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Animal welfare and pork quality of intact male pigs in organic farming according to genotype

Bénédicte LEBRET[1], S. Ferchaud[2], A. Poissonnet[3], A. Prunier[1]

[1]INRAE PEGASE, [1]INRAE Porganic, [3]IFIP

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Context and objectives - 1

Pig farming, conventional or organic

- Ban of surgical castration of male pigs without anesthesia in France from January 2022
- Rearing intact males: risks for aggressive behaviors and for undesirable odor and/or flavor of meat: boar taint (androstenone, skatole)
  - ➢ Possible impairment in animal welfare and/or pork quality

Lundström et al., 2009; Prunier et al., 2013; Parois et al., 2018

Organic farming

- EU regulation (2018/848 and 2020/464) in force in 2022
- Endorsed by European policy: Farm to fork strategy for a fair, healthy and environmentally friendly food system (EU, 2020)
- Organic food chosen by consumers for health, food quality, and ethical motives: environmental consciousness and animal welfare

Baudry et al., 2017; AgenceBio, 2022

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Context and objectives - 2

Organic pig farming

- Avoid surgical castration, but develop strategies to **prevent undesired behaviors** (mounting, aggressions) in intact males and **avoid boar taint** in meat and pork products
- Allow ending of surgical castration in good conditions for animals, farmers, consumers

Pig genotype: lever to modulate/improve welfare and meat quality in organic pigs ?

- **Health and welfare indicators, boar taint, carcass and meat quality from intact male pigs in 2 genotypes: Duroc (x Large White) vs Piétrain (x Large White)**
  - *Breed differences in animal behavior* *Terlouw et al., 2009;*
  - *Piétrain: "standard", used in conventional and organic, low risk for boar taint*
  - *Duroc: improved meat eating and technological quality, higher risk for boar taint*

  Lebret & Candek-Potokar, 2022; Lebret et al., 2023
- **Prediction of boar taint risk at lower slaughter live weight**

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Experimental design

INRAE Porganic experimental facilities

Partners: IFIP (health & welfare), Nucleus (genetic selection), Cooperl (slaughterhouse)

- ✓ *2 experimental replicates, each including one group of intact males per genotype*
  => 47 DuxLW and 34 PixLW in total
- ✓ *Feeding: growing and finishing organic diets (ad libitum) and hay in a rack*
- ✓ *2 slaughtering sessions per replicate, with similar number of pigs from each genotype*

- ✓ *Observations of health and welfare during rearing*
- ✓ *Blood sampling during fattening (2 to 4 samples/pig)*
- ✓ *Growth performance and carcass traits*
- ✓ *Meat quality traits and boar taint components*

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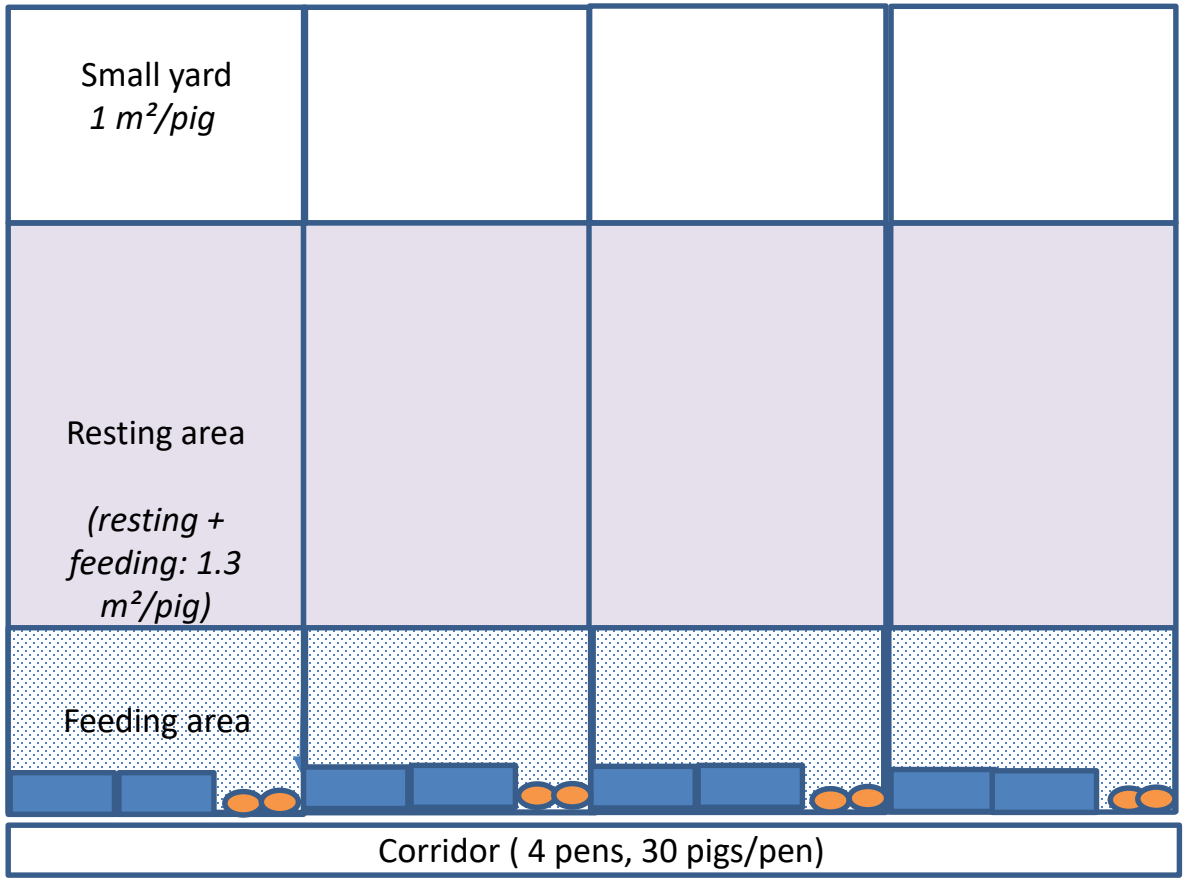
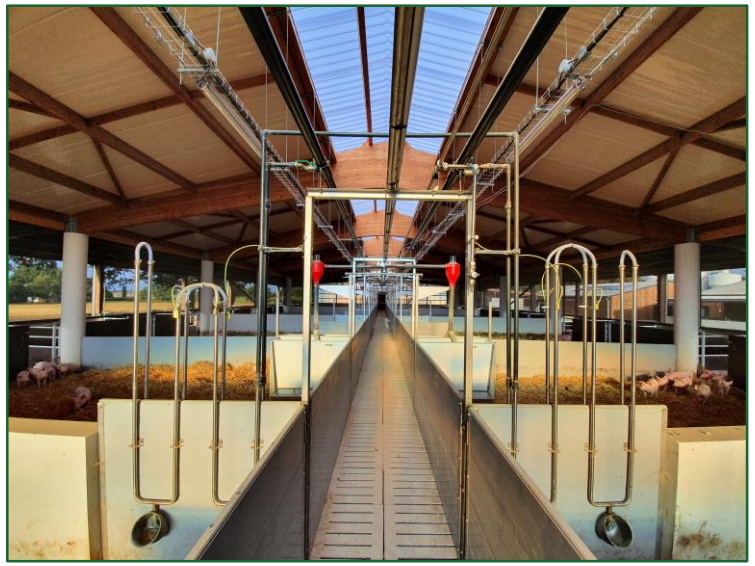
Porganic experimental facilities





2 pens filled every 6 weeks

1 pen Pietrain x LW, 1 pen Duroc x LW

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Results

Indicators of health and welfare

Health indicators	Duroc x LW	Pietrain x LW
Mortality rate	0 %	5.6 %
Bad general state (% pigs)	0.7	0
Pigs with lameness, score of severity (% pigs)		
- 0: no sign of lameness	100	97.1
- 1	0	1.0
- 2	0	0
- 3 = severely lame, impossible to walk	0	1.9

➢ *Lower mortality rate and lameness for Duroc vs Pietrain crossbred males*

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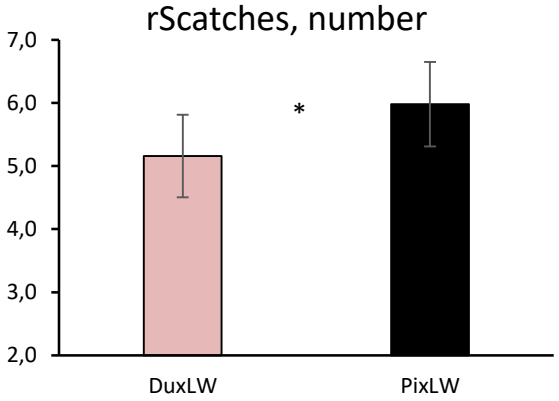
Indicators of health and welfare

Welfare indicators on farm	Duroc x LW	Pietrain x LW
Pigs with skin wounds larger than 5 cm (% pigs)	1.4	2.9
Pigs with at least 15 scratches on one side (% pigs)	0	24
Pigs with tail lesions, score of severity (% pigs)		
- 0: no sign of lesion	95.2	96.5
- 1	4.8	3.5
- 2	0	0
- 3 = severe lesion	0	0



Carcass scratches at slaughterhouse
(square root values)

- *Lower skin wounds and scratches scores for Duroc vs Pietrain crossbred males*
- *↘ aggressive or mounting behaviors (or lower fragility of skin from Duroc ?)*

- ***Improvement of health and welfare indicators in intact males of Duroc vs Pietrain genotype***

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Growth performance and carcass traits

	Duroc x LW	Pietrain x LW	Significance
Number of pigs	47	34	
Final live weight, kg	124.2	125.4	ns
Average growth rate (27-125 kg), g/d	952	966	ns
Average daily feed intake, kg	2.73	2.80	-
Feed conversion ratio	2.85	2.88	-
Carcass dressing, %	76.1	76.8	G*, R**
Hot carcass weight, kg	96.5	98.4	G*
Lean meat content, %	58.9	60.8	G***

effects of genotype: G and replicate: R; ***: P<0.001, **: P<0.01 *: P<0.05), ns : P>0.05

- *Similar growth performance in Duroc and Pietrain crossbreeds*
- *Lower carcass weight and lean meat content in Duroc pigs (higher fat and lower muscle thickness)*

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Meat quality traits of the loin (longissimus)

	Duroc x LW	Pietrain x LW	Sign.
pH 24 h	5.51	5.50	
Drip loss,%	4.70	5.66	G*
Colour: lightness (L*)	48.9	50.0	G*
Colour: redness (a*)	9.97	9.22	G*
Intramuscular fat content, %	2.50	1.90	G***
Shear force of cooked meat, N	33.2	35.0	G^t

(effects of genotype G and replicate R, ***: P<0.001, *: P<0.05, t: P<0.10)

- *Similar ultimate pH (also in ham muscles)*
- *Overall: higher water-holding capacity, redness and IMF, lower lightness and toughness of pork in* ***Duroc pigs => higher technological and sensory quality traits***

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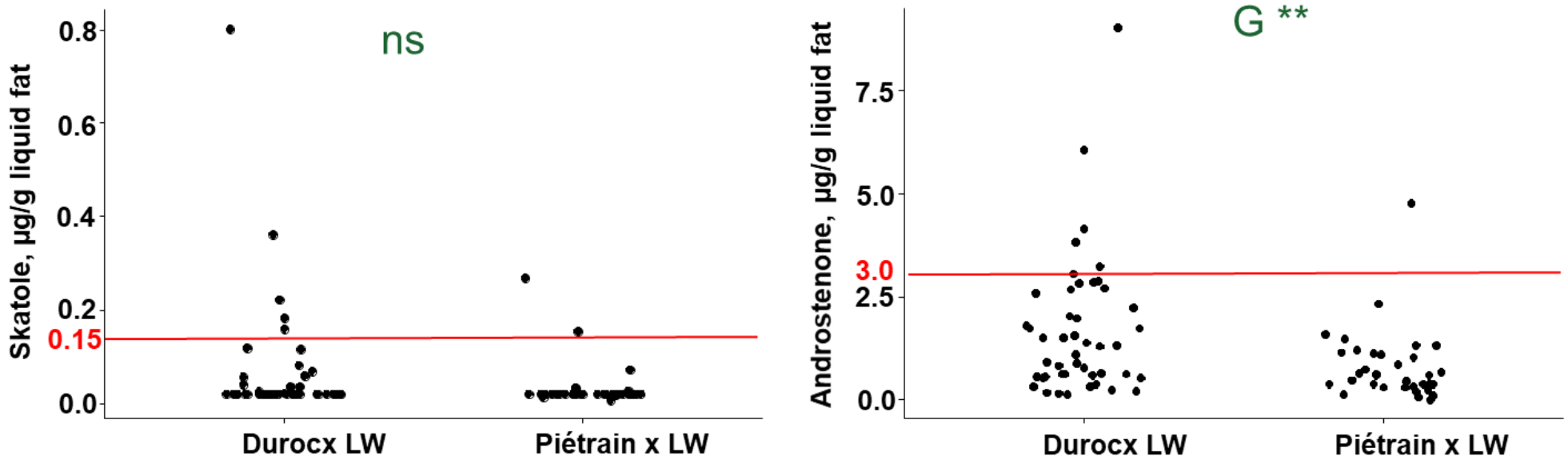
Boar taint components in backfat



- *Similar average skatole, but higher androstenone content in Duroc vs Pietrain crossbreeds*
- *Only 1 Duroc carcass detected as odorant at slaughterhouse (highest skatole content)*
- *Considering **limits of "perception"** (rejection) by consumers to be **0.15 µg/g** for skatole and **3.0 µg/g** for androstenone, **more carcasses from Duroc (17.4%) than Pietrain (8.8%) crossbreeds would be rejected***

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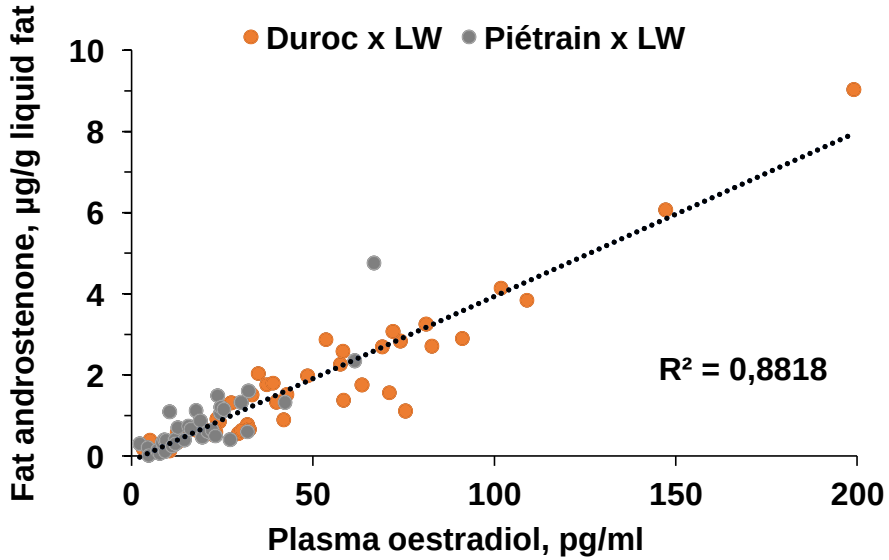
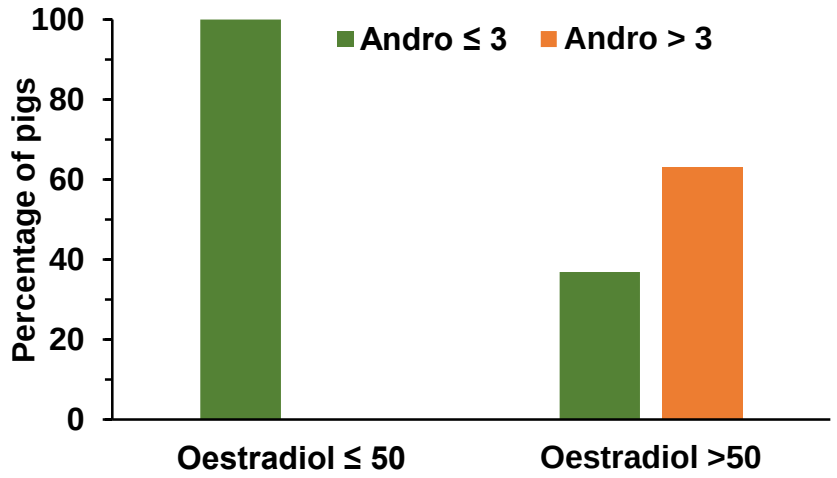
Plasma oestradiol and relationships with androstenone in backfat





- *Higher plasma oestradiol for Du vs Pi pigs*
- *Very high correlation between plasma oestradiol and fat androstenone*
  => plasma oestradiol can be used to predict fat androstenone

Estimation of risk for boar taint related to androstenone

- *≤ 50 pg oestradiol/ml plasma: close to 0*
- *> 50 pg oestradiol/ml plasma: around 63 %*

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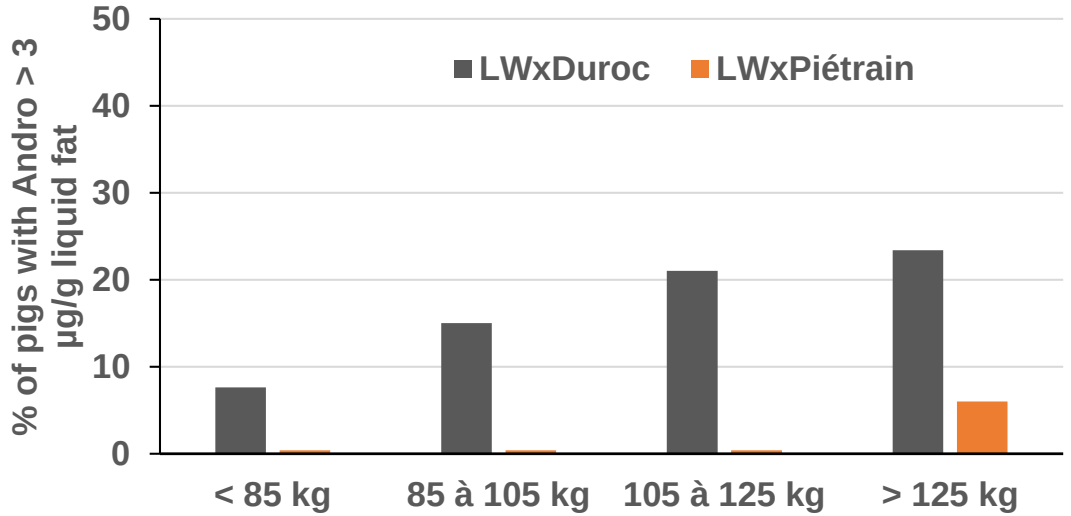
Effect of genotype and reduction of slaughter live weight on the risk for boar taint

Plasma oestradiol (2 to 4 blood samples during fattening on each pig)

***Calculation of boar taint risk due to androstenone at given slaughter weight**, considering:*

- *Risk = 0 for plasma oestradiol ≤ 50 pg/ml and risk = 63% for oestradiol > 50 pg/ml*



- *Pietrain : very low risk below 125 kg, close to 6% above 125 kg live weight*
- *Duroc : **gradual increase of risk** from ≈ 8% below 85 kg to ≈ 23% above 125 kg live weight*
- ***Risk due to skatole**: probably independent of live weight, low if good environmental conditions: clean animals (clean bedding) and good air renewal*

Parois et al., 2018

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Conclusions

Pig genotype: Duroc vs Pietrain crossbreeds

- Improvement of **health and welfare indicators** for intact males

- Similar **growth performance** between both genotypes
- **Lower carcass leanness** (-> lower commercial value)

- **Higher technological quality** (i.e. ability for processing)
- Meat quality traits (intramuscular fat, shear force) suggest higher meat tenderness
- ***But* higher risk for boar taint** (androstenone)

Reduction of live weight at slaughter

- **Decreases the risk for androstenone**, especially for Duroc crossbreeds
- For both genotypes, avoid live weight above 125 kg

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benedicte.lebret@inrae.fr

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