Meat quality. What is the future and why is it important?

Stephen Conroy, Andrew Cromie & Thierry Pabiou (Irish Cattle Breeding Federation)
ICBF Background

• ICBF Formally Established in 2000.

• Membership/Board: AI companies (18%), Milk Recording (18%), Breed Societies (18%) & Farmer Organisations (46%).

• Stakeholders in cattle breeding control decision making.

• Mission: To achieve the greatest possible genetic improvement in the national cattle herd – Dairy & Beef.
Recent history of beef evaluations

Within breed muscle and skeletal for LM, CH, SI 40,000 recs

Calving (200,000) and Carcass evaluations (100,000 records)

Fertility and milkability evaluations. First overall beef profit indexes

39 million pedigrees
Calving 10 million
Livewts 4 million
Mart 2 million
Carcass 7 million
Fertility 4 million
50,000 foreign ebvs
750,000 genotypes

Key events
2005
2007
2010
2013
2015

2008-2012 suckler scheme 40,000 herds
2013-2014 BDP scheme
2015-2020 BDGP scheme

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How does ICBF make an impact?

The body in charge of the recording and processing of all data in Irish cattle breeding.

Genetic Indexes

EBI

Euro-Stars

Intended to help farmers to make more profitable and efficient breeding decisions.
What is meat quality?

- **Meat quality** is defined by the **compositional quality** (lean to fat ratio) and the **palatability factors** such as visual appearance, smell, firmness, juiciness, tenderness and flavour.
Meat quality – Why is it important?

- Consumer tracking data (Pelegrin Research Group, 2014; Lusk and Murray, 2015) suggest that “taste” is number 1 attribute for majority of consumers and is the primary reason consumers purchase beef when compared with other types of meat.

- Consumers want to “trade up”. In the USA Certified Angus Beef® (CAB) increased by 112 percentage points between 2009 and 2014, whereas demand for commodity Choice beef declined by 2 percentage points (Zimmerman and Schroeder, 2013; Suther, 2015).

- Consumers don’t buy carcasses. Consumers want to buy guaranteed meal results (Dr. Rod Polkinghorne).

- Consumers take up to 3 months to purchase beef after a bad experience.

- Finishers are generally not rewarded for eating quality apart from some breed premium schemes. Despite, recent studies showing that there is more variation within breeds for meat tenderness than between breeds (Koohamaraie etc al., 2005).

- There is a need for farmers and processors to work together to produce a more consistent product for consumers.
Can we breed for better meat eating quality?

• Huge improvements in meat eating quality over past 10 years (e.g., animal handling, slow-chilling, hip-hanging & dry-age process).

• However, genetic influence for meat eating quality needs to be further explored as genetic improvement is cumulative and permanent.

• Breed premium schemes in place in Ireland (Angus, Shorthorn & Hereford).

• Objective: Quantify the influence of genetics on meat eating quality and identify the best sires for the trait to be used in the national breeding program.
Data collection

- 1,508 (1168 bulls and 340 steers) animals finished at Tully test station
- Slaughtered from 2013 to present
- All progeny of AI sires – DNA verified
Measurements obtained

- Acclimatisation period: (30 days).
  Vaccination IBR, BVD, RSV, PI3, Blackleg & other clostridia diseases.

- Diet
  - Bulls (ad-lib concentrates); Steers (8 kg concentrates & 5 kg hay freshweight)

- Performance test measures (90 day testing period).
  - Average daily gain (g/day), Feed conversion efficiency (DMI/ADG), Linear Scores, Scanned muscle and fat depth and intramuscular fat (mm) & Scrotal circumference (cm).

- Health & disease traits.
  - Recording lameness, genetic defects, pneumonia and other illnesses.

- Genomics.
  - Genotyped using customised chip.

- Age at slaughter
  - Bulls (15-18 months)
  - Steers (17-23 months of age)
Measurements obtained at the factory

- Meat quality
- Carcass wt, fat and conformation
- Primal yields
  - British spec
  - 19 different cuts
- pH
  - Hourly and ultimate
Measurements obtained cont’d

- Meat eating quality
- Colour of loin
- Visual marbling of the loin
- Composition analysis
  - Intramuscular fat %, protein % & moisture %
- Cook loss and shear force
- Sensory analysis
Sensory analysis

Meat Tasting Phenotypes

3 phenotypes: Tenderness, Juiciness, & Flavour - Scored 1 to 9

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>6</th>
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<tbody>
<tr>
<td>“Extremely Tough”</td>
<td>“Extremely Tender”</td>
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<tr>
<td>“Off-note”</td>
<td>“Extremely flavoursome”</td>
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Meat Tasting Protocol

*Longissimus thoracis* muscle from right side of each carcass 2.5cm steaks and vacuum packed. Steaks were aged for 14 days before being frozen. They were then thawed at 4°C 24 hours before analysis.

Grilled to a ‘medium’ cooking finish, allowed to rest for two minutes. Data was collected using trained panelists.

- Eolas International, Co. Cork
- 7-10 trained panellists
- http://www.eolasinternational.com
In order to make genetic progress a trait must be heritable. A heritable trait is one that is passed from a parent to offspring.
Heritability - International studies
## Breeds and Bulls

**Top Romantic A.I. bulls in Ireland: Best for Tenderness**

<table>
<thead>
<tr>
<th>Breed</th>
<th>International ID</th>
<th>Name</th>
<th>Birth year</th>
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<tr>
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<td>AANIRLM121657620895</td>
<td>LISDUFF DANDY K895</td>
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<tr>
<td>Belgian Blue</td>
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<td>KUBITUS DE BRAY</td>
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<td>Charolais</td>
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<td>ULRICH</td>
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<tr>
<td>Limousine</td>
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<td>ROCKY</td>
<td>2000</td>
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<tr>
<td>Salers</td>
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<td>CORLURGAN OURSON</td>
<td>1998</td>
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<tr>
<td>Simmental</td>
<td>SIMAUTM000276570944</td>
<td>ENFIELD HURRICANE HUGO</td>
<td>1988</td>
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</table>

Graph limited to 1040 A.I. sires of AA, BB, CH, HE, LM, SA, and SI breeds.
5 star versus 1 star comparison

- Analysis on 1000 bulls

<table>
<thead>
<tr>
<th>Terminal €uro-Star index</th>
<th>One star</th>
<th>Five star</th>
<th>Difference (€)</th>
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<tbody>
<tr>
<td>Total feed consumed (kg)</td>
<td>1302</td>
<td>1250</td>
<td>14</td>
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<tr>
<td>Av. age at slaughter (days)</td>
<td>496</td>
<td>481</td>
<td>30</td>
</tr>
<tr>
<td>Carcass weight (kg)</td>
<td>394</td>
<td>408</td>
<td>56</td>
</tr>
</tbody>
</table>

| Conformation score       | U-       | U+       |                |
| Total meat (kg)          | 314      | 324      |                |
| Tenderness (scale 1-9)   | 5.87     | 6.24     |                |
| Juiciness (scale 1-9)    | 5.81     | 6.28     |                |
| Flavour (scale 1-9)      | 5.74     | 6.08     |                |
The ICBF has developed a genetic index for beef eating-quality.
- Data from 1,200 bulls fed at Tully progeny-testing centre used to develop index.
- Tested on 101 consumers at BEEF 2016. Given two steak samples, one from a high- and one from a low-index animal.
- Asked to identify high eating-quality index beef.
- 75% correctly identified the high-index eating quality beef.
# Consumer validation cont’d

ICBF consumer tasting session, Teagasc Grange BEEF 2016, 5 July 2016

<table>
<thead>
<tr>
<th>Pair</th>
<th>Breed</th>
<th>Tag No.</th>
<th>EBV</th>
<th>Breed</th>
<th>Tag No.</th>
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<td>LM</td>
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<tr>
<td>7</td>
<td>SA</td>
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</tbody>
</table>

|       |       |        |     |       |        |     |          |         |
| High  | 2.4   |        |     | Low   | -2.5  |    | 75       | 26      |
Role of genomics

- Ireland recently rolled out a Beef data genomics program (BDGP)
- Focused on breeding more profitable, sustainable and carbon efficient cows.
- Funded from EU Rural Development Program.
  - Under article 28 (Climate + Environment).
  - Co-funded by Irish government (DAFM).
- €300m total funding 6 years (2015-2020)
  - Farmers paid ~€90/cow/year to complete 6 actions
- ~2.5m animals will be genotyped during period of scheme.
The use of DNA information to predict how good an animal might be. Important tool in accelerating genetic gain

Up to know we relied on parentage information on young animals

We then need to wait until they have progeny to see how good they ‘breed’

DNA gives an extra 15-30% in terms of reliability.

This is added to the existing €uro-Star indexes of the animal => more accurate evaluation.
Role of genomics for eating quality

- Genetic evaluation using genomics will allow for more accurate identification of the best bulls for eating quality.
Meat quality. What next?

- In Ireland carcasses are graded mechanical carcass grading has replaced visual grading
  - Video imaging analysis (VIA) system

EUROP Classification to grade carcasses

<table>
<thead>
<tr>
<th>Conformation</th>
<th>Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>S &gt; E &gt; U &gt; R &gt; O &gt; P</td>
<td>1 &lt; 2 &lt; 3 &lt; 4 &lt; 5</td>
</tr>
</tbody>
</table>
Currently we use carcass weight, conformation and fat score as part of our genetic evaluations for terminal and replacement €uro-Star Indexes.
Predicting cuts using VIA images

- 8% of carcass weight accounts for over 30% of carcass value (Drennan et al., 2008)

- Converting images into cut weights

Multiple Regression Analysis

- Lower value cuts
- Medium value cuts
- High value cuts
- Very high value cuts

Also available on steers:
- Total meat weight
- Total fat weight
- Total bone weight
Since 2007 ICBF have been storing 1.6 million VIA images per year.

Further develop and validate the prediction equations for VIA images across genders using 81630 carcasses.
• Meat eating quality exhibits genetic variation. No differences between breeds.

• Need to collect more data - Excellent industry engagement in the collection of relevant phenotypes.

• Look more closely at more routinely available predictors (pH, shear force, image data.....)

• Assign a monetary value for each unit increase in eating quality with a view to publishing a genetic index for eating quality.

• Genomics is going to play an important role in identifying elite sires for meat quality.

• VIA are an important tool to predict carcass cuts and composition.

• All stages of the food chain can effect meat quality. Therefore everyone has to work together to ensure consumers consume more beef and are willing to pay appropriately in order to return a profit to all involved.
Thank You!