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

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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 m³ open-circuit respiration
- chamber.
- Catheterized in the external jugular vein.

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):

Diet:

1800 and 2100).

Starter diet (crude protein content: 20.9% DM;

approximately equal parts (at 0900, 1200, 1500,

gross energy content: 18.35 MJ/kg DM). Daily feed intake: 125 g/kg BW^{0.60} in 5

- Daily feed intake, feces and urine production. Continuous measurements:
- O₂ consumption and CO₂ 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-13C glucose: Measurement of ¹³CO₂ 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 O₂ consumption, CO₂ production and urinary N (Brouwer, 1965). Oxidation rate of dietary glucose as ¹³C recovery during 24h.
- Modeling of ¹³CO₂ 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		Genet	Genetic line		Significance
Before	After	RFI-	RFI+	- isu	Significance
1710	1724	1734	1700	52	-
67.2	65.3	64.9	67.6	2.1	P†, L*
1.070	1.071	1.074	1.068	0.010	P×L*
50.1	48.6	47.5	51.1	1.6	P^{\dagger} , L*, $P \times L^{*}$
4.2	3.8	3.6	4.4	0.2	P**, L**, P × L**
	Per Before 1710 67.2 1.070 50.1 4.2	Period Before After 1710 1724 67.2 65.3 1.070 1.071 50.1 48.6 4.2 3.8	Period Genet Before After RFI- 1710 1724 1734 67.2 65.3 64.9 1.070 1.071 1.074 50.1 48.6 47.5 4.2 3.8 3.6	Period Genetic line Before After RFI- RFI+ 1710 1724 1734 1700 67.2 65.3 64.9 67.6 1.070 1.071 1.074 1.068 50.1 48.6 47.5 51.1 4.2 3.8 3.6 4.4	Period Genetic line rsd Before After RFI- RFI+ 1710 1724 1734 1700 52 67.2 65.3 64.9 67.6 2.1 1.070 1.071 1.074 1.068 0.010 50.1 48.6 47.5 51.1 1.6 4.2 3.8 3.6 4.4 0.2

rsd: residual standard deviation, $^{\dagger}P \leq 0.10$, $^{*}P \leq 0.05$; $^{**}P \leq 0.01$

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.

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