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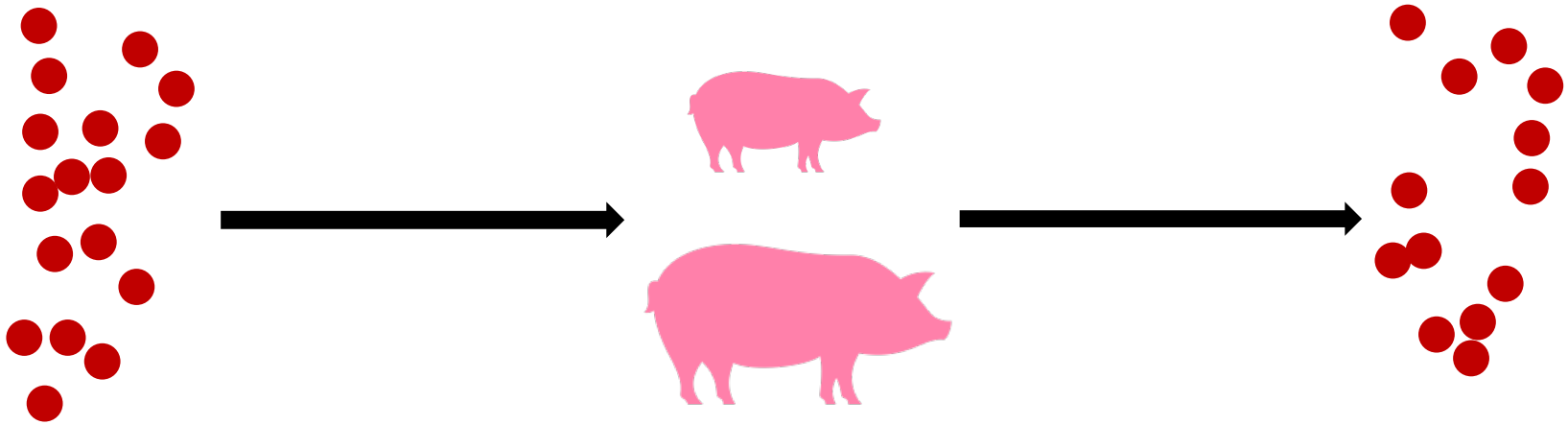
Agroscope

Estimating the efficiency of amino acid use using chemical composition data from growing pigs

Marion Lautrou, Giuseppe Bee

4th September 2024 – EAAP Firenze – Session 75

Context



Nitrogen intake

Excreted nitrogen

Expensive element

Profitability ?

Environment ?

Nitrogen emissions

- Eutrophication
- Cost

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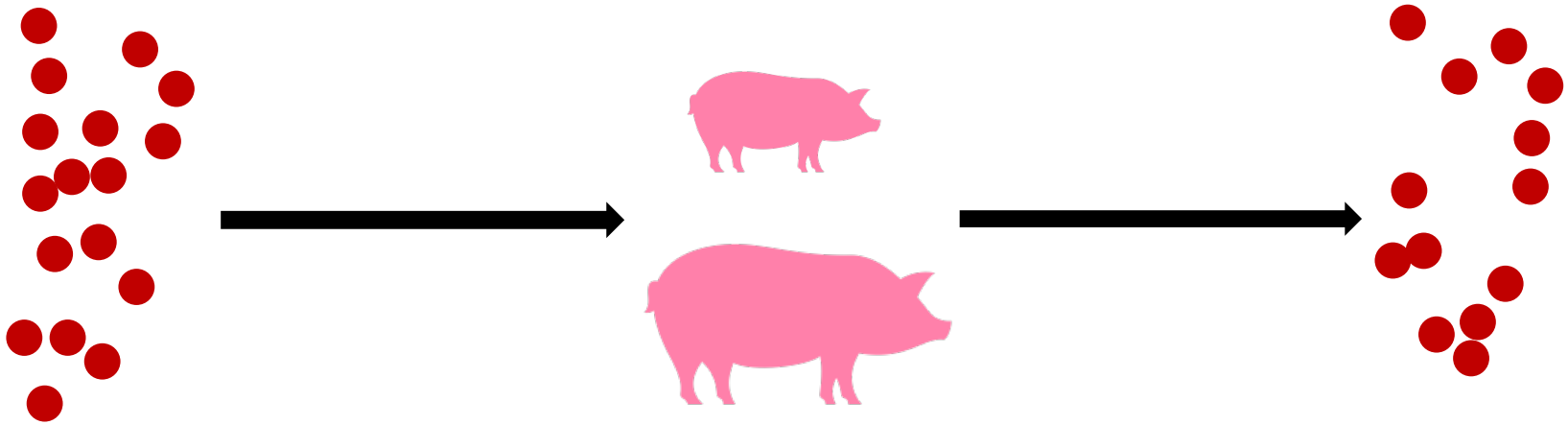

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Adjusting supplies to requirements

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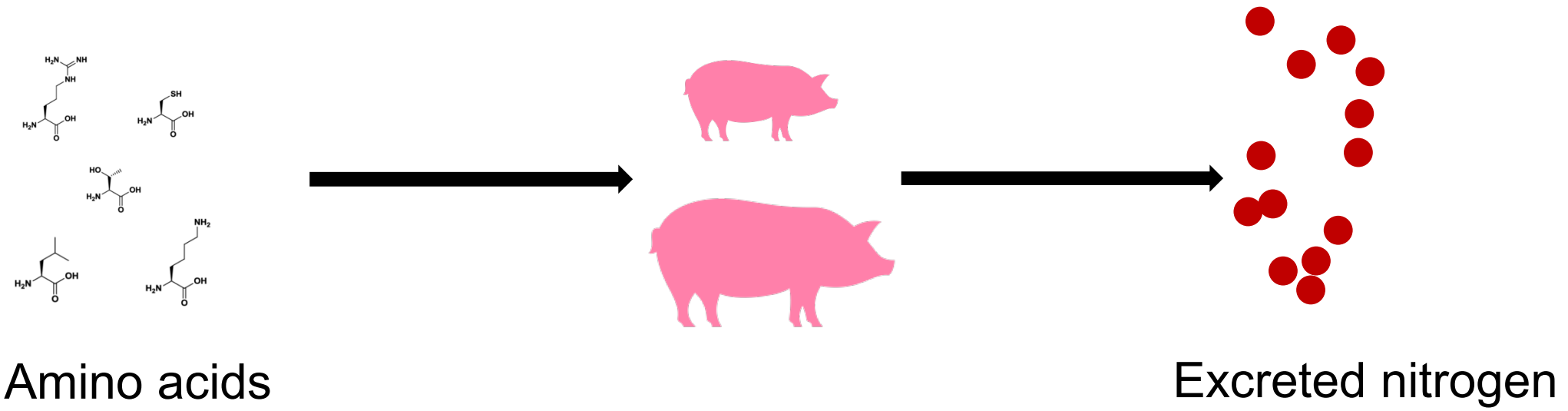

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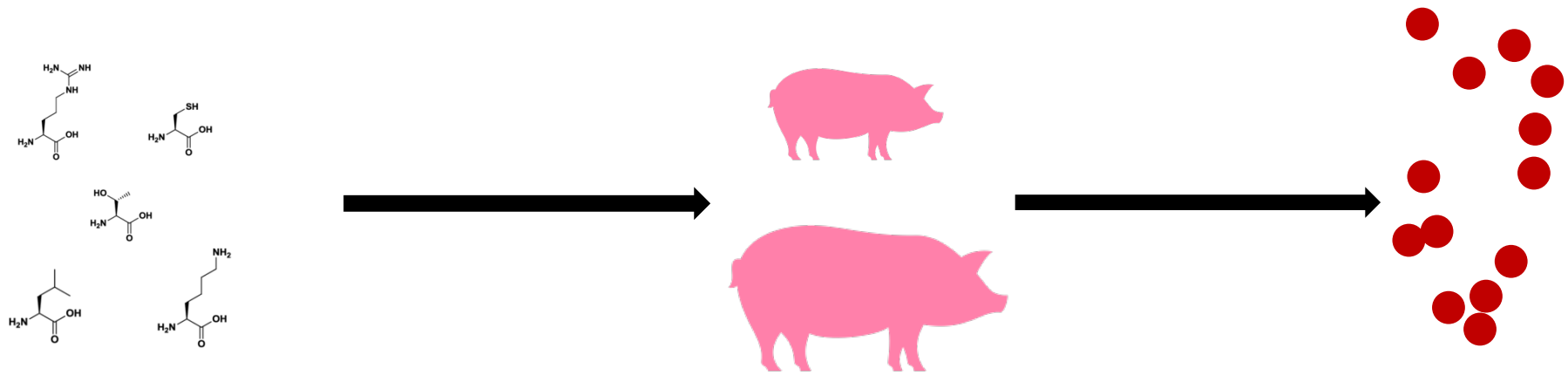

Amino acids

Excreted nitrogen

Adjusting supplies to requirements

Efficiency of amino acids use

Current estimation of amino acids use efficiency

InraPorc, 2008	**Agroscope**, 2005
Maximum Lys efficiency: estimated	Lys requirements: estimated
Efficiency other AA : calculated	Other AA : fixed profil

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No difference according the animals' **body weight**

No difference according the animals' **sex**
Data before 2000

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No difference according the animals' **body weight**

No difference according the animals' **sex**
Data before 2000

Entire males (EM), more efficients than the castrated males (CA) et females (F) (Ruiz *et al*., 2017, Bee *et al*., 2020)

Phenotypic – anatomical – chemical changes (Lautrou *et al*., 2022, Quiniou *et al*., 2023)

Context

Objective :

To evaluate and identify some factors of variation of the **efficiency use** of **amino acids** (AA) of recent genetic lines

We will use chemical composition data of growing pigs to test the effect of:

- The **body weight**
- The **sex**
- The **protein and amino acids** levels in the feed

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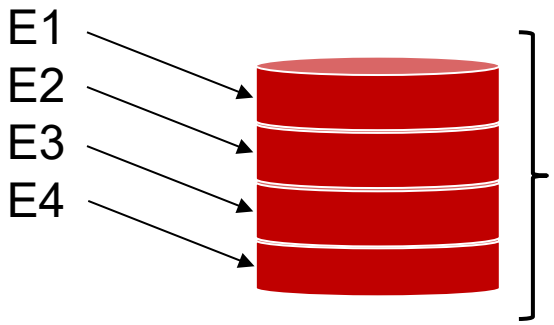
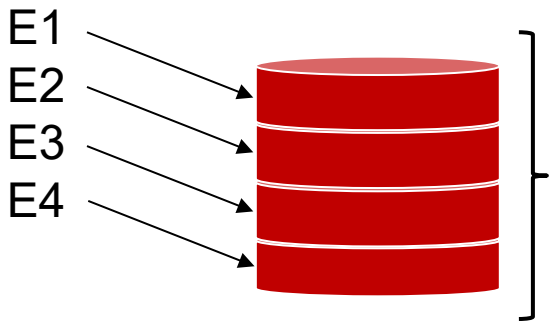
Material and methods



Common objective: to study the effect of protein level decrease in feed (-20%)

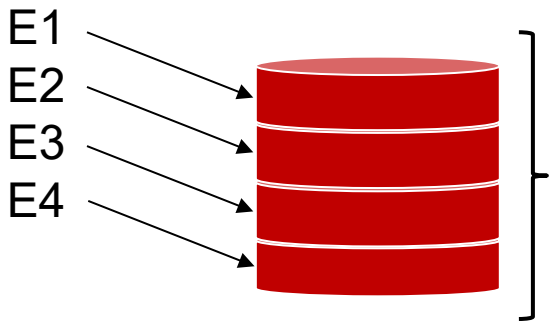
Material and methods



Common objective: to study the effect of protein level decrease in feed (-20%)

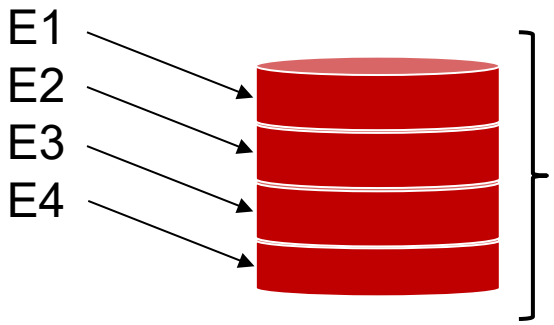
- **Same feed** chemically and very similar in composition
- Same experimental farm– **same practices**
  - Weekly weighing
  - Individual feeding
  - Slaughter protocol, same dissection and analysis

Material and methods



2012-2016
343 porcs (Swiss Large White)
3 sexes (Females, Castrated males, Entire males)
3 diets

Material and methods



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Slaughter weight	20 kg	40 kg	60 kg	80 kg	100 kg	120 kg	140 kg
Number of pigs	38	32	58	40	58	40	40

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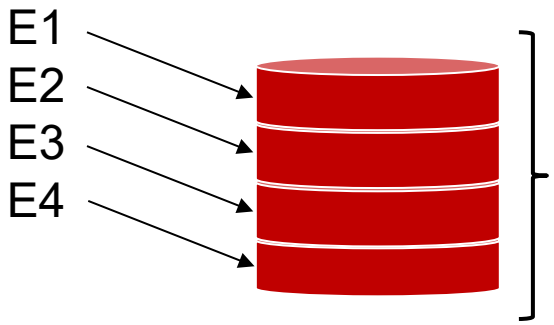

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Animals:

Body composition in AA

Weekly **weighing**
Daily individual **intake**

Diets:

Feed analysis: dry matter and **AA**

Standardized ileal digestibility (SID) of AA :
EvaPig and INRAe-CIRAD-AFZ tables

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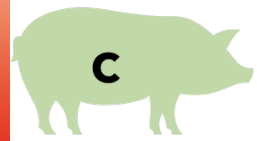
Material and methods



	Ad libitum	Phase 1	Phase 2	Phase 3
Net energy		9,8 MJ/kg	9,8 MJ/kg	9,9 MJ/kg
Proteins coverage*	100%	162 g/kg	139 g/kg	123 g/kg
Lys, met+cys, thr, trp*	100%	8,6 g/kg	6,3 g/kg	6,3 g/kg
Other AA profile*	Balanced			

* According to the recommendations of Agroscope (2005)

Swiss standard: EM receives 5% more of proteins and AA

Material and methods

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R1	**Net energy**		9,9 MJ/kg	9,8 MJ/kg	10,0 MJ/kg
	Proteins coverage*	80%	139 g/kg	121 g/kg	103 g/kg
	Lys, met+cys, thr, trp*	80%	7,2 g/kg	5,5 g/kg	5,35 g/kg
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	Other AA profile*	Balanced			
R2	**Net energy**		9,9 MJ/kg	9,9 MJ/kg	9,9 MJ/kg
	Proteins coverage*	80%	130 g/kg	113 g/kg	102 g/kg
	Lys, met+cys, thr, trp*	80%	6,8 g/kg	5,1 g/kg	4,87 g/kg
	Other AA profile*	Non balanced			

* According to the recommendations of Agroscope (2005)

Swiss standard: EM receives 5% more of proteins and AA

20 60 100 140

Weight-dependent phase change

Material and methods

$$\text{AA use efficiency} = \frac{\text{AA retention (g)}}{\text{SID AA intake (g)} - \text{maintenance requirements(g)}}$$

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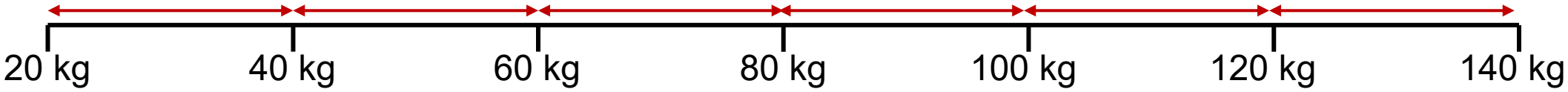
Essentials and semi-essentials AA:

Lysine, methionine+cysteine, threonine, tryptophan, isoleucine, leucine, valine, phenylalanine+tyrosine, histidine, arginine



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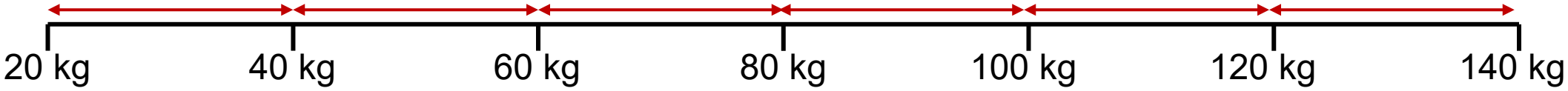
Chemical analysis of total AA
SID factors

InraPorc (Van Milgen *et al.*, 2008)



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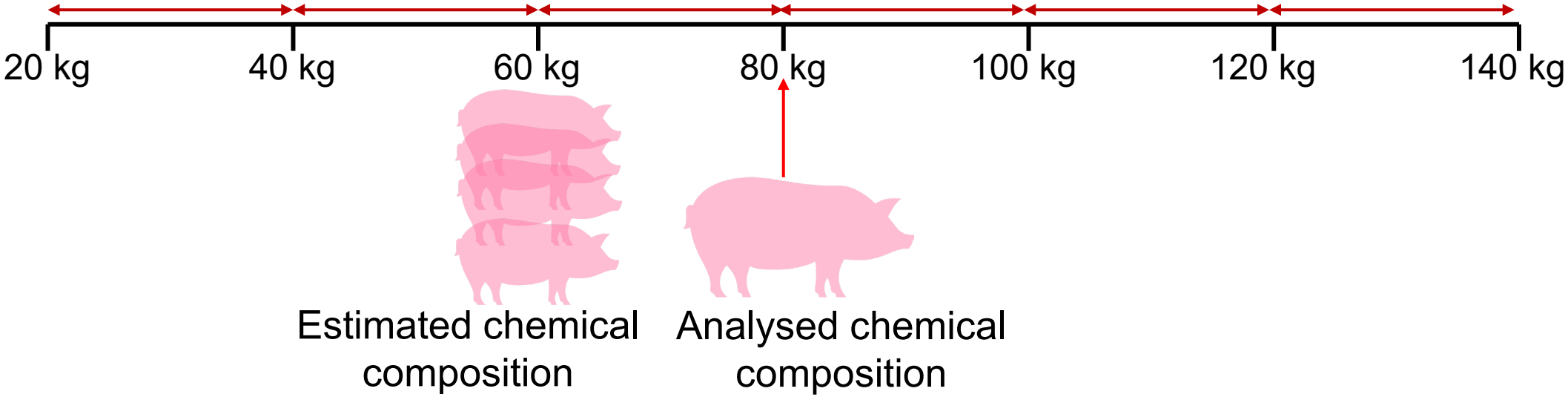
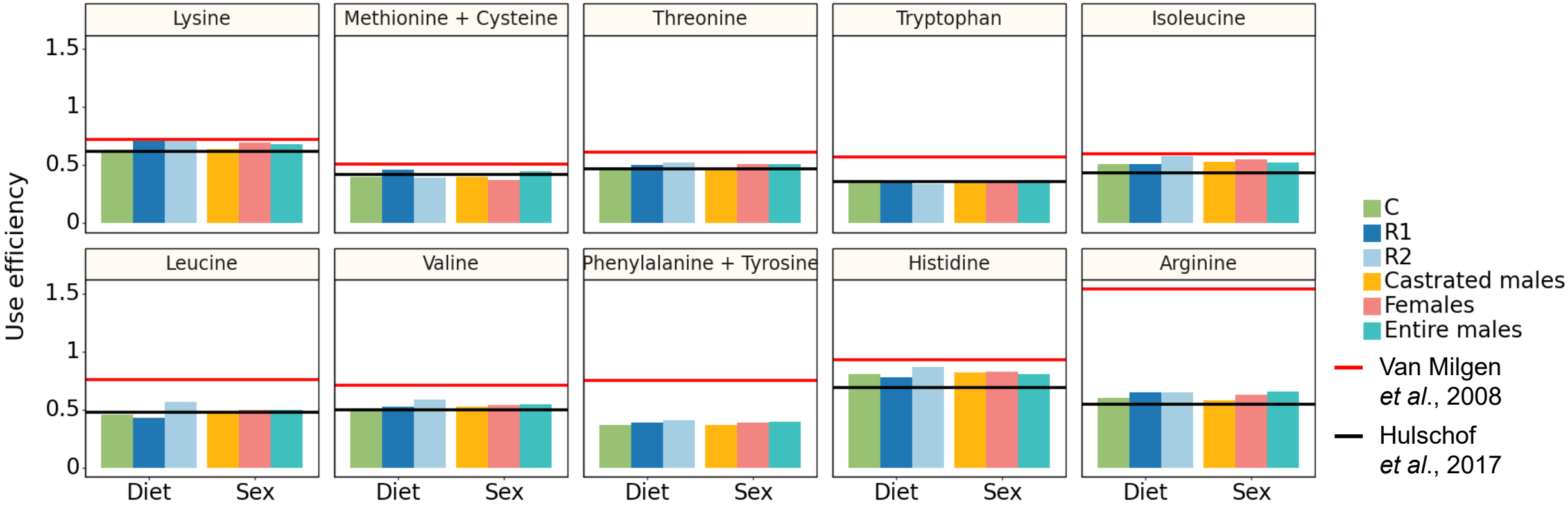


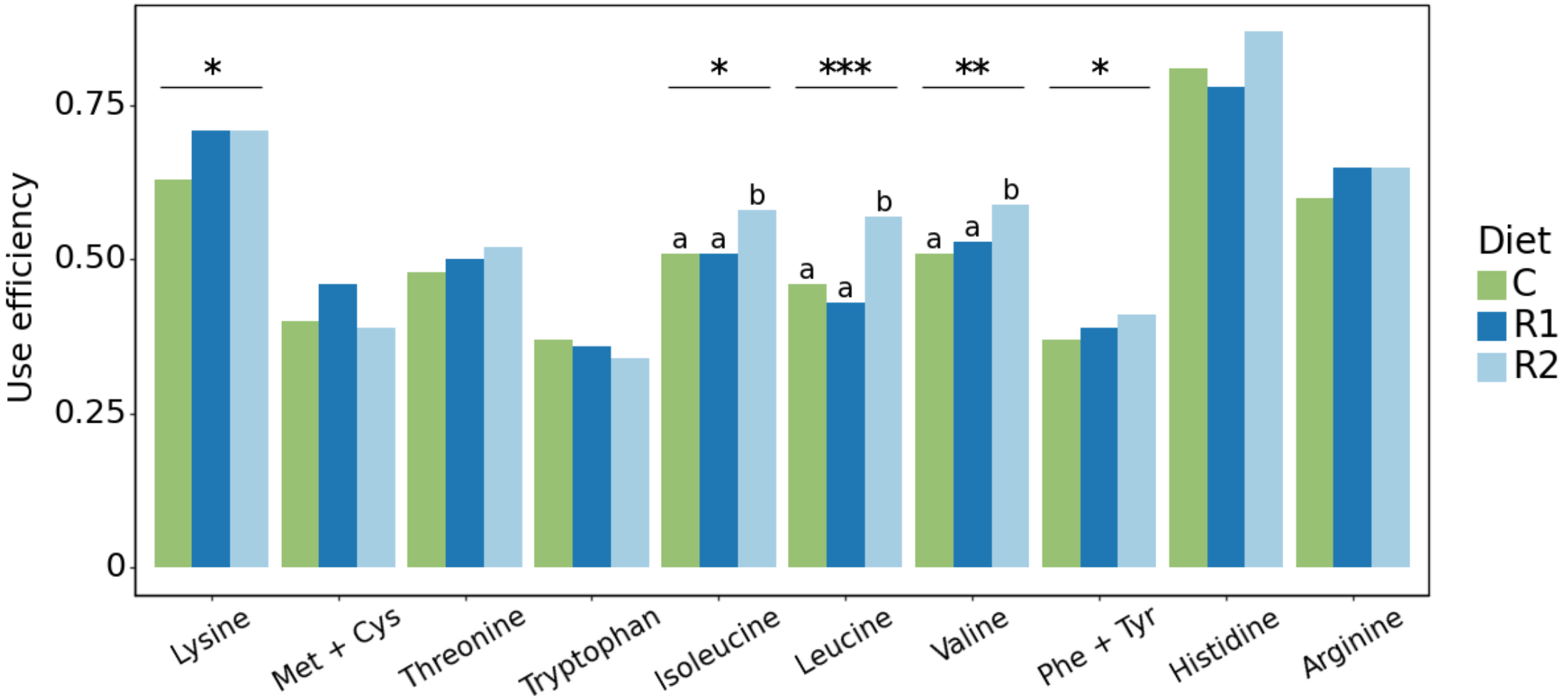
Material and methods

- Analysis of variance (package car, R version 4.2.2)
  - Experimental unit: **pig**
  - Variable to explain: **AA use efficiency**
  - Fixed effect: **experiment** + **sex** + **diet**
  - Covariable : **mean body weight**
  - Interactions : diet*sex*body weight tested and **NS** except for **arginine**

Use efficiency of the different amino acids



Effect of the diet on the AA use efficiency



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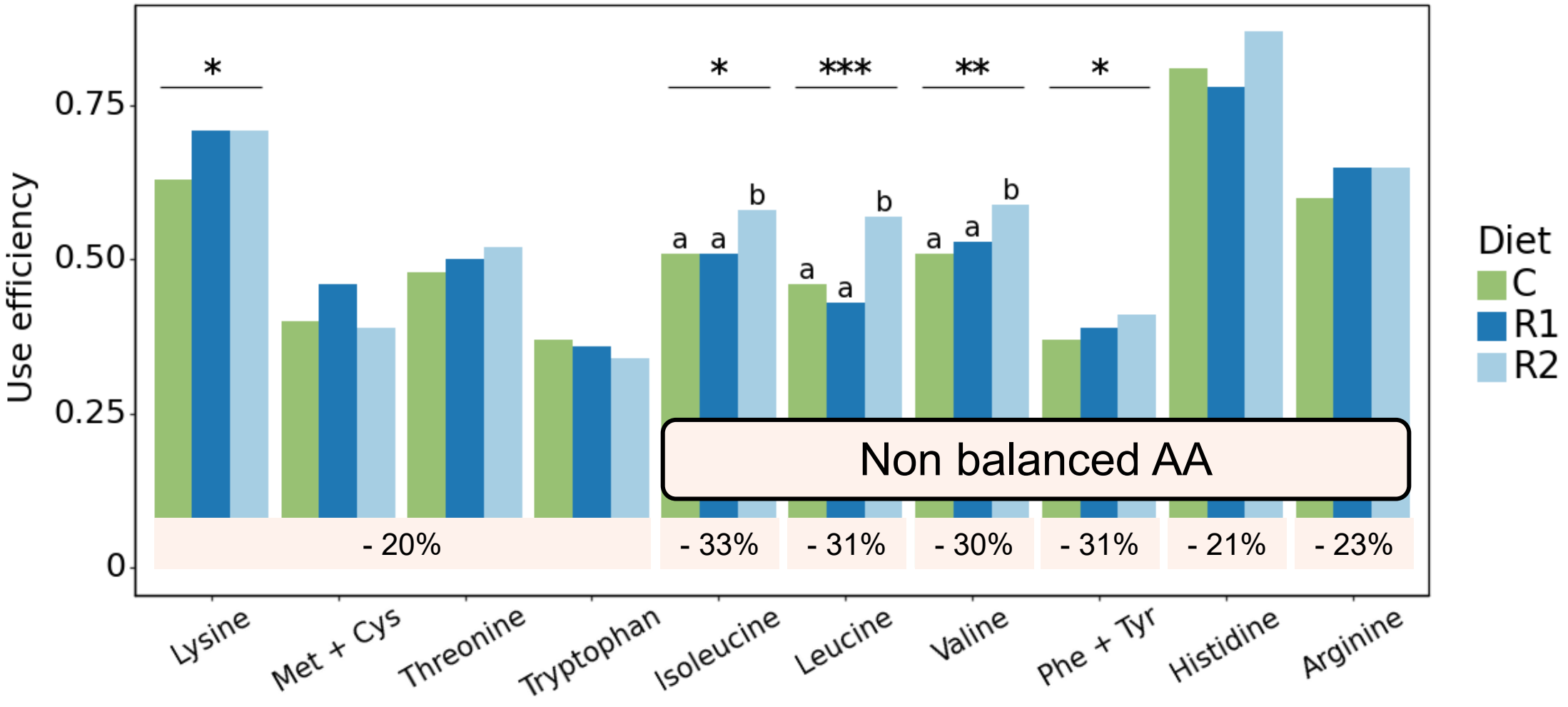

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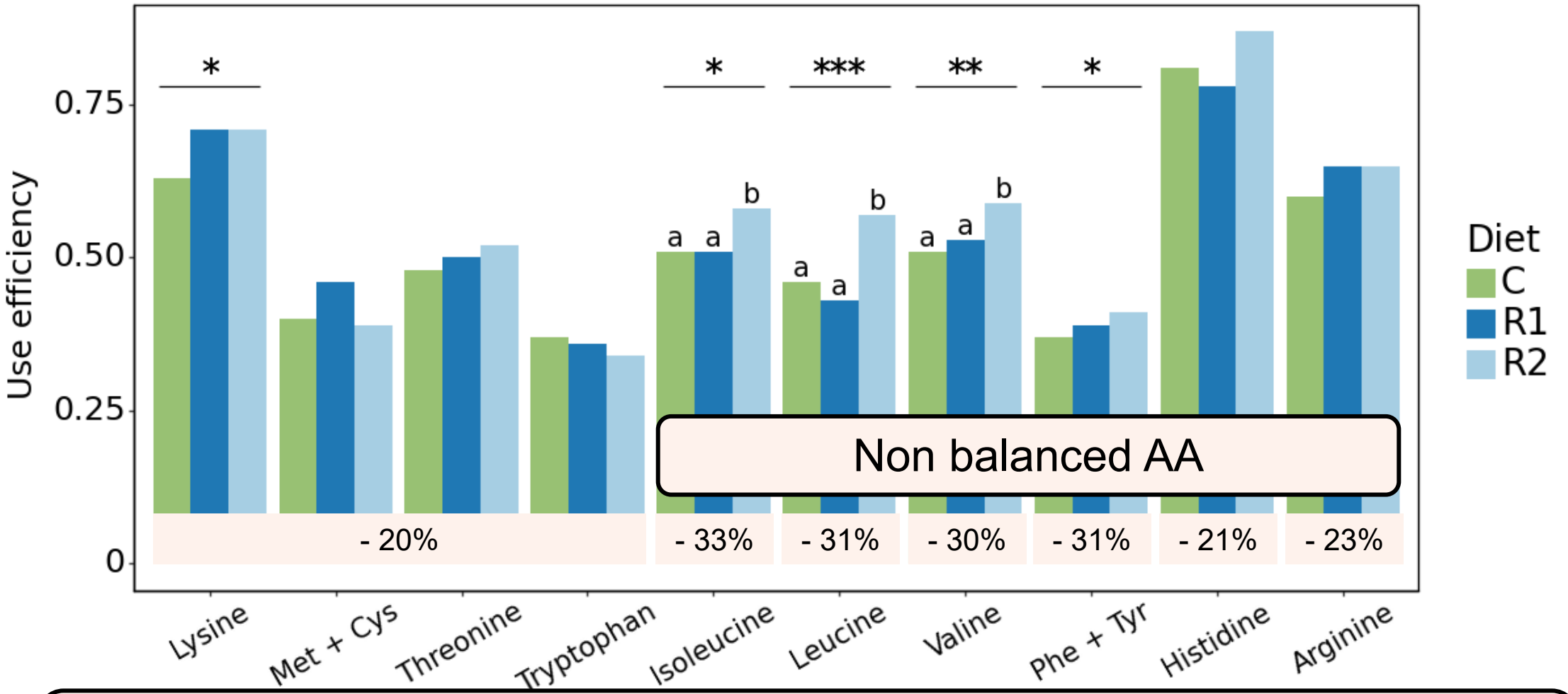
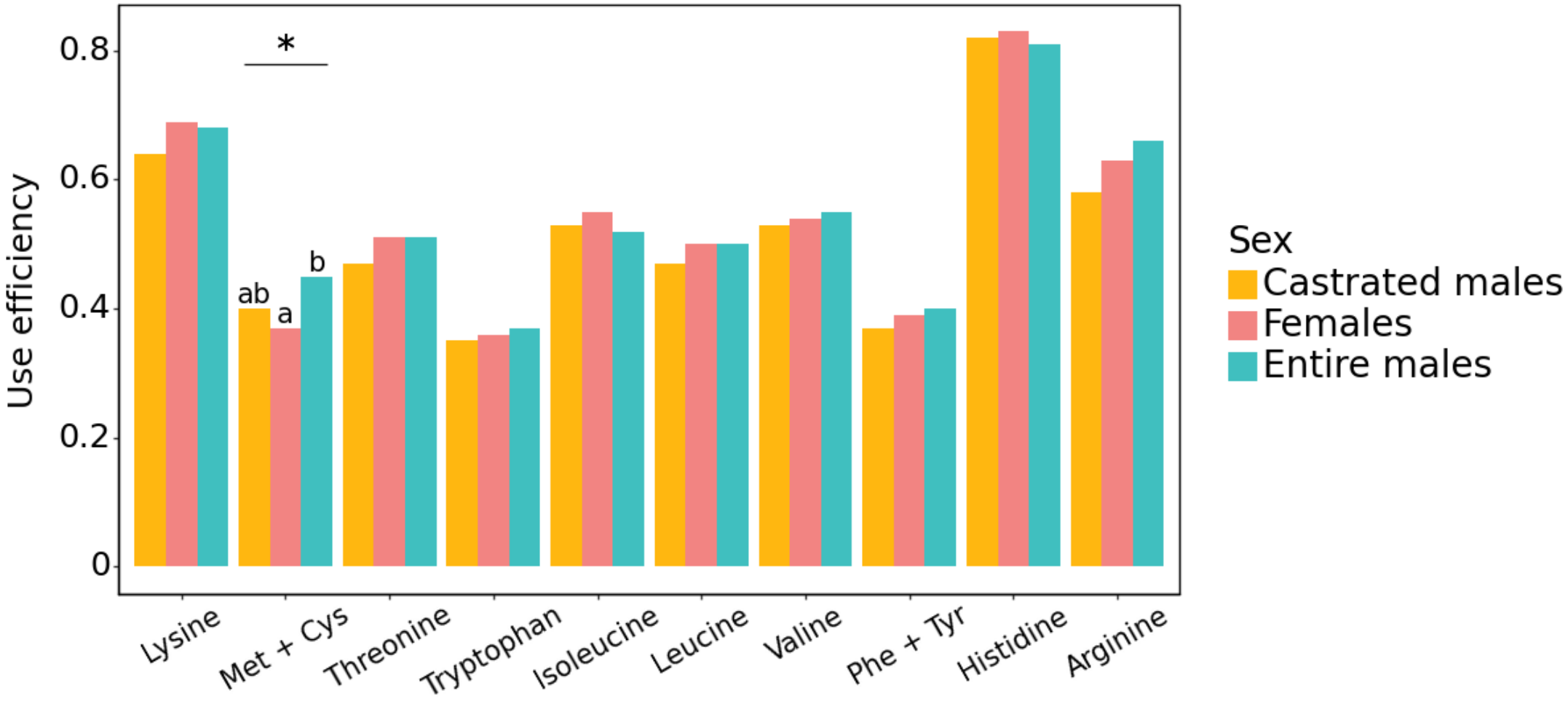


The **AA reduction** in the feed has to be **higher than 20%** to have an effect on their use efficiency

Effect of the gender on the AA use efficiency



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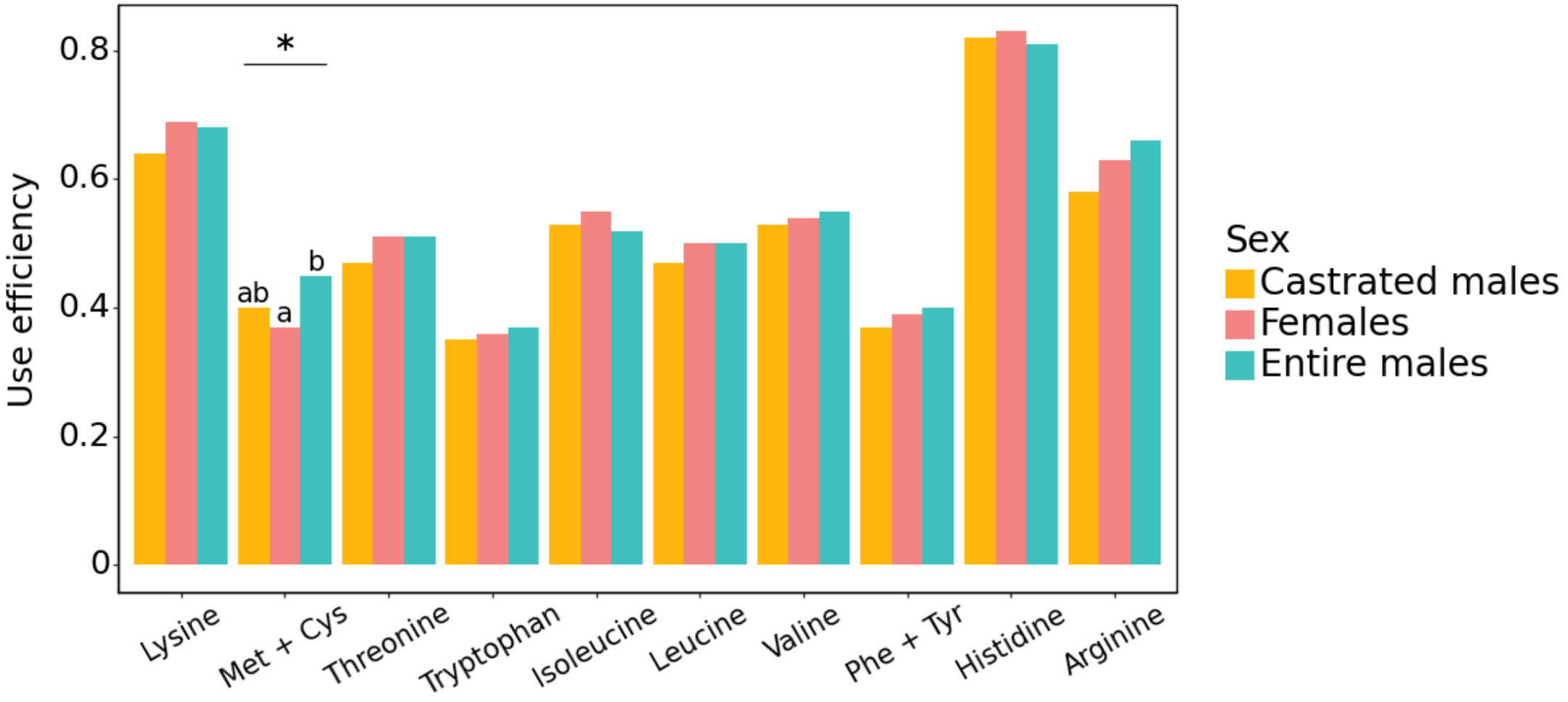
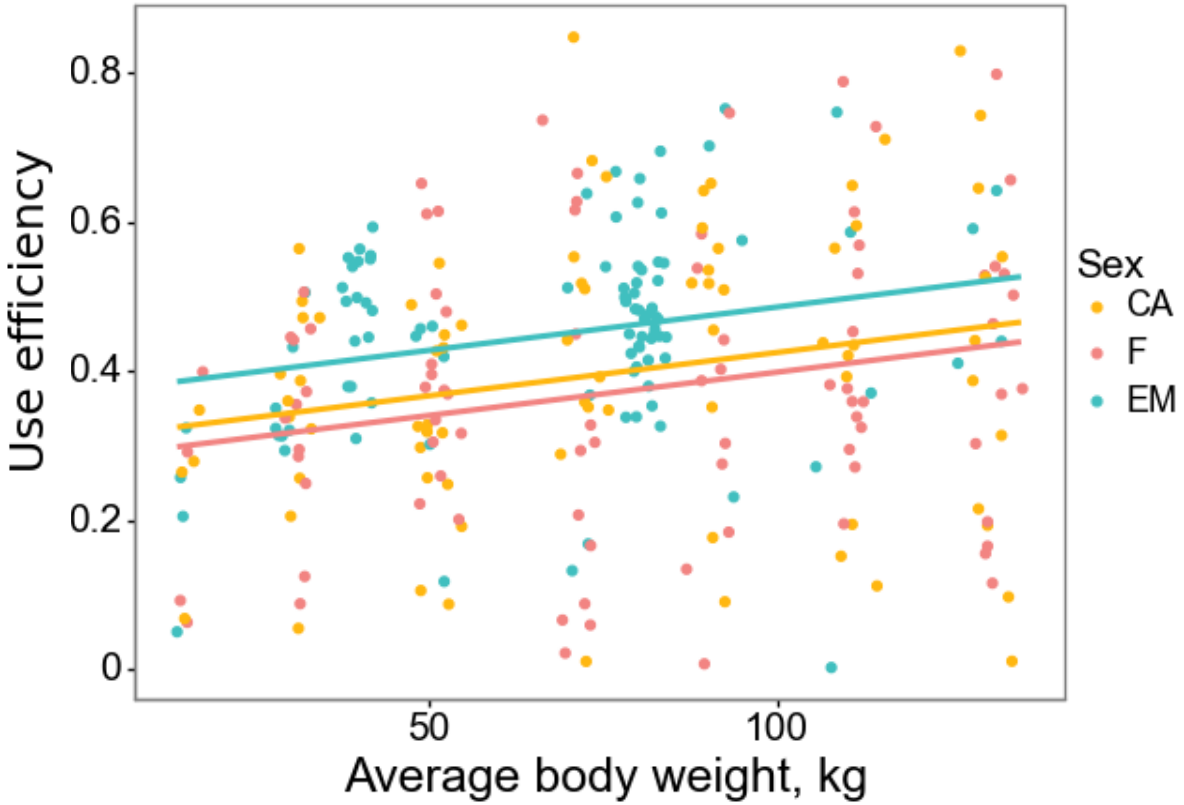


Little effect of the gender, certainly due to the experimental design

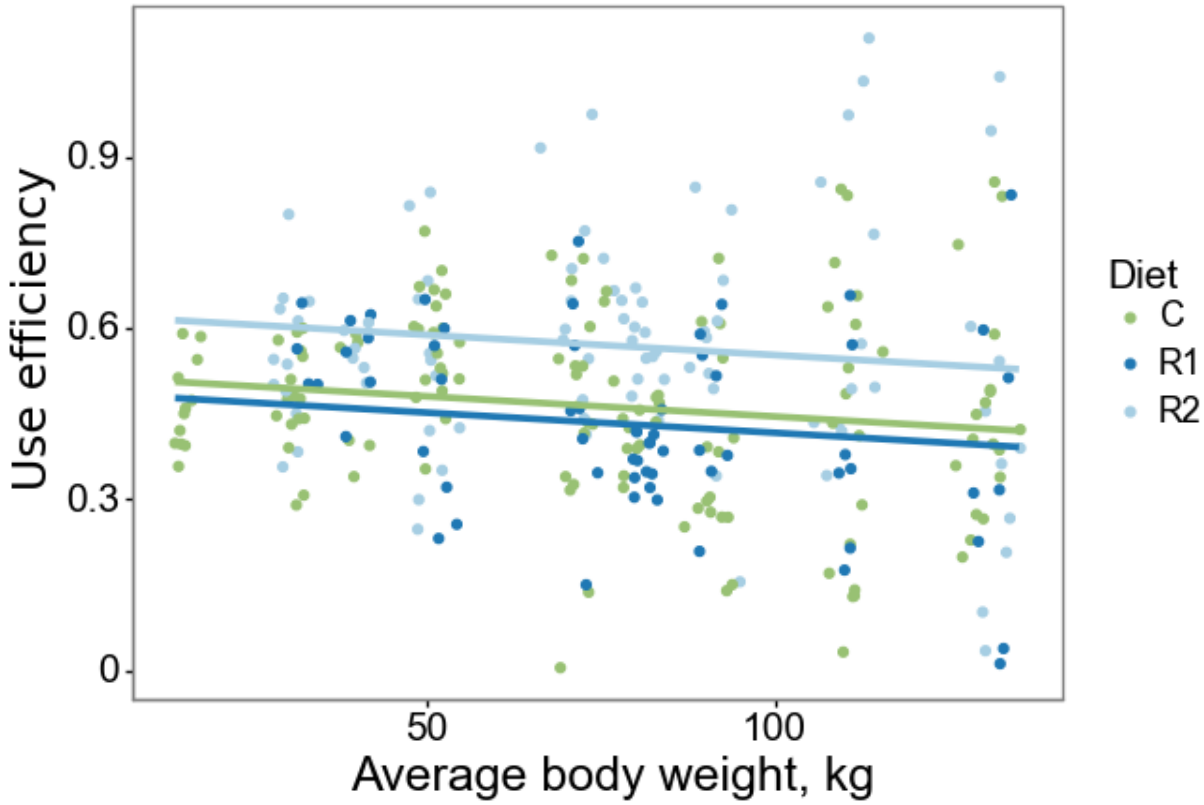
Effect of the body weight on the AA use efficiency

No effect of the body weight on the use efficiency of the lysine, threonine, tryptophan, isoleucine, valine, phenylalanine + tyrosine and histidine

Methionine + Cysteine



Leucine



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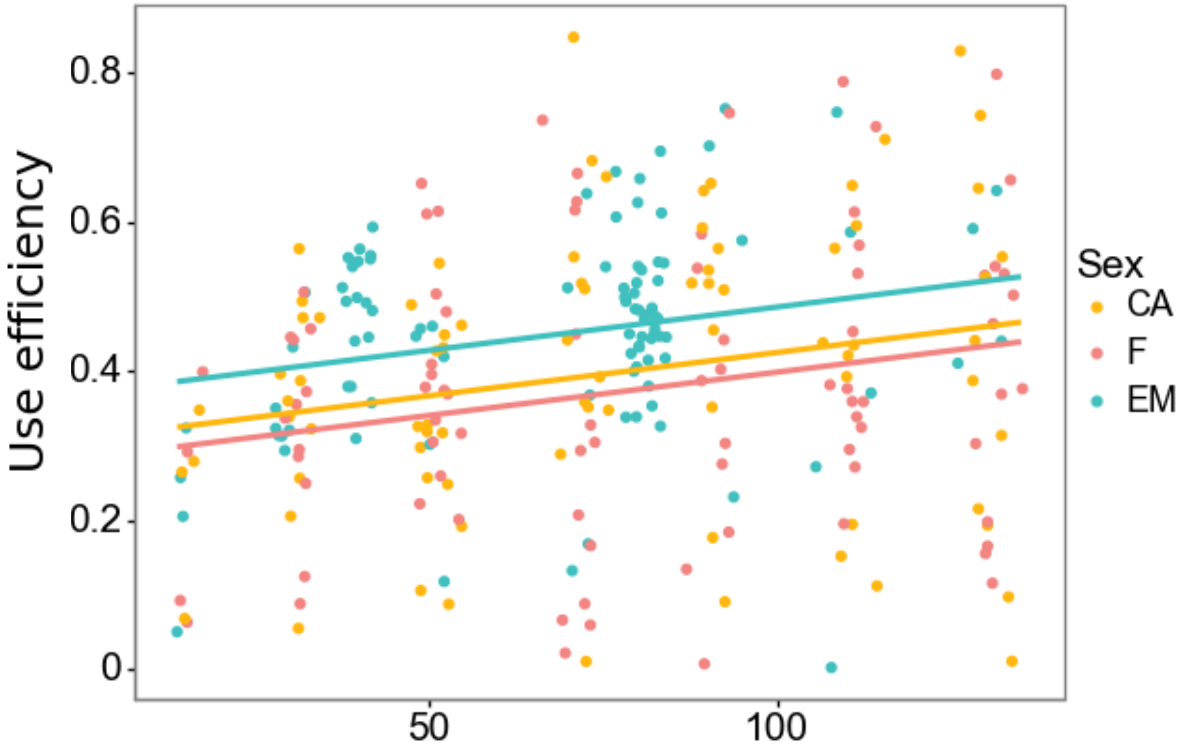

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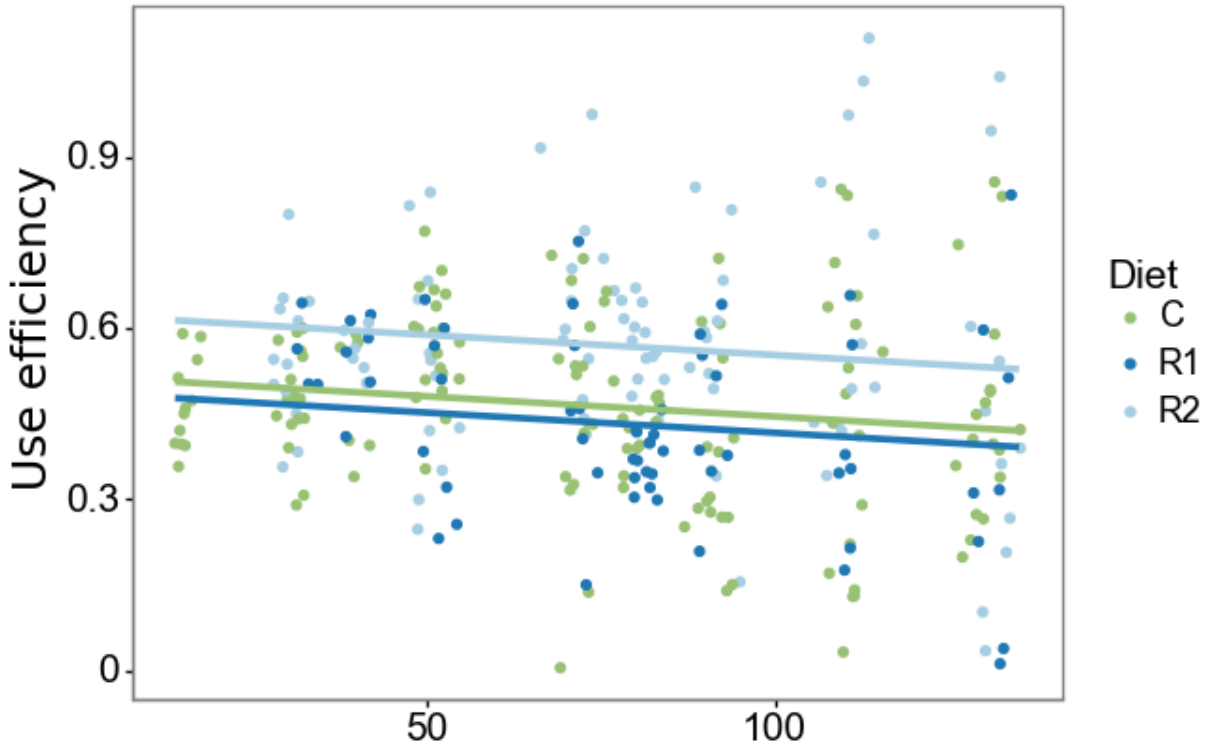

The effect of the body weight on the use efficiency **varies according to the AA**
Individual variability increases with the body weight

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Conclusion

- **Limited effect of the body weight**, individual variability ?
- **A -20% decrease of the level in feed is insufficient** to significatively increase the AA use efficiency
- Same efficiencies between the castrated males and the females
  Hard to conclude about the entire males
- **New data, current,** of the use efficiency of amino acids
  For under-studied AA and growth stages

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Thank you for your attention

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