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AUSTRALIAN Pork

# Challenges in pig breeding in the next decade

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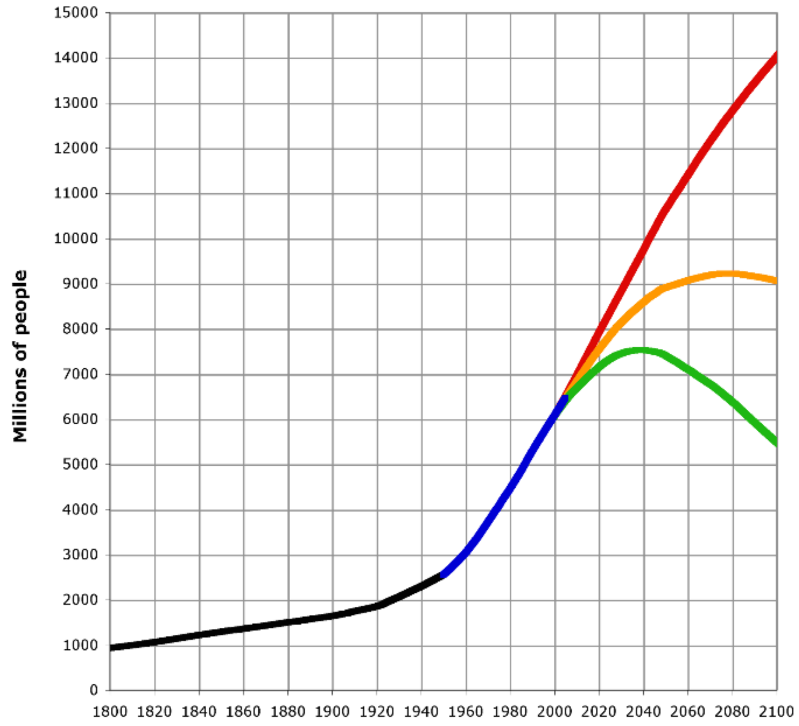
# Challenges in pig breeding?

Sufficient supply of high quality pork that meets the demands of consumers

# Sufficient supply

## Exponential increase in demand




http://en.wikipedia.org/wiki/World_population

# Implications for pig breeding

- Production efficiency continues to be important
  - Increased demand and costs of feed
  - Lower environmental footprint per unit output
- Selection for productivity increases physiological demands (Prunier et al. 2010)
  - Increased stress and disease susceptibility
  - More behaviour, leg and reproductive problems
  - Reduced pork quality

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# Sufficient supply

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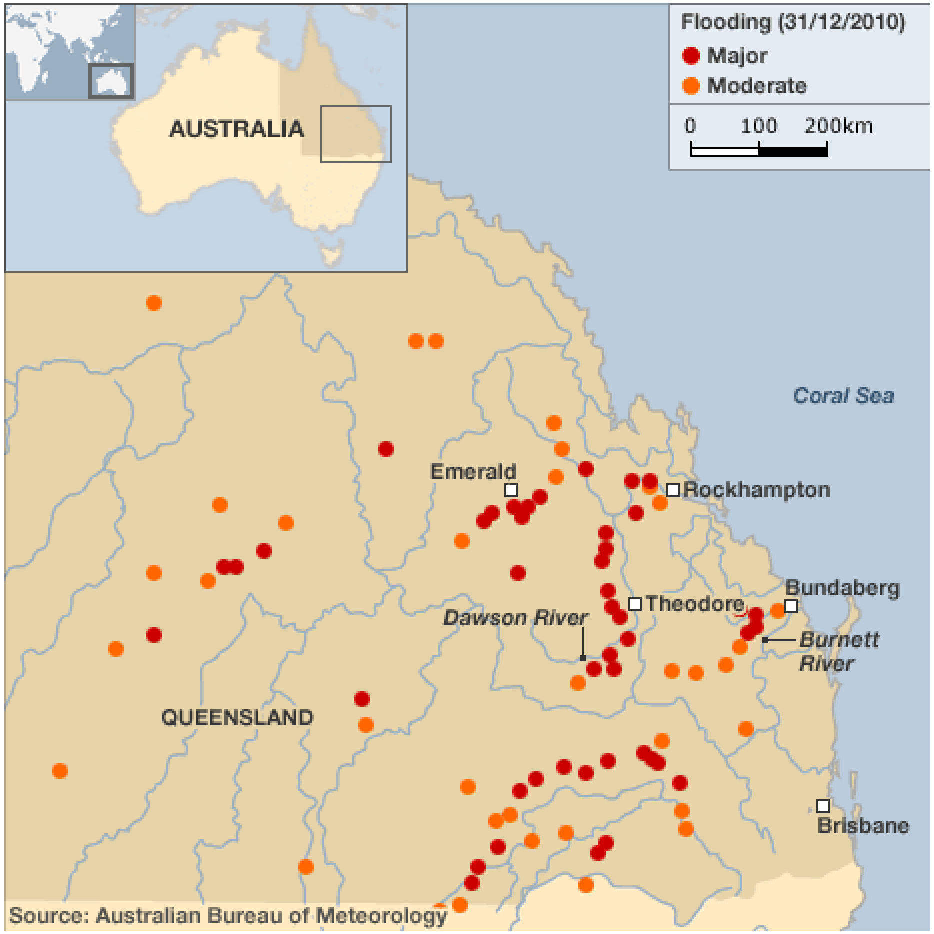
## Less certainty in environmental conditions





# Implications for pig breeding

- Importance of genotype by environment interactions will increase
  - International breeding companies supply genotypes for different market and production systems
  - Models indicate that selection for productivity increases environmental sensitivity

Shift in paradigm:

Maximum performance - Optimal performance

# Healthy, robust pig genotypes

Selection of highly productive pigs across a variety of environments without compromises to their health and welfare

- Part of High Integrity Australian Pork CRC

# Challenges in pig breeding?

Sufficient supply of high quality pork that meets the demands of consumers

# Demands of consumers differ

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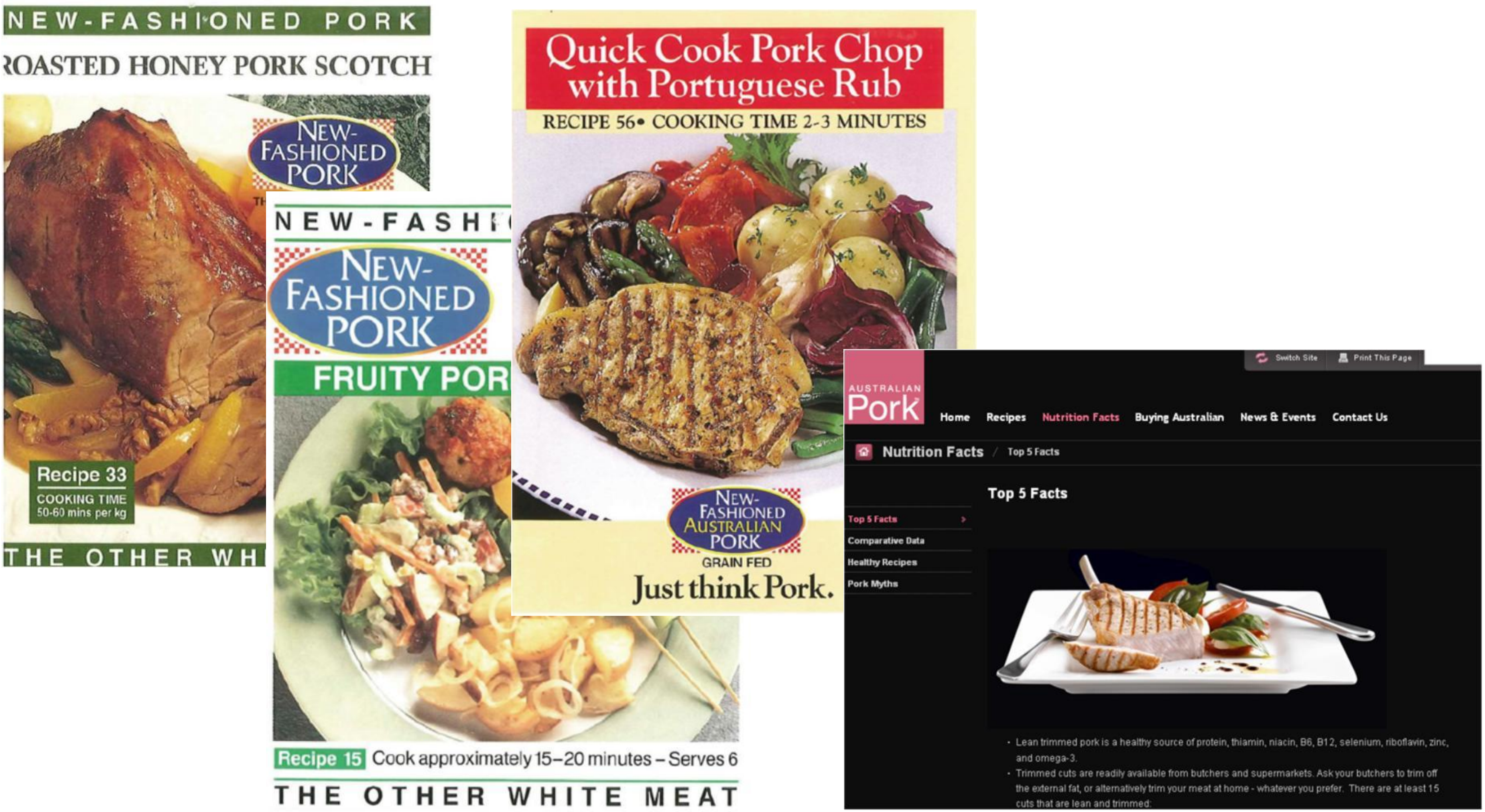
# Changes in marketing strategies



# Implications for pig breeding

- Strategies to meet (changing) requirements of different (international) markets
  - Definition of breeding objectives
  - Selection within versus between breeds/lines
  - Carcase quality versus Pork quality

## Carcase quality

- Overall lean meat percentage
- Composition of specific cuts (ie belly composition)
- Weight of primal cuts

## Pork quality:

- Fat quality
- Meat and eating quality
- Nutritional value

# **Carcase quality:** belly composition

- High lean meat content is preferable in a number of markets
  - Bacon production (ie Australia)
  - Grillfleisch/BBQ meat (ie Germany)
  - Stir-fry (Asia; Singapore)

# Predicting belly composition

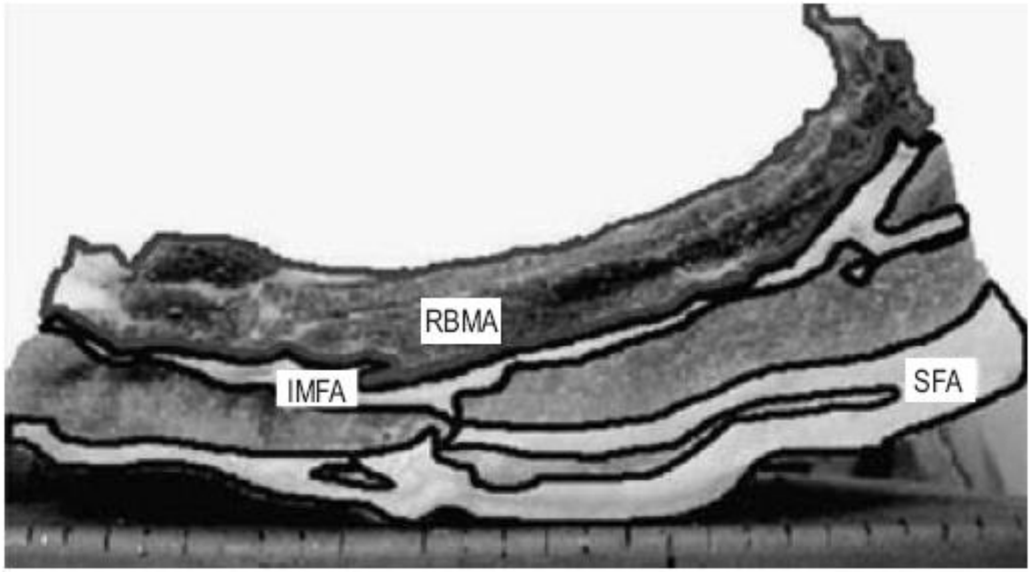



**Figure 1** Definition of area measurements on anterior side of the **belly** used to predict fat percentage of the belly (modified from Shaw **and** Rosetto, 2003). RBMA: area of rib bone and muscle; IMFA: intermuscular fat area; SFA: subcutaneous fat area.

FATPC = 13.7 – 0.226 RBMA + 0.484 IMFA + 0.271 SFA + 0.549 P2

Shown in Hermesch (2008)

# Belly characteristics were genetically different traits

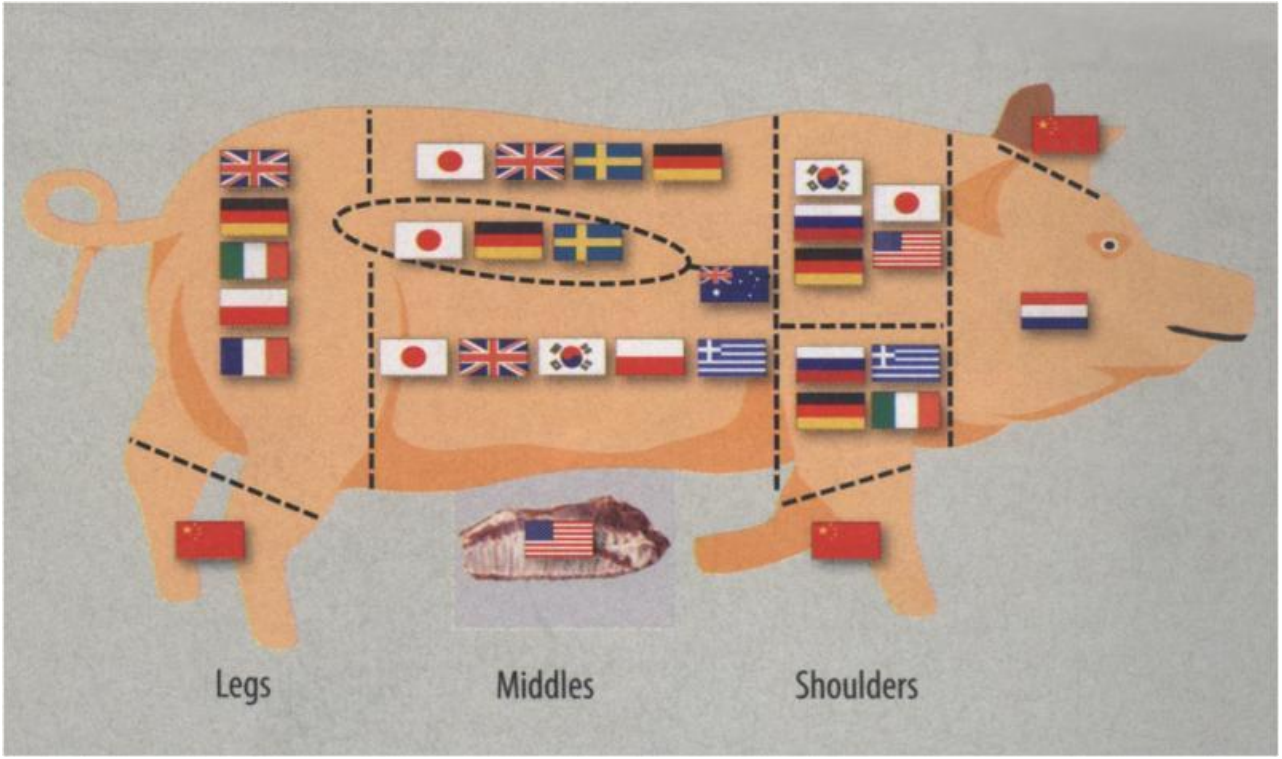
| | FATPC | RMBA | IMFA | SFA | P2 |
|---|---|---|---|---|---|
| FATPC | <u>0.34</u> | | | | |
| RMBA | -0.48 | <u>0.25</u> | | | |
| IMFA | 0.71 | 0.03 | <u>0.23</u> | | |
| SFA | 0.84 | -0.09 | 0.56 | <u>0.32</u> | |
| P2 | 0.85 | -0.24 | 0.63 | 0.73 | <u>0.28</u> |

Hermesch (2008)

Questions:

- How many traits to consider in breeding programs?
- What are the physiological limits?

# Carcase quality:
## weight of individual cuts




Distribution of meat from Danish abattoir in Horsens

(Pig Progress No 2, 2008)

# Australian Pork Wholesale Prices

## (Sydney c/kg)

| Carcase | Pork | Bacon |
|---|---|---|
| Oct. 2010 RAA* | 442 | 403 |

| Broken Sales | Legs | Legs Ham Trim | Saddles | Loin | Fore-quarters | Bellies |
|---|---|---|---|---|---|---|
| Oct. 2010 RAA* | 442 | 486 | 502 | 539 | 332 | 659 |

| Carton Sales | US Ribs | Boneless Legs | Fillets | Boneless Middles <13mm | Boneless Middles >12mm | Boneless Shoulders | Pork Neck | Trim 90CL |
|---|---|---|---|---|---|---|---|---|
| Oct. 2010 RAA* | 1150 | 630 | 1121 | 444 | 391 | 502 | 655 | 394 |

*RAA: rolling annual average

Source: Eyes and Ears, Issue #402, Oct. 2010

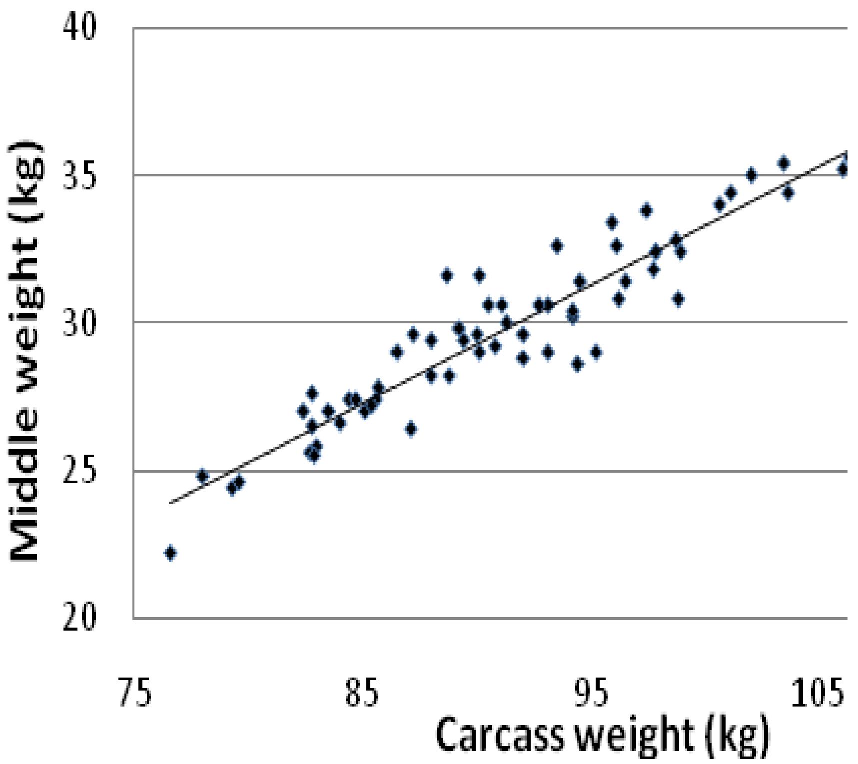
# Example: increasing weight of more valuable primal cut (middle)

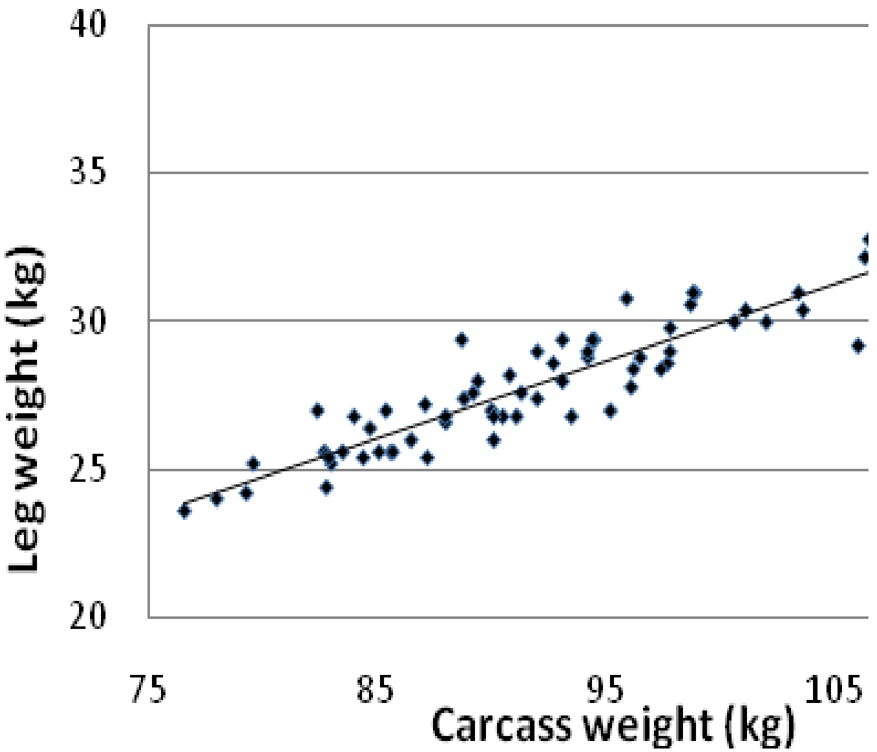
| | Price ($/kg) | Original weight (kg/pig) | Original return ($/pig) | New weight (kg/pig) | New return ($/pig) |
|---|---|---|---|---|---|
| Middle | 5.9 | 30 | 177.0 | 31 | 182.9 |
| Legs | 4.8 | 28 | 134.4 | 28 | 134.4 |
| Shoulders | 3.7 | 27 | 99.9 | 26 | 96.2 |
| Total | | 85 | 411.3 | 85 | 413.5 |

- Constant carcase weight of 85 kg/pig
- Higher weight of middle at the expense of less shoulder weight (1 kg)
- Difference in returns (2.2$ per pig = 413.5 – 411.3) represents difference in price for middles versus shoulders (5.9 versus 3.7 $/kg)

Economic weight: Difference in price of individual cuts

# Variation in primal cuts
## (first Australian data)




$R^2$: 0.87; Regr. coeff.: 0.39

$R^2$: 0.79; Regr. coeff.: 0.25

# Challenges – carcase quality

- Reach of physiological and economic limits
  - Limited variability of fat depth
    - Same may hold for predicted lean meat percentage
  - Low economic weight for fat depth (LMP)

- (Some) additional returns from better composition and more weight in individual cuts
  - Variability in market incentives
  - Additional measurements are required
    - CTScan offers most opportunities
  - Ultimately, physiological limits will also be reached

# **Pork quality:** Nutritional value

Table 1. *Contribution (proportion) of trace elements and vitamins from livestock products to the human diet and the proportion of population with intakes below RNI (Henderson* et al. *2002)*

| | Contribution to human diet | | | | Proportion below RNI | |
|---|---|---|---|---|---|---|
| | Milk | Eggs | Meat | Total | Male | Female |
| Trace elements | | | | | | |
| Copper | 0·05 | 0·02 | 0·15 | 0·22 | 0·38 | 0·72 |
| Iodine | 0·38 | 0·05 | 0·07 | 0·50 | 0·18 | 0·41 |
| Iron | 0·01 | 0·03 | 0·17 | 0·21 | 0·15 | 0·35 |
| Selenium | 0·08 | 0·04 | 0·32 | 0·44 | NR | NR |
| Zinc | 0·17 | 0·03 | 0·34 | 0·54 | 0·42 | 0·42 |
| Vitamins | | | | | | |
| Cobalamin | 0·36 | 0·06 | 0·30 | 0·72 | 0·01 | 0·02 |
| Folate | 0·08 | 0·03 | 0·07 | 0·18 | 0·11 | 0·28 |
| Retinol | 0·14 | 0·05 | 0·28 | 0·47 | 0·50 | 0·59 |
| Riboflavin | 0·33 | 0·04 | 0·15 | 0·52 | 0·19 | 0·37 |
| $\alpha$-Tocopherol | 0·04 | 0·03 | 0·11 | 0·18 | 0·02 | 0·03 |

NR, not reported.

Table from Rooke et al. (2010)

Table 2. *Mean Cu, Fe and Zn concentrations for muscle meats, milk and eggs from the Food Standards Agency (2002) together with the range of values derived from recent literature (see Supplementary Material for details)*

| Product | Cu (mg/kg) | Fe (mg/kg) | Zn (mg/kg) |
|---|---|---|---|
| Eggs | 0·12 | 2·7 | 17 |
| | 0·6–0·8 | 16–27 | 7–17 |
| Milk | 0·1 | 0·8 | 3·9 |
| | 0·02–0·16 | 0·6–9 | 2–13 |
| Muscle | | | |
| Bovine | 0·35 | 18 | 36 |
| | 0·4–14 | 13–61 | 23–77 |
| Ovine | 0·6 | 11 | 25 |
| | 0·3–1·3 | 17–36 | 21–74 |
| Porcine | 0·53 | 6·3 | 17 |
| | 0·3–5·9 | 3–30 | 5–59 |
| Chicken | 0·48 | 5·5 | 10 |
| | 0·2–2·9 | 4–54 | 5–30 |

Table from Rooke et al. (2010)

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# Australian project to improve iron content in pork

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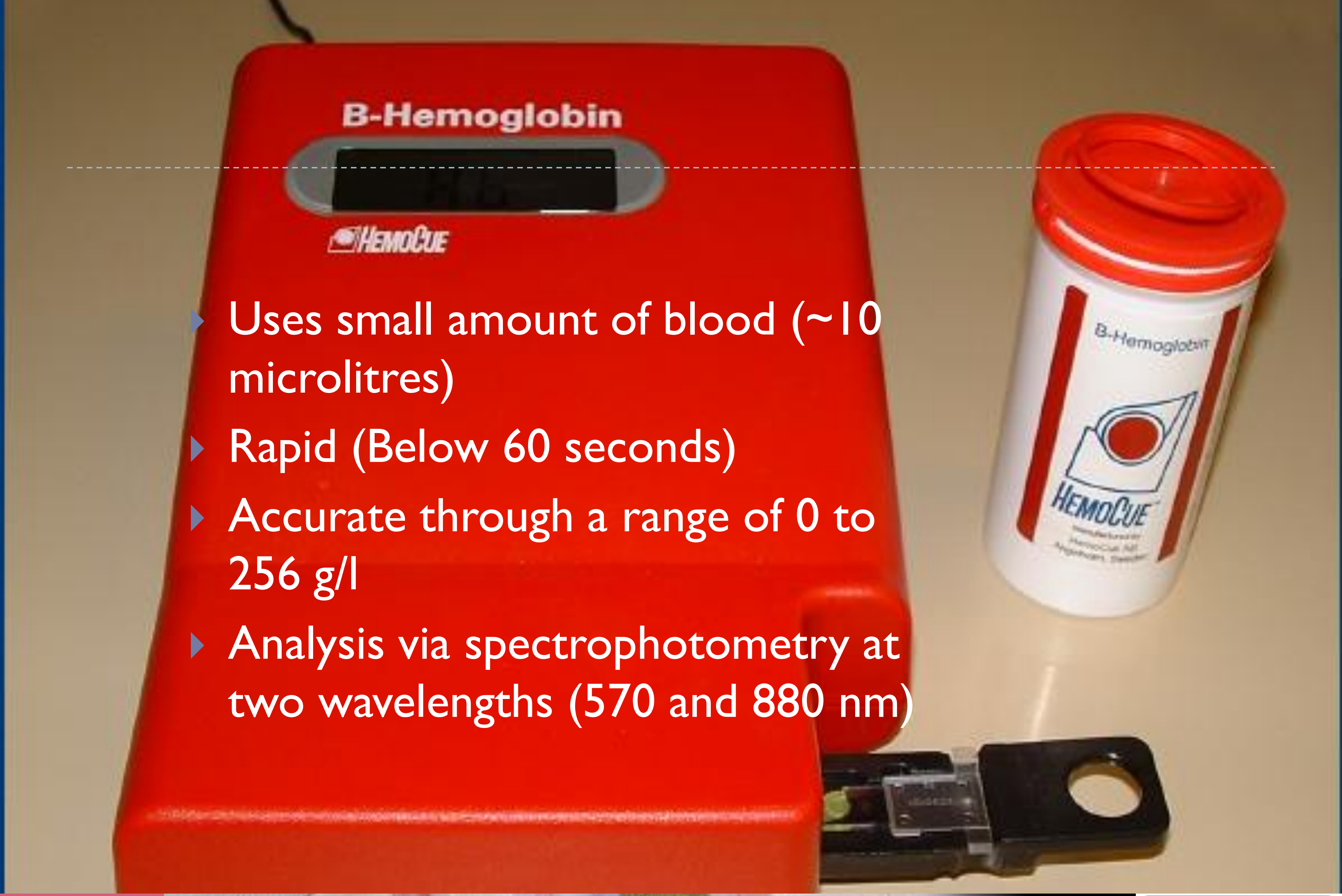
- Pork iron levels are declining
- Faster growing genotype had lower haematin and myoglobin levels in comparison to slower growing genotype (Oksbjerg et al. 2000)
- Major pork iron source is haem within myoglobin
    - Haem complex in blood and muscle

# Overview of measurements



- On-farm haemoglobin measure
  – 5 and 21 weeks of age
- Iron content in pork
- Other performance traits
  – Growth, feed intake, carcase and meat quality traits




- Uses small amount of blood (~10 microlitres)
- Rapid (Below 60 seconds)
- Accurate through a range of 0 to 256 g/l
- Analysis via spectrophotometry at two wavelengths (570 and 880 nm)

# First results (Jones and Hermesch, 2010)



- Haemoglobin levels:
  - Low heritabilities: ~0.05
  - Common litter effect: ~0.10
  - Opportunities to improve accuracy of measurement are being explored
- Iron content:
  - Moderate heritability ( 0.28±0.08)
  - Litter effect (0.10±0.04)

# Challenges – Pork Quality

- Definition of breeding objective traits
- Performance recording
- Genetic gains

# Pork quality – breeding objectives



- Importance of different pork quality aspects differ vastly between markets
  - Limited market incentives – “the cost of doing business”
  - Breeding programs can not follow market shifts quickly
  - Good overall quality versus specific quality characteristics
- Specific traits or trait groups
  - Avoidance of PSE and DFD meat (benefits animal, processor, consumer)
  - Drip loss percentage – weight loss (benefits processor)
  - Nutritional characteristics – health benefits for humans
    - Health benefits for animal?

# Pork quality – performance recording

- Limited information available from abattoirs in routine genetic evaluations
  - Most recordings available from test stations linked to an abattoir in various European countries
- Potential live animal measures
  - CTScan or ultrasound for intramuscular fat content
  - Biological markers
- Genetic markers
  - Validation across populations required

# Pork quality – Genetic gains

- Genetic gains are achievable – in principal
  - High emphasis and good performance recording

- Unfavourable genetic associations with leanness and efficiency traits
  - Costs of trade-offs

- Limited genetic variation for some traits
  - Intramuscular fat content
  - pH measures

# Challenges in pig breeding

- Optimal performance of genotypes across environments to make best use of limited resources
- Further increase in overall leanness is less desirable
  - Some additional gains from other carcase characteristics
- Importance of pork quality differs between markets and over time
  - Breeding programs can not follow every market trend

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# Imagine ....