Effect of Productive Type, age and dietary protein supply on protein and fat metabolism

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Introduction

The Genetic Selection pressure exerted on different pig breeds in performance parameters (ADG, FCR, meat quality, etc.) that differences in:

Protein and Fat metabolism

That also changes as the pig grows

Understanding these processes allow us to use precision feeding strategies, optimizing natural resources and decreasing environmental load.

Objectives

Our purpose was to analyse the influence of three factors:

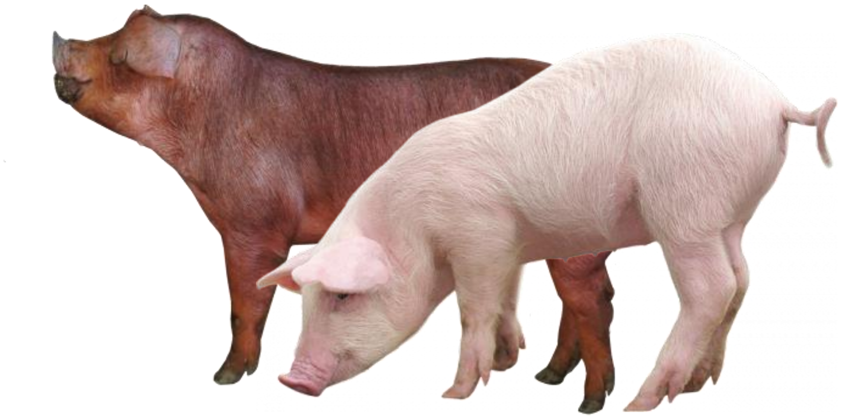
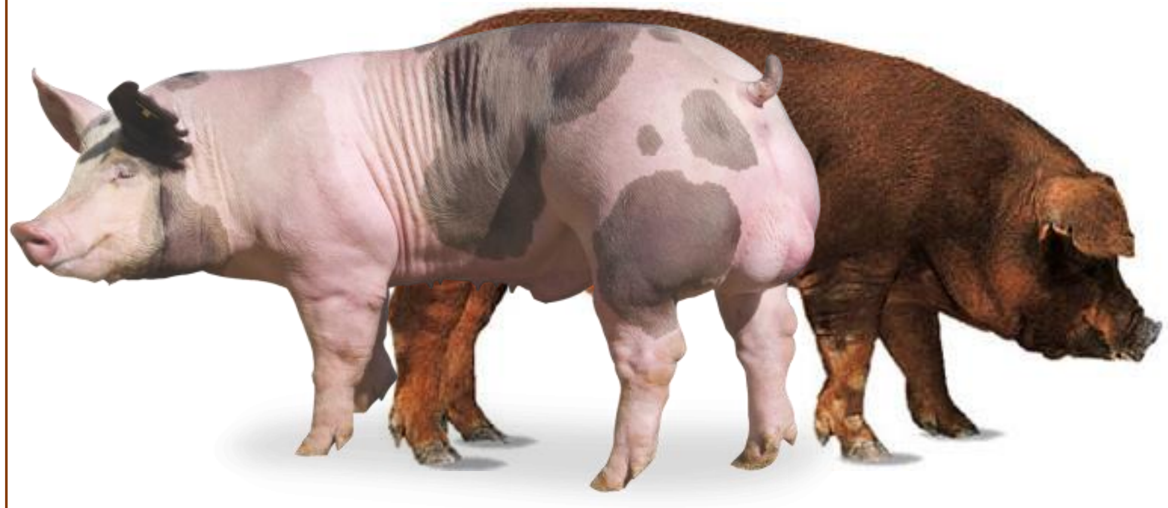
- Productive type (TP)
- Dietary crude protein (CP) content
- Animal age

On Protein and Fat metabolism (Synthesis and Deposition), in order to improve further **precision feeding** and **productive efficiency**

Material & Methods

Animals

A total of **32** male pigs of **2** physiological phases and **2 productive types (PT)**:

1st phase	2nd phase
	
16 — **29.4** ± 0.85 kg BW	**16** — **88.5** ± 1.66 kg BW

8 entire **F2** hybrid pigs:

8 castrated purebred **Durocs**

(Pietrain ♂ x (Duroc x Landrace) ♀)

Material & Methods

Diets

4 pigs/ PT:

During 7 days

LOW PROTEIN (LP) DIET:

- **15% CP** in growing pigs
- **13% CP** in fattening pigs

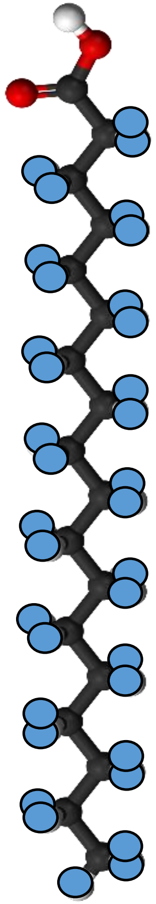
STANDARD PROTEIN (NP) DIET:

- **17% CP** in growing pigs
- **15% CP** in fattening pigs

Ad libitum

0.029%

C18:0D35

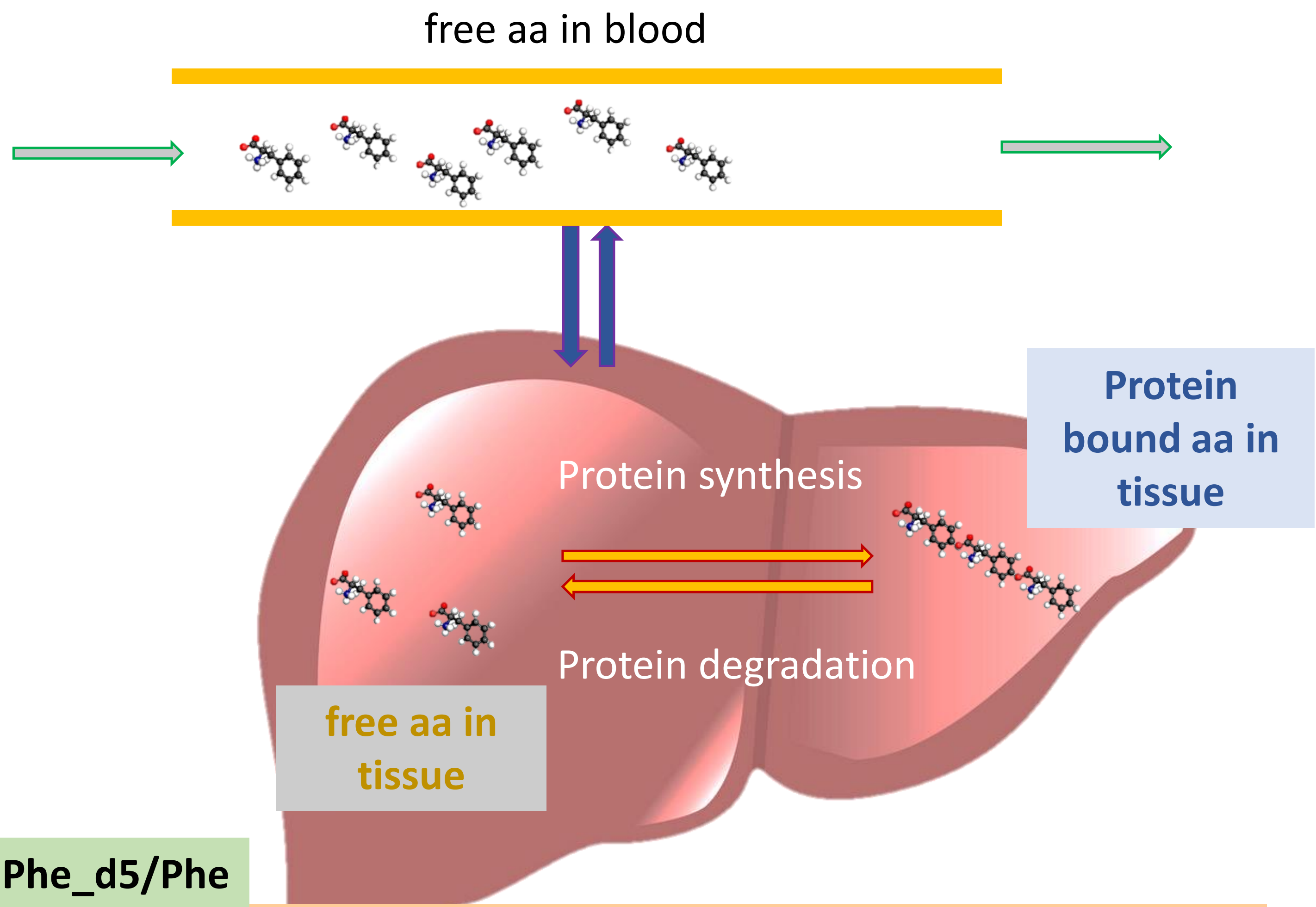


Material & Methods

Pigs were housed in Metabolic cages (MC) during 5 days in which they were subjected to:

- Catheterization (right external jugular vein)
- Daily blood sampling
- **Flooding dose technique** (last day of trial)

Protein metabolism



r=Phe_d5/Phe

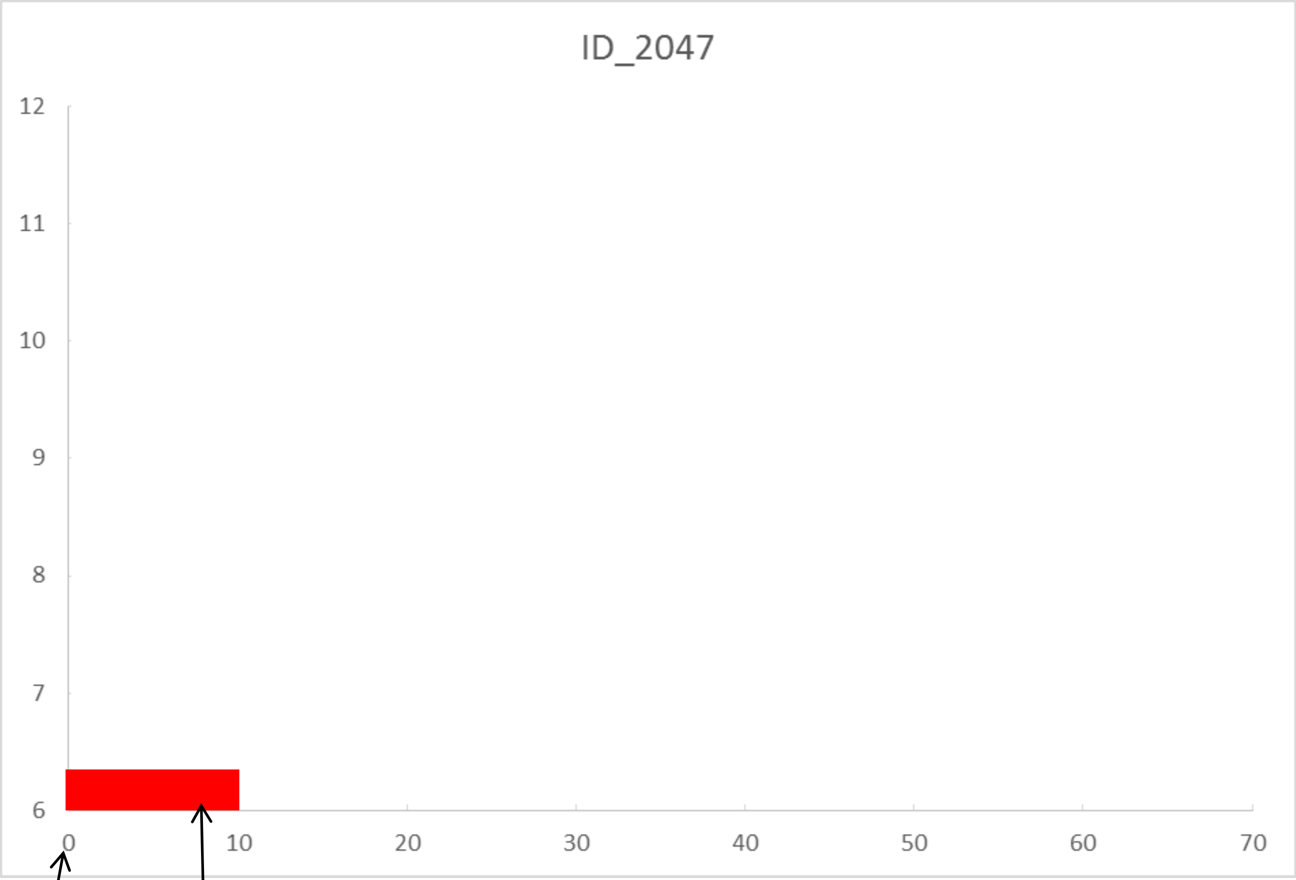
$$\text{MPE(moles percent excess)} = \frac{PheD5}{Phe\ tot} = \frac{PheD5}{Phe+PheD5} = \frac{PheD5/_{Phe}}{1+PheD5/_{Phe}} = \frac{r}{1+r}$$

Garlick *et al.* (1980)

Waterlow *et al.*, 1978

Material & Methods

Free Phe in plasma



time (min)

Phe Infusion 10'

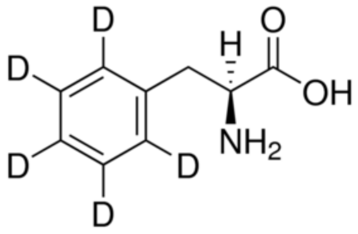
Blood sampling

Flooding dose Technique

Garlick *et al.* (1980) → Rivera-Ferre *et al.* (2005)

1. **Determination of natural enrichment in AA**

2. **Flooding dose of Phenylalanine**

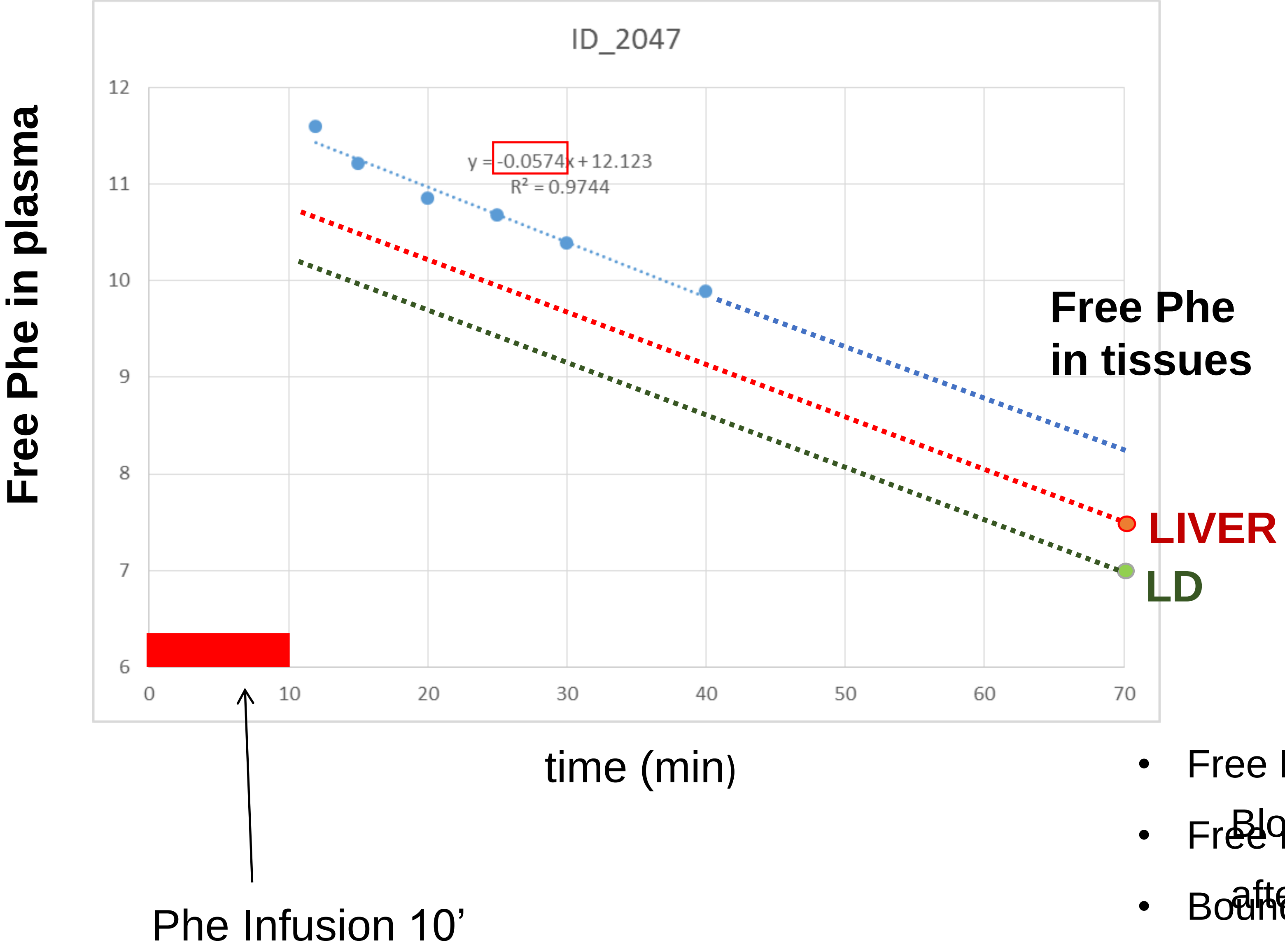


15% of ^{2}**H$_5$-Phe**

3. **Determination of the Phe enrichment curve in plasma**

Blood sampling on **12, 15, 20, 25, 30** and **40'** after the start of the infusion

Material & Methods



Flooding dose Technique

Garlick *et al.* (1980) → Rivera-Ferre *et al.* (2005)

1. **Determination of natural enrichment in AA**
2. **Flooding dose of Phenylalanine**
3. **Determination of the Phe enrichment curve in plasma**

Sample collection:

- **Liver**
- **Duodenum (DUD)**
- ***Longissimus dorsi* (LD)**
- ***Biceps femoris* muscle (BF)**

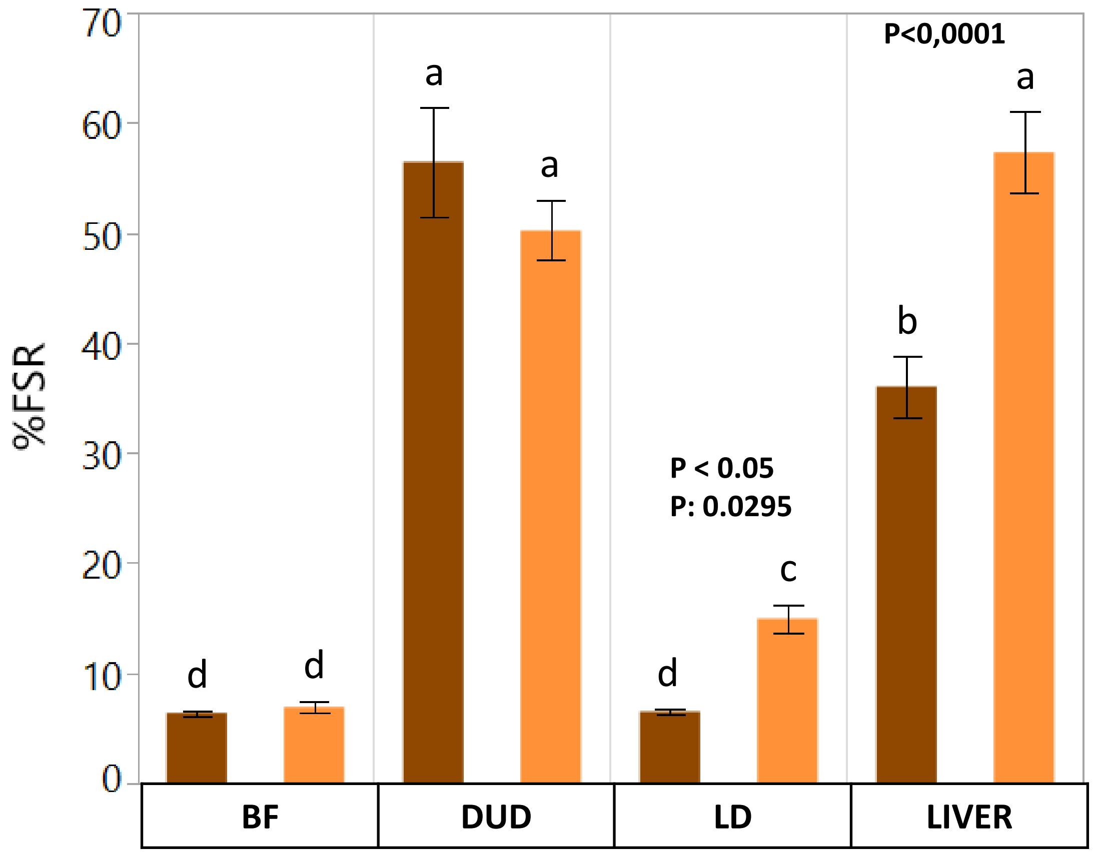
Blood sampling on **12, 15, 20, 25, 30 and 40'** after the start of the infusion

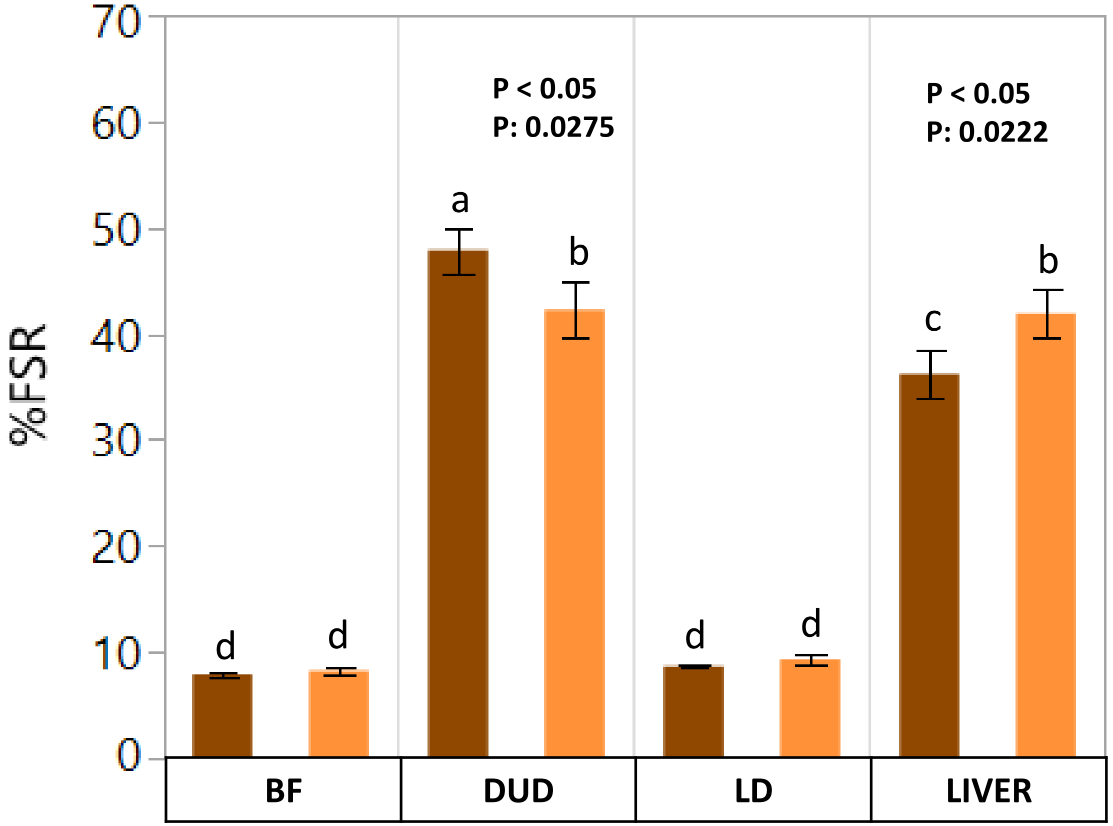
- Free Phe in plasma → Piraud et al. (2005)
- Free Phe in tissues → Qin et al. (2015)
- Bound Phe in tissue → Colgrave et al. (2008)
- Quantification AA UPLC/MS → Guo et al. (2013)

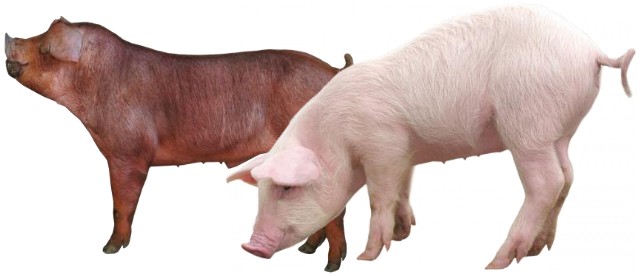
Results

Duroc
F2

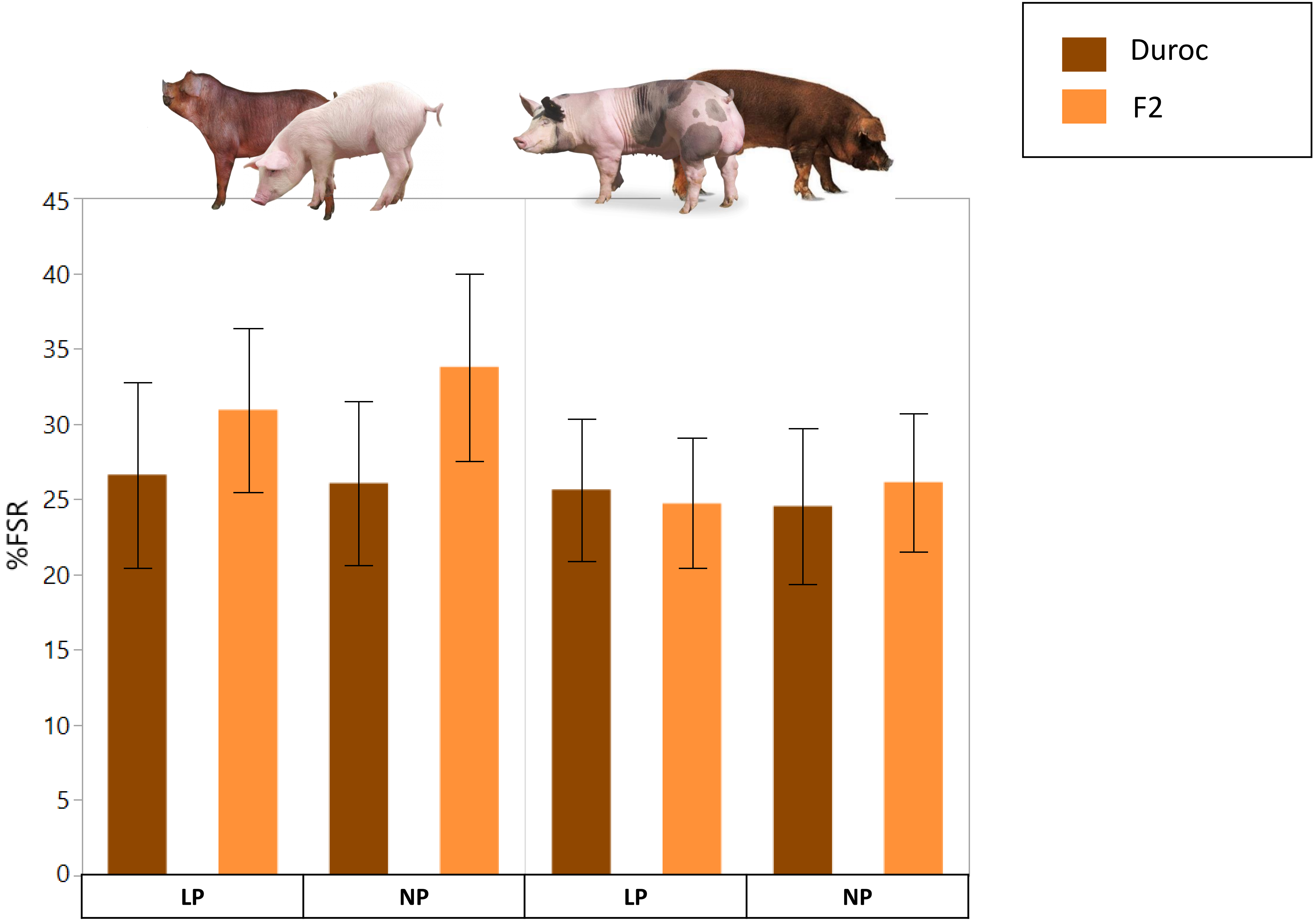
$$FSR\ (\%/day) = \frac{MPEbound}{aveMPEfree} \times \frac{100}{t\ (days)}$$





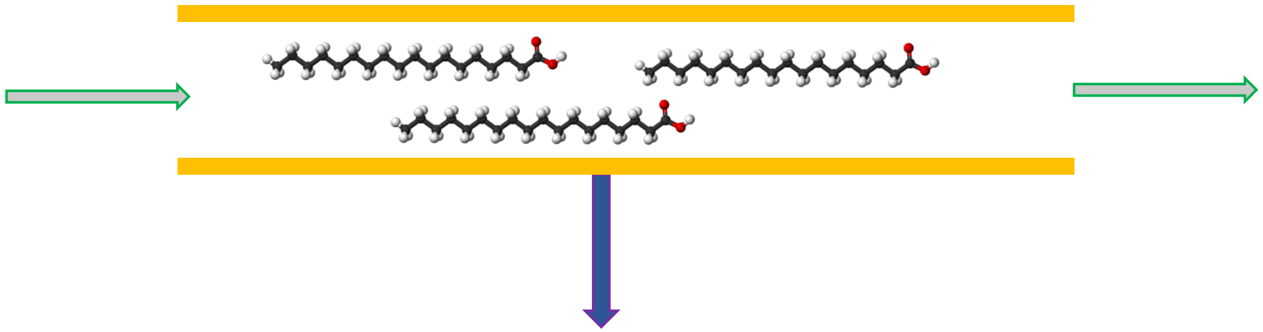


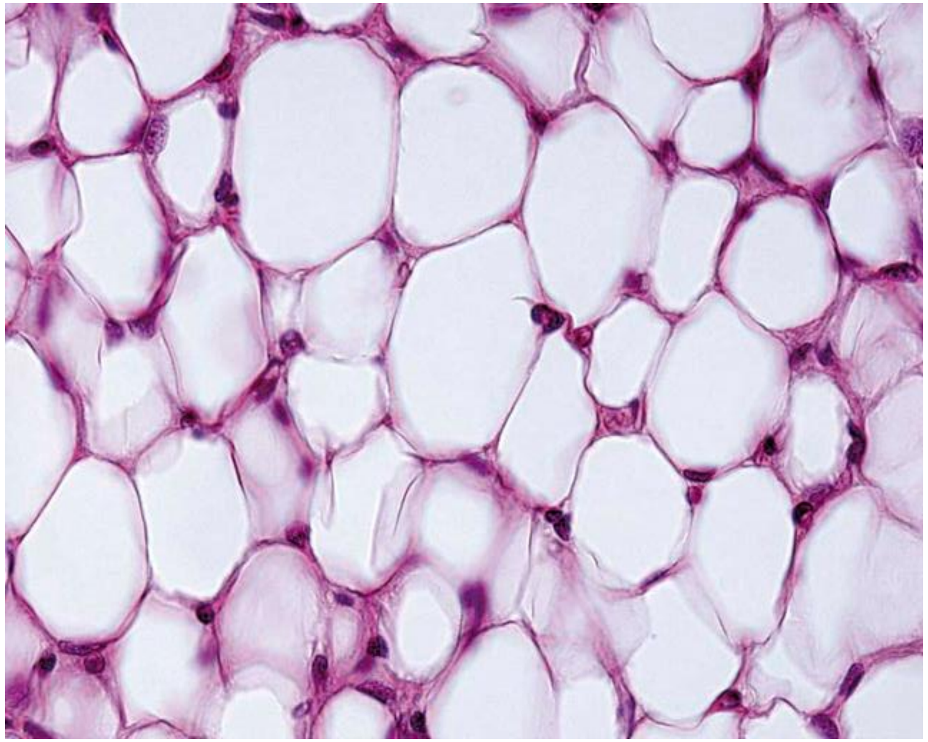
Results

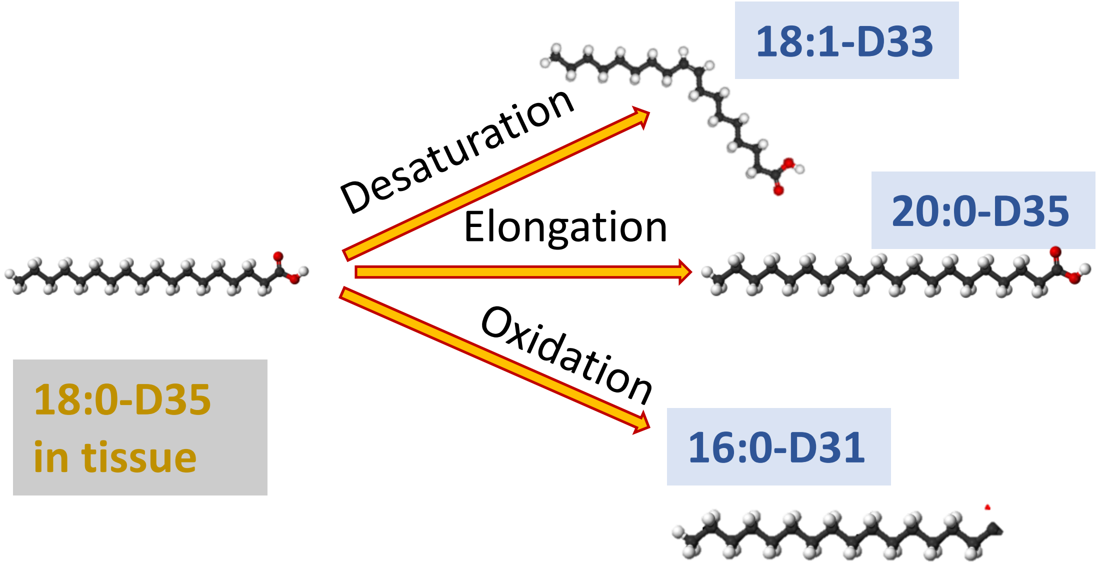


Fat metabolism

18:0-D35 in blood







r=Ste_d35/Ste
MPE= r/(r+1)

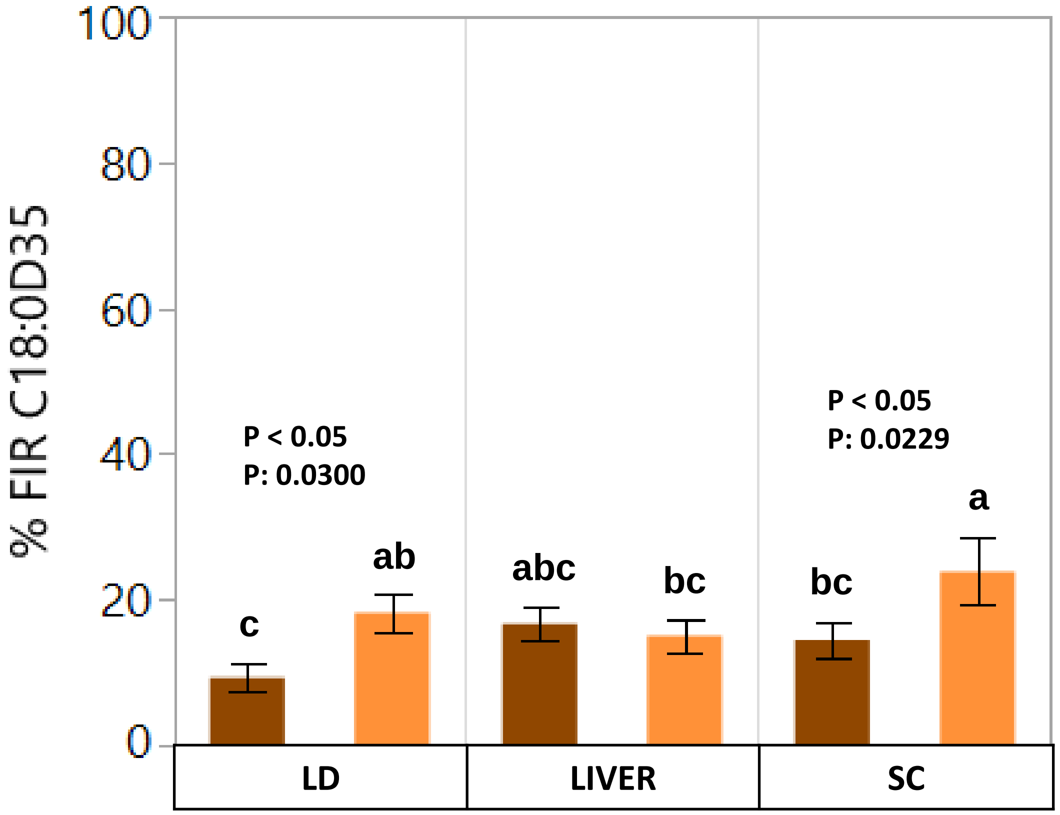
Garlick *et al.* (1980)

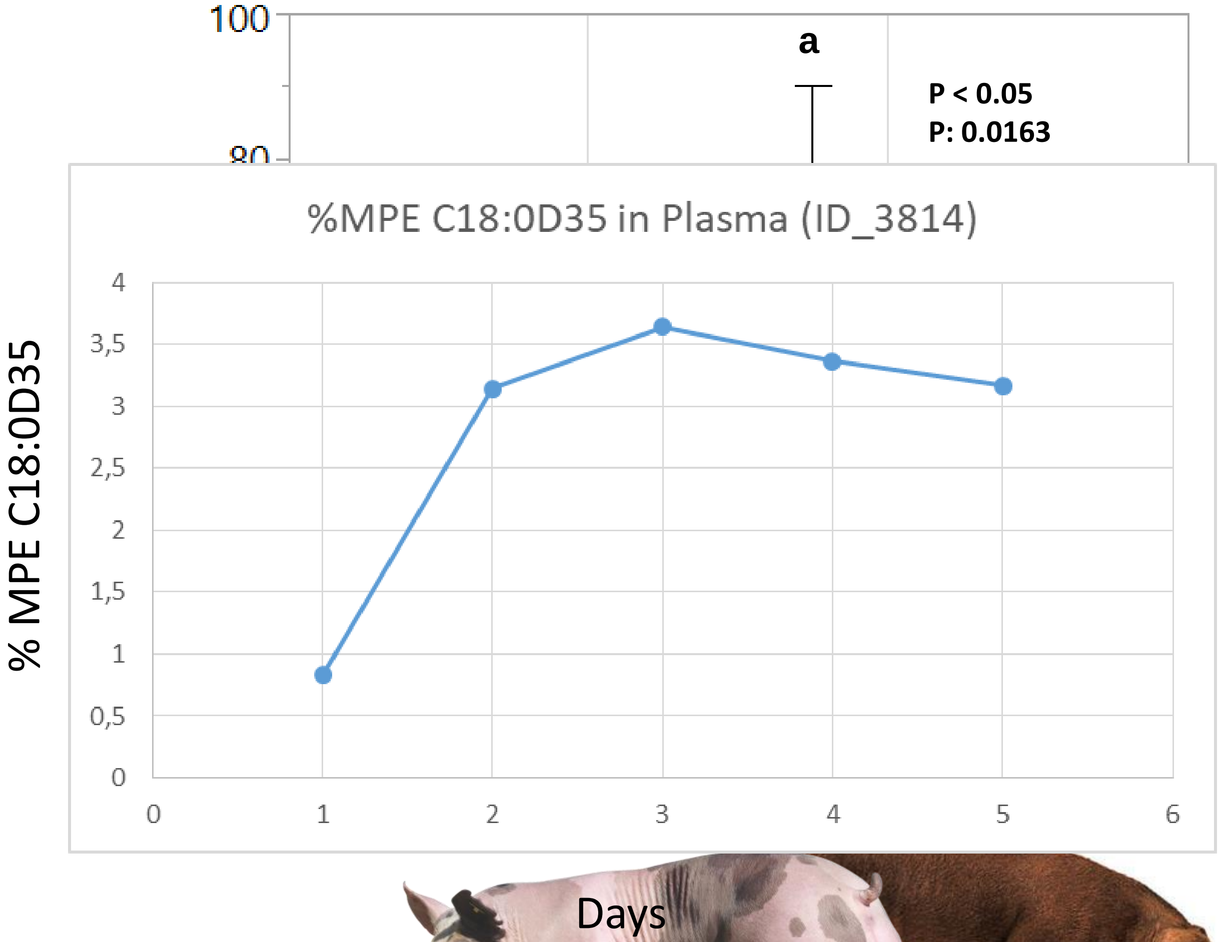
Results

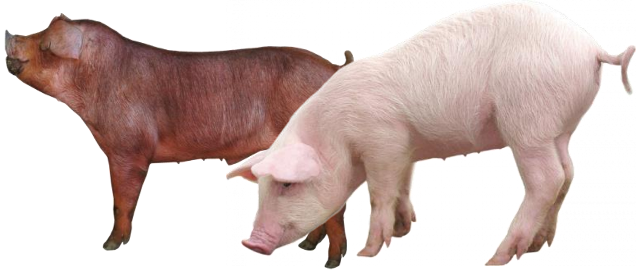
Duroc

F2

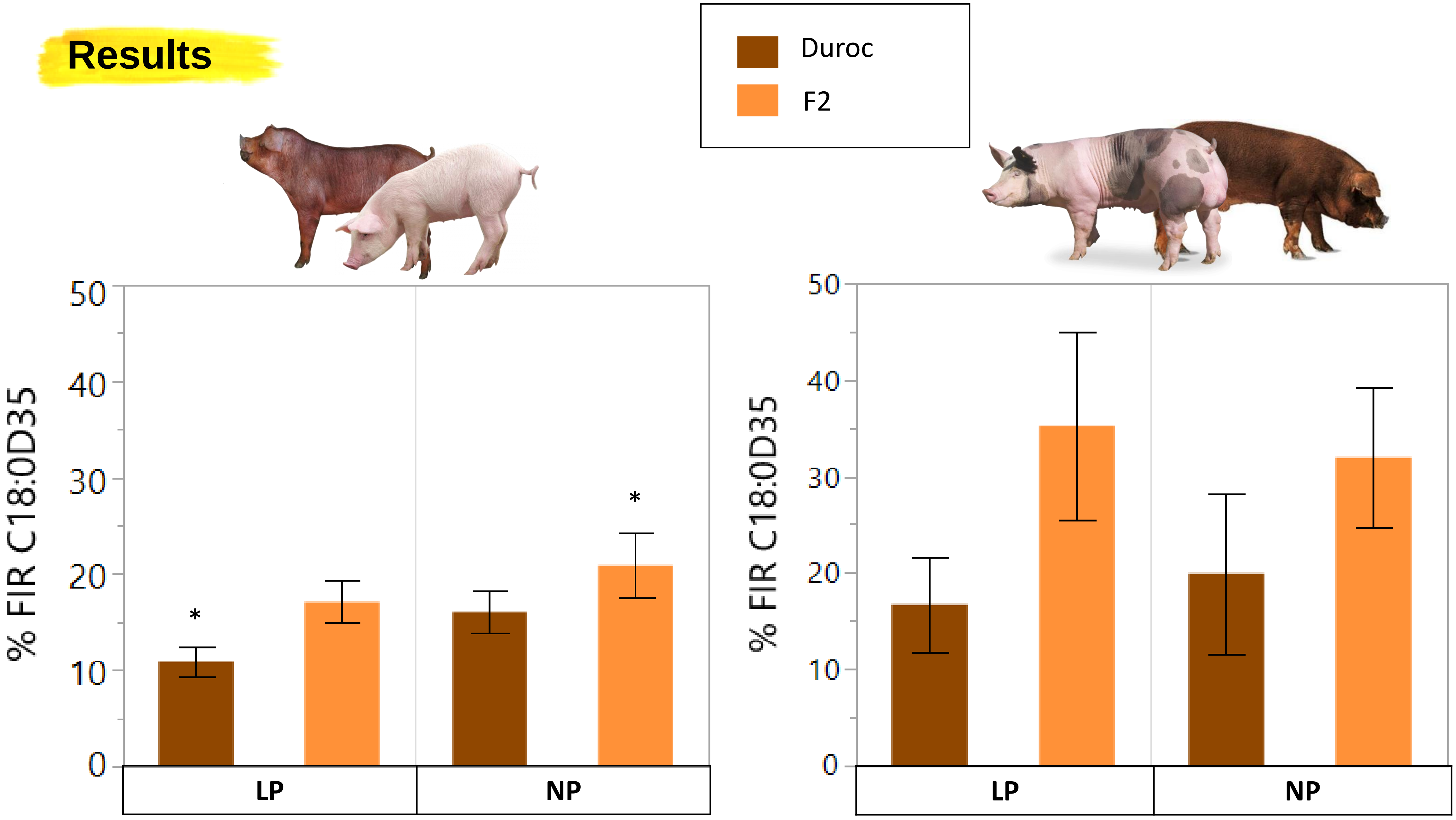
$$\text{FIR (\%/day)} = \frac{MPE\ \ C18{:}0D35\ in\ tissue}{aveMPE\ \ C18{:}0D35\ in\ plasma} \times \frac{100}{t\ (days\ )}$$







Results



Duroc
F2
% FIR C18:0D35
50
40
30
20
10
0
*
*
LP
NP
% FIR C18:0D35
50
40
30
20
10
0
LP
NP

Conclusions … about **Protein Fractional Synthesis Rate**

- The FSR is higher in visceral tissues, due to their greater rates of protein turnover.
- The F2 hybrid pigs obtain higher data in LIVER in both physiological phases and also in LD in growing pigs, explaining the better productive performance and lean meat of this breed.
- Duroc fattening pigs show a higher FSR in the duodenum, due to a possible more intense metabolic activity of their gastrointestinal tract.

Conclusions … about **Fractional Incorporation Rate of Fat**

- The FIR of C18:0D35 is higher in Fattening pigs than in the growing ones, since the adipose tissue is more active at later stages.
- The LIVER gets higher values than the other tissues in fattening pigs, due to the higher fat metabolism that occurs in this organ in this physiological phase.
- The F2 pigs show higher results, which could be related to increased lipid activity, including mobilization.

Acknowledgments

Universitat de Lleida

Feed-a-Gene

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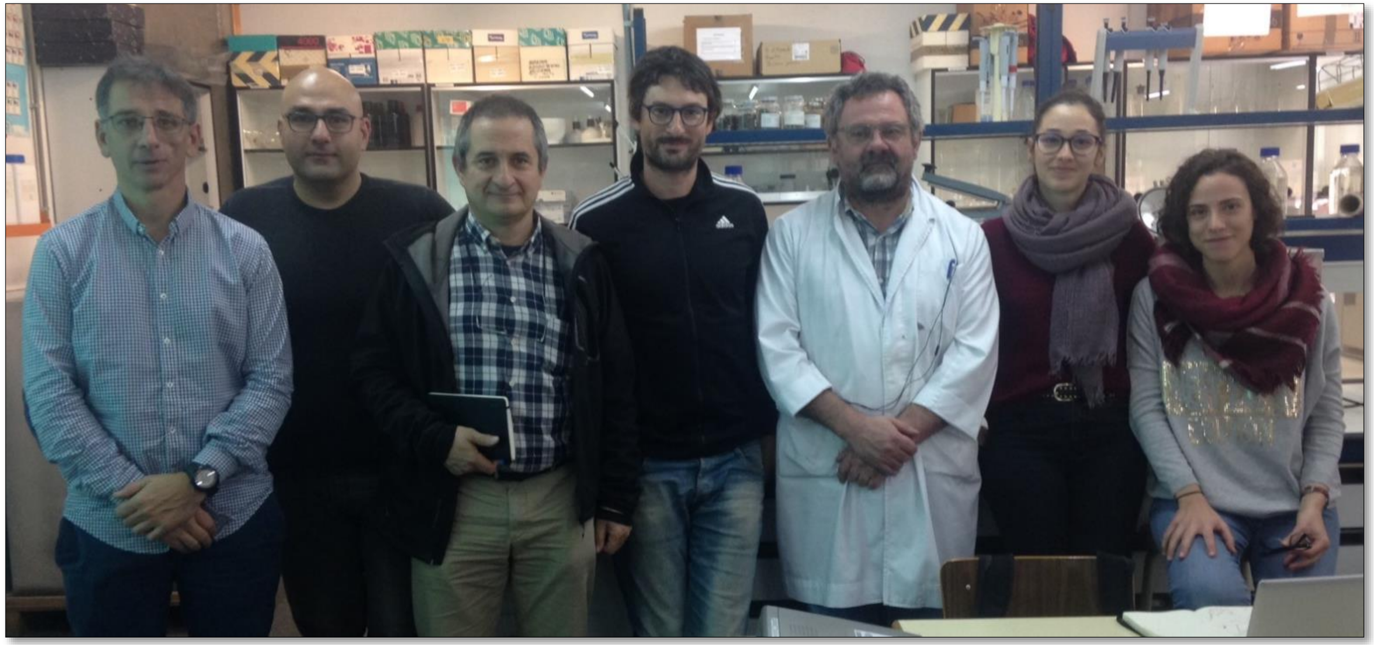
MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

Thanks for your attention!



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