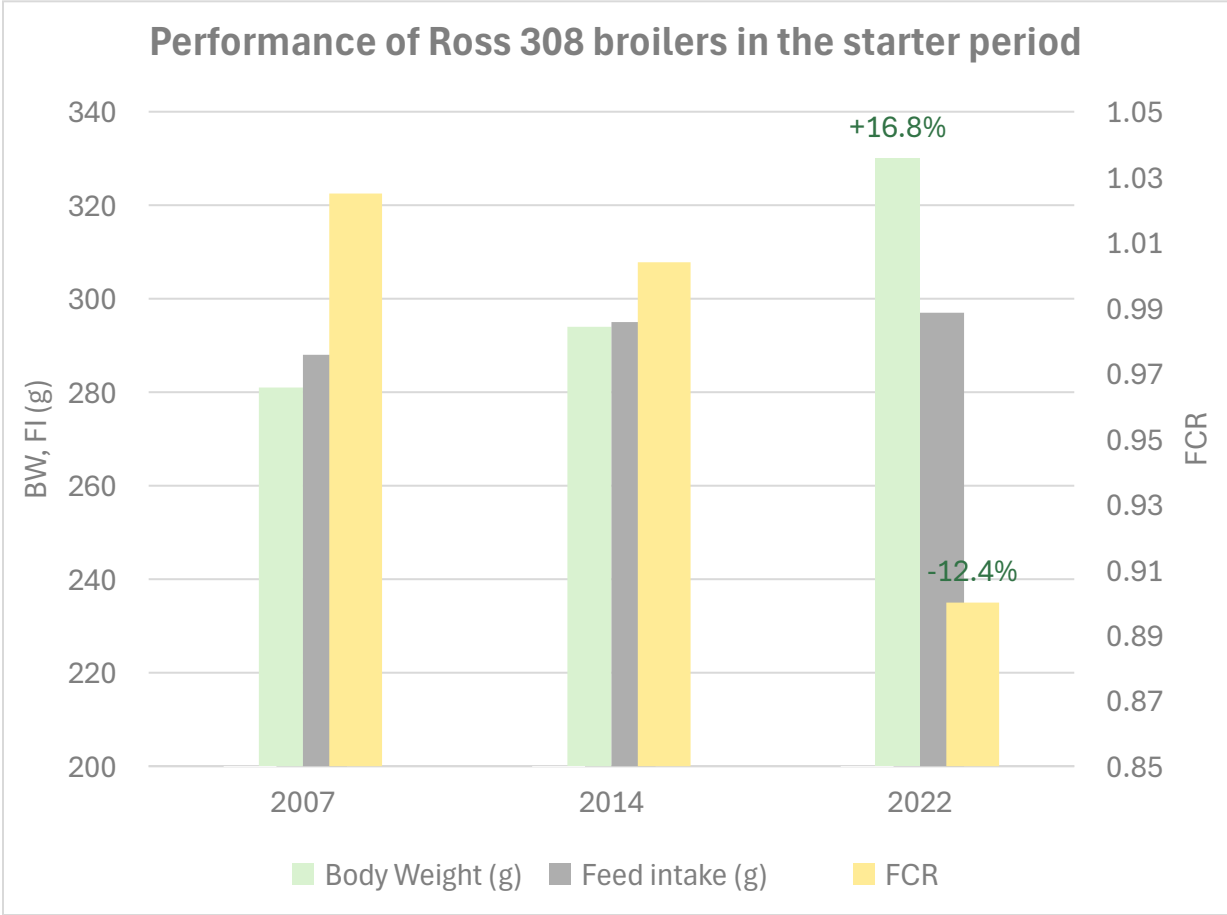
## Objective of poultry production



The conversion of the nutrients  
from the diets into protein for  
human consumption...  
in the most efficient way.

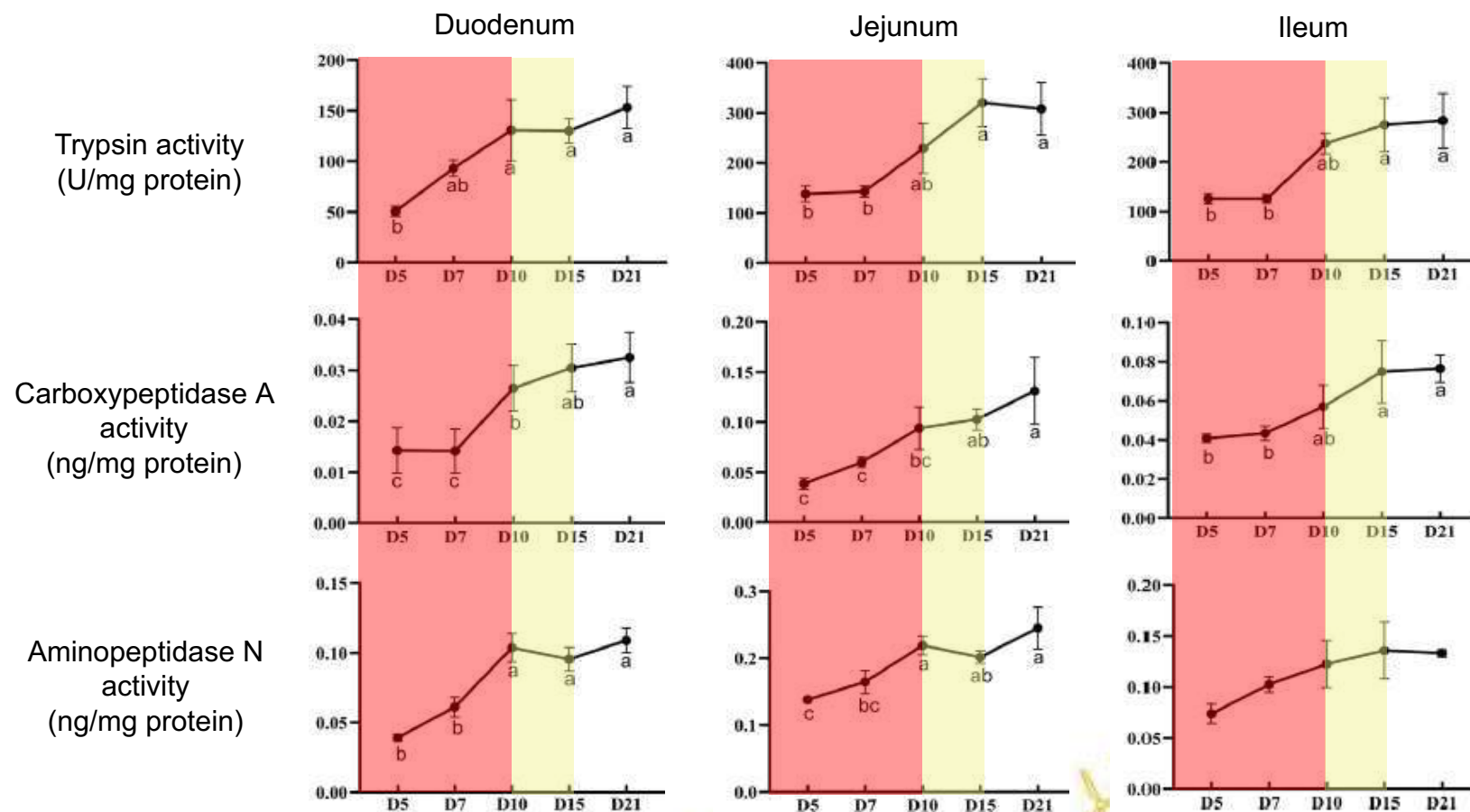


# Improvements increase the pressure during the starter period



# Proteolytic enzyme activity in broiler's digesta is very low up to day 10 of life – hindering protein digestibility

Arbor Acres broilers corn-SBM based diets



**How can we improve...**

- Tissue deposition efficiency**
- Animal productivity**



# Focus: nutrition

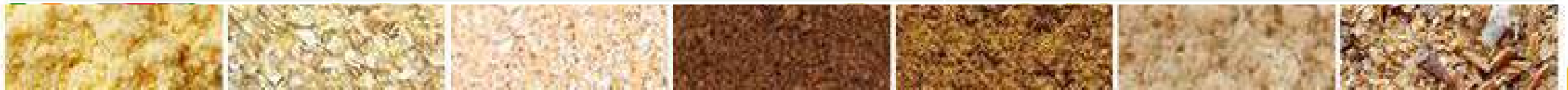
- Protein sources: advantages & disadvantages
- Soybean meal quality: thresholds for anti-nutritional factors?
- Digestive dynamics: new research (and variables) to consider in nutrition
- Protein kinetics: why fast protein?
- Practical considerations: what to put into practice



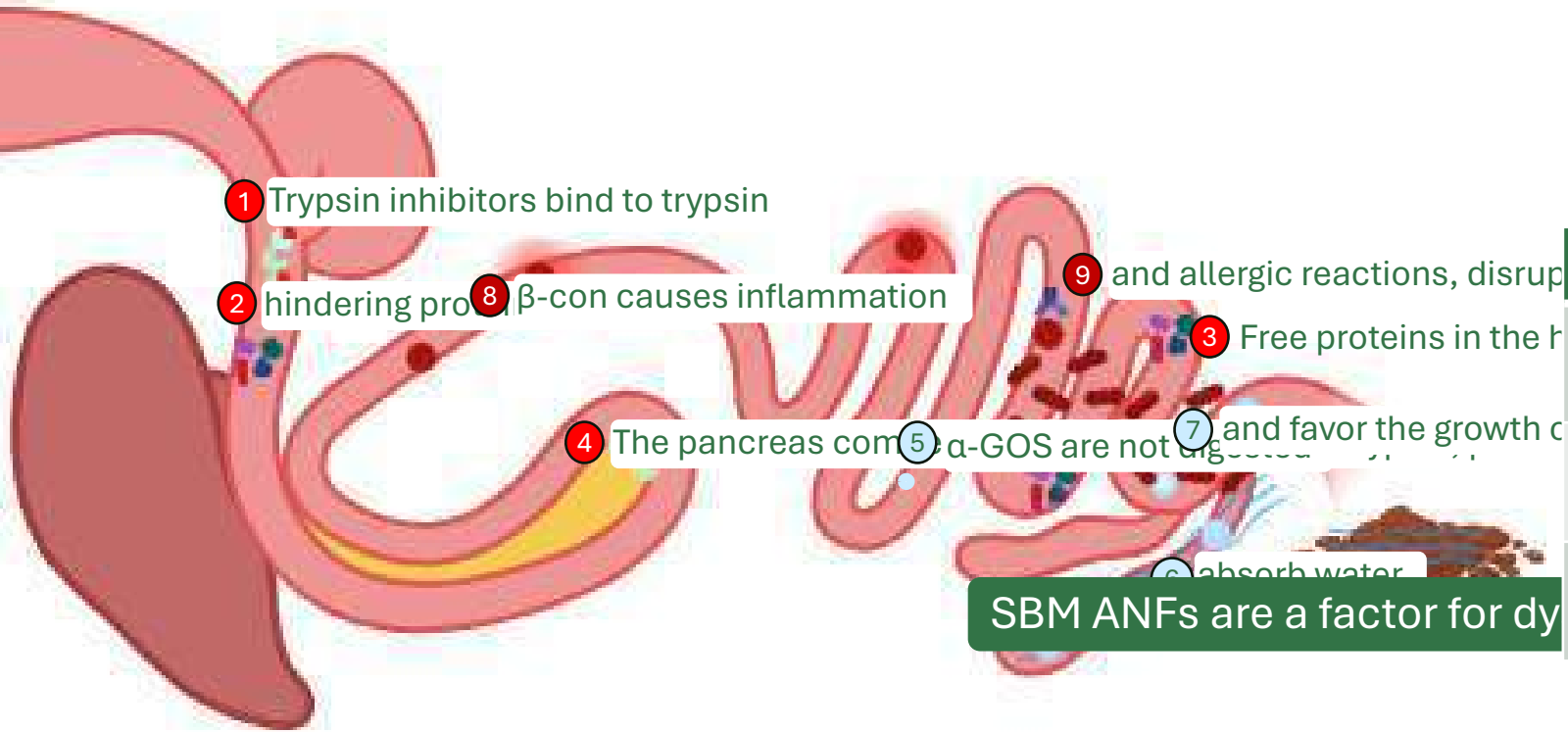
17<sup>th</sup> Poultry  
**Kn**owledge  
Day **25** NOVEMBER

## (some) Protein sources used in poultry (starter) feeds

Source	Advantages	Disadvantages
Animal proteins	High digestibility Excellent amino acid content	Microbial contamination Reactive oxygen species (ROS) Biogenic amines
Corn Gluten Meal (CGM)	High protein & methionine	Low threonine & tryptophan High fiber
DDGS	High protein & energy Cost-effective	Mycotoxin contamination High variability
Potato protein	High protein content High digestibility	Trypsin inhibitors & solanine Poor amino acid profile
Rapeseed (canola) meal	Good protein content Good amino acid profile (high lysine)	Glucosinolates Phytic acid Non-starch polysaccharides (NSPs)
Soybean meal (SBM)	High availability Good digestibility Excellent amino acid content	Trypsin inhibitors $\alpha$ -galacto-oligosaccharides B-conglycinin



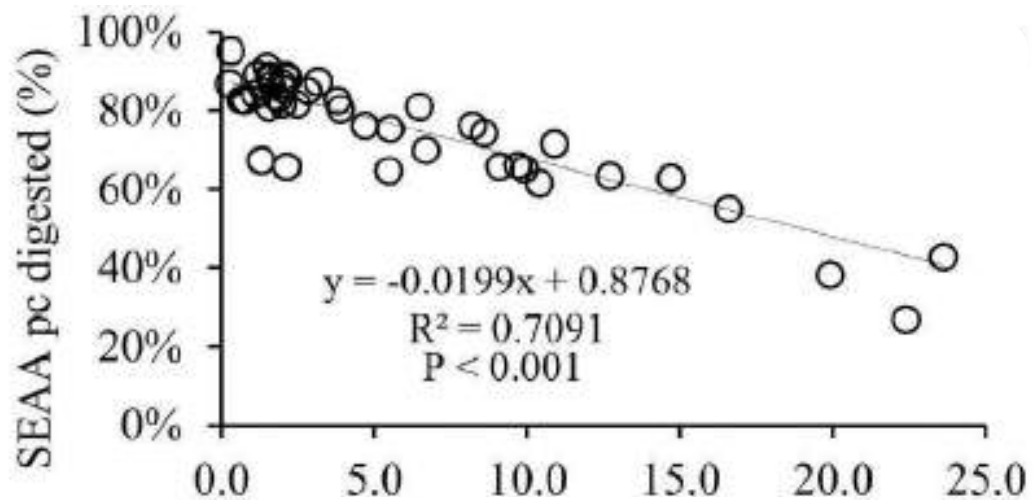
# Soybean meal, the predominant protein for animal nutrition, contains anti-nutritional factors, hindering performance during critical periods



ANF	Recommended*
Trypsin Inhibitor Activity (TIA)	<1.4 mg/g in the diet
α-Galacto-oligosaccharides (GOS)	<1.25% in the diet
β-conglycinin (β-CON)	<25000 ppm in diet

\*in starter feed

## Recommended TIA limit < 1.4 mg/g feed - background

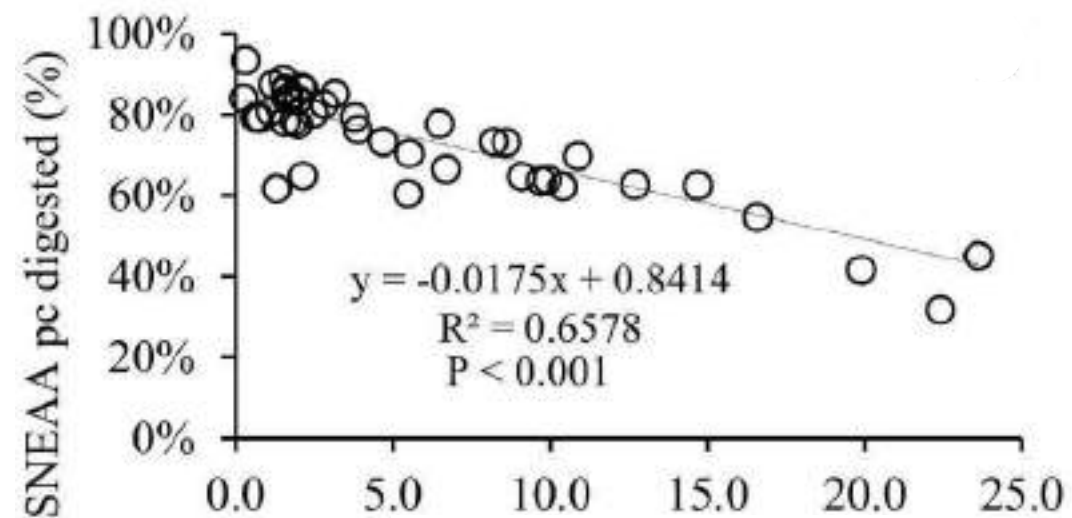


TIA mg/g in Expellers SBM

TIA significantly depressed 21-day-old broilers' pre-cecal digestibility of amino acids ( $P < 0.001$ ).

SEAA: sum of essential amino acids

SNEAA: sum of non-essential amino acids



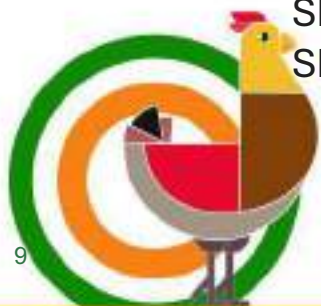
TIA mg/g in Expellers SBM

Levels from 0.4 to 8.5 mg/g in feed, 91 diets.

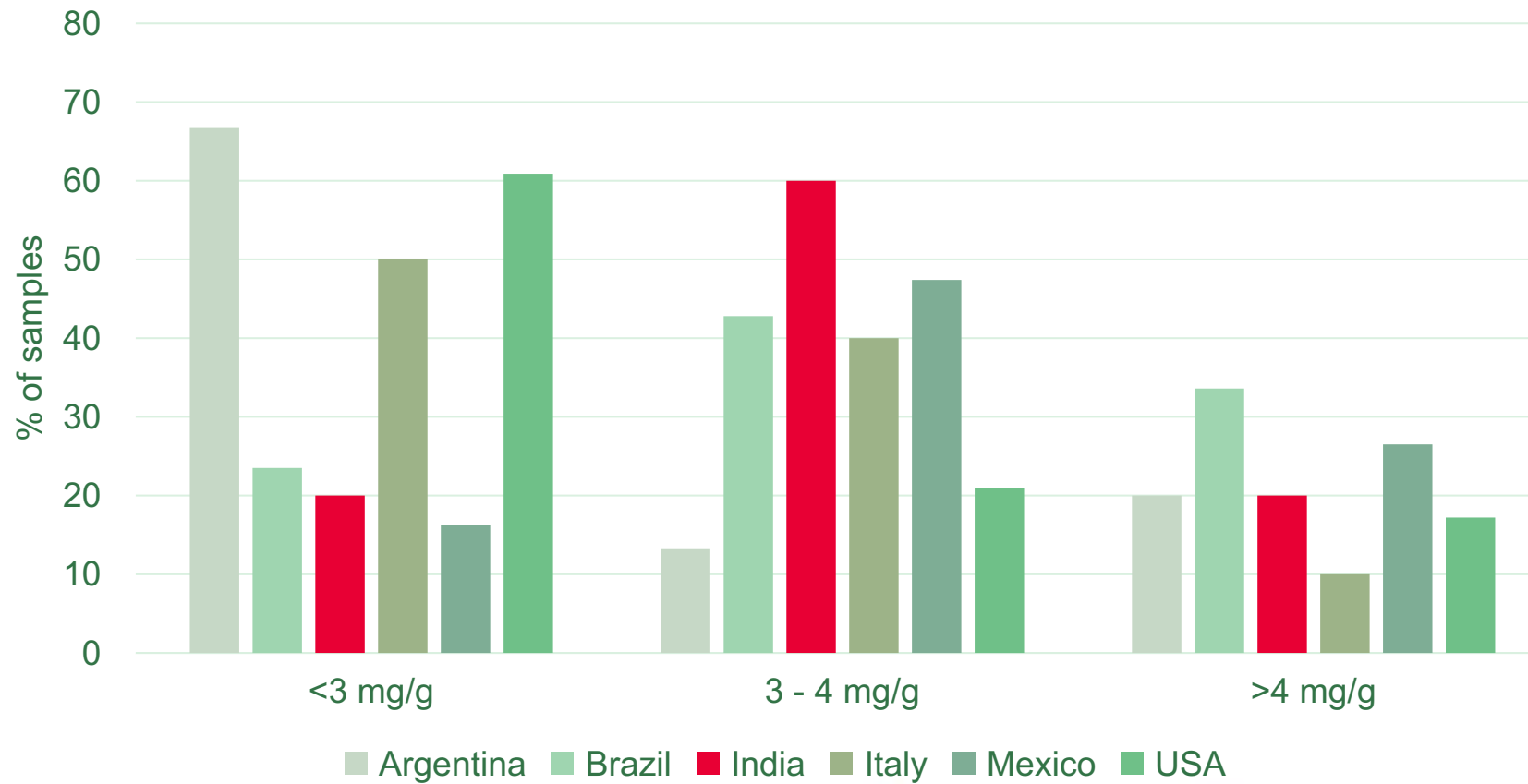
Lowest intercept: arg (1.21 mg/g TIA)

ranging from 1.6 to 1.8 mg/g TIA in feed

<https://doi.org/10.1016/j.psj.2022.101740>

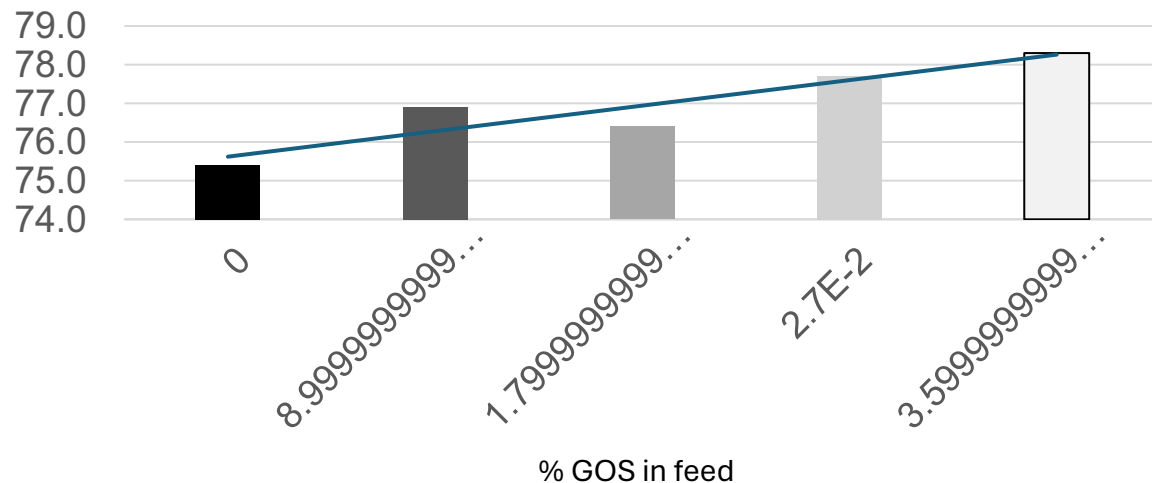


## TIA levels in SBM of different origins

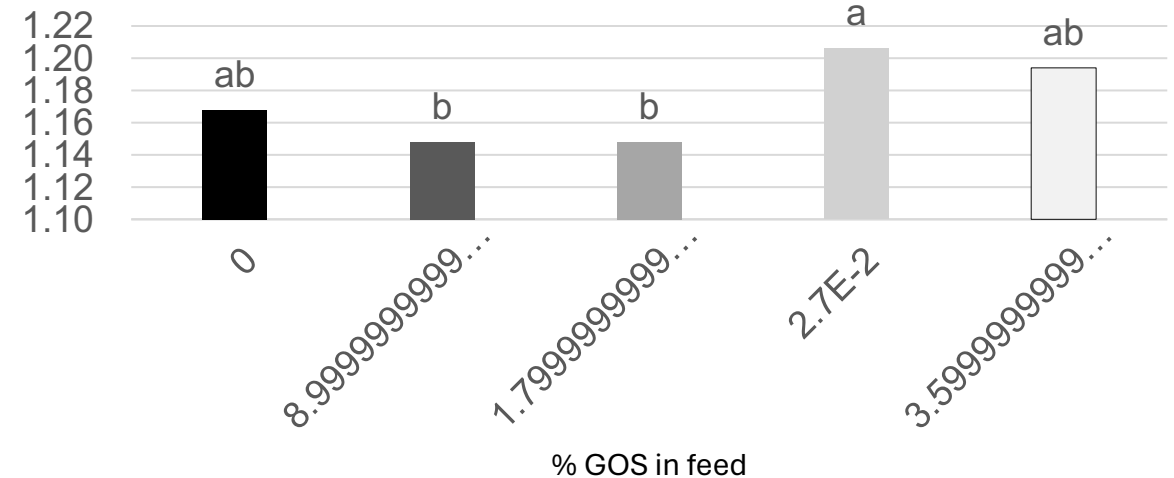


# Recommended $\alpha$ -GOS limit < 1.25% in feed - background

% Moisture in excreta at day 14 with increasing levels of  $\alpha$ -GOS



FCR at day 21 with increasing levels of  $\alpha$ -GOS



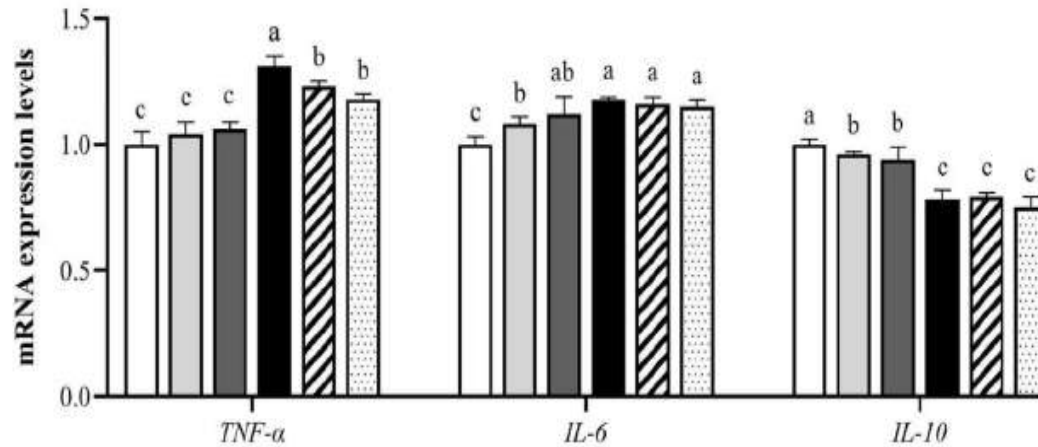
Diet were based on soy protein isolate (SPI) +  $\alpha$ -GOS at 0.0, 0.9, 1.8, 2.7, or 3.6% added stachyose and raffinose in a ratio of 4:1.

$\alpha$ -GOS increase FCR in 21-day-old chicks.  
 $\alpha$ -GOS increase moisture in excreta, compromising gut health  
<https://doi.org/10.1016/j.psj.2022.102440>

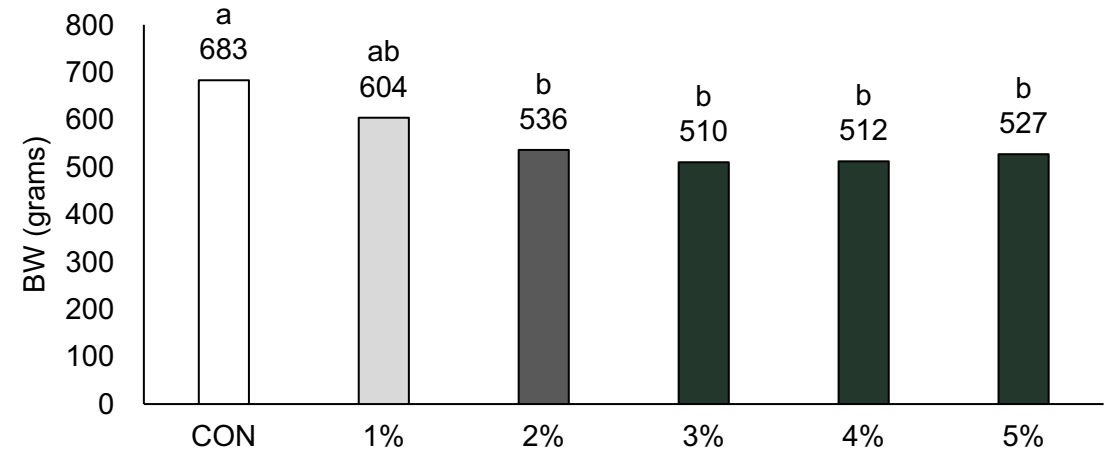


# $\beta$ -CON < 25000 ppm in feed - background

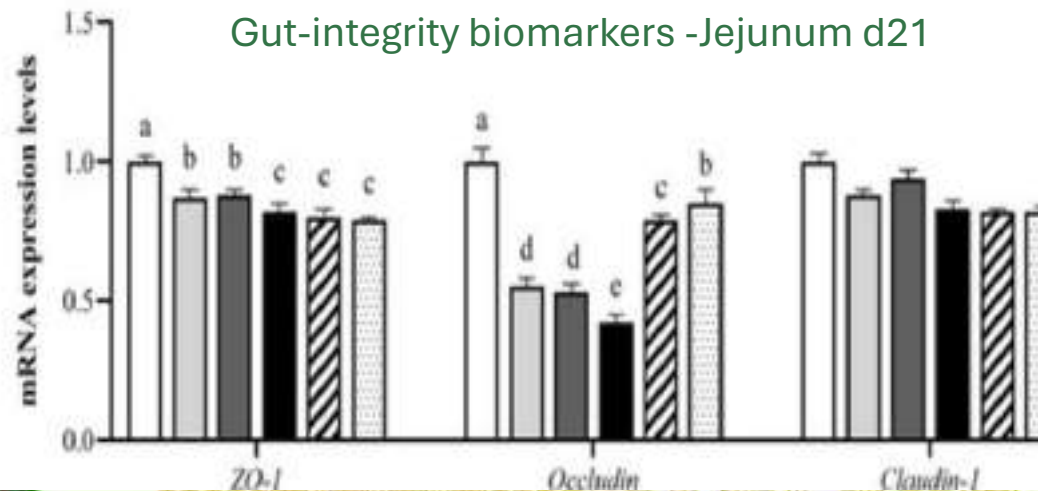
Inflammation biomarkers -Jejunum d21



Body Weight (g) d28



Gut-integrity biomarkers -Jejunum d21



Chronic inflammation diverts resources from growth and performance and increases the susceptibility to gut-health issues



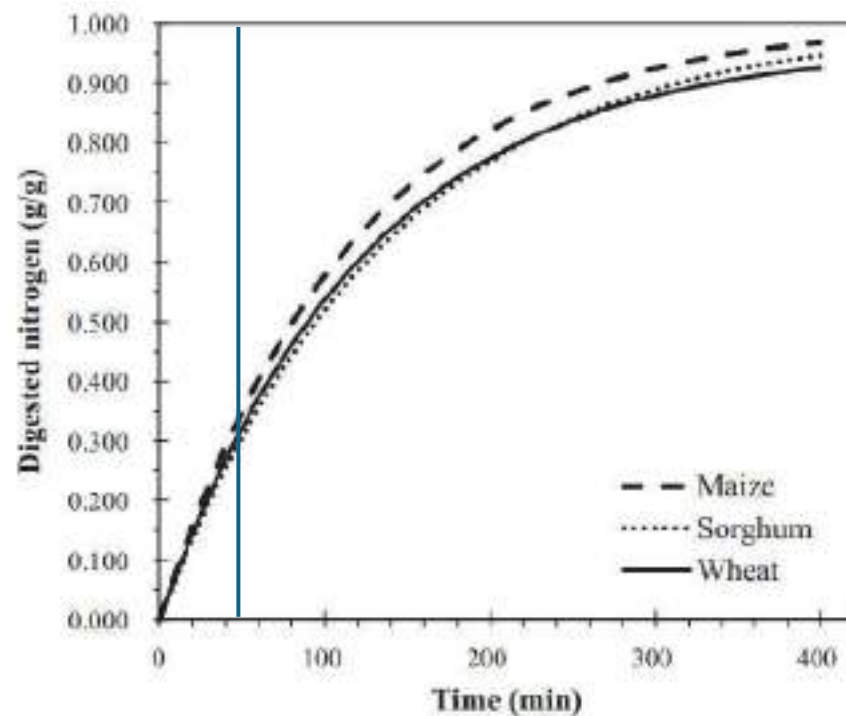
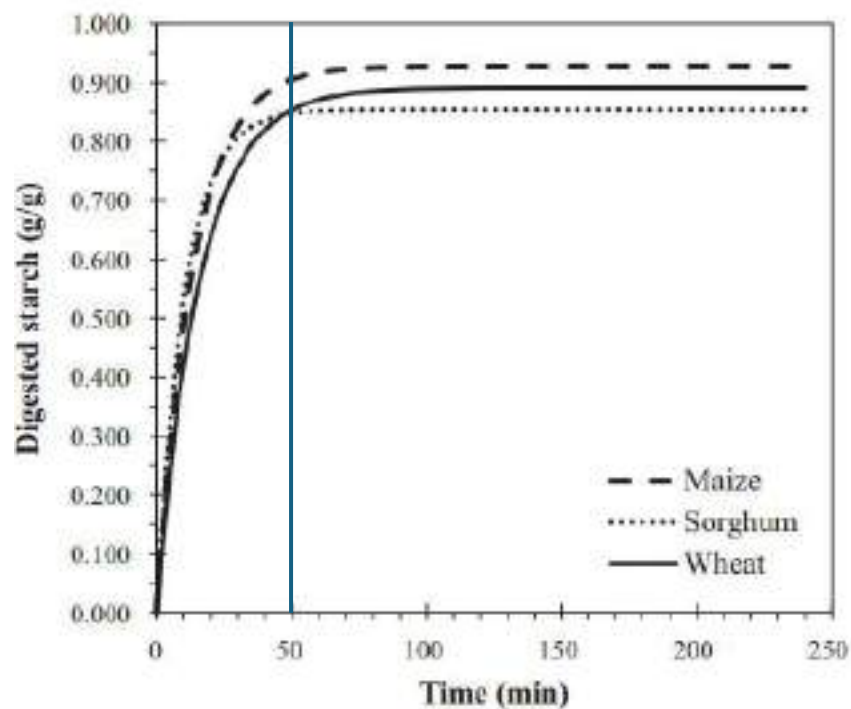
**Low ANF and high digestibility are not enough.  
The protein for critical periods also needs**

**Fast absorption**

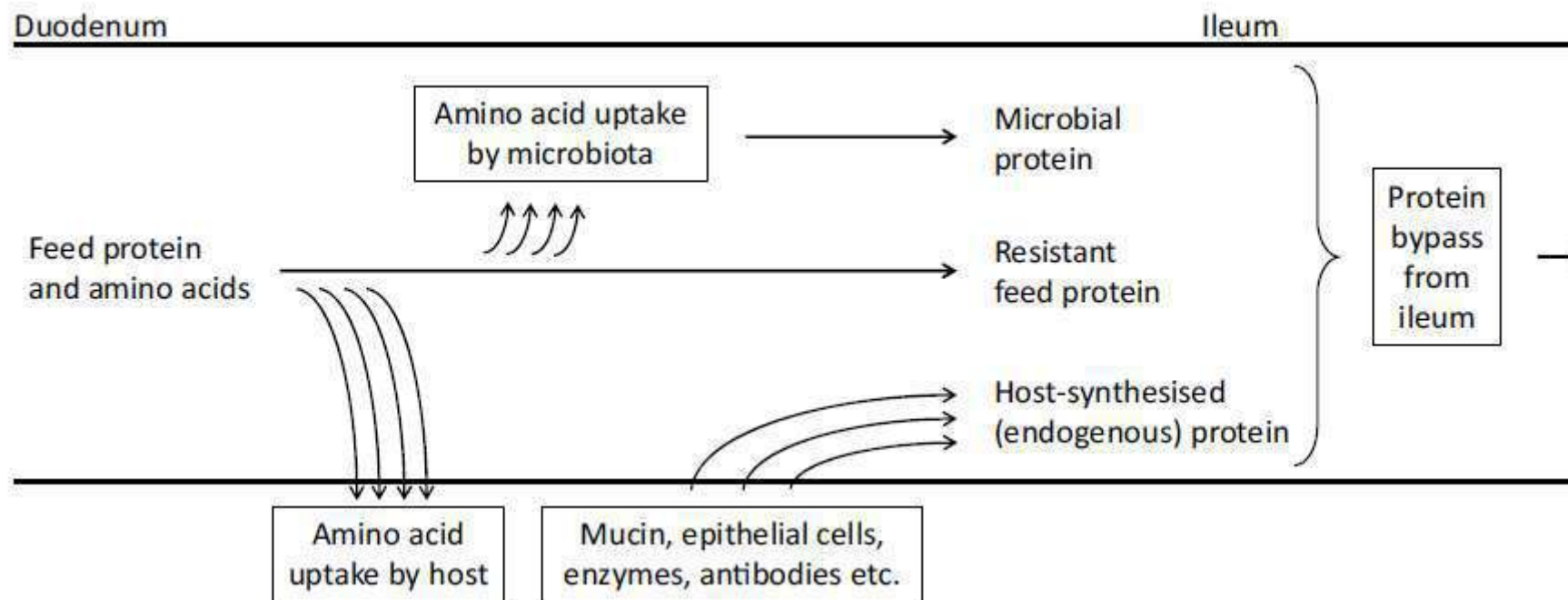


# Starch and Nitrogen digestion curves

Complete broiler diets based on maize, sorghum, and wheat + SBM and canola meal

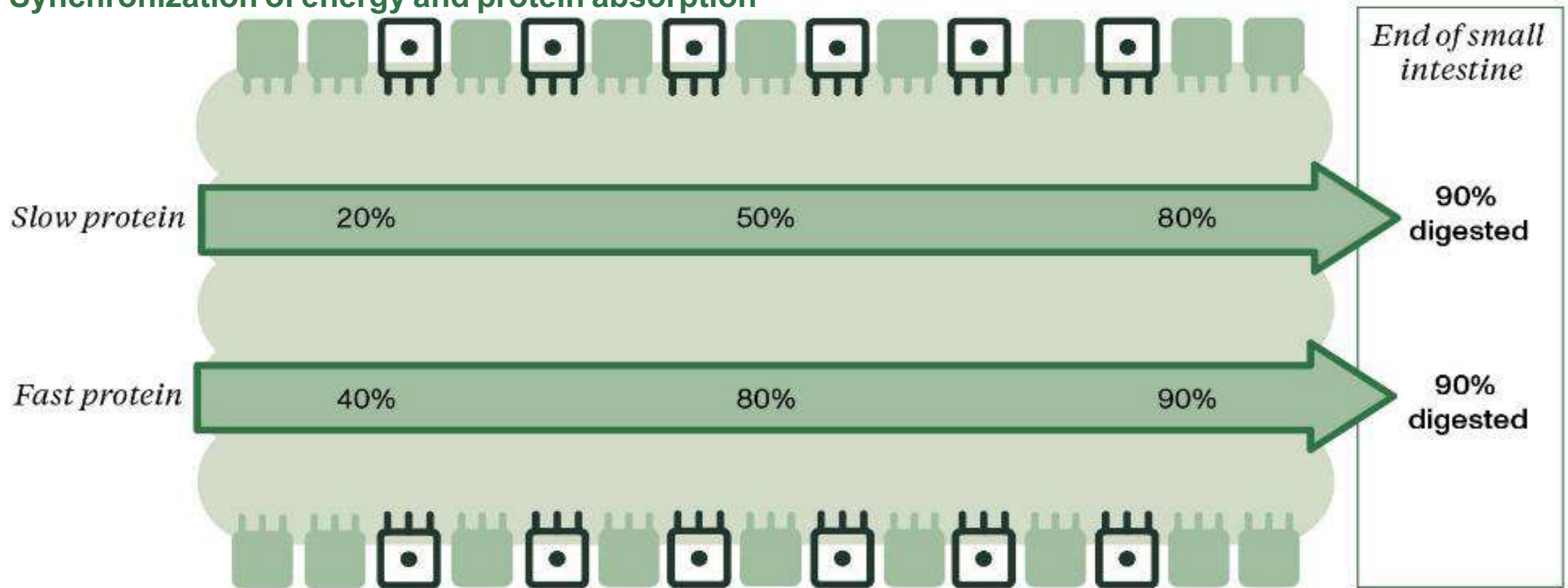


# Protein digestion

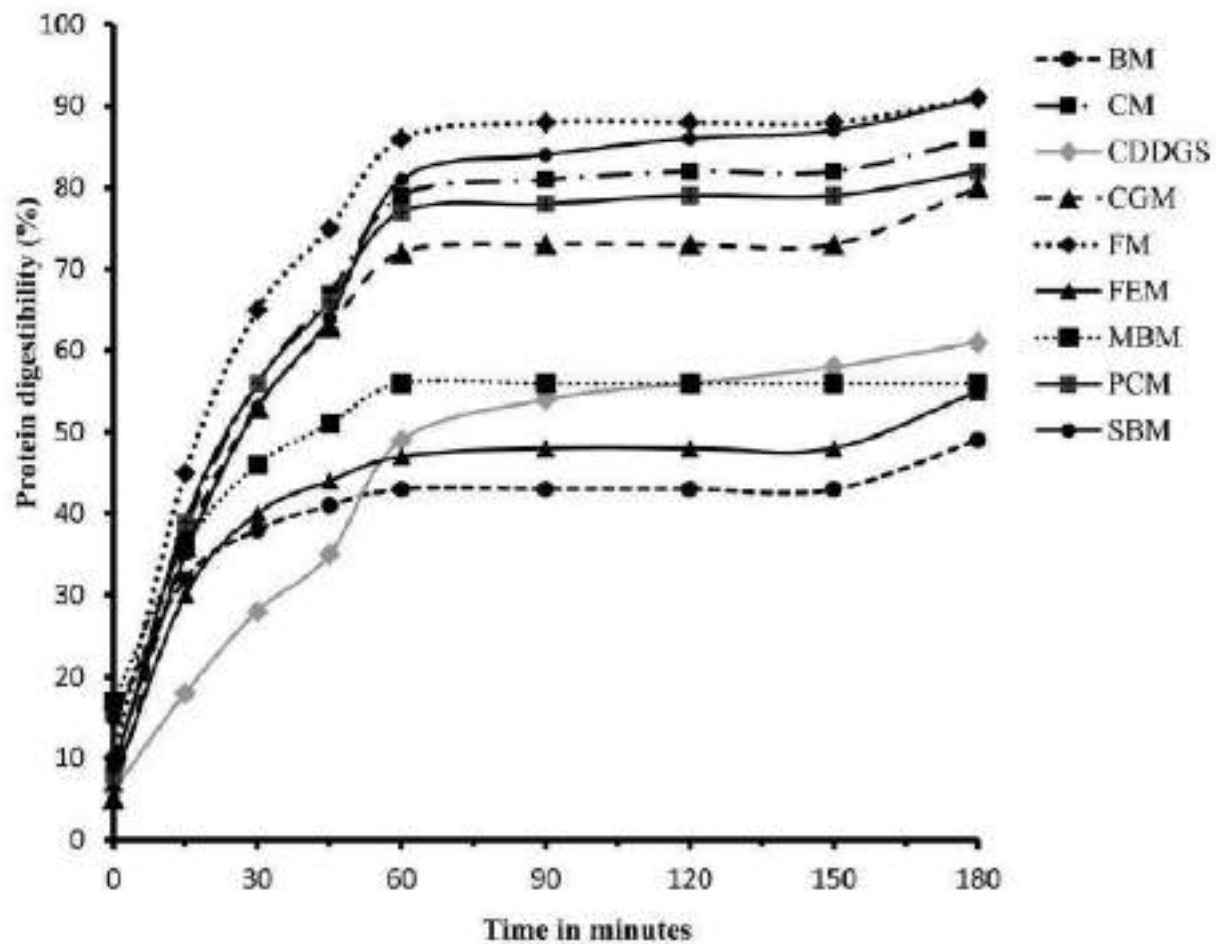


# Same digestibility but different absorption speed

- In conventional diets, the faster a protein is digested, the more it can be used for growth
- Synchronization of energy and protein absorption

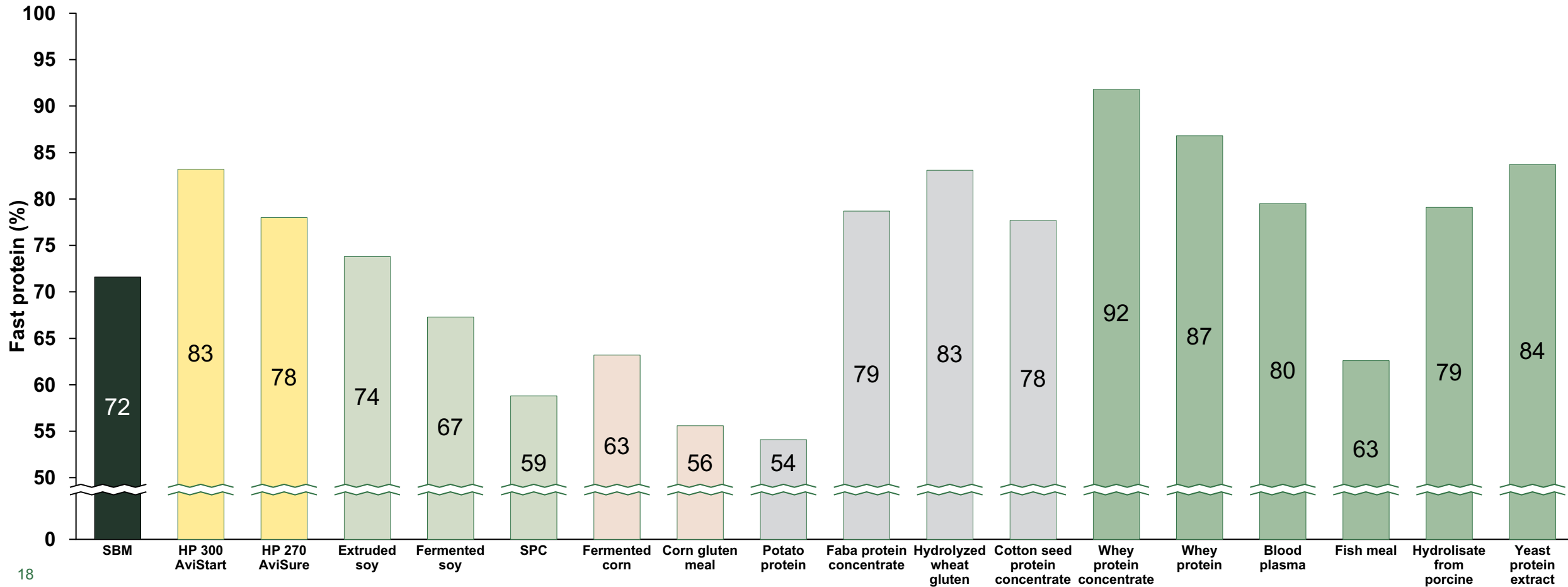


## *in vitro* Protein digestion



# *in vitro* Protein digestion

## pH-stat method - Hamlet Protein & Aarhus University



# Protein kinetics

Explained in 4 easy steps

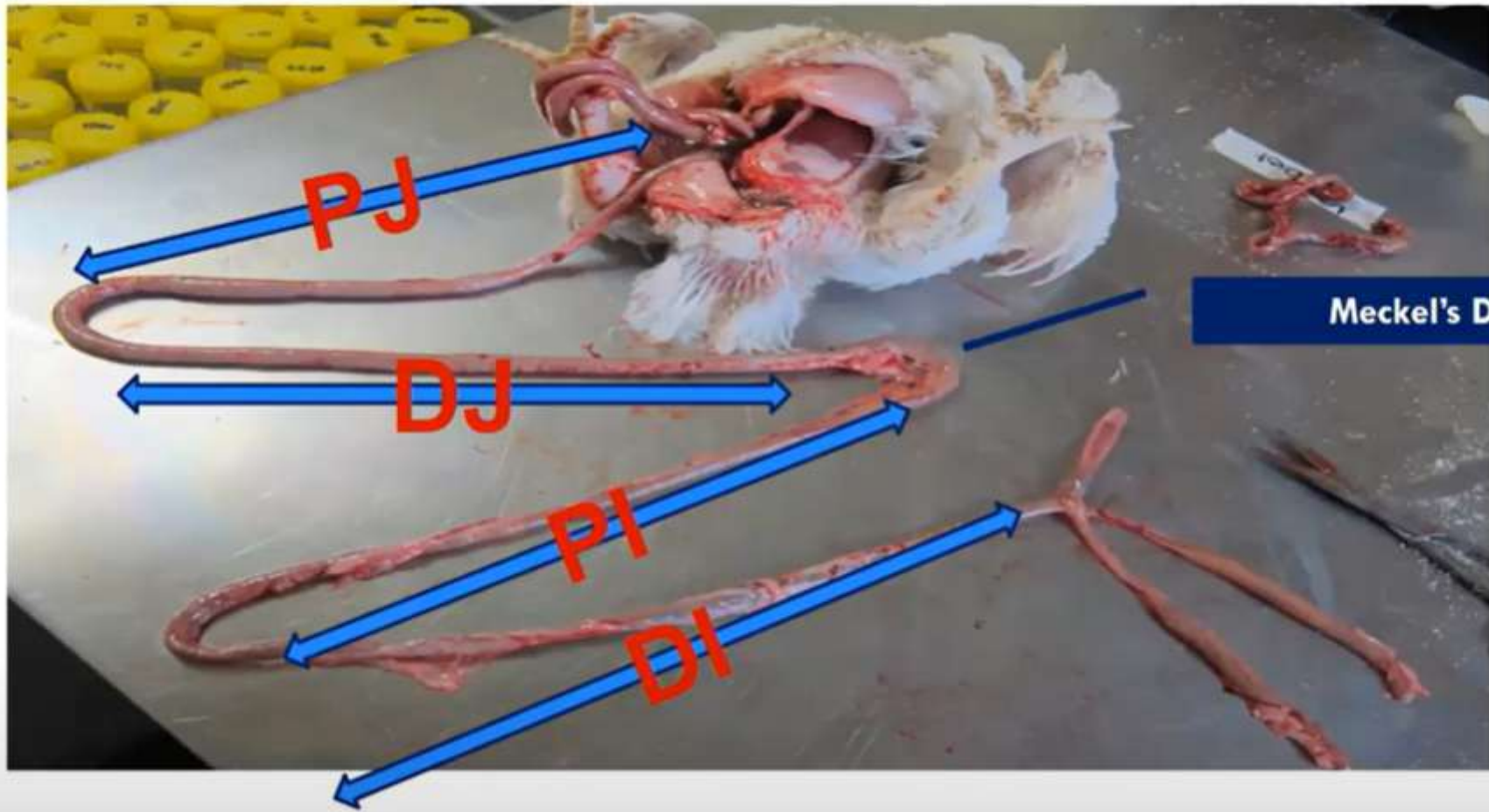
- 1** Faster protein hydrolysis in proximal small intestine
- 2** Faster absorption of amino acids in blood
- 3** Increased protein availability for tissues, and organs
- 4** Increased protein deposition and lower FCR



PROTEIN KINETICS  
BY HAMLET PROTEIN



17<sup>th</sup> Poultry  
**Kn**wledge  
Day 25 NOVEMBER



Meckel's Diverticulum



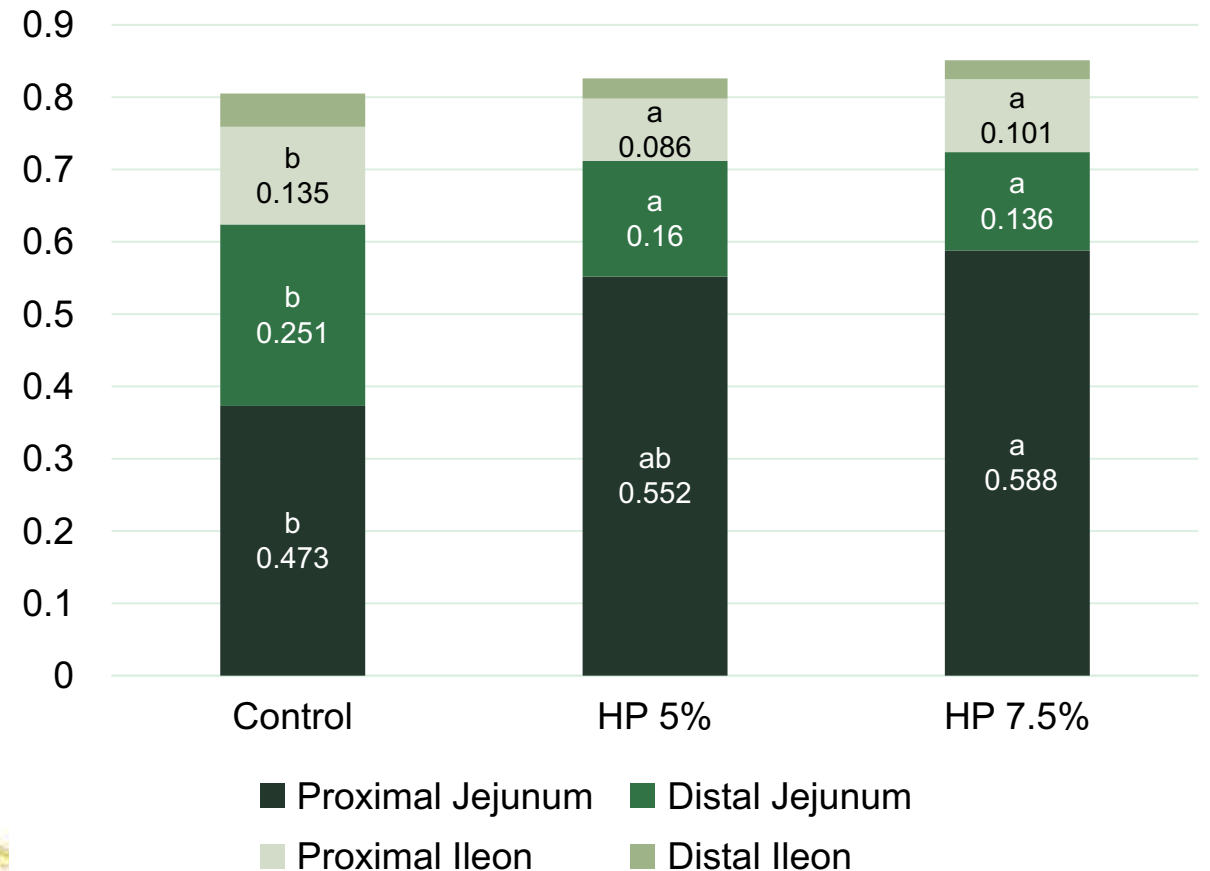
# Protein kinetics 1: digestion

## Sydney University

- Data at day 14 of feeding the experimental diets
- Caged broilers Ross 308: 3 groups, 8 reps of 21 birds
- Corn-SBM based diets

	Control	HP Avistart 5.0%	HP Avistart 7.5%
Corn	61.40%	61.00%	60.80%
SBM	30.60%	26.20%	24.00%
HP Avistart	-	5.00%	7.50%
Added AA	1.63%	1.45%	1.36%
AME (kcal/kg)	2980	2980	2980
Lys	1.30%	1.30%	1.30%
SAA	0.99%	0.99%	0.99%

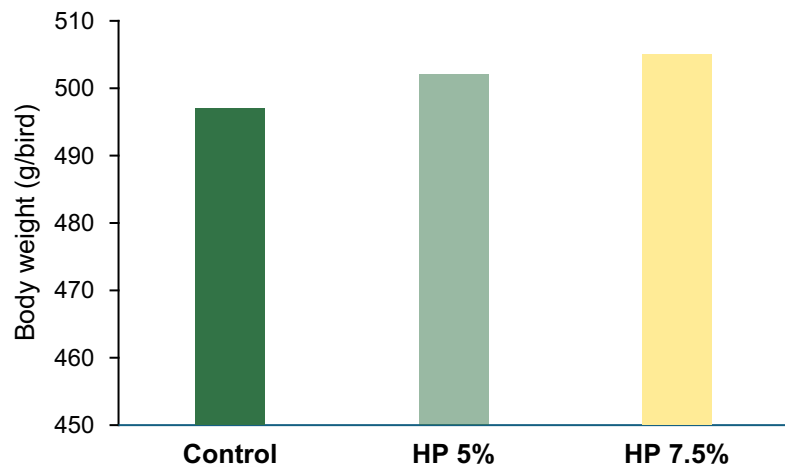
## Protein digestibility



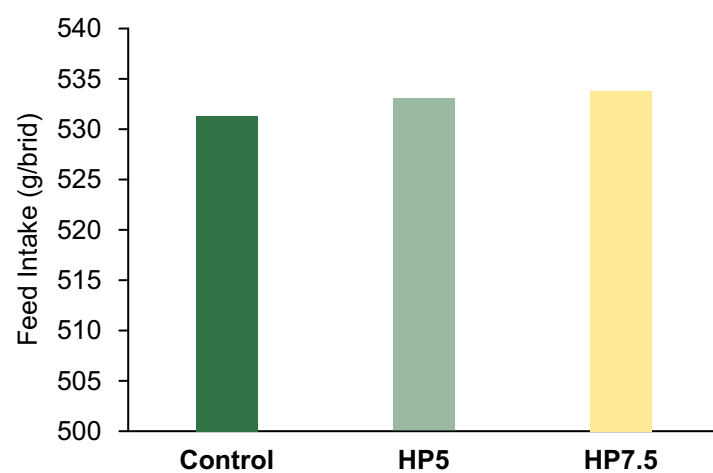
# Protein kinetics 4: performance

BW:  $\approx 95\%$  of genetic potential, 1 to 1.6% of increase at day 14

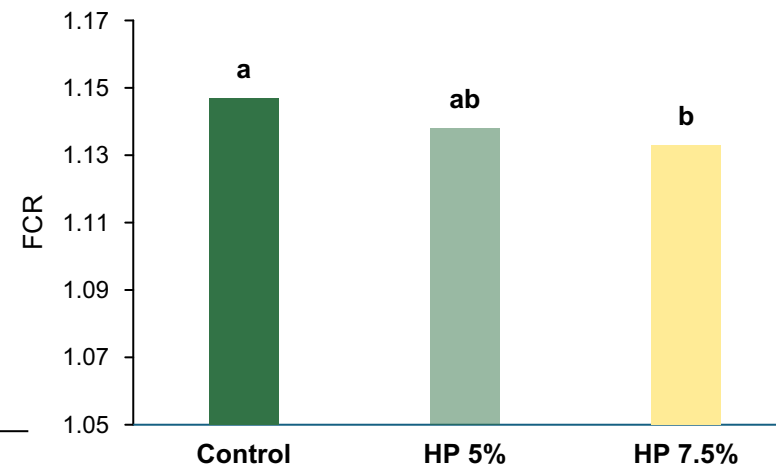
Body weight (P = 0.284)



Feed Intake (P = 0.157)



FCR (P = 0.003)

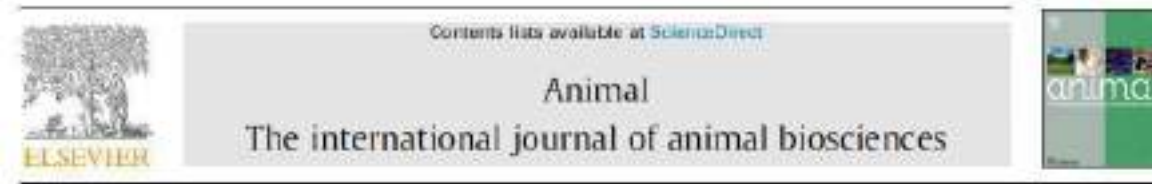


# Higher digestibility of dry matter and crude protein

Research at the University of Northwest A&F  
Yangling, Shaanxi, China

- Feeding period: 10 days – 5% ESBM
- Duration: 42 days
- Broilers in cages: 2 groups, 10 repetitions of 15 AA broilers

	Control	ESBM 5.0%
Corn	58.40%	58.62%
SBM	22.00%	14.69%
Cottonseed meal	11.56%	11.58%
Added AA	0.39%	0.36%
AME (kcal/kg)	2796	2798
Crude protein %	22.18%	22.17%
Lysine	1.39%	1.38%



Early addition of enzyme-treated soybean in the diet improves amino acid absorption and protein digestibility by promoting digestive enzyme activity in broilers

C.L. Ma<sup>a</sup>, Z.C. Yin<sup>a</sup>, X.Y. Zhang<sup>b</sup>, C.X. Zhang<sup>c</sup>, W.Y. Zhang<sup>b</sup>, Y.X. Li<sup>c</sup>, X.J. Yang<sup>a\*</sup>

<sup>a</sup> College of Animal Science and Technology, Northwest A&F University, Yangling, Shaanxi, China

<sup>b</sup> Shaanxi Shi Yang Co., Ltd., Xi'an, Shaanxi, China

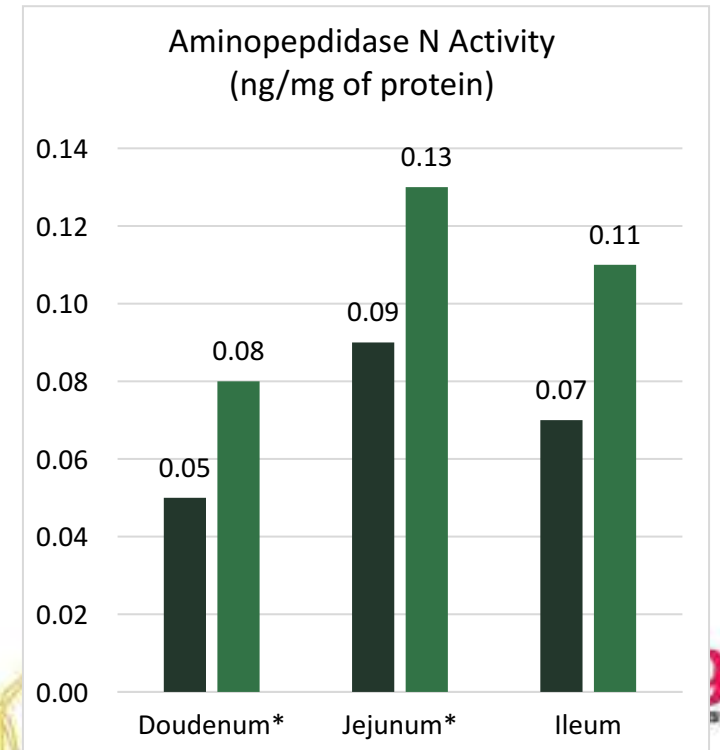
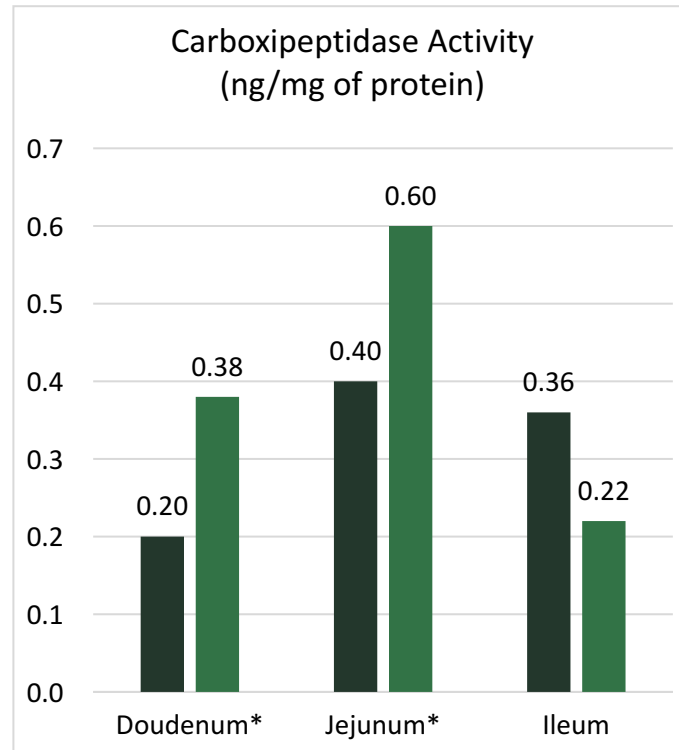
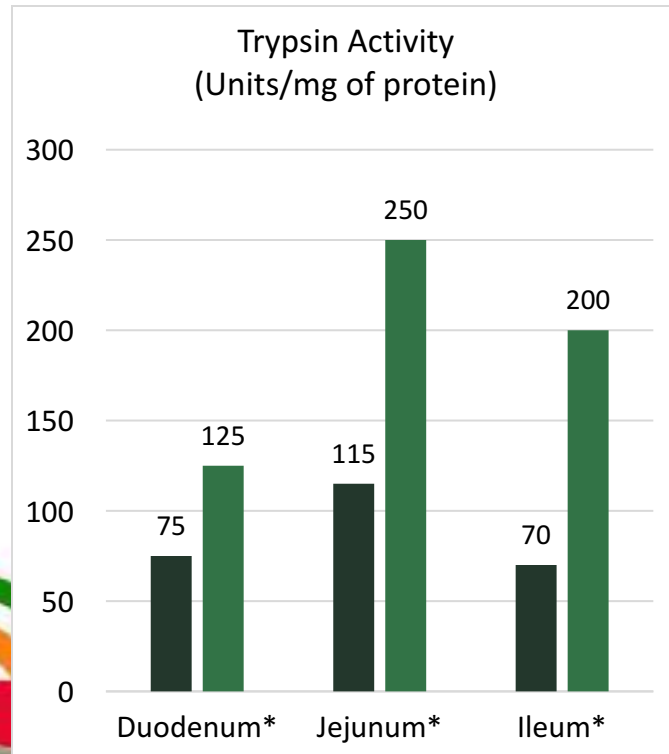
<sup>c</sup> Hamlet Protein Qingdao Office, No. 1603, 436 Meiling Road, Laoshan District, Qingdao, Shandong Province 266106, China



# Higher proteolytic enzyme activity in digesta at day 10

## Protein Kinetics 1 – Digestion

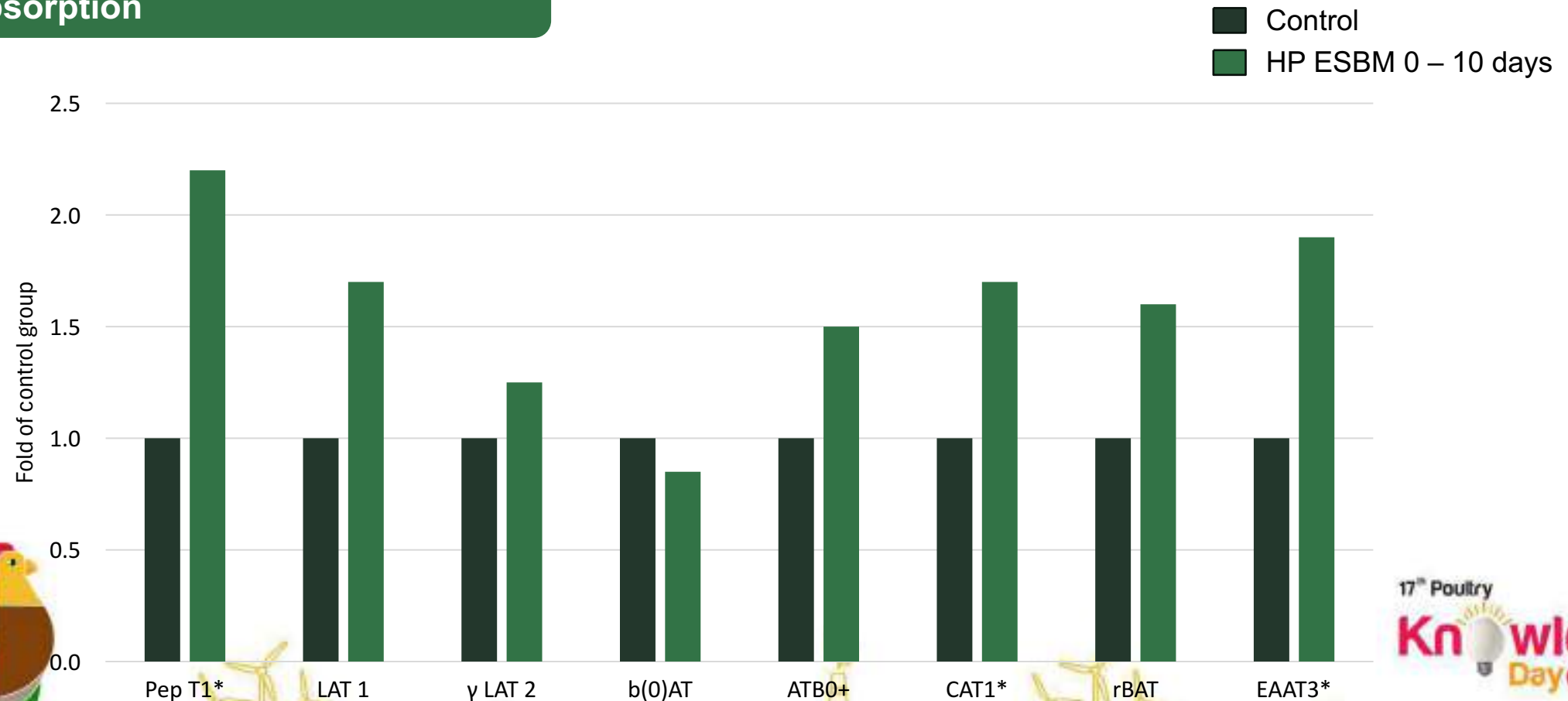
■ Control  
■ HP ESBM 0 – 10 days



\*Indicate statistically significant differences ( $P < 0.05$ )

# Higher expression of amino acid transporters at day 10

## Protein Kinetics 2 – Absorption



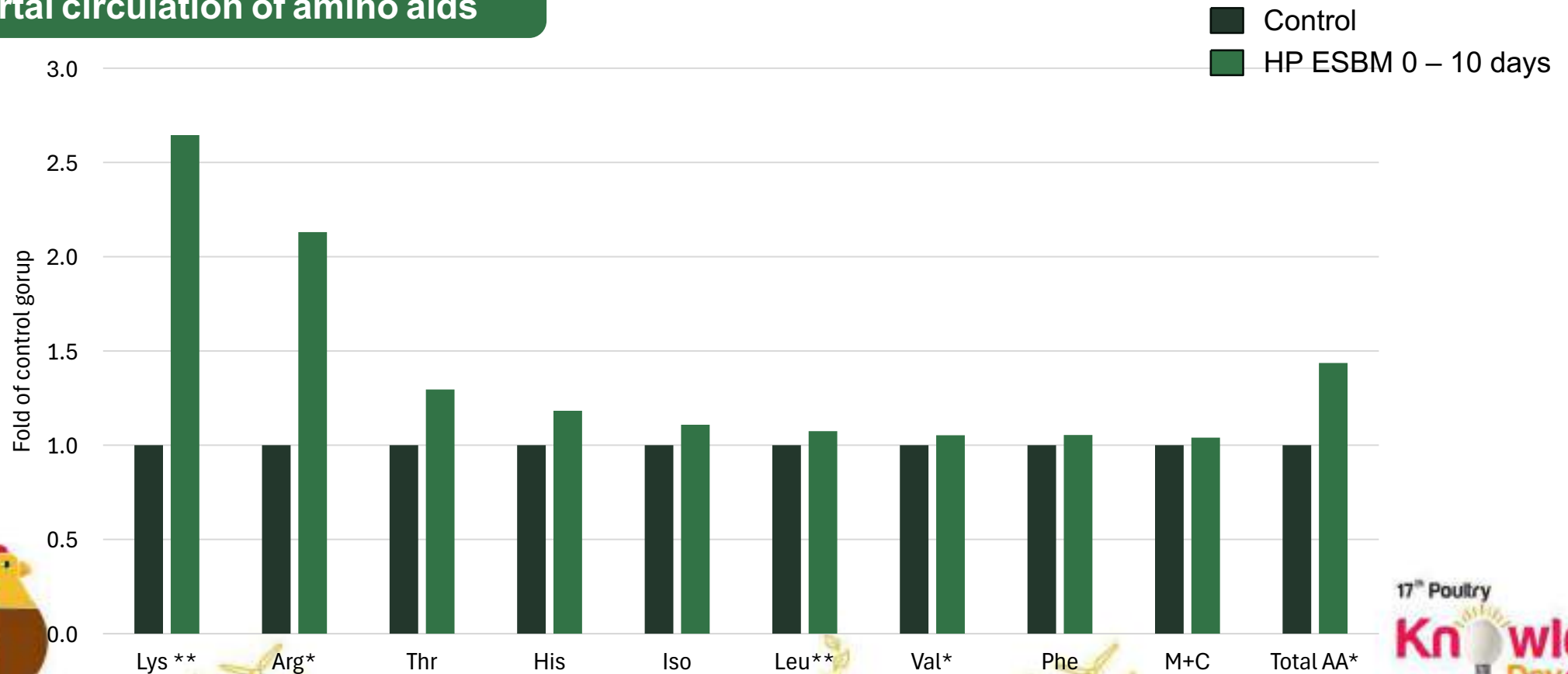
\*Indicate statistically significant differences (P<0.05)



# Higher serum amino acids at day 10

## Protein Kinetics

### 3 – Portal circulation of amino acids



\*Indicate statistically significant differences (P<0.05)

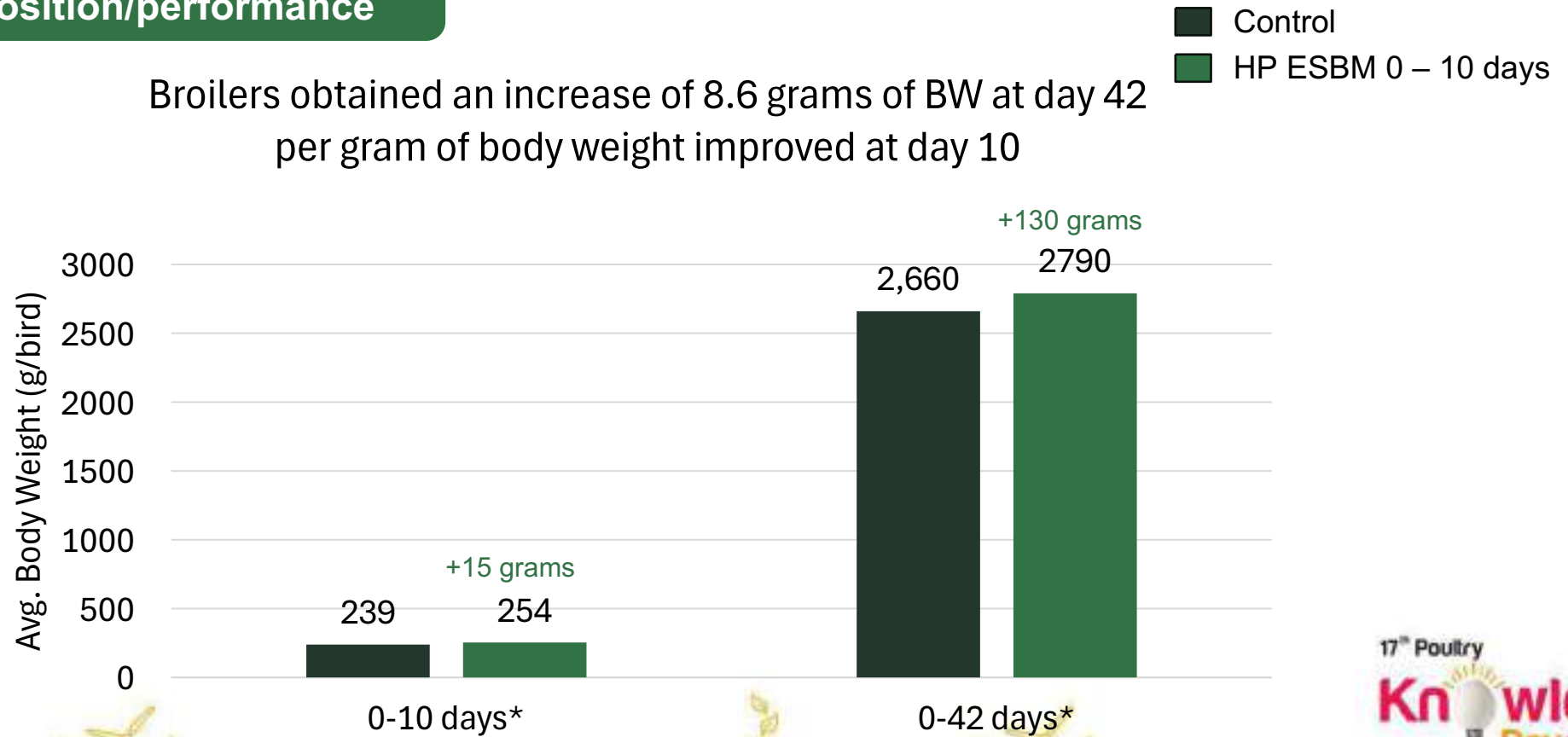


# Improved performance

Protein Kinetics

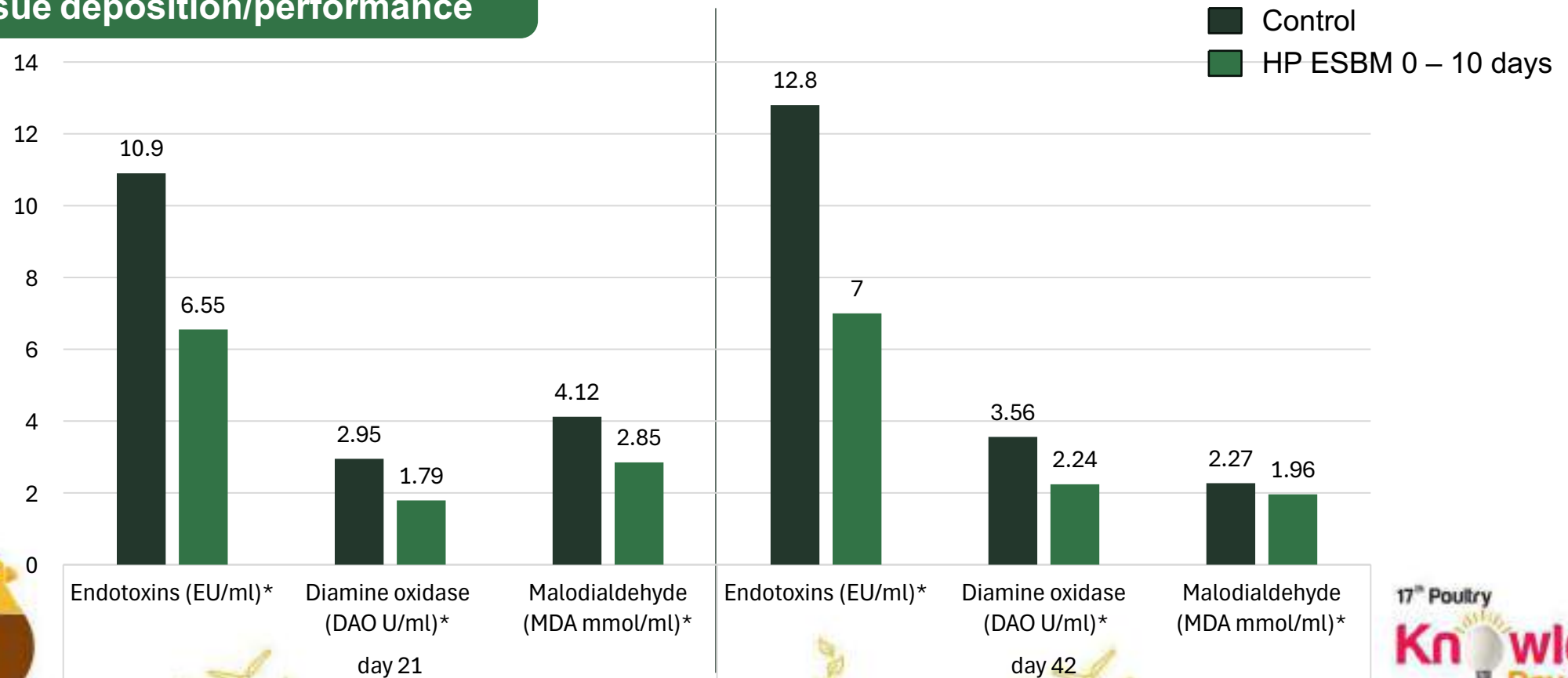
4 – Tissue deposition/performance

Broilers obtained an increase of 8.6 grams of BW at day 42 per gram of body weight improved at day 10



# Improved gut health biomarkers

## Protein Kinetics 4 – Tissue deposition/performance



\*Indicate statistically significant differences (P<0.05)



# Protein kinetics *in vivo* – results

## Protein Kinetics 1 - Digestion

Increase in endogenous protease activity:  
≈ **2x** of the control group in all intestinal segments

Hydrolyzing:  
proteins to peptides  
peptides to amino acids

## Protein Kinetics 2 - Absorption

Increase in expression of peptide and amino acid transporters  
≈ **2x** of the control group for PEPT1, LAT1, CAT1, EAAT3

**Compared with SBM:**  
20% higher protein  
absorption in the  
proximal jejunum

## Protein Kinetics 3 - Portal circulation

Increase in blood amino acids:  
≈ **1.5x** of the control group for total AA  
≈ **2x** of the control group for lysine and arginine

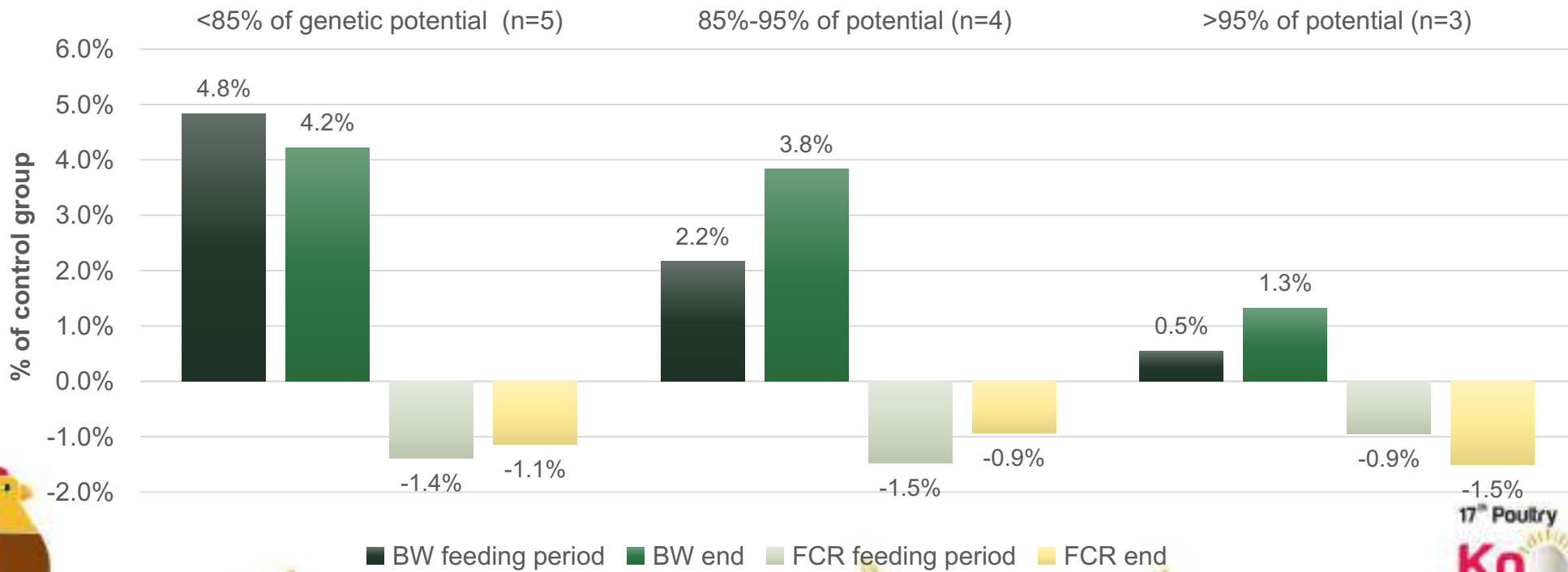


# What can we bring into practice?



# Does fast protein in the starter phase work at different performance levels?

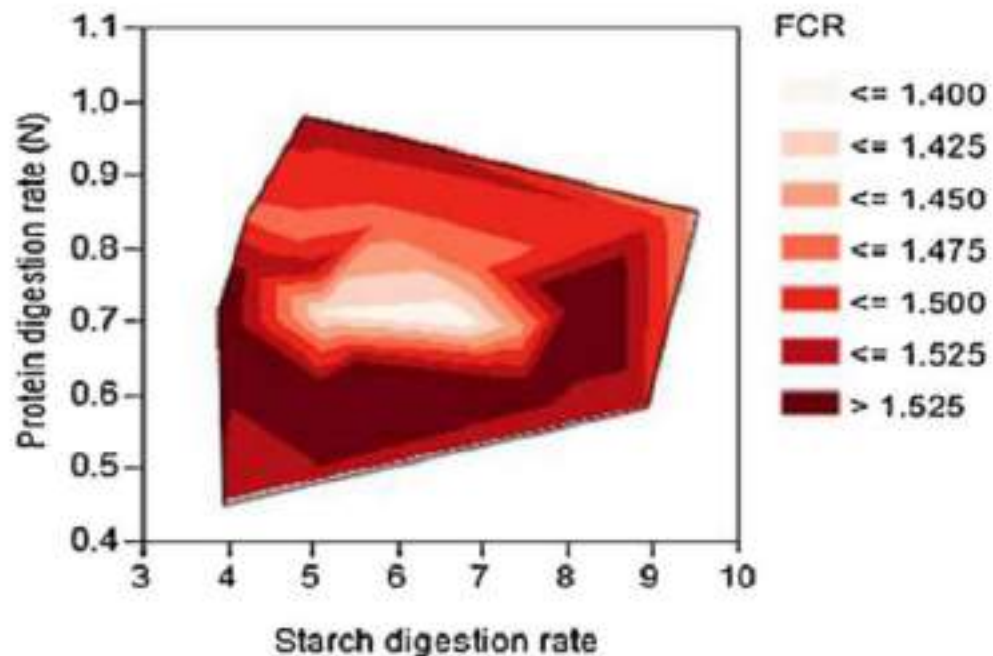
## % of improvement relative to a control group



\*Starter phase from 0 to 14 days  
Data from 2018 to 2024



## In practice: keep an eye on fast protein sources and quantity



Including **more fast protein** in poultry starter diets has an economic return: it increases protein deposition and performance at the end of the cycle.

**How much** fast protein?

The quantity of fast protein to include depends on different conditions...

- Monitor fast protein
- Increase it in diets for **critical periods.**





**HAMLET**  
PROTEIN™

**Hamlet Protein  
Protein for critical periods.**