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Beef Quality Measurement and Prediction

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Summary Points - Sustainable Beef Quality for Europe I.

SUSTAINABLE BEEF QUALITY FOR EUROPE

A Workshop for Industry & Scientists

Milan, October 2015

<u>Eating Quality</u>

- Reduce inconsistency
- Methods to monitor eating quality
- Identify cost of unacceptable quality

<u>Nutritional quality</u>

- Better knowledge of nutritional benefits

<u>Consumers</u>

- Greater communication with consumers (esp. nutrition)
- Greater understanding of consumers
- Halt the decline in consumption

<u>Production</u>

- Greater efficiency at farm level

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Farmer et al., Viandes et Produits Carnes, 2016

What does Industry want from Researchers?

Inconsistency of beef eating quality.

European consumer studies on beef*:

- 20% grilled striploin
- 25% grilled rump
- 54% roast topside

"Unsatisfactory"

Methods for Prediction of Quality.

Must be:

- Rapid (on-line)
- Robust
- Non-destructive
- Easy to use and
- **Cost effective!**

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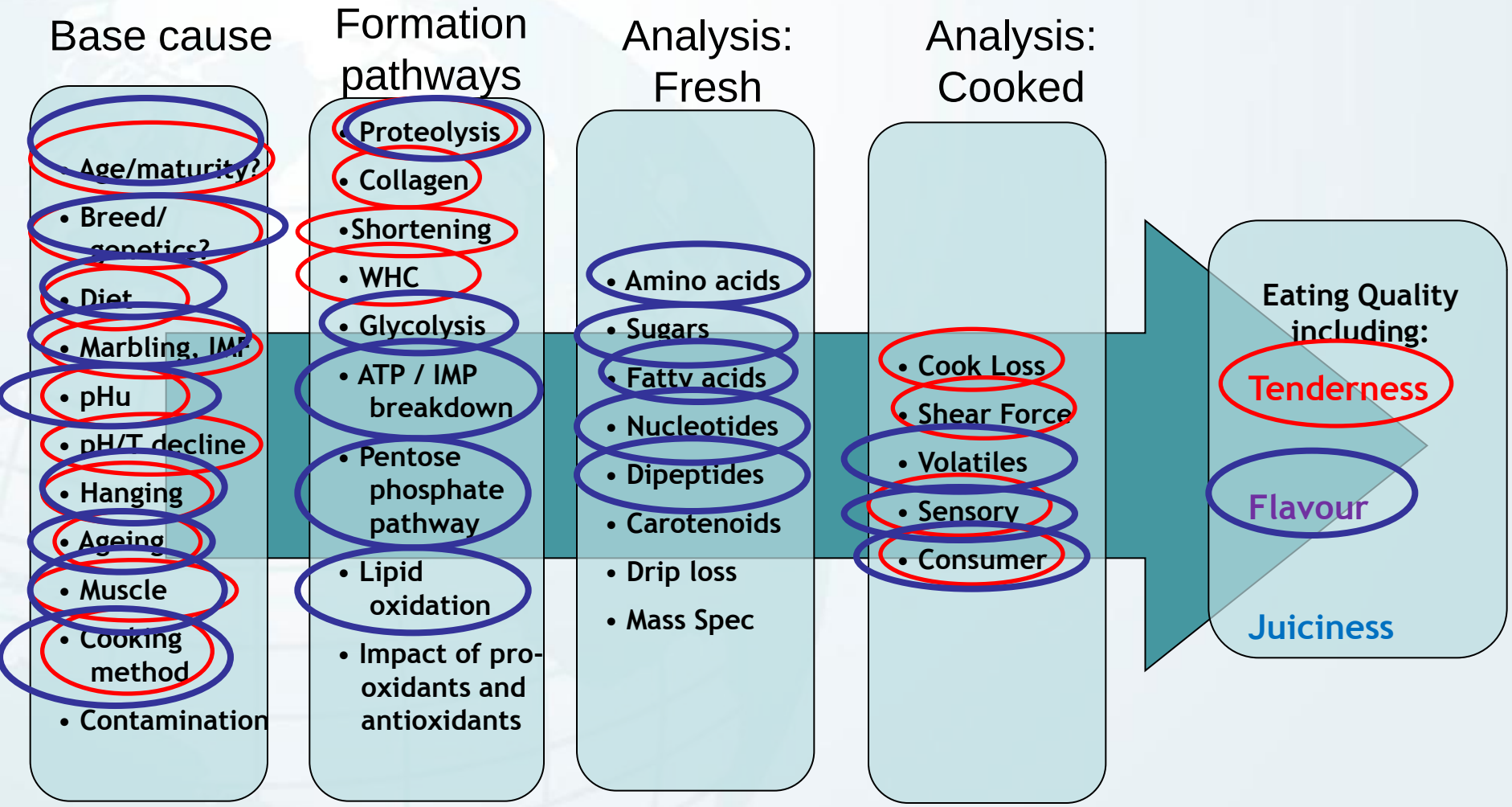
** Bonny, S. et al. 2015; Farmer et al., 2016*

What can research offer?



However, Established methods are:

- Destructive & Costly
- Not suitable for online measurement

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Towards Beef Quality Prediction.

1. Beef Eating Quality systems:

- Main Factors of each system
- Comparison of quality systems

2. Rapid Methods of Prediction:

- Methods available
- How well do they work?

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Beef eating quality systems

Summary of classifications

Grades	System			
	MLC	USDA	NZ QMark	MSA
Outside system	Ungraded	Ungraded	Ungraded	Ungraded / failed
Graded as unsatisfactory		Utility Commercial		Unsatisfactory
Graded as satisfactory or good	Blueprint "Blueprint plus" *(~21d ageing)*	Standard (x3) Select (x2) Choice (x3) Prime (x3)	QMark	3* 4* 5*
Grade applied to:	*whole carcase (selected premium cuts)*	*whole carcase (cuts not specified)*	*whole carcase (selected premium cuts)*	*each cut / ageing period / cooking method*

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Beef eating quality systems

Main factors

MLC

Age
Maturity (teeth)
Fat cover
Fat class
Hanging method
Chill regime
Meat and fat colour
pHu
EUROP Grade
Ageing (Bulls)

USDA

Maturity (oss.)
Marbling
Visible meat texture & colour

NZ QMark

Age (teeth)
Transport
Mixing
Lairage
pH/temp
ES
pHu
Shear force

MSA

Breed (Brahman)
Maturity (oss.)
Fat cover
Marbling
Transport
Mixing& Lairage
pH/temp. decline
Meat & fat colour
pHu
Hanging method
ES
Ageing
Cut/muscle
Cooking method

Comparison of beef eating quality systems

- **None of the systems are perfect**
  - Variability of “satisfactory graded” beef is reduced but not removed
- **Best delivery of eating quality to consumers:**
  - Best: Modification of MSA system
  - Possible: Modification of MLC system
- **Best quantity of graded beef:**
  - MSA gave best quantity of graded beef

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Rapid Methods of Prediction – Basic concept.

Established Methods:
pH, Colour, AOs, Fatty Acids, Precursors, Fatty acids, Volatiles, WBSF and Sensory evaluation.

Statistical modelling:
PLS, PLSR, SR, DA, SVM & others

Rapid Method examples:
Ultrasound, VIA, CT, X- Ray, Raman, Vis, NIR spectroscopy and HSI.

% Calibration, % Validation

Predictive Equations

Validation

Working Predictive model !!

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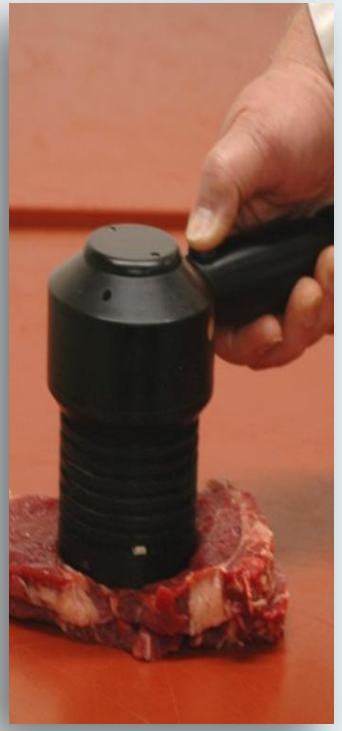
Instrumental prediction
(Literature 2010-2016)

- Moss et al., 2010 — Hyperspectral Imaging (HSI)/ Raman spectroscopy
- Yancey et al., 2010 — Visible & Near-Infrared spectroscopy (Vis-NIR)
- ElMasry et al., 2012 — HSI
- Roehe et al., 2013 — Robotic pH, VIA, CT scanning, ultrasonic fat depth, Vis-NIR, Raman, HSI

"Scottish programme for "Integrated Management of Eating Quality"

- **Font-i-Furnols et al., 2014** — Computed Tomography (CT) scanning
- Qiao et al., 2015 — Visible Hyperspectral Imaging
- Peng & Dhakal 2015 — Optical methods - review
- Lee et al., 2015 — Magnetic Resonance Imaging (MRI)



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Instrumental prediction
(Literature 2010-2016)

Composition

- **Robotic pH** – robotics work well but pH sensory technology needs improvement
- **VIA** – as good or better than manual grading for saleable meat and carcase fat
- **CT Scanning** – very good for composition, but expensive. Reference method.
- **MRI** – very good for IMF, but not an on-line procedure
- **HSI** – prediction for IMF: R^2 ~ 70%
- **HSI** – variable prediction for fatty acid groups: R^2 ~ 50-70%
- **HSI** – variable prediction of pH: R^2 ~ 23-73%

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Moss et al., 2010; ElMasry et al., 2012; Roehe et al., 2013; Lee et al., 2015; Qiao et al., 2015

Instrumental prediction
(Literature 2010-2016)

Eating Quality

- **Vis-NIR Spectroscopy –**
  - **Predicts Shear Force (SSF): R^2 = 9% - 50% (dep. d. post sl.)**
  - **Predicts tenderness: R^2 = 7-46% (dep. muscle)**
- **HSI –**
  - **Predicts Shear Force (SSF/WBSF): R^2 = 20-83% (dep. d. post sl. & muscle)**
  - **Predicts tenderness: R^2 = 7-50% (dep. muscle, lab, ?)**
  - **Predicts flavour: R^2 = 32-50% (dep. muscle, lab, ?)**

Moss et al., 2010; ElMasry et al., 2012; Roehe et al., 2013; Qiao et al., 2015

Beef Quality Prediction – Recent Months

"Classifying of Nellore cattle on Normal and DFD...". Nubiato, Z., et al.

"HSI system to predict DFD- correct classification of 73/ 78 animals – 93.6%"

"HSI, analysis, prediction and classification of muscle foods". Sun, D.W., et al (Review)

Tenderness R^2 - 67- 95%
WHC R^2 - 88%
pH R^2 - 73%

However, no validation listed.

Aug 2016

"EQ prediction of beef from Italian Simmental cattle based on experts' steak assessment". Borgogno, M. et al.

"Accuracy of predictive model was 96.6%"

Sept 2016

"CFD modelling of industrial cooling of large beef carcasess". Kuffi, K.D., et al.

"Excellent prediction in deep positions of the hind quarter"

Oct 2016

"Exploration of microwave dielectric and NIR spectroscopy... Fat content in ground beef". Downey, G., et al.

"Microwave R^2 prediction of 0.87
NIR R^2 prediction of 0.99"

Jan 2017

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What Next?

- Research can assess beef quality using well established methods.
- Industry requires fast on-line measurements.
- Options:
  - Eating Quality Grading Systems
  - Prediction technologies

- Current solutions not perfect but
  - EQ grading systems under consideration across Europe
  - On-line technology shows potential

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