An Alternative Way of Castration

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Pfizer Animal Health
Agenda

• Why we castrate pigs
• Surgical castration
• Alternatives to surgical castration
• Immunological castration
  – How it works
  – Efficacy
  – Impact on production
  – Practical considerations
Current castration practice

- No castration – UK and Ireland
- Some castration – Spain and Portugal
- Nearly 100% castration – rest of Europe and most of the world
  - Mostly surgically without anaesthesia

Approximately 100 million piglets / year in the EU
Why castrate pigs?

• To eliminate the risk of boar taint in meat from sexually mature male pigs
Boar taint

- Unpleasant taste / odour in pork from many sexually maturing male pigs
  - Androstenone (testicular steroid, pheromone)
  - Skatole (product of tryptophan metabolism in the gut, reduced tissue clearance in males)
- Around 50% of intact males are affected at typical slaughter weights
  - Fat concentrations exceeding recognized threshold values
- Variation in individual consumer susceptibility
  - 25% highly sensitive, 75% at least moderately sensitive
  - Women more sensitive than men
  - Higher sensitivity in some racial groups
- Not dangerous, but unacceptable
  - Must be controlled to maintain the viability of pork production
Boar Taint – Chemical assay
Incidence in boars

- Androstenone & skatole in fat tissue from boars
  - Nearly 50% above the sensory threshold: tainted

Data on file. Pfizer Inc.
Castration eliminates boar taint

Dunshea et al. (2001)
- But is not quite 100%

• Castrated and female pigs in highly contaminated environments can still have high skatole concentrations

• Occasional “apparently castrated” pigs can have high androstenone
  – Cryptorchid pigs (one or both testicles retained in the body)
  – Intersex pigs
  – Adrenal malfunction

• 2.2% (4/180) male castrates had high androstenone (Nederveld et al. IPVS 2006)
Why castrate pigs?

- To eliminate the risk of boar taint in meat from sexually mature male pigs.
- To reduce the incidence of sexual and aggressive behaviour in boars (and co-housed gilts) in the late fattening period.
Effects on Behavior

- Behaviour events per 24 hours at 21 weeks of age *

![Bar graph showing aggression and mounting behavior events per 24 hours for boars and surgical castrates.](image)

Skin lesions caused by fighting
Castration reduces fighting lesions

McCauley et al. (2003)
SEXUAL POLITICS

Leaving boars entire can lead to a range of problems: heightened sexual activity, aggression, continual riding, immense stress, fatal injuries, and pregnancy at slaughter. Some producers would prefer to castrate...

Would it be the kindest cut of all on some units?

Pig World (UK) April 2007
Why castrate pigs?

- To eliminate the risk of boar taint in meat from sexually mature male pigs
- To reduce the incidence of sexual and aggressive behaviour in boars (and co-housed gilts)
- To take advantage of the higher fat content of castrates (historic reason)
Current practice – surgical castration

- **Traditional method** – without anaesthesia / analgesia early in life
- **Covered by EU Directive 2001/93**
  - Castration “without tearing of tissues” permitted as an exception
  - Must be performed by a trained person
  - After 7 days of life must be performed by a veterinarian under anaesthesia and with additional prolonged analgesia
Problems with current practice

- **Animal welfare issue**
  - Target of welfare activists
  - Concern for retailers and others
  - New legislation is likely
    - Restrictions already in place / planned in Norway and Switzerland

- **Reduces productivity**
  - Direct losses from surgical complications and infection
  - Loss of potential – because castrates are less metabolically efficient
Castration reduces lean tissue deposition at high weights.
Castration increases fat tissue deposition at all weights

Suster et al. (2006)
Castration increases FCR

Feed conversion ratio

- Suster (2005)
- Dunshea et al. (1993)
- Dunshea et al. (2001) - 23 weeks
- Dunshea et al. (2001) - 26 weeks

Boar
Barrow
Alternatives to current practice – boar production

• **Light weight boar production**
  - Current practice in some markets
  - Impractical on a European basis
    ▪ Some products need heavier carcasses
    ▪ Increase in resources and production cost

• **Boar production at current slaughter weights**
  - Genetic selection to reduce boar taint
    ▪ Early work also selected undesirable traits (poor growth / fertility)
    ▪ Work with more specific genetic markers has long-term promise
  - On-line carcass screening
    ▪ Doesn‘t exist but technically feasible (e-nose)
    ▪ Added cost
    ▪ Only economically viable if relatively few carcasses are rejected

Still a potential problem of behaviour control
Alternatives to current practice – other approaches

- Surgical castration with anaesthesia / analgesia
  - Availability of effective drugs and methods
  - On-farm practicality
  - Added cost

- Semen sorting to produce all female litters
  - Not (yet) viable for routine use

- Immunological castration
Physiology of boar taint

- Hypothalamus
- GnRF
- LH & FSH
- Testes
- Many steroids (testosterone, androstenone)
- Skatole
- Fertility
- Libido
- Behaviour

Brain

Pituitary

Brain

Hypothalamus

Pituitary

Testes

Skatole
Immunological castration

- Vaccination to immunize against GnRF
  - Stimulate production specific antibodies that bind to GnRF and stop activity
- Well-recognized scientific approach
  - Commercially used in pigs
    - Since 1998 in Australia and new Zealand
    - More recently in Brazil, Mexico, South Africa
    - Recently approved for use in Switzerland
  - In wild animal populations for population control
  - In man for prostate cancer control
- Need to overcome the fact that GnRF itself is too small to stimulate an immune response.
  - Swine approach uses a modified GnRF molecule linked to a large protein
Mode of Action

- Hypothalamus
- Brain
- Pituitary
- LH & FSH
- Many steroids
- Testes
- Fertility
- Libido
- Behaviour
- Androstenone
- Skatole
- GnRF

Pfizer Animal Health
Immunological castration in pigs

• Two doses are required at least 4 weeks apart
  – First dose primes the immune system
  – Second dose stimulates antibody production
• Effect is temporary as antibodies decay with time
  – Reliable control of boar taint from two weeks to 8 weeks after second dose
  – Time second dose for 4 to 6 weeks prior to slaughter
The 1st dose primes the immune system.

Peak antibody levels occur about 7-10 days after the 2nd dose.

Protective antibody levels last until at least 8 weeks after the 2nd dose.

Boar taint is reliably suppressed for at least 8 weeks.
Efficacy of immunological castration in pigs

- **Boar taint prevention**
  - ≈99% effective (similar to surgical castration), shown by sensory panels and measurement of taint compounds
  - Pork from treated pigs indistinguishable from that of females and surgical castrates (all superior to boars)

- **Male behavior control**
  - Incidence of mounting and aggressive behaviour rapidly declines to levels similar to surgical castrates

- **Effects on testicular size**
  - Testicles become smaller than those of untreated boars
  - Important tool for assessing compliance
Efficacy - Boar Taint Prevention

Incidence in boars

- Androstenone & skatole in fat tissue from boars
  - Nearly 50% above the sensory threshold: tainted
Efficacy - Boar Taint Prevention
Incidence after Immunological Castration

- Androstenone & skatole in fat tissues after IC
  - Taint compounds below sensory threshold in ~100%

Data on file. Pfizer Inc.
Effects on Behaviour

- Behaviour events per 24 hours at 21 weeks of age *

- Second dose given at 18 weeks of age

Immunological castration (IC) causes a decrease in testes size. Testes size, measured as the maximum width of the pair of testes, was significantly less (\(P<0.01\)) at wks 6 and 8 (or 2 and 4 wks post 2nd dose).

Effect on testes size

- A typical difference in testes size

Boar Immunological castrate

Pigs ~100-105 kg live weight and ~23 weeks of age
Effects on production

Immunological castration does not directly enhance performance but it allows pigs to be managed in a more efficient way:

• Entire male pigs are more efficient than castrates
  – Better feed conversion efficiency
  – More lean meat deposition
  – Less effluent production

• Immunologically castrating a few weeks before slaughter is more efficient than surgically castrating pigs at 1 week of age
  – Because immunologically castrated pigs spend most of their lives as entire males

• In the countries where it is used immunological castration is seen as a way to improve production and profitability – it is not an added cost
### Performance data

**Immunological vs. surgical castrates: % improvement**

<table>
<thead>
<tr>
<th>Trial</th>
<th>No. pigs / country</th>
<th>Slaughter weight (kg)</th>
<th>FCE</th>
<th>ADG</th>
<th>Lean Meat (% carcass weight)</th>
<th>Backfat (p2)</th>
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<tbody>
<tr>
<td>1</td>
<td>24 – MX</td>
<td>108-110</td>
<td>+7.7*</td>
<td>NS</td>
<td>+7.7*</td>
<td>22.4*</td>
</tr>
<tr>
<td>2</td>
<td>30 – AU</td>
<td>~105</td>
<td>+15.1*</td>
<td>+6.8*</td>
<td>ND</td>
<td>7.2*</td>
</tr>
<tr>
<td>3**</td>
<td>50 – AU</td>
<td>96-100</td>
<td>+10.0*</td>
<td>NS</td>
<td>ND</td>
<td>17.4*</td>
</tr>
<tr>
<td>4**</td>
<td>50 – AU</td>
<td>113-120</td>
<td>+16.9*</td>
<td>NS</td>
<td>ND</td>
<td>11.7*</td>
</tr>
<tr>
<td>5</td>
<td>260 – CH</td>
<td>100-110</td>
<td>ND</td>
<td>NS</td>
<td>+1.4*</td>
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<tr>
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<td>+7.9*</td>
<td>+4.8*</td>
<td>ND</td>
<td>12.1*</td>
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<tr>
<td>7</td>
<td>24 – BR</td>
<td>125-138</td>
<td>+9.3*</td>
<td>+10.6*</td>
<td>+9.3*</td>
<td>ND</td>
</tr>
<tr>
<td>8</td>
<td>160 – US</td>
<td>125-130</td>
<td>+8.6*</td>
<td>NS</td>
<td>+7.6*</td>
<td>8.1*</td>
</tr>
</tbody>
</table>

FCE = Feed conversion efficiency  
ADG = Average Daily Gain  
NS = Not statistically significant at p<0.05  
* statistically significant at p<0.05  
** FCE only determined over last 4 weeks prior to slaughter  
ND = Not determined
Effect on meat quality

Boars have less fat than castrates

Fat of immunologically castrated pigs is typically between boars and surgical castrates (influenced by feeding, timing and genetics)

High acceptance in taste panels

Photographs from a study conducted in Asian pigs
Practical considerations – on farm

• Pigs need to be injected twice, the second injection 4 to 6 weeks prior to slaughter
  – Not a problem with appropriate procedures
• Every male pig must be fully dosed
  – SOPs and training to ensure compliance
• On farm QA procedures required
  – Observation of testicle size and behaviour to identify and treat any possibly missed pigs
• Operator safety is important
  – Training and use of a safety vaccinator

Experience in existing markets shows that producers can achieve a very high level of reliability
Ensuring High Compliance

- Smaller testes size following vaccination can be used to assess compliance and efficacy

Pigs ~100-105 kg live weight and ~23 weeks of age
On the Slaughter line

Boar Immunological castrate

Pigs ~100 kg live weight and ~23 weeks of age
Consumer Acceptance

- Well accepted in all sectors of Australian market since 1999
  - Major supermarkets, Asian butchers, high quality manufacturers
- Well accepted by Australian consumer groups
  - Aust. & NZ Food Authority, Aust. Consumers Assoc & Public Health Authority
- No restriction on exports
- Proactive stakeholder communication pre-launch
- Consumer market research – positive results
  - Australia
  - Sweden
Immunological castration - Summary

- Represents a safe, effective and practical approach to the control of boar taint in entire (intact) male pigs
- Eliminates the need for surgical castration to control boar taint
- Prevents the losses in growth performance, feed efficiency and carcass quality as consequence of surgical castration or slaughter of lightweight male pigs, and so improves the profitability of pig production
- Provides a welfare friendly alternative to surgical castration