Effect of chronic lung inflammation on glucose oxidation in piglets selected for low or high residual feed intake

Etienne Labussière, Serge Dubois, Jean-Noel J.-N. Thibault, Jaap J. van Milgen, Jean Noblet

Effect of chronic lung inflammation on glucose oxidation in piglets selected for low or high residual feed intake

LABUSSIERE E., DUBOIS S., THIBAULT J.N., VAN MILGEN J., NOBLET J.
INRA – AGROCAMPUS OUEST, UMR1079, Systèmes d'Elevage, Nutrition Animale et Humaine, F-35590 Saint-Gilles, FRANCE

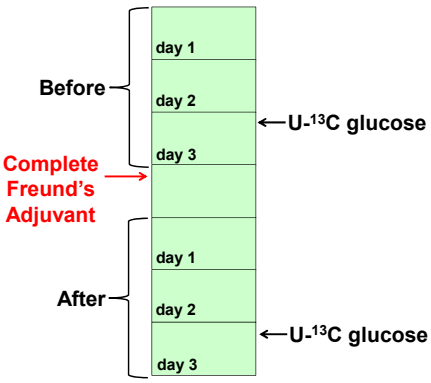
The residual feed intake (RFI) of a growing animal is defined as the difference between its actual and its theoretical feed intake, which is calculated to satisfy its requirements for maintenance and growth.
In pig farms, chronic exposition to inflammatory challenge forces pigs to orientate part of their dietary nutrients for immune response rather than for growth.
The objectives of this experiment are to determine the effect of chronic lung inflammation on glucose oxidation in piglets selected for a low or a high RFI (RFI- or RFI+).

Methods

Animals:
16 French Large White castrated male piglets (mean body weight: 19.6 kg):
- **8 pairs of littermates from two genetic lines (RFI- and RFI+).**
- **Housed individually in a 1.7 m^3 open-circuit respiration chamber.**
- **Catheterized in the external jugular vein.**

Diet:
Starter diet (crude protein content: 20.9% DM; gross energy content: 18.35 MJ/kg DM).
Daily feed intake: 125 g/kg $BW^{0.60}$ in 5 approximately equal parts (at 0900, 1200, 1500, 1800 and 2100).

Experimental design:



Chronic lung inflammation was induced by intravenous injection of Complete Freund's Adjuvant (killed *Mycobacterium tuberculosis* cells).
Measurements during 2 periods of 3 days (before and after the injection):
Daily feed intake, feces and urine production.
Continuous measurements:
- **O_2 consumption and CO_2 production.**
- **Temperature and relative humidity of the air in the respiration chamber, ventilation rate.**
- **Dynamics of feed intake and physical activity (force sensors placed under the cage of the piglet).**

On day 3 of each period, supplementation of the 0900 meal with 0.4% of U-^{13}C glucose:
- **Measurement of $^{13}CO_2$ production.**

Calculations:
- **Digestibility coefficients for protein and energy from feed intake and fecal collection.**
- **Oxidation rate of protein as the ratio between urinary excreted N and digested N .**
- **Calculation of metabolizable energy (ME) intake as the difference between energy intake and energy excreted in feces and urine.**
- **Heat production (HP) from O_2 consumption, CO_2 production and urinary N (Brouwer, 1965).**
- **Oxidation rate of dietary glucose as ^{13}C recovery during 24h.**
- **Modeling of $^{13}CO_2$ production according to a 3-compartment system : calculation of mean duration of glucose oxidation.**

Statistical analyses (on 14 piglets):
- **Repeated measurements; effects of period (P), genetic line (L) and their interaction (P × L; Proc MIXED, SAS).**

Results

No effect of chronic lung inflammation and genetic selection on digestibility coefficients for dry matter, protein and energy.
No effect of chronic lung inflammation and genetic selection on oxidation rate of protein.
RFI+ piglets had higher HP, glucose oxidation rate and mean duration of glucose oxidation than RFI- piglets.
Chronic lung inflammation tended to decrease heat production in both genetic lines.
Chronic lung inflammation did not affect glucose oxidation rate and mean duration of glucose oxidation in RFI- piglets but decreased these parameters in RFI+ piglets.

	Period		Genetic line		rsd	Significance
	Before	After	RFI-	RFI+		
ME intake (kJ/kg $BW^{0.60}$ per day)	1710	1724	1734	1700	52	-
HP (% ME intake)	67.2	65.3	64.9	67.6	2.1	P†, L*
Respiratory Quotient	1.070	1.071	1.074	1.068	0.010	P × L*
Glucose oxidation rate (%)	50.1	48.6	47.5	51.1	1.6	P†, L*, P × L*
Mean duration of glucose oxidation (h)	4.2	3.8	3.6	4.4	0.2	P**, L**, P × L**

rsd: residual standard deviation, †$P \leq 0.10$, *$P \leq 0.05$; **$P \leq 0.01$

Conclusions

Genetic selection for a decrease in RFI resulted in breeding more efficient piglets, with lower energy expenditure and glucose oxidation rate. The constant oxidation rate of protein suggests that fat deposition may be enhanced by a decrease in RFI.
Chronic lung inflammation had no effect on protein oxidation rate, but possible use of dietary amino acids for synthesis of proteins involved in inflammatory response may decrease synthesis of body proteins.
Chronic lung inflammation modified glucose oxidation in RFI+ piglets but not in RFI- piglets.

The study was funded by the French National Research Agency (L'Agence Nationale de la Recherche, ANR, ANR-08-GENM038 PIG_FEED Project)