EAAP
European Federation of Animal Science

Session 78
"Collaboration in experimental research for sustainable pig production (with PIGWEB)"

PIGWEB

Piglet response to L-leucine supply during the post-weaning phase depends on piglet birth weight

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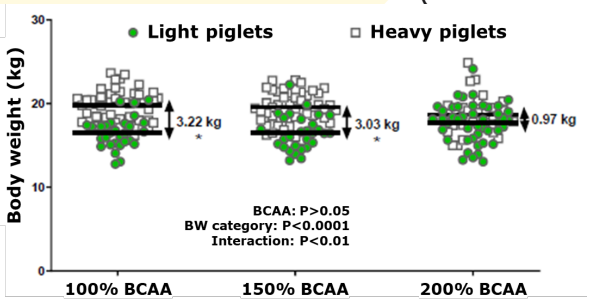
INTRODUCTION

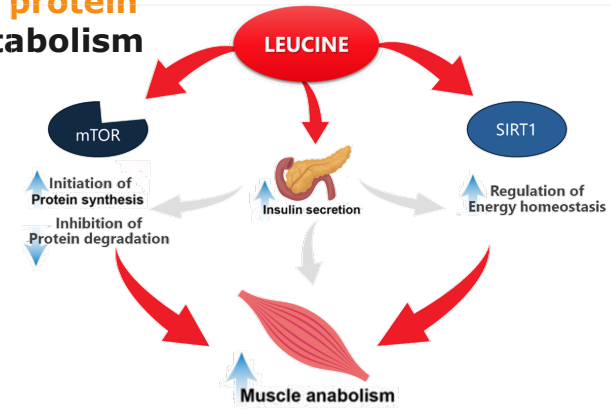
1 **branched-chain amino acids (BCAA: Val, Ile, Leu) contribute to minimise BW difference between light and heavy piglets**

(Chalvon-Demersay et al., 2020)



2 **among BCAA, leucine (Leu) is the AA involved in the control of protein synthesis and energy metabolism**

(Duan et al., 2016)



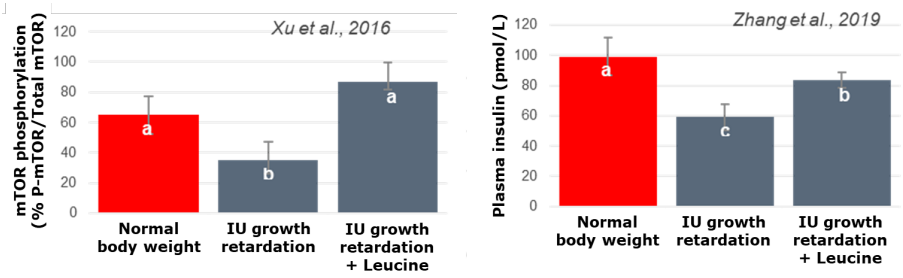
mTOR = mammalian target of rapamycin
SIRT1 = silent information regulator transcript 1

Hypothesis:

Piglet response to dietary leucine level during the post-weaning phase depends on their body weight

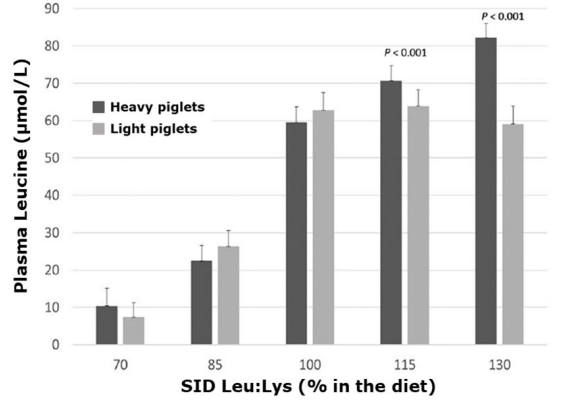
3 **dietary Leu supplementation reactivate the metabolism of growth retarded piglets**

(Xu et al., 2016; Zhang et al., 2019)



4 **different metabolic response (plasma Leu content) to dietary Leu level, between light and heavy piglets**

(Bertocchi et al., 2019)

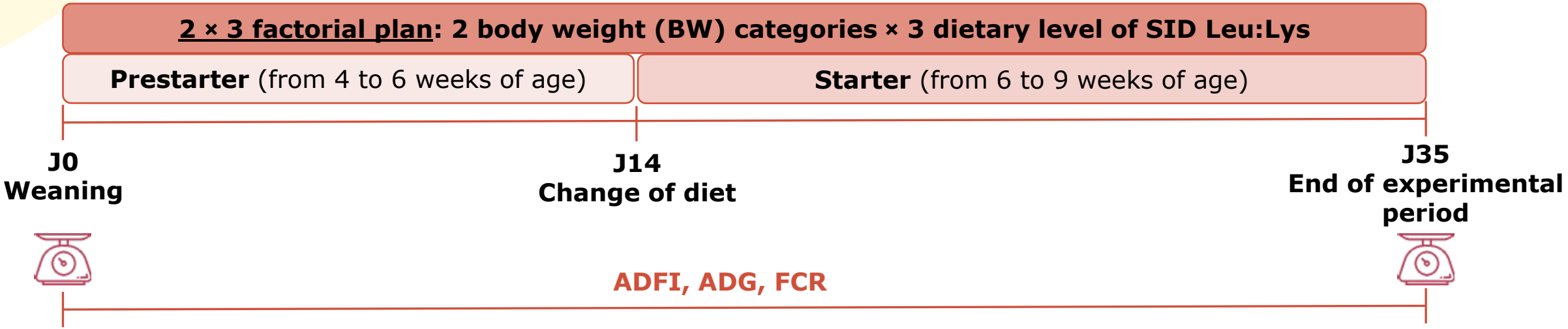


MATERIEL ET METHODES

Animals, experimental design and statistics

180 piglets: (Piétrain boar and a hybrid sow: RA-SE genetics)

- weaned at 26-28d
- 6 treatments × 2 rounds × 3 pens/treatment × 5 piglets/pen
- gilts (1 pen/treatment/round) and barrow (2 pens/treatment/round)



Body weight categories: birth weight => 3 categories (< 1kg not considered) => medium BW category removed

- light piglets = 1.31kg ± 0.06 at birth, **7.13kg ± 0.31 at weaning ➔ treatments T1 to T3**
- heavy piglets = 1.85kg ± 0.13 at birth, **8.98kg ± 0.27 at weaning ➔ treatments T4 to T6**

Dietary level of SID Leu:Lys: 85, 100 and 115% ➔ considered as "deficiency", "adequacy", "excess"

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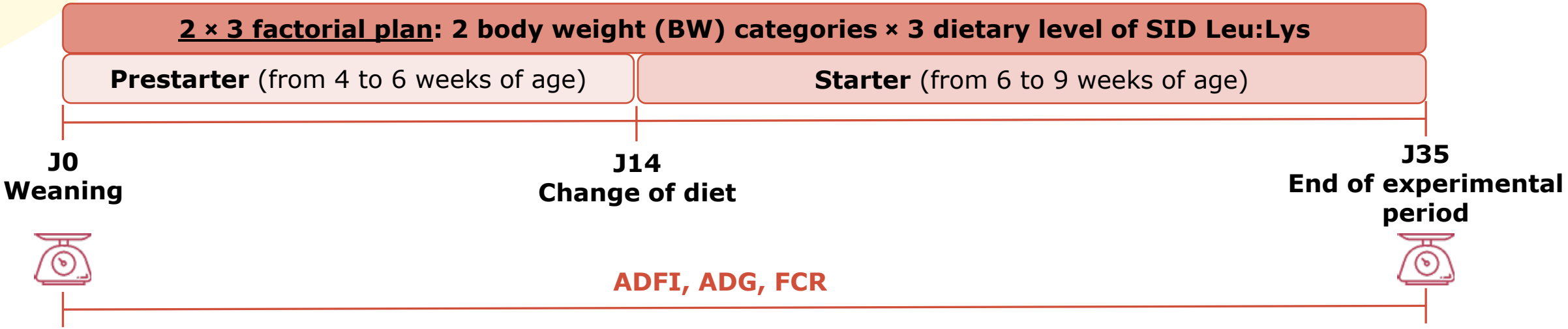

Statistical analysis: experimental unit = pen

Linear mixed models with the round as random effect:

- two-way ANOVA with fixed effects of dietary Leu level [LEU], BW category [BW], [LEU] × [BW] interaction and sex
- one-way ANOVA with dietary treatment (n = 6) and sex as fixed factors

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Experimental diets

Experimental diets: typical Belgium feed

- wheat- & barley-based diet => low corn to minimise and control the Leu level
- iso-lysine, iso-protein & iso-energy => only varying in Leu level
- amino acid profile according to CVB recommendations

	Prestarter (from 4 to 6 weeks of age)			Starter (from 7 to 9 weeks of age)		
	T1/T4	**T2/T5**	**T3/T6**	**T1/T4**	**T2/T5**	**T3/T6**
SID Leu:Lys, %	**85**	**100**	**115**	**85**	**100**	**115**
SID Lys, %	1.15	1.15	1.15	1.18	1.18	1.18
Crude Protein, %	17.5	17.5	17.5	18.0	18.0	18.0
SID Lys:CP, %	6.6	6.6	6.6	6.6	6.6	6.6
Net Energy, MJ/kg	10.1	10.1	10.1	10.1	10.1	10.1

- the T1/T4 diets were produced (85% SID Leu:Lys) and L-Leu was added to the other batches to reach 100 and 115% SID Leu:Lys levels
- all diets were pelleted
- feed and water *ad libitum*

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Experimental diets

Feeding phase	Prestarter			Starter		
Treatments	**T1/T4**	**T2/T5**	**T3/T6**	**T1/T4**	**T2/T5**	**T3/T6**
SID Leu:Lys, %	**85**	**100**	**115**	**85**	**100**	**115**
Barley / Wheat	28.5 / 28.0	28.5 /27.8	28.5 /27.6	35.6 / 28.0	35.6 /27.8	35.6 / 27.6
Corn	2.9	2.9	2.9	0.2	0.2	0.1
Soybeans	15	15	15	15	15	15
Soybean meal	9	9	9	9	9	9
Mineral	1.8	1.8	1.8	2.1	2.1	2.1
Premix (incl. dairy products)	9	9	9	3	3	3
Other	4.03	4.03	4.03	4.83	4.83	4.83
Soy oil	0.17	0.17	0.17	0.68	0.68	0.68
L-Lys HCl / L-Thr / DL-Met / L-Trp	1.240	1.240	1.240	1.280	1.280	1.280
L-Val	0.200	0.200	0.200	0.195	0.195	0.195
L-Ile	0.200	0.200	0.200	0.065	0.065	0.065
L-His HCl	0.050	0.050	0.050	0.040	0.040	0.040
L-Leu	-	0.180	0.350	-	0.180	0.360

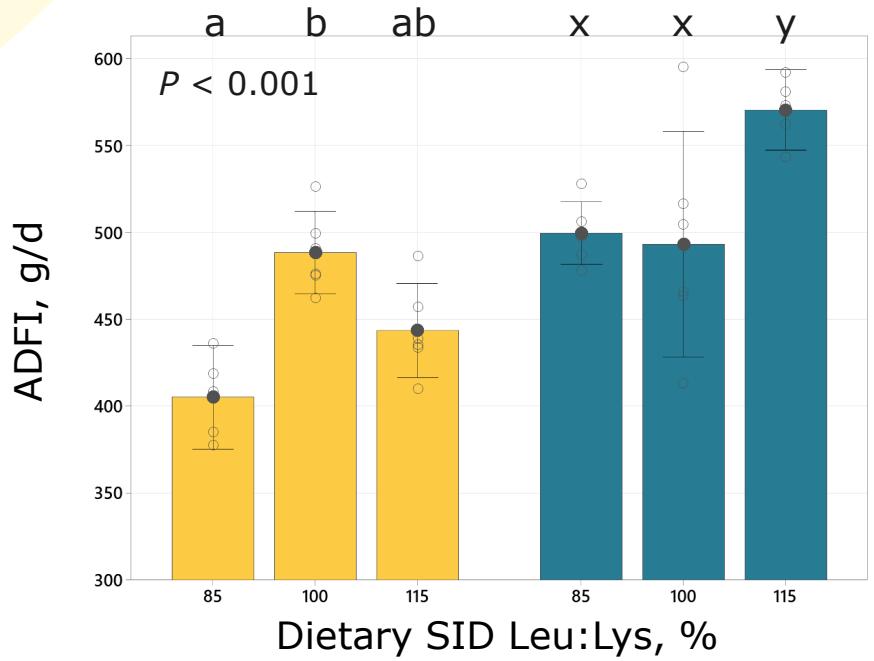
➔ Final feeds were analysed: proximate analysis + AA content ➔ in line with expected values

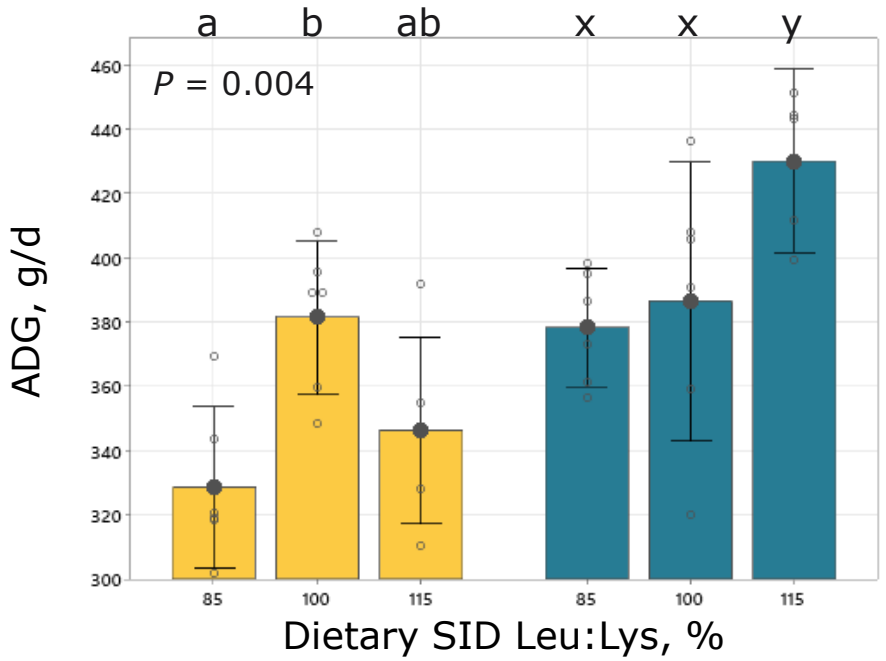
RESULTS & DISCUSSION

Two-way ANOVA analysis (n = 3 × 2)

Light piglets
Heavy piglets

Significant [LEU] × [BW] interaction for: ADFI, ADG and final BW





➔ The piglet response to Leu is **different according to the BW category**

➔ The **feed intake** seems to drive this response

➔ In both BW categories, **85% SID Leu:Lys is too low to optimize performance**
= increasing the Leu level led to increased performance

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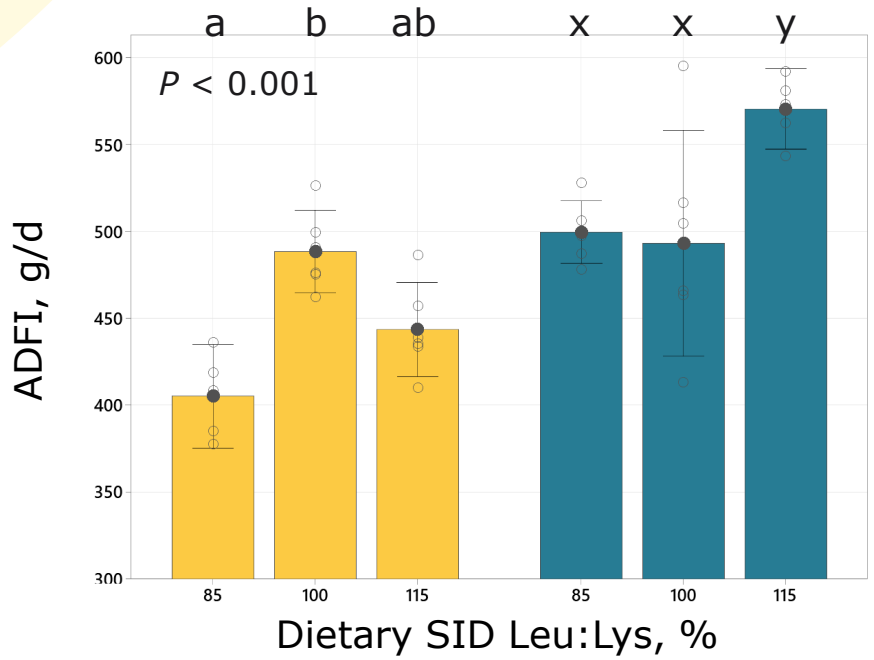

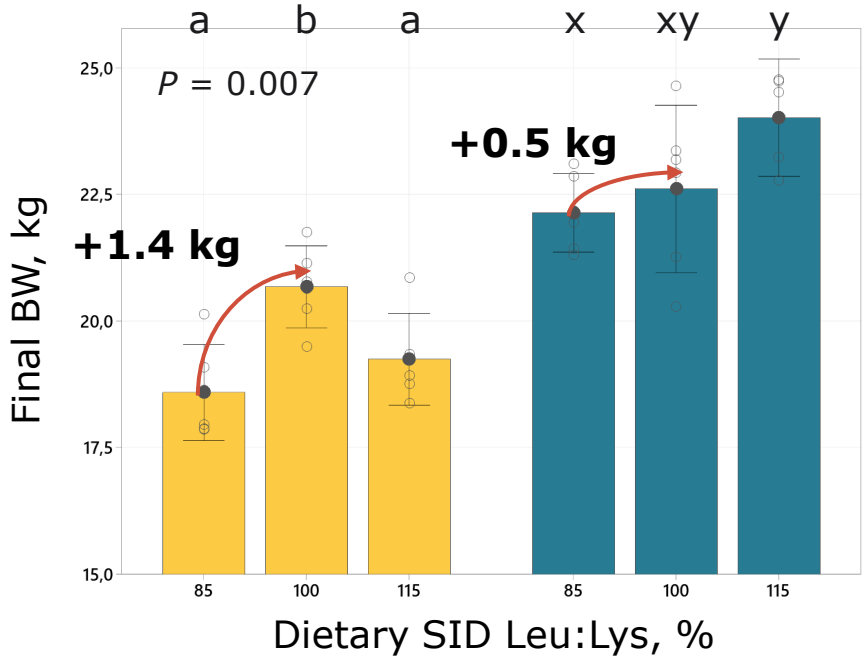

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➔ In both BW categories, **85% SID Leu:Lys is too low to optimize performance**
= increasing the Leu level led to increased performance

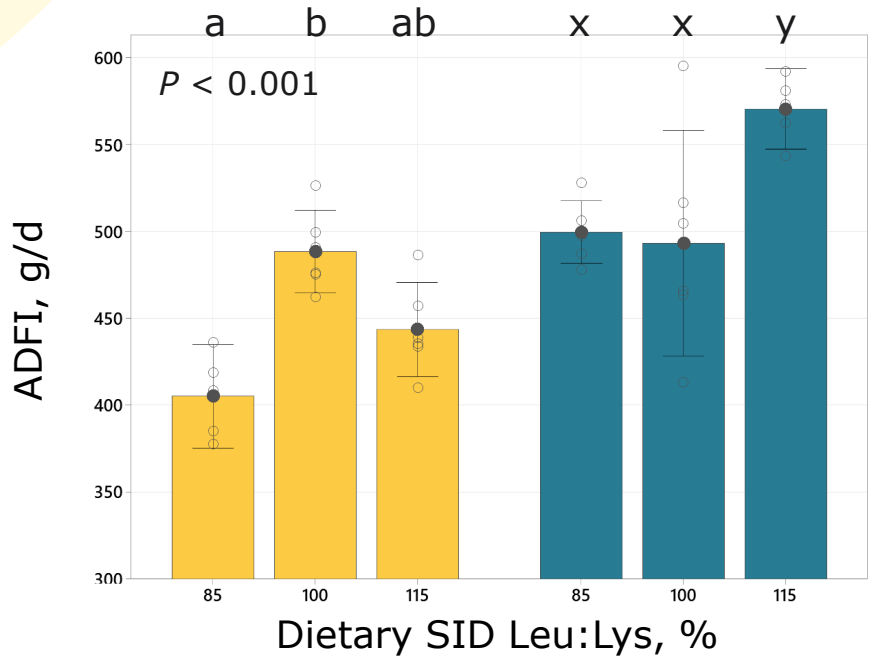
➔ From 85 to 100% SID Leu:Lys, the **response of the light piglets is stronger**

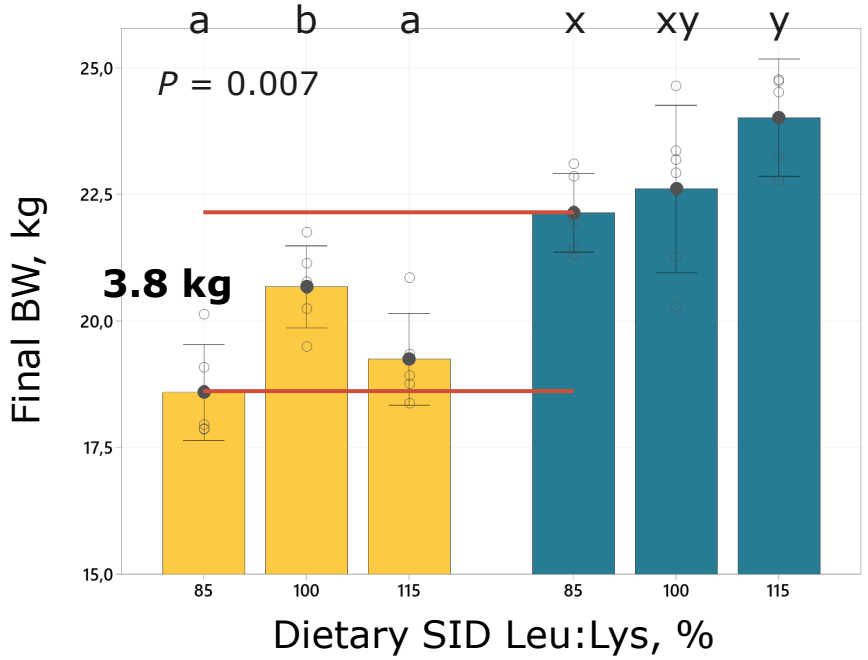
RESULTS & DISCUSSION

Two-way ANOVA analysis (n = 3 × 2)

Light piglets
Heavy piglets

Significant [LEU] × [BW] interaction for: ADFI, ADG and final BW





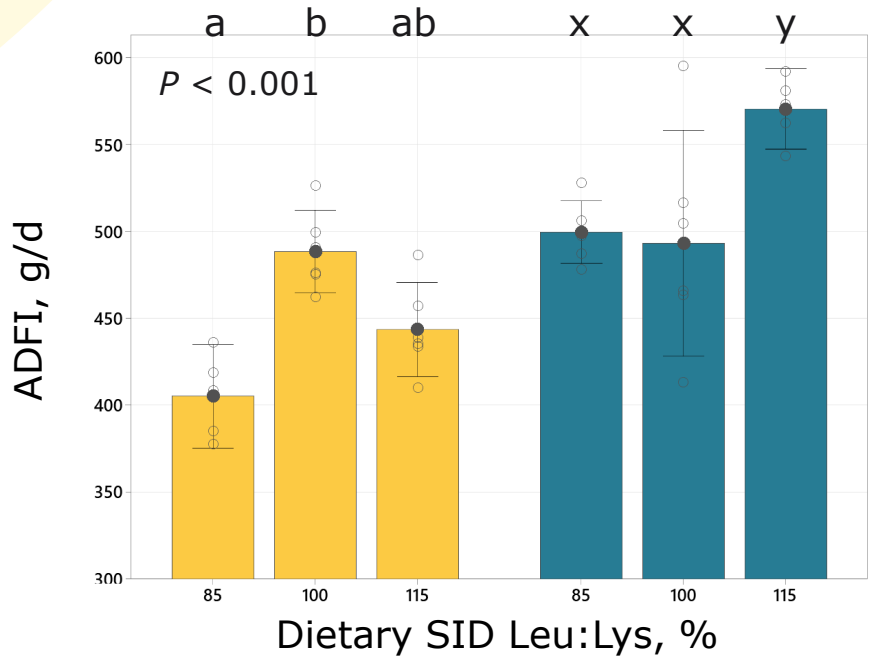
➔ Increasing from 85 to 100% SID Leu:Lys allows to **reduce the difference** in final BW **between light and heavy piglets** by half: **from 3.8 to 1.9kg BW difference**

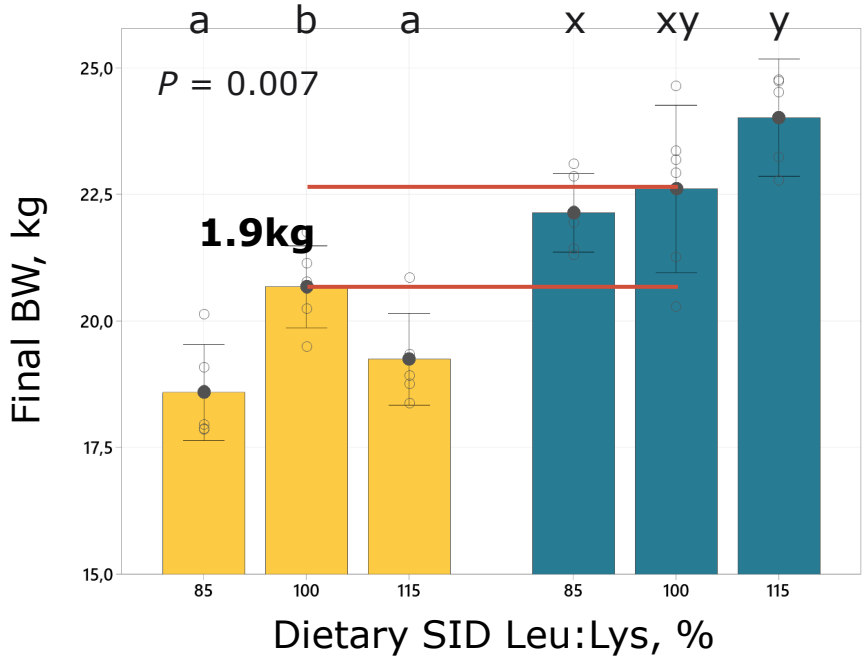
RESULTS & DISCUSSION

Two-way ANOVA analysis (n = 3 × 2)

Light piglets
Heavy piglets

Significant [LEU] × [BW] interaction for: ADFI, ADG and final BW



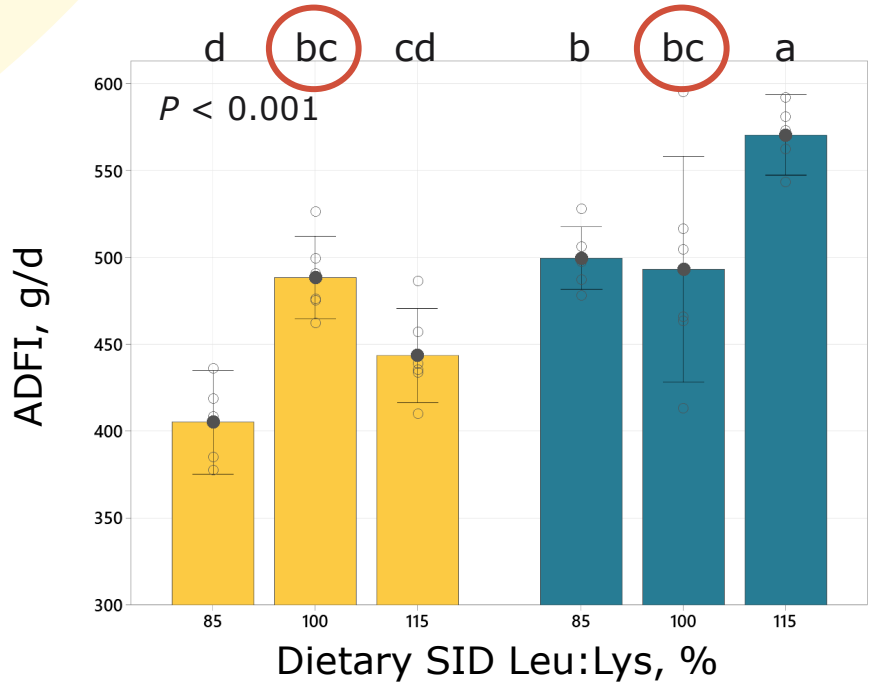


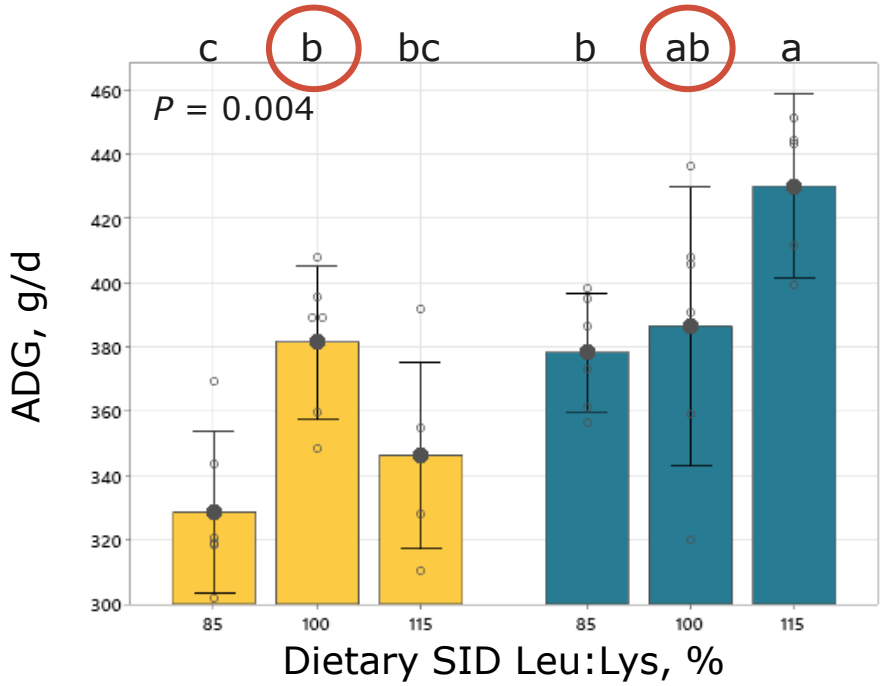
➔ Increasing from 85 to 100% SID Leu:Lys allows to **reduce the difference** in final BW **between light and heavy piglets** by half: **from 3.8 to 1.9kg BW difference**

RESULTS & DISCUSSION

One-way ANOVA analysis (n = 6)

Light piglets
Heavy piglets





➔ Being at 100% SID Leu:Lys allows to **homogenize ADFI and ADG** between light and heavy piglets

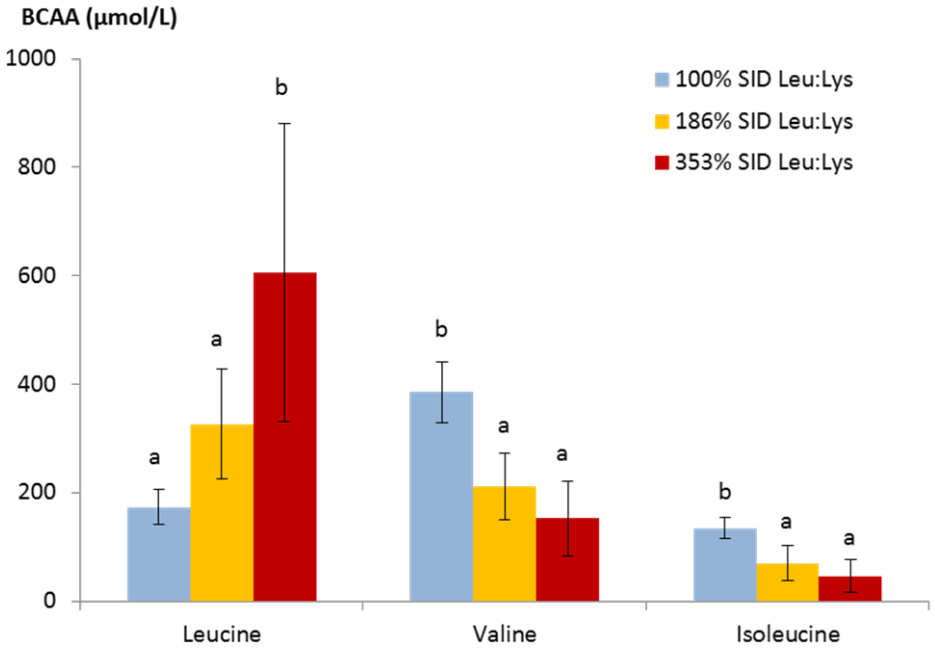
RESULTS & DISCUSSION

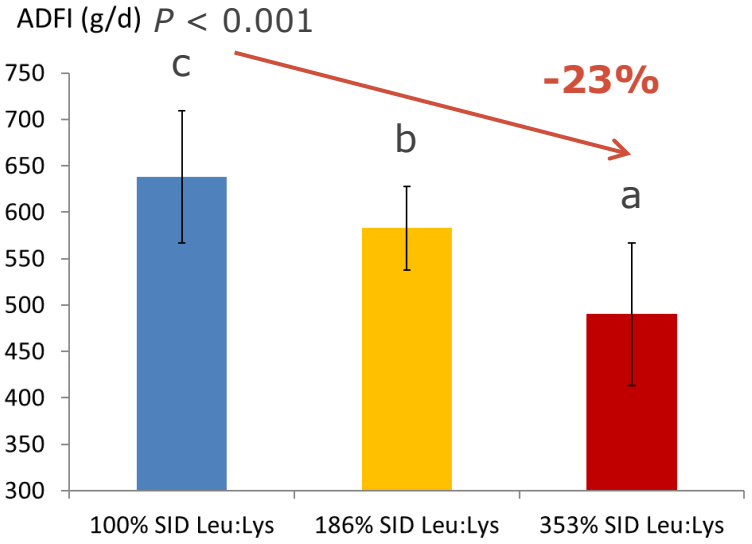
Consequences of Leu excess on piglet performance

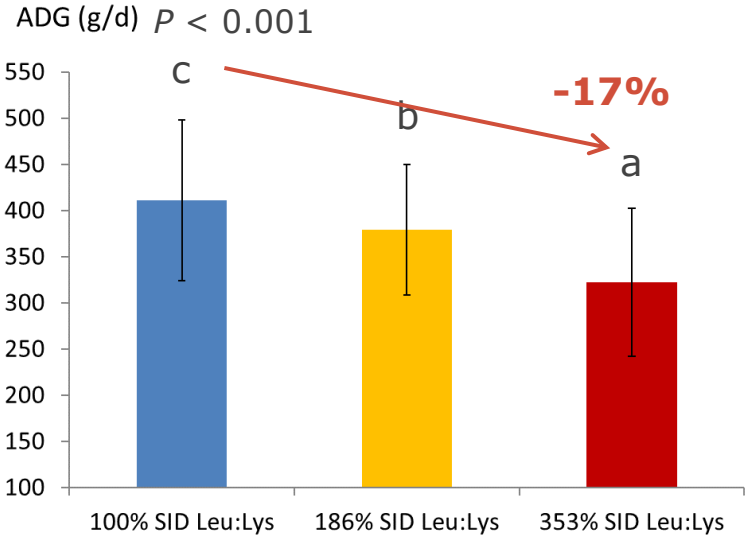
For light piglets, 100% SID Leu:Lys is sufficient

➔ Can 115% SID Leu:Lys be considered as "excess" ?

Wessels et al., 2016 (post-weaning piglets from 5 to 10 weeks of age)







➔ As a reaction to the metabolic imbalance, piglets reduce their feed intake

➔ The consequence is a reduced growth rate

Activation of GCN2 pathway ?

CONCLUSIONS

1. **Significant interaction between dietary Leu level and body weight category** =
   'Piglet response to dietary leucine level during the post-weaning phase depends on their body weight'
   ➔ **validation of our hypothesis**

2. **For both BW categories:**
   - a dietary level at 85% SID Leu:Lys is deficient
   - the feed intake seems to drive this response, with no effect on FCR

3. **From 85 to 100% SID Leu:Lys**
   - light piglets respond stronger than heavy piglets: +1.4kg BW vs +0.5kg BW

4. **From 100% to 115% SID Leu:Lys**
   - heavy piglets: improvement of feed intake and growth rate
   - light piglets: no improvement of performance, even deterioration
     ➔ 115% SID Leu:Lys considered as an excess for light piglets?

5. **Being at 100% SID Leu:Lys allows to:**
   - reduce the difference in final BW between light and heavy piglets: **from 3.8 to 1.9kg**
   - homogenize ADFI and ADG between light and heavy piglets

ACKNOWLEDGMENTS

This work was supported by the PIGWEB project, which has received funding from the European Union's Horizon 2020 program under grant agreement N° 101004770

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