Pig adaptation to cold environment enhances oxidative and glycolytic Longissimus muscle metabolism

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Pig adaptation to cold environment enhances oxidative and glycolytic Longissimus muscle metabolism

Faure J., Lebret B., Bonhomme N., Ecolan P., Kouba M., Lefaucheur L.

INRA-Agrocampus Ouest
Pig adaptation to ambient temperature

Introduction

Energy intake

Heat production

Available energy for production

Cold conditions
Thermoneutral zone
Warm conditions

Challenge for growth and energy metabolism

≈ 12 °C (Rennes – France)*
28 °C (8-25 kg)
18°C-20°C (60 kg)

Outdoor production (NW EU)

Adapted from Quiniou et al., 2000, Le Dividich et al., 1998
* mean/year source: Météo France
Complex pig adaptation to cold environment

Introduction

Outdoor system

Animal

Cold (variation, season)

Activity

Feeding

Sanitary

Housing

Intake

Growth

Dynamic balance

Homeostasis

AMPK

Muscle metabolism

Meat quality

Bare effects of a constant cold exposure during growth until commercial stage (115 kg)?
Experimental conditions

LW x (LW x Landrace)
Ad Libitum
Conventional system

Short-term
Post-weaning (PW)

Long-term
Growing-finishing (GF)

8 kg

25 kg

115 kg

T

28°C → 23°C

TT

23°C

C

23°C → 15°C

CC

12°C

**Longissimus muscle LM:**
- enzymes capacities (LDH, HAD, CS)
- energy substrates (GP, LIM)
- homeostasis (AMPK phosphorylation)
- meat quality (pH, drip, sensory)

**Growth performance:**
AFI, ADG, FCR
Animal adaptation depending on physiological stage

**Short-term**

Post-weaning (PW)

- AFI: + 50 g/d (***)
- ADG: - 27 g/d (**)
- FCR: + 0.21 kg/kg (***)

**Long-term**

Growing-finishing (GF)

- AFI: + 394 g/d (***)
- ADG: ≈911 g/d
- FCR: + 0.56 kg/kg (***)

**Growth retardation**

Lower body fat and energy reserves

**Early compensatory growth**

Optimize energy retention

Average Feed Intake (AFI), Average Daily Gain (ADG), Feed Conversion Ratio (FCR)
Both oxidative and glycolytic capacities enhanced by cold

**Long-term adaptation**

- **LDH/CS**: $+13\%$ *
  - Higher glycolysis

- **HAD/CS**: $+37\%$ **
  - Increase of mitochondrial oxidation
  - Increase of carbohydrate use

- $\approx p\text{AMPK}/\text{AMPK}$
  - Homeostasis potential preserved

Belated response to cold conditions
Diversity of energy use allowing muscle energy balance

Lactate Dehydrogenase (LDH), Citrate Synthase (CS), β-hydroxy-acyl-CoA (HAD)
Cold effects of energy substrates modulated meat quality of loin

+ 22 % GP ***

- ultimate pH ***

↑ Drip loss ***

+ 0.58pt IMF **

≈ Juiciness and flavor

Impairement of technological meat quality but positive modulation on sensory quality

Glycolytic Potential (GP), Intramuscular Fat content (IMF)
Long term effects and diversification of LM metabolism

Constant cold environment (in a conventional pig system)

Conclusion

Muscle type specific strategy = adaptation to cold conditions
LM= higher resistance to protect its energy metabolism to another external stress?
Thank you for your attention!

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