



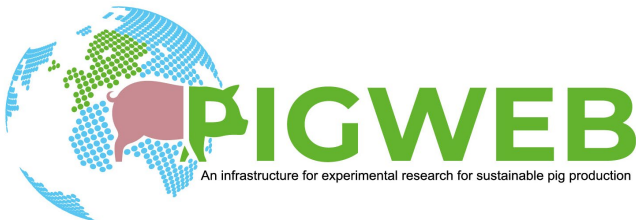
Continuous monitoring of glycaemia to sense variations in intermediary metabolism during night and day cycles in growing pig

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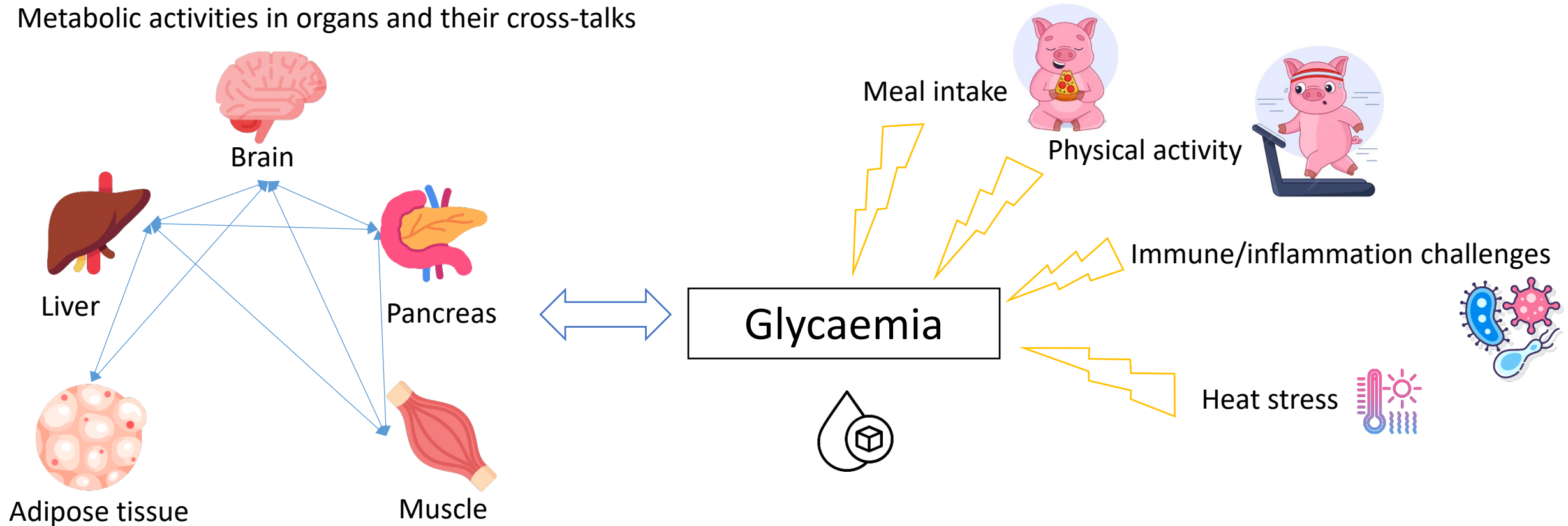
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Factors influencing glucose concentrations in circulating blood

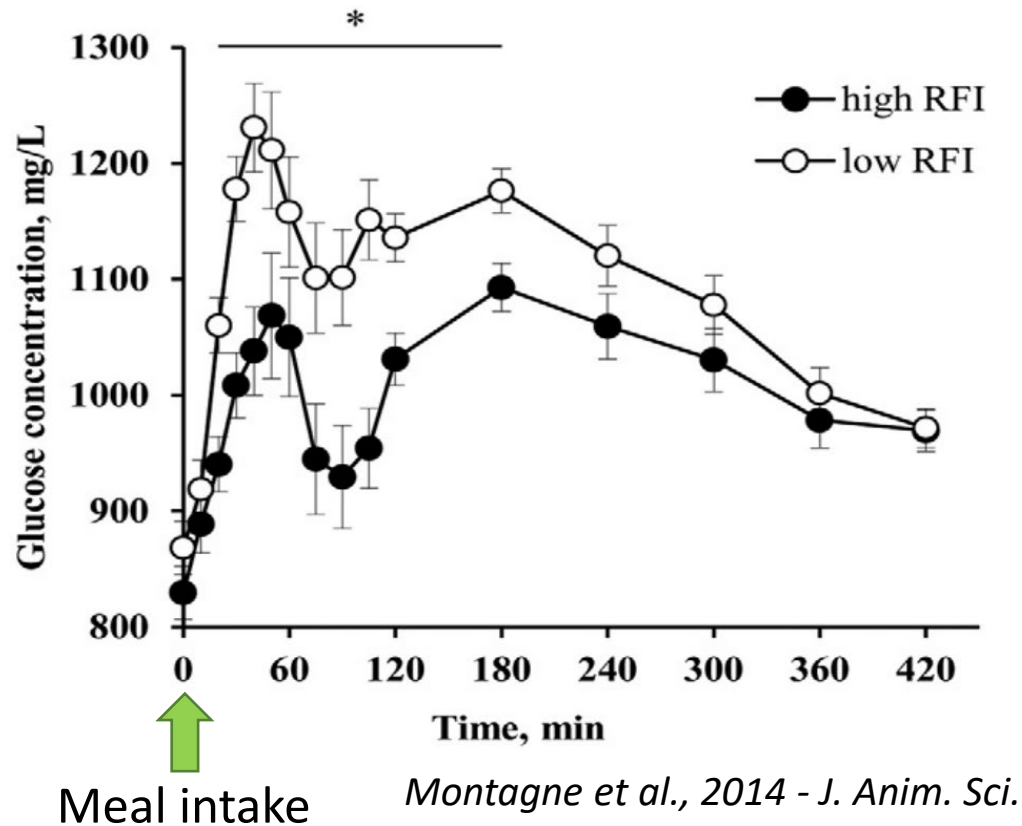
Metabolic activities in organs and their cross-talks



Changes in glycaemia are indicative of physiological responses and physiopathology

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Basal and time-course changes in glycaemia



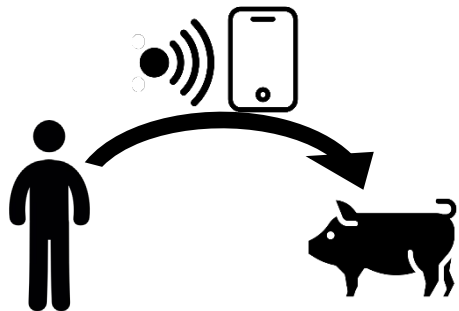
Serial blood sampling needs animals equipped with a catheter and is performed during a limited test period (few hours)

It is not friendly for the animal and for the human staff



Taking advantage of new connected tools to monitor glycaemia ?

Aim of the study



- Testing continuous glucose monitoring system (CGM), that is developed in human medicine, for its relevance in growing pigs



- Depicting glycaemic events during day and night and relationships

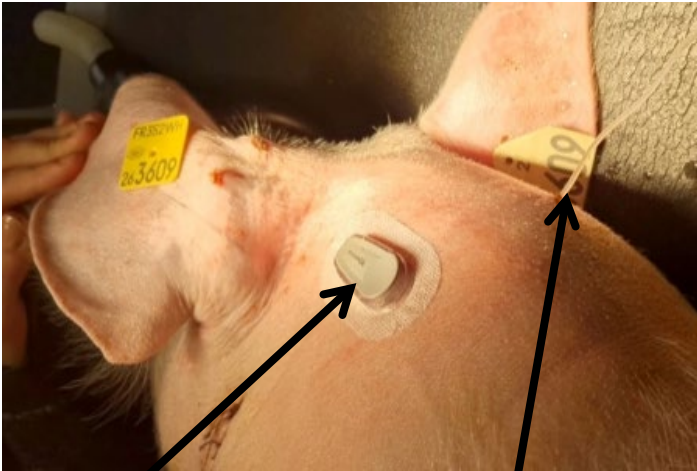
➔ Sensing animal physiology continuously by new technology to optimize future livestock husbandry practices

Experimental strategy

- Pietrain x (Large White x Landrace) pig (n = 8)
- 50 kg live weight
- Individual pen



Dexcom CGM



Measurement of
glucose concentrations
in interstitial fluid
every 5 minutes



Jugular catheter to sample **blood**
at specific intervals
during the first 4 hours
after meal test



Overnight fast

Meal at 09:00 AM

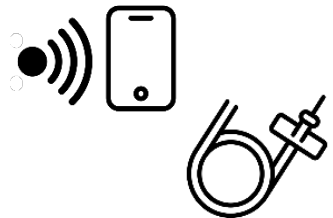
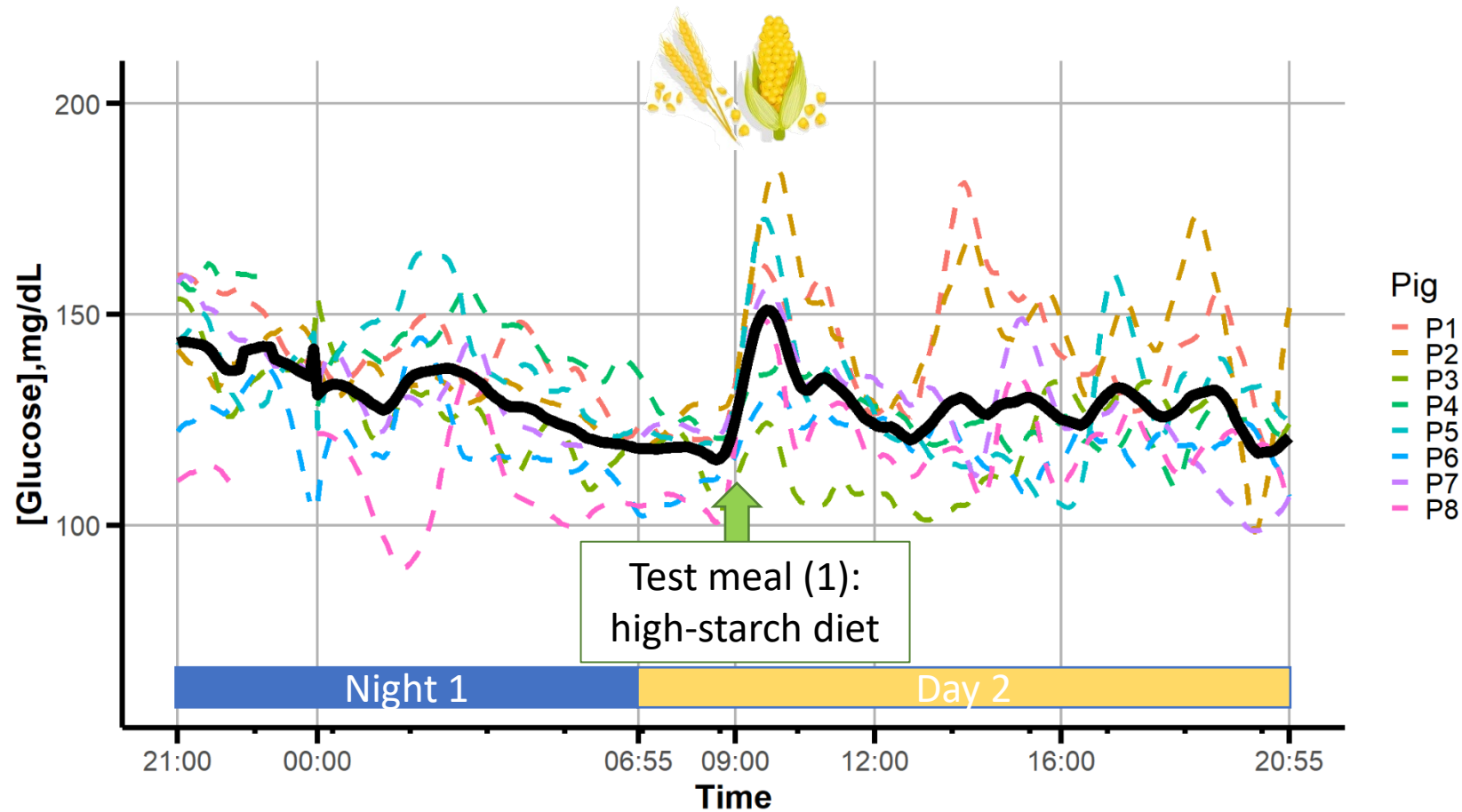
Test meal 1:
high-starch diet
(HS; 4% lipids)



Test meal 2:
high-fat diet
(HF, 12% lipids)



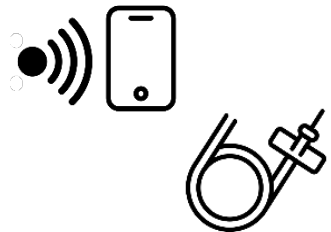
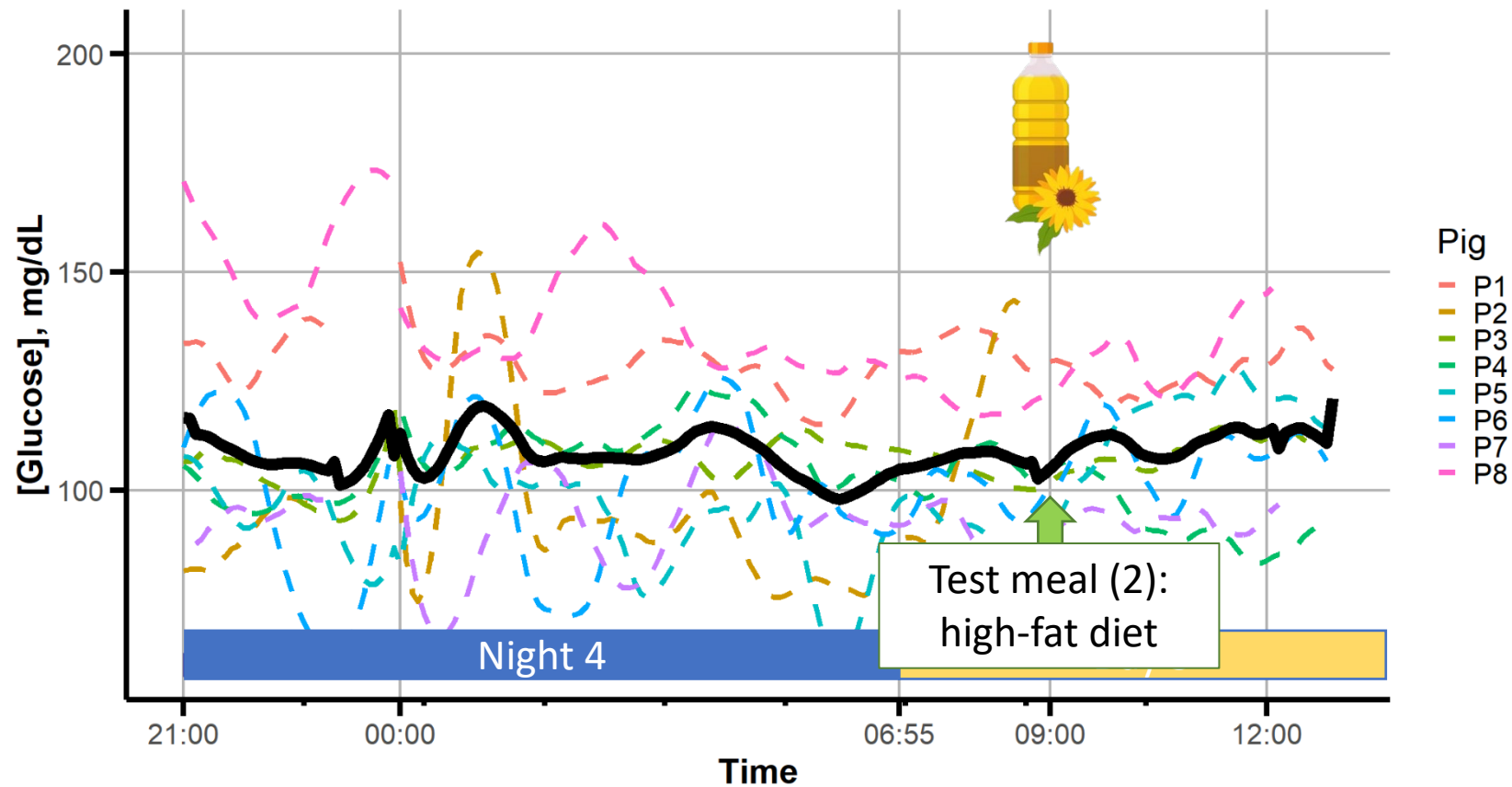
Time-course variations of glycaemia as sent by the sensor



Correlations sensor / catheter during the 4 hours postprandial:

$$r = 0.70^{***}$$

Time-course variations of glycaemia as sent by the sensor



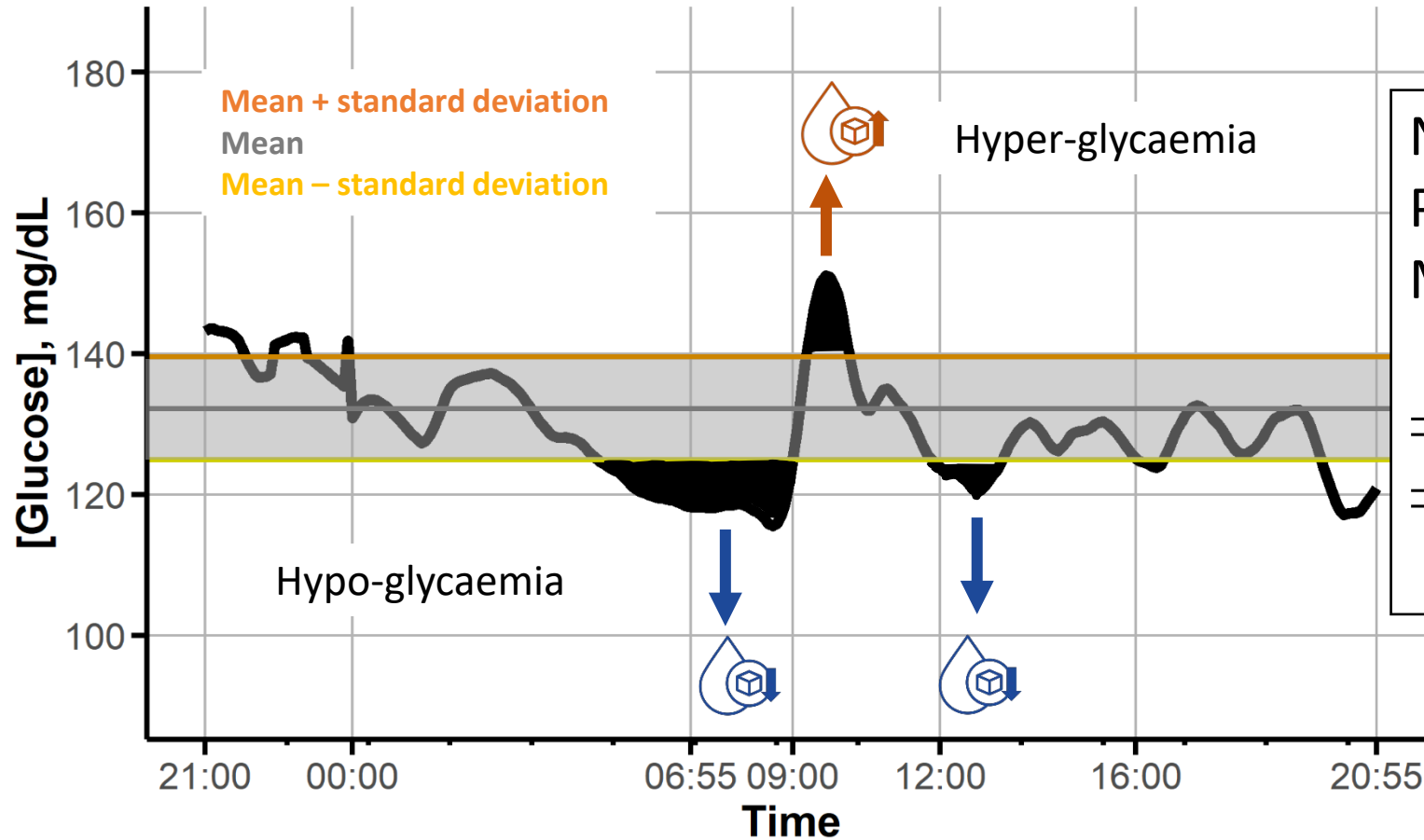
Correlations sensor / catheter during the 4 hours postprandial:

$$r = 0.43^{***}$$

Defining glycaemic events



Focusing on high starch diet



Number of peaks

Peaks duration

Maximum (minimum) value at peak

⇒ Periods of hyper (hypo) glycaemia

⇒ The most significant peak for
hyper (hypo) glycaemia

Description of glycaemic events



Night		Day	
mean	± sd	mean	± sd

Hyper-glycaemia

Number of peaks (n)	1.6	± 0.5	3.2	± 1.8
Total duration (min)	91	± 21	183	± 172
Maximal value at peak (mg/dL)	154	± 10	162	± 21
Duration of the peak (min)	76	± 29	72	± 50

Hypo-glycaemia

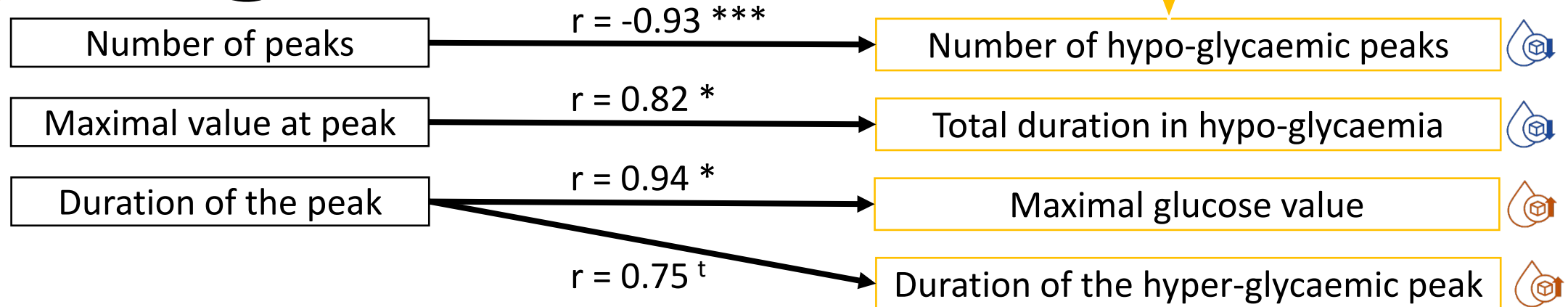
Number of peaks (n)	2.0	± 0.9	3.3	± 0.8
Total duration (min)	74	± 27	336	± 239
Minimal value at peak (mg/dL)	114	± 12	104	± 6
Duration of the peak (min)	62	± 32	218	± 199

Hyper-glycaemic and hypo-glycaemic peaks occurred during night, but the inter-variability for each glycaemic event was lower at night than during the day

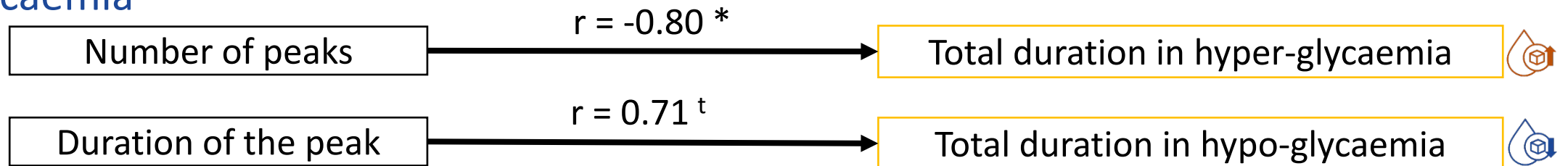
Correlations between diurnal and nocturnal events



Hyper-glycaemia



Hypo-glycaemia



**The more frequently the pig was hyper-glycaemic at night,
the less hypo-glycaemia would occur during the day
and the greater the hyper-glycaemia was during the day**

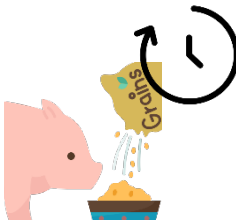


Conclusion

- Continuous glucose monitoring sensors are suitable for growing pigs
- New evidence for glycaemic excursions in night (hypo and hyper)
- Night and day glycaemic events were correlated

Perspectives

- Better understand the inter-individual variability in nocturnal glycaemia excursions (glycogen reserve ? sensitivity to stressors ? nibbling behavior during the day ? etc.)
- To pilot glycaemic events ?
⇒ Feeding frequencies or diet composition (chrono-nutrition) in precision livestock farming to optimize animal physiology ?



Acknowledgements



The PigWeb project has received funding from the European Union's Horizon 2020 under the Grant Agreement N° 101004770.

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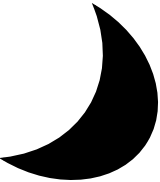
Thanks to Sophie Daré (INRAE Pegase)
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Thanks to Francis Aman Eugenio (Agroscope Posieux)
for his valuable participation to blood sampling procedures

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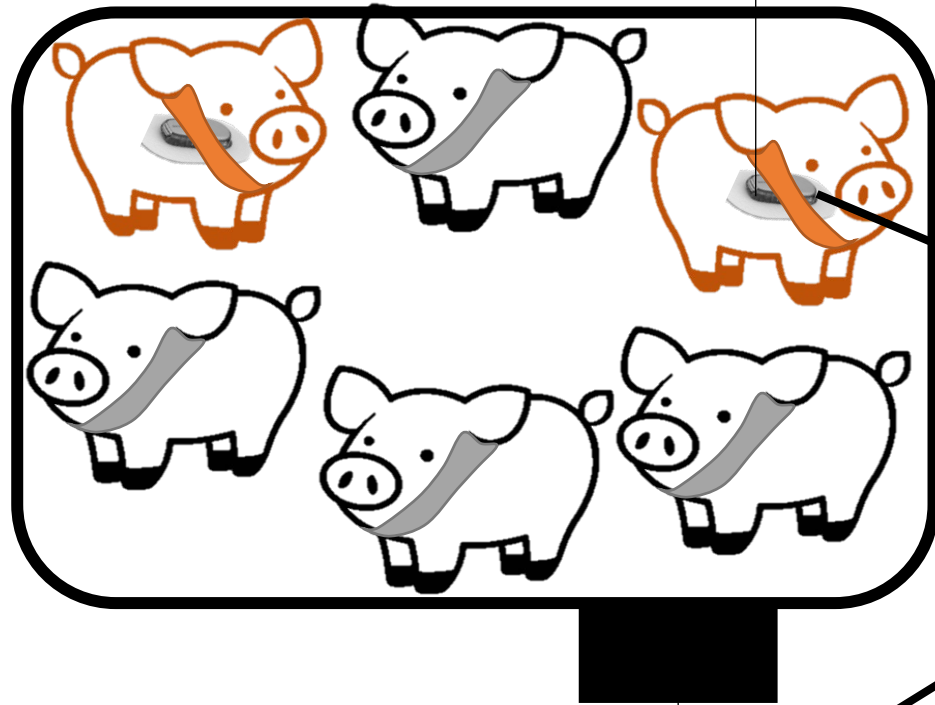
Corresponding author: Florence Gondret (florence.gondret@inrae.fr)

Effects of diet composition on glycaemia events

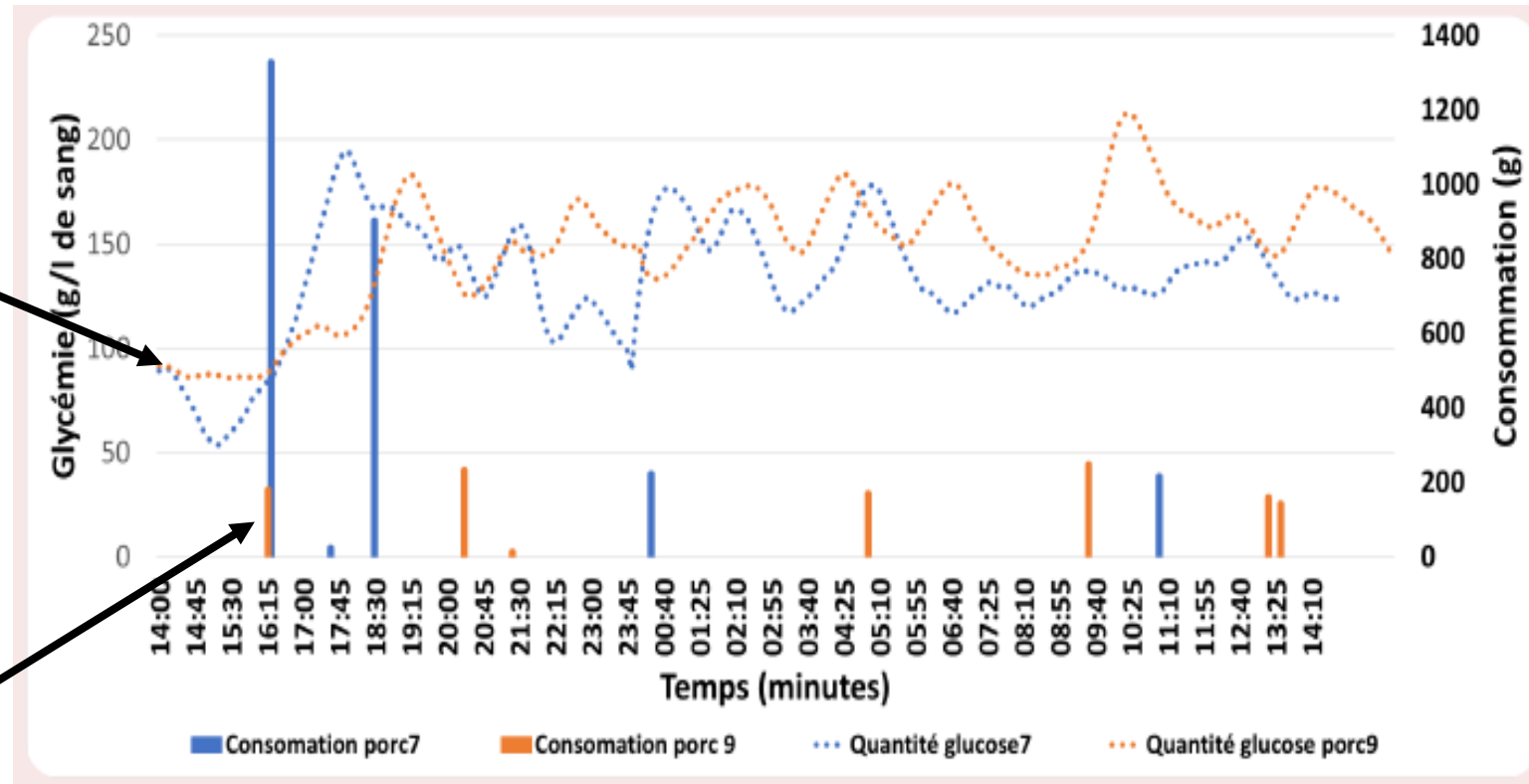
		Diet		<i>p-value</i>
		High Starch	High fat	
Diurnal				
	Minimal glycemic value (mg/dL)	119	100	0.08
	Maximal glycemic value (mg/dL)	159	129	0.01
Nocturnal				
	Minimal glyccemic value (mg/dL)	114	86	0.02
	Maximal glycemic value (mg/dL)	154	135	0.05
	Duration of the hyperglycemic peak (min)	76	43	0.03
	Number of hyperglycemic peak	1.6	2.3	0.06

Situation in pigs reared in groups

Continuous glucose monitoring sensor



Individual and automatic feeding *ad libitum*



On the figure, glucose peak of the blue pig was linked to the feed consumption contrary to the orange pig.