



3rd Annual Meeting
May 2020



GenTORE

Genomic management Tools to Optimise
Resilience and Efficiency

**WP2 – Resilience and Efficiency biology across
growing and adult phases**

**T2.3 – Multi-site experiment to validate RFI and
resilience measures, and develop precision livestock
phenotyping of resilience and efficiency components**



Characterizing suckler cow individual responses to nutritional challenges depending on stage of lactation



OBJECTIVES

- Determine components of **RESILIENCE** in Parda de Montaña cows throughout lactation
- Repeated over 2 calving seasons (Autumn 2018, Spring 2019), 16 cows per calving season (16 x 2)
- Response to five nutritional challenges (55% during 4 days) repeated over lactation
- (+ + retrospective classification according to animal productive traits and / or RFI)



Animals and diets



- **Cows: n=32**

	autumn-calving cows (n=16)	spring-calving cows (n=16)
Calving date	20-oct-18	24-feb-19
LW calving	643	605
BCS calving	2.95	2.65
Milk yield 1 st mo	8.5	7.7

- **Feedstuffs:**

	Hay	Concentrate
% DM	91.98	88.67
% CP	9.44	16.82
% NDF	58.45	25.34
UFL (NE/kg)	0.76	1.05

- **Diets:**

DIET	Hay, kg DM/d	Concentrate, kg DM/d	UFL / d
100% reqs	7.36	2.66	8.28
55% reqs	6.44		4.89

Management



month	m1				m2				m3				m4					
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Mgt					ch1				ch2				ch3	ch4	ch5			
Diet	100%					100%					100%							

4 d RESTR 55%
+ 4 d REC 100%

4 d RESTR 55%
+ 4 d REC 100%

4 d RESTR 55%
+ 3 d REC 100%

4 d RESTR 55%
+ 3 d REC 100%

4 d RESTR 55%
+ 3 d REC 100%

Five nutritional challenges (55% diet during 4 days)
repeated over lactation

Phases

- **Basal:** 100% diet pre-challenge
- **Challenge:** 4 d on 55% diet
- **Post-challenge:** 100% diet



Analytical approach



month	m1				m2				m3				m4					
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Mgt					ch1				ch2				ch3					
Diet	100%					100%					100%							

4 d RESTR 55%
+ 4 d REC 100%

4 d RESTR 55%
+ 4 d REC 100%

4 d RESTR 55%
+ 3 d REC 100%

day	-4	-2			2	3	4	5	6	7	8	
diet	100%				55%				100%			
	basal				challenge				refeeding			

x 3

a) Comparison of Challenges 1 – 2 – 3

Effect of a short nutritional challenge

in different stages of lactation (months 2-3-4)



Analytical approach



month	m1					m2					m3					m4				
Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16				
Mgt													ch3	ch4	ch5					

	ch3			ch4			ch5														
day	-4	-2		2	3	4	5	6	0	2	3	4	5	6	0	2	3	4	5	6	0
diet	100%			55%			100%			55%			100%			55%			100%		
	basal			challenge			refeeding			challenge			refeeding			challenge			refeeding		
	common																				

b) Comparison of Challenges 3 – 4 – 5

Cumulative effect of 3 consecutive short nutritional challenges at the end of lactation (month 4)



Measurements

All data uploaded
at RFI repository



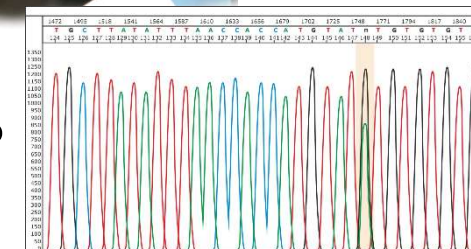
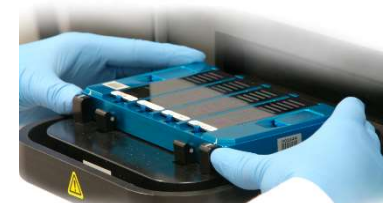
On a daily basis

- BW of cows and calves**
- Milk yield and Milk Composition (+FA)**
- Apparent digestibility**
- Metabolic profiles**
- Animal Behaviour (Medria[®] sensors)**



Another frequency

- BCS and Subcutaneous fat thickness**
(US, start and end of each challenge)
- Follicular growth** (US, around 2nd challenge)
- Cyclicity** P4 analyses at 10-d intervals
- Genotypes: BovineSNP50 BeadChip (54,609 SNPs) WP.4?**



SNP



Current state



- Data collection finished
- Laboratory analyses almost finished
- Partial results presented /accepted in different scientific meetings:

2019

XVIII Jornadas sobre Producción Animal AIDA, Zaragoza (Spain), May 2019

- Orquera et al. "**Metabolic and productive** response of suckler cows to a short nutritional challenge at the **start of lactation**"

70th Annual Meeting EAAP (European Federation of Animal Science), Ghent (Belgium), August 2019

- Casasús et al. "**Performance and oxidative status** and of beef cows facing short nutritional challenges **during lactation**".



2020



ADSA Annual Meeting of the American Dairy Science Association (virtual), June 2020

- Casasús et al. "**Milk fatty acid profiles** of beef cows in response to a short feed restriction during lactation "

71st Annual Meeting EAAP (virtual), December 2020

- Orquera et al. "**Indicators of body fat mobilization** of lactating beef cows under short nutritional challenges “
- Orquera et al. "The effect of **routine management practices** on the **behaviour** of beef cows according to their feeding management".

in collaboration with INRAe

to be presented tomorrow at the Young Scientist Session!!



... Karina Orquera's PhD thesis

Preliminary results

(Challenges 1-3)

months 2-4 post-calving



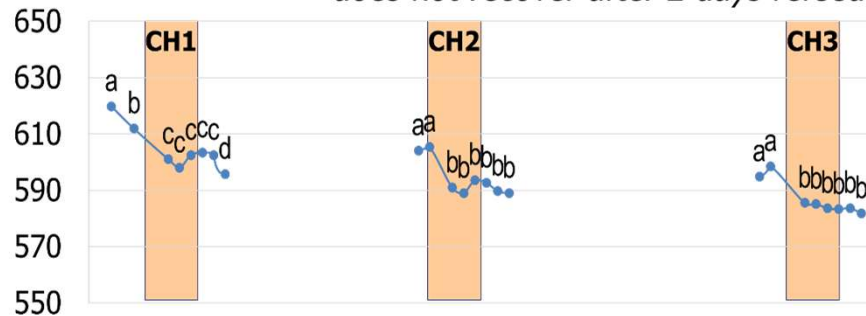
Cow Weight and Milk Yield

(weigh-suckle-weigh technique)

- Decreasing performance throughout lactation
- Immediate RESPONSE to undernutrition in all challenges

Cow weight, kg

does not recover after 2 days refeeding

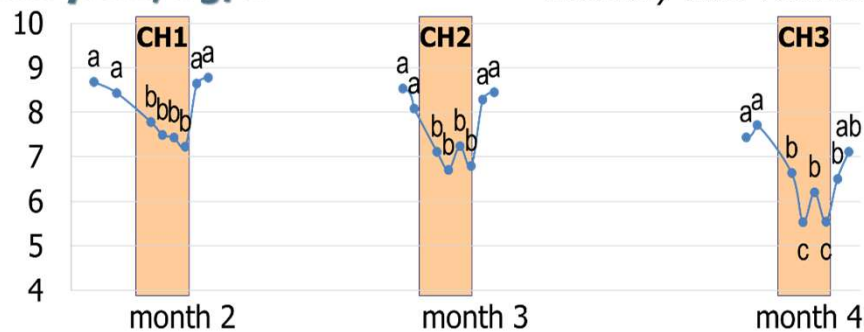


but RESILIENCE decreases through lactation
(greater response, less recovery)

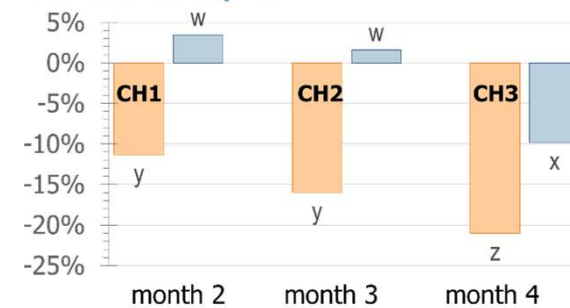
Orange bar: Δ challenge / basal
Blue bar: Δ refeeding / basal

Milk yield, kg/d

recovery after refeeding



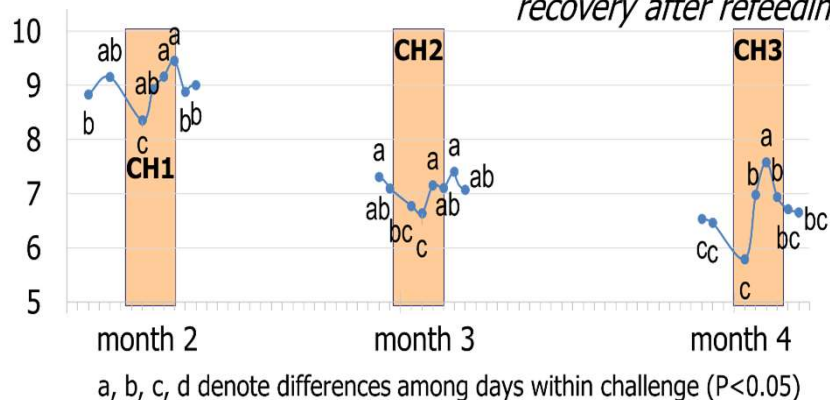
Δ Milk Yield, %



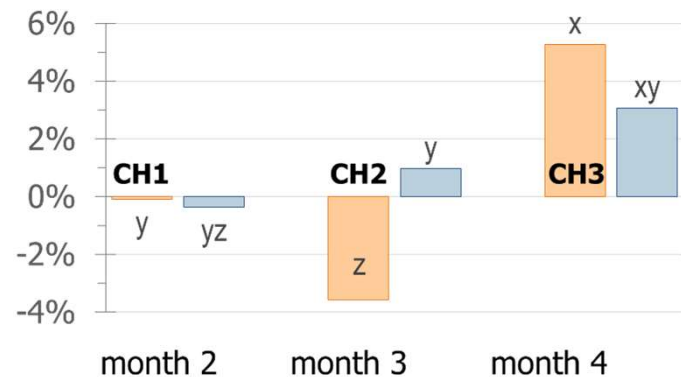
Oxidative status *plasma malondialdehyde (MDA) by UPLC-FLD*

- Decreasing oxidative status throughout lactation
- Immediate RESPONSE to undernutrition in all challenges

Oxidative status, MDA μM *drop and rise during challenge recovery after refeeding*



Δ MDA, %



w, x, y, z denote differences among periods (P<0.05)

The **patterns** with which beef cows face a short but severe nutrient restriction **change throughout lactation.**

Indicators of body fat mobilization

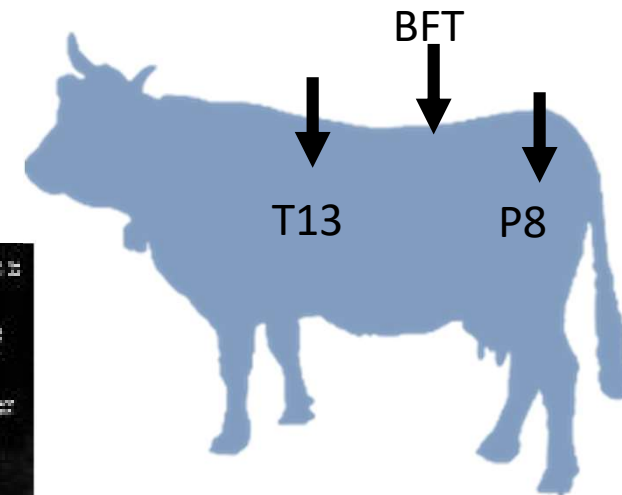
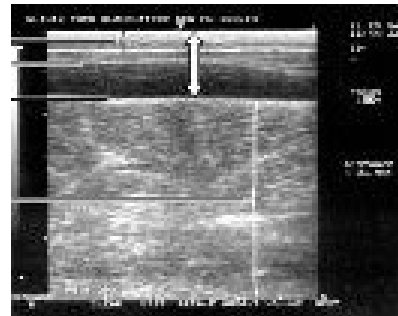
(Challenges 1-2)

months 2 and 3 post-calving



1. External measurements

- Body condition scored (**BCS**, 1-5 scale)
- Back fat thickness(**BFT**)
- P8 rump site (**P8**)
- 13th thoracic vertebra (**T13**)

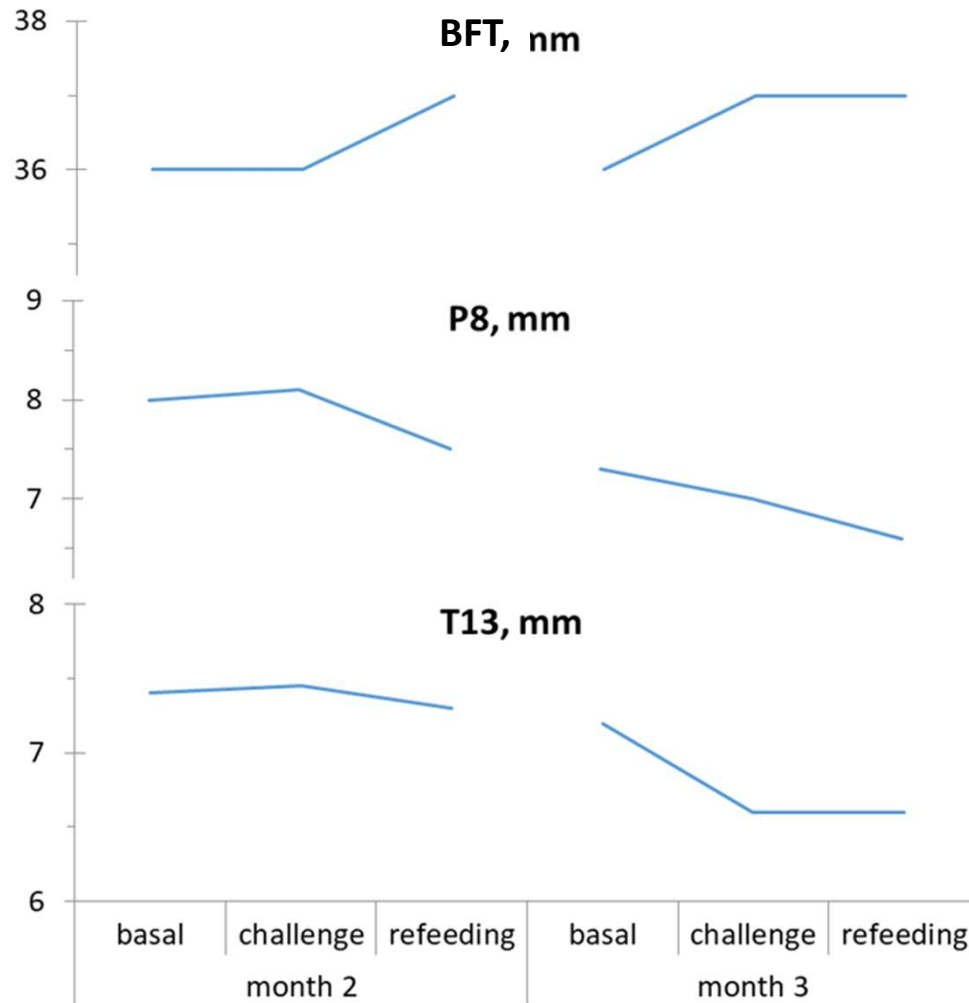


2. Metabolites

- β -hydroxybutirate (**BHB**)
- Non-esterified fatty acids (**NEFA**)
- Malondyaldehyde (**MDA**)



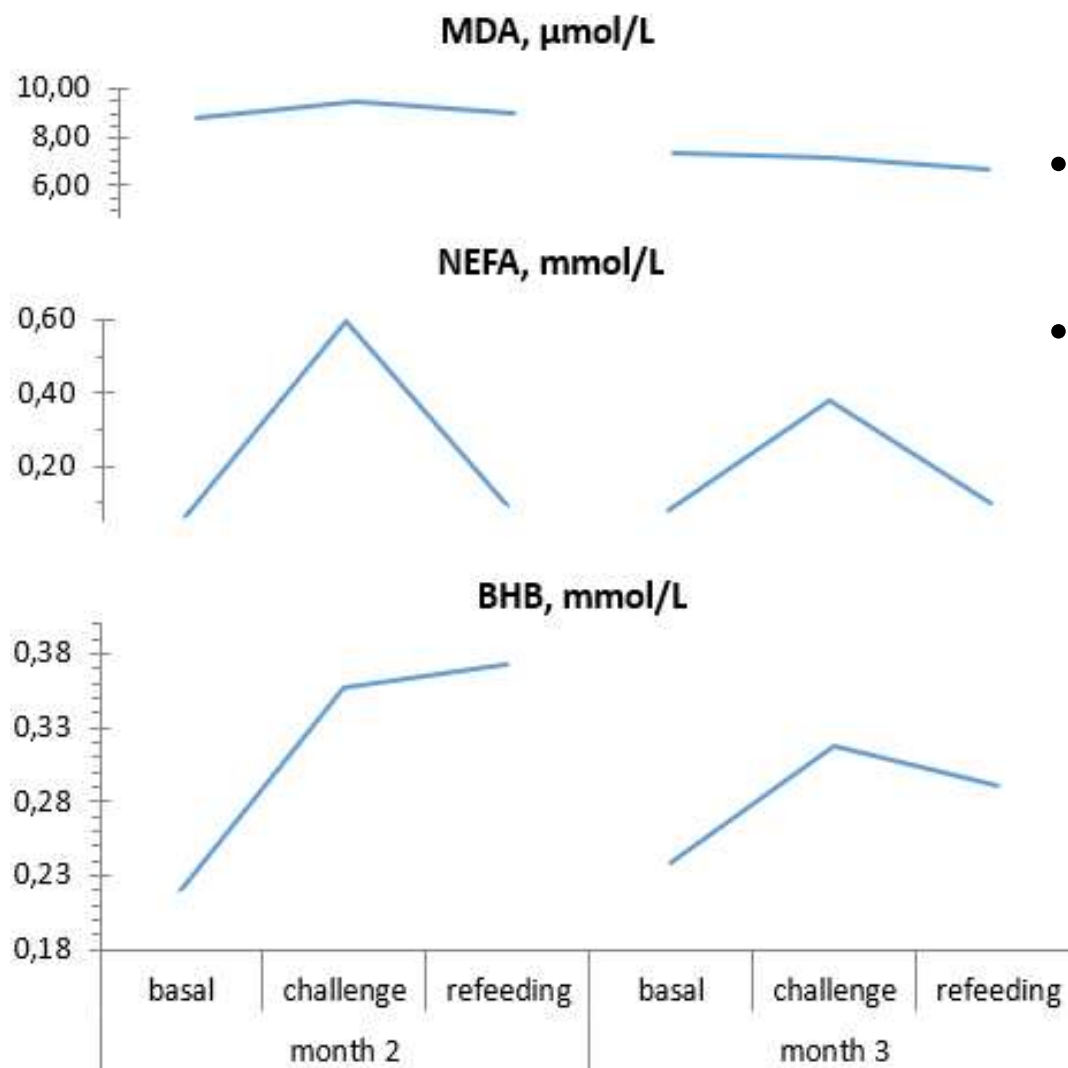
1. External measurements of body fatness



- BCS, BFT not affected by month or phase ($P > 0.05$)
- P8, T13 decreased from month 2 to 3 ($P < 0.001$)
- P8 decreased from basal to refeeding phase ($P < 0.01$)

Except for P8, they only reflected changes in the **long term**

2. Metabolites related to fat mobilization



- Immediate response to feed changes in month 2
- Less intense difference among phases in month 3

NEFA ($P < 0.001$)

MDA ($P < 0.01$)

BHB ($P = 0.06$)

good indicators in the **short term**, especially in **early lactation**.

Milk fatty acid profile

(Challenge 2) month 3 post-calving



<i>day</i>		x		x	x		x	x	x
<i>diet</i>	100%			55%			100%		
	basal			challenge			refeeding		



Hand-milked samples after calf suckling
Individual FA identified by gas chromatography
Calculation of sums

Number and position of double bonds

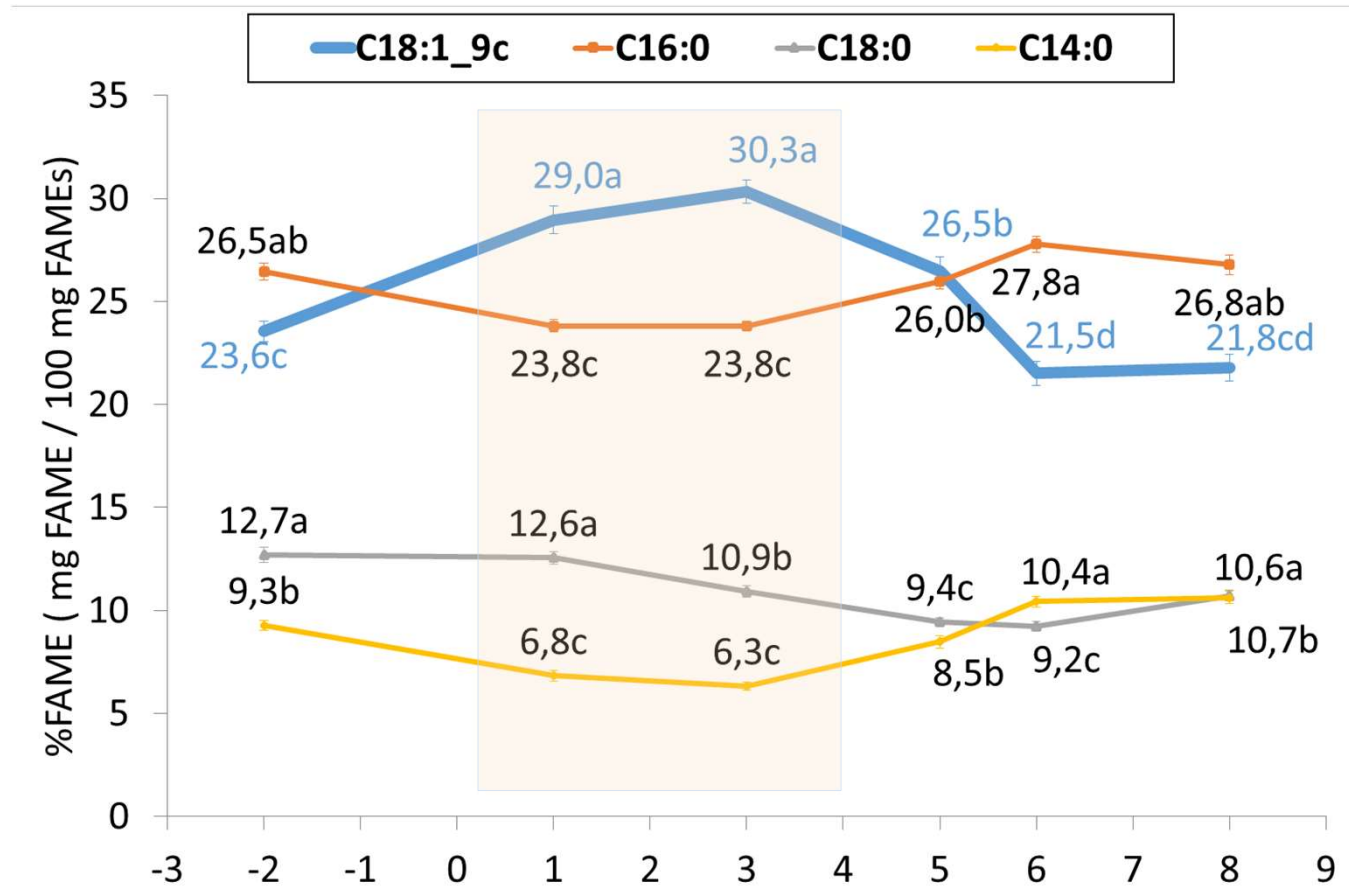
- saturated (SFA)
- monounsaturated (MUFA)
- polyunsaturated (PUFA)
- cis-MUFA
- trans-MUFA

Chain length

- C4-C15 de-novo synthesis FA
- C16-C24 mobilization FA

**Very limited references
in beef cattle**

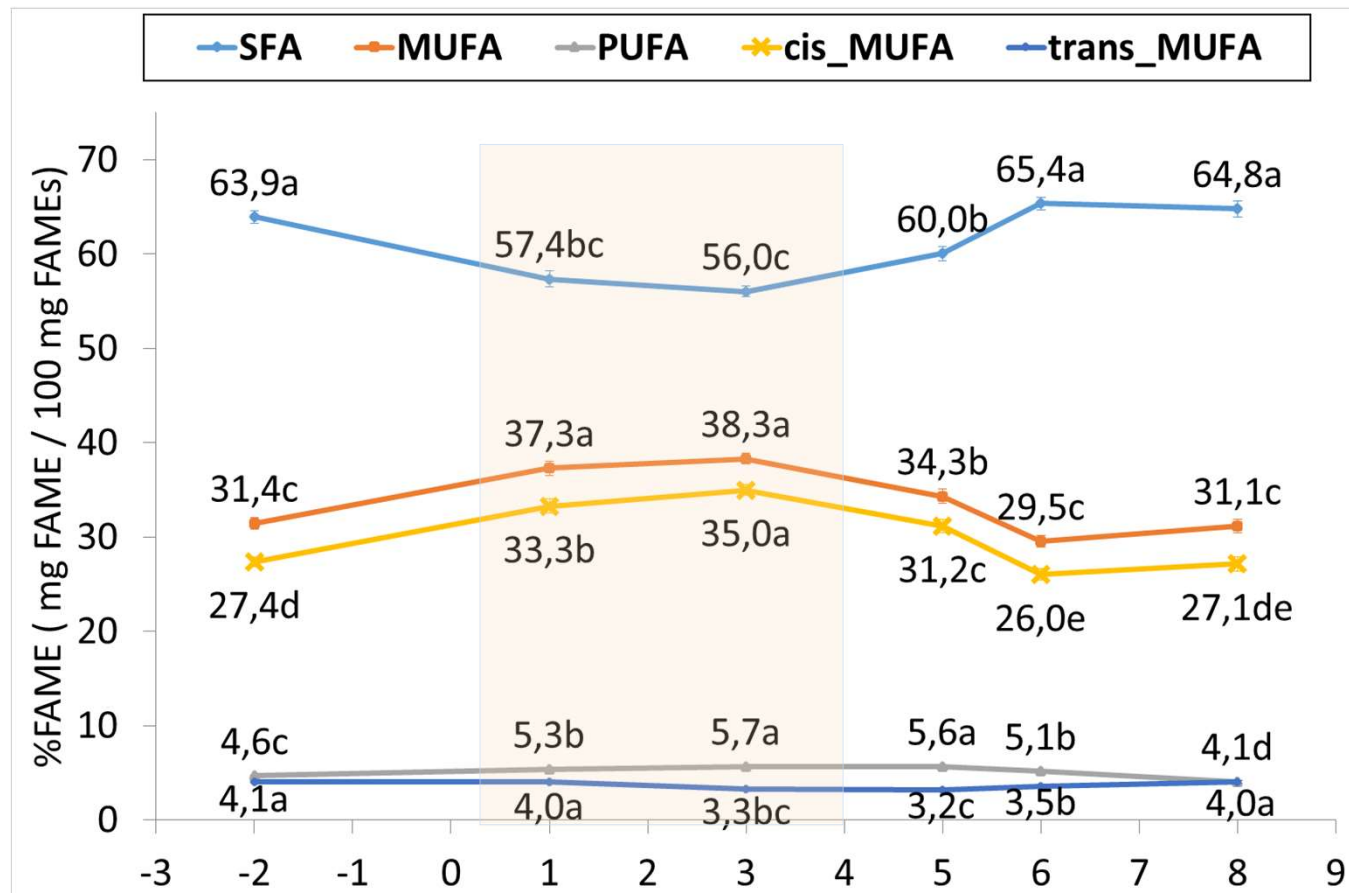
Major individual Fatty Acids



Immediate response to changes in diet/energy balance

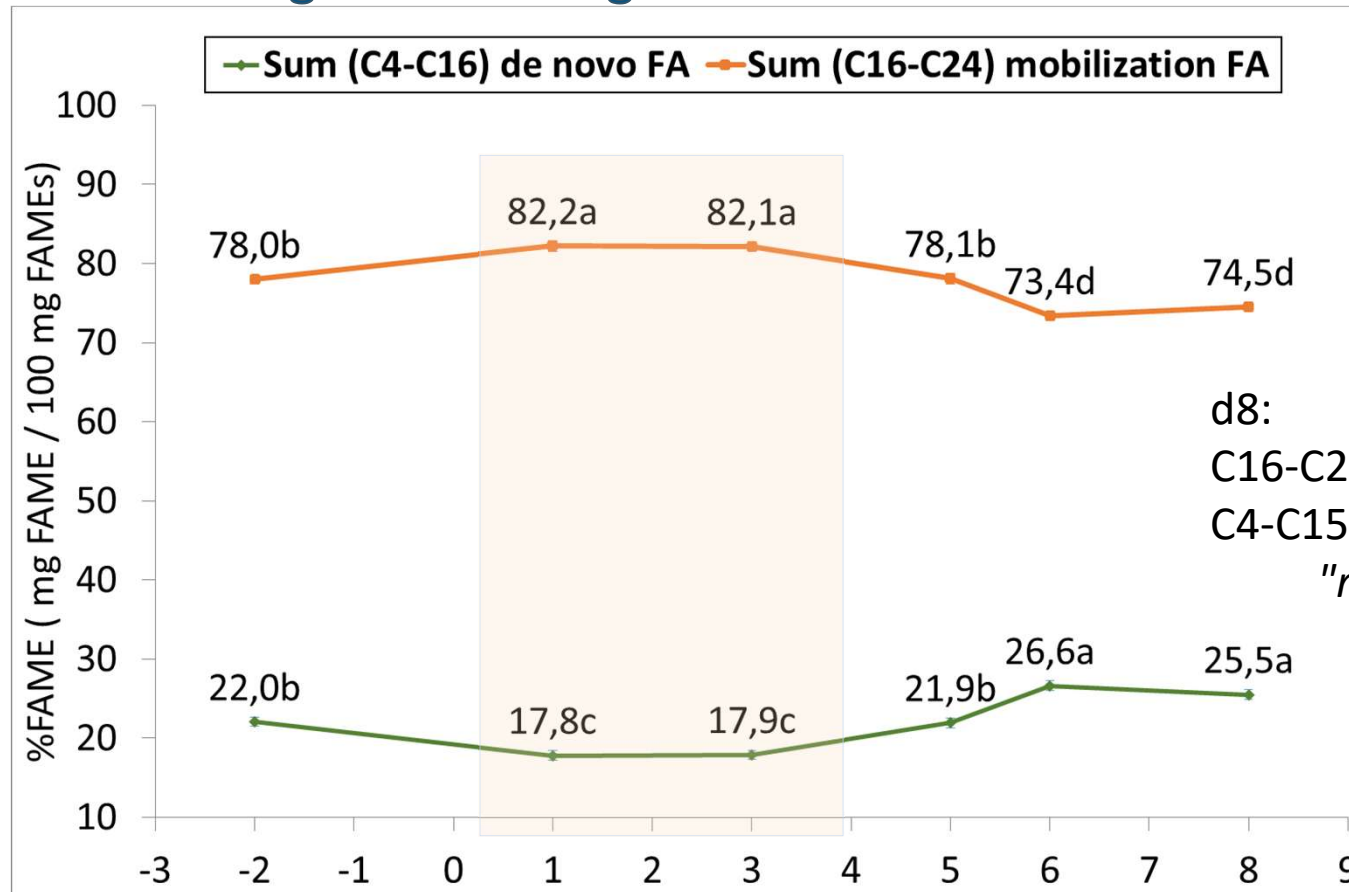
- **Challenge:** increase in **C18:1-9c**, predominant in body fat
- **Refeeding:** increase in **C16** (preformed and de novo) and **C14** (de novo)

FA according to number and position of double bonds



- **Challenge:** increased MUFA, Cis-MUFA (especially C18:1-9c) and PUFA
- **Refeeding:** decreased MUFA and increased SFA (de-novo FAs and C16:0)

FA according to chain length



d8:
 C16-C24 mob FAs < basal
 C4-C15 de-novo FAs > basal
 "rebound effect" ?

- **Challenge:** rise in C16-24, enhanced fat mobilization
- **Refeeding:** rise in the de-novo synthesis FAs and C16:0, reflecting the reversion of fat mobilization.

From now on...



Remaining analyses:

- feed efficiency (DMI and performance between challenges)
- apparent digestibility, cyclicality
- feeding behaviour (common methodology with INRAe)

Statistical analyses

Retrospective definition of cow typologies:

cow characteristics, , RFI...
patterns of response to challenges



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Genomic management Tools to Optimise Resilience and Efficiency



**Orquera K., Blanco M., Ferrer J., Joy M., Sanz A.,
Ripoll G., Bertolín J.R., Casasús, I.**

