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LESS BOAR TAINT IN OFFSPRING FROM DANBRED DUROC BOARS WITH LOW ANDROSTENONE LEVELS

TRIAL REPORT NO. 1138

Androstenone levels and sensory reactions to boar taint can be reduced when DanBred Duroc boars with low androstenone levels are used for production of intact males.

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Abstract

It is possible to reduce androstenone levels and the sensory reaction to boar taint by using DanBred Duroc boars selected for low androstenone levels for production of intact males.

Sows were inseminated with semen from one of two groups of Duroc boars: one with low androstenone levels and one with high, and results reveal a significant difference in androstenone in their offspring. The difference in androstenone in fat from Duroc boars selected for high and low androstenone levels, respectively, was 2.6 ppm, and in the offspring of these boars, the difference in androstenone in fat was 1.1 ppm. Selection of boars based on high/low androstenone levels did not affect skatole levels.

The trial also included analysis of the effect of adding 15% chicory to the feed. Chicory significantly lowered skatole levels in fat, though from the outset they were very low in this trial. Chicory did not affect androstenone in fat. This supports finding in previous trials.

Sensory analyses demonstrated that boar taint was related to androstenone when skatole levels were low. In pork roast and rib, androstenone significantly affected all boar taint parameters and had a greater effect on taste than on odour.

Results show that it is possible to select a group of Duroc boars for production of intact males with low androstenone on the basis of genetic value and/or an analysis of androstenone level in a biopsy. Results also show that the inclusion of fibre in the form of chicory to the feed for a short period before slaughter lowered skatole levels. It will thereby be possible to cut rejection rates based on skatole and androstenone. Thus, in the future when skatole as well as androstenone are included in the rejection process, production of intact males may be a possibility by combining fathers with low androstenone levels and feed containing fibre.

Background

As far as we know today, androstenone levels can only be lowered either by slaughtering intact males at a low weight [1], [2] or by genetic selection [3]. Skatole can be affected through feeding and management [4], [5], [6].

Research has pinpointed variations in boar taint compounds between the pure breeds where the highest skatole level in fat tissue is found in Landrace boars and where Duroc boars have significantly more androstenone in fat tissue compared with both Yorkshire and Hampshire boars [7]. Whether dissemination of boar taint is found in offspring/hybrids is not clearly established, but a fairly high degree of heritability is expected.

A Danish genome scanning project involving purebred boars previously demonstrated that it is possible to pinpoint Danish boars with a low degree of boar taint. Fat biopsies were taken from purebred boars to determine the levels of skatole and androstenone in live boars at roughly 100 kg [3].

The aim of part 1 of this trial was to investigate if it was possible to affect boar taint (skatole and androstenone) in carcasses from intact males (DLY hybrids) sired by Duroc boars selected for high or low androstenone levels, respectively. The secondary aim was to test the effect on skatole and androstenone of feeding the pigs chicory from four days before slaughter.

In part 2 of the trial, the correlation between skatole and androstenone and sensory traits in different cuts was assessed in intact males.

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The Animal Experiments Inspectorate approved collection of fat biopsies, approval no.: 2012-15-2934-00160.

Materials and method

A total of 308 DanBred Duroc boars were tested over a long period of time at Bøgildgård trial station. Approximately 25% of the boars had androstenone levels below 1.5 ppm and 25% had androstenone levels above 1.8 ppm (figure 1).

Seventeen of these boars were selected for the trial and split into two groups (high or low androstenone) selected on the basis of the genetic value of androstenone and androstenone levels measured in biopsies from back fat.

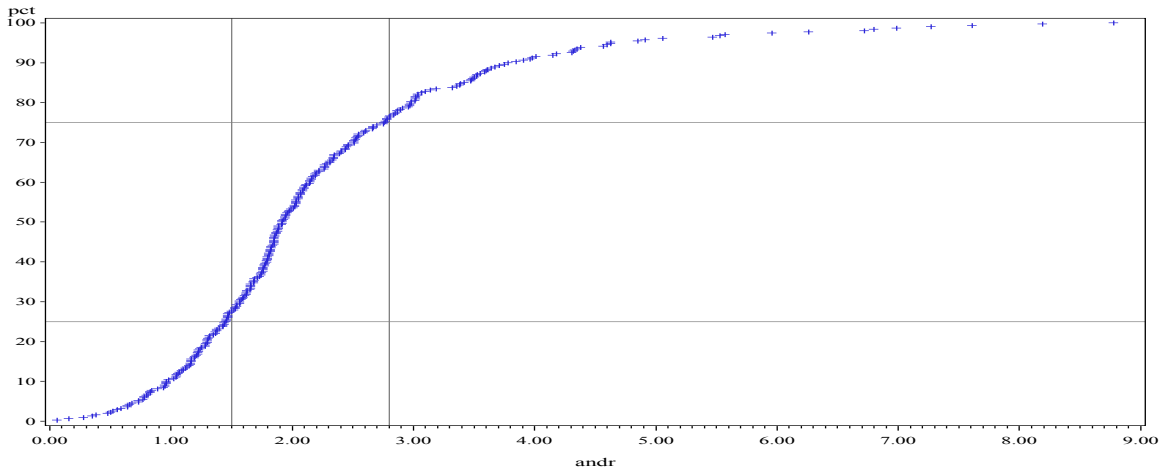

Figure 1. Percentage Duroc boars in relation to androstenone levels (biopsies)

Part 1: Duroc boars with high/low androstenone levels

The trial comprised 17 Duroc boars: eight with low androstenone levels and nine with high androstenone levels (table 1). Semen was collected from these boars at the AI station; the semen doses were individually labelled and shipped to a commercial herd where DanBred LY sows (LY sows) were inseminated to produce the offspring used in the trial. At farrowing, three male pigs were randomly selected to ensure that minimum one would be left for slaughter. The trial comprised a total of 70 DLY male pigs.

Table 1. Selection of Duroc boars

Genetic value androstenone	Androstenone* av ppm	Boars total	Pigs in trial, total
Low	0.97	8	36
High	3.63	9	34

*) not all boars had a biopsy value for androstenone

Table 2. Trial design (number of DLY offspring)

Group	DLY offspring		Total
	Low androstenone	High androstenone	
Control (0% chicory)	21	19	40
Trial, 15% chicory	15	15	30
Total	36	34	70

At 30 kg, the 70 intact males were transported to Grønhøj trial station where they were housed in finisher pens accommodating 8-9 pigs each. The pigs were sorted according to the androstenone levels of their father (high/low).

Half of the pigs were given feed containing 15% chicory from four days before the first pigs in the pen were ready for slaughter, and the other half were fed control feed until slaughter. All pigs were slaughtered at an optimum slaughter weight of approx. 115 kg live weight. The pigs did not fast prior to slaughter, and they were slaughtered at Danish Crown's abattoir in Herning.

Lean meat percentage and carcass weight were recorded at slaughter. The day after slaughter, back fat samples were collected and forwarded to the DMRI Technological Institute for analysis of skatole and androstenone using the HPLC method [8].

Table 3. Analysis methods and detection levels

Method		Unit	Detection levels
Laboratory, HPLC	Skatole	ppm = mg/kg	> 0.25 [1]
	Androstenone	ppm = mg/kg	> 1.00 / 2.00 [5] *

* Today, there is no agreed detection level for androstenone as this is not yet being analysed

Scientists across the world are still discussing the correct detection levels for rejection based on androstenone from different viewpoints such as consumer responses. Several levels are currently in play: >1.00 ppm and >0.50 ppm androstenone [6], but also >2.00 ppm is being considered. One common rejection limit for boar taint (measured on skatole, androstenone and/or the human nose method) has yet to be established.

Part 2: Sensory analyses

In the second part of the trial, the correlation between the analysed values of skatole, androstenone and sensory traits; boar odour in fat (human nose), boar taint in rib and pork roast were analysed by a sensory panel. These pigs used for these analyses were fed control feed. Back fat samples were analysed for skatole and androstenone (ASI LC-MS-method). The following sensory analyses were made:

- Human nose (98 intact males; 8 trained judges per sample, 4 step scale 0-3)
- Ribs (86 intact males, 8 trained judges per sample)
- Loin for pork roast (33 intact males, 74 consumers from 19 families cooking the roasts at home)

- Loin for pork roast (43 intact males, 8 trained judges per sample).

Statistical analyses

Analysis values for skatole and androstenone below the detection level were entered as the detection level divided by 2. Skatole and androstenone were logarithmically transformed prior to statistical analysis to achieve normal distribution and subsequently back-transformed.

Logarithmically transformed analysis values for skatole and androstenone and slaughter data were subject to analysis in a model including the two factors feed and father (high/low) with repeated recordings on fathers. Interaction between father androstenone levels and feeding were tested.

Results and discussion

Part 1: Duroc boars with high/low androstenone levels

Analyses of fat biopsies revealed an average difference in androstenone levels of 2.66 ppm (3.63 vs 0.97) between the fathers selected for the trial.

Results showed no interaction between androstenone level and chicory on boar taint parameters. Results are therefore shown either according to androstenone level (table 4) or feeding with or without chicory (table 5).

Table 4. Slaughter data (LS-Means) and boar taint (median). DLY offspring grouped according to fathers' androstenone level. 95% confidence interval in parenthesis.

	Boars androstenone		
	Low	High	Significance[1]
Pigs (head)	36	34	-
Age at slaughter (days)	151	154	-
Carcass weight (kg)	87	88	-
Lean meat %	60.9	60.3	-
Skatole (ppm)	0.03 (0.02-0.06)	0.02 (0.01-0.04)	-
Androstenone (ppm)	0.37 (0.19-0.69)	1.45 (0.80-2.61)	***

1. *** p< 0.01, NS = not significant, - = not calculated

Table 5. Slaughter data (LS Means) and boar taint (median). DLY offspring grouped according to feed with and without chicory. 95% confidence interval in parenthesis.

	Diet		
	Control	15% chicory	Significance [1]
Pigs (head)	40	30	-
Age at slaughter (days)	152	152	NS
Carcass weight (kg)	87	88	NS
Lean meat %	60.5	60.8	NS
Skatole (ppm)	0.04 (0.03-0.06)	0.02 (0.03-0.01)	***
Androstenone (ppm)	0.83 (0.40-1.72)	0.59 (0.27-1.31)	NS

1. *** p< 0.01, NS = not significant, - = not calculated

Offspring from Duroc boars with high androstenone levels had a significantly higher androstenone level than offspring from Duroc boars with low androstenone levels. The difference was 1.08 ppm. There were no differences in skatole levels (table 4). There were no differences in age at slaughter, carcass weight or lean meat percentage depending on the androstenone levels of the DanBred Duroc boars (table 4).

Intact males fed 15% chicory from four days before the first pigs in the pen were slaughtered had lower skatole levels than intact males fed control feed until slaughter, even though skatole levels were very low. Androstenone levels were unaffected by the inclusion of chicory to the pigs' feed (table 5).

Part 2: Sensory analyses

Skatole levels were generally low for all intact males included in part 2. The variations found in boar taint were primarily due to androstenone. It is therefore not possible in this trial to determine the effect of androstenone at high skatole levels.

Analyses revealed a correlation between androstenone and human nose evaluated by the trained sensory panel. Only few intact males with low (< 1.0 ppm) androstenone levels had a human nose score above 2.5 ('boar taint') on a scale from 0 to 3, while several intact males with high (> 2.0 ppm) androstenone levels had a human nose score above 2.5.

Sensory evaluation of pork roast and rib

Analyses demonstrated a clear correlation between androstenone in back fat and boar taint in both rib and pork roast. The greatest effect was seen for rib. In pork roast and rib, androstenone significantly affected all boar taint parametres, with the greatest effect found on taste rather than on odour.

Consumer evaluation of pork roast

There was no correlation between androstenone in back fat and consumer response to pork roast cooked at home, regardless of whether consumers were able to detect androstenone. There were no differences between men and women in their sensitivity to boar taint; overall 44% were able to detect androstenone and 74% were able to detect skatole. There were large differences in whether consumers liked androstenone and skatole, regardless of whether they were able to detect it.

Conclusion

Offspring of Duroc boars with high androstenone levels had significantly higher androstenone levels than offspring of Duroc boars with low androstenone levels, but there were no differences in skatole levels. The inclusion of 15% chicory in the feed the last four days before the first pigs were slaughtered reduced skatole levels, but did not affect androstenone levels. Sensory analyses revealed that boar taint was related to androstenone content in intact male with low skatole levels. None of the pigs in this trial had high skatole levels.

Overall, the outcome demonstrates that it is possible to lower androstenone levels and the sensory response to boar taint by selecting DanBred Duroc boars with low androstenone levels for production of intact males. Skatole levels can be lowered by feeding the pigs chicory.

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Participants

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Appendix

Composition of diets – ingredients (% of diet)

Ingredient	Control	Fibre
Wheat	34.07	18.51
Barley	37.00	37.00
Wheat bran	2.31	1.27
Sunflower meal, dehul.	9.00	9.00
Soybean meal, dehul. toast.	12.31	14.07
Sugar beet molasses	1.00	1.00
Palm oil	1.20	1.20
Mono calcium phosphat	1.41	0.41
Calcium carbonate	1.45	1.35
Salt	0.47	0.43
Lysine	0.44	0.40
Methionine	0.02	0.03
Threonine	0.09	0.09
Vitamins DA vit. SL	0.20	0.20
Ronozyme HiPhos	0.03	0.03
Chicory	-	15.00

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