

# For Good Beef, Sex is More Important than Breed



Bonny S.P.F.,<sup>1</sup> D. W. Pethick 1, I. Legrand 2, J. Wierzbicki 3, P. Allen 4, L. J. Farmer 7, R. Polkinghorne 5, J-F. Hocquette 6, G. E. Gardner 1



<sup>1</sup> School of Veterinary and Biomedical Science, Murdoch University, Murdoch, Western Australia 6150, Australia  
Email: s.bonny@murdoch.edu.au

<sup>2</sup> Institut de l'Élevage, Service Qualité des Viandes, MRAL, 87060 Limoges Cedex 2, France;

<sup>3</sup> Polish Beef Association ul. Kruczkowskiego 300-380 Warszawa, Poland;

<sup>4</sup> Teagasc Food Research Centre, Ashtown, Dublin 15., Ireland;

<sup>5</sup> 431 Timor Road, Murrurundi, NSW 2338, Australia;

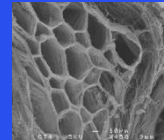
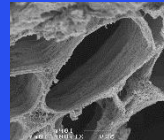
<sup>6</sup> INRA-VetAgro Sup, UMRH 1213 Theix, 63122 Saint Genes Champanelle, France;

<sup>7</sup> Agri-Food and Biosciences Institute, Newforge Lane, Belfast BT9 5PX, U;



# Outline

- Marbling and collagen differ between breeds and sexes



- Modelling breed and sex



- Need to take sex and breed into account when predicting eating quality

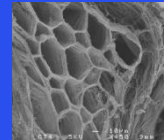
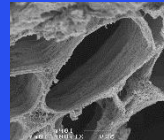


Which is better?



# Outline

- Marbling and collagen differ between breeds and sexes



- Modelling breed and sex
- Need to take sex and breed into account when predicting eating quality

# Dairy



# Beef



## High IMF

Garcia-de-Siles *et al.*, 1997  
Thompson, 2001



## Low IMF



# Dairy



# Beef



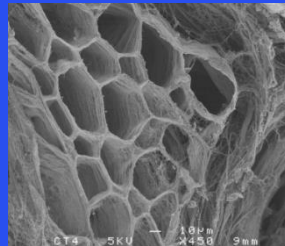
High IMF



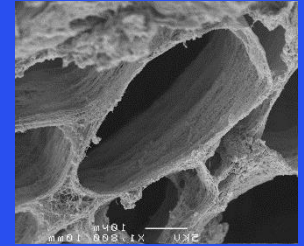
Low IMF



More Collagen



Less Collagen

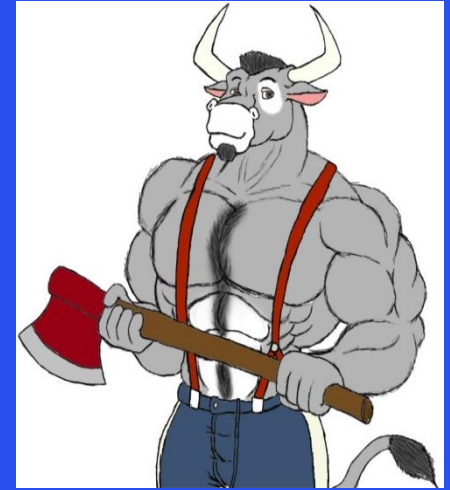


Boccard *et al.* 1979

# Dairy & Females



# Beef & Bulls



High IMF

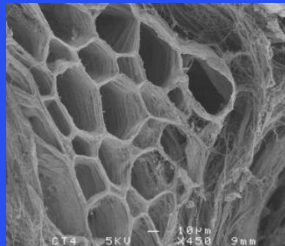
Venkata Reddy *et al.*, 2015



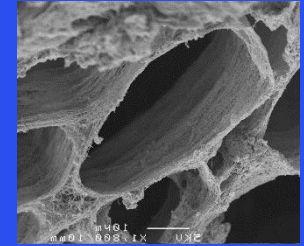
Low IMF



More Collagen



Less Collagen



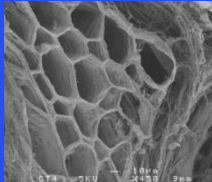
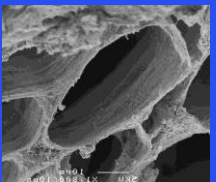
# Hypothesis



Breeds and sexes will differ in quality



Differences in quality will be explained by maturity and IMF





# Outline

- Marbling and collagen differ between breeds and sexes

- Modelling breed and sex



- Need to take sex and breed into account when predicting eating quality

# 482 carcasses

- Bull: 94
- Female: 173
- Steer: 215

- 5 countries
- Aged between 5-28 days
- Two hanging methods
  - 4 cooking methods
  - 18 muscle types
- All graded by MSA trained graders

## 482 carcasses

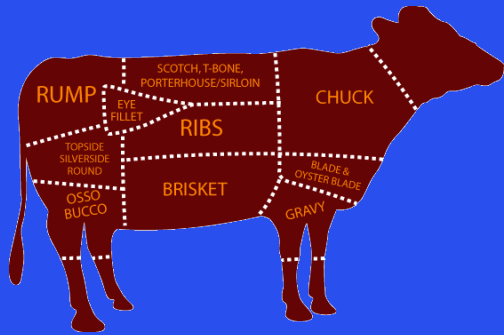
- Bull: 94
- Female: 173
- Steer: 215

## 482 carcasses

- Beef: 207
- Dairy: 151
- Cross: 124

- 5 countries
- Aged between 5-28 days
- Two hanging methods
  - 4 cooking methods
  - 18 muscle types
- All graded by MSA trained graders

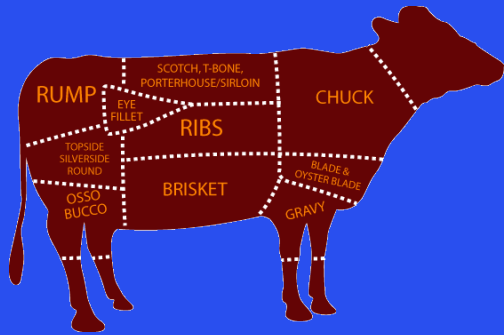
# Taste Panels



482 Carcasses

# Taste Panels

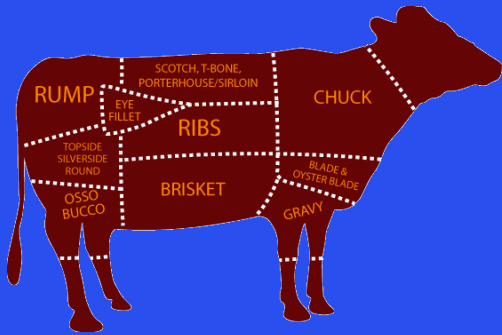
18 Muscles



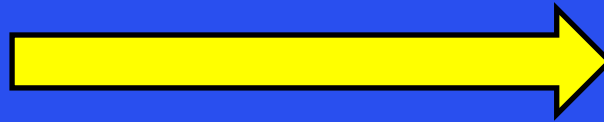
482 Carcasses

# Taste Panels

18 Muscles



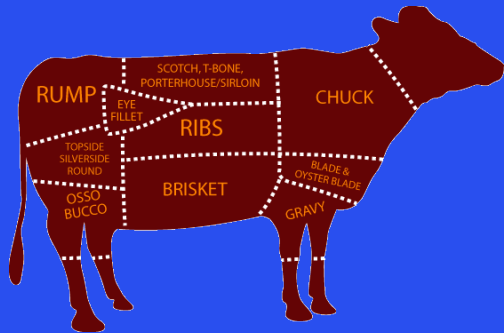
X 10 samples



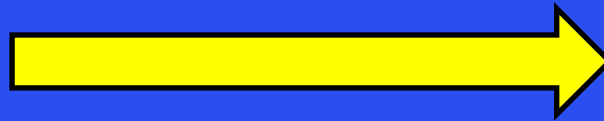
482 Carcasses

# Taste Panels

18 Muscles



X 10 samples

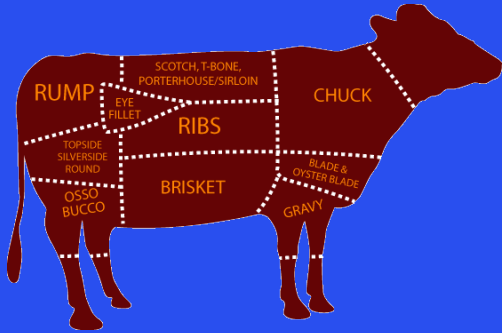


482 Carcasses

11268 Consumers

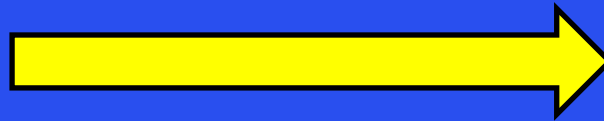
# Taste Panels

18 Muscles



482 Carcasses

X 10 samples



**Untrained**

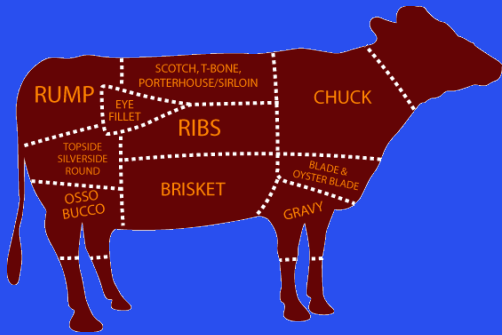


11268 Consumers



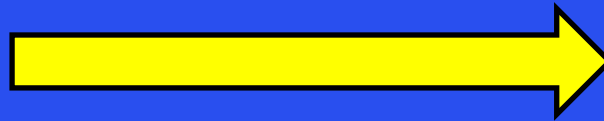
# Taste Panels

18 Muscles



482 Carcasses

X 10 samples

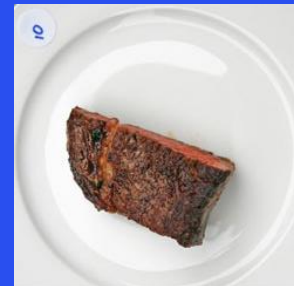


**Untrained**



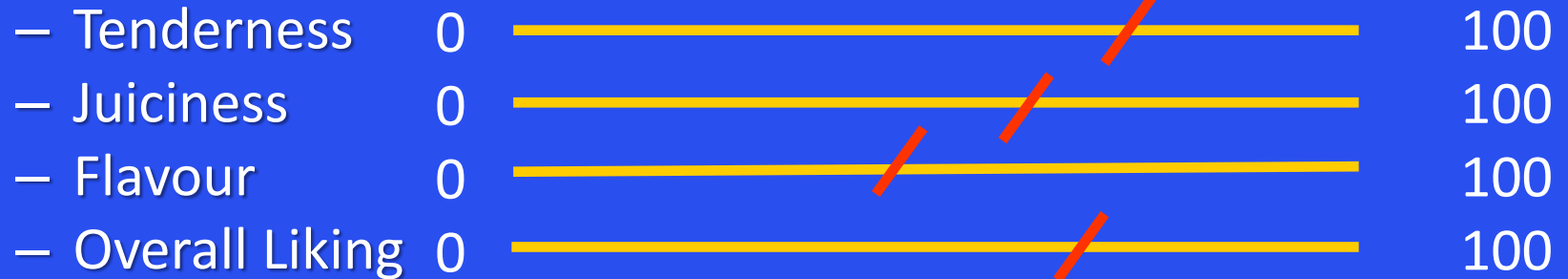
11268 Consumers

X 6 Samples



# Taste Panels

- Scored for



- Scores then weighted and combined into a single MQ4 value

Tenderness	x 0.3
+	
Juiciness	x 0.1
+	
Flavour	x 0.3
+	
Overall Liking	x 0.3

**=MQ4**



# The Meat Standards Australia System

- Predictors

- Breed (2-10) restricted to
  - Bosindicus content
- Sex (2)
- Growth path (10)
  - carcass wt
  - **ossification score**
  - Milk fed veal
- Hanging (0-10)
- **Marble score** (2-10)
- Ageing: 5d min (0-6)
- Cooking method (0-12)
- Muscle (30)
- **pHu**
- Rib fat

- Basic criteria

- Stress minimization
- Optimal processing

- Thresholds (requirement)

- Ultimate pH < 5.7 / colour
- Rib fat > 3mm



# The Meat Standards Australia System

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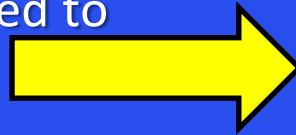
= Predicted MQ4



# The Meat Standards Australia System

## • Predictors

- **Breed** (2-10) restricted to
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- **Sex** (2)
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  - carcass wt
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- **Hanging** (0-10)
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- **Ageing: 5d min** (0-6)
- **Cooking method** (0-12)
- **Muscle** (30)
- **pHu**
- **Rib fat**



- **Mostly Beef Breeds**
- **No Bulls**

## • Thresholds (requirements)

- Ultimate pH < 5.7 / colour
- Rib fat > 3mm



# Statistical Analysis

## Linear mixed effects model

### – Fixed Effects

- Source country
- Hang method
- Muscle
- Cook method
- Sex
- Breed

### – Random Terms

- Animal I.D.
- Taste panel country
- Kill Group

### – Covariates

- Days aged

# Statistical Analysis

## Linear mixed effects model

### – Fixed Effects

- Source country
- Hang method
- Muscle
- Cook method
- **Sex**
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### – Random Terms

- Animal I.D.
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### – Covariates

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# Statistical Analysis

## Linear mixed effects model

### – Fixed Effects

- Source country
- Hang method
- Muscle
- Cook method
- **Sex**
- **Breed**

### – Random Terms

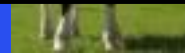
- Animal I.D.
- Taste panel country
- Kill Group

### – Covariates

- Days aged



Two Models:  
1) MQ4  
2) Prediction accuracy





# Outline

- Marbling and collagen differ between breeds and sexes
- Modelling breed and sex
- Need to take sex and breed into account when predicting eating quality

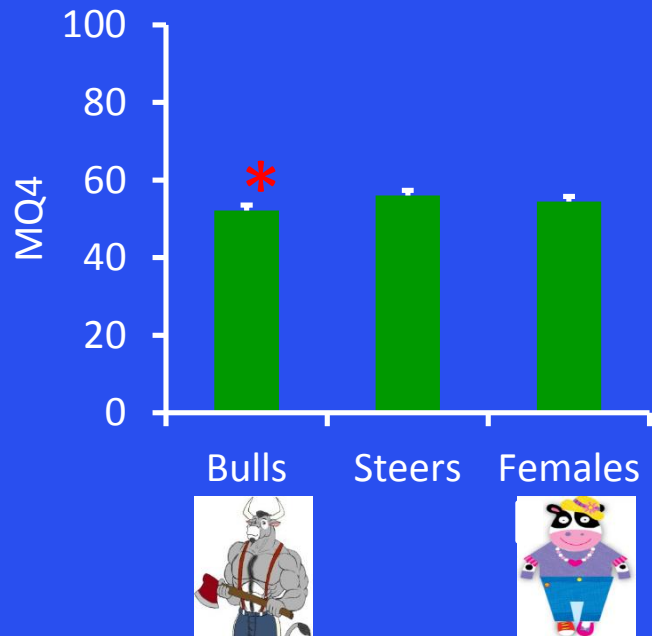


# MQ4

# MSA accuracy



Lower scores



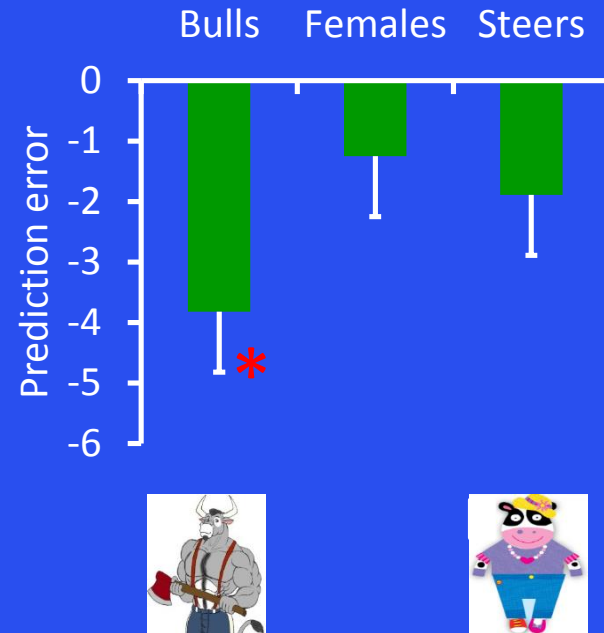
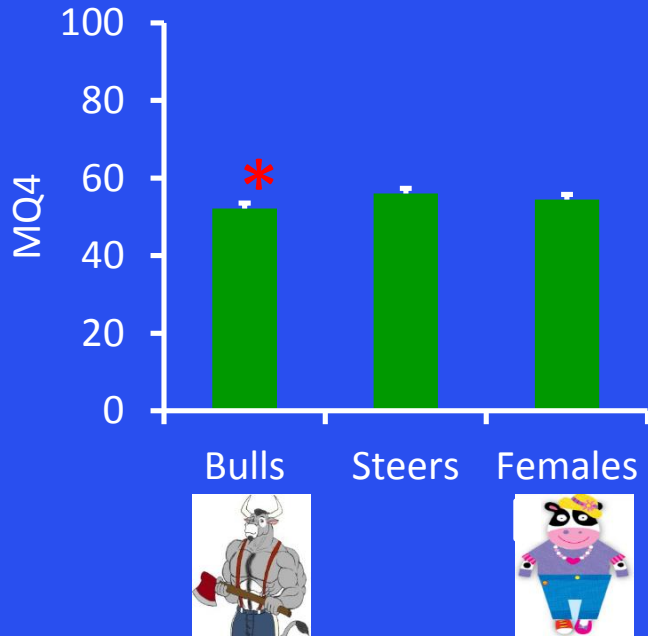
# MQ4

# MSA accuracy



Lower scores →

Not fully explained by MSA



# MQ4

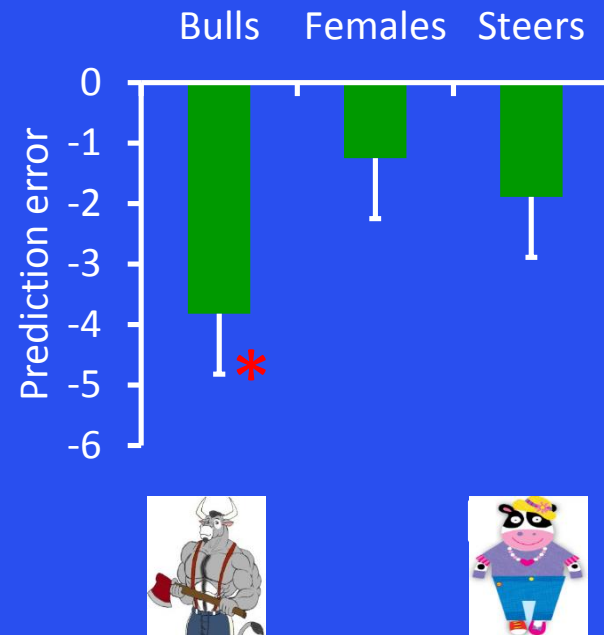
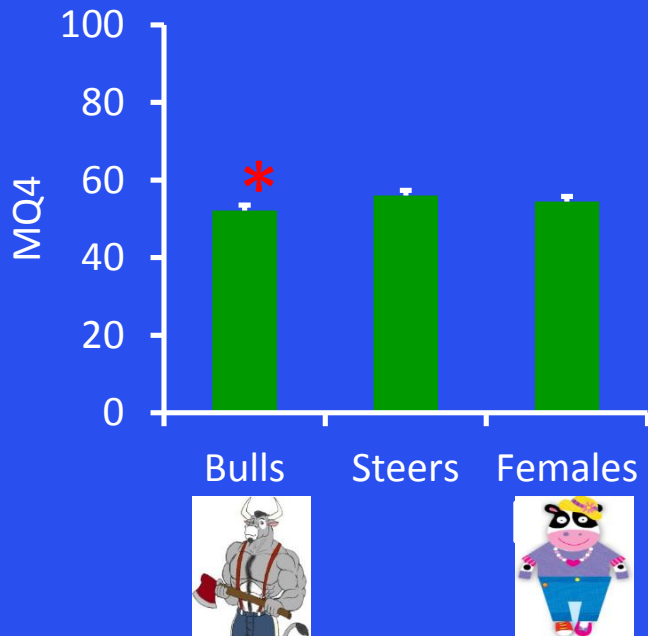
# MSA accuracy



Lower scores →

Needs adjustment for:  
**Bulls**

ex



# MQ4

# MSA accuracy

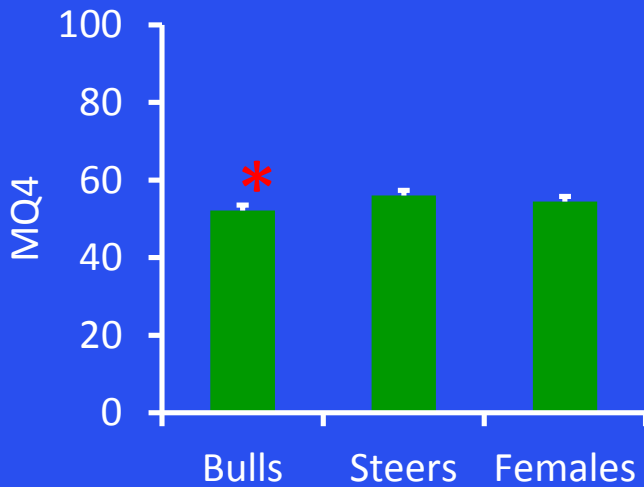


Lower scores →

ex

Needs adjustment for:  
**Bulls**

Not explained by:  
**Age**  
**Ultimate pH**  
**Marbling score**



# MQ4

# MSA accuracy

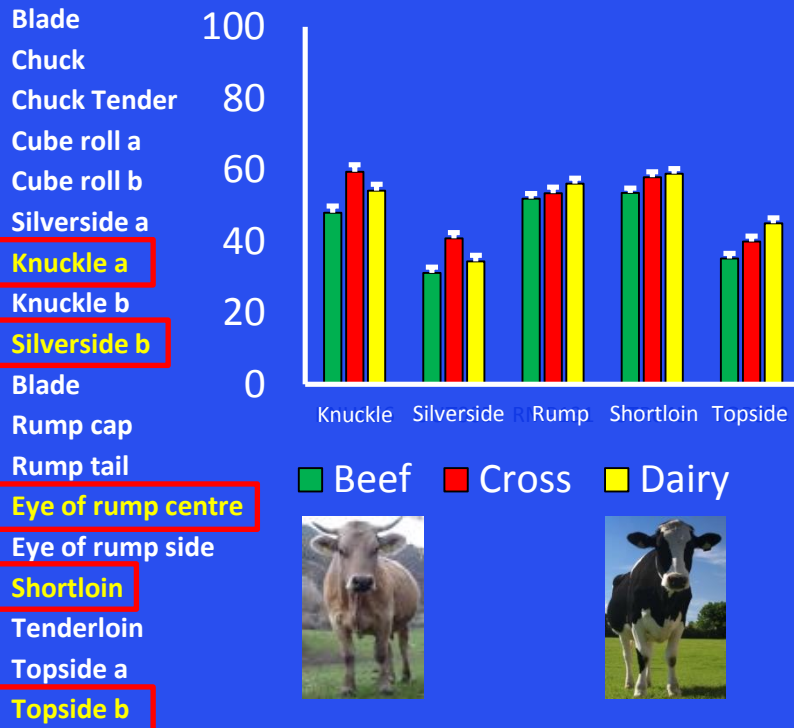
Blade  
Chuck  
Chuck Tender  
Cube roll a  
Cube roll b  
Silverside a  
Knuckle a  
Knuckle b  
Silverside b  
Blade  
Rump cap  
Rump tail  
Eye of rump centre  
Eye of rump side  
Shortloin  
Tenderloin  
Topside a  
Topside b

# MQ4

# MSA accuracy



## Higher scores



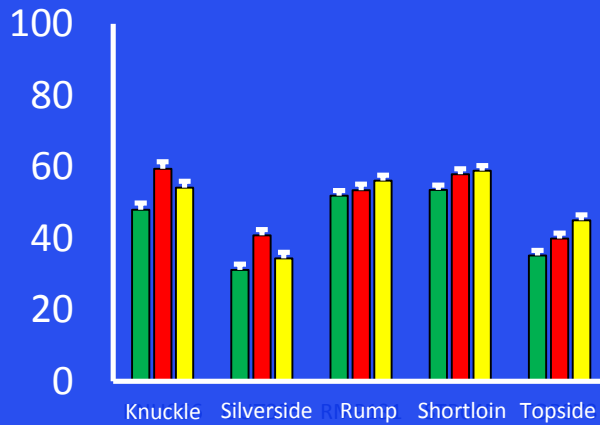
# MQ4

# MSA accuracy



## Higher scores

Blade  
 Chuck  
 Chuck Tender  
 Cube roll a  
 Cube roll b  
 Silverside a  
**Knuckle a**  
 Knuckle b  
**Silverside b**  
 Blade  
 Rump cap  
 Rump tail  
**Eye of rump centre**  
 Eye of rump side  
**Shortloin**  
 Tenderloin  
 Topside a  
**Topside b**



■ Beef ■ Cross ■ Dairy



Blade  
 Chuck  
 Chuck Tender  
 cube roll a  
 cube roll b  
 Silverside a  
**knuckle a**  
 knuckle b  
**Silverside b**  
**Blade**  
 rump cap  
 rump tail  
**eye of rump centre**  
 eye of rump side  
**Shortloin**  
 Tenderloin  
 topside a  
**topside b**

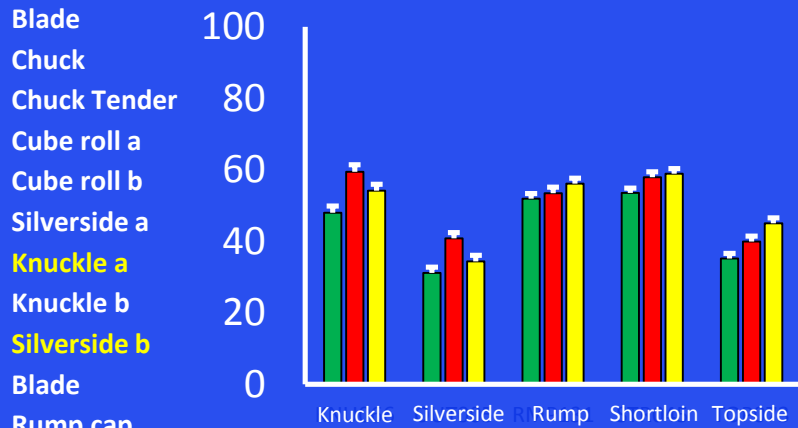


# MQ4

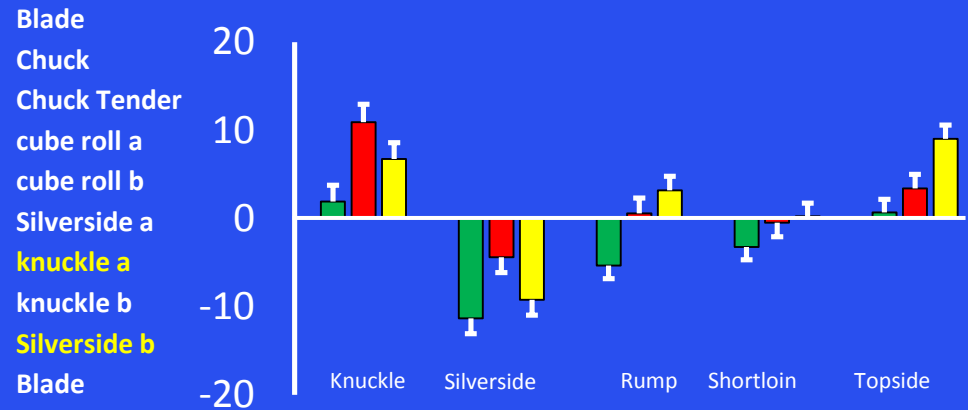
# MSA accuracy



## Higher scores



■ Beef ■ Cross ■ Dairy



■ Beef ■ Cross ■ Dairy

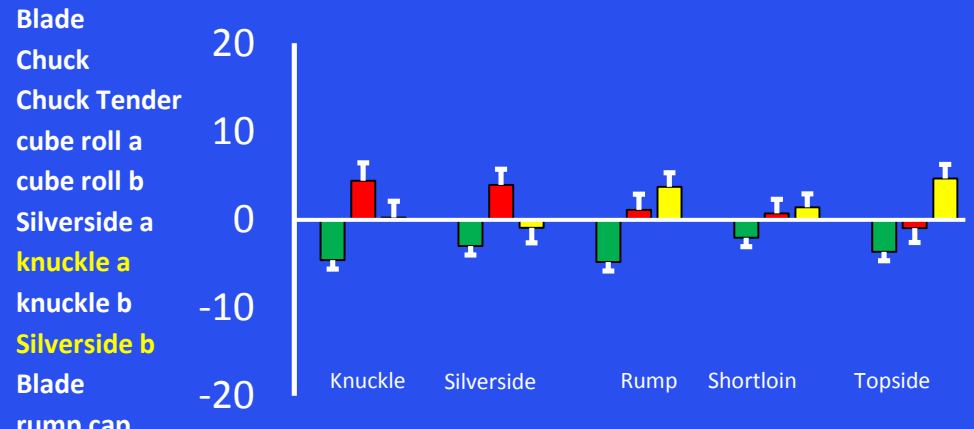
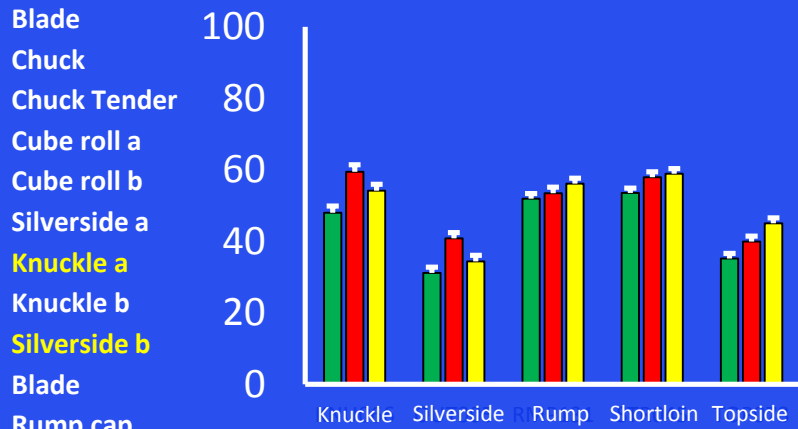


# MQ4

# MSA accuracy



## Higher scores



- Blade
- Chuck
- Chuck Tender
- Cube roll a
- Cube roll b
- Silverside a
- Knuckle a**
- Knuckle b
- Silverside b**
- Blade
- Rump cap
- Rump tail
- Eye of rump centre**
- Eye of rump side
- Shortloin**
- Tenderloin
- Topside a
- Topside b**

■ Beef ■ Cross ■ Dairy



- Blade
- Chuck
- Chuck Tender
- cube roll a
- cube roll b
- Silverside a
- knuckle a**
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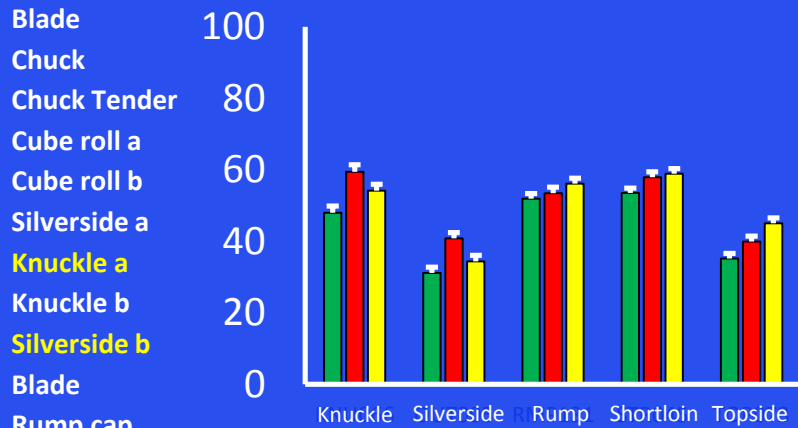


# MQ4

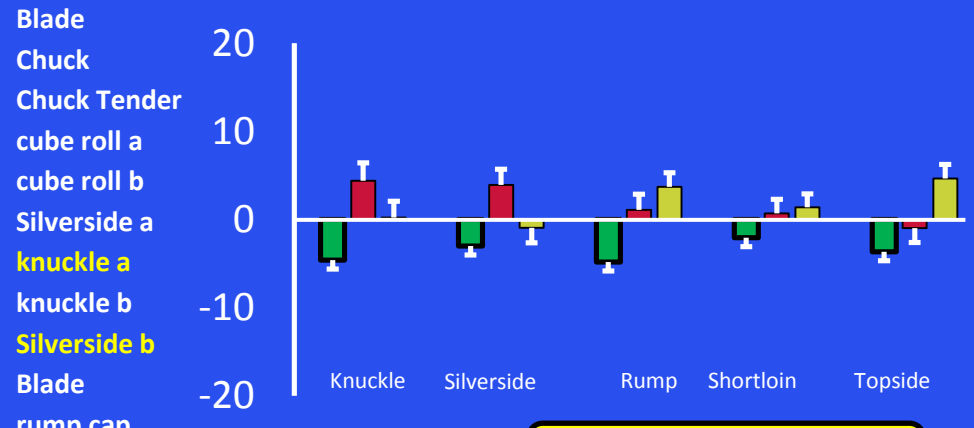
# MSA accuracy



## Higher scores



■ Beef ■ Cross ■ Dairy



■ Beef

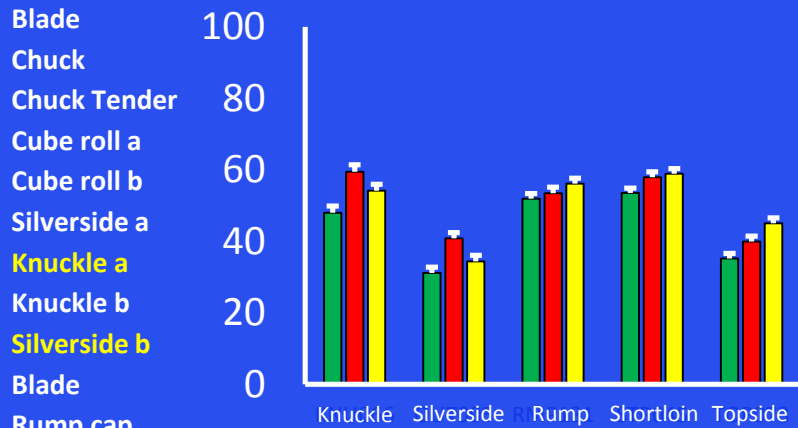
Lower Values



# MQ4



Higher scores

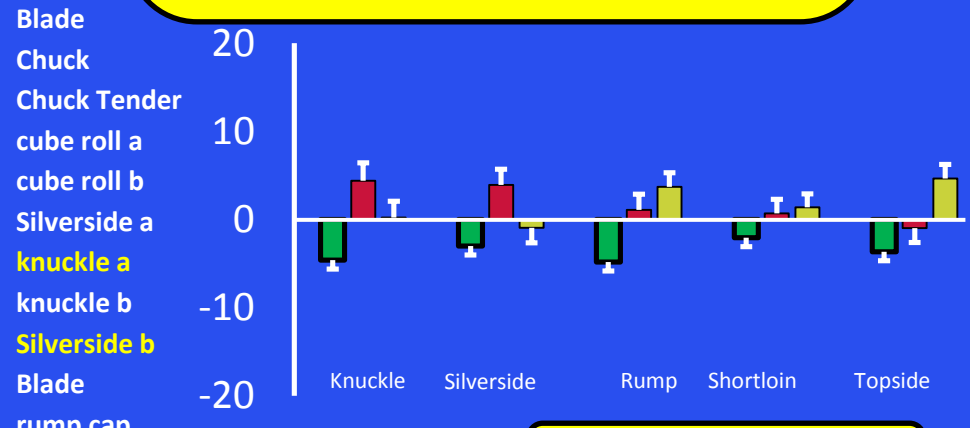


■ Beef ■ Cross ■ Dairy



# MSA accuracy

Needs additional adjustment for:  
**Muscle type**  
**AND**  
**Breed**



■ Beef

Lower Values



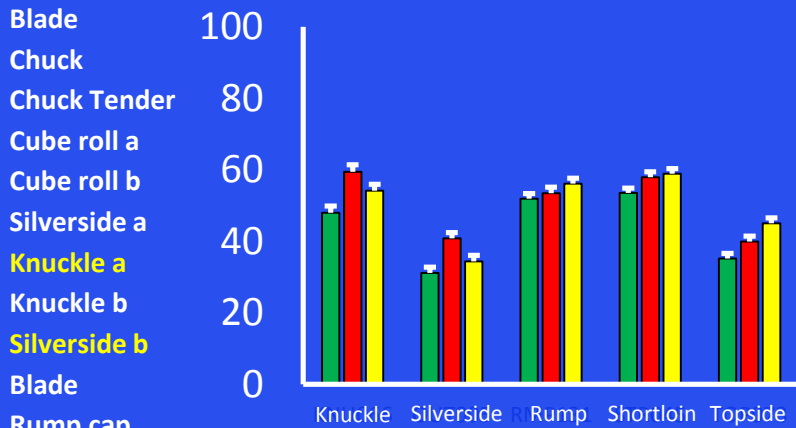
Blade  
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Shortloin  
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Topside a  
Topside b

Blade  
Chuck  
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cube roll a  
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Blade  
rump cap  
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eye of rump centre  
eye of rump side  
Shortloin  
Tenderloin  
topside a  
topside b

# MQ4



Higher scores



■ Beef ■ Cross ■ Dairy



- Blade
- Chuck
- Chuck Tender
- Cube roll a
- Cube roll b
- Silverside a
- Knuckle a
- Knuckle b
- Silverside b
- Blade
- Rump cap
- Rump tail
- Eye of rump centre
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- Topside b

# MSA accuracy

Needs additional adjustment for:  
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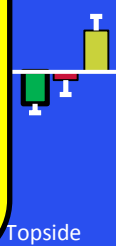
Not explained by:  
**Age**  
**Ultimate pH**  
**Marbling score**

- Blade
- Chuck
- Chuck Tender
- cube roll a
- cube roll b
- Silverside
- knuckle a
- knuckle b
- Silverside
- Blade
- rump cap
- rump tail
- eye of rump centre
- eye of rump side
- Shortloin
- Tenderloin
- topside a
- topside b

■ Beef



Lower Values



# Conclusion



Breeds and sexes  
differ in quality



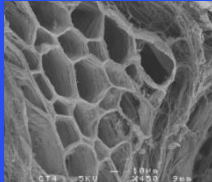
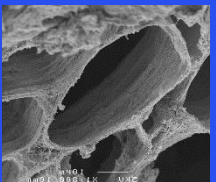
# Conclusion



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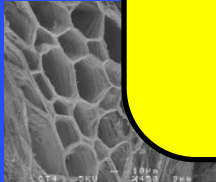
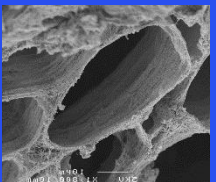
Differences are explained  
by carcass traits



# Conclusion



Breeds and sexes  
differ in quality



**Need sex and breed  
adjustments to guarantee  
and predict quality**



# Contributors

- Australia: Rod Polkinghorne, David Pethick, Graham Gardner
- France: Isabelle Legrand, Jean-François Hocquette
- Ireland: Paul Allen, Declan Troy
- Northern Ireland: Linda Farmer
- Poland: Jerzy Wierzbicki, Agnieszka Wierzbicka



M. triceps brachii caput longum	Blade
M. serratus ventralis cervicis	Chuck
M. supraspinatus	Chuck Tender
M. longissimus dorsi	Cube Roll a
M. spinalis dorsi	Cube Roll b
M. semitendinosus	Silverside a
M. rectus femoris	<b>Knuckle a</b>
M. vastus lateralis	Knuckle b
M. biceps femoris (syn. gluteobiceps)	<b>Silverside b</b>
M. infraspinatus	Blade
M. biceps femoris (syn. gluteobiceps)	rump cap
M. tensor fasciae latae	rump tail
M. gluteus medius	<b>eye of rump centre</b>
M. gluteus medius	eye of rump side
M. longissimus dorsi	<b>Shortloin</b>
M. psoas major	Tenderloin
M. adductor femoris	Topside a
M. semimembranosus	<b>Topside b</b>

# Contributors

