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Ban of castration? Product quality matters

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Agenda

- Danish case
- Boar taint
  - Substances responsible
  - Incidence
- Product quality
- Recommendations

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Production of entire males - why?

- Animal welfare

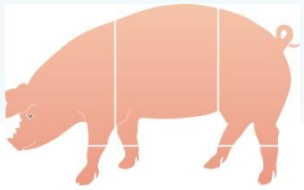
- Production economy
  - no work in connection with castration
  - feed conversion is more efficient
  - higher lean meat content

- Product quality
  - more meat/less fat

- Sustainability
  - less manure due to a higher feed conversion rate

Product quality matters - entire males

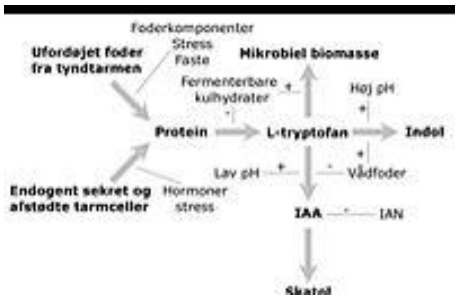
Pros	Animal welfare Sustainability - higher feed efficiency Higher meat content Fat quality/more unsaturated fat
Cons	Boar taint Low fat content Fat quality - soft Carcass composition - heavy fore parts Animal welfare/skin damages



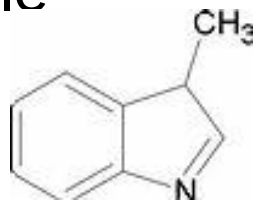
Different markets - different demands!!

The Danish Case

- Entire male project in the 1990's with the aim of improving
  - animal welfare
  - production economy



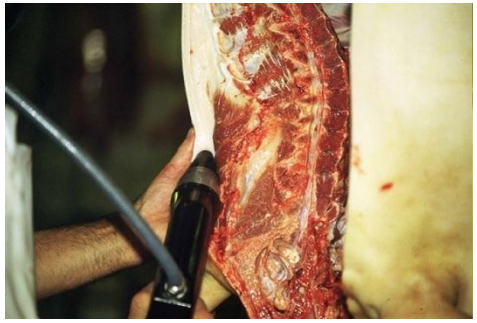
- Development and implementation of the skatole method at the slaughterhouses



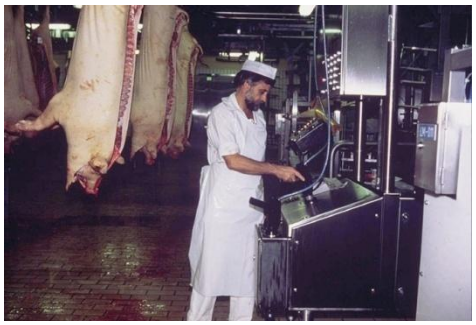
- Production of entire males
- Tainted carcasses separated according to skatole content
- German de facto inhibition of meat from entire males

⟹ decline of entire male production

The Danish sorting method



Sampling of back-fat

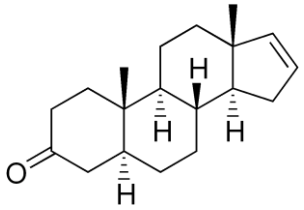


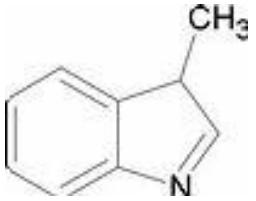
Sampling station

Automatic analysis

- Capacity: 200 samples per hour
- Time lapse between sampling and result: approx. 20 min.
- Limit of detection: 0.03 ppm ”skatole units”
- Rejection level: 0.25 ppm
- Rejected carcasses: 4 to 5 %
- Payment to the producer dependent on skatole result
- The equipment is the only one of its kind and is approx. 20 years old
- More than 25 mio. samples have been analysed

Boar taint





	Androstenone	Skatole
Characteristics	urine	faeces
Threshold value	0.5 - 1.0 ppm	0.20 - 0.25 ppm
Solubility - water	0.00023 g/l (25 C)	0.45 g/l (20 C)

Lundström et al., 2009

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

Boar taint/deviating flavour
- influence of flavour compounds

Compound	RMSE
Androstenone	1.30
Skatole	1.18
Skatole + androstenone	1.11

Støier & Olsen, 1994

Reference: Sensory panel

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

Skatole (ug/g)	Androstenone (ug/g)		
	≤ 0.50	≤ 1.25	≤ 1.99
≤ 0.15	2.0	1.1	1.5
≤ 0.20	1.4	1.2	2.3
≤ 0.25	1.6	1.2	3.0
≤ 0.39	4.1	2.7	5.4

Godt et al., 1996

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

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

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

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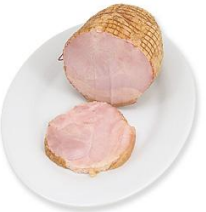
Fresh meat

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)

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Boar taint in meat products

Product	Female	Male - low	Male - high
Dry, oven roasted pork	2.5^{a}	3.0^{a}	5.6^{b}
Stewed, oven cooked pork	4.9^{a}	5.4^{a}	8.6^{b}
Marinated, oven cooked pork	1.0^{a}	1.1^{a}	3.6^{b}
Bacon	1.4^{a}	1.5^{a}	5.8^{b}
Ham, consumed cold	1.6^{ab}	1.5^{a}	2.0^{b}
Salami, consumed cold	1.5^{b}	0.8^{a}	1.5^{b}

McCauley et al., 1997

Low levels: 0.25 ppm androstenone and 0.06 ppm skatole
High levels: 1.1 ppm androstenone and 0.17 ppm skatole
Scale: absent = 0; strong = 10

Meat products
- use of meat from entire males

Skatole content	Products	Accepability
< 0.35 ppm	Bacon, saveloy, mettwurst	OK - if served cold Deviating taste - if bacon is served warm
< 0.5 ppm	Salted meat products with low fat content - ham, belly, neck, loin and frankfurters	OK
> 0.65 ppm	Meat products in general Cooked ham, canadian style bacon	NO OK - if no reheating

Bejerholm (1982), Lustrup (1988 and 1989)

Meat products

- possibilities of reducing boar taint

Smoke

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

Starter cultures (fermented products)

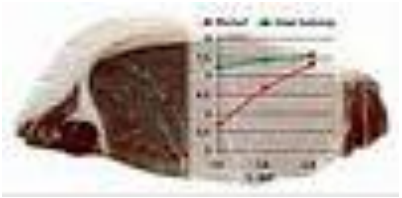
- reduce boar taint, but do not eliminate the taint
  (Stolzenbach et al., 2009)

Marinating

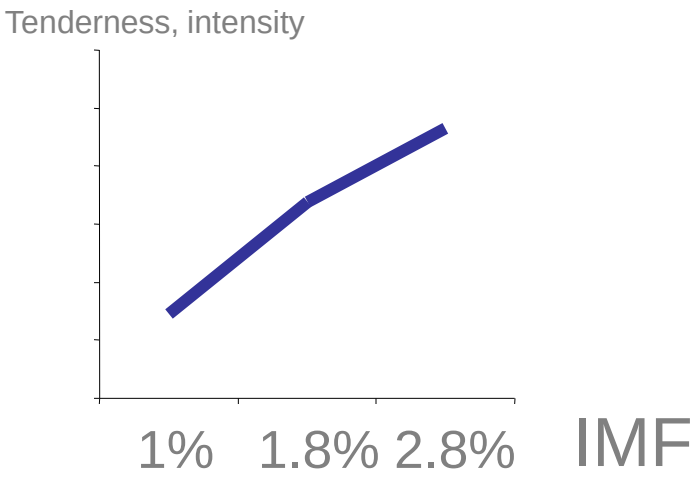
- reduces boar taint - dependent on ingredients

Fat content and quality

- Lower fat content
  - Eating quality
  - Belly quality – floppy
- More soft fat (unsaturated)
  - Belly quality - floppy
  - Hams with fat layer



Tenderness and marbling



0.8% IMF

1.7% IMF

3.4% IMF

Aggression

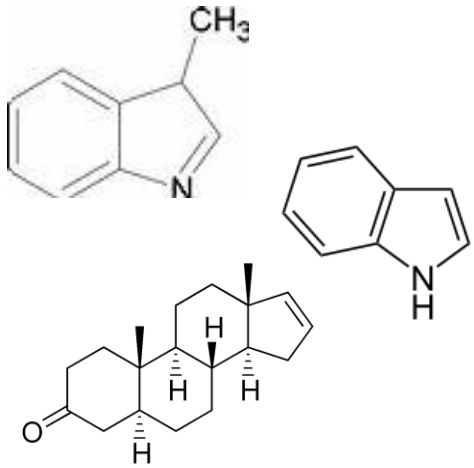
- Entire males more aggressive than castrates and female pigs
  - Rind quality/skin damages
  - PSE
  - DFD
- Need procedures to avoid fighting

Production of meat from entire males - preconditions

- Sorting of the carcasses according to risk of boar taint
  - Danish skatole method
  - Human nose test
    - capacity
    - accuracy
    - calibration
    - rejection limit

- Need for a new, specific and sensitive online detection method

Reference analysis



- Chemical analysis/HPLC method
  - Flavour compounds - skatole, indole, androstenone...
  - Proficiency tests
  - Improvements and control of procedures
  - Accuracy and repeatability
- Sensory analysis
  - Selection and training of panellists
  - Selection of sensory attributes
  - Reference samples
  - Effect on sensory profile of variation in skatole and androstenone content

Recommendations

- Sorting of carcasses
  - 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
- Identification of market and consumer demands