Smarter

SMAll RuminanTs breeding for Efficiency and Resilience

Training School 2023| Toulouse, France

universidad de león

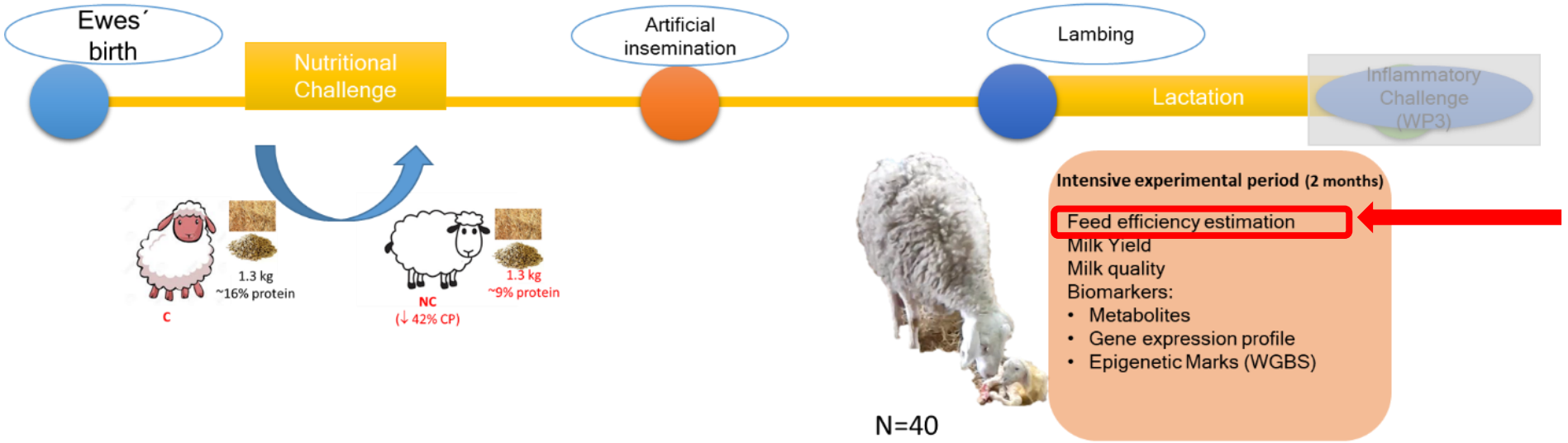
CSIC
Consejo Superior de Investigaciones Científicas

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n°772787

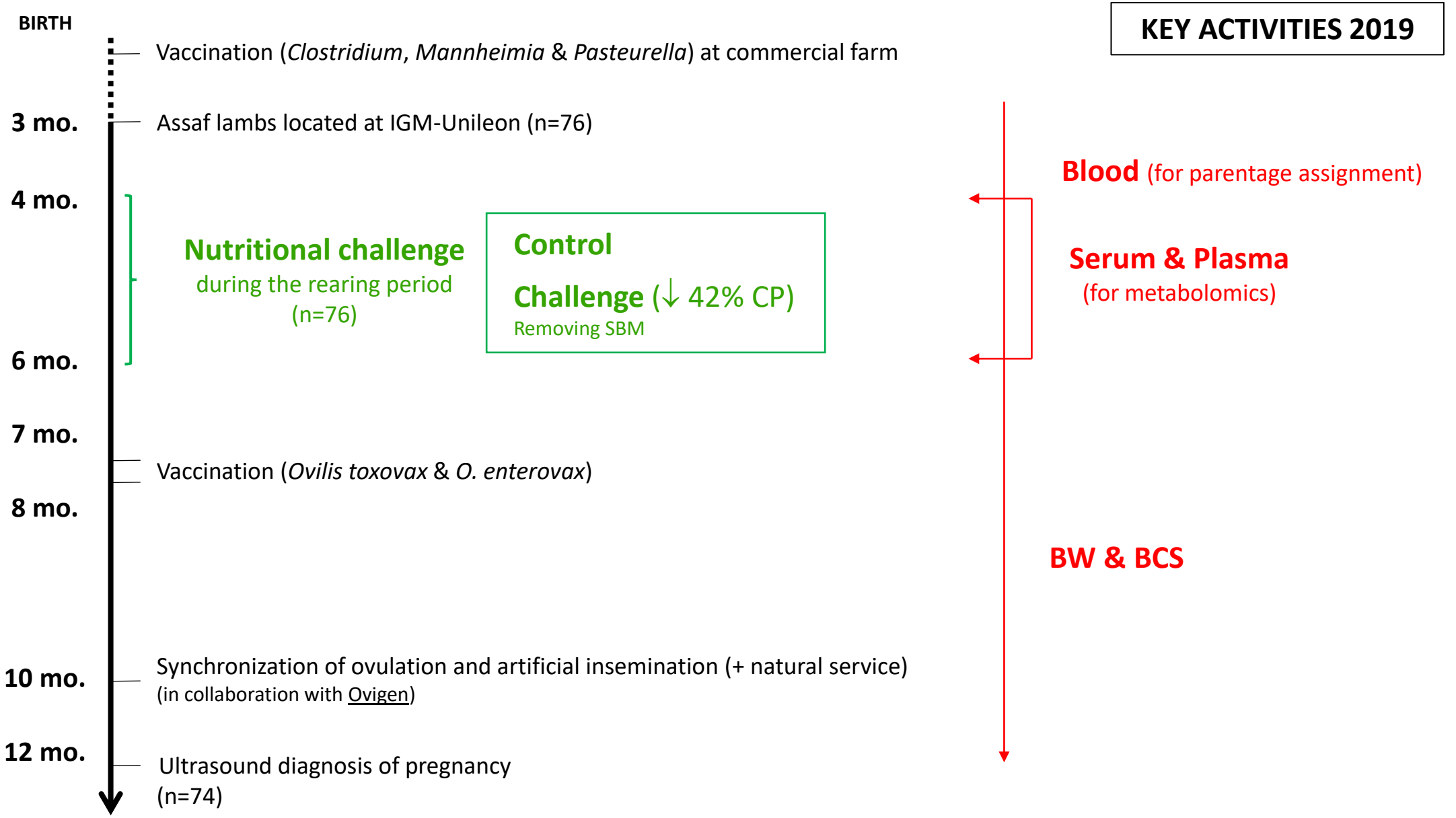
EXPERIMENTAL DESIGN= Nutritional Challenge

UNILEON/CSIC Experimental population

Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	may-19	jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20
M1	M2	M3	M4	M5	M6	M7	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22



KEY ACTIVITIES 2019



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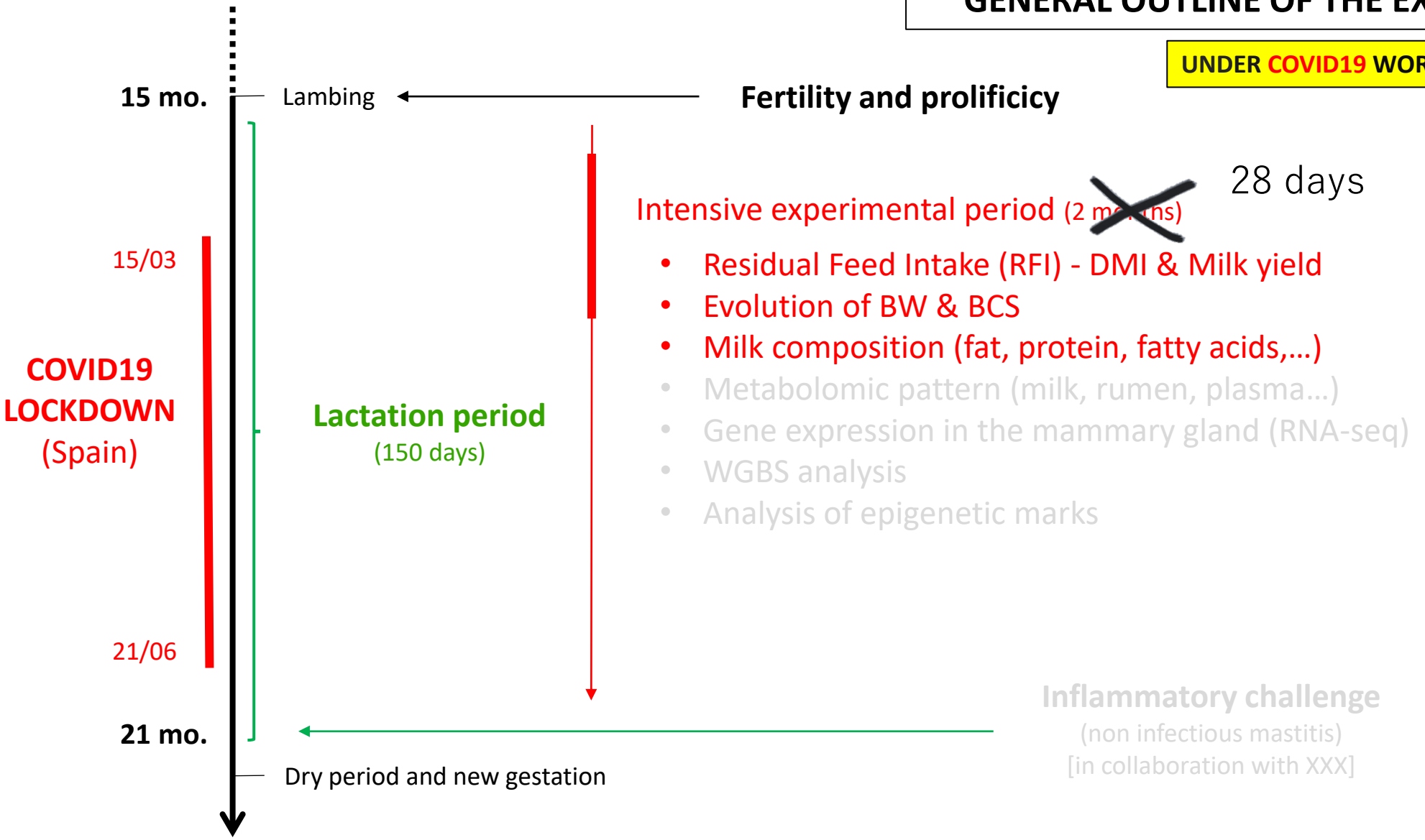
GENERAL OUTLINE OF THE EXPERIMENT

UNDER COVID19 WORKING CONDITIONS



Intensive experimental period (2 ~~months~~ 28 days)

- Residual Feed Intake (RFI) - DMI & Milk yield
- Evolution of BW & BCS
- Milk composition (fat, protein, fatty acids,…)
- Metabolomic pattern (milk, rumen, plasma…)
- Gene expression in the mammary gland (RNA-seq)
- WGBS analysis
- Analysis of epigenetic marks

Inflammatory challenge
(non infectious mastitis)
[in collaboration with XXX]

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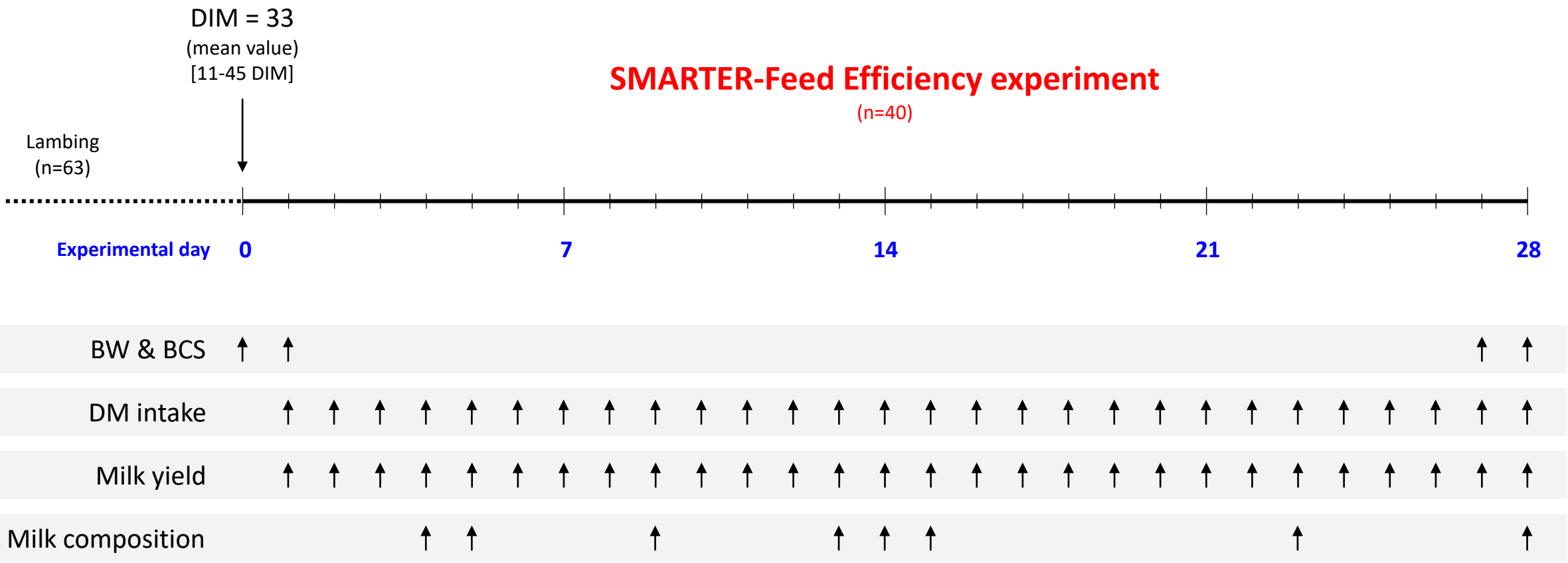

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WP1 - SMARTER

Feed Efficiency

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UNILEON-CSIC Dataset

40 Animals phenotyped

Animal_ID	Treatment	meanBW	BWC1	days_period	Fat	Protein	Milk	intake	energyTMR	DIM
61472	Control	66.9	-1	31	66.2	49.1	2.63	2.61	0.93	23
61473	Control	73.4	0	31	59.8	46.1	2.55	2.714	0.93	29
61474	Control	66.1	0.6	31	55.3	49.8	1.53	2.462	0.93	32
61477	Challenge	54.4	-6	31	71.7	50.6	2.18	2.307	0.93	31
61480	Control	66.8	0	31	55.4	49.6	2.63	2.985	0.93	50
61483	Control	77.9	0	31	52.8	49.6	3.04	3.156	0.93	28
61484	Control	58.7	2.6	31	56.7	46.1	2.53	2.985	0.93	52

- ***Animal_ID:*** Animal identification
- ***Treatment:*** Categorical variable indicating if the animals was subjected (***challenge***) or not to (***control***) a protein restriction (~40% reduction)
- ***meanBW:*** Average body weight (kg)
- ***BWC1:*** Body weight change during the experimental period
- ***days_period:*** Days in the experiment
- ***Fat:*** Fat yield (g/kg)
- ***Protein:*** Protein yield (g/kg)
- ***Milk:*** Milk yield (kg/d)
- ***intake:*** Actual dry matter intake
- ***energyTMR:*** Energy content of the total mixed ratio (TMR)
- ***DIM:*** Days in milk

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FEED EFFICIENCY INDEX (FEI)

$$FEI = DMI_R - DMI_P$$

- DMI_R is the mean value of <u>recorded</u> DMI over the experimental period
- DMI_P is the mean value of <u>predicted</u> DMI for the experimental period

$$DMI_P = NE_R / NE_{TMR}$$

- NE_R is net energy requirements (UFL/d) for maintenance, milk production, and BW change
  [using the equations proposed by INRA (2018)]
- NE_{TMR} is the net energy of the TMR (UFL/kg DM)
  [estimated from INRA (2018) nutritional value tables]

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FEED CONVERSION RATIO (FCR)

Dry matter intake (DMI; kg DM/d)

$$FCR = \frac{\text{Feed intake}}{\text{Milk production}}$$

Energy corrected milk (ECM; kg/d)

Proposed by INRA (2018) for dairy sheep

ECM = kg/d of milk yield × [(0.0071 × g/kg of milk fat) + (0.0043 × g/kg of milk protein) + 0.2224

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RESIDUAL FEED INTAKE (RFI) – see Pryce et al. (2015)

Parameters used to calculate RFI

Days in milk	DIM	days
Dry matter intake	DMI	kg DM/d

Body weight	BW	kg
BW change	BWC1	kg (period)
BW change	BWC2	kg/d
✓ Metabolic BW	MBW	kg
MBW change	MBWC1	kg (period)
MBW change	MBWC2	kg/d
✓ Interaction BW × BW change	BWBWC	change/d

Milk yield	MY	kg/d
Milk fat	MF	g/kg
Milk protein	MP	g/kg
Milk lactose	ML	g/kg
Milk fat yield	MFY	g/d
Milk protein yield	MPY	g/d
Milk lactose yield	MLY	g/d
Energy corrected milk	ECM	kg/d ✓

RFI was estimated as the residuals of the following regression model:

$DMI = \mu + a \times ECM + b \times MBW + c \times BWBWC + RFI$

(R^2 regression model selected = 0.80)

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RESIDUAL FEED INTAKE 2 (RFI2)

Parameters used to calculate RFI

Days in milk	DIM	days
Dry matter intake	DMI	kg DM/d

Body weight	BW	kg
BW change	BWC1	kg (period)
BW change	BWC2	kg/d
✓ Metabolic BW	MBW	kg
MBW change	MBWC1	kg (period)
✓ MBW change	MBWC2	kg/d
Interaction BW × BW change	BWBWC	change/d

Milk yield	MY	kg/d
Milk fat	MF	g/kg
Milk protein	MP	g/kg
Milk lactose	ML	g/kg
Milk fat yield	MFY	g/d
Milk protein yield	MPY	g/d
Milk lactose yield	MLY	g/d
Energy corrected milk	ECM	kg/d ✓

RFI was estimated as the residuals of the following regression model:

$DMI = \mu + a \times ECM + b \times MBW + c \times MBWC2 + RFI$

(R^2 regression model selected = 0.80)

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RESIDUAL FEED INTAKE 3 (RFI3)

Parameters used to calculate RFI

Days in milk	DIM	days
Dry matter intake	DMI	kg DM/d

Body weight	BW	kg
BW change	BWC1	kg (period)
BW change	BWC2	kg/d
✓ Metabolic BW	MBW	kg
MBW change	MBWC1	kg (period)
MBW change	MBWC2	kg/d
✓ Interaction BW × BW change	BWBWC2	change/period

Milk yield	MY	kg/d
Milk fat	MF	g/kg
Milk protein	MP	g/kg
Milk lactose	ML	g/kg
Milk fat yield	MFY	g/d
Milk protein yield	MPY	g/d
Milk lactose yield	MLY	g/d
Energy corrected milk	ECM	kg/d ✓

RFI was estimated as the residuals of the following regression model:

$DMI = \mu + a \times ECM + b \times MBW + c \times BWBWC2 + RFI$

(R^2 regression model selected = 0.80)

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Hands on

- https://github.com/pablobio/FeedEfficiency_SMARTER2023

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