it’s all about innovation

Boar taint
12 June 2013
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Boar taint – detection, consumer response and product quality

• What is boar taint?
• Detection methods
• Sorting
• Consumer response
• Product quality
Castration of piglets to avoid boar taint

Pros and Cons for a stop in using castration

Pros
- Animal welfare
- Sustainability – Higher feed efficiency
- Higher meat percentage
- Lower fat content
- More unsaturated fat

Cons
- **Boar taint**
- Lower fat content
- Fat quality – soft fat
- Carcass composition
- Skin damage – aggression
What is boar taint?

A complex sensory issue that relates to a few compounds in pork from entire male pigs.
What is boar taint?

Two major compounds

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Androstenone</th>
<th>Skatole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics</td>
<td>urine</td>
<td>faeces</td>
</tr>
<tr>
<td>Threshold value</td>
<td>0.5 - 1.0 ppm</td>
<td>0.20 - 0.25 ppm</td>
</tr>
<tr>
<td>Solubility - water</td>
<td>0.00023 g/l (25 C)</td>
<td>0.45 g/l (20 C)</td>
</tr>
</tbody>
</table>

Lundström et al., 2009

- Human differences regarding sensitivity towards the flavour compounds
- A proportion of consumers are anosmic towards androstenone
Sorting of entire males

- Sampling of back-fat
- Sampling station
- Automatic analysis

- Danish skatole method
  - Capacity: 200 samples per hour
  - Time lapse between sampling and result: approx. 20 min.
  - Limit of detection: 0.03 ppm “skatole units”

- Human nose test
  - Performance – capacity, accuracy?
  - Calibration
  - Rejection limit

- Need for a new, specific and sensitive online method
Detection methods – Human Nose

On-line

Smell and noise!

At-line
Human nose test - at line

→

[Image of a pig and a person smelling a beaker]

→

[Images of different meat cuts]

thumbs up 😊 thumbs up 😊 thumbs down 😞

→

?
Human nose test - at line

1. 100 mL sample flask
2. 5 g lard (medium size)
3. 75 mL boiling hot water
4. Stand for 2 min
5. Assess the samples

Scale: Keep it simple!
0 = no boar taint,
1 = week boar taint
2 = clear boar taint
3 = doubt
Detection methods – the future

- Electronic nose
- Mass spectrometry
- Immune based ELISA
- Trained insects
European consumer study

Raw material
• Production of more than 4000 entire males in 6 European countries
• 420 entire males selected to represent a range of skatole and androstenone
• Loin samples distributed to 7 countries - UK, DK, FR, SE, NL, ES, DE

Consumer test
• In hall
• 380 to 480 consumers per country
• Reheated meat samples

Results
□ Significant differences between country panels in their liking of meat from entire males
□ Greater degree of dislike as both skatole and androstenone increased
□ Consumer reaction was stronger for skatole than androstenone
□ Consumers reacted more negatively in terms of odour than flavour

Matthews et al., 2000
Danish consumer study

Proportion of consumers with a negative reaction in their evaluation of eating quality at or below given levels of skatole and androstenone

<table>
<thead>
<tr>
<th>Skatole (ug/g)</th>
<th>Androstenone (ug/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 0.50</td>
</tr>
<tr>
<td>≤ 0.15</td>
<td>2.0</td>
</tr>
<tr>
<td>≤ 0.20</td>
<td>1.4</td>
</tr>
<tr>
<td>≤ 0.25</td>
<td>1.6</td>
</tr>
<tr>
<td>≤ 0.39</td>
<td>4.1</td>
</tr>
</tbody>
</table>

- 539 families, in home test
- Loins selected by content of skatole and androstenone

Godt et al., 1996

Skatole seems to be more effective as a parameter for identification of the unpleasant odour than androstenone
Sensitivity

- Non sensitive
- Sensitive
- Very sensitive
Rejection limits

Basis for establishment of rejection limits

Graph showing the relationship between liking and Androstenon/skatol levels for different food items:
- Ikke følsomme
- Følsomme forbrugere
- Meget følsomme forbrugere
- kotelet
- hakket kød
- bacon

The graph illustrates the rejection limits based on consumer sensitivity to Androstenon/skatol.
Consumer study

16 locations in 5 regions  1409 consumers

Results??
Characteristics
- preliminary data

16 locations in 5 regions

Skatole
- Chemical: 243
- Pissoir: 167
- Flower: 173
- Rancid: 96
- Perfume: 146
- Acid/sharp: 153
- Manure: 125
- Swimming pool: 147

Androstenone
- Chemical: 116
- Pissoir: 199
- Flower: 32
- Rancid: 59
- Perfume: 33
- Acid/sharp: 98
- Manure: 46
- Swimming pool: 18

1409 consumers
### Sensitivity towards Skatole and Androstenone

Percentage of consumers in different age groups very sensitive towards Skatole and sensitive towards Androstenone.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Skatole, 0.15 ppm</th>
<th>Androstenone, 20 ppm</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-20</td>
<td>7</td>
<td>19</td>
<td>238</td>
</tr>
<tr>
<td>21-30</td>
<td>5</td>
<td>23</td>
<td>162</td>
</tr>
<tr>
<td>31-40</td>
<td>4</td>
<td>30</td>
<td>219</td>
</tr>
<tr>
<td>41-50</td>
<td>6</td>
<td>30</td>
<td>275</td>
</tr>
<tr>
<td>51-60</td>
<td>6</td>
<td>33</td>
<td>177</td>
</tr>
<tr>
<td>61-70</td>
<td>3</td>
<td>38</td>
<td>127</td>
</tr>
<tr>
<td>&gt;71</td>
<td>3</td>
<td>24</td>
<td>96</td>
</tr>
</tbody>
</table>

P(age difference)  

Aaslyng et al (2013)
Sensitivity towards Skatole and Androstenone

Percentage of females and males very sensitive towards Skatole and sensitive towards Androstenone

<table>
<thead>
<tr>
<th>Gender</th>
<th>Skatole, 0.15 ppm</th>
<th>Androstenone, 20 ppm</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>5</td>
<td>33</td>
<td>717</td>
</tr>
<tr>
<td>Male</td>
<td>6</td>
<td>21</td>
<td>577</td>
</tr>
</tbody>
</table>

\[ P(\text{gender difference}) = P=0.4303 \]
\[ P<0.001 \]

Aaslyng et al (2013)
Use of tainted meat

20 mill. pigs pr. year

Now

The future

- Female pigs
- Castrates
- Male pigs OK
- Male pigs not-OK

Now

The future

20 mill. pigs pr. year

T pr. year

0

5000

10000

15000

20000

25000

30000

35000

40000

Now

The future
Fresh meat

Heat treatment
• Reduced boar taint in ham muscles heat treated to 80C compared with 65C
• The influence of skatole is high at 68C, while androstenone is more pronounced at 80C (Agerhem & Tornberg, 1996)
• Boar taint is more pronounced in roasted meat compared with cooked meat

Serving temperature
• Intensity of boar taint is higher in products served warm (65C) than after chilling (25C) (Kock et al., 2001)

Storage
• Androstenone content in lard is reduced during long term frozen storage (Otto et al., 1980)
Meat products - possibilities of reducing boar taint

Smoke
• improves the taste/mask unwanted taste (Malmfors & Lundström, 1983, Lustrup, 1988)

Starter cultures (fermented products)
• reduce boar taint, but do not eliminate the taint (Stolzenbach et al., 2009)

Marinating
• reduces boar taint - dependent on ingredients
Use of tainted meat

- Aroma
- Spices
- Smoke

- Fat
- Meat

- Heat
- Enzymatic
- Microbial
- Chemical
Use of tainted meat

Aim:
Investigate the influence on Skatole and Androstenone on sensory quality of meat products
Use of tainted meat

**Cooked ham**

- No effect of Skatole
- Androstenone has a big influence:
  - $< 0.4$ ppm if served cold
  - $< 0.2$ ppm if served heated
- Core temperature from $70 \, ^\circ\text{C}$ to $90 \, ^\circ\text{C}$ – no effect

**Danish flank roll**

Use of tainted meat
Use of tainted meat

Bacon

- Androstenone, Skatole and serving temperature have an effect on boar taint related off flavour
- Androstenone has an effect on the smell in the kitchen (max. 0,9 ppm)
- Fried bacon made of meat from entire males deviates from bacon made from castrates when served hot
- Cold serving eliminates the off flavour, but not the off taste
- Sharp smell and smell of sweat and urine are the most intense characteristics in hot bacon while taste of sweat and urine are more intense in cold bacon
Yield

- Entire males have heavier fore parts compared to castrates
- Entire males have less backs compared to castrates
DMRI activities

Reference methods
• Optimization of DMRI reference methods
• EU reference method (JRC)

Detection methods
• Review of possible detection methods
• Requirement specification - new online boar taint detection methods
• Human nose (2011)
• BoarCheck (EU)

Use of tainted meat
• Use of tainted meat for different products
• Atlas – distribution of boar taint compounds in the carcass

Consumer studies
• Consumer studies in DK and UK
• CAMPIG (EU)
Summary

- Identification of market demands and consumer response
- Sorting of carcasses
  - reference methods – sensory and chemical analysis
  - agreement on sorting criteria
  - development of an on-line detection method
  - implementation of sorting
- Use of meat from rejected carcasses
- Reduce incidence of boar taint
  - Breeding, feeding, management
- Handling of entire males/avoid fighting